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ECONOMIC PROSPERITY INITIATIVE (EPI)

2011 PERSUAP

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USAID ECONOMIC PROSPERITY INITIATIVE (EPI)

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Name of Component: Environmental Compliance

Author(s): Alan Schroeder, PhD, MBA

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ABSTRACT

The purpose of this document is to conduct a Pesticide Evaluation Report (PER) and Safe Use and Action Plan (SUAP) to bring USAID-funded projects into compliance with USAID's environmental regulations (Title 22 of the Code of Federal Regulations part 216, or Regulation 216) on pesticide use. Beyond compliance, this document offers best practices and helps ensure that projects reduce the chances for errors and liability.

This 2011 PERSUAP was developed for and under the direction of CNFA. It applies to all of the current or forthcoming agriculture assistance projects for Georgia. This approach was used to economize resources such that each USAID project would not need to duplicate costs to produce their own PERSUAP report. Moreover, the objective is to have one document, which can guide and inform the work of the COTR and MEO where pesticides are or could be involved in any project in Georgia.

Before errors (such as human poisonings) occur, it is the responsibility of USAID project implementers to put these mitigation recommendations into action, as soon as possible. Implementers will then monitor changes in risks, impacts, and mitigation success using EMMPs (Environmental Mitigation and Monitoring Plans). Finally, the implementers will report positive or negative changes from mitigation success baselines in semi-annual reporting instruments.

The report begins with sections that evaluate background and risks across the inputs sectors in Georgia, including treatment of seed, field crops, greenhouse crops, and livestock as well as processing. And, it promotes the use of preventive and curative Integrated Pest Management (IPM) and Good Agriculture Practices (GAPs). It analyzes pesticide active ingredients registered for use in Georgia and recommends against use of pesticides containing active ingredients that are: not EPA registered, Restricted Use Pesticides (RUPs), Class I, Known Carcinogens, and Known Water Pollutants.

ABBREVIATIONS

AFR	Africa Bureau, USAID
AI	Active Ingredient (when pesticide reference)
ANE	Asia and Near East Bureau, USAID
APO	Agricultural Pesticides Ordinance, Pakistan
BCI	Better Cotton Initiative
BMP	Best Management Practice
BT	*Bacillus thuringiensis* (a bacteria that produces a toxin used as a pesticide)
BRC	British Retail Consortium
CAR	Central Asian Republics
CCD	Colony Collapse Disorder
CFR	Code of Federal Regulations
CIS	Commonwealth of Independent States
CNFA	Citizen‘s Network for Foreign Agriculture
COP	Chief of Party
COTR	Contracting Officer‘s Technical Representative
DS	Powders for dry seed treatment (pesticide formulation)
EA	Environmental Assessment
EASC	EuroAsian Interstate Council for Standardization, Meteorology and Certification
EC	Emulsifiable Concentrate (pesticide formulation)
EC50	Effective Concentration 50 (acute toxicity measure)
EDD	Environmental Due Diligence
EMMP	Environmental Mitigation &
MOA	Ministry of Agriculture
MRL	Maximum/Minimum Residue Level/Limit
MSDS	Material Safety Data Sheet
MSL	meters above sea level
MT	Moderately Toxic
NARS	National Agriculture Research Systems
NAT	Not Acutely Toxic
NCAT	National Center for Appropriate Technology
NEPA	National Environmental Policy Act (US)
NGOs	Non-Governmental Organizations
NIFA	National Institute of Food and Agriculture
NPV	Nuclear Polyhedrosis Virus
PAN	Pesticide Action Network
PEA	Programmatic Environmental Assessment
PER	Pesticide Evaluation Report
PERSUAP	Pesticide Evaluation Report and Safe Use Action Plan
pH	Log of Hydrogen concentration, measure of acidity
PHI	Pre-Harvest Interval
PIC	Prior Informed Consent (a treaty, relates to toxic pesticides)
POPs	Persistent Organic Pollutants (a treaty, relates to toxic persistent pesticides)
PMP	Pest Management Plan

	Monitoring Plan
EPA	U.S. Environmental Protection Agency (also known as USEPA)
EU	European Union
FAO	Food and Agriculture Organization (United Nations agency)
FDA	Food and Drug Administration (US)
FFP	Food for Peace
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FS	Flowable concentrate for Seed treatment (pesticide formulation)
GAP	Good Agriculture Practice
GDA	Global Development Alliance (USAID)
GDP	Gross Domestic Product
GlobalGAP	Global Good Agriculture Practices, a certification system
GMO	Genetically Modified Organism
GUP	General Use Pesticide
Ha	Hectares
HT	Highly Toxic
ID	Identification
IDP	Internally Displaced Persons
IEE	Initial Environmental Examination
IGR	Insect Growth Regulator
IPM	Integrated Pest Management
IVM	Integrated Vector Management
IWM	Integrated Weed Management
LC50	Lethal Concentration 50 (acute toxicity measure)
LD50	Lethal Dose 50 (acute toxicity measure)
PNT	Practically Non-Toxic
PPE	Personal Protection Equipment
R&D toxin	Reproductive and Developmental toxin
REA	Regional Environmental Advisor
Reg 216	Regulation 216 (USAID Environmental Procedures)
REI	Re-Entry Interval (safety period after pesticide spraying)
RUP	Restricted Use Pesticide
S&C	Standards and Certification
SC	Suspension Concentrate (pesticide formulation)
ST	Slightly Toxic
SUAP	Safe Use Action Plan
UC	University of California
UN	United Nations
USAID	United States Agency for International Development
USDA Agriculture	United States Department of
USEPA	US Environmental Protection Agency (also known as EPA)
VHT	Very Highly Toxic
WFP	World Food Program (UN)
WHO	World Health Organization
WP	Wettable Powder (pesticide formulation)
WS	Water dispersible powder for Slurry treatment (pesticide formulation)

M&E	Monitoring and Evaluation
MD	Micro Dispersion (pesticide formulation)
MEO	Mission Environmental Officer

CONTENTS

EXECUTIVE SUMMARY

The purpose of this document is to conduct a Pesticide Evaluation Report (PER) and Safe Use and Action Plan (SUAP) to bring USAID-funded projects into compliance with USAID's environmental regulations (Title 22 of the Code of Federal Regulations (CFR), part 216, or Regulation 216) on pesticide use. Beyond compliance, this document offers best practices and helps ensure that projects reduce the chances for errors and liability.

This 2011 Georgia PERSUAP was developed for and under the direction of CNFA. It applies to all of the current or forthcoming agriculture assistance projects for Georgia. This approach was used to economize resources such that each USAID project would not need to duplicate costs to produce their own PERSUAP report. Moreover, the objective is to have one document, which can guide and inform the work of the COTR and MEO where pesticides are or could be involved in any project in Georgia.

Risks are inevitably present with the use of pesticides and similar chemicals used for agricultural crop and livestock production and processing. In addition to required compliance, this PERSUAP provides project implementers with the most common risks likely to be encountered. And, it contains or references recommended mitigation measures and international best practices to reduce each risk. Projects can then use these risk-mitigation pairings to inform and guide their own development of risk monitoring, mitigation and reporting plans, as USAID requires.

For the purposes of this PERSUAP, the word *pesticide* is used, following EPA's guidelines[1], for the following: fumigants, insecticides, miticides/acaricides, nematicides, molluscicides, fungicides, antimicrobials, bactericides/biocides, microbicides/antibiotics, herbicides, rodenticides, avicides, algicides, ovicides (kill eggs), disinfectants/sanitizers and anti-fouling agents (chemicals that repel or kill things like barnacles that attach to boats). Even biological agents such as biopesticides, microbial pesticides, attractants/pheromones, repellents, defoliants, dessicants, insect growth regulators, and plant growth regulators are included as pesticides.

Note that farmers can, with their own funding, buy and use the pesticides they want, as long as they are not part of a USAID project, used in USAID-procured equipment, and the treated produce does not enter a USAID-funded program. USAID projects can also promote, purchase, or donate pesticide training, pesticides and equipment as long as these and risks associated with them have been evaluated in a PERSUAP.

Before errors (such as human poisonings) occur, it is the responsibility of USAID project implementers to put these mitigation recommendations into action, as soon as possible. Implementers will then monitor changes in risks, impacts, and mitigation success using EMMPs (Environmental Mitigation and Monitoring Plans). Finally, the implementers will report positive or negative changes from mitigation success baselines in semi-annual reporting instruments.

The report begins with sections that evaluate background and risks across the inputs sectors in Georgia, including treatment of seed, field crops, greenhouse crops and livestock as well

[1] http://www.epa.gov/pesticides/about/types.htm

as processing. And, it promotes the use of Integrated Pest Management (IPM) and Good Agriculture Practices (GAPs).

After the Introductory and Background sections build the case for risks to Georgian beneficiaries, farmers and their resources, and the use of best practices, then the PER section addresses the 12 informational factors (a through l) required in the Agency's Pesticide Procedures, under 22 CFR 216.3 (b)(1)(i). Finally, the SUAP puts the conclusions and recommendations reached in the PER into a plan of action. Projects are then expected to assign responsibility for each recommendation to appropriate staff members connected with risk mitigation, and develop a timetable and a budget for doing this.

This 54-page PERSUAP study—with an additional 73 pages of useful Annexes and References—including findings from field trips to project sites identifies risks and fills some information and knowledge gaps where pests, IPM, and pesticides are concerned. It also helps ensure (along with implementation of recommended mitigation/monitoring/reporting measures, and AID audits) compliance.

PERSUAP FINDINGS THAT INDICATE RISKS FROM PESTICIDES

For this study, it was assumed that in order for project field staff and beneficiaries using USAID resources to properly, safely and correctly provide advice to cooperating farmers, demonstration farms and during training, at minimum, they should understand:

- Primary pests impacting each project-supported crop, livestock or warehouse/processer
- Integrated Pest Management (IPM) tools and tactics used by the target beneficiaries to prevent primary pests
- Pesticides used for each primary pest
- Local pesticide information
- Pesticide risk issues like relative toxicity and internationally restricted/banned pesticides
- PPE (Personal Protection Equipment) needed—and to be used—for specific pesticides

Some USAID project beneficiaries interviewed for this study do understand most of these issues sufficiently to mitigate risk significantly, but a sufficient number do not and therefore require remedial training.

Field visits to project sites in Georgia found cooperating beneficiaries who will require inputs through their local farm service centers (FSCs) which sell seeds, pesticides, fertilizers, and farm tools. Most FSCs were found to be well organized, as recommended, with pesticides separated by use type (insecticide, fungicide, and herbicide) and with crop products in one room or side of the store and veterinary products on the other side. And, each FSC had tiled (non-absorbent) flooring, fire extinguishers, emergency information, and proper power ventilation.

At the same time, issues that increase risks still exist. For instance, large (5-20 liters) containers of pesticides were found to be open and half empty in FSCs—a sure sign of sub-dividing the pesticides into smaller containers. Some bottles of expired (2009) pesticides were found and FSCs had little PPE for sale and no back-pack sprayer spare parts for

repairing leaks. Most small and medium scale farmers reportedly do not use PPE, although most large commercial producers do use PPE. And, some highly toxic pesticides containing Active Ingredients (AIs) like aluminum phosphide, ethoprophos, methyl bromide, metam sodium and oxymyl are still actively registered.

For larger operations, for instance at AMP centers, tractors and equipment are rinsed over collection pits that send rinsate containing oils, dirt and pesticide residues to a holding tank in the ground, where they can be collected and disposed of. One risk is foreseen with at least two of the AMP centers that are next to small rivers or streams, where flooding could carry the wastes down-stream. In these cases, the tractor washing stations should be moved to beyond the flood line.

Common Best Management Practices (BMPs) recommend that pesticide calibration be done carefully to avoid leftovers. Disposal of any leftover pesticide is rinsed into the field sprayed, away from runoff canals and open water. Best practices for filling and washing sprayers is found at http://edis.ifas.ufl.edu/hs139.

BMPs for use of chemicals would dictate that Georgian projects field staff correct PPE deficiencies with their beneficiaries. One way to resolve issues with safety is to encourage the development of spraying and record-keeping services that will have and use PPE and will be hired by farmers to do spraying and record keeping. These services should be linked to places or ways that farmers congregate, either at associations, input stores or produce collection points.

Training is also significantly lacking. Beyond recommending and procuring PPE, Georgian Implementing Partners, demonstration farmers and other beneficiaries will need to be trained in useful IPM tools and tactics as well as pesticide safe use best practices.

THE PERSUAP STUDY FOCUS ON IPM, PMPS AND PESTICIDES

The practice of IPM – the use of which is considered to be a policy of USAID[2] – is fully supported and promoted in Section 1.5 of this PERSUAP as well as in the required PER Section 3.3 Factor C analysis. Section 2.8 carries this theme further with focus on GAPs, many of which are important IPM precursors. USDA supports the use of IPM through regional centers[3], and through the development of Pest Management Plans (PMPs)[4]. Moreover, Annex 1 of this PERSUAP presents off-the-shelf IPM and GAPs researched and extended to farmers in other countries, particularly the USA and other developed countries, for the very same or similar crop-pest combinations as those found at project implementation locations. These IPM tactics (which include pesticides registered and used in the USA for the same crop-pest combinations) are presented for the MOA to consider, test, and adopt, as is practical and desired.

Further, the crop-pest-GAP/IPM/pesticide information in the 45-page Annex 1—the heart and soul of the document—is meant to provide project staff and beneficiaries with a solid starting point for developing their own locally-adapted PMPs for each crop. A guide for making detailed PMPs is provided in Annex 2, and it is expected that the implementing partners will work with demonstration farmers, farm managers and other beneficiaries to

[2] USAID.1990.Integrated Pest Management: A.I.D. Policy and Implementation

[3] http://www.csrees.usda.gov/nea/pest/in_focus/ipm_if_regional.html

[4] http://www.ipmcenters.org/pmsp/

prepare PMPs and pest management posters or flyers to assist in the prediction and prevention of damage caused by specific pests and crop production constraints.

Annex 3 provides an updated adaptation of an outline of important IPM program elements funded by USAID and developed by FAO[5], and implemented quite successfully in Indonesia in the 1980s. These 10 timeless elements are offered to project field managers to consider for planning purposes in developing and implementing IPM strategies.

This PERSUAP focuses strongly on GAP and IPM tools including commercialized natural pesticides containing AIs extracted from plants, microbes, marine organisms, spices and minerals (see Annexes 4 and 5) as well as cultural practices and synthetic pesticides used in the USA, some of which are available in Caucusus countries, or could be made available in the future as crop production diversifies.

Annex 6 shows important differences between EPA's and World Health Organization's (WHO) systems for classifying acute human health risk, and references the Russian acute toxicity system. Following this is Annex 7, which compiles all of the AIs in pesticides (natural and synthetic) found registered in the Georgia, as well as those safely used in the USA for the same pests, and that can be considered for registration and use by MOA. Project decision-makers—especially those who interface at the field level with beneficiary demonstration farmers—are encouraged to look at the label of potential pesticide choices to determine the AIs contained in them. Then, use this Annex 7 as a quick reference guide to attributes of—and issues with—each chemical.

The pesticide attributes in Annex 7 include pesticide class (to manage resistance by rotating chemicals from different classes), EPA registration and Restricted Use Pesticide (RUP) status (to comply with Regulation 216) and acute toxicity (judged by this document to be safe, or not, for small-holder farmers—most Class I chemicals are not considered safe for smallholder farmers to use). Annex 7 also presents chronic human health issues, water pollution potential, and potential toxicities to important non-target organisms like fish, honeybee pollinators, birds, earthworms and several aquatic organisms.

Further, Annex 7 contains basic pieces of human safety and environmental data needed for the various analyses required throughout the PER 12 Factor analysis; in fact, Annex 7 is referred to throughout this document. And it provides data used to produce the critical information contained in Annex 8, pesticide active ingredients rejected for use by this PERSUAP, with exceptions.

Annex 9 contains common veterinary chemicals and antibiotics (microbiocides, a type of pesticide) and their associated risks. Finally, Annex 10 of this report synthesizes training topics that should be covered by projects where pesticides will be or may be used, and Annex 11 provides a monitoring format.

Thus, this PERSUAP provides useful tools for evaluating and choosing among IPM options, (including pesticides) while adhering to 22 CFR 216, as well as many of the rapidly-evolving international and market-driven BMPs found throughout S&C systems like Organic, Fair Trade, GlobalGAP and others. Below are the key best management practices and recommendations synthesized from the PER, and found in the SUAP.

[5] http://www.communityipm.org/Countries/indonesia.htm

HOW TO USE THE PERSUAP EFFICIENTLY

Most USAID-funded projects will focus on one or a couple of the sectors covered by this PERSUAP, and will focus on just a handful of crops. The best way to use this document then is to focus on the parts that apply to the crops produced, the pests of each and the preventive and curative tools and tactics, including pesticides. To do this efficiently, search this document for the specific target sector(s), crops or even pests (common or scientific name) using the Word computer program's ―Find" feature, which allows one to enter the word or phrase desired, and then takes one to the exact parts of the report where the word or phrase is emphasized or used. Pesticide active ingredients, and in Annex 1 commercial names of pesticide products can be found using the same method.

UPDATE THE REPORT ANNUALLY AND AMEND THE REPORT IN TWO YEARS

It is important to note that the development of new pesticides, new EPA and international pesticide regulations and registrations, as well as new international market requirements for pesticide residues on food are all highly dynamic, changing every month. And, new human health and environmental data is produced continuously. For these reasons, and others, this PERSUAP should be updated—at least annually—and amended after two years to remain current and accurate.

POLICY RECOMMENDATIONS

- Control FSC-level sub-division of pesticides from large containers to small water and juice bottles that do not contain label and safety information.
- Develop a system for return of empty plastic pesticide containers to FSCs, using incentives like a rebate system. FSCs may triple-rinse empty containers and properly dispose of them with municipal waste or enter them into a plastic recycling system.
- MOA work with donor projects to develop crop-specific, state of the art PMPs.
- Subsidize purchase of PPE for commercial farmers.
- Subsidize farm certification costs.

RECOMMENDATIONS TO MITIGATE PESTICIDE RISKS

Immediate Actions Recommended for Safety
Perform IPM and Safe Pesticide Use training (on two or more occasions to ensure that training sticks) for all Georgia assistance project implementers and beneficiaries that use or procure pesticides with project assistance (see Annex 10).
Subsidize recommended PPE for all Georgia assistance project implementers and beneficiaries that use or procure pesticides with project assistance (see PPE websites referred and linked to herein).
Projects ensure that implementers and beneficiaries do not procure or use certain pesticides

containing the Active Ingredients in Annex 8 with USAID assistance; perform EDD (Environmental Due Diligence) and provide training and recommendations for avoiding any use of such pesticides; perform EDD and require that assisted enterprises show progress to complying with Georgia law as a condition for receiving project assistance other than training.
Projects use lists of pesticides analyzed herein to match pesticide commercial product names with each of the Active Ingredients found in Annex 8; make a list for Annex 8 and distribute this list to each Georgia assistance projects implementer.
Ensure that each project implementer has a copy of the list of pesticides currently registered and available for use, and recommended for future use if registered in Georgia (these are all listed in Annex 1 with both Active Ingredient (AI) and product names and Annex 7 with pesticide AI names only) and understands their use.
Projects make efforts to obtain, as available, copies of the Material Safety Data Sheets (MSDS) for each of the pesticide products used by beneficiaries on Georgia assistance projects. See MSDS at: http://www.bayercropscience.com.au/resources/uploads/msds/file7219.pdf.
Translate into a local language the most critical PERSUAP sections and Annexes for a more efficient use of PERSUAP findings.

Action Recommended by May 2011
Projects work with the Georgian MOA to make provisional PMPs for each Project crop (use Annexes 1, 2 and 3 as well as local farmer knowledge) so managers and farmers have a tool to predict, prevent and manage pests throughout the season (see PMP examples at http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html, website upper left ―Year-Round IPM Programs").

Continuous Actions Recommended for Safety and BMPs
Project implementers do hands-on and workshop training that encourages project-assisted farmers to use PPE, pesticide safety best practices and apply pesticides only during the appropriate times of day (early morning/late afternoon, low wind, no rain).
Once Georgia begins to register pesticides anew, assistance projects check the list of registered pesticides every 6 months to obtain new pesticide registrations & regulatory

changes.
As Georgia registers them, or they become available, and when the use of pesticides is required to achieve project goals, Georgia assistance projects implementers promote commercially available pesticides containing natural chemicals listed in Annexes 4 and 5.
For all demonstrations, project implementers introduce pesticide record-keeping concepts and tools following GlobalGAP or other internationally accepted BMP procedures.

Program Management Actions on Compliance
Projects monitor beneficiary farmers for their understanding and use of best practices found in the field form in Annex 11.
Projects report on monitoring in Annual Reports to USAID COTR and MEO, under a heading titled –Environmental Mitigation and Monitoring.”
Projects implementers report on any changes in Georgia pesticide regulations and registrations.
Annually participate in the amending of this PERSUAP to contain new IPM tactics and any new pesticides registered or available.
Projects write the names of pesticides that cannot be used with USAID assistance into any future grant or sub-contract.
Projects environmental staff members include relevant actions drawn from this SUAP in EMMPs or draft an EMMP containing pesticide issues identified in the SUAP, with ways to mitigate the most common risks.

SECTION 1: INTRODUCTION

1.1 USAID ENVIRONMENTAL REGULATIONS DEVELOPMENT

From 1974 to 1976, over 2,800 Pakistan malaria spray personnel were poisoned (five to death) by insecticide mishaps on a USAID/WHO anti-malaria program[6]. In response to this and other incidents arising from USAID programs, a lawsuit was brought by a coalition of environmental groups for lack of environmental procedures for overseas projects. USAID, in response to the lawsuit, drafted US 22 CFR 216. This regulation, which was updated in 1979 to include extraterritorial affairs (in response to changes in the scope of the application of the National Environmental Policy Act (NEPA)), now guides most USAID activities that could have potentially negative environmental impacts.

Regulation 216 (also called Part 216) of 22 CFR states that certain environmental compliance processes and procedures must be followed on overseas projects in order to:

- Respond to market demand for clean, high-quality agricultural produce, and meet import expectations
- Create modern state-of-the-art development
- Achieve optimal economic results with every dollar invested
- Avoid harming people in both our partner countries and the US
- Avert unintended negative economic growth
- Reinforce practical civil society and democracy through transparency and public participation
- Reduce diplomatic incidents
- Engender public trust and confidence in USAID
- Comply with the law
- Represent good business.

1.2 REGULATION 216

According to Regulation 216, all USAID activities are subject to analysis and evaluation via – at minimum – an Initial Environmental Examination (IEE), and – at maximum – an Environmental Assessment (EA). A large part of Regulation 216 – part 216.3 – is devoted to pesticide use and safety. Part 216.3 requires that 12 pesticide factors be analyzed and recommendations be written to mitigate risks to human health and environmental resources, to be followed up with appropriate training, monitoring and reporting for continuous improvement on risk reduction and adoption of international best practices for crop production, protection, and pesticide use safety.

[6] http://www.ncbi.nlm.nih.gov/pubmed/74508

1.3 THE PESTICIDE EVALUATION REPORT AND SAFER USE ACTION PLAN (PERSUAP)

In the USA, the EPA can rely on the following safety-enhancing factors, not present to the same degree in most developing countries—including Georgia:

- An educated literate population of farmers
- Quality IPM information and PMPs
- A well-functioning research and extension system to extend IPM information to farmers
- Certification systems for farmer training on restricted and other pesticides
- Quality affordable PPE to reduce pesticide exposure
- Quality pesticide labels and Material Safety Data Sheets (MSDS) to guide farmer safety
- Accurate information and training on pesticide use, transport, storage and disposal

In the late 1990s, USAID's Bureau for Africa (AFR) developed the Pesticide Evaluation Report and Safe Use Action Plan (PERSUAP)—a tool to analyze the pesticide system or sector in any given country or territory. The PERSUAP focuses on the particular circumstances, crops, pests, and IPM/pesticide choices of a project or program. This "systems approach" analyzes the pesticide sector or system from registration to import through use to disposal, and develops a pesticide risk profile based on the analysis.

A PERSUAP is generally recommended by and submitted as an amendment to the project IEE or an EA. Further, the application of PERSUAP recommendations helps prepare project participants to be able to more rapidly adopt BMPs, GlobalGAP, Organic and other S&C systems principles, as desired, for future market access.

1.4 ANALYSIS OF PERSUAP PRECEDENT FOR GEORGIA

In April of 2006, a PERSUAP was developed for ACDI-VOCA to cover the AgVantage project in Georgia. This was to be the first PERSUAP of its kind for Georgia. It covered the following crops:

- Export Crops
- Potatoes
- Tomatoes
- Apples and Stone Fruits (early stages)
- Mandarins and Other Citrus
- Winter Greenhouse Greens: Dill, Parsley, Spring Onion, Garden Cress, Coriander (no pests)
- Berries: Blueberries, Raspberries (wild, not cultivated)

- Vegetables: Asparagus, Chinese cabbage, Over-wintering onions
- Specialty Products
- Bayleaf
- Hazelnuts
- Mushrooms (early development stages, no pests listed yet)
- Chestnuts (mostly wild, not cultivated)
- Poultry (no pests controlled)
- Dairy (no pests controlled)

In addition, it evaluated IPM measures used internationally for the major pests of each crop. It analyzed 14 fungicide AIs, 10 insecticide AIs, 6 herbicide AIs and one nematocide that were registered and available in Georgia (but not all of which were acceptable on AID projects).

At that time, small amounts of pesticides had been used on most crops in Georgia, due to lack of financial resources and lack of a well-developed pesticide system in the country. That is currently changing. A relatively small number of shops outside of Tbilisi were beginning to stock a limited number of products (10-15) and limited amounts (10 Kilograms, 10 liters on hand) of pesticides by Syngenta, Bayer, Safa Tarim (Turkish), Russian products, and Parijat (Indian). For economic reasons of both the farmer and the shopkeepers, many pesticides were sub-divided in the store from large containers to smaller ones (baggies, plastic bottles), without labels. Most farmers (or laborers they hired) used plastic hand-pump backpack sprayers that leaked and were using minimal if no safety equipment, even though some had received training.

Then in 2009, USAID and CNFA developed GARRP (Georgia Agricultural Risk Reduction Program). The initial goal of the program was to assist farmers affected by the 2008 conflict, in communities that were immediately accessible outside the Russian-controlled ~~"b~~buffer zone," to plant crops of winter wheat and maize, thereby returning them to production and restoring livelihoods. Additional agreements added provision of farm machinery, fertilizers, seeds, and pesticides. At that time, the mission updated the 2007 PERSUAP to fit GARRP's goals, crops, pests, IPM tools including pesticides.

1.5 INTEGRATED PEST MANAGEMENT—USAID POLICY

In the early 1990s, USAID adopted the philosophy and practice of Integrated Pest Management (IPM) (for livestock pests, most of which are disease vectors, this becomes Integrated Vector Management or IVM) as official policy. IPM is also strongly promoted and required as part of Regulation 216.3. Since the early 2000s, IPM—which includes judicious use of 'safer' pesticides—has been an integral part of GAPs and is increasingly considered to constitute best management practices in agriculture.

A good definition of IPM from UC-Davis[7] follows:

[7] http://www.ipm.ucdavis.edu/IPMPROJECT/about.html

"Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials [pesticides] are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment."

The strongest selling points for IPM beyond the health and environmental benefits are, that IPM:

- Is more effective than synthetic pesticides in the long run.
- Is, once established, self-perpetuating to a degree.
- Is less damaging to essential soil health and nutrient cycling.
- Generally requires less capital (but more labor) investment.
- Can be used preventatively to eliminate or minimize the need for "responsive" controls (e.g. applying pesticides after a pest outbreak occurs to an already-damaged area).

IPM can include possible pest management techniques and tools including:

- Soil and water tests, raised-bed production, tunnels, drip-irrigation[8]
- Pest scouting, monitoring, and identification for accurate decision-making
- Cultural methods that promote pest avoidance and a healthy plant that can better tolerate or resist pests. These methods include, but are not limited to, use of resistant varieties, early/late plantings/harvestings, crop rotation, pruning diseased parts, destruction of pest refuge plants near fields and crop residues, and GAP practices
- Natural pest control by encouraging and protecting parasitoids, predators, and pest diseases (i.e. planting predator-attracting plants/flowers on field margins)
- Mechanical weed or insect pest control using manual, hoe and machine practices
- Chemical practices such as use of judicious, knowledgeable, and safe application of synthetic and "natural" (derived from nature; extracted from plants, microbes, and other organisms) pesticides

For most crops, soils need to provide adequate nutrients and moisture and be well drained. The soil is where plant health begins and ends. A healthy soil will have a greater capacity to moderate the uptake of fertilizers and will allow a more balanced uptake of nutrients, creating a healthy plant that is less attractive to pests and more resistant to pest damage.

[8] Note that drip irrigation does not re-charge underground aquifers, so water must be used carefully.

1.6 GEORGIA PERSUAP METHODOLOGY

During February and March of 2011, consultant collected and analyzed information on target crops, pests, IPM methods used. In April 2011, consultant visited EPI and AMP projects, Georgian government officials, pesticide distributors and shops, and farms in Gori, Marneuli, and Zestaponi. Information was collected on seed treatments, field crops, greenhouse crops, veterinary treatments and food storage and processing needs. The findings are presented in this PERSUAP report.

The strategy used for writing this PERSUAP is for it to contain as many links to websites with best practices as possible, both to make it easier to use (reduce the length and thickness) and more up-to-date or accurate (as websites are updated). Therefore, instead of having numerous Annexes containing pesticide safety equipment recommendations or safe pesticide use practices, websites now take their place.

SECTION 2: BACKGROUND

2.1 COUNTRY BACKGROUND

Georgia, between Russia to the north and Turkey, Armenia and Azerbaijan to the south is largely mountainous with Great Caucasus Mountains in the north and Lesser Caucasus Mountains in the south; Kolkhet'is Dablobi (Kolkhida Lowland) opens to the Black Sea in the west; Mtkvari River Basin in the east; good soils in river valley flood plains, foothills of Kolkhida Lowland.

Map of Georgia

Natural resources include forests, hydropower, manganese deposits, iron ore, copper, minor coal and oil deposits; coastal climate and soils allow for important tea and citrus growth. Arable land accounts for 11.5% of the territory and permanent crops comprise 3.8%. Georgia's main economic activities include the cultivation of agricultural products such as grapes, citrus fruits, and hazelnuts; mining of manganese and copper; and output of a small industrial sector producing alcoholic and nonalcoholic beverages, metals, machinery, and chemicals. Agricultural products include citrus, grapes, tea, hazelnuts, vegetables, and livestock.

Georgia has made significant progress in improving the economic environment and building the economy. However, the next needed steps to achieve broad-based sustainable economic growth will be more complex. Critical constraints to improving Georgia‘s economic competitiveness include fragmented markets, a lack of economic information, and low productivity. Solutions to these issues will require addressing fundamental issues in public and private sector economic institutions; sustained and coordinated capacity building initiatives; and development of systems to enable the flow of economic and technical information.

Agriculture accounts for approximately 9% of GDP, but provides income to more than half the population of Georgia. According to data from the Ministry of Agriculture, in 2006 Georgia had 656,000 farms with an average size of 1.70 hectares. Of these, there were 16,000 farms of 4 hectares or greater, which represent 40% of arable cropland in private hands (owned or leased). For farm households, monthly income from sale of farm products averaged just 27.2 GEL, or less than $200 per year. This low level of productivity and income is the result of a number of factors including:

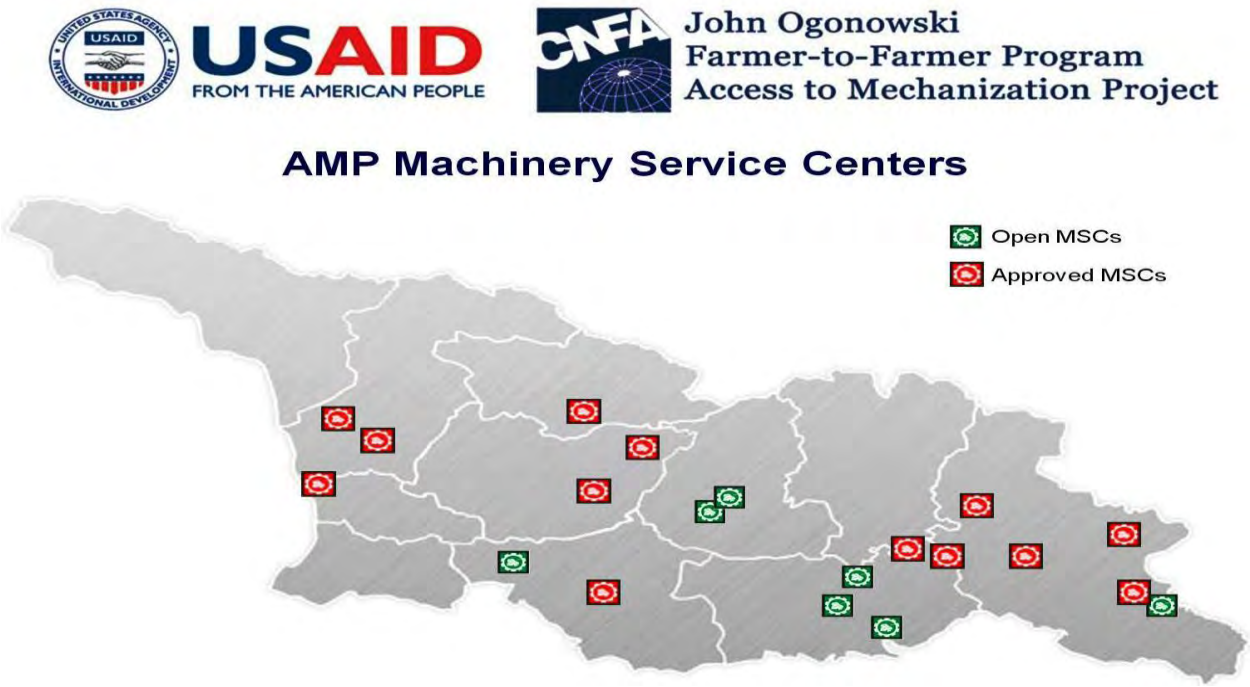
- Small land plots which do not allow for the efficient use of machinery and technology
- Traditional commodity products with low market value
- Low quality of products, further reducing market value and export potential, caused by poor productivity skills
- Inefficient post-harvest handling, resulting in loss of output and market value
- Poorly developed value chains which keep male and female farmers from realizing full potential value of the output
- Lack of extension services, including veterinary services
- Lack of information about markets and weak to no linkages to domestic, regional and global markets
- Lack of access to agricultural machinery and technologies

2.2 GEORGIA USAID 2010-2011 PROJECT BACKGROUNDS

ACCESS TO MECHANIZATION PROJECT (AMP)

AMP addresses Georgia‘s severe shortage of agricultural machinery using a commercially sustainable, market-oriented methodology for development of machinery service providers. In order to properly serve farmers, AMP machinery service centers must provide pesticide application services. This implies the need to identify allowable and unallowable plant protection products that may be stocked and utilized by AMP MSCs, as well as the need for training of MSC staff in proper handling, storage, transport, use, and disposal of these products. Building on the PERSUAP completed in 2006 for AgVantage and 2009 for the GARRP program, these issues should be considered and the findings incorporated into ongoing AMP implementation.

Provision of technical and material assistance to farmers under NEO will include small scale business development activities, for example, assistance in livestock breeding, poultry and dairy farm operations, improvements in seedlings, and other interventions aimed at increasing agricultural productivity; Provision or short-term subsidization of agriculture inputs to increase on farm production and to promote private sector agri-business, or other micro-enterprise ventures. The project might involve dissemination of information on pesticides, which has potentially negative impacts on land, air, water food, human health, biodiversity, and threatened, endangered, and protected species. This PERSUAP is being conducted in order to identify prior to recommendations, trainings, and information dissemination regarding the use of pesticides.



ECONOMIC PROSPERITY INITIATIVE (EPI)

EPI will improve Georgia's overall economic competitiveness through assistance designed to improve both economic governance and private sector competitiveness. Activities will be structured within three program areas:

- Expand and Deepen Georgia's Economic Governance Capacity and Country-Level Competitiveness
- Improve the Competitiveness of Agriculture Sector
- Improve the Competitiveness of Targeted Non-Agriculture Sectors

EPI is a $40.4 million, four-year program with a focus on increasing productivity, increasing sales and exports, increasing access to credit (including foreign direct investment) and increasing employment across the Georgian economy.

EPI is tasked with increasing the productivity of the Georgian agricultural sector. An important part of this process is the appropriate use of modern pesticides so that economic yield can be maximized. Thus, the project may directly or indirectly disseminate information on pesticides used to control weeds, insects, and fungus. It is envisioned that the EPI project or its local partners will provide training on the appropriate storage, transportation, handling, use (including application rates), and disposal of these products.

NEW ECONOMIC OPPORTUNITIES (NEO)

NEO is a four-year program (not yet awarded at the time of this PERSUAP draft) estimated at $22.5 million designed to improve rural incomes; reduce poverty levels; improve food security; address critical, small-scale household and agricultural water constraints in targeted communities; enable targeted internally displaced persons (IDP) communities (old and new) to sustainably maintain their households; and assist communities distressed by natural or other disasters.

In order to achieve the programs results targets NEO will have following four components: 1) Community level economic development planning; 2) Rural Economic Development; 3) Assistance to strengthen highly vulnerable households and individuals, and 4) Promoting Sustainability of IDP houses being rehabilitated with support from the USG. In the rural sector, NEO aims to improve agricultural productivity; reduce poverty levels; improve food security; NEO will provide demand-based vocational training, agriculture practices or other technical assistance to develop targeted existing or prospective employment opportunities (e.g., horticulture, vegetable, livestock, handicraft, service provision, etc) from production through market linkages.

2.3 GEORGIA AND INTERNATIONAL CONVENTIONS

Georgia was a party to the Convention on Biological Diversity[9] since June 2, 1994 as an accession, but not a signatory. A Draft National Biosafety Framework was developed under a UNEP-GEF Biosafety Project in 2005 and was published in Georgia in 2007. Georgia

[9] http://www.cbd.int/convention/parties/list/

ratified the Cartagena Protocol on Biosafety[10] on November 4, 2008 and it entered into force on February 2, 2009.

Georgia acceded to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)[11] on September 13, 1996 and entered into force on December 12, 1996.

Further, Georgia was a signatory to the Stockholm Convention POPs Treaty in 2001 and ratified it in 2006[12]. Georgia acceded to the Rotterdam PIC (Prior Informed Consent) Treaty in 2007[13]. From 2005 to 2008, donors led by the Dutch cleaned up large stockpiles of obsolete pesticides, including POPs and PIC chemicals in Georgia[14]. In order to prevent future stockpiles, the MOA, shopkeepers, and farmers need to know how to deal with leftover and obsolete pesticides. The following website http://www.epa.gov/oppfead1/labeling/lrm/chap-13.htm provides pesticide disposal options.

2.4 Georgia Pesticide Regulations and Import from Neighboring Countries

GEORGIA

On May 1, 1999, Georgian law No. 1420-IIs on hazardous chemical substances entered into force. This Law regulates the development, testing, standardization, registration, production, packing, marking and labeling, transportation, use, export and import, processing, rendering harmless, prohibition and elimination of hazardous chemical substances. It also establishes the rules for state and department supervision over such substances.

The purposes of the Law shall be: (a) regulate the legal relationship between authorities and natural and legal persons (regardless of the property or organizational or legal type) regarding the safe use of hazardous chemical substances; (b) prohibit the unsystematic or unauthorized use of hazardous chemical substances; (c) require the identification and registration of hazardous chemical substances; (d) regulate the use of hazardous chemical substances and prevent their harmful effects on human health and the environment; (e) regulate the notification processes for hazardous chemical substances intended for sale, their testing and official expertise, standardization, registration, packing, marking, import and export; and (f) keep the population informed and raise public awareness regarding the risks of hazardous chemical substances. In order to appraise their effects on human health and the environment, the classes of toxicity and risks of hazardous chemical substances are specified.

At present, the MOA considers that if OECD has tested and approved a pesticide, it is redundant to repeat the exact same tests. As such, pesticides already tested by OECD are permitted to be registered in Georgia. As stated above, until about 2007, very few agricultural inputs had been used in Georgia. And, there are still not sufficient funds for an extension service. Use and dosage recommendations are made by pesticide shopkeepers.

[10] http://bch.cbd.int/about/countryprofile.shtml?country=ge

[11] http://www.cites.org/eng/disc/parties/alphabet.shtml

[12] http://www.pops.int/documents/signature/signstatus.htm

[13] http://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-14&chapter=27&lang=en

[14] http://obsoletepesticides.net/

Currently the following numbers of different types of pesticides are registered for use in Georgia: 82 fungicides, 49 insecticides, 43 herbicides, two miticides, two nematocides, one molluscicide, two rodenticides and 7 pheromones.

ARMENIA

According to pesticide importers and distributors, Armenia is a potential future source of counterfeit Chinese pesticides; however, at present this entry route is highly monitored and controlled such that these products have not yet significantly entered Georgian markets. FSCs are cautioned about purchasing and selling these products.

CHINA

After the United States, China is the second largest producer of pesticides. Chinese factories and pesticide companies produce the active ingredients for both the top and bottom ends of the sector. Some of the better companies now are sub-contracted to produce active ingredients for pesticides in international brand-name companies. However, many of the rest of the companies flood developing world markets with the most popular chemicals that are easy to make, but may have contaminants or less active ingredient (AI) than advertised. In China, since 1963, the manufacture and sale of agricultural pesticides is regulated by the Ministry of Agriculture's Institute for the Control of Agrochemicals of the Ministry of Agriculture (ICAMA). Numerous Chinese products, some appearing with pirated international labels and others of sufficient quality can be found in the CAR and Caucusus region.

RUSSIA

Each year, Russia produces an annually updated list of pesticides registered for production, import, export, and use. A copy of the list is found at http://www.mcx.ru/documents/document/show/13153.133.htm. At present, it is difficult to find Russian products in mainstream Georgian stores in the center of the country.

EUROASIAN INTERSTATE COUNCIL FOR STANDARDIZATION, METEOROLOGY, AND CERTIFICATION (EASC)[15]

The EASC provides former Soviet Union states an information repository and forum for decision-makers to discuss regulatory and harmonization issues. The EASC's modality and resources ensure that all CIS standards are coordinated on the issues of human health and environmental protection. Thus, CIS countries that do not have pesticide regulations or wish to harmonize regulations; they may refer EASC for standards to adopt and follow.

ANOTHER PESTICIDE IMPORT FACTOR: FUTURE MARKETS FOR GEORGIAN PRODUCE

Trade with western countries will further drive the direction for registration and enforcement of imports of quality pesticides. Certain pesticide products and byproducts are permitted on produce exported to Western Europe and others are not. Those that are not will likely be dropped from use by countries seeking trade opportunities with Western Europe especially for certified produce markets.

[15] http://www.easc.org.by/english/mgs_org_en.php

2.5 PESTICIDE USE SECTORS IN GEORGIA

SEED TREATMENT WITH PESTICIDES AND GMOS

Many USAID agriculture projects donate or assist with acquisition of quality hybrid crop seed for farmers they serve. Almost all of this seed, as well as practically all modern vegetable seeds are treated with pesticides (see the photo below of treated vegetable seeds of every color).

Most commercial seed treatment, by volume, is done by the company that produces and packages the seed, and is not by donors and not by farmers. And almost all treated seed is colored to show that it has been treated—this is so that it is not confused with food grain, cooked, and eaten.

Many farmers in Central Asia and Caucasus, including Georgia, save seed from season to season and treat it themselves with at least one of the following pesticide products found available in the region: Raxil, Fundazole, Kalfigo Super, Maxim, Vitavax, and Vinner. Generally, seed-treatment pesticides are formulated as one of the following: FS = Flowable concentrate for Seed treatment (most seed treatments); DS = Powders for Dry Seed treatment; SC = Suspension Concentrate; WP = Wettable Powder; MD = Micro Dispersion; WS = Water dispersible powder for Slurry treatment.

Photo: Pesticide-treated vegetable seeds for sale

As stated above, Georgia has a Biosafety Protocol in place and has signed The Cartagena Protocol on Biosafety to the Convention on Biological Diversity[16]. However, to provide biosafety while using GMOs (Genetically Modified Organisms), and the effective use of biotechnologies, the following measures need to be taken: developing legislative and

[16] http://www.cbd.int/countries/contacts.shtml?country=kg; http://bch.cbd.int/protocol/

institutional base in this field; training specialists and creating a special body controlling the GMO management; and developing special programs on informing the population of genetically modified organisms.

USAID has Agency Procedures for Safe Use of GMO[17]**.** If an activity will potentially involve the use of genetically modified organisms in research, field trials, or dissemination, the activity must be reviewed and approved for compliance with applicable U.S. requirements by the USAID Biosafety Officer in Washington prior to obligation of funds and prior to the transfer, testing, or release of biotechnology products into the environment. This review and approval is limited to the safety aspects of the proposed activity and may involve external peer review or demonstration of comparable safety oversight by other expert U.S. federal agencies. Therefore, adequate time should be budgeted for this approval process. This biosafety determination is separate from, and precedes and informs, the 22 CFR 216 environmental impact assessment determinations.

ADVANTAGES OF SEED TREATMENTS AND GMOS

Since they are used at very small amounts of active ingredient per seed and thus per unit of land, and take the chemical directly to the pest, seed treatments with permitted pesticides fit nicely within an IPM program. They exert a much lighter impact on the environment than spraying an entire field. They protect the seed from numerous soil and seed-borne fungal, bacterial, and insect pests, so that germination and seedling growth can proceed unimpeded. And, there are some biological seed treatments available and some new ones being developed. Use of some GMOs, like GMO cotton, can help reduce the number of pesticide sprays needed[18] to control boll-penetrating moth larvae.

RISKS FROM TREATING SEED WITH PESTICIDES ON-FARM

Treating seed involves many of the same risks as for mixing concentrated pesticide products and applying them to field or greenhouse crops. First, it assumes that the farmer knows the principle soil diseases and pests present and what to use against them. And, it assumes that farmers understand the risks associated with treating, packaging, labeling, storing, and planting the seed.

Ideally, seed would be treated in a specialized ―seed treater" composed of a mixing tank, treater head and coating chamber to apply precisely measured quantities of pesticide. Proper PPE must be used by the farmer applicator and unused pesticide and residues must be properly disposed of. Next, the treated seed must be properly labeled as ―Treated" with the common (Active Ingredient) and trade (Product) names of the pesticide used, health hazards of the pesticide such as skin or eye irritant or if it is a carcinogen. For highly toxic chemicals, the statement ―This seed is treated with a poison" and for toxic chemicals, the statement ―Do not use for food, feed or oil purposes" should be used.

Seed treated for planting should be stored separately from grain to be used for food, animal feed, or oil extraction. Storage should be in a dry, well-ventilated space. Farmers should keep treated seed out of reach of small children. More Best Management Practices (BMPs) for seed treatment are found at http://www.ksre.ksu.edu/library/entml2/s18.pdf.

[17] http://www.usaid.gov/our_work/environment/compliance/apsugeo.html

[18] http://www.ars.usda.gov/is/np/btcotton/btcotton.pdf

AID implementing partners are effectively limited to promoting or purchasing and donating only seed treatment pesticides or seed already treated with pesticides registered by EPA for same or similar uses. For this reason, this PERSUAP evaluates in Annex 7 all of the AIs commonly found in seed treatment pesticides for EPA registration, human health, and environmental risks, among other factors. Note again that the AIs commonly found in concentrated and formulated seed treatment pesticide products will present more application risks than seed already treated, due to a dilution effect.

Some GMO crops present risks as well as advantages. Risks include the development of pest resistance to the modified crop. So-called ―super weeds" have developed from over-use of glyphosate (Roundup) on Roundup Ready soybeans[19]. Risks also include cross-pollination of GMO plants with open pollinated non-GMO crop plants, causing contamination.

FIELD AGRICULTURE PESTICIDE USE

A large number of USAID development projects focus on increasing agricultural production in countries where agriculture still consumes most of a country's labor, natural resources, and GDP output. Inevitably, these projects work with providing farmers access to improved varieties and tools, best practices and inputs. These inputs include fertilizers and pesticides. Pesticides generally include insecticides, miticides, nematocides, molluscicides, fungicides, herbicides, bactericides, avicides, and rodenticides. Insecticides that are gaseous or produce toxic gas are called fumigants. Most fumigants are for soil treatment used for high value crops (like strawberries in the USA) that kills almost everything in the soil, and are Class I toxins (the most toxic).

ADVANTAGES OF FIELD AGRICULTURE PESTICIDE TREATMENTS

Some pests significantly reduce yield and yield potential of certain crops. Pesticides, if used wisely and safely in an IPM program, can reduce pests to tolerable levels, leading to lower pest damage risks and protected yield.

RISKS FROM FIELD AGRICULTURE PESTICIDE TREATMENTS

Risks from use of pesticides in the field are numerous, but the highest risk is encountered when the container of pesticide is opened because of the potential for contact with a high concentration of the AI. Once the AI becomes mixed with water and sprayed, risk decreases somewhat, but not completely, due to dilution. Risk goes up with higher concentrations of AI and with higher AI acute toxicity classes.

As noted in the introduction, AID implementing partners are effectively limited to discussing during training, promoting, purchasing, or donating only pesticides registered by EPA for same or similar uses.

GREENHOUSE PESTICIDE USE

At present USAID funds numerous agriculture projects that focus at least in part on greenhouse production. This is true in CIS countries in general, and Georgia in specific. Greenhouse environments provide a variety of benefits for plant production; however, many greenhouses favor pest development as well. The warm, humid conditions and abundant food are ideal for pest build up.

[19] http://www.nytimes.com/2010/05/04/business/energy-environment/04weed.html; http://www.rodale.com/monsanto

Natural enemies that serve to keep some pests under control in the field are absent in the greenhouse. For these reasons, pest problems often develop more rapidly and are more severe in these enclosed systems. Greenhouses generally tend most likely to be infested with very small crop pests like spider mites, scales, mealy bugs, whiteflies, aphids, leaf miners fungus gnats and thrips. Common greenhouse diseases include powdery and downy mildews.

ADVANTAGES FOR GREENHOUSE PRODUCTION

The primary advantage of using pesticides in a greenhouse is that the pests are trapped and cannot leave, increasing the chance that they will be poisoned. The use of biological controls (predators, parasites, or diseases that attack pests) can be effective for the same reason. The website[20] maintained by the National Sustainable Agriculture Information Service contains numerous biological control resources for greenhouse production. And, many small pests can be excluded (and biological controls kept in) by using fine mesh screens on greenhouse openings.

RISKS FROM TREATING GREENHOUSES WITH PESTICIDES

The risk of phytotoxicity—the injury to plants by pesticides—is greater in a greenhouses where plants grow rapidly and are exceptionally succulent. The greenhouse environment is in some ways more challenging than the field in that it is an enclosed space where pesticides can become concentrated in the air, with little room for error for applicator safety.

Concentrated liquid formulations are generally more hazardous to the applicator than dry formulations as they may be easily absorbed through the skin. Aerosols and fogs usually penetrate dense foliage better than conventional sprays so better pest control is achieved, but they pose greater risk to people of exposure through the eyes or by inhalation. Special metering or application equipment may be needed and some of the chemicals used may be highly toxic.

Many pesticides labeled for field use are prohibited for greenhouse use because of concerns about worker safety, phytotoxicity leading to crop injury, and/or pesticide resistance management. Regulation 216 applies to greenhouse production in the same way that it applies to field uses. In Annex 7, this PERSUAP evaluates AIs contained in the most common greenhouse pesticides.

FOOD WAREHOUSE /PROCESSING PESTICIDE USE

Several species of insects, mites, and rodents may infest grain in storage. The principal pests that cause damage are the adult and larval stages of beetles, and the larval stage of moths. Rodents (rats and mice) or their hair, urine and feces are another possible stored food contaminant. All may be a problem by their presence, either alive or dead, or in grain that is to be processed for food, or already processed. Stored-grain insects are known as ~~-in~~ternal feeders" if they feed within the kernels, otherwise they are referred to as ~~-e~~xternal feeders."

Stored grain and foods can be turned to dust and contaminants very quickly if a pest population is left unchecked. Generally, warehouses are fumigated to kill all pests at once and the fumigant of choice is aluminum phosphide (which produces highly toxic phosphine gas). Others may use carbon dioxide. These gases are especially effective against internal

[20] http://attra.ncat.org/attra-pub/gh-ipm.html

grain feeders as non-gas pesticides may not reach into the grain. Several non-fumigants are also used.

ADVANTAGES OF WAREHOUSE TREATMENT

The warehouse environment is largely a sealed environment where pests—especially well hidden and protected pests inside grain and food—being controlled cannot escape, and are controlled with toxic gases. Bait boxes can be placed near warehouses to control rodents attracted to the warehouse.

RISKS FROM TREATING WAREHOUSES WITH PESTICIDES

The closed environment and use of gases poses unique and potentially deadly risks to humans, especially if they are not trained and equipped properly. Fumigation personnel must be trained and present in a pair, have self-contained oxygen or canister filter masks, phosphine meter and chemical resistant gloves. Non-gas warehouse treatments also have specific best practices found at http://fcamin.nic.in/admin/an4.pdf. Most stored grain issues are dealt with using good sanitation practices. Regulation 216 applies to warehouse storage in the same way that it applies to other uses. In Annex 7, this PERSUAP evaluates AIs contained in the most common warehouse pesticides.

LIVESTOCK PESTICIDE USE

Like field agricultural production, USAID also supports ways to increase production in countries reliant on pastoralism or livestock rearing for meat and milk. The singular important pest problem with livestock production involves the annoyance and transmission of diseases by ectoparasite ticks, mites, and biting flies. Along with cultural practices and IVM, acaricides and insecticides are used to control these pests. In Annex 7, this PERSUAP evaluates AIs contained in the most common veterinary pesticides.

ADVANTAGES OF LIVESTOCK PESTICIDE USE

Cattle diseased from tick or fly bites or bothered by biting flies lose weight and do not produce quantity or quality meat and hides. Acaricides and Insecticides reduce these risks.

RISKS FROM TREATING LIVESTOCK WITH PESTICIDES

One major risk from livestock treatment is the use of livestock dips whereby a deep pit is dug into the ground, generally next to a water source like a river or stream, and filled with a pesticide solution. Livestock are then run through and submerged in the dip. What to do with the dip water once dipping is complete poses risks to the environment. Occasional floods, as well as intentional disposal by dumping often carry the dip water down the stream, contaminating the water resource and killing aquatic organism. USAID generally does not support the use of dips.

Many farmers use backpack sprayers to apply acaricides. More recently, herders and ranchers apply acaricides using pour-on formulations. And, some without resources apply acaricides by using a rag soaked in pesticides and applied using bare hands. They should be encouraged to keep and use chemical-resistant gloves for these purposes.

2.6 EVALUATION OF GEORGIA PESTICIDE RISKS NEAR PROJECT SITES

Georgia presently has a pesticide registration system, and a list of registered (permitted) pesticides to guide famers and others. Pesticides found in FSCs in Gori, Marneuli and

Zestaponi come primarily from name-brand Western companies and exporters as well as some multinationals including Bayer, DuPont, Syngenta, and others, but in the region there are also pesticides produced in China, some of which are fine and a few of which are likely of questionable quality. Since there is limited analytical capability in Georgia, pesticides containing additional byproducts and chemicals may be registered and are likely to enter Georgia undetected.

No pesticides are formulated in Georgia, however some are re-packaged. Chinese backpack sprayers are available. Small, single-use pesticide sachets are available and are considered a best practice because there are no leftover pesticide issues and little packaging to deal with. Scarce safety equipment is available, and any that is available is relatively very expensive. According to numerous sources, most small and medium-scale farmers do not and will not use PPE. Larger commercial farms tend to afford and ensure use PPE by hired laborers.

In every country or region, there exist factors that increase or decrease the risk profile of the agrochemical inputs system. Following conversations with sector experts in Georgia, and others, these risks have been categorized into groups and enumerated below as ―Factors that Increase Risks from Pesticides" and ―Factors that Reduce Risks from pesticides." Most of the farmers producing crops being promoted by the USAID Productive Agriculture Project in Georgia will have the potential to use some riskier pesticides as the sector develops more, albeit without a system for registration.

Factors that indicate *Increased* risks from pesticides

Problems, constraints or risks in the Georgia pesticide cycle of use	Recommendations for donors and USAID projects	USAID Priority
Farm Service Centers sub-dividing pesticides from large containers to empty water and drink bottles	Government disincentives and incentives provided to reduce this behavior	High
Lower quality, illegal & pirated Chinese pesticides present in low but increasing quantities	Do repeated training on pesticide quality choices	Med
Certified analytical capacity for analyzing and monitoring pesticides and residues is insufficient	Donors and produce exporters and authorities combine resources	High
Limited resources for pesticide regulations enforcement	Taxes need to be levied from agriculture sector	Low
Limited resources for extension	Do demonstration farms and field days	High

Limited farmer knowledge of pest ID & IPM tools	Increase knowledge, do repeated training on IPM	High
Pesticide shops with limited safety equipment available	Train shop-keepers on pesticide safety	Low
Pesticides stored in the home	Do repeated training on proper pesticide storage	High
Little use of PPE by pesticide appliers	Do training on proper PPE to use; provide PPE Encourage development and use of spray and spray record-keeping service with PPE to be hired and do all spraying and records	High
Over- and under-applications of pesticides and no record-keeping	Do repeated training on calibration & application or use spray and record-keeping service attached to cooperatives	Med
Pesticides applied at wrong time of day and with winds too high	Do repeated training on application times risks	Med
Wrong pesticide applied for pest	Do repeated training on pesticide choice	High
Back-pack sprayers leak onto spray personnel	Do repeated training on sprayer maintenance	High
Toxic aluminum phosphide present in input stores	Do repeated training on pesticide choice & quality	High
Increased chronic health issues in past	Do repeated training on pesticide acute and chronic toxicities & PPE	Low

Obsolete pesticides & container disposal	Do repeated training on proper disposal	High

Factors that *Reduce* risks from pesticides

- Georgia has developed and amended detailed pesticide regulations and registration procedures in place, and now regularly updates a list of registered pesticides.
- Except for cotton and some small grains like wheat, there has not been a culture of heavy reliance on pesticides for the production of fruits and vegetables, so unsafe use behavior patterns have not been set, moreover GAP patterns may be easier to set.
- There are some ‗natural' pesticide products available that contain extracts of chili, pyrethrum, garlic, neem, bacterial extracts abamectin (Vertimec), spinosad and the bacteria *Bacillus subtilis and Bacillus thuringiensis*, as well as products containing sulfur and copper.
- Some pesticide sellers understand the most important crop production pests, pesticides/dosages to use against the pests, risks that come with pesticide use, and the need for PPE.
- There is no field evidence of pesticide misuse leading to poisonings of domestic animals or environmental poisoning (like fish kills).
- Various development project activities will involve demonstrations to farmers by well-trained staff, so there is a possibility for the transfer of IPM and safe pesticide use practices.

Although there are a few positive factors, numerous issues can and do increase the risk for pesticide errors to occur in Georgia. This situation increases the risk of exposing small-scale farmers, laborers and farm family members to dangerous poisons, and polluting their environment. Thus, the pesticide risk profile is higher than might be encountered in more developed countries, so extra care is required.

2.7 CLIMATE CHANGE AND GEORGIA AGRICULTURE

According to a World Wildlife Fund report[21], the Southern Caucasus region already shows climate induced changes with increasing temperatures, shrinking glaciers, sea level rise, reduction, and redistribution of river flows, decreasing snowfall and an upward shift of the snowline. More extreme weather events have also characterized the last ten years with flooding, landslides, forest fires and coastal erosion with significant economic losses and human casualties as a result. Reported damages due to flooding, frost, and drought in the three countries amounted to more than US$ 175 million, and from the Azerbaijan part of the Caspian Sea, more than US$ 2 billion of damages from coastal erosion and flooding were

[21] http://assets.wwf.no/downloads/climate_changes_caucasus___wwf_2008___final_april_2009.pdf

reported during a 20-year period. The current trends in the region will continue with large-scale changes of ecosystems in both lowlands and mountains and negative impacts on economic activities, especially agriculture and food production, but also health further aggravated."

Many unique species are dependent on alpine habitats in the Lesser Caucasus where the amount of living space will dramatically reduce, and species confined to already fragmented habitats like the southern Caucasus contain a plethora of biodiversity and wetlands will suffer. Species already facing threats from other human activities like livestock grazing in arid lowland areas will also experience problems to cope.

Water shortages could (and in the case of Uzbekistan, already do) result in drought and spark regional conflicts. Depletion of the soil organic carbon pool exacerbates carbon dioxide emissions to the atmosphere. Soil degradation decreases methane uptake by agricultural soils. And, CO_2 emission due to intensively used soils has increased.

Waterlogging and indiscriminate use of nitrogen-containing fertilizers increases nitrous oxide emissions from croplands. All of these may increase the rate of organic matter decomposition and soil degradation. Challenges include finding land use strategies and crops that restore degraded ecosystems and soils by improving water use efficiency, enhancing soil quality, and sequestering carbon in soil biomass.

Increases in temperatures will favor the spread of insect and disease pests further toward more northerly and southerly extremes. Many pests, which would die while overwintering, will now survive. The increase in crop pests will lead to the use of more pesticides, which will increase the resistance of pests to these pesticides. And, human diseases such as malaria have increased in recent years and are moving steadily northward in their range.

2.8 GOOD AGRICULTURE PRACTICES AND IPM FOR GEORGIA PROJECT CROPS

IPM – without the synthetic chemicals – has generally been a basic philosophy and strategy for Organic crops and markets for over 20 years. Since the early 2000s, IPM practices have been making their way into market-driven GAPs (GlobalGAP, British Retail Consortium-BRC, Fair Trade, Organic, and others) S&C systems. Food safety incidents and food poisoning deaths have been publicized in domestic and international news, and have hastened the pace for GAP adoption. GAPs are also referred to as agriculture and pesticide use Best Management Practices (BMPs).

The use of GAPs ensure the production of strong, vigorous plants (that can resist or tolerate pest damage) and safe food, while IPM focuses on decreasing risks from certain pests and other constraints to production.

GAPs emphasize maintaining proper plant health, and thus *prevention* of problems, through use of:

- Quality hybrid pest- and constraint-resistant treated seed;
- Proper land preparation and tillage such as sowing in raised-bed plantings;
- Soil fertility testing, monitoring and management;
- Water and soil moisture testing and management to avoid salinity, bacterial and chemical contaminants, and soil-borne diseases;

- Nutrient management through use of combinations of biological and mineral fertilizers;
- Organic matter management through use of manures, composting, and mulching;
- Proper pesticide choice, storage, use, and disposal.

According to a World Bank Study, the application of integrated pest management (IPM) is very limited in the country, as it is judged too expensive and not commercially viable. Since there is no extension system, farmers are often unaware of IPM methods or tend to apply them in a non-systematic way[22].

[22] http://www.worldbank.org/eca/pubs/envint/Volume%20II/English/Review%20GEO-final.pdf

SECTION 3: PESTICIDE EVALUATION REPORT

This part of the PERSUAP, the PER (Pesticide Evaluation Report), addresses pesticide choices based upon environmental and human health issues, uses, alternate options, IPM, biodiversity, conservation, training, PPE options, monitoring and mitigation recommendations according to the twelve Regulation 216.3(b)(1) Pesticide Procedures Factors, outlined and analyzed below.

Reg. 216.3(b)(1)(i) stipulates: ~~"~~When a project includes assistance for procurement or use, or both, of pesticides registered for the same or similar uses by USEPA without restriction, the Initial Environmental Examination for the project shall include a separate section evaluating the economic, social and environmental risks and benefits of the planned pesticide use to determine whether the use may result in significant environmental impact. Factors to be considered in such an evaluation shall include, but not be limited to the following": (see box, right)

THE 12 PESTICIDE FACTORS

Factor A. USEPA Registration Status of the Proposed Pesticides

Factor B. Basis for Selection of Pesticides

Factor C. Extent to which the proposed pesticide use is, or could be, part of an IPM program

Factor D. Proposed method or methods of application, including the availability of application and safety equipment

Factor E. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards

Factor F. Effectiveness of the requested pesticide for the proposed use

Factor G. Compatibility of the proposed pesticide use with target and non-target ecosystems

Factor H. Conditions under which the pesticide is to be used, including climate, geography, hydrology, and soils

Factor I. Availability of other pesticides or non-chemical control methods

Factor J. Host country's ability to regulate or control the distribution, storage, use, and disposal of the requested pesticide

Factor K. Provision for training of users and applicators.

Factor L. Provision made for monitoring the use and effectiveness of each pesticide

Pesticides can be homemade (artesenal) or synthesized in a factory, and may contain either natural extracts from plants, microbes, spices, oils, minerals, or synthesized chemicals, or occasionally both. Pesticides generally contain more than just the AI; they also contain a carrier (water, oil, or emulsion), emulsifiers, synergists, safeners, adhesives, and other components.

Pesticides generally contain just one AI, but can contain more than one AI, in a mixture. When produced commercially, each pesticide is made, marketed, and sold with a product commercial name. This name, in addition to artesenal products, is the ~~"~~pesticide" referred to by Regulation 216. These pesticide names can be ubiquitous (like Roundup for products containing the AI glyphosate) or can be given different names in different countries or regions depending upon cultural and linguistic differences and clever marketing.

3.1 FACTOR A: USEPA REGISTRATION STATUS OF THE PROPOSED PESTICIDE

Georgia assistance projects activities are effectively limited to mentioning during training, promoting, recommending, buying, or permitting on demonstration farms pesticides containing active ingredients (AIs) in products registered in the host country and in the US by the EPA for the same or *similar* uses. Emphasis is placed on ~~"s~~similar use" because a few of the crops and their pest species found overseas are not present in the US, and therefore pesticides may not be registered for the exact same use, but often are registered for similar pests and pest situations. Annex 7 provides EPA registration status for each AI found in Georgia.

The USEPA classifies pesticides according to actual toxicity of the formulated products, taking formulation types and concentrations into account, thus generally making the formulated product less toxic than the active ingredients alone would be. This method of classifying acute toxicity is accurate and representative of actual risks encountered in the field. By contrast, the WHO acute toxicity classification system is based on the active ingredient only. For a comparison of USEPA and WHO acute toxicity classification systems, see Annex 6.

The USEPA categorizes pesticides as either ~~"r~~egistered" or ~~"n~~ot registered." Pesticides containing AIs that are not registered in any products in the USA are not permitted on USAID projects.

In the USA, some specific commercial pesticide products are labeled as Restricted Use Pesticides (RUPs) due to inordinate risks. And, for each AI which may be in a number of RUP products, there are generally additional or other products, formulations and uses—with the exact same AI—which do not possess the same risks and are thus labeled or determined to be General Use Pesticides (GUP)—that is—not RUP. Ergo, for each AI, there may be RUP and non-RUP products depending upon risks they do or do not pose. This PERSUAP makes this distinction when analyzing each AI.

For AIs that are contained in both RUP and non-RUP products, specific websites containing continuously updated lists of RUP and non-RUP pesticide products registered by EPA are hot-linked. This is done so that project staff can immediately determine the RUP status of individual pesticide products, and if desired choose those that are not RUP.

ISSUE: PRODUCTS CONTAINING ACTIVE INGREDIENTS NOT EPA-REGISTERED

Annex 8 lists pesticide AIs in products currently registered in Georgia that are not registered by EPA in any products. Products and AIs that are not registered by EPA are *not permitted* for use on USAID-supported projects with USAID support (and therefore cannot be promoted during training or used on Georgia assistance projects demonstration farms with USAID resources). They are either cancelled for use in the USA, or have insufficient market demand, and have thus not been through EPA's battery of environmental and human health tests.

RECOMMENDATIONS FOR MITIGATION

- Georgia projects do not buy, promote, or allow use on demonstration farms of pesticides containing AIs not registered by EPA (see Annex 8).

ISSUE: RESTRICTED USE PESTICIDES (RUPS)

The EPA classifies individual pesticide products as ~~r~~restricted" if it determines that the pesticide may be hazardous to human health or to the environment *even when used according to the label*. As noted above, in quotes under 3.0, Regulation 216.3 (b)(1)(i), ~~p~~esticides registered for the same, or similar uses by USEPA *without restriction…*" The interpretation of ~~w~~ithout restriction" is that USAID projects will not buy or use approved pesticide products (not necessarily AIs) that are RUP.

Several of the pesticide AIs being imported into the Georgia in certain products are designated as RUPs by the USEPA (comprehensively screened in Annex 7) and non-RUP products containing the same AI, if they exist, are referenced and hot-linked in Annex 8.

RECOMMENDATIONS FOR MITIGATION

- Georgia projects do not buy, promote, or allow use on demonstration farms of pesticides designated by EPA to be RUP (however, see Annex 8 with references to similar products containing the same AIs—but that are not designated as RUPs).

ADDITIONAL RECOMMENDATIONS FOR MITIGATION

- Do training on GAPs/IPM, the production and use of pest management plans (PMPs) and safe pesticide use and management. Training will introduce beneficiary farmers to: IPM philosophy, tools and tactics (Annex 1); Pesticides not permitted for use with USAID resources, and those that can be recommended; and Safe Pesticide Use practices including use of basic PPE.

- Get all project offices copies of MSDSs for commonly-used pesticide to keep on-hand (pesticide MSDSs contain specific information on risks and risk mitigation for each pesticide product, and what measures to take in case of an accidental spill, fire or poisoning). MSDS information can also be used during training.

3.2 FACTOR B: BASIS FOR SELECTION OF PESTICIDES

This procedure generally refers to the practical, economic, and/or environmental rationales for choosing a particular pesticide. In general, best practices and USAID – which promote IPM as policy – dictate that the *least toxic* pesticide that is effective is selected. Fortunately, as a general but important trend, the more toxic pesticides (Class I) are decreasing in number worldwide and the number of the least toxic pesticides (Class IV) are increasing.

AGRICULTURE (CROP SEEDS, FIELD CROPS, AND GREENHOUSE CROPS)

Up until recently, the bases for selection of pesticides have most often been availability, efficacy, and price; not environmental or human safety. Farmers have wanted a pesticide that has rapid knock-down action to satisfy the need to defeat the pest quickly and visibly – farmers want to see the pest immediately drop on its back with its legs twitching and flailing in the air as it dies.

Farmers who will use GAP systems for export crops or high-value local markets will focus more on factors such as human safety and low environmental impact, by necessity as much as by choice. Such lower toxicity pesticides may take longer to kill the pest – usually after the farmer has left the field – but they are effective, nevertheless. Another factor of importance is the abeyance of pesticide-specific PHIs (pre-harvest intervals) and MRLs (maximum residue levels), which can be influenced by choosing products with rapid post-application degradation. The three most common bases for traditional farmer pesticide selection for crops in Georgia are currently price, availability, and efficacy.

Individual pesticides are generally formulated specifically for each of the above uses, and will be labeled for use on seed or for use in greenhouses. Some pesticides found in Georgia are formulated and labeled specifically for seed treatment; however, the demand and market for specifically labeled greenhouse pesticides is too small, so no specially formulated greenhouse pesticides are available. In any case, this PERSUAP reviews the most common greenhouse pesticides used worldwide in proactive anticipation of markets expanding sufficiently that greenhouse production increases in Georgia.

FUMIGATION OF FOOD STORAGE AND PROCESSING

Pesticides and fumigants used for treating stored grains and foods are generally well known in the sector, and are relatively few in number. Selection is based on what is available, recommended, affordable, and efficacious against the pests at hand. Further, the World Food Program (WFP), which deals with food security, has specifications and guidelines (Standard Operating Procedures) on which pesticides or fumigants to use and how to use them safely[23]. Non-gas warehouse treatments also have specific best practices found at http://fcamin.nic.in/admin/an4.pdf.

UN'S CODEX ALIMENTARIUS COMMISSION

The Codex Alimentarius Commission was created in 1963 by the UN (FAO and WHO) to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Program. The main purposes of this Program are protecting health of the consumers and ensuring fair trade practices in the food trade, and promoting coordination of all food standards work undertaken by international governmental and non-governmental organizations. Its website is www.codexalimentarius.net.

VETERINARY TREATMENTS

Few pests like disease-transmitting ticks and some biting flies affect livestock and likewise there are few specific insecticides and miticides available for treatment. Most are synthetic pyrethroids due to relative safety of these products over other classes of pesticides.

ISSUE: MOST BENEFICIARIES DO NOT CONSIDER FACTORS SUCH AS:

- Reducing risks to human health by using products that contain active ingredients with low acute human toxicity and few to no chronic health risks;
- Reducing risks to scarce and valuable water resources on the surface and underground;
- Reducing risks to biodiversity and environmental resources, and the services, they provide.

RECOMMENDATIONS FOR MITIGATION

- Choose and use pesticides with low human and environmental risk profiles (see decision matrix in Annex 7, MSDSs, and pesticide labels), as practical.

[23] http://foodquality.wfp.org/FoodSafetyandHygiene/PestManagement/Fumigation/tabid/322/Default.aspx?PageContentID=531

- Georgia assistance projects staff be aware of biological and naturally derived pesticides, as practical, such as those listed in Annexes 4 and 5, and that are registered and available.
- During training courses, include training on pesticide selection factors based on findings and recommendations of this report, material found in MSDSs and pesticide labels, and material found on pest management websites found in Annex 1.

3.3 FACTOR C: EXTENT TO WHICH THE PROPOSED PESTICIDE USE IS, OR COULD BE, PART OF AN IPM PROGRAM

USAID promotes training in, and development and use of, integrated approaches to pest management tools and tactics whenever possible. This section emphasizes how commercially used preventive tools and tactics can be incorporated into an overall IPM strategy that includes pesticides.

The susceptibility of crop plants or livestock to pests and diseases is greatly influenced by the general health of the plant or livestock, as discussed above in Section 2.8. Therefore, good crop management practices can strongly affect IPM, and good agronomic or cultural practices are the most basic and often the most important prerequisites for an effective IPM program. A healthy crop optimizes both capacity to prevent or tolerate pest damage while maintaining or increasing yield potential.

The USDA supports several programs aimed at investigating and developing IPM tools and tactics, including NIFA[24] (the National Institute of Food and Agriculture) and the National Sustainable Agriculture Information Service of the National Center for Appropriate Technology[25] (NCAT).

ISSUE: MOST GEORGIA BENEFICIARIES ARE NOT AWARE OF ALL OF THE IPM TACTICS AVAILABLE

Most commercial farmers do not use the following IPM tactics:

- Soil nutrient, texture and pH testing
- Plastic or other mulches
- Soil moisture measurements
- Use of organic fertilizers (manure, compost)
- Combinations of organic and mineral fertilizers
- Crop rotation
- Use of green manure crops
- Early/late plantings/harvestings to avoid pests

[24] http://www.csrees.usda.gov/pesticides.cfm

[25] http://www.attra.ncat.org/

- Use of trap crops to trap and destroy pests
- Planting parasite-attracting plants on field margins
- Inter-planting crops with aromatic herbs (celery, cilantro, parsley) that repel pests
- Farmer ability to correctly identify predators, parasites and pest diseases
- Pest monitoring with yellow sticky traps
- Use of pheromone traps to monitor moth pest levels
- Crop residue destruction at end of season

According to CNFA and others, among the IPM tools and tactics used by at least some commercial as well as some small-scale home garden farmers in Georgia include:

- Pest resistant/tolerant seed
- Seed treatment with pesticides
- Raised-bed planting technique
- Follow seeding rate & thinning recommendations
- Use of purchased mineral fertilizers
- Pruning and sanitation of diseased plants/trees
- Farmer ability to correctly identify pests
- Mechanical weed control by hoe or tiller
- Use of herbicides for weed control
- Spot treatment of pest hotspots with pesticides (instead of area spraying)

The analysis shows that some farmers use a number of possible tools. The challenge remaining is to spread information on these tools and tactics to additional farmers. Additional IPM tools and tactics that might be tried include:

- Solar soil sterilization
- Weekly field scouting to assess pest levels/damage
- Mechanical pest control by hand picking (small hectarage, high value)
- Use of pheromone inundation to confuse moth mating
- Apply local artisanal plant extracts to kill pests
- Do things to encourage predator/parasite build-up

Farmers should also consider the areas outlined below.

SOIL, WATER, ENERGY, OR BIODIVERSITY CONSERVATION PRACTICES

Annex 1 shows a Crop-Pest-IPM-Pesticide matrix for each crop to be grown by Georgian assistance project farmers, most major pests of each crop, a list of preventive tools and tactics recommended for the same pests in countries with significant commercial production and a list of natural and synthetic chemical alternatives.

FOOD STORAGE AND PROCESSING FUMIGATION

Food treatment consists of several chemical, physical (use of temperature extremes) and cultural (sanitation, rapid marketing, sale and use of agricultural products; customer acceptance of cosmetically imperfect products) choices. Ergo, non-chemical integrated options exist and can be practical.

Sanitation of the warehouse is the primary non-pesticide tactic that will keep pest populations under control so they do not require treating with pesticides, or require fewer treatments. Several sanitation best practices, tools, and tactics for pests of cereals, small grains, and dry beans/peas are included in Annex 1.

According to EPI, the following BMPs/IPM are used for stored grain pests:

- Sanitation/Cleaning up of all residues
- First & foremost, routine monitoring is done
- Good aeration of commodities
- Accurate pest identification capabilities

VETERINARY TREATMENTS

In addition to pesticides, IVM can include and integrate other tactics like use of fly baits and vaccines against tick-transmitted diseases, as well as handpicking ticks.

Both the FAO[26]and EPA[27] have BMPs for livestock rearing and feeding, which are too numerous to include in this document, but which can easily be found electronically with the click of a computer mouse.

RECOMMENDATIONS FOR MITIGATION

- Project field staff members assist with the production pest-specific PMPs, using the information in Annex 1 and organized by crop phenology, pest phenology, or seasonality, and developed into field technical flyers or posters.
- During training and field visits by projects field staff, enhance understanding of, and emphasis on, IPM/IVM philosophy, tools, and techniques for each crop-pest combination, with a focus on prevention and the use of the least toxic synthetic pesticides as a last resort.

[26] http://www.fao.org/bestpractices/topics/topic2.jsp

[27] http://www.epa.gov/oecaagct/anafobmp.html

3.4 FACTOR D: PROPOSED METHOD OR METHODS OF APPLICATION, INCLUDING THE AVAILABILITY OF APPLICATION AND SAFETY EQUIPMENT

This section examines how the pesticides are to be applied, to understand specific risks with different application equipment available and application methodologies, and the measures to be taken (repeated training especially of younger future farmers, use of PPE) to ensure safe use for each application type. Pesticides can and do enter the body through the nose and mouth as vapors, through the skin and eyes by leaky sprayers, mixing spillage/splashing and spray drift, and mouth by accidental splashing or ingestion on food or cigarettes.

FIELD CROPS

According to field visits, farmers use any of the following types of pesticide applicators:

- Hand-pump backpack sprayer with wand
- Motorized backpack sprayer for orchards
- Tractor-pulled spray tank and boom unit for field crops
- Tractor-pulled air-blast fan sprayers for orchards

Although most Georgia farmers do not use PPE, project-supported beneficiaries will be promoting their use as a best practice. Pesticide labels should provide guidance on appropriate PPE to use, and EPA has such guidance on a dedicated website[28].

GREENHOUSE CROPS

Most project pesticides in greenhouses will be applied by hand-pumped backpack sprayers (liquids) or a few by hand (powders and granules). Although most Georgia farmers do not use PPE, project-supported beneficiaries will be promoting their use as a best practice. Pesticide labels should provide guidance on appropriate PPE to use, and the EPA website noted above can be referenced.

FOOD STORAGE AND PROCESSING TREATMENT

Fumigation, only if done only by a trained and equipped fumigation service, and not by USAID project-supported farmers (**absolutely requires two trained and certified fumigators for each fumigation event**):

- Use a continuous monitoring and detection program to check for and ID pests.
- In the USA, ~~p~~persons who are not trained and certified for the use of grain fumigants should not attempt to fumigate stored grain."
- Follow the aluminum phosphide label to determine correct amount of chemical to use per cubic meter of infested food commodity.
- Calm warm day with no wind and temperature above 16 degrees (and not less than 4 degrees) Celsius.

[28] http://www.epa.gov/oppfead1/safety/workers/equip.htm

- Learn & follow all safety regulations.
- Have ***two trained people*** present for safety.
- Plan to finish fumigation in 15-20 minutes maximum.
- Post warning signs on all warehouse doors.
- Use tape and 4 ml polyethylene sheeting.
- Leave only necessary holes for putting aluminum phosphide tablets or gas from .gas generator and quickly sealing them.
- If using tablets, use probes to put tablets around (not in) grain sacks and pallets.
- Remove webbing if Indian meal moth larvae are present.
- Use proper respiratory protection equipment (self-contained oxygen or canister filter) for ***both fumigators.***
- Use phosphine gas detection devices.
- Absolutely no phosphine tablets or residues come into direct contact with wheat flour.

Other pesticide applications are by hand-pumped backpack sprayers (liquids) or a few by hand (powders). See reference above for selection of appropriate PPE.

LIVESTOCK TREATMENT

Many livestock ranchers apply acaricides using back-pack sprayers. Some ranchers use backpack sprayers to apply acaricides. The use of dips (pesticide baths) for livestock has fallen out of use and favor due to water contamination. See reference above for selection of appropriate PPE.

ISSUE: LEAKY BACK-PACK SPRAYERS

Hand-pump backpack sprayers, used by small- and medium-scale farmers, among others, can and do eventually develop leaks at almost every parts junction (filler cap, pump handle entry, exit hose attachment, lance attachment to the hose and at the lance handle) and these leaks soak into exposed skin. Moreover, clothing serves to wick that holds these pesticides in contact with skin. This concentrates pesticides use after use, until the clothes are washed and may bring them into contact with other family members.

RECOMMENDATIONS FOR MITIGATION

- Projects, as part of its provision of inputs, include budget allocations for repair and maintenance of application equipment, and develop a management program that includes oversight of repair and maintenance by a selected member of a farmer cooperative or association.

ISSUE: PESTICIDE GRANULES AND POWDERS APPLIED BY HAND

Many farmers that use pesticides formulated as granules or powders apply these by hand, without benefit of gloves. Gloves must be used for these applications.

RECOMMENDATIONS FOR MITIGATION

- Projects ensure that farmers that use powders or granules do so only with gloves.

ISSUE: FARMERS DO NOT USE PPE

Reasons that many Georgia farmers do not use PPE to reduce pesticide exposure risks include:

- Farmers and workers either discredit or do not completely understand the potential health risks associated with pesticides. Since they have not associated health problems with pesticide exposure they continue to take risks;
- Climatic conditions (particularly heat) make it uncomfortable to use the safety equipment (despite the fact that it is recommended that many pesticides should be applied very early in the morning when it is cool and there is a lack of wind and rain);
- Appropriate PPE (especially carbon cartridge respirators necessary for filtering organic chemical vapors) equipment is generally not available at all and if it is available, it is too expensive;
- Farmers may not understand either the warning labels or pictograms provided on pesticide labels.

RECOMMENDATIONS FOR MITIGATION

- Project training should include descriptions of health risks to spray operators, their families, and their village (see risks for each pesticide AI in Annex 7).
- Training should include advice on minimizing discomfort from wearing PPE, like spraying in early morning before it becomes hot, or late in the afternoon where there is little wind and no rain.
- Ensure that (i.e., budget for) protective clothing (carbon-filter respirator mask, gloves, frequently-washed long-sleeved shirt and pants or Tyvec outfit, boots, and goggles if indicated on the label) recommended for the most commonly-used pesticides are available to farmers and farm workers involved with pesticide use. General examples of PPE to be used for different types of pesticide are found in the following website: http://www.epa.gov/oppfead1/safety/workers/equip.htm.
- Provide training on the need for exclusion times and zones for areas that are being or have been sprayed. Include information about sensitive populations (pregnant women, children, elderly and sick).
- Put into place sprayer equipment maintenance procedures, proper spray techniques that reduce sprayed area walk-through, as well as frequent washing of application clothing.
- If farmer illiteracy issues exist, training should use and explain pictogram representations. Some general mitigation measures to ensure safe pesticide use are contained in Chapter 13 of the following website: http://pdf.usaid.gov/pdf_docs/PNADK154.pdf.

- Set out a schedule for, and budget for, repeated training in safe handling and use of pesticides – including aspects such as types and classes of pesticides, human and environmental risk associated with pesticides, use and maintenance of PPE, understanding information on labels and proper disposal of pesticide containers and packaging.

3.5 FACTOR E: ANY ACUTE AND LONG-TERM TOXICOLOGICAL HAZARDS, EITHER HUMAN OR ENVIRONMENTAL, ASSOCIATED WITH THE PROPOSED USE, AND MEASURES AVAILABLE TO MINIMIZE SUCH HAZARDS

This section of the PERSUAP examines the acute and chronic toxicological risks associated with the proposed pesticides.

The pesticide AI analysis matrix in Annex 7 contains information on acute and chronic human and environmental toxicological risks for every pesticide AIs found in Georgia. USAID-supported projects must be limited to EPA-registered pesticides, and decisions should be biased toward those pesticides with lower human and environmental risks. Nevertheless, pesticides are poisons, and nearly all of them present acute and/or long-term toxicological hazards, especially if they are used incorrectly. For instance, the WHO estimates that about 220,000 acute pesticide poisoning occur per year globally[29]. And, in the Benin cotton sector, farmers are routinely poisoned to death by cotton insecticide endosulfan diverted to use and its subsequent residues on vegetables[30].

ISSUE: PESTICIDE ACTIVE INGREDIENTS ON POPS AND PIC LISTS

The Stockholm Convention on Persistent Organic Pollutants (POPs) and Rotterdam Convention's Prior Informed Consent (PIC) procedure that list banned and highly regulated toxic chemicals, respectively, were not known when Regulation 216 was written, so there is no language directly governing their use on USAID projects. Nevertheless, they present high risks to users and the environment, due to persistence and toxicity. It is thus prudent that they be discussed. The following websites contain current lists of all POPs and PIC chemicals: http://www.pops.int; http://www.pic.int. The latest versions of these lists are included in Annex 8, Pesticide Active Ingredients Not to be used on USAID-Supported Activities. In addition, endosulfan has been nominated for addition to the POPs list (2009) and the recent (June 2010) phase out and ban in the USA will hasten this decision, so it should not be used.

RECOMMENDATIONS FOR MITIGATION

- None of these POPs or PIC chemicals, listed on the POPs and PIC websites (and in Annex 8), and including endosulfan, should be used on Georgia assistance projects beneficiary demonstration farms.

ISSUE: VERY HIGH ACUTE TOXICITY

A few of the pesticides found in Georgia contain active ingredients that are EPA Class I or WHO Class Ia or Ib (the highest toxicities by mg/kg of body weight), which are *too toxic for*

[29] http://magazine.panna.org/spring2006/inDepthGlobalPoisoning.html

[30] http://www.panna.org/resources/panups/panup_20080403

small-scale, unaware and uninformed farmers to use. These very highly acutely toxic pesticide AIs are found in Annex 8. Less toxic alternatives, including preventive tactics and tools (Annex 1), and several curative pesticide choices, including some that are less toxic than Class I chemicals (Classes II, III and IV for instance), also found in Annex 1, exist, and should thus be used in place of Class I pesticides.

RECOMMENDATIONS FOR MITIGATION

- With the exception of rodenticides and some copper-containing fungicides, project beneficiaries should not use products containing active ingredients that are WHO Class 1a or 1b, or pesticide products that are classified by EPA as Class I (see Annex 8).

ISSUE: MODERATE ACUTE TOXICITY

All pesticide products that have at least acute WHO and EPA toxicity ratings of II (see Annex 7) are considered to be *too toxic for use without farmer training and proper use of PPE*.

RECOMMENDATIONS FOR MITIGATION

- Pesticide products containing active ingredients with Class II acute toxicity ratings (see Annex 7) should not be recommended unless there are no safer effective alternatives (Class III or IV).
- Moreover, recommendations should not be made to use such products unless it can be ascertained that appropriate training and PPE are available *and will be used*.

ISSUE: LOWER ACUTE TOXICITY PESTICIDES

Even EPA Class III and IV and WHO Class III and U pesticides, mostly classified by EPA as General Use Pesticides (GUPs), sold to the public at large in the USA, may present acute and chronic human health and environmental risks (see decision matrix in Annex 7). In sufficiently high doses, they may kill or harm humans or the environment. Thus, pesticide safe use and handling training and practice are required for their use as well as for the use of more toxic products.

RECOMMENDATIONS FOR MITIGATION OF HUMAN TOXICOLOGICAL EXPOSURES

Most pesticide poisonings result from careless handling practices or from a lack of knowledge regarding the safer handling of pesticides. Pesticides can enter the body in four major ways: through the skin, the mouth, the nose, and the eyes. Chapter 13 in the resource http://pdf.usaid.gov/pdf_docs/PNADK154.pdf contains measures to reduce risks of exposure via oral, dermal, respiratory and eyes. The time spent learning about safer procedures and how to use them is an investment in the health and safety of oneself, one‘s family, and others.

- Project field staff should encourage demonstration farmers and beneficiaries with whom they work to not use POPs or PIC products or products containing very highly toxic active ingredients.
- Train beneficiaries and provide posters/flyers on pesticide safe-use BMPs. For each group of farmers to be trained, identify the pesticides most likely to be used on their specific crops, and then identify the human health risks associated with

each by using information on pesticide labels, in the attached Annex 7, and on MSDSs.

- Provide training on, and follow basic first aid for pesticide overexposure. Train managers and farmers on basic pesticide overexposure first aid, while following recommendations found in Chapter 13 of http://pdf.usaid.gov/pdf_docs/PNADK154.pdf, as well as any special first aid information included on labels and MSDSs for commonly used pesticides.

RECOMMENDATIONS FOR MITIGATION OF EXPOSURES TO ENVIRONMENTAL RESOURCES

Ecotoxicological exposures can be mitigated by adhering to the following do's and don'ts:

Do's

- Emphasize and use IPM practices in crop production
- Read and follow pesticide label instructions
- Choose the pesticide least toxic to fish and wildlife (see Annex 7) and pesticide label
- Protect field borders, bodies of water and other non-crop habitats from pesticide exposure
- Completely cover pesticide granules with soil, especially spilled granules at the ends of rows
- Minimize chemical spray drift by using low-pressure sprays and nozzles that produce large droplets, properly calibrating and maintaining spray equipment, and use of a drift-control agent
- Properly dispose of empty pesticide containers (provide training on what this means locally)
- Maintain a 2.5 to 5 km buffer no-spray zone around national parks, water bodies or other protected areas
- Warn beekeepers of upcoming spray events so that they may move or protect their hives

Don'ts

- Do not spray over ponds and drainage ditches
- Never wash equipment or containers in streams or where rinse water could enter ponds or streams
- Do not use pesticides with potential or known groundwater risks near drinking water sources, or where the water table is less than 2 meters, and on sandy soils with high water tables
- Do not apply pesticides in protected parks
- Do not use aerial applications near sensitive habitats

- Do not spray when wind speeds are more than 13 kph
- Do not apply granular pesticides in fields known to be frequented by migratory waterfowl
- Do not apply insecticides from 10 am to 4 pm when honeybees are foraging; insecticides are best applied early in the morning when it is cool with no wind or rain, and when honeybees do not forage

3.6 FACTOR F: EFFECTIVENESS OF THE REQUESTED PESTICIDE FOR THE PROPOSED USE

This section of the PERSUAP requires information similar to that provided previously, but more specific to the actual conditions of application and product quality. This section considers the potential for use of low-quality products (such as many of those imported from China and a few from India) as well as the development of pest resistance to proposed pesticides, both of which will decrease effectiveness (efficacy). The issues and mitigations will be the same for all of the sectors covered.

AGRICULTURE SEED TREATMENT, FIELD CROPS, AND GREENHOUSE CROPS

Local knowledge is essential to choosing the correct pesticides. Local farmers know what has or has not worked for them in the past, and Georgia assistance projects can increase local knowledge as to what is available, possibly effective, and presents the lowest risk.

Resistance of pests to pesticides used on Georgia assistance projects crops will likely occur with increased use. Many farmers over- and under-dose and use non-selective pesticides, all of which increases chances for resistance development. The primary tool in the battle against resistance is rotation among available chemicals, combined with the use of preventive IPM tools and tactics.

FOOD STORAGE AND PROCESSING TREATMENT

Managing stored grain pest resistance to certain insecticides is a major challenge to this sector[31]. There are even insects that have developed resistance to deadly phosphine gas[32]. Most food security pesticide applicators trained by the UN WFP will know the insect, mite, and other pest species that have developed resistance to certain pesticides or classes of pesticides. And, they will know the alternative pesticides available for rotation.

LIVESTOCK TREATMENT

Pathogen, insect and tick resistance to vaccines/antibiotics/medicines, insecticides and acaricides, respectively is a major challenge facing veterinary technicians. Fully 41% of pest resistance occurs in the veterinary field[33]. The primary tool in the battle against resistance is rotation among available chemicals, combined with the use of preventive IVM tools and tactics.

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[31] http://ipm.illinois.edu/pubs/iapmh/05chapter.pdf

[32] http://bru.gmprc.ksu.edu/proj/iwcspp/pdf/9/kps41.pdf

[33] http://science.jrank.org/pages/48691/Pesticide-Resistance.html

ISSUE: LACK OF KNOWLEDGE AND INFORMATION ON PESTICIDE EFFECTIVENESS

At some point, project field staff and demonstration farmers may begin to note that some products no longer work well to control pests in their field, and will likely begin to blame pesticide manufacturers for a weaker product. This could be the development of insecticide resistance, improper dosing, or use of cheap generic products from unreputable companies in China, India, Iran, and a few other countries. Farmers should be trained to monitor for the development of insecticide resistance, and project implementers should be on the lookout for it during their field visits.

RECOMMENDATIONS FOR MITIGATION

- Through training, project field staff increase local knowledge on pesticides available, possibly effective, and present the lowest risk (see Annex 7).
- Teach farmers and other beneficiaries to rotate pesticides to reduce the build-up of resistance.
- Monitor resistance by noting reduction in efficacy of each pesticide product.

3.7 FACTOR G: COMPATIBILITY OF THE PROPOSED PESTICIDE USE WITH TARGET AND NON-TARGET ECOSYSTEMS.

This section examines the potential effect of the pesticides on organisms other than the target pest (herein called critical resources). Non-target species of concern include fish, honeybees, birds, earthworms, aquatic organisms, and beneficial insects. The potential for negative impact on non-target species should be assessed and appropriate steps identified to mitigate adverse impacts; and this would be included in the Georgia assistance projects' Environmental Mitigation and Monitoring Plan (EMMP).

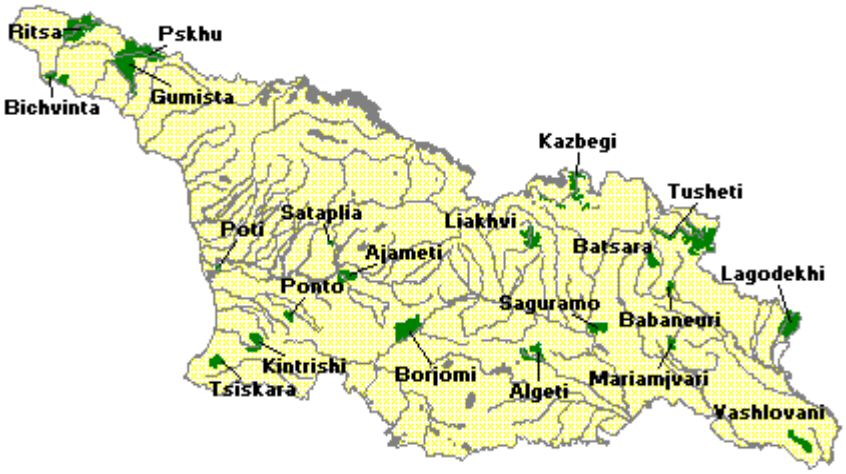
Annex 7 shows the relative known risks to the different types of terrestrial and aquatic organisms referred to above for each pesticide active ingredient found in pesticide products discovered likely to be used in Georgia and covered by this PERSUAP, so that informed product choices can be made if the pesticide is to be used in or near sensitive areas or resources. Maps below show natural resources.

ISSUE: PROTECTED AREAS AND BIODIVERSITY

According to EarthTrends[34], Georgia has 244,000 hectares of Nature Reserves, Wilderness Areas, and National Parks (of categories I and II) and 46,000 hectares of Natural Monuments, Species Management Areas, Protected Landscapes and Seascapes (categories III, IV, and V). The number of protected areas totals 34.

[34] http://earthtrends.wri.org/pdf_library/country_profiles/bio_cou_268.pdf

Georgia has the following: 4,350 total species of higher plants; 107 mammals (of which 13 are endangered); 208 species of breeding birds (of which 3 are endangered); 61 reptiles (of which 7 are endangered); 15 amphibians (one of which is endangered) and 49 species of fish (of which 6 are endangered).



Georgia has the following nature reserves/protected areas[35]:

- Ajameti
- Algeti
- Babaneuri
- Batsara
- Bichvinta-Miusera
- Borjomi
- Gumista
- Kazbegi
- Kintrishi
- Kolkheti
- Lagodekhi
- Liakhvi
- Mariamjvari
- *Ponto*
- Pskhu
- Ritsa
- Saguramo
- Sataplia
- Skurcha
- *Tsiskara*
- Tusheti
- Vashlovani

[35] http://enrin.grida.no/htmls/georgia/soegeor/english/biodiv/reserves/prot.htm

According to the EPI and AMP as well as NEO documents, there are no project sites within 10 kilometers of these protected areas, which is a sufficient buffer zone[36].

ISSUE: PESTICIDE PERSISTENCE

The effect of each pesticide on non-target ecosystems will depend on how long it stays in the environment, or rather its rate of breakdown, or half-life. Half-life is defined as the time (in days, weeks or years) required for half of the pesticide present after an application to break down into degradation products. The rate of pesticide breakdown depends on a variety of factors including temperature, soil pH, soil microbe content, and whether or not the pesticide is exposed to light, water, and oxygen.

Many pesticide breakdown products are themselves toxic, and each may have a significant half-life. Since pesticides break down with exposure to soil microbes and natural chemicals, sunlight and water, there are half-lives for exposure to each of these factors.

In the soil, types and numbers of microbes present, water, oxygen, temperature, pH, and soil type (sand, clay, loam) all affect the rate of breakdown. Most pesticides also break down, or photo-degrade, with exposure to light, especially ultraviolet rays. Lastly, pesticides can be broken down, or hydrolyzed, with exposure to water. Pesticides with a long residual period (that are labeled persistent and last for years) include atrazine herbicide and organochlorine pesticides. Many of the newer carbamate, organophosphate, and synthetic pyrethroid pesticides break down much quicker, generally within weeks, in the environment.

RECOMMENDATIONS FOR MITIGATION

- Consider the toxicity, half-life, and breakdown products of pesticides during the selection process, and choose pesticides that are less toxic and break down quickly in the environment.
- Avoid using pesticides in or within a 2km buffer zone from protected areas or national parks and where endangered species are known to exist.
- If agricultural production is done within 10km up-wind or up-stream from a protected area, investigate the use of botanical and biological controls, as practical, or produce Organic crops near these valuable natural resources.
- Apply pesticides early in the morning before honeybees forage. Do not apply during heavy rains or winds. Follow instructions on pesticide packaging.
- Apply pesticides at least 35 meters from open water.

3.8 FACTOR H: CONDITIONS UNDER WHICH THE PESTICIDE IS TO BE USED, INCLUDING CLIMATE, GEOGRAPHY, HYDROLOGY, AND SOILS

In general, in addition to element G above, this requirement attempts to protect natural resources from the dangers of pesticide misuse and contamination, especially of groundwater resources. The following conditions apply, regardless of pesticide use sector, and thus the information here covers all seven sectors.

[36] http://www.cerium.ca/IMG/pdf/Primitive_ideas.pdf

GEORGIA CLIMATE[37]

Georgia's climate is affected by subtropical influences from the west and Mediterranean influences from the east. The Greater Caucasus range moderates local climate by serving as a barrier against cold air from the north. Warm, moist air from the Black Sea moves easily into the coastal lowlands from the west. Climatic zones are determined by distance from the Black Sea and by altitude. Along the Black Sea coast, from Abkhazia to the Turkish border, and in the region known as the Kolkhida Lowlands inland from the coast, the dominant subtropical climate features high humidity and heavy precipitation (1,000 to 2,000 millimeters per year; the Black Sea port of Batumi receives 2,500 millimeters per year). Several varieties of palm trees grow in these regions, where the midwinter average temperature is 5° C and the midsummer average is 22° C.

The plains of eastern Georgia are shielded from the influence of the Black Sea by mountains that provide a more continental climate. Summer temperatures average 20° C to 24° C, winter temperatures 2° C to 4° C. Humidity is lower and rainfall averages 500 to 800 millimeters per year. Alpine and highland regions in the east and west, as well as a semiarid region on the Lori Plateau to the southeast, have distinct microclimates.

At higher elevations, precipitation is sometimes twice as heavy as in the eastern plains. In the west, the climate is subtropical to about 650 meters; above that altitude (and to the north and east) is a band of moist and moderately warm weather, then a band of cool and wet conditions. Alpine conditions begin at about 2,100 meters, and above 3,600 meters, snow and ice are present year-round.

GEORGIA GEOGRAPHY[38]

Located in the region known as the Caucasus or Caucasia, Georgia is a small country of approximately 69,875 square kilometers--about the size of West Virginia. To the north and northeast, Georgia borders the Russian republics of Chechnya, Ingushetia, and North Ossetia (all of which began to seek autonomy from Russia in 1992). Neighbors to the south are Armenia, Azerbaijan, and Turkey. The shoreline of the Black Sea constitutes Georgia's entire western border.

Despite its small area, Georgia has one of the most varied topographies of the former Soviet republics. Georgia lies mostly in the Caucasus Mountains, and its northern boundary is partly defined by the Greater Caucasus range. The Lesser Caucasus range, which runs parallel to the Turkish and Armenian borders, and the Surami and Imereti ranges, which connect the Greater Caucasus and the Lesser Caucasus, create natural barriers that are partly responsible for cultural and linguistic differences among regions. Because of their elevation and a poorly developed transportation infrastructure, many mountain villages are virtually isolated from the outside world during the winter. Earthquakes and landslides in mountainous areas present a significant threat to life and property. Among the most recent natural disasters were massive rock- and mudslides in Ajaria in 1989 that displaced thousands in southwestern Georgia, and two earthquakes in 1991 that destroyed several villages in north central Georgia and South Ossetia.

Georgia has about 25,000 rivers, many of which power small hydroelectric stations. Drainage is into the Black Sea to the west and through Azerbaijan to the Caspian Sea to the

[37] http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field%28DOCID+ge0034%29

[38] http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field%28DOCID+ge0033%29

east. The largest river is the Mtkvari (formerly known by its Azerbaijani name, Kura, which is still used in Azerbaijan), which flows 1,364 kilometers from northeast Turkey across the plains of eastern Georgia, through the capital, Tbilisi, and into the Caspian Sea. The Rioni River, the largest river in western Georgia, rises in the Greater Caucasus and empties into the Black Sea at the port of Poti. Soviet engineers turned the river lowlands along the Black Sea coast into prime subtropical agricultural land, embanked and straightened many stretches of river, and built an extensive system of canals. Deep mountain gorges form topographical belts within the Greater Caucasus.

Map: Georgia Geography and Topography

GEORGIA HYDROLOGY

Surface Waters of Georgia[39]

There are approximately 26, 060 rivers in the country with total length of 59, 000 km. Most of these rivers (97.3%) are less than 10 km long. Largest rivers are Rioni (12.6 cubic km), Mtkvari (7.2 cubic km), Chorokhi (8.9 cubic km), Enguri (5.9 cubic km), Kodori (4.1 cubic km), Alazani (3.1 cubic km).

The Mtkvari flows for approximately 300 km through Georgia and drains about 15, 000 km2, or 23% of the country. The river is relatively unpolluted when it enters Georgia, but is severely degraded by the time it flows into Azerbaijan, a transboundary issue between the two countries. The Rioni River basin constitutes almost 20% of Georgia's total land area. It is considered the largest single source of pollution along the Georgian Black Sea coast. Georgia's Kolkheti marshes and Lake Paliastomi comprise one of the most extensive wetland areas within the Black Sea region. They act as a natural filter for Rioni River, which reaches the Black Sea at Poti.

There are about 860 lakes and reservoirs in Georgia, with total area equal to 170 sq. km. Reservoirs (43) are used mainly for irrigation and energy production. Their annual discharge

[39] http://enrin.grida.no/htmls/georgia/soegeor/english/water/surface.htm

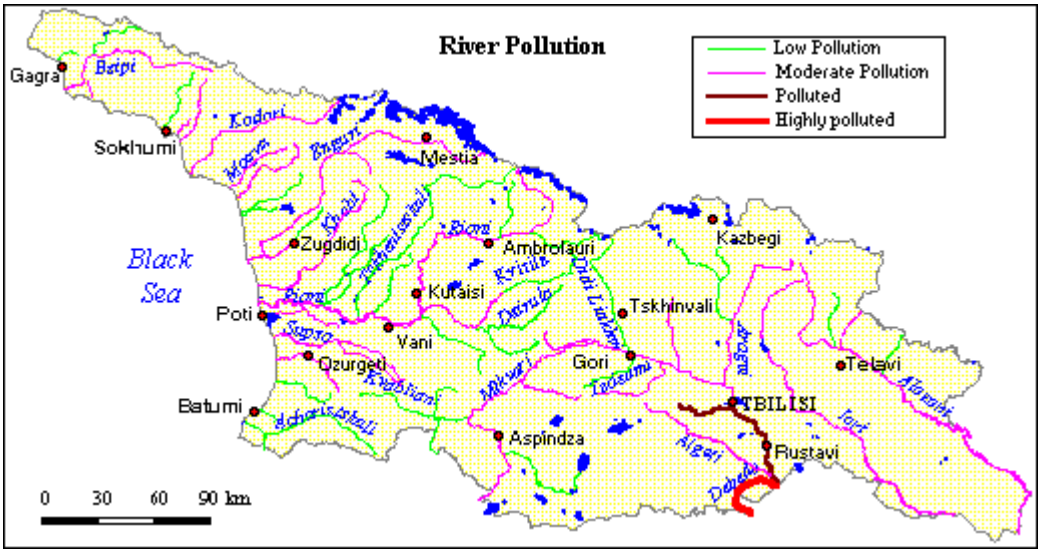
volume is 2184.85 million cubic km, including 1297.6 (35 reservoirs) in Eastern Georgia and 851.25 (8 reservoirs) in the Western part of the country.

In 1991 1144.38 million cubic meters of water was discharged in water bodies, 526 million cubic meters then in 1990 (and 359 mill. cub. m less than in 1989). Major pollutants entering the country's water bodies in 1991 are oil products, nitrous ammonia, organic substances, and heavy metal ions. Major contributions are the metallurgy, oil refining, coal mining, chemical industry and energy sector.

Nitrogen compounds, organic substances, and suspended particulate matter are entering water bodies through communal sewers (for instance, ammonia - 8 t/y, organic substances – 8,370 t/y, suspended particulates - 9.28 thousand t/y). In addition, Georgia's rivers are heavily polluted because of diffuse agricultural sources of pollution. This is the reason that the pollution by pesticides and nitrogen compounds exceed permissible levels in almost every water body.

A special integral parameter is used to assess the quality of surface waters called Water Pollution Indices:

- I class - < 0.3 - very clean
- II class - 0.3-1 - clean
- III class - 1-2.5 - slightly polluted
- IV class - 2.5-4 - moderately polluted
- V class - 4-6 - polluted
- VI class - 6-10 - heavily polluted
- VII class - >10 - extremely polluted



For the Black Sea basin water bodies the hydrochemical observations are conducted for 43 rivers, 2 lakes, and 2 reservoirs. Major artery is Rioni River. Hydrochemical observations are performed at 10 sections. Major pollutants are phenols. For the Caspian Sea basin, water

basin observations are conducted for 29 rivers, 4 lakes 3 reservoirs and 1 collector. Major artery is Mtkvari River, which polluted with ammonia.

GROUND WATERS OF GEORGIA[40]

The country is rich of ground water resources (fresh, mineral, industrial, and thermal). Total resources of fresh ground water are 560 cubic m/sec of which 100 cubic m/s is used. Georgia has plenty and diverse mineral water resources. Major factors affecting the quality of ground waters are the use of chemicals in agriculture and pollution of ground water from industrial facilities. And, Georgia has numerous thermal water resources. Their exploitational capacity is 329,5 thousand cubic meters in 24 hours.

The main sources of underwater pollution is use of agrochemical and spilling of wastewater from industrial sources (because of ox existing better available technologies) In former period active use of fertilizers 250 thousand tons annually, half of them was nitrogen containing. Additionally thousand tons of toxic chemicals were used. Big part of them is washed into the soil, because of the contrasting landscape and high precipitation and spill into the sea or underground horizons.

SOILS OF GEORGIA[41]

Spatial distribution of soils in Georgia is characterized by vertical variability. The Kolkheti lowland is dominated by swamp soils with an area of 200, 600 ha (3.0% of the countries territory). In Achara and Guria foothills, at an elevation of 300-400 msl, there is red earth is the predominant type of soil with an area of 130, 400 ha.

In Imereti and Apkhazeti yellow earth soils are spread at 300-400 msl, 225 800 ha. In the southern part of Samegrelo the old sea terraces are dominated by subtropical podzolic soils covering 317, 600 ha (4.5% of Georgia). In western Georgia, at an elevation of 400-1000 msl non-calcareous parent rocks are covered by yellow and brown forest soils covering 106, 000 ha.

In Western and Eastern Georgia soil variability is observed only under 1000 msl. At high elevations, soil types are homogeneous. At the same time, the southern parts of the country are characterized by vertical variability. In Western and Eastern Georgia at an elevation of 1000-2000 msl, soils are of a brown forest type covering about 1, 172, 200 ha (16.9%).

On the whole territory of the country 1800-2000 msl elevations are covered by mountain forest and meadow soils covering 492, 000 ha; at 2000-3700 msl mountain meadow soils covering 1, 477, 200 ha (22.1%). Calcareous parent rocks above the 700 msl produce humic carbonate soils. In the East of the country (Gardabani and Marneuli districts), 350-500 msl, grey-cinnamonic and meadow-grey-cinnamonic soils cover the surface (7.3%).

Southeastern parts of the country is dominated by black earths covering 266, 800 ha (3.7%). In the Eastern Georgia and mainly on Alazani lowland dominate solty soils covering 112, 600 ha. The middle belts of the southern Georgia mountains are covered by 157, 600 hectares of black earth soils.

And, along the rivers, soils of alluvial origin are present, total area being 351 400 ha (5.0%).

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[40] http://enrin.grida.no/htmls/georgia/soegeor/english/water/ground.htm

[41] http://enrin.grida.no/htmls/georgia/soegeor/english/soils/soils.htm

ISSUE: PESTICIDE SOIL ADSORPTION, LEACHING AND WATER CONTAMINATION POTENTIALS

Each pesticide has physical characteristics, such as solubility in water, ability to bind to soil particles and be held (adsorbed) by soil so they do not enter the soil water layers and the ground water table, and their natural breakdown rate in nature. This data can be found for the pesticides discovered in Georgia by checking each pesticide on the following website: http://sitem.herts.ac.uk/aeru/footprint/en/index.htm. The water solubility, soil absorption, and natural breakdown rates, if available, are included throughout the webpage, for each parent chemical.

In general, pesticides with water solubility greater than 3 mg/liter have the *potential* to contaminate groundwater; and pesticides with a soil adsorption coefficient of less than 1,900 have the *potential* to contaminate groundwater. In addition, pesticides with an aerobic soil half-life greater than 690 days or an anaerobic soil half-life greater than 9 days have the *potential* to contaminate groundwater. Moreover, pesticides with a hydrolysis half-life greater than 14 days have *potential* to contaminate groundwater.

The potential for pesticides to enter groundwater resources depends, as indicated above, on the electrical charge contained on a pesticide molecule and its ability and propensity to adhere to soil particles, but this also depends on the nature and charge of the soil particles dominant in the agriculture production area. Sand, clay and organic matter, and different combinations of all of these, have different charges and adhesion potential for organic and inorganic molecules. Sandy soil often has less charge capacity than clay or organic matter, and will thus not interact significantly with and hold charged pesticide molecules. So, in areas with sandy soil, the leaching potential for pesticides is increased.

A pesticide‘s ability to enter groundwater resources also depends on how quickly and by what means it is broken down and the distance (and thus time) it has to travel to the groundwater. If the groundwater table is high, the risk that the pesticide will enter it before being broken down is increased. Thus, a sandy soil with a high water table is the most risky situation for groundwater contamination by pesticides. Groundwater contamination potential for each pesticide active ingredient available in Georgia is provided in Annex 7.

RECOMMENDATIONS FOR MITIGATION

- Ensure that pesticides labeled for certain types of use environments, or areas, are in fact used according to label recommendations.
- Since transport of pesticides absorbed to soil particles is a likely transportation route to waterways, techniques should be employed to reduce farm soil erosion (such as terracing, employing ground covers between rows, planting rows perpendicular to the slope, using drip irrigation, and so on).
- Do not use herbicides or other pesticides with high leaching and groundwater pollution potential (see Annex 7) on highly sandy soils or soils with water tables close (2-3 meters) to the surface. Pay particular care when spraying near waterways, so that pesticides do not enter surface water.
- Do not spray synthetic pyrethroid or other pesticides with high toxicities to aquatic organisms before an impending rainstorm, as they can be washed into waterways before breaking down.

3.9 FACTOR I: AVAILABILITY OF OTHER PESTICIDES OR NON-CHEMICAL CONTROL METHODS

This section identifies less toxic synthetic, as well as non-synthetic or ‗natural' (extracts of naturally-occurring plants, spices, oils, fatty acids, induced resistance elicitors, minerals, microbes or microbial extracts) pesticide options for control of pests, and their relative advantages and disadvantages. Many of these ‗natural' pesticides can be toxic to humans, and several are even classified as RUP due to environmental risks; thus safe pesticide use practices extend to these natural as well as synthetic (produced in laboratories or factories) pesticides.

Annex 1—the heart of this PERSUAP—contains numerous non-chemical control methods for every major pest of every USAID-supported crop in Georgia. It is the intent of this PERSUAP that USAID projects dealing with agriculture use this valuable resource, which compiles all known IPM tools and tactics for each pest.

VETERINARY

There are several alternate livestock IVM tools and techniques listed above under factor C.

ISSUE: NATURAL PEST CONTROLS AVAILABILITY

Many non-synthetic chemical IPM tools and technologies are listed in Annexes 4 and 5. The list of natural pesticides likely entering Georgia is not as extensive as other developing countries. In general, most synthetic nematocides and soil pesticides/fumigants are very highly toxic. However, there are some companies producing next-generation natural chemicals in the USA: Bio Huma Netics, http://www.bhn.name for natural nematocides and Agra Quest, http://www.agraquest.com for bioactive essential oils.

For commercial operations, especially greenhouses, biological controls, and beneficial organisms are available commercially from local Biolabs as well as two large international companies, Koppert of Holland and Biobest of Belgium. Koppert provides many biological controls against spider mites, beetles, leaf miners, mealy bugs, thrips, aphids, whiteflies, and moth and butterfly larvae. Koppert also provides the Koppert Side Effects List, a list of the side effects of pesticides on biological organisms, at http://www.koppert.com. Biobest of Belgium provides many of the same or similar biological controls as Koppert, and includes a control against leaf hoppers. Their website is http://www.biobest.be. These are especially useful for greenhouse and seedling production systems. Both companies also sell live bumblebees for greenhouse pollination assistance.

RECOMMENDATIONS FOR MITIGATION

- As appropriate, try low-risk natural chemical pest controls that are found available in Georgia.

3.10 FACTOR J: HOST COUNTRY'S ABILITY TO REGULATE OR CONTROL THE DISTRIBUTION, STORAGE, USE, AND DISPOSAL OF THE REQUESTED PESTICIDE

This section examines the host country's existing infrastructure and human resources for managing the use of the proposed pesticides. If the host country's ability to regulate pesticides is inadequate, the proposed action – use of pesticides – could result in greater risk to human health and the environment.

AGRICULTURE SEED TREATMENT, FIELD CROPS, GREENHOUSE CROPS, FOOD SECURITY/WAREHOUSES AND VETERINARY

The Ministry of Agriculture in Georgia has produced updated pesticide regulations and an up-to-date list of permitted pesticides for agriculture, veterinary and warehouse pest control. However, it has very limited research, extension, and enforcement services.

ISSUE: LIMITED RESOURCES TO CONTROL PESTICIDES

Georgia has limited systems and resources enforcing the registration and regulation of the import, sale, and use of pesticides. Further, their ability to cover the country and eliminate banned or highly toxic chemicals is limited due to limited resources. The list of pesticides available contain some very highly toxic chemicals that should not be handled by illiterate, untrained, unprotected and often unaware small-holder farmers like those found throughout Georgia. Most farmers do not have access to and cannot afford PPE in order to follow GAPs.

ISSUE: ILLEGAL PRODUCTS FROM NEIGHBORING COUNTRIES

~~L~~eaky" country border crossings could be likely sources of pesticides that are not officially registered in CAR countries. Some PIC chemicals have been found in formal and informal markets in the region, as have some POPs chemicals.

ISSUE: DISPOSAL OF PESTICIDE CONTAINERS

Some Georgian farmers retain empty and partially full plastic pesticide containers. Some use them to store water. Before disposal, the standard practice has been to triple-rinse the containers, puncture them to discourage re-use, and bury or burn them. Burning plastic bottles and single-use pesticide sachets can lead to the formation of toxic (and POPs) furans and dioxins, and is not recommended. GlobalGAP and other S&C systems require that empty pesticide containers are triple rinsed over a pesticide soak pit with layered soil, lime, and carbon, or a bioactive pit, and then properly stored in plastic drums in the field or storage shed, to await disposal or recycling. There are no pesticide container recycling activities occurring anywhere in Asia.

The website http://www.epa.gov/oppfead1/labeling/lrm/chap-13.htm provides pesticide disposal options.

RECOMMENDATIONS FOR MITIGATION

- Georgia assistance projects staff members encourage and follow developments in the regulation and registration of pesticides in Georgia.
- Absolutely no POPs or PIC chemicals should be used on Georgia assistance projects -supported fruit and vegetable production. This includes endosulfan, a POPs Treaty candidate, which is highly popular among vegetable producers the world over, but has killed numerous farmers as well.
- Georgia assistance projects field staff members encourage and support the use of GlobalGAP best practices with pesticide storage, use and disposal, whether or not certification is required for market access.

3.11 FACTOR K: PROVISION FOR TRAINING OF USERS AND APPLICATORS

USAID recognizes that, in addition to the use of PPE, safety training is an essential component in programs involving the use of pesticides. The need for thorough training is particularly acute in developing countries, where the level of education of applicators may typically be lower than in developed countries.

AGRICULTURE SEED TREATMENT, FIELD CROPS, GREENHOUSE CROPS, FOOD STORAGE AND PROCESSING AND VETERINARY

Issue: Farmers need intensive and repeated training

Training in Safe Pesticide Use and GAP/IPM are of paramount importance for Georgia assistance projects farmers and farm laborers using pesticides. Georgia assistance projects -supported agriculture activities should focus strongly on providing GlobalGAP, IPM and safe pesticide use training. Additional and refresher training are superb means for affecting beneficiary farmer behavior, now, as they continue to expand their agricultural opportunities, and before risky behaviors become further set.

Recommendations for Mitigation

- Implement GAP, IPM and Pesticide Safe Use training for Georgia assistance projects staff and beneficiaries.
- Use Annex 1 to produce and promote the use of Pest Management Plans for farmers to anticipate and better manage primary pests.

3.12 FACTOR L: PROVISION MADE FOR MONITORING THE USE AND EFFECTIVENESS OF EACH PESTICIDE

Evaluating the risks, impacts, and benefits of pesticide use should be an ongoing, dynamic process. Pest resistance is one of the risks for which this element is intended, as well as human health and safety and environmental effects.

AGRICULTURE SEED TREATMENT, FIELD CROPS, GREENHOUSE CROPS, FOOD STORAGE AND PROCESSING AND VETERINARY

Record keeping should track quantities and types of pesticides used. Making notes on effectiveness of individual pesticides and pest numbers will help develop a more sustainable pesticide use plan for each Productive Agriculture Project beneficiary producer. Records of farmers, as well as Georgia assistance projects agronomists, will need to make note of any reductions in pesticide efficacy experienced, which is the first indication that resistance may be developing, and then a strategy needs to be in place to determine a shift to a different pesticide class, and rotation among classes, to overcome resistance development.

Issue: Georgia assistance projects and Farm Record-Keeping

On Georgia assistance projects proposed demonstration farms, pesticide use documentation is either non-existent or not retained from year to year. Developing a more systemized approach to record keeping will allow seasonal and annual comparison of pesticide effectiveness, pest numbers, crop production, maintenance of safety equipment, and so on. The following aspects should be included in the record keeping system, for a USAID-funded program:

- Local, EPA and EU regulatory compliance: A list of country, EPA and EU laws related to the use of agrochemicals for plant protection, short notes on the relevance of the law, dates the laws come into or exit force and MRLs for each crop-pesticide combination.
- A pesticide checklist: This list allows agronomists to ensure that the pesticides they are using are not banned by international treaties (POPs, PIC) and registered through the USEPA. It should also provide notes on special safety requirements.
- GAPs/IPM measures tried/used (see Annex 1): Georgia assistance projects agronomists should try to incorporate a minimum of at least three new IPM measures per annum and document their success or failure.
- PPE: Lists of the types of equipment made available to applicators, number of pieces, prices and contact details of suppliers, dates when equipment needs to be washed, maintained, or replaced. PPE should be numbered or personally assigned to applicators to ensure that it is not taken home where (as a contaminated material) it could pose a risk to family members.
- Monitoring/recording pests: Agronomists should incorporate into their records regular field pest monitoring and identification. This could be done by the agronomists themselves, or if properly trained, by farmers.
- Environmental conditions: Field conditions should be incorporated into the record keeping system (for example; precipitation, soil analyses and moisture, soil pH, temperatures and so on).
- Information should be transmitted at least annually and Georgia assistance projects should report to USAID on this progress in pesticide safety and GAP/IPM use in annual reports.

Issue: Monitoring by Georgia assistance projects Field Staff and Farmers Should Detect:

- Resistance: Pesticide resistance development among pests has likely occurred and could eventually occur more, and will be noted by farmers complaining that the spray no longer works as it once did.
- Human poisonings and any incidences of chronic health issues.
- Farm animal and livestock deaths.
- Any incidences of water pollution.
- Fish, bird, wildlife, or honeybee kills.

Any of the above items should be reported immediately to USAID. Other information should be transmitted at least annually to USAID, and Georgia assistance projects should report on this progress in pesticide environmental and human health safety in annual reports.

ISSUE: GEORGIA ASSISTANCE PROJECTS PLANNING AND REPORTING

Several issues could receive more attention in Georgia assistance projects annual work plans and annual reports. These include a section on Environmental Impact Mitigation and Best Practices, with subsections (and issues) on:

- Country and EPA regulation compliance (documents and enforcement status, risk, pollution, mitigation)
- GAPs/IPM measures tried/used and on what percent of Georgia assistance projects farms
- Biodiversity and conservation (soil, water, energy, protected habitats, biodiversity and protected species) measures used on what percent of farms
- Inputs and PPE use and issues (types, amounts and issues with products, sprayers, MRLs, REIs, MSDSs)
- Training/capacity building in IPM and Safe Use (hands-on, demos, sessions, meetings, extension, flyers, brochures, pamphlets, posters, crop technical GAP information sheets, and radio and TV outreach/safety message enforcement)

Recommendations for Mitigation

- Georgia assistance projects to follow all of the above best practices in monitoring, record keeping, evaluation/analyses and reporting.
- Site managers/agronomists should develop a record-keeping system, which is also a requirement for GlobalGAP and other international market-driven produce certification systems. It is highly recommended that records are kept in an electronic format for easy editing, updating, and modification.
- Using Annex 11, Georgia assistance projects staff should put plans for monitoring the environmental and human health impact of production activities, following recommendations found in this PERSUAP into the Annual Action Plans.
- Georgia assistance projects staff keeps records on the implementation of the recommendations found in this PERSUAP, and report on them in Quarterly and Annual Reports, under a heading titled –Environmental Impact Mitigation and Best Practices."

SECTION 4: PESTICIDE SAFE USE ACTION PLAN (SUAP) FOR GEORGIA ASSISTANCE PROJECTS

Action Plan Title: Actions to increase awareness of and mitigate pesticide risks on Georgia assistance projects sites

Action Plan Objectives: Reduce risks from pesticides

On the following Action Plan Matrix, COP or delegate insert the start and end dates for each activity (see recommendations in Executive Summary for guidance on deadlines) or action or groups of sub-actions or activities to complete the action with the names of those responsible for each action, and a budget. Once this is action plan is completely filled, and actions are under way or done, it can be transmitted to AID to show Regulation 216 compliance progress reducing pesticide risks on your project.

Actions/Activities	Start	End	Who	Budget
Reiterating Pesticide Restrictions				
Ensure that beneficiaries do not use fumigant aluminum phosphide to treat stored grain or produce (instead use trained and equipped fumigation services)				
Ensure that beneficiaries do not use pesticide products containing active ingredients in Annex 8				
Check for any movement by the MOA on the registration of pesticides, and obtain information on new pesticide registrations				
Pesticide Risk Awareness and Mitigation				
Provide annual training for project staff and beneficiaries using the training topic list in Annex 9				

Ensure that beneficiaries use PPE and apply pesticides only early in the early morning or late afternoon when it is cooler, and when there is no wind or rain				
Annually train and test pesticide users on knowledge of human safety and environmental protection				
Good Agriculture Practices/IPM				
Test pest-specific crop-pest-IPM-pesticide information in Annex 1 with beneficiary farmers and processors for field use, validation, modification or adaptation				
Use information in Annex 1 to produce crop-specific production PMPs, and then field reference guides or posters for farmers to use to anticipate and manage pests				
Follow GlobalGAP standards and website http://www.epa.gov/oppfead1/labeling/lrm/chap-13.htm for empty container disposal and pesticide record-keeping				
Project Management Responsibilities				
Keep copies of the current list of pesticide AIs analyzed by this PERSUAP at all project sites				
Collect and keep copies of MSDSs for each commercial pesticide that beneficiaries use at all project sites				
Keep copies of prohibited pesticide products containing active ingredients in Annex 8 at all project sites				
Keep PERSUAP recommendation implementation records and report on them in Annual Reports, under a heading titled				

~~-~~Environmental Compliance and Best Practices"				
Provide for SUAP enforcement				

Action Plan Goals: Decrease the number of beneficiary farmers unaware of pesticide safety, environmental and natural resource protection, and IPM concepts

Action Plan Discussion:

Action Plan Final Sign-off: COP _____, date: _____

Once filled and signed by COP, this Action Plan can be sent to USAID for project management monitoring purposes, so USAID staff can see the degree to which PERSUAP recommendations are being implemented, issue with implementation, and to set future targets for impacts of pesticide safety activities.

ANNEX 1: MATRIX OF GEORGIAN CROPS WITH PRIMARY PESTS, PEST PREVENTION TOOLS AND TACTICS, AND PEST CONTROL OR MANAGEMENT TOOLS AND TACTICS[42],[43],[44]

[42] Reference websites for this table are at end of table

[43] Note that pesticide recommendations shown in the table are all EPA registered. These recommendations include both products registered in Georgia as well as those that might become registered in the near future. For now, use only those registered currently for use in Georgia and by EPA.

[44] To find MRLs for each crop and pesticide, see http://www.mrldatabase.com/ and choose MRLs for the market targeted by each crop, be it USA, EU, Russia or, in the absence of a national MRL database, Codex. A Georgia MRL database is not known to exist as of PERSUAP drafting.

Primary Pests	Preventive management IPM tools/tactics to integrate	Curative management IPM tools/tactics
For all crops		
For most pests	• Do pest, predator and parasite monitoring, survey and proper identification. • Use treated and certified clean seed from pest-resistant or tolerant cultivars, hybrids, or varieties. • Do soil tests for soil structure, pH, macronutrient, and micronutrient levels for precision soil amendment targeting. • Regularly test soil moisture levels in order to manage soil-borne diseases and reduce amount of irrigation water needed. • Use raised-bed or bund production to better manage water use, soil moisture and speed seedling growth. • Use minimum and no-tillage, cover crops, terracing and contour plowing to conserve soil. • Rotate crops and intercrop different crop types. • Use organic mulches and cover crops to suppress weeds, conserve irrigation water, manage soil moisture, and thus protect soil from rapid salinization. • To add organic nitrogen and structure to the soil, use green manures or rotate with nitrogen-fixing legume crops, use inter-planting with legumes and agroforestry techniques. • Use manures and compost (do not compost weeds that have	• Seed treatments with pesticides. • Commercially available: • Biological control of certain fungal diseases by inoculation with *Trichoderma* species or *Gliocladium virens*. • Biological control of certain bacterial diseases by inoculation with *Pseudomonas fluorescens* and *Pseudomonas putida*. • Natural inorganic mineral pesticides (depending on pest, containing compounds of sulfur, copper, potassium bicarbonate, iron phosphate or calcium). • Natural extracts from plants, roots, microbes, spices, fatty acids, horticultural oils, essential oils, soaps, marine organisms and dusts. • Natural chemicals (inducers) that stimulate plant vigor and pest

	flowered and set seed) to increase soil organic matter and nutrition, decrease soil-borne pathogens, sequester carbon, hold moisture and decrease need for increasingly more expensive synthetic nitrogen fertilizers derived from fossil fuels. • Sanitation: Harvest and destroy crop residues and weeds in and near field. • Have a pest management plan, organized chronologically by season or crop stage, which combines all or parts of these preventive and curative tactics. •	control properties. • Living predators, parasites, or diseases of pests. • Synthetic (man-made) pesticides containing AIs, or mixes of AIs that control pests.
• Cereals/Small Grains: Wheat/Winter Wheat, Barley/Winter Barley, Rye, Oats, Triticale		
Apids: Wheat Aphid (*Diuraphis noxia*) and *Aphis* species. Aphids transmit BYDV (Barley Yellow Dwarf Virus)	• A number of coccinellid and syrphid predators, parasites, and fungal diseases usually keep aphid populations below damaging levels. • Maintain adequate soil moisture and fertilization (Plants stressed for water or nutrients are more susceptible to and suffer greater damage from aphids). • Use regular monitoring, yellow sticky traps. • Use resistant varieties. • Sanitation: Field disking and destruction of crop residues are important for control of aphid pests of leafy vegetables to reduce their migration into nearby crops. • Avoid early planting.	• Treatments with natural chemicals, if needed, can include narrow range oils, pyrethrin, and rotenone. • For high levels of BYDV, use systemic synthetic insecticide seed treatments containing thiamethoxam (Cruiser) or imidacloprid (Gaucho). • No synthetic pesticides are recommended for spraying.

	• Avoid excessively high soil nitrogen levels. • Use wheat varieties that are resistant to BYDV.	
Wheat thrips (Haplothrips tritici)	• Predatory thrips, *Aelothrips* species, as well as other predators such as bugs, ladybirds, lacewing larvae, ground beetles, Staphilinid beetles, and robber flies are capable lowering thrip numbers. • Use early wheat sowing and early two-phase harvesting. • Early deep plowing. • Use crop rotation. • Growing of early-ripening wheat cultivars.	• Synthetic pesticides are not recommended to control wheat thrips.
Cereal Leaf Beetle (CLB) (*Oulema* = *Lema melanopus*)	• Natural controls include lady beetles and larvae, some wasp larvae parasites of CLB eggs (*Anaphes flavipes*) and larvae (*Tatrastichus julis*, *Diaparrsis carinifer*) and *Lemophagus curtus*) and a Tachinid fly larvae (*Hyalomyodes triangulifer*) that attacks CLB larvae. • Assure a thick, well tillered, healthy crop (planting on time, good seed bed preparation, using high quality seed, correct drill calibration, and being sure to get good soil-seed contact at the proper seeding depth). • In spring, before the boot stage and before the flag leaf emerges, monitor for eggs and larvae on 10 plants in 5 field locations, and spray if 3 or more eggs/larvae are found per plant; after flag leaf emergence, spray after 1 or more larvae are discovered per plant.	• Use, at early head-fill stage, synthetic insecticides containing spinosad (Tracer Natrualyte), malathion or carbaryl (Sevin, wheat only) or lambda-cyhalothrin (but do not use near open water).
Barley flea beetle	• Parasitoids like the Braconid wasp *Microcotonus vittage* parasitize	• Commercial formulations of

(*Phyllotreta vittula*)	and kill adult flea beetles. • Use living mulches or polycultures. • Trap crops: Interplant field and margins with giant mustard or radish and destroy these plants once heavily infested. • Floating mesh or screen row covers such as Reemay can be used to cover seedlings and provide a barrier to adult beetles. • White and yellow sticky traps placed every 15 to 30 feet of row. • Sanitation: Clean up and (do not compost weeds that have flowered and set seed) plant debris from field and around field. • Use repellents containing herbal extracts of garlic, onion, and mint.	insect-eating nematodes are effective agents for controlling flea beetle larvae. Applied to the soil, the nematodes attack the beetle's larval stage, reducing root feeding and helping to prevent emergence of the next cycle of adults. • Use of organic botanical insecticides such as neem, rotenone, pyrethrin, and formulations of these in some combination. • Use of organic combinations of rotenone and insecticidal soap (M-pede) are very effective. • Use of organic diatomaceous earth to reduce flea-beetle populations. • Use of organic kaolin clay-based product Surround or cryolite.
Turnip moth (Agrotis = Scotia segetum)	• Natural enemies include larvae of parasitic Braconid wasps and Tachinid flies. Predators include ground beetles, lacewings, praying mantis, and weaver ants. • Use crop rotation--plant alfalfa or beans after tomato. • Removal of weeds in and around fields will reduce egg-laying sites	• Botanical and homemade extracts include basil, neem, Finger euphorbia and Spanish needle. • Use pheromone traps.

	and will help in the prevention of cutworm infestation. Do this at least 2-3 weeks before planting to reduce the incidence of cutworm larvae transferring to newly planted crops. • Interplant main crops with onion, garlic, peppermint, coriander, or garlic every 10-20 rows to repel cutworms. • Sunflowers and cosmos can also be planted as a trap crop in or around fields. • Plow and harrow fields properly before planting. This will destroy eggs and expose larvae to chicken, ants, birds, and other predators.	• Use sprays of BT, if and when they become registered and available. • Find ‗hot-spots' (places of high infestation) and treat only those hot spots. If registered, can treat with synthetic insecticides containing carbaryl (Sevin bait, chlorpyrifos (Lorsban) and permethrin (Ambush) (*do not allow synthetic pyrethroids into enter open water, get RUP training)*.
Hessian Cereal Fly (*Mayetiola destructor*)	• Use resistant or tolerant varieties. • Use crop rotation away from wheat. • Disk wheat stubble after harvest. • Delay winter wheat planting until after first freeze.	• Use systemic synthetic insecticide seed treatments containing thiamethoxam (Cruiser) or imidacloprid (Gaucho).
Sunn Pest (*Eurygaster integriceps* and other species)	• Use resistant varieties. • Rotate crops. • Monitor for presence of natural enemies. • Destroy alternate host plants near fields.	• Might use synthetic pesticides containing fenitrothion or pyrethroids lambda-cyhalothrin or deltamethrin (but do not use either near open water).
Wheat grain beetle/wheat chafer	• Vernalization and early sowing of cereal grain crops.	• Can use natural commercial formulation of fungus

(*Anisoplia austriaca*)	• Soil cultivation and inter-row treatment in spring and in early summer as a method of destroying pupae. • Quick two-phase harvesting at the beginning of grain ripening. • Early post-harvesting plowing of soil.	*Metarhizium anisopliae* against beetles. • Can use synthetic insecticides like permitted (not EPA restricted or Class I) formulations of zeta-cypermethrin against the beetles if their population density is higher than economic threshold.
Cereal cyst nematode (*Heterodera avenae*)	• Use of resistant cultivars • Grow healthy plants (use appropriate seed, spacing, watering, weeding and fertilizer). • Use crop rotation, deep plowing, fallowing and avoid mono cropping. • Rotate with broccoli, cauliflower, sorghum, flax, Sudan grass, rape, and mustard seed which are resistant to nematodes. • Sanitation: Remove and compost crop debris. • Use of organic fertilizer particularly chicken manure and composts to add organic matter and soil structure to sandy soils. • African and French marigold (*Tagetes minuta* and *T. patula,* respectively) plowed under the soil also suppress and reduce nematodes. Plant marigolds early and plow the marigolds under 2 months later.	• Botanical and homemade water extracts of basil, garlic and neem seed may be effective controls. • Two new commercialized products, once registered for use, can be used as effective nematode controls: the microbe *Myrothecium verrucaria* and natural soil biopesticide labeled as Promax (containing extracts of tomatillo oil and thyme oil).
Smuts (Wheat covered smut and loose smut)	• Use certified smut-free seed.	• For seed treatment, use synthetic pesticides containing carboxin +

Tilletia caries and Tilletia foetida, Ustilago hordei Ustilago tritici , Ustilago nuda, Ustilago nigra	• Hot water treatment can eliminate smut fungi from contaminated seed, but it must be used carefully to avoid reducing seed vitality. • For covered smut, which is on the outside of the seed, treatment of seed with contact-type fungicides will control covered smut. • For loose smut, which resides inside the seed, seed treatment with systemic fungicides is necessary.	thiram (Vitavaks 200 FF) or tebuconazole (Raxil, Raks).
Powdery Mildews: *Blumeria graminis (Erysiphe graminis* f. sp*. tritici*) infects wheat; *Erysiphe* graminis f. sp. *hordei* infects barley*; Erysiphe graminis* f. sp. *avenae* infects oats and wild oats	• Use certified disease-free resistant hybrid seed. • Resistant cultivars of barley and wheat are available. • Crop rotation. • Elimination of crop residue. • Control of volunteer grains and weed hosts reduce inoculum survival from one season to the next.	• Although normally not economical, foliar fungicides containing propiconazole (Tilt) can be used to control disease outbreaks and provide partial disease control. To protect the flag leaf, applications should be made between tillering and heading.
Rusts: Leaf and Brown: *Puccinia recondita* and *Puccinia triticana* (wheat) Stem rust/black rust (*Puccinia graminis*) Glume rust (Puccinia	• Use certified disease-free resistant hybrid seed. • Resistant cultivars of barley and wheat are available.	• If new races of the fungus render current sources of resistance obsolete, fungicides such as propiconazole (Tilt) can be applied at 4 oz per acre to control disease outbreaks. To protect the flag leaf, applications should be made between tillering and heading.

glumarun) and Yellow or Stripe rust (Puccinia stratiifromis)		
Septoria spot (Septoria tritici	• Use certified disease-free resistant hybrid seed. • Crop rotation will not work. The presence of the airborne ascospores that can spread long distances very quickly in the wheat growing regions, means that crop rotation will not allow wheat to escape from the source of inoculum. • Later plantings of wheat (Nov. to Dec.) are less likely to be severely affected. The impact of the disease is most severe in early planted wheat (October) because the plants are exposed to the pathogen over a longer period of time during a period when weather conditions are frequently favorable to disease development.	• Although normally not economical, foliar fungicides can be used to control disease outbreaks and provide partial disease control. • Depending on the weather conditions from tillering to early dough stage, one or more applications of synthetic fungicides may be needed, like those containing mancozeb or propiconazole. Applications should be made between tillering and heading to protect the flag leaf.
Cereals Weeds:	• Deploy integrated weed management. • Adequate drainage is necessary for fields planted to small grains. Excessive moisture in low areas creates and aggravates problems such as stand loss, loss of soil nutrients, reduced oxygen supply, and root diseases. Chiseling the soil before seedbed preparation increases drainage and root development. • Use pre-irrigation or first rain to germinate weed seeds and remove them by tilling before planting or by applying postemergent	• For fallow period, use synthetic herbicides containing glyphosate (Roundup), pyraflufen-ethyl (ET). • Preplant, use synthetic herbicides containing glyphosate (Roundup). • Post-plant, wheat, before weeds emerge, use synthetic herbicides containing pendimethalin (Prowl

	herbicides, land preparation. • Under dryland conditions, after the first autumn rainfall, primary fall tillage with a disk, chisel plow, or moldboard plow usually follows to eliminate germinating winter weed seedlings.	H2O). • Post-plant, wheat, after weeds emerge, use synthetic herbicides containing tralkoxydim (Achieve), bromoxynil (Buctril), fenoxaprop (Puma), mesosulfuron-methyl (Osprey), carfentrazone (Shark), clopyralid (Stinger), chlorosulfuron (Glean), pyraflufen-ethyl (ET). • Post-plant, barley, after weeds emerge, use synthetic herbicides containing tralkoxydim (Achieve), bromoxynil (Buctril), carfentazone (Shark), chlorosulfuron (Glean), fenoxaprop (Puma), clopyralid (Stinger). • Post-plant oats, after weeds emerge, use synthetic herbicides containing bromoxynil (Buctril), chlorosulfuron (Glean), carfentrazone (Shark), clopyralid (Stinger).
Corn/Maize; Sorghum		
Corn stalk borers (*Ostrinia nubilalis*)	• Natural enemies of larvae include parasitoids Braconid family of parasitic wasps, wasps of the genus Cotesia, and Tachinid fly larvae. *Trichogramma* parasitoids attack eggs of stalk borers.	• Use natural pesticides containing BT toxin or spinosad (both extracts from soil microbes)

	Predators include ground beetles, lacewing larvae and adults, praying mantis and weaver ants. • Use borer-resistant varieties. • Use crop rotation and intercrop maize with cowpea. • Plow deeply and harrow. • Plant early at the beginning of rains or within 2 weeks. • Monitor plants for larva's presence 2-4 weeks after sowing. Select 100 plants randomly across the field. If more than five plants are infested with stalk borer larvae (out of 100 monitored plants), then control measure is necessary. • Intercropping with pulses (cowpea, groundnut) in alternate rows reduces stem borers. • Sanitation: Remove and destroy stalks by burning, feeding to cattle or composting.	between the egg stage and leaf-feeding stage (before they bore into the stem). • Use releases of *Trichogramma* egg parasitoids.
Turnip moth (Agrotis = Scotia segetum)	• Natural enemies include larvae of parasitic Braconid wasps and Tachinid flies. Predators include ground beetles, lacewings, praying mantis and weaver ants. • Use crop rotation--plant alfalfa or beans after tomato. • Removal of weeds in and around fields will reduce egg-laying sites and will help in the prevention of cutworm infestation. Do this at least 2-3 weeks before planting to reduce the incidence of cutworm larvae transferring to newly planted crops. • Interplant main crops with onion, garlic, peppermint, coriander, or	• Botanical and homemade extracts include basil, neem, Finger euphorbia and Spanish needle. • Use pheromone traps. • Use sprays of BT, if and when they become registered and available. • Find ‗hot-spots' (places of high

	garlic every 10-20 rows to repel cutworms. • Sunflowers and cosmos can also be planted as a trap crop in or around fields. • Plow and harrow fields properly before planting. This will destroy eggs and expose larvae to chicken, ants, birds, and other predators.	infestation) and treat only those hot-spots. If registered, can treat with synthetic insecticides containing carbaryl (Sevin bait, chlorpyrifos (Lorsban) and permethrin (Ambush) (*do not allow synthetic pyrethroids into enter open water, get RUP training)*.
Aphids: corn leaf aphid (*Rhopalosiphum maidis*	• Natural enemies include Braconid parasitoids, ground beetles, spiders, rove beetles, ladybird beetles, lacewings, damsel bugs, aphid midges and hoverfly larvae. • To monitor aphid populations, examine the undersides of the leaves and the bud areas for groups or colonies of aphids. Prompt control is necessary as aphids can multiply rapidly. • Grow different crops or grow crops in rotation every cropping season. This practice provides food, shelter, and it increases the number of natural enemies that prey on aphids. At the same time, it disrupts the aphids' lifecycle and maintains its population below the economic threshold level. • Plant trap crops such as lupine, nasturtiums, and timothy grass near the crop to be protected (plow under or spray). Anise, chives, garlic, onions, and radish are good companion crops. • Control ants which protect aphids. • Avoid using heavy doses of highly soluble nitrogen fertilizers. Instead apply fertilizer into 3 phases: during seeding, vegetative,	• Use botanical and homemade water extracts of chili, ginger, neem, turmeric, tomato leaf, narrow range oil, Yam Bean and soap sprays (caution: may injure foliage). • If registered, can apply synthetic pesticide dimethoate. •

	and reproductive stages of plant growth. • Use yellow sticky board traps placed in field (spread used motor oil on yellow painted plastic, thick cardboard or wood). •	
Maize Weeds:	• Proper seed selection. When possible use high quality seeds and certain crop varieties. • Perform thorough land preparation (soil tillage, fertilizer, and water management). • Narrow row spacing makes the crop more competitive than the weeds, use intercropping. • Place the fertilizer in such a way that the crop has access to it but the weeds do not. This allows the crop to be more competitive with weeds. • Maintain cleanliness on the irrigation canals. • Keep the surroundings of your farm free of weeds, unless they are maintained and intended as habitats for natural enemies. • Regularly clean farm tools. • Use green manure which chokes out weeds. • Use intercropping. • Hand weeding and composting (do not compost weeds that have flowered and set	• Before planting, use synthetic herbicides containing EPTC (Eradicane), glyphosate (Roundup). • At planting, use synthetic herbicides containing glyphosate (Roundup), pendimethalin (Prowl), EPTC (Eradicane). • After planting, use synthetic herbicides containing nicosulfuron (Accent), pendimethalin (Prowl), glyphosate (Roudnup), bromoxynil (Buctril), metribuzin (Sencor), halosulfuron (Sandea), carfentrazone (Shark), foramsulfuron (Option).

	• Hoeing, mowing, and cutting.	
Cole Crops/Crucifers/Brassicas and Lettuces: Cabbages, Cauliflower, Brussels Sprouts, Broccoli, Mustards, Turnips, Radish, Lettuces		
Aphids: Cabbage aphid (*Brevicoryne brassicae)*	• Use of ~~-ha~~bitat plantings" (flowering perennial plants that attract aphid parasites and predators. • Carefully manage nitrogen levels so that they are neither too high (which significantly attracts aphids) or too low (which impedes plant growth). • Natural enemies that can be attracted to fields with habitat plantings include aphid and syrphid flies, lacewings, and the predaceous midge, minute pirate bugs, bigeyed bugs, lady beetles, soldier beetles, and parasitic wasps like *Diaeretiella rapae*. • In some humid areas there are outbreaks of naturally existing fungi that cause epidemics among aphid colonies. • When plants are young and leaf cupping has not yet occurred, high pressure overhead sprinkler irrigation dislodges aphids. • Inter-planting with clover (as a ~~-li~~ving mulch") reduces aphid populations. • Use trap crops: Plant mustards or collards on field margins or inter-planted and destroy these plants once heavily infested.	• Organically accepted insecticides include those containing insecticidal soap (M-pede), neem (Neemix, Argoneem, Azadirect), rotenone, and pyrethrum/pyrethrins (Pyganic). • Use synthetic pesticides containing acephate (Orthene), acetamiprid (Assail), spirotetramat (Movento), chlorpyrifos (Lorsban), or pymetrozine (Fulfill).
Caterpillar pests: Diamondback moth (*Plutella xylostella*)	• Caterpillar natural enemies (keep populations down) include predators like ground beetles, spiders, damsel bugs, minute pirate bugs, assassin bugs, bigeyed bugs, and lacewing larvae. Parasitic wasps of *Trichogramma* species, *Copidosoma* species, *Apanteles* species, *Diadegma*, and *Hyposoter* species sting and parasitize eggs	• Use of natural pesticides consisting of *Bacillus thuringiensis*/BT (Agree, Deliver, Javelin, Dipel, Xantari, Prolong, Britz BT Dust), *Beauveria bassiana*

Imported cabbage worm (*Pieris rapae, Pieris brassicae*) Armyworm (Mamestra brasicae)	and larvae (some of these organisms are available commercially). • Use of organic herbal repellents like those extracted from garlic (Cropguard, Garlic Barrier), red chili peppers or neem oil. • Use of nocturnal overhead sprinkler irrigation to dislodge and repel pests. • Use of pheromone misters and emitters to disrupt mating. • Use of floating row screen or mesh covers to exclude egg-laying moths.	(Mycotrol, Naturalis, Botanigard), spinosad (Entrust), viruses (Spod-X, Gemstarand); plant extracts neem (Neemix, Argoneem, Azadirect), pyrethrin (Pyganic) and pyrethrin combined with diatomaceous earth (Diatect V). • Use of synthetic pesticides containing indoxacarb (Avaunt), spinetoram (Radiant), chlorantraniliprole (Coragen), flubendiamide (Synapse), methoxyfenozide (Intrepid), or crylolite.
Spring cabbage fly/maggot (*Delia radicum)* Summer cabbage fly, (*Delia floralis*)	• Natural predators include ground and rove beetles, spiders, harvestmen (daddy longlegs), and ants. • Use compost and straw mulches to reduce maggot populations by hiding predators and excluding egg-laying flies. • Intercrop with clovers or other legumes to reduce open soil available for egg-laying flies. • Use of floating row screen or mesh covers to exclude egg-laying flies.	• A solution of crushed rhubarb leaves or a vinegar solution sprayed periodically around cole crop plants may deter and manage the cabbage maggot. • Commercial formulations of maggot-eating nematodes are effective agents for controlling flea beetle larvae, and are available commercially from several companies, including by mail order from GrowQuest (http://www.growquest.com) and

		Arbico, Biocontrol Network (http://www.biconet.com) in the USA. They are applied to the soil, the nematodes attack the beetle's larval stage, reducing root feeding and helping to prevent emergence of the next cycle of adults.
Cabbage bacterial rot (Erwinia carotovora, Erwinia aroideae)	• Use of certified disease-free propagation material. • Do weed control. • Use resistant or tolerant varieties. • Plant in well-drained soils, avoid over-irrigation. • Use deep well water for irrigation. • Remove and destroy diseased plants.	• Spray with copper-containing compounds.
Black leg (*Phoma lingam)*	• Clean, certified or hot-water treated seed. • Good soil drainage. • Rotation with non-brassica type crops. • Control of brassica-type weeds. • Deep incorporation of cole crop residues. • Planting resistant varieties.	• Use synthetic pesticide containing iprodione (Rovral).

Downy mildew (*Peronospora brassicae)*	• Promoting good drainage. • Increasing spacing for better aeration. • Controlling brassica-type weeds. • Using resistant varieties. • Rotating with non-cole crops. • Sanitation: After harvest, deep plow or destroy plant debris. • Avoid the use of overhead irrigation.	• Use of mineral copper for organic production. • Use synthetic pesticide containing chlorothalonil (various), mefenoxam (Ridomil Gold/Bravo), or fosetyl aluminum (Aliette).
Cole Crops Weeds	• Monitor and identify weed species present. • Use fallow practices. • Sanitation: To reduce seed production, disc or mow harvested fields before weeds flower and produce seeds. Cultivation equipment and irrigation water must also be kept free of weed seeds and vegetative propagules to avoid spreading weed populations. Cultivate areas around the field such as field edges, fence lines, roadsides, and irrigation ditches regularly to prevent weed seed production. To reduce seed production, disc or mow harvested fields before weeds flower and produce seeds. • Preplant plowing, followed by irrigation and one or two discings before bed formation, will destroy many weeds. • Proper bed preparation is important for successful weed cultivation after the crop is planted.	• During fallow, use synthetic herbicides containing glyphosate (Roundup), EPTC (Eptam Selective), pelargonic acid (Scythe). • Pre-plant, before weeds emerge, use synthetic herbicides containing trifluralin (Treflan), bensulide (Prefar), napropoamide (Devrinol).

	• Regularly clean farm tools. • Use green manure which chokes out weeds. • Use intercropping. • Hand weeding during their earlier growing period. Do not let the weeds flower (do not compost weeds that have flowered and set seed). • Hoeing, mowing, and cutting.	
Solanaceous Crops: Tomato; Potato; Peppers/Paprika; Eggplant		
Potato aphid (Macrosiphum euphorbiae)	• Many types of natural enemies and pathogens may control these aphids under low insecticide input situations. However, these aphids reproduce quickly and move into protected areas of the plants, thereby greatly reducing the potential impact of their predators and parasitoids in older stage plants. • Use resistant varieties. • Use regular monitoring with yellow sticky traps. • Field disking and destruction of crop residues are important for control of aphid pests of leafy vegetables to reduce their migration into nearby crops.	• If control is needed, treat when aphids are found to be reproducing, particularly when second and later generation wingless females have started reproduction. Aphid populations are easier to control before the plants begin to cup. • Insecticides containing systemic synthetic insecticides imidacloprid, acetamiprid or pymetrozine can be used.
Colorado Potato Beetle (CPB) (*Leptinotarsa decemlineata)*	• Controlled in nature by ground beetles, lady beetles, predatory stink bugs, spiders and green lacewings. • Use resistant varieties. • Use crop rotation to reduce population build-up.	• Use natural insecticides containing rotenone or pyrethrum (caution: rotenone is toxic to fish). • Use natural insecticides containing extracts (no greater than 1% due to

	• Do mulching with wheat or rye straw. • Do farmscaping: Plant pollen and nectar source plants along field border and field strips (see http://attra.ncat.org/attra-pub/summaries/farmscaping.html). • Use floating row covers to exclude CPB.	phytotoxicity of potato) of neem (azadirachtin) (Neemix, BioNeem, and Margosan-O). • Use natural insecticides containing Bacillus thuringiensis (BT) or *Beauveria bassiana,* canola oil and pyrethrins (Pyola). • Commercially available parasitic nematodes *Heterorhabditis* species and *Steinernema* species control CPB.
Potato tuber worm moth (*Phthorimaea operculella)*	• Use pheromone traps. • Shallow setting varieties are generally more susceptible than varieties that set tubers deep. • Any practice that reduces the exposure of tubers to egg-laying female moths will reduce tuberworm damage. • Prevention of soil cracking in the beds will reduce tuberworm damage. Thus, Furrow-irrigated fields have a much greater potential to become infested than sprinkler-irrigated fields (cracking of the soil is less severe under sprinkler irrigation than with furrow irrigation). • Prompt, thorough harvest and sanitation are also essential. • Sanitation: Destroy cull piles and volunteer potatoes. Piles of cull potatoes provide a year-round breeding site for tuberworm.	• Use natural sprays of the Entrust formulation of spinosad. • Use synthetic insecticides containing indoxacarb (Avaunt) or novaluron (Rimon).

Potato stem borer (*Hydraecia micacea*)	• Sanitation: Destruction of weeds on fields and adjacent sites early in the season and removal of plant residues after harvest.	• Generally no insecticides are recommended or economical for control.
Turnip moth (Agrotis = Scotia segetum)	• Natural enemies include larvae of parasitic Braconid wasps and Tachinid flies. Predators include ground beetles, lacewings, praying mantis and weaver ants. • Use crop rotation--plant alfalfa or beans after tomato. • Removal of weeds in and around fields will reduce egg-laying sites and will help in the prevention of cutworm infestation. Do this at least 2-3 weeks before planting to reduce the incidence of cutworm larvae transferring to newly planted crops. • Interplant main crops with onion, garlic, peppermint, coriander, or garlic every 10-20 rows to repel cutworms. • Sunflowers and cosmos can also be planted as a trap crop in or around fields. • Plow and harrow fields properly before planting. This will destroy eggs and expose larvae to chicken, ants, birds, and other predators. •	• Botanical and homemade extracts include basil, neem, Finger euphorbia and Spanish needle. • Use pheromone traps. • Use sprays of BT, if and when they become registered and available. • Find ‗hot-spots' (places of high infestation) and treat only those hot-spots. If registered, can treat with synthetic insecticides containing carbaryl (Sevin bait, chlorpyrifos (Lorsban) and permethrin (Ambush) (*do not allow synthetic pyrethroids into enter open water, get RUP training)*. •
Nematodes: Potato cyst nematode (*Globodera*	• Use of resistant cultivars and grow healthy plants (use appropriate seed, spacing, watering, weeding and fertilizer).	• Management of nematodes is difficult, especially in sandy soils.

rostochinesis) Potato Rot Nematode (*Ditylenchus destructor*)	• Use Soil solarization using plastic. • Use crop rotation, deep plowing, fallowing and avoid mono cropping. Rotate with broccoli, cauliflower, sorghum, Sudan grass, rape, and mustard seed which are resistant to nematodes. • Sanitation: Remove and compost crop debris. • Use of organic fertilizer particularly chicken manure and composts to add organic matter and soil structure to sandy soils • Growing flax, a tropical herb, is good for controlling root knot nematodes. • African and French marigold (*Tagetes minuta* and *T. patula,* respectively) plowed under the soil also suppress and reduce nematodes. Plant and plow under 2 months later. •	• Botanical and homemade water extracts of basil, garlic and neem seed may be effective controls. • Two new commercialized products, once registered for use, can be used as effective nematode controls: the microbe *Myrothecium verrucaria* and natural soil biopesticide labeled as Promax (containing extracts of tomatillo oil and thyme oil) •
Late blight or Downy mildew (*Phytophthora infestans*)	• Use tolerant varieties and raised-bed production • Drain the growing field adequately before planting • Follow proper planting date; do not plant late • Farmers use sticks and lines to raise tomato plants and fruit into the air to aerate the plant and raise the leaves and fruit away from the soil	• Use synthetic fungicides containing azoxystrobin (Quadris), cymoxanil (Curzate), copper sulfate, famoxidone (Tanos), mancozeb, maneb, chlorothalonil, dimethomorph (Acrobat), pyraclostrobin (Headline) and fenamidone (Reason).
Bacterial (black) wilt and canker (*Erwinia*	• Use of certified disease-free propagation material.	• Spray with copper-containing

carotovora)	• Do weed control. • Use resistant or tolerant varieties. • Plant in well-drained soils, avoid over-irrigation. • Use deep well water for irrigation. • Remove and destroy diseased plants.	compounds.
Weeds of Solanaceous Crops	• Herbicide expenses make farmers use hand weeding, hoeing or cultivation. • At end of the harvest, manual removal of weeds. • Clean weeds along irrigation canals that can transmit weeds to the field. • Use crop rotation. • Use transplants which can out-compete weeds quicker. • Use soil solarization. • Use soil mulches and pruning. • Continue hoe and hand weeding. • Can use drip irrigation to regulate water in the crop and avoid weed emergence.	• Tomato • In fall beds, before weeds emerge, use synthetic herbicides containing metribuzin (Sencor DF), oxyfluorfen (Goal). • After weeds emerge, use glyphosate (Roundup). • Pre-plant before weeds emerge, use synthetic herbicides containing metolachlor (Dual Magnum), napropamide (Devrinol), trifluralin (Treflan), pendimethalin (Prowl). • Post-plant before weeds emerge, use synthetic herbicides containing rimsulfuron (Matrix), metolachlor (Dual Magnum). • Post-plant after weeds emerge, use synthetic herbicides

		containing clethodim (Select Max), halosulfuron (Sandea), metribuzin (Sencor), rimsulfuron (Matrix), sethoxydim (Poast). • Potato • Pre- and Post-plant, use synthetic herbicides containing dimethenamid (Outlook), EPTC (Eptam), glyphosate (Roudnup), pendimethalin (Prowl), sethoxydim (Poast), rimsulfuron (Matrix). • Eggplant/Pepper • On preformed beds, use synthetic herbicides containing glyphosate (Roudup), carfentrazone (Shark), pelargonic acid (Scythe). • Pre-plant, use synthetic herbicides containing bensulide (Prefar), napropamide (Devrinol). • Post-plant, use synthetic herbicides containing sethoxydim (Poast), napropamide (Devrinol), clethodim (Select Max), halosulfuron (Sandea), carfentrazone (Shark), pelargonic

		acid (Scythe).
Alliums: Onions; Garlic; Leeks; Chives; Shallots		
Onion fly (Delia antiqua)	• Control soil moisture. • Floating row covers exclude onion fly. • During the growing season, minimize damage to bulbs caused by insects and diseases. • Provide for quick drying following topping, especially if temperatures are high. • Rotate 3 to 4 years out of onions, garlic, and leeks. • Control other soil insects and foliage diseases that cause wounds entered by onion fly larvae. • Harvest only after onion tops are well matured, cure onions properly before storage and store onions at cool temperatures since infection is favored by warm conditions. • Sanitation: Clean up all cull and volunteer onions out of fields before planting. • Use fall plowing to destroy pupae.	• Use synthetic pesticides containing malathion, if needed.
Leek moth (Acrolepiopsis assectella)	• Natural parasites and predators exert a lot of control to leek moth larvae. • If economical and available, use pheromone traps to monitor. • Row covers provide an alternative strategy and these are used to	• Can use natural insecticides containing BT or spinosad. •

	cover crops during the adult flight periods, preventing gravid females from laying eggs.	
Tulip bulb mite (*Aceria tulipae*)	• Use certified clean propagation material/bulbs. • Hot water treatment before planting may reduce mite infestation. • Avoid planting successive and rapid onion, leek or garlic crops. • Sanitation: Plow under crop residues especially decaying cole crops like cauliflower which may harbor very high bulb mite populations. • Practice fallow fields to allow complete decomposition of organic matter; this reduces field populations of the mite. • Flood irrigation or heavy rains during the winter may reduce mite levels in the soil.	• Fumigate soil only as a last resort if prevention does not work.
Onion stem nematode (*Ditylenchus dipsaci*)	• There are currently no resistant cultivars available. • Use certified clean propagation material. • Treat bulbs with hot water to eradicate nematodes from garlic cloves. • Rotate or alternate alliums with nonhost crops such as carrots and lettuce for several years. • Sanitation: Avoid infesting new fields by cleaning machinery and equipment with water, and preventing movement of infested soil.	• Fumigate soil only as a last resort if prevention does not work.
Downy mildew (Peronospora	• Plastic mulch covering to avoid plant contact with soil and minimize	• Use synthetic pesticide as soil

destructor)	weeds that enhance microclimate conditions favorable to disease dispersion. • Heat treatment of bulbs at 35 to 40 °C for 4 to 8h reduces the disease significantly. • Bulb dipping with a synthetic fungicide containing metalaxyl • Eliminate crop residues, plant during dry season, avoid irrigation during heat of the day. • Use crop rotation. • Use certified seed and good drainage.	drench and spray applications containing of chlorothalonil, captan, thiophannate methyl, metalaxyl + mancozeb (Ridomil Gold MC) followed by oxadixyl + copper oxychloride.
Weeds of Alliums	• Use the most weed-free field possible. • To avoid buildup of weed seed in the soil, cultivate weeds before they set seed in rotation crops. • Clean cultivate the field or plant a green manure crop to limit weed infestations after onion harvest. • Irrigate the field before planting to germinate weed seeds and afterwards cultivate the soil killing the weeds. • After pre-irrigation, cultivate shallow so that weed seed is not brought up from deeper soil layers. Maintaining deep furrows keeps the bed tops from becoming overly wet while maintaining adequate soil moisture for the crop (by keeping the bed tops drier, fewer weeds are likely to germinate in the soil surface). • To avoid excessive competition with the onions and to make removal easier, cultivate when weeds are small. Hand weeding is a	• At pre-plant, use synthetic herbicide containing glyphosate (Roundup). • At post-plant before weeds and crop emerge, use a synthetic herbicide containing DCPA (Dacthal), bensulfide (Prefar), dimethanamid (Outlook), pendimethalin (Prowl), bormoxynil (Buctril), oxyfluorfen (Goal), sethoxydim (Poast), fluazifop-P-butyl (Fusilade DX, clethodim (Select Max), ethofumesate (Norton). • For layby, use a synthetic herbicide containing DCPA

	very efficient method for weed control. • Use soil solarization.	(Dacthal).
Cucurbits: Cucumbers; Squashes; Pumpkins; Melons; Watermelon		
Aphids (Several including melon or cotton aphid, *Aphis gossypii*, Pea aphid, *Acyrthosiphon pisum*)	• Use resistant varieties • Use regular monitoring with yellow sticky traps • Many types of natural enemies and pathogens may control these aphids under low insecticide input situations. • Sanitation: Field disking and destruction of crop residues are important for control of aphid pests of leafy vegetables to reduce their migration into nearby crops. • If control is needed, treat when aphids are found to be reproducing, particularly when second and later generation wingless females have started reproduction. Aphid populations are easier to control before the plants begin to cup.	• Foliar contact insecticides have limited impact as plants enter the cupping stage. • While insecticides may help reduce secondary spread of aphid transmitted viruses, they do not prevent primary infection of fields. • Synthetic insecticides containing imidacloprid, acetamiprid or pymetrozine can be used. •
Mangold flea beetle (*Chaetocnema concinna*)	• Use proper water and fertilization to grow vigorous plants and eliminate plant stress from insufficient moisture and powdery mildew.	• Can use natural inseciticdes containing pyrethrin. • Can use synthetic insecticides containing acetamiprid (Assail), carbaryl (Sevin), or cryolite (Kryocide).
Weeds of Cucurbits	• Cultivate weeds under before they set seed in rotation crops. • Pre-irrigate before planting crop and cultivate or spray weeds that	• Before planting, treatment with synthetic herbicides containing bensulide (Prefar), glyphosate

	emerge. • Plant or transplant cucurbits into uniform beds and use a precision planting system that puts crop in straight line that will allow cultivation close to the seed line. • Use mulches to smother weeds near plants.	(Roundup Powermax, Touchdown), carfentrazone (Shark), oxyfluorfen (GoalTender). • At planting use synthetic hrebicides containing bensulide (Prefar), ethalfluralin (Curbit). • After planting use synthetic herbicides containing sethoxydim (Poast), halosulfuron (Sandea), DCPA (Dacthal), clethodim (Select Max). • For layby use synthetic herbicides containing trifluralin (Treflan) or ethafluralin (Curbit).
Umbelliferous Crops: Carrots; Parsnip; Celery/Celeriac, Fennel, Parsley; Coriander; Cilantro; Chervil		
Carrot rust fly (*Psila rosea*)	• Monitor with yellow sticky traps. • Floating row covers exclude rust fly. • Use crop rotation to non-Umbellifers.	• Seeds can be treated with synthetic insecticides spinosad (Entrust, natural), thiamethoxam (Cruiser), clothianidan and imidacloprid (Supresto). • Can use natural insecticide containing diatomaceous earth (Perma Guard). • Can use synthetic insecticides containing cypermethrin

		(Ripcord), diazinon, spriotetramat (Movento), lambda-cyhalothrin (Matador) or phosmet (Imidan).
Weeds of Umbellifers	• Monitor and identify predominant weeds to make a management plan. • Avoid planting carrots in fields last planted to cereals or in fields with known infestations of perennial weeds. • To prevent the buildup of weed seed in the soil, cultivate weeds before they set seed in rotation crops. • Soil solarization can be used to control most weeds in carrots. • Carrots should be planted in the most weed-free fields. • Do not practice close cultivation with machinery or hoe (risk of damage to roots is too high).	• Pre-plant, use synthetic herbicides containing glyphosate (Roundup) or trifluralin (Treflan HFP). • Post-plant, before crop emerges, use synthetic herbicides containing trifluralin (Treflan HFP), linuron (Lorox) or pendimethalin (Prowl H2O). • After crop emerges, use synthetic herbicides containing linuron (Lorox), fluazifop-P-butyl (Fusilade DX), sethoxydim (Poast), clethodim (Select Max). •
Grape vines: Wine grapes; Table grapes; Raisin grapes		
Vine Mealybugs (*Planococcus ficus*)	• Natural parasitic wasps and predators such as lady beetle adults and larvae, lacewings adults and larvae, minute pirate bugs and spiders can control mealybugs. • Do regular monitoring, note taking and mapping of mealbug infestations.	• In the spring, can apply a delayed dormant insecticide containing imidacloprid (Admire Pro) directly or via drip irrigation. • In the summer, treatments can include insecticides containing

	• Control honeydew-seeking ants using tillage and common vetch cover crops. • Peel back the thin bark on spurs in the current season's prunings and look for the presence of mealybug crawlers (larvae); if 20% of samples show crawlers apply a delayed dormant insecticide.	dimethoate or buprofezin (Applaud).
Grape Leafroller (Sparganothis pilleriana), Apple leafroller (*Choreutis pariana*)	• Predators such as green lacewings, minute pirate bugs and spiders feed on omnivorous leafroller larvae. • Use pheromone traps to monitor and trap adult moths. • Sanitation: Control weeds in and around orchard. Disc under grape mummy clusters and weeds.	• Can use natural insecticides containing *Bacillus thuringiensis (BT)* Kurtaski and the Entrust formulation of spinosad. • For the first generation, use synthetic insecticides containing cryolite (Prokil Cryolite), methoxyfenozide (Intrepid). • For second and third generations, use synthetic insecticides containing methoxyfenozide (Intrepid), spinosad (Entrust), phosmet (Imidan) and *Bacillus thuringiensis* Kurtaski (BT).
Mites: Grape Erineum Mite or Vine Leaf Blister Mite (*Colomerus vitis*). Garden Spider Mite (*Eotetranychus pruni*)	• Natural predators and parasites control large proportions of spider mite populations. The western predatory mite, *Galendromus (=Metaseiulus) occidentalis,* can be purchased and released onto field. • Apply water to reduce dust on roads in the vineyard. Maintain resident vegetation or other cover in the vineyard middles to further reduce dust.	• Can use natural insecticides containing narrow range oils, neem oil (Trilogy) and insecticidal soap (M-Pede). • Can use synthetic insecticides containing propargite (Omite), fenpyroximate (Fujimite),

	• Irrigate in a manner that will avoid stressing vines. Overhead watering has been shown to reduce mite problems, but it can increase some diseases.	pyridaben (Nexter), hexythizox (Savey), dicofol (Kelthane).
Grape vine moth (*Lobesia botrana*)	• Numerous predators and parasitoids control the vine moth. • Can use pheromone traps to monitor. • Can use mating disruption with pheromone inundative releases, but only on large scale orchards of more than 10ha.	• Can use natural insecticides containing *Bacillus thuringiensis* Kurtaski (BT) or spinosad (Entrust).
Soft scale of grapes/wooly vine scale (*Neopulvianaria innumerabilis*)	• Parasites and predators often keep populations below damaging levels. • Control honeydew-seeking ants near and in orchard. • Provide plants with good growing conditions and proper cultural care; especially appropriate irrigation. • Prune off heavily infested twigs and branches to eliminate scales when infestations are on limited parts of the plant. • Pruning to open up vine canopies helps to control some scale species.	• Can use natural sprays of narrow-range oils and neem oils especially during the larval crawler stage. • Can use synthetic insecticides containing imidacloprid.
Grape phylloxera (*Viteus vitifolii*)	• Resistant rootstocks are an organically acceptable management tool for this pest. • For new vineyards, use only clean propagating material and do not hold clean material in infested areas before planting.	• A pesticide treatment will not eradicate phylloxera populations; the chemical cannot easily penetrate the heavy soils that this pest prefers. • Use synthetic insecticides containing imidacloprid (Adminre

		Pro) or sodium tetrathiocarbonate (Enzone).
Silverleaf whitefly (Schizotetranychus pruni)	• Several natural predators and parasites control white flies. • If possible keep cotton fields as far away from pomegranate as possible. • Do weed control in orchard. • Avoid or remove plants that repeatedly host high populations of whiteflies. • Aluminum foil or reflective mulches can repel whiteflies. • Yellow sticky traps can reduce whitefly populations.	• Insecticidal soaps or oils such as neem oil may reduce but not eliminate populations. • Use of insecticides containing imidacloprid and thiamethoxam.
Anthracnose (Elsinoe = Sphaceloma ampelina)	• Use resistant varieties. • Prune out and destroy (remove from the vineyard) diseased plant parts during the dormant season. This includes infected shoots, cluster stems, and berries. • Eliminate wild grapes near the vineyard. • Prune the vines so that air and sunlight can enter the canopy.	• Can use dormant liquid lime sulfur in early spring. • Can use synthetic fungicide containing myclobutanil (Rally).
Downy Mildew (Plasmopara viticola)	• The pathogen is dispersed by splashing rain and wind. • Use effective soil drainage and reduction of sources of overwintering inoculum. • If sprinkler irrigation is used, extend the intervals between sprays.	• Apply preventive fungicides (mancozeb, maneb, and copper hydroxide and copper sulfate compounds) before an infection period begins.

		• Apply curative synthetic fungicides containing azoxystrobin (Abound), pyraclostrbin, boscalid (Pristine), kresoxim-methyl (Sovran), mefenoxam (Ridomil Gold), trifloxystrobin (Flint).
Powdery Mildew (*Uncinula necator*)	• Monitor in spring to decide when to treat.	• Can use natural controls containing sulfur (dust, wettable, flowable, or micronized), products by AgrQuest (http://www.agraquest.com) like *Bacillus subtilis* (Serenade), *Bacillus pumilus* (Sonata), insecticidal soap, potassium bicarbonate (Kaligreen, MilStop), Harpin protein (Messenger) and Organic JMS Stylet Oil are acceptable on most organically certified grapes. • Can use synthetic fungicides containing tebuconazole (Elite), triflumizole (Procure), myclobutanil (Rally), fenarimol (Rubigan), azoxystrobin (Abound), trifloxystrobin (Flint), kresoxim-methyl (Sovran), pyraclostrbin, boscalid (Pristine), quinoxyfen (Quintec),

Gray mold or bunch rot (*Botrytis cinerea*)	• Do regular monitoring for gray mold. • Use sanitation: Clean up and destroy crop residues. • Avoid over-head sprinkler irrigation.	• Can use natural fungicides containing neem oil, *Bacillus subitlis*, or potassium bicarbonate. • Can use synthetic fungicides containing chlorothalonil or iprodione.
White mold or rot (Coniella = Coniothyrium diplodiella)	• Training system to keep clusters high above the ground. • Sanitation: Clean up infected berries.	• Use synthetic fungicides like Baitai water soluble granules or copper sulfate.
Weeds of Grape Vines	• Use mulches to suppress weeds or black plastic to kill them. • Use mechanical cultivation to cut and burry weeds. Furrow-irrigated vineyards are amenable to in-row cultivation. • Geese can be released into vineyard to control weeds. • Grow cover crops to choke out unwanted weeds.	• Several organic, contact-type herbicide products may be used if registered for this use. These soap-based (Scythe), clove oil based (Matran 2), or acetic acid based (All-Down) products all damage any green vegetation contacted, including the leaves and young stems (not old stems) of grape vines, so use care with application. Because these herbicides only kill contacted tissue, good coverage is essential. • For established weeds and site preparation, use synthetic

		herbicides containing glyphosate, fluazifop-P-butyl (Fusilade), sethoxydim (Poast), clethodim (Select Max), oxyfluorfen (GoalTender) or 2,4-D. • Pre-Emergence, after planting, use synthetic herbicides containing orzalin (Surflan), napropamide (Devrinonl), oxyfluorfen (GoalTender), flumioxazin (Chateau), isoxaben (Gallery), simazine, pendimethalin or reimsulfuron.
Fruit Trees: Pomes Fruits: Apple; Pear[45]; Loquat; Quince; and Stone Fruits: Apricot; Peach; Plum; Prune; Cherry[46]; Almond		
Codling moth (Cydia = Laspeyresia pomonella)	• Sanitation: Remove infested & dropped apples, oil spray on apples when females fly, • Mass trapping and mating disruption using pheromone traps. • Pruning tree for height and spraying efficacy. • Remove host trees in nearby abandoned orchards (apple, pear, and walnut) to destroy reservoirs of codling moth.	• Use natural sprays of codling moth granulovirus (Cyd-X), the Entrust formulations of spinosad, narrow range oil and kaolin clay (Surround). • Use synthetic insecticides containing chlorantraniliprole (Altacor), spinetoram (Delegate), acetamid (Assail), phsomet

[45] http://www.ipm.ucdavis.edu/PMG/C603/m603yi01.html

[46] see http://www.ipm.ucdavis.edu/PMG/C105/m105yi01.html

	• Remove props, picking bins, and fruit piles from the orchard.	(Imidan), thiacloprid (Calypso), methoxyfenozide (Intrepid).
Fruit trees: Fall webworm (*Hyphantria cunea*)	• Hand removal and destruction of webbing nests in fall.	• Applications of insecticides containing BT.
Gypsy moth (Lymantria dispar)	• Natural enemies include parasitic and predatory insects such as wasps, flies, ground beetles, and ants; many species of spider; several species of birds and small mammals. • Monitor for gypsy moth. • Maintain tree vigor by watering and fertilizing properly. • Use sticky bands or burlap bands around tree trunks to trap and destroy migrating larvae.	• Use natural sprays of insecticides containing BT. • Use synthetic insecticides containing acephate, carbaryl or diflubenzuron.
Soft and armored scales (*Ceroplastes japonicus)*	• Many predators and parasites control scales, including beetles, bugs, green lacewings and predatory mites. • Monitor for presence of scales and in the summer, crawlers. • Provide plants with good growing conditions and especially appropriate irrigation. • Prune branches to open them up to light, sun and predators. • Sanitation: Prune off and destroy heavily infested branches. • Manage ants that tend the scales by placing tanglefoot around the	• Use natural dormant or summer oil and insecticidal soap to kill crawlers (larval stage). • During winter and early fall, apply synthetic insecticides containing imidaclorpid or dinotefuran (Safari) as a soil drench around tree base.

	tree trunk.	
Aphids, several species including Green apple aphid (*Aphis pomi*)	• Natural enemies that control aphids include green and brown lacewings, lady bettles, Syrphid fly larvae.	• Use biological controls and sprays of insecticidal soap, narrow range oils and azadirachtin (Neemix). • Can use synthetic insecticides containing imidacloprid (Provado), acetamiprid (Assail).
San Jose scale (Quadraspidiotus = Diaspidiotus perniciosus)	• A number of parasites and predators like lady beetles feed on scales.	• Use natural applications of lime or dormant narrow range oils.
Cherry fruitfly (*Rhagoletis cerasi*)	• Use pheromone trap or yellow sticky trap to monitor and eliminate.	• Use natural insecticide containing spinosad (Entrust) as a spray or a bait formulation.
Mites: Brown fruit mite (*Bryobia redicorzevi* Red spider mite (*Panonychus ulmi*) Fruit tree spider mite *(Tetranychus*	• Predatory mites control large numbers of these pests. • Do weed control in orchard. • Control dust near orchard by watering or oiling dirt roads. • Prevent water stress by irrigating or watering orchard during dry times. • Broad-spectrum insecticide treatments for other pests frequently cause mite outbreaks, so avoid these when possible.	• Use of organic insecticidal soaps or oils can be used for management. Oils and soaps must contact mites to kill them so excellent coverage, especially on the undersides of leaves, is essential and repeat applications may be required. • Use synthetic miticides containing bifenzate (Acramite), abamectin, narrow range oil, propargite (Omite),

viennensis)		acequinocyl (Kanemite), spirodiclofen (Envidor), etoxazole (Zeal), hexithiazox (Onager), fenpyroximate (Fujimite), pyridaben/sulfur (Desperado) and clofentezine (Apollo).
Pear blister moth (Cemiostoma scitella/Leucoptera malifoliella)	• Sanitation: Use autumn plowing and digging of soil around trunks for destruction of wintering pupae, collection and destruction of fallen leaves in autumn or in early spring, and cleaning of old bark.	• Can use pesticides containing insect growth regulators diflubenzuron (Dimilin), flufenoxuron (Cascade), lufenuron (Match), teflubenzuron (Nomolt) or triflumuron (Alsystin). • Synthetic insecticides containing deltamethrin or permethrin may also be used.
Brown-tailed moth (*Euproctis* chrysorrhoea)	• Many parasitic wasps and flies attack the larvae.	• Can use insecticides containing natural *Bacillus thuringiensis* (BT, subspecies Kurstaki) or insect growth regulator diflubenzuron (Dimilin). • Can use synthetic insecticides containing indoxacarb (Avount).
Oriental fruit moth (*Grapholita molesta*)	• For monitoring, use pheromone traps.	• Use natural insecticides containing spineotram (Delegate) or spinosad (Entrust, Success). • Use synthetic insecticides

		containing phosmet (Imidan).
Leaf miners (unknown species of families Nepticulidae and Stigmellidae)	• Several parasitic wasps attack leafminers. Normally a combination of parasites, predators, and high temperatures cause leafminer populations to drop rapidly. • Monitor leafminers to determine the need to treat. • Do not apply large amounts of nitrogen while miners are present. • Sanitation: remove crop debris and weeds.	• The synthetic insecticide malathion, acephate, carbaryl, permethrin, deltamethrin or imidacloprid may be used.
Pear leaf blister mite (Eriophyes = Phytoptus pyri)	• Resistant varieties with naturally russetted surfaces (Bosc, Hardy, Winter and Nelis) do not show the effects of blister mite attack. • Monitor and treat in fall or dormant season.	• Can use natural sulfur sprays and narrow range oil sprays or combinations of these after harvest. • Can combine oil spray with abamectin.
Cherry weevil (Furcipus rectirostris)	• Apply a 3- to 4-inch band of sticky material on the trunk of young trees to trap crawling adults in May when the first adult feeding is observed. Apply Stickem or Tanglefoot over a special tape or painted areas of the trunk of young trees to prevent bark damage. Reapply the sticky material when it becomes dirty or is no longer sticky.	• Treatments by synthetic insecticides containing carbaryl (Sevin) at main bud blossoming stage and right after full blossoming.
Sawflies: Pear Fruit Sawfly (*Hoplocampa brevis*)	• Several natural parasites and predators generally control lots of sawflies. • Field trials have found that sticky-coated, non-ultraviolet-reflecting white rectangles to be the most effective trap for capturing and	• Sawflies are closely related to bees and wasps, so chemicals that kill sawflies may also affect honeybees needed for pollination—use extra

Cherry slug/Pear fruit sawfly (*Caliroa cerasi*) Plum Sawfly (Hoplocampa flava) Black Plum Sawfly (*Hoplocampa minuta*) Apple Sawfly (Hoplocampa testudinea)	monitoring adult sawfly populations. • Cultivation around tree base to destroy pupae. • On small hectarage orchards, hand-pick larvae.	caution. • Use natural insecticide containing spinosad (Entrust), horticultural oil, permethrins, permethrin, neem oil, insecticidal soap or fatty acids (Peak Plus). • Use synthetic insecticides containing spinetoram, malathion, deltamethrin (decis) or carbaryl (Sevin).
Plum Fruit Moth/Oriental Fruit Moth (Laspeyresia funebrana, Grapholita funebrana)	• Many natural parasites and predators control this pest. • Pheromone traps can help determine when moths are flying. • Sanitation: remove infested & dropped apples.	• Can use oil sprays on apples when females fly. • No insecticide treatment is recommended because this pest is difficult to control.
Bud or blossom weevils (Anthonomus pyri and Anthonomus pomorum)	• There are no current management studies for weevil pests of tree fruits. • A cultural method suggested by the older literature is to plant a cover crop for a few years after clearing the sagebrush, before planting the orchard.	• Pyrethroids used on other crops for related weevil species will likely be effective on adults. Several applications may be necessary.

Apple scab (Venturia inaequalis)	• Prevent or reduce primary infections in spring. • Use a fall foliar fertilizer application of zinc sulfate and urea to hasten leaf fall and speed decomposition of fallen leaves (reduces the level of overwintering apple scab inoculum).	• Can use synthetic fungicides containing fenarimol (Rubigan), myclobutanil (Rally), triflumizole (Procure), trifloxystrobin (Flint), pyrimethanil (Scala), kresoxim-methyl (Sovran), thiophannate methyl (Topsin M), cyprodinil (Vangard), captan, mancozeb (Dithane), ziram.
Pear scab (Venturia inaequalis and Venturia pyrina)	• Monitoring/degree day-humidity modeling/prediction. • Fall foliar fertilizer application. • Sanitation: cultivate leaves into soil.	• Can use early control with natural sulfur or lime-sulfur.
Powdery mildew (Podosphaera leucotricha)	• Sanitation: Prune away and destroy infected shoots during dormancy or early spring.	• Treatments with sulfur alone, natural lime and sulfur, or with fixed copper products. • Can use synthetic fungicides containing fenarimol (Rubigan), myclobutanil (Rally), triflumizole (Procure), trifloxystrobin (Flint), triadimefon (Bayleton), thiophannate methyl (Topsin M).
Monilia fruit rot (*Monilia fructigena*)	• Reduce mechanical wounding of fruit. • Sanitation: Removal and destruction of infected mummy fruits.	• Can use synthetic fungicides containing propiconazole (Orbit), irpodione (Rovral), thiophannate methyl (TopsinM), pyraclostrobin,

		boscalid (Pristine), pyrimethanil (Scala), cyprodinil (Vangard), myclobutanil (Rally), captan, clorothalonil (Echo 720, Bravo Weather Stik), azoxystrobin (Abound).
Peach leaf curl or leaf blister of peach (*Taphrinia deformans*)	• Sanitation: pruning diseased parts.	• Use Bordeaux mixture.
Shot-hole disease (Stigmina = Clasterosporium carpophilum)	• Maintain a vigorous plant by properly watering and fertilizing following soil test results. • Sanitation: Prune out dead plant material and material with lesions and dead buds; Removal and destruction of infected fruits and leaves.	• Use a natural dormant Bordeaux mix or fixed copper. • At red bud, full bloom and petal fall, use a synthetic fungicide containing ziram, pyroclostrobin, boscalid (Pristine), captan, chlorothaonil (Echo 720), trifloxystrobin (Gem), iprodione (Rovral), azoxystrobin (Abound), or cyprodinil (Vangard).
Citrus: Lemons; Mandarins		
White flies (Dialeurodes citri)	• Controlled in nature by hymenopteran parasitoids (*Encarsia* species), lady beetles and minute pirate bugs. • Monitoring crops and establishment of a pesticide program after finding 1 WF per 10 plants, the chemical suggested are:	• Spray solution of local soap (2%) or horticultural oil if infestation is heavy. • Selective chemicals as:

	azadirachtin (neem oil), Insect Growth Regulator pyriproxyfen, imidacloprid • Yellow sticky traps may reduce populations but cannot prevent the spread.	azadirachtin (neem oil), Insect Growth Regulator pyriproxyfen, abamectin, imidacloprid, *Beauveria bassiana* • Soil application of a systemic, nicotinoid insecticide (imidacloprid, acetamiprid) at crop initiation
Mites: Citrus red mite (*Panonychus citri*); Citrus rust mite or Silver mite (*Phyllocoptruta oleivorus*)	• Predatory mites control large numbers of these pests. • Do weed control in orchard. • Control dust near orchard by watering or oiling dirt roads. • Prevent water stress by irrigating or watering orchard during dry times. • Broad-spectrum insecticide treatments for other pests frequently cause mite outbreaks, so avoid these when possible.	• Use of organic insecticidal soaps or oils can be used for management. Oils and soaps must contact mites to kill them so excellent coverage, especially on the undersides of leaves, is essential and repeat applications may be required. • Use synthetic miticides containing bifenzate (Acramite), abamectin, narrow range oil, propargite (Omite), acequinocyl (Kanemite), spirodiclofen (Envidor), etoxazole (Zeal), hexithiazox (Onager), fenpyroximate (Fujimite), pyridaben/sulfur (Desperado) and clofentezine (Apollo).
Citrus leaf miner (Phillocnistis citrella)	• In older orchards, controlled by several species of wasp parasites. • Avoid pruning live branches more than one time a year, to reduce new leaf flushes.	• Young tree nurseries and young orchards (less than 4 years old), use synthetic insecticides containing imidacloprid (Admire, Nuprid) applied through irrigation.

	• Do not apply large amounts of nitrogen while miners are present. • Remove ‗water sprouts' (vigorous shoots that grow above graft unions) and ‗suckers' (grow below graft unions). • Sanitation: remove crop debris and weeds. • Do crop monitoring for detection and control decisions. • Use pheromone traps for monitoring and mass trapping.	• Can use natural narrow range oils and natural insecticide neem oil/azadirachtin (Neemix) to kill eggs laid on leaves. • Can spray trees with synthetic insecticides containing imidacloprid (Admire Pro, Nuprid), methoxyfenozide (Intrepid), narrow range oil, acetamiprid (Assail).
Mealybugs: Obscure mealybug (*Pseudococcus obscurus*); Citrus mealy bug (*Pseudococcus gahani*)	• Natural parasitic wasps and predators such as lady beetle adults and larvae, lacewings adults and larvae, minute pirate bugs and spiders can control mealybugs. • Do regular monitoring, note taking and mapping of mealbug infestations. • Control honeydew-seeking ants using tillage and common vetch cover crops. • Peel back the thin bark on spurs in the current season's prunings and look for the presence of mealybug crawlers (larvae); if 20% of samples show crawlers apply a delayed dormant insecticide.	• In the spring, can apply a delayed dormant insecticide containing imidacloprid (Admire Pro) directly or via drip irrigation. • In the summer, treatments can include insecticides containing dimethoate or buprofezin (Applaud).
Scales: Chinese wax scale (*Ceroplastes sinensis*); Citrus scale (*Lepidosaphes beckii*)	• Many predators and parasites control scales, including beetles, bugs, green lacewings and predatory mites. • Monitor for presence of scales and in the summer, crawlers. • Provide plants with good growing conditions and especially	• Use natural dormant or summer oil and insecticidal soap to kill crawlers (larval stage). • During winter and early fall, apply synthetic insecticides containing imidaclorpid or dinotefuran

	appropriate irrigation. • Prune branches to open them up to light, sun and predators. • Sanitation: Prune off and destroy heavily infested branches. • Manage ants that tend the scales by placing tanglefoot around the tree trunk.	(Safari) as a soil drench around tree base.
Oil and Seed Crops: Sunflower; Safflower; Sesame		
Sunflower mildew (Plasmopara halstedii)	• Use resistant varieties. • Provide good air circulation. • Do crop rotation. • Control weed hosts near field. • Avoid wetting foliage, use drip irrigation if possible.	• Use a seed treatment with azoxystrobin (Protégé). • Foliar fungicides are not economical and not generally used.
Weeds of Sunflower: Sunflower broomrape (*Orobanche cumana*) and others	• Control measures include the use of resistant cultivars with obligatory crop rotation. • Perform thorough land preparation (soil tillage, fertilizer, and water management). • Narrow row spacing makes the crop more competitive than the weeds, use intercropping. • Place the fertilizer in such a way that the crop has access to it but the weeds do not. This allows the crop to be more competitive with weeds.	• Can use synthetic herbicide containing imazapic (Cadre). • Can use herbicides containing fluchloralin at 2.0 l/ha before sowing and incorporate or apply as pre-emergence spray on 5 day after sowing followed by irrigation or apply pendimethalin as pre-emergence spray 3 days after sowing.

	• Maintain cleanliness on the irrigation canals. • Keep the surroundings of your farm free of weeds, unless they are maintained and intended as habitats for natural enemies. • Regularly clean farm tools. • Use green manure which chokes out weeds. • Use intercropping. • Hand weeding and composting (do not compost weeds that have flowered and set • Hoeing, mowing, and cutting.	
Forage legumes: Alfalfa/Lucerne; Clovers; Vetches; Trefoils		
Curculios and Weevils: Alfalfa Snout Beetle (*Otiorhynchus ligustici*) Alfalfa seed weevil (*Tychius aureoles*)	• A Fungal disease infects weevils and several tiny wasp species parasitize weevil larvae. • After weevil larvae are present, monitor every 2-4 days. • Use early cutting of the plant at the bud stage if weevil damage seems imminent. • Closely monitor alfalfa re-growth for the second cutting to detect feeding damage.	• Use synthetic insecticides containing indoxacarb (Steward), phosmet (Imidan), lambda-cyhalothrin (Warrior), or malathion 8E.
Nuts: Walnut; Hazelnut		
Gypsy moth (Lymantria = Ocneria dispar)	• Water and fertilize the trees to maintain vigor.	• Use natural sprays containing BT

	• Remove objects around the outside of the home that provide shelter for gypsy moth larvae and pupae, such as flaps of bark, dead tree branches, dead trees, boxes, cans, or old tires. • Use barrier bands, consisting of commercially available double-sided sticky tapes, or sticky material such as Tanglefoot, petroleum jelly, or grease, to prevent larvae from crawling up the trunks of susceptible trees. These products should be applied to the surface of an impermeable material, such as duct tape or tar paper, and not applied directly to the bark.	(*Bacillus thuringiensis,* Dipel). • Use synthetic insecticides containing acephate.
Fall webworm (Hyphantria cunea)	• Hand removal and destruction of webbing nests in fall. • Monitor. • On small trees, cut out and destroy infested twigs.	• Applications of insecticides containing BT.
Nut weevil (Curculio = Balanicus nucum)	• Cultivate under plants to destroy overwintering weevils.	• Chemical controls are not common.
Hazelnut long-horn twig borer (*Oberea linearis*)	• Sanitation: cut or prune and burn dry branches and branch tips in autumn.	• Very difficult to control chemically.
Caterpillars: Leaf-tiers (Machimia tentoriferella); Leaf-rollers (Calpodes ethlius and Choristoneura rosaceana);	• Naturally occurring parasitoids keep populations under control. Use pesticides judiciously to protect beneficial insects in the orchard. • Can use pheromone traps to monitor.	• Use natural insecticides containing neem oil or BT. • Use synthetic insecticides containing chlorpyrifos (Lorsban), diflubenzuron (Dimilan), esfenvalerate (Asana), methoxyfenozide (Intrepid),

		permethrin (Ambush, Pounce) or spinosad (Entrust, Success).
Fall webworm (Hyphantria cunea)	• Hand removal and destruction of webbing nests in fall.	• Applications of insecticides containing BT.
Filbert big bud mites (Phytocoptella = Phytoptus avellanae)	• Maintaing proper plant watering and nutrition for a vigorous plant. • Collect and burn infested buds in winter.	• Currently there are no chemical controls registered to manage big bud mite infestations on hazelnuts.
Aphids: Filbert aphid (*Corylobium avellanae*)	• A number of coccinellid and syrphid predators, parasites and fungal diseases usually keep aphid populations below damaging levels. • Maintain adequate soil moisture and fertilization (Plants stressed for water or nutrients are more susceptible to and suffer greater damage from aphids). • Use regular monitoring, yellow sticky traps. • Sanitation: Field disking and destruction of crop residues are important for control of aphid pests of leafy vegetables to reduce their migration into nearby crops. • Avoid early planting. • Avoid excessively high soil nitrogen levels.	• Treatments with natural chemicals, if needed, can include narrow range oils, pyrethrin and rotenone. • No synthetic pesticides are recommended for spraying.
Blights: Fungal blight: (*Anisogramma anomola*);	• Scout trees in the winter for cankers, and in the summer between July and August for flagging branches.	• Synthetic fungicides containing copper hydroxide (Kocide, Bordeaux) applied at bud-break

Bacterial blight: (Xanthomonas campestris pv. corylina)	• Infected branches should be pruned .6 to .9 meters below the edge of a canker, as the fungus grows ahead of the area in which it produces reproductive structures. • Disinfect pruning shears with bleach between trees and cuts. • Sanitation: The cut branches should be burned or chipped, because the fungus can continue to sporulate in the cut branch as long as it has moisture.	in the spring and prior to leaf fall at the end of the season.
Blueberries		
Leafrollers (*Choristoneura rosaceana* and others)	• Use pheromone traps to monitor for adult moths. • Consider control if more than 5% of the terminal growth and floral parts have larvae or larval damage. • Pruning effectively will help reduce leafroller numbers by removing over wintering sites • Sanitation: Do weeding in and near fields to remove alternate hosts for this pest.	• Spraying is generally not recommended or economically justified and may harm natural predatros and parasites of leaf roller larvae. • Use natural insecticides containing *Bacillus thuringiensis* (BT, Dipel, Thuricide and Bio-Guard).
Chafers: adult beetles feed on foliage and white C-shaped grubs feed on roots (*Macrodactylus subspinosus,* Japanese beetle, *Popillia japonica* and oriental beetle, *Anomala*	• Treatment of nearby lawn areas should reduce the numbers of beetles. • Reduce or fully compost all organic material used around blueberry plants.	• Insect pathogenic nematodes, especially *Heterorhabditis bacteriophora* (Terranem) and *Steinernema carpocapsae*, are available commercially for control of these root-feeding grubs. • For grubs, apply synthetic

orientali)		insecticides containing imidacloprid (Admire) through drip irrigation. For adult beetles, use synthetic pesticides containing acephate, azadirachtin, or malathion.
Weevils: Plum curculio (*Conotrachelus nenuphar*); Cranberry weevil/ blueberry blossom weevil (*Anthonomus musculus*)	• Sanitation: Clean cultivation and destruction of trash on surrounding land helps reduce the number overwintering. • Remove any wild blueberries that are nearby.	• Spraying or dusting with synthetic insecticides containing methoxychlor or malathion just as the buds swell to kill overwintering beetles.
Blueberry maggot (*Rhagoletis mendax*)	• In small plantings it may be possible to control this pest with yellow sticky traps.	• Two or three sprays of malathion, applied at ten day intervals, starting when the berries begin to turn blue.
Mummy berry (Monilinia vaccinii-corymbosi)	• The blueberry varieties Jersey, Dixi, Darrow, Collins, and Bluetta are considered resistant. • Sanitation and culture are very important for disease control and help to avoid the buildup of the fungus. • If possible, rake and remove mummified berries from the vicinity of the planting. • Alternative measures include covering fallen mummies with approximately 2 inches of soil or mulch or disking the soil beneath the planting to bury the mummies. These steps should be	• When the disease is severe and/or the weather is wet between budbreak and bloom, fungicide sprays are often necessary. Use fungicides containing triforine or chlorothalonil.

	completed before budbreak.	
Botrytis blight and berry rot (*Botrytis cinerea*)	• Pruning and removing any dead twigs or branches during the dormant season. • Cultural practices such as adjusting soil pH and avoiding over-fertilization (rapidly growing, over-fertilized shoots are prone to infection) help to minimize the effects of this disease.	• When the planting has a history of disease or when wet weather persists during bloom, fungicide sprays with synthetic fungicides containing fenhexamid.
Beets (fodder and sugar)		
Turnip moth (Agrotis = Scotia segetum)	• Natural enemies include larvae of parasitic Braconid wasps and Tachinid flies. Predators include ground beetles, lacewings, praying mantis and weaver ants. • Use crop rotation--plant alfalfa or beans after tomato. • Removal of weeds in and around fields will reduce egg-laying sites and will help in the prevention of cutworm infestation. Do this at least 2-3 weeks before planting to reduce the incidence of cutworm larvae transferring to newly planted crops. • Interplant main crops with onion, garlic, peppermint, coriander, or garlic every 10-20 rows to repel cutworms. • Sunflowers and cosmos can also be planted as a trap crop in or around fields. • Plow and harrow fields properly before planting. This will destroy eggs and expose larvae to chicken, ants, birds, and other predators.	• Botanical and homemade extracts include basil, neem, Finger euphorbia and Spanish needle. • Use pheromone traps. • Use sprays of BT, if and when they become registered and available. • Find ‗hot-spots' (places of high infestation) and treat only those hot-spots. If registered, can treat with synthetic insecticides containing carbaryl (Sevin bait, chlorpyrifos (Lorsban) and permethrin (Ambush) (*do not allow synthetic pyrethroids into enter open water, get RUP*

		training).
Sugar beet flea beetle (*Chaetocnema breviuscula*)	• Sanitation: Keep fields and field margins free from weeds, especially mustards and field bindweed. • Heavily damaged fields may require re-planting.	• Use synthetic insecticide containing carbaryl or imidacloprid (Confidor).
Sugarbeet weevil (Bothynoderes = Asproparthenis punctiventris)	• Weevil parasitoids exist and exert significant control. • Plant a parsley trap crop to attract and destroy with cultivation. • Clean weeds from field and field margins. • Use crop rotation to non-Umbellifers. • Sanitation: Disc or plow under parsley after first cutting.	• Seeds can be treated with synthetic insecticides spinosad (Entrust, natural), thiamethoxam (Cruiser), clothianidan and imidacloprid (Gaucho). • Can use natural insecticide containing diatomaceous earth (Perma Guard). • Can use synthetic insecticides containing cypermethrin (Ripcord), spriotetramat (Movento), lambda-cyhalothrin (Matador) or phosmet (Imidan).
Sugar beet root aphid (*Pemphigus fuscicornis*)	• A fungus and a fly larva generally provide good control of sugarbeet aphid. • Use proper irrigation and avoid water stress. • Sanitation: Clean up and destroy all weeds (especially redroot pigweed and lambsquarters) and in and around field and beet roots left in field after harvest. • Crop rotation: Rotate out of sugar and table beets, spinach and chard for	• No pesticides are recommended for this aphid species.

	3 years. • Clean all equipment and implements before moving from an infested to a noninfested field.	
Black bean aphid (*Aphis fabae*)	• Use regular monitoring, yellow sticky traps • Use resistant varieties • Many types of natural enemies and pathogens may control these aphids under low insecticide input situations. However, these aphids reproduce quickly and move into protected areas of the plants, thereby greatly reducing the potential impact of their predators and parasitoids in older stage plants. • Field disking and destruction of crop residues are important for control of aphid pests of leafy vegetables to reduce their migration into nearby crops.	• If they become registered, insecticides containing imidacloprid, acetamiprid or pymetrozine can be used.
Beet leaf miner (*Pegomyia hyosciami*)	• Natural parasites and predators control most leaf miner infestations. • Sanitation: Control weeds in and around field. • Do crop monitoring. • Use crop rotation.	• Through treatment is not usually required, sprays of azadirachtin (Neemix) and spinosad are acceptable for use on organically grown produce. • If needed, sprays of abamectin and pyrethrin may be used.
Sugar beet cyst nematode (*Heterodera schachtii*)	• Use resistant cultivars. • Striving for optimum growing conditions by addressing plant stress factors such as soil moisture, nutrition, insect pests, and other diseases may minimize nematode damage.	• Use of organic alternatives like Promax (Bio Huma Netics www.humagrow.com) and *Myrothecium verrucaria* that are currently available.

	• Monitor and positively identify the nematode species present. • Clean soil from equipment with water before moving from infested to noninfested fields. • Clean fallow and green manure will help to reduce populations of root knot nematodes. Growing cover crops of oats (cv. *Saia)*, marigolds, rattlebox *(Crotalaria spectabilis)*, hairy indigo *(Indigo hirsuta)* is known to reduce populations of plant parasitic nematodes. • Deep plowing, fallowing, and solarization can further reduce nematode population levels.	• Although this is dangerous, soil may be fumigated to reduce nematode populations.
Zonate leaf spot (*Phoma betae*)	• Use resistant varieties and clean, certified or hot-water treated seed. • Ensure good soil drainage. • Sanitation: Remove and destroy weeds and crop residues at end of season. • Use of Trichoderma as a soil treatment reduces Phoma.	• Spraying periodically with copper oxychloride or copper sulphate is recommended.
Weeds:	• Use mulch around the berry plants to prevent weed emergence.	• For established weeds and site preparation, use synthetic herbicides containing glyphosate, fluazifop-P-butyl (Fusilade), sethoxydim (Poast), clethodim (Select Max), oxyfluorfen (GoalTender) or 2,4-D.

Oil Crop: Rape Seed/Canola		
Rape Bug (Eurydema oleracea)	• Maintenance of crop rotation with spatial and temporal isolation of cruciferous crop plantations. • Destruction of cruciferous weeds before their flowering on fields, near fields, and on waste grounds.	• Spring insecticide treatments on winter-cress, wild radish, and other cruciferous weeds against the overwintered bugs. • Treatments of cruciferous crop plantations by available insecticides against the pest larvae. • Can use natural insecticidal soaps or refined rape oil. • Can use synthetic insecticides containing malathion.
Rape Pollen Beetle (*Meligethes aeneus*)	• Eradication of weeds in and around field. • Saniation: Winter plowing to destroy plant residues. • A trap crop of turnip rape (*Brassica rapa* var. *silvestris*) sown as a perimeter strip of 6 to 12 m within the rape and then destroyed by plowing under traps and destroys bettles.	• Beetles are resistant to most pyrethroid insecticides. • Use synthetic insecticides containing chlorpyrifos, thiaclorpid (Biscaya) or taufluvaniate (Mavrik).
General Pests of Several Crops		
Pea leaf weevils (*Sitona lineatus*)	• Use crop rotation with cereals following lentils. • Do scouting and monitoring to determine pest presence, quantity	• Use synthetic insecticides containing phosmet (Imidan).

	and damage. • Sanitation: Cut and destroy crop residues by burning or burying.	
Rice leaf miner (*Hydrellia griseola*)	• Several parasitic wasps attack the rice leafminer. Normally a combination of parasites, predators, and high temperatures cause leafminer populations to drop rapidly. • Level the field as accurately as possible. • Manage water levels in the field to encourage the rice to emerge quickly and grow erect. • Monitor for rice leafminers to determine the need to treat.	• The synthetic insecticide malathion may be used.
Ground beetle (Zabrus tenebrioides) Small grains, corn/maize.	• Use treated seed. • Use crop rotation (no more than two years of consecutive grain crops) with sugar beet, fallow or legumes. • Early harvest of grain crops, exclusion of grain losses, immediate. • Sanitation: Careful removal of straw from fields, stubble shelling with subsequent plowing to a depth of 20-22 cm.	• Can treat seed with imidacloprid (Gaucho) or other systemic insecticide.
Owlet moth/grey grain moth (*Apamea anceps*)	• Use resistant varieties of wheat. • Control measures include timely and minimal loss harvesting, shelling, and early autumn plowing to turn under crop stubble and soil. • Optimum timing of spring wheat sowing.	• Inter-row treatments of tilled cultures and treating fallows in the first third of June. • Use natural insecticides containing BT.

	• Pheromone traps are used for pest monitoring. • Use late sowing/planting.	
European Wheat Stem Sawfly (*Cephus pygmaeus*)	• Several natural parasites and predators control sawflies. • Use sawfly resistant cultivars. • Use crop rotation. • Delay planting of spring wheat. • Sanitation: Use shallow fall tillage to destroy and burry crop stubble.	• No chemicals are recommended.
Cereal Stem Flea Beetles (*Chaetocnema aridula*)	• Natural parasites include Braconid wasps. Natural predators include crickets and lacewings. • Sanitation: Keep fields and field margins free from weeds, especially mustards and field bindweed. • Heavily damaged fields may require re-planting. • Remove and destroy or compost all plant residues. • Plant the barrier crop along the edges of the field ahead of the main crop. Radish and Chinese mustard are good trap crops. • Keep fields weed-free, particularly of field bindweed and mustard, which are preferred hosts of flea beetles. Heavily damaged fields should be replanted.	• Use synthetic insecticide containing carbaryl or imidacloprid (Confidor). • Botanical and homemade water extracts of neem may provide effective control. • White or yellow sticky traps placed in every 5-10 m on the rows. • Thick mulch in isolated planting interferes the larva's feeding activities • If registered, carbaryl (Sevin) pesticide may be applied if

		feeding damage is heavy.
Chloropid Gout Fly (*Chlorops pumilionis*)	• Use late fall sowing or earlier spring sowing to avoid gout fly. • Sanitation: Destroy crop stubble and plow under at end of season. • Control weeds in and around field.	• Do not use pyrethroids. • Can use seed treated with imidacloprid and perhaps chlorpyrifos.
Grain gall midge (*Contarinia tritici*)	• Use resistant cultivars or varieties. • Use deep autumn plowing. • Regular crop rotation can reduce the midge population.	• Can use synthetic insecticides containing deltamethrin.
Frit fly (Oscinella frit)	• Use resistant cultivars. • Use white sticky traps to monitor for frit fly.	• Can use synthetic insecticides containing permethrin (Prelude, Astro, Dragnet, Perm-X) or diazinon.
English Grain Aphid (Macrosiphum = Sitobion avenae) Spring grain aphid, greenbug (*Schizaphis graminum*)	• Many parasites and predators attack aphids. Among the more common predators are lady beetles and their larvae, lacewing larvae, and syrphid fly larvae. Populations of green peach aphids are reduced in winter by a parasitic fungus, *Entomophthora aphidis*. • Controlling weeds in and around the field. • Reflective aluminum mulches will deter aphids from landing on plants.	• Agricultural oil and/or insecticidal soaps. • Can use malathion, imidacloprid, permethrin--do not allow to enter open water and get RUP training, thiamethoxam.
Common Mole Cricket	• Many parasites and predators attack and control mole crickets	• Insecticides containing natural nematodes *Steinernema*

(Gryllotalpa gryllotalpa)	• Biological control using parasitic wasps, flies and nematodes has worked well in Florida. • Tillage exposes and destroys mole crickets. • In some places farmers put rotting vegetation in a pit in the ground, which attracts the mole crickets, which can then be dug up and destroyed.	*carpocapsae* (Nemastar by E-Nema, http://www.cost850.ch/publications/20040502_merelbeke/9Merelbeke-E-nema.pdf).
Oriental Armyworm (*Mythimna separate*)	• Caterpillar natural enemies (keep populations down) include predators like ground beetles, spiders, damsel bugs, minute pirate bugs, assassin bugs, bigeyed bugs, and lacewing larvae. Parasitic wasps of *Trichogramma* species, *Copidosoma* species, *Apanteles* species, *Diadegma*, and *Hyposoter* species sting and parasitize eggs and larvae (some of these organisms are available commercially). • Use of organic herbal repellents like those extracted from garlic (Cropguard, Garlic Barrier), red chili peppers or neem oil. • Use of nocturnal overhead sprinkler irrigation to dislodge and repel pests. • Use of pheromone misters and emitters to disrupt mating. • Use of floating row screen or mesh covers to exclude egg-laying moths.	• Use of organic biopesticides or microbial controls consisting of *Bacillus thuringiensis*/BT (Agree, Deliver, Javelin, Dipel, Xantari, Prolong, Britz BT Dust), the insect-eating fungus *Beauveria bassiana (*Mycotrol, Naturalis, Botanigard), bacterial extracts like spinosad (Entrust) and living caterpillar viruses (Spod-X, Gemstarand). • Use of organic botanical insecticides like neem (Neemix, Argoneem, Azadirect), pyrethrin (Pyganic) and pyrethrin combined with diatomaceous earth (Diatect V). • Use of synthetic pesticides containing indoxacarb (Avaunt), spinetoram (Radiant), chlorantraniliprole (Coragen), flubendiamide (Synapse),

		methoxyfenozide (Intrepid), or crylolite.
Beet webworm (Pyrausta sticticalis/Loxostege sticticali) Wheat, corn/maize, beets.	• Many natural biological parasites and predators attack webworms. • Beets can tolerate considerable defoliation without yield loss. • Monitor webworm populations closely. • Keep fields weed-free, especially from pigweed and lambsquarters	• Treatment with natural or biological insecticides containing BT (*Bacillus thuringiensis* Kurtaski) or spinosad (Entrust). • Can use synthetic insecticides containing methoxyfenozide (Intrepid).
Maize leaf weevil, Southern Gray Weevil (*Tanymecus dilaticollis*) Maize/corn, sunflower, beet.	• Limit maize production to 2 or less years in a crop rotation. • Use crop rotation and alternate cereals with sunflower and maize.	• Can treat seed with synthetic insecticides containing thiamethoxam (Cruiser).
Red turnip beetle (Entomoscelis adonidis) Turnip, radish, cabbage crucifers mustard, rapeseed/canola and horseradish.	• Use crop rotation away from crucifers. • Control mustard family weeds in field. • Sanitation: In late fall or early spring, rake or plow under crop residue to kill beetle eggs.	• Use common synthetic insecticide products containing carbaryl (Sevin) or permethrin.

References: http://ipmguidelines.org/TreeFruits/content/CH11/default.asp; http://ipm.ifas.ufl.edu/agriculture/index.shtml; http://www.ipm.msu.edu/; http://ipm.wsu.edu/; http://www.gaipm.org/; http://attra.ncat.org/index.php; http://www.pestmanagement.info/npmt/pesticideinfo.cfm?crop=cumin&search=Crop;

http://www.inra.fr/hyp3/diseases.html; http://humagro.com/index.html; http://www.ipm.ucdavis.edu/; http://www.agroatlas.ru/en/about/; http://www.omafra.gov.on.ca/english/crops/facts/93-077.htm; http://www.plantprotection.hu/modulok/angol/apple/miner_app.htm.

APPENDIX 2. GUIDELINES FOR PEST MANAGEMENT PLANS (PMPS) FOR GEORGIA CROPS AND BENEFICIARIES[47]

WHAT IS A PMP?

Pest Management Plans or Guides provide field crop, livestock production or project decision-makers – farmers and farm managers – with best production practices recommendations, usually adapted by region, crop phenology and seasons. The aims of PMPs are to reduce the risks to production from pests by using a combination of best practices, including IPM, Integrated Vector Management (IVM) and Integrated Weed Management (IWM), that maximize crop or livestock health, and thus resilience to or tolerance of pests, and without an over-reliance on pesticides needed when best practices are not followed. Thus, prevention of pests plays a strongly pivotal role in the PMP, followed closely by management of pests when prevention alone is not adequate for the level of control needed or desired.

Who are the PMP's intended audiences and users?

- Farm land preparation and crop production/livestock and project decision-makers
- Farmers
- Farm managers

WHY IS A PMP BEING DONE?

PMP Objectives:

- Prevent or reduce pest damage risk to agricultural production or health
- Protect the health of farmers, farm family members, laborers and community members from pesticide risks
- Maintain economically sound practices
- Reduce environmental pollution and degradation risks
- Enhance the overall quality and quantity of biodiversity on the sustainable farm work environment

[47] PMPs or Year-Round (seasonal) IPM Programs are state of the art in many developed countries, and they help institutionalize IPM in planning and practice. PMPs provide agriculture managers and farmers with a tool to predict and prevent many crop pests of each crop throughout a season. See examples of PMPs at http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html, upper left corner under ~~"Y~~Year-Round IPM Programs". Projects may use or modify PMPs as they see fit.

- Respond to foreign market demand for the use of agriculture sector best management practice standards, also called Good Agriculture Practices (GAPs) which include IPM measures, to achieve farm and produce certification
- Comply with local, regional, donor and international laws, conventions, and regulations

ORGANIZATION OF THE PMP

The following pieces of crop- or livestock-specific background information are used to build a PMP base

- General information on the crop/livestock/sector
- Crop/livestock common/species names:
- Crop/livestock developmental stages:
- Production regions and how they differ by soil type, pH, fertility, etc
- Overall concerns and priorities for crop/livestock production
- Crop/livestock cultural best practices
- Crop/livestock Good Agriculture Practices (GAPs) including some IPM (see PERSUAP section on GAPS and IPM) recommendations

Individual Pest Prevention and Management Sections for each of the following pest types:

- Invertebrate (Insects, Mites, Slugs/Snails, Nematodes)
- Diseases (Fungi, Bacteria, Viruses, Other)
- Weeds (annual grasses, broadleaves, perennial grasses, broadleaves, sedges, others)
- Vertebrates (birds, rodents, other)

For each pest type, first, identify overall priorities for pest prevention and management in the target crop or livestock.

Next, identify individual pest species noting the type of damage incurred; part of plant damaged: roots/rhizomes/tubers, stems/stalks, leaves, florescence, or seeds (field or stored); or if livestock, part of animal affected.

To best understand how to manage a pest, one needs to understand how, where, when and on what parts of the plant or animal, the pest feeds. For field pests and stored grain/food pests, many PMPs are designed and outlined as follows containing the following information, *for each major species of pest (insects, mites, slugs/snails, nematodes)*:

- Photographs of each pest, life stages
- Photographs of plant or livestock damage

- Description of the pest, life cycle and survival strategies[48]:
- Description of damage symptoms
- Best Prevention Practices
- Use any and all of the above GAPs including IPM
- Country or region-specific information
- Best Management Practices
- Focus on prevention (above)
- Country or region-specific information

INFORMATION ON PMP-RECOMMENDED PESTICIDES:

Information needed for each pesticide referenced in the above PMP, by pest (so the farmer/farm manager has the information at their fingertips and do not need to refer to other documents and tables to find it):

- Pesticide essential information needed:
- Active Ingredient (AI) name
- Product Trade names (with EPA and WHO Acute Toxicity Classifications in parenthesis)
- Amounts to use per hectare
- PHI
- Special comments on best application methods and frequency
- Any resistance management strategies needed
- Pesticide application record sheet
- Guidelines for reducing spray drift
- Re-entry interval (REI): field safe re-entry period after spraying
- Maximum residue levels (MRL) permitted by markets

[48] Survival strategies: All pests have survival strategies that allow them to live and breed in each crop‘s farming systems. Knowing the survival strategies, including overwintering habit and alternate host plants, that are employed by the pest can help with decision making at the farming systems-level (e.g. choice of rotation crops) and also can help to anticipate pest outbreaks.

- Pesticide precautions with use including
- Reading the label
- Legal responsibilities and permitted registration uses
- Permit requirements for possession and use
- Recommended and obligated use of PPE and best practices
- First aid and antidotes
- Transportation best practices
- Storage best practices
- Safe use best practices
- Container disposal best practices
- Leftover pesticide disposal best practices
- Protection of non-pest animals, plants, endangered species and water body quality
- Protect natural enemies & honeybees: http://www.ipm.ucdavis.edu/PMG/r584310111.html
- Posting signage in treated fields
- Some chemicals not permitted on processed crops
- Potential for phytotoxicity (crop injury) on some crops
- Documentation and record-keeping on farms

INFORMATION NEEDED ON NATURAL ENEMIES OF PESTS:

Common Names of Predators and Parasitoids effective against above pests: For a list of common natural enemies of crop pests, see http://www.ipm.ucdavis.edu/PMG/NE/index.html. Genera will likely be the same around the world, with different species in different continents, filling similar niches.

Additional Information Needed:

Will there be an IPM Coordinator, an IPM Advisory Committee, Education and Licensing for Applicators, Currency and Approval of the PMP?

APPENDIX 3. ELEMENTS OF IPM PROGRAM[49]

Although farmers are likely using numerous IPM tactics, without really calling them that, IPM philosophy or planning is not generally an active part of crop production in Georgia plots; thus, a basic understanding of the steps or elements needed in an IPM program are addressed below.

STEP 1: LEARN AND VALUE FARMERS' INDIGENOUS IPM TACTICS.

Most farmers are already using their own forms of GAPs and IPM, many of which are novel, self-created, adapted for local conditions, and many of which work well. These local tools and tactics need to be well understood and taken into account when making PMPs. Accurate assessments of these farmer's GAP and IPM technologies, as well as an understanding of actual losses due to different constraints in farmers' fields are required before designing a crop production and pest management program. S&C farmers will have records of historical pesticide use and trends, as well as information on current use of artisanal or local IPM tactics.

STEP 2: IDENTIFY KEY PESTS FOR EACH TARGET CROP.

Although perhaps up to ten species of pests may impact a crop and yields at different plant growth stages, generally only two or three are considered serious enough to spend money controlling. Farmers should be encouraged to monitor their population size, their life cycle, the kind of damage they cause and actual losses. Note that crop loss figures based on farmers' perceptions of damage and loss are often overestimated.

STEP 3: EVALUATE ALL MANAGEMENT OPTIONS.

Use of best management practices, preventive measures, and ~~-o~~rganic" options to control pest impacts may eliminate the need for synthetic pesticides.

STEP 4: CHOOSE IPM METHODS, IDENTIFY NEEDS AND ESTABLISH PRIORITIES.

Continue dialog with project field staff, ministry extension staff and farmers when choosing methods to be used. Consider the feasibility of attractive methods, including the availability of resources needed, farmers' perceptions of pest problems, their abilities to identify pests, their predators, diseases and parasites, and to act upon their observations.

STEP 5: DO EFFECTIVE ACTIVITIES AND TRAINING TO PROMOTE IPM.

Next, identify strategies and mechanisms for fostering the transfer of the needed IPM technology under various project and institutional arrangements, mechanisms, and funding levels. Define what is available for immediate transfer and what may require more adaptation and validation research. Set up an initial planning workshop (with a COP-supported and signed Action Plan) to help define and orient implementation activities, and begin to assign individual responsibilities.

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[49] http://www.fao.org/docrep/006/ad487e/ad487e00.htm; http://www.fao.org/docrep/006/ad487e/ad487e02.htm; http://en.wikipedia.org/wiki/Farmer_Field_School; http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html

Learning-by-doing/discovery training programs

The adoption of new techniques by small-, medium- and large-holder farmers occurs most readily when program participants acquire knowledge and skills through personal experience, observation, analysis, experimentation, decision-making and practice. At first, frequent (usually weekly) sessions are conducted for 10–20 farmers during the cropping season in farmers' fields by trained instructors or extension agents.

Smallholder support and discussion groups

Weekly meetings of smallholders, held during the cropping season, to discuss pest and related problems can be useful for sharing the success of various control methods. However, maintaining attendance is difficult except when there is a clear financial incentive (e.g., credit).

Educational material

In many countries, basic written and photographic guides to pest identification and crop-specific management techniques are unavailable or out of date. Videos featuring graphic pictures of the effects of acute and chronic pesticide exposure, and interviews with poisoning victims can be particularly effective.

Youth education

Promoting and improving the quality of programs on IPM and the risks of synthetic pesticides has been effective at technical schools for rural youth. In addition to becoming future farmers, these students can bring informed views back to their communities.

Food market incentives (especially important in the last decade)

Promoting Organic, GlobalGAP, BRC, Fair Trade or other certification for access to the lucrative and rapidly growing S&C systems-driven international and regional food markets can be, and is, a strong incentive to adopt IPM.

STEP 6: PARTNER SUCCESSFULLY WITH OTHER IPM IMPLEMENTERS.

The following design steps are considered essential.

Articulate the partnership's vision of IPM

Organizations may forge partnerships based on a common commitment to ~~"~~IPM" – only to discover too late that that their visions of IPM differ considerably. It is therefore highly important that partners articulate a common, detailed vision of IPM, centered on the crops and conditions the project will encounter.

Confirm partner institutions' commitment

The extent of commitment to IPM integration into project, design, and thus implementation depends strongly upon the following key variables:

IPM program integration into larger project. The IPM program is likely to be part of a larger ~~"~~sustainable agriculture" project. The IPM program must fit into a partner's overall goals. The extent of this integration should be clearly expressed in the proposed annual work plan.

Cost sharing. The extent of funds (or in-kind resources) is a good measure of a genuine partner commitment.

Participation of key IPM personnel. Organizations should have staff with expertise in IPM. In strong partnerships, these staff members are actively involved in the partnership.

STEP 7: MONITOR THE FIELDS REGULARLY.

At minimum twice a week, farmers should monitor their fields for pests, as some pest populations increase rapidly and unexpectedly; this increase is usually related closely to the stage of crop growth and weather conditions, but it is difficult to predict the severity of pest problems in advance.

STEP 8: SELECT AN APPROPRIATE BLEND OF IPM TOOLS.

A good IPM program draws from and integrates a variety of pest management techniques, like those presented in the above list. Flexibility to fit local needs is a key variable. Pesticides should be used only if no practical, effective, and economic non-chemical control methods are available. Once the pesticide has been carefully chosen for the pest, crop, and environment, it should be applied only to keep the pest population low, not necessarily eliminate it.

STEP 9: DEVELOP EDUCATION, TRAINING, AND DEMONSTRATION PROGRAMS FOR EXTENSION WORKERS.

Implementation of IPM depends heavily on education, training, and demonstration to help farmers and extension workers develop and evaluate the IPM methods. Hands-on training conducted in farmers‘ fields (as opposed to a classroom) is a must. Special training for extension workers and educational programs for government officials and the public are also important.

STEP 10: MONITORING, RECORD-KEEPING AND EVALUATION (M&E).

Develop data collection forms and checklists, collect baseline GAP/IPM data at the beginning of the project, and set targets.

For the use and maintenance of Good Agriculture Practices (that include safe pesticide storage, use and disposal), maintain farm or project files of: farmer and farm employee training records certification; farm soil, water, biodiversity, cropping and pesticide use maps; pesticide purchase and stock records; chemical application instructions including target pest, type of chemical applied, dosage, time of spray, rates at which pesticides were applied, harvest interval days, application machinery, PPE required and used, and any special instructions on mixing, exposure to children or dangers. Further, for project staff, beneficiaries, produce processing facilities, food warehouses, seed multipliers, or farmers that store seed or food and deal with stored seed and food pests, there are warehouse BMPs and monitoring reports that incorporate some IPM tactics. These monitoring forms track, by location or warehouse, use of pallets, stacking, general hygiene and sanitation, damaged packages, actual infestations or signs of rodents, molds, insects, drainage, locks and security measures, use of IPM tactics including least toxic chemicals and strict BMPs for use of common but hazardous fumigants like aluminum phosphide.

APPENDIX 4. BOTANICAL ACTIVE INGREDIENTS IN PESTICIDES, REPELLENTS, AND BAITS REGULATED BY USEPA

Name	Other Names	Use	Toxicity	EPA Tracking Number
Allium sativum	Garlic	Repels insects	Low	128827
Allyl isothiocyanate	Oil of Mustard	Kills & repels insects	Questionable	004901
Anise Oil	Repels vertebrates	Low	004301	
4-allyl anisole	Estragole	Kills beetles	Low	062150
Azadirachtin	Azadirachta indica Neem tree extract	Kills & repels insects	Low, IV	121701
Bergamot		Repels vertebrates		129029
Canola Oil	Brassica Napus B. Campestris	Kills many insects	Low	011332
Capsaicin	Capsicum frutescans	Repels vertebrates	Low, III	070701
Castor Oil		Repels vertebrates	Low	031608
Cedarwood Oil		Repels moth larvae	Low	040505
Cinnamaldehyde	Ceylon and Chinese	Kills insects, fungi & repels	Low	040506

Name	Other Names	Use	Toxicity	EPA Tracking Number
	cinnamon oils	vertebrates*		
Citronella Oil		Repels insects & vertebrates	Low	021901
Cloves, Crushed			Low	128895
Dihydroazadirachtin	Neem tree extract Azadirachta indica	Kills & repels insects	III-IV	121702
Eucalyptus Oil		Repels insects, mites fleas & mosquitoes	Low	040503
Eugenol	Oil of cloves	Kills insects**	Low	102701
Geraniol	Oil of rose isomeric w/ linalool	Repels vertebrates**	Low	597501
Geranium Oil			Low	597500
Indole	from all plants	Trap bait: corn rootworm beetles	Low	25000-
Jasmine Oil			Low	040501
Jojoba Oil		Kills & repels whitefly kills powdery mildew	Low	067200
Lavandin Oil		Repels clothes moth	Low	040500
Lemongrass		Repels vertebrates	Low	040502
Linalool	Oil of Ceylon isomeric w/geraniol	Repels insects, ticks, mites &	Low	128838

Name	Other Names	Use	Toxicity	EPA Tracking Number
		spiders		
Maple lactone		Roach trap bait	Low	004049
Methyl salicylate	Oil of wintergreen	Repels moths, beetle & vertebrates	May be Toxic in large quantity	76601-
Mint	Herb	Kills aphids	Low	128892
Mint Oil		Kills aphids	Low	128800
Mustard Oil		Repels insects, spiders & vertebrates	Low	004901
Neem Oil		Kills whitefly, aphids	Low	025006
1-Octen-3-ol	From clover, alfalfa	Trap bait: mosquitoes	Low	69037-
Orange		Repels vertebrates	Low	040517
p-Methane-3,8 diol	Eucalyptus sp.	Repels biting flies, mosquitoes	Low	
2-Phenylethyl-propionate	From peanuts	Kills insects, ticks, mites & spiders	Low	102601
Pyrethrum	Chrysanthemum sp.	Stored products use	III	
Red pepper	Chilli	Repels insects	Low	070703
Rosemary	Herb		Low	128893

Name	Other Names	Use	Toxicity	EPA Tracking Number
Rotenone	Derris sp., Tephrosia	Controls ticks	III	
Ryania	Ryania speciosa	Kills thrips, codling moth, corn borers		
Sabadilla	Schoenocaulon sp.		III	
Sesame Oil	Sesamum indicum	Pyrethroid synergist	Low	
Soybean Oil	Soja	Kills insects, mites	Low	031605
Thyme	Herb	Controls aphids	Low	128894
1,2,4 Trimethoxy-benzene	From squash	Trap bait: corn rootworm, cucumber beetles	Low	40515-
Verbenone	From pine trees	Repels bark beetles	Low	128986

* attracts corn rootworm beetles, ** attracts Japanese beetles. Not all plant extracts are listed. More detailed information available for most oils: http://www.epa.gov/pesticides/reregistration/status.htm. Natural Source: Only one or a few sources are listed. Most of these chemicals are found in many different plants.

Since the time in the late 1990s when EPA did register biological ingredients listed above, it has since developed a list of botanical extracts (mostly essential oils) under ―Minimum Risk Pesticides Exempted under FIFRA Section 25(b)[50]". Some of the very same ingredients are in both lists. However, most US states and USAID consider botanical extracts and essential oils used to kill, destroy, mitigate, or repel pests to be analyzed and treated as pesticides.

[50] http://www.epa.gov/oppbppd1/biopesticides/regtools/25b_list.htm

APPENDIX 5. NATURAL PESTICIDES THAT HAVE BEEN COMMERCIALIZED[51]

INSECTICIDES

azadirachtin—component in neem oil	botanical extract
Bacillus thuringiensis-BT	microbial
Beauveria basiana	microbial
cartap hydrochloride extract	marine worm (*Lumbriconereis heterodopa*)
chili pepper extract	botanical (spice)
emamectin benzoate	botanical extract
garlic extract/allicin	botanical extract (spice)
harpin protein	plant induced resistance elicitor
kaolin clay	inorganic mineral
d-limonene	citrus extract (spice)
Metarhizium anisopliae	microbial
narrow range dormant oil	paraffin oil
neem oil	botanical extract
nuclear polyhedrosis virus (NPV)	microbial
Paecilomyces lilacinus	microbial
Paecilomyces fumosoroseus	microbial
pyrethrin	botanical extract
pyrethrum	botanical extract
pyriproxyfen	IGR (Juvenile Hormone mimic)

[51] Reference: Compiled from Annexes 1 and 7, and from other PERSUAPs.

ryania	botanical extract
soap (insecticidal)	fatty acids
spinosad	microbial extract
buprofezin	IGR (Chitin Synthesis inhibitor)

FUNGICIDES

Bacillus subtilis	microbial
Bordeaux mix	inorganic (Bordeaux ingredients EPA registered)
copper	inorganic
copper hydroxide	inorganic
copper oxychloride	inorganic
copper sulfate	inorganic
harpin protein	plant induced resistance elicitor
sulfur	inorganic
Trichoderma spp.	microbial

NEMATOCIDES

Myrothecium verrucaria	microbial
tomatillo oil + thyme oil extracts (Promax[52])	botanical + spice extracts—soil biopesticide

MOLLUSCICIDE

iron phosphate	inorganic

[52] http://www.bhn.name/humagro/biopesticides.html

APPENDIX 6. TOXICITY OF PESTICIDES: EPA, WHO AND RUSSIAN CLASSIFICATIONS

GENERAL TOXICITY

Pesticides, by necessity, are poisons, but the toxicity and hazards of different compounds vary greatly. Toxicity refers to the inherent intoxicating ability of a compound whereas hazard refers to the risk or danger of poisoning when the pesticide is used or applied. Pesticide hazard depends not only on toxicity but also on the chance of exposure to toxic amounts of the pesticide. Pesticides can enter the body through oral ingestion, through the skin or through inhalation. Once inside the body, they may produce poisoning symptoms, which are either acute (from a single exposure) or chronic (from repeated exposures or absorption of smaller amounts of toxicant).

EPA AND WHO TOXICITY CLASSIFICATIONS

There are two systems of pesticide toxicity classification. These are the USEPA and the WHO systems of classification. It is important to note that the WHO classification is based on the active ingredient only, whereas USEPA uses product formulations to determine the toxicity class of pesticides. So, WHO classification shows relative toxicities of all pesticide active (or technical) ingredients, whereas EPA classification shows actual toxicity of the formulated products, which can be more or less toxic than the active ingredient alone and are more representative of actual dangers encountered in the field. The tables below show classification of pesticides according to the two systems.

USEPA CLASSIFICATION (BASED ON FORMULATED PRODUCT = ACTIVE INGREDIENT PLUS INERT AND OTHER INGREDIENTS)

Class	Descriptive term	Mammalian LD_{50}		Mammalian Inhalation LC_{50}	Irritation		Aquatic invert/fish (LC_{50} or EC_{50})[2]	Honey bee acute oral (LD_{50})
		Oral	Dermal		Eye[1]	Skin		
I	Extremely toxic	≤50	≤200	≤0.2	Corrosive	Corrosive	< 0.1	
II	Highly toxic	50-500	200-2000	0.2-2.0	Severe	Severe	0.11-1.0	< 2 µg/bee

III	Moderately toxic	500-5000	2000-20000	2.0-20	No corneal opacity	Moderate	1.1-10.0	2.1-11 µg/bee
IV	Slightly toxic	≥5000	≥20000	≥20	None	Moderate or slight	10.1-100	
	Relatively non-toxic						101-1000	
	Practically non-toxic						1001-10,000	> 11 µg/bee
	Non-toxic						> 10,000	

[1] Corneal opacity not reversible within 7 days for Class I pesticides; corneal opacity reversible within 7 days but irritation persists during that period for Class II pesticides; no corneal opacity and irritation is reversible within 7 days for Class III pesticides; and Class IV pesticides cause no irritation

[2] Expressed in ppm or mg/l of water

WHO CLASSIFICATION (BASED ONLY ON ACTIVE OR ‗TECHNICAL' INGREDIENT)

Class	Descriptive term	Oral LD_{50} for the rat (mg/kg body wt)		Dermal LD_{50} for the rat (mg/kg body wt)	
		Solids	Liquids	Solids	Liquids
Ia	Extremely hazardous	≤5	≤20	≤10	≤40
Ib	Highly hazardous	5-50	20-200	10-100	40-400
II	Moderately hazardous	50-500	20-2000	100-1000	400-4000
III	Slightly hazardous	≥501	≥2001	≥1001	≥4001
U	Unlikely to present acute hazard in normal use	≥2000	≥3000	-	-

APPENDIX 7: ANALYSES OF ACTIVE INGREDIENTS IN PESTICIDES FOUND IN GEORGIA

INTRODUCTION TO ANNEX 7

Annex 7 below compiles all of the AIs in pesticides (natural and synthetic) imported to and found in Georgia, and likely to be imported from China, Pakistan, Afghanistan, Uzbekistan, Georgia, as well as a few products from Russia, Iran and Turkey, and presents this data in Annex 7. Project decision-makers—especially those who interface at the field level with beneficiary farmers—are encouraged to look at the label of potential pesticide choices to determine the AIs contained in them and then use this Annex as a quick reference guide to attributes and issues with each chemical. These attributes include pesticide class (to manage resistance by rotating chemicals from different classes), EPA registration and Restricted Use Pesticide (RUP) status (to comply with Regulation 216) and acute toxicity (judged by this document to be safe, or not, for small-holder farmers—most Class I chemicals are not considered safe for smallholder farmers to use). Annex 7 also presents chronic health issues, water pollution potential, and potential toxicities to important non-target organisms like fish, honeybee pollinators, birds and several aquatic organisms.

Further, Annex 7 contains basic pieces of human safety and environmental data needed for the various analyses required throughout the PER; ergo it is referred to throughout this document. And it provides data used to produce the project-critical information contained in Annexes 8 and 9. Thus, this PERSUAP provides useful tools for evaluating and choosing among IPM options, including natural and synthetic pesticides, while adhering to 22 CFR 216, as well as aiming at the market-driven best practices found in Standards and Certification (S&C) systems—the highest international standards available.

See Annex 7 Matrix, below.

Key to matrix:

Special Uses: S = Seed; G = Greenhouse; W = Warehouse; F = Fumigation; V = Veterinary

WHO Acute Toxicity Classes: O = Obsolete; Ia = Extremely Hazardous; Ib = Highly Hazardous;

II = Moderately Hazardous; III = Slightly Hazardous; U = Unlikely to present acute hazard in normal use

EPA Acute Toxicity Classes: I = Extremely Toxic; II = Highly Toxic; III = Moderately Toxic;

IV = Slightly Toxic

Chronic Human Toxicity: KC = Known Carcinogen; PC = Possible Carcinogen; ED = Endocrine Disruptor Suspect; RD = Reproductive & Development Toxin; P = Parkinson‘s

Ecotoxicity: PNT = Practically Not Toxic; NAT = Not Acutely Toxic; ST = Slightly Toxic; MT = Moderately Toxic; HT = Highly Toxic; VHT = Very Highly Toxic

References for Annex 7: See references at the end of the report.

Appendix 7: Matrix of 2011 Georgia Pesticide Active Ingredient Human and Environmental Risk Factors

Active Ingredients (AIs) in Georgia Registered Insecticides

									Ecotoxicity								
Active Ingredients	Class	Special Uses	EPA Registered	Restricted Use	WHO Acute Toxicity Class	EPA Acute Toxicity Class	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
abamectin(e)/avermectin	microbial extract	G	yes	no	none	II, III	RD	no data	ST	HT	PNT				HT	VHT	VHT
acetamiprid	neonicotinoid	S	yes	no	none	III	none	no data	NAT	MT	HT				NAT		
alpha cypermethrin	synthetic pyrethroid	W, V	no	yes	II	II, III	PC	no data	HT	HT	PNT			MT	VHT	VHT	VHT
aluminum phosphide	inorganic	F, W	yes	yes	none	I	none	no data	HT	HT	HT				MT		
azadirachtin/neem oil	botanical extract	G	yes	no	none	III	none	no data	ST	NAT	NAT	MT				MT	

Bacillus thuringiensis/BT	microbial	G, W	yes	no	III	III	none	no data	MT	PNT	NAT	NAT		ST	ST		
bifenthrin/biphenthrin	synthetic pyrethroid	G	yes	some	II	II, III	PC, ED, RD	no data	VHT	HT	MT				HT		
bromopropylate	benzilate		no	no	U	IV	none	no data	MT	ST	MT	MT	MT	MT	MT		
carbosulfan	carbamate		no	no	II	II	none	no data	HT	HT	HT		HT		HT		
chlorpyrifos ethyl	organophosphate	S, G, W	yes	some	II	II, III	ED	no data	HT	HT	HT	MT	PNT	MT	VHT	HT	MT
chlorpyrifos methyl	organophosphate		yes	no	U	I, III	none	no data	MT	HT	MT	MT			VHT	VHT	MT
clofentezine	tetrazine		yes	no	U	III	PC, RD	no data	ST	PNT	ST						ST
cypermethrin	synthetic pyrethroid	V	no	some	none	II, III	PC, ED, RD	no data	HT	HT	PNT			MT	VHT	VHT	VHT
dazomet	unclassified	V	yes	no	III	III	none	potential	ST	PNT	ST		MT		HT		HT
deltamethrin	synthetic pyrethroid	W	yes	some	II	II, III	none	no data	HT	MT		VHT		NAT		VHT	VHT

diflubenzuron	insect growth regulator		yes	some	U	III	none	no data	ST	NAT	PNT	NAT		NAT	NAT	ST	MT
dimethoate	organophosphate		yes	no	II	II	PC, ED, RD	potential	ST	VHT	VHT	HT	MT	VHT	HT	VHT	MT
ethoprop(hos)	organophosphate		yes	some	Ia	I	KC	potential	MT	MT	HT		MT		MT		
fenazaquin	unclassified		no		II		none	no data	HT	MT	MT		MT	HT	HT	HT	HT
fenoxycarb/phenoxycarb	insect growth regulator	G	yes	no	U	III	**KC**, RD	potential	VHT	PNT	PNT					VHT	MT
fenpyroximate	pyrazole		yes	no		II	none	no data	HT	MT	MT		MT		HT		
fensulfothion	organophosphate		no	yes	O	I, IIII	none	potential	HT		HT						VHT
fenthion	organophosphate		no	no	II	II	none	potential	MT	MT	VHT	VHT		HT	HT	VHT	VHT
fenvalerate	synthetic pyrethroid	V	no	no	II	III	ED	no data	VHT	HT	ST	HT	VHT	HT	HT	HT	VHT
horticultural oil	mineral oil		yes	no	none	III	none	no data	NAT								

imidacloprid	neonicotinoid	S, W	yes	no	II	II, III	none	potential	NAT		MT			VHT
indoxacarb	oxadiazine		yes	no	O	III	none	no data	MT	HT	HT	NAT	MT	

Active Ingredients (AIs) in Georgia Registered Insecticides

									Ecotoxicity								
Active Ingredients	Class	Special Uses	EPA Registered	Restricted Use	WHO Acute Toxicity	EPA Acute Toxicity	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
lambda cyhalothrin	synthetic pyrethroid	S, V	yes	some	II	II, III	ED	no data	VHT	HT	PNT		VHT	VHT	VHT	VHT	
malathion	organophosphate	G, W	yes	no	III	II, III	PC, ED	potential	MT	HT	MT	HT	ST	VHT	MT	VHT	HT
metam sodium	dithiocarbamate	F	yes	yes	II	I	**KC**, RD	no data	MT	MT	MT		VHT		VHT		HT
methomyl/methomil	carbamate		yes	yes	Ib	**I**, III	ED	potential	MT	HT	HT	ST	HT	ST	HT	VHT	HT
methyl bromide	halogenated organic	F	yes	yes	none	I	RD	no data	MT	PNT		MT	MT	MT	MT	MT	MT
oil: mineral, summer, narrow range	petroleum/paraffin		yes	no	none	III	none	no data	NAT								

phosalone	organophosphate		no	no	II	II	none	potential	HT	PNT	ST			MT	HT		
phosmet	organophosphate		yes	no	II	**I**, II, III	PC	potential	MT	VHT	MT		NAT	ST	HT	MT	HT
propargite	unclassified		yes	no	none	III	PC, RD	no data	HT	PNT		HT			NAT		HT
pyridaben	unclassified		yes	no	II	II, III	none	no data	VHT	HT	ST		MT		HT		VHT
pyrimiphos methyl	organophosphate	W	yes	no	III	**I**, II, III	none	no data	MT	MT	HT		MT			VHT	VHT
pyriproxyfen	insect growth regulator	W	yes	no	U	II, III	none	no data	MT	MT	MT		MT		MT		VHT
spinosad/spinosins A & D	microbial extract	G	yes	no	U	III	none	no data	MT	HT	PNT		ST			HT	MT
spirodiclofen	keto-enol		yes	no	none	III	PC	no data	MT	HT	NAT		NAT	MT	MT	MT	
spiromesifen	keto-enol (tetronic acid)		yes	no	none	III	none	no data	HT	ST	MT		MT				
sulfur/sulphur	inorganic	G	yes	no	U	III	none	no data	NAT	NAT	NAT	NAT					NAT

tebufenpyrad/tebuphenpyrad	pyrazole		yes	no	III	II	none	no data	HT	MT	MT		MT		HT		
thiacloprid	neonicotinoid	S	yes	no	II	II	PC	no data		MT	ST		MT			VHT	ST
thiamethoxam	neonicotinoid	S	yes	no	none	III	PC	no data	PNT	HT	PNT		PNT	PNT	PNT	PNT	
zeta cypermethrin	pyrethroid		yes	some	Ib	II, III	PC, ED	no data	VHT	VHT	NAT		NAT	VHT	VHT	VHT	
AIs in Georgia Registered Miticides																	
abamectin(e)/avermectin	microbial extract	G	yes	no	none	II, III	RD	no data	ST	HT	PNT				HT	VHT	VHT
bifenthrin/biphenthrin	synthetic pyrethroid	G	yes	some	II	II, III	PC, ED, RD	no data	VHT	HT	MT				HT		
bromopropylate	benzilate		no	no	III, U	IV	none	no data	MT	ST	MT	MT	MT	MT	MT		
carbosulfan	carbamate		no	no	II	II	none	no data	HT	HT	HT		HT		HT		
horticultural oil	mineral oil		yes	no	non	III	none	no	NA								

					e			data	T						
lambda cyhalothrin	synthetic pyrethroid	S, V	yes	some	II	II, III	ED	no data	VHT	HT	PNT		VHT	VHT	VHT	VHT

AIs in Georgia Registered Nematocides

Active Ingredients	Class	Special Uses	EPA Registered	Restricted Use	WHO Acute Toxicity Class	EPA Acute Toxicity Class	Chronic Toxicity	Groundwater contaminant	Ecotoxicity								
									fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
dazomet	unclassified	F	yes	no	III	III	none	potential	ST	PNT	ST		MT		HT		HT
ethoprop(hos)	organophosphate		yes	some	Ia	I	KC	potential	MT	MT	HT		MT		MT		
metam sodium	dithiocarbamate	F	yes	yes	II	I	PC, RD		MT	MT	MT		VHT		VHT		HT
oxamyl	carbamate	G	yes	yes	Ib	I	none	no data	ST	HT	VHT		HT		ST		MT

AI in Georgia Registered Molluscide

metaldehyde	aldehyde	G	yes	yes	II	II, III	PC	poten	NAT	PNT	MT	PNT	PNT	PNT	PNT	PNT	PNT

								tial								
AIs in Georgia Registered Fungicides																
aluminum phosphide	inorganic	F	yes	yes	none	I	none	no data	HT	HT	HT			MT		
azoxystrobin	strobin	S	yes	no	U	III	none	potential	MT	MT	MT		MT	MT		VHT
benalaxyl	xylylalanine		no		U	none	none	no data	MT	MT	ST		MT	MT		
benalaxyl-M	phenylamide		no	no	U	none	none	no data	MT	ST	ST		MT	MT		
bitertanol	azole		no	no	U	none	none	no data	MT	PNT	PNT		PNT	MT		MT
boscalid/nicobifen	carboximide (anilide)		yes	no	none	II, III	PC	no data	MT	MT	MT		MT	MT		
calcium hydroxide	inorganic		yes	no		III	none	no data	ST				MT			
captan(e)	thiopthalamide	S, G	yes	no	none	**I**, II, III	KC	no data	HT	NAT	PNT	MT		MT	NAT	MT	MT

carbendazim(e)/carbendazin	benzimidazole	S	yes	no	U	III	PC, ED	no data	MT	NAT	ST	ST			ST		HT
chlorothalonil	chloronitrile	G	yes	no	none	**I**, II, III	PC	potential	VHT			HT		ST	VHT	MT	MT
copper hydroxide	inorganic	G	yes	no	II	II, III	none	no data	HT	MT	MT		MT	HT	NAT	HT	HT
copper oxychloride	inorganic	G	yes	no	none	II, III	none	no data	MT	MT	MT		MT				VHT
copper sulfate	inorganic	S, G	yes	no	II	**I**, III	none	no data	MT	HT	PNT	HT	HT	VHT	ST		ST
cymoxanil	unclassified		yes	no	III	III	none	no data	MT	MT	ST		MT		MT	MT	ST
cyneb/zineb	dithiocarbamate		no	no	U	II, III	ED, RD	no data	MT	MT	MT	NAT	MT	NAT	ST	ST	ST
cyproconazole	azole		yes	no	III	III	PC	no data	MT	MT	MT		MT				MT
cyprodinil	unclassified		yes	no	none	III	none	potential	MT	ST	MT		MT		MT	MT	
dazomet	unclassified		yes	no	III	III	none	potential	ST	PNT	ST		MT		HT		HT

dicloran/DCNA	substituted benzene	G	yes	no	U	II	none	potential	MT	MT	MT	MT	MT	MT
difenoconazole	azole	S	yes	no	III	III	PC	no data	MT	MT	ST	MT	MT	HT
dimethomorph	morpholine		yes	no	U	III	none	no data	MT	MT	MT	MT		ST

AIs in Georgia Registered Fungicides, continued

									Ecotoxicity								
Active Ingredients	Class	Special Uses	EPA Registered	Restricted Use	WHO Acute Toxicity Class	EPA Acute Toxicity Class	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
diniconazole	triazole		no		III		none	no data	MT	MT	MT				MT		
dithianon	pyrimidine		no		III	none	none	no data	HT	MT	MT	MT	MT	ST	MT	MT	
dodemorph/didemorf	morpholine	G	no		U	none	none	no data	MT						MT		
epoxiconazole	triazole		no		none	none	PC	no data	MT	MT	MT		MT				
famoxadone	oxazole		yes	no	U	III	none	no data	HT	MT	ST				HT		
fenarimol	pyrimidine	G	yes	no	U	III	ED	potential	MT	MT	MT			ST	MT	MT	

fenhexamid	hydroxyanilide		yes	no	U	III	none	potential	MT	MT	MT		MT		MT		MT
fludioxonil	phenylpyrrole	S	yes	no	U	III	none	potential	MT	MT	MT		MT		MT		
fluopicolide/fluopykolide	benzamide		yes	no	none	III	none	no data	MT	MT	NAT		MT		MT		
flusilazole	azole		no	no	III	III	none	no data	MT	MT	MT		MT		MT		
flutriafol	triazole		no	no	III	none	ED	potential	MT	MT	LT		MT		MT		
folpet	thiophthalimide		yes	no	U	II, III	KC	no data	HT	PNT	ST	HT	MT	ST	HT		MT
fosetyl aluminum	unclassified	S	yes	no	none	III	none	potential	NAT	ST	ST		MT		NAT		MT
hexaconazole	azole		no	no	U	IV	PC	no data	MT	HT	NAT		MT		MT	NAT	
iprodione	dicarboximide	G	yes	no	U	III	PC, ED	potential	MT	NAT	ST				HT		
iprovalicarb	unclassified		no		U	none	PC	no data	MT	ST	MT		MT				

kresoxim-methyl	strobin		yes	no	U	III	PC	potential	ST	ST	ST		MT	MT	VHT
Melaleuca alternifolia	biological oil extract		no				none	no data							
mancozeb	dithiocarbamate	S, G	yes	no	U	III	PC, ED, RD	no data	MT	MT	ST	HT			NAT
metalaxyl-M/mefenoxam	phenylamide	S	yes	no	II	II, III	none	no data	MT	NAT	MT		MT	MT	
metalaxyl	benzanoid	S, G	yes	no	III	II, III	none	potential	ST	PNT	PNT				ST
metam sodium	dithiocarbamate		yes	yes	II	I	**KC**, RD	no data	MT	MT	MT		VHT	VHT	HT
metiram	dithiocarbamate		yes	no	U	III	PC, RD	no data	ST	PNT	ST		MT	MT	MT
penconazole	azole		no		U		none	no data	MT	MT	MT		MT	MT	
pencycuron	urea	S	no		U	IV	none	no data	HT	MT	MT		MT	MT	
propamocarb HCl	carbamate		yes	no	none	III	none	no data	MT	MT	MT		MT	MT	

propiconazole	azole	S	yes	no	II	II, III	PC, RD	potential	MT				MT	ST	MT	MT
propineb	dithiocarbamate Zn		no	no	U		RD	no data	MT	PNT	PNT		MT	MT	MT	MT
proquinazid	unclassified		no		III		none	no data	MT				MT	MT		MT
pyraclostrobin	strobin		yes	no	none	II, III	none	no data	ST	MT	MT	MT		HT		
pyrimethanil	anilinopyrimidine		yes	no	U	III	PC, ED	no data	MT		PNT	MT		MT	MT	MT

AIs in Georgia Registered Fungicides, continued

									Ecotoxicity								
Active Ingredients	Class	Special Uses	EPA Registered	Restricted Use	WHO Acute Toxicity	EPA Acute Toxicity	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
spiroxamin	unclassified		yes	no	II	III	none	no data	MT	MT	MT		MT		MT		
sulfur/sulphur	inorganic	G	yes	no	U	III	none	no data	NAT	NAT	NAT	NAT					NAT
tebuconazole	azole	S	yes	no	III	II, III	PC	potential	MT	MT	MT		MT		MT	MT	HT
tetraconazole	azole		yes	no	II	II, III	PC	no data	MT	MT	MT		MT		MT		
thiophanate methyl	benzamidazole	S, G	yes	no	U	III	PC, RD	potential	MT	PNT		NAT			ST		
tolylfluanid	sulfamide		no		U		PC	no data	MT	LT	HT		MT		MT		

triadimefon	triazole	G	yes	no	III	II, III	PC, ED, RD	potential	MT	MT	PNT		MT		NAT	
triadimenol	triazole	S	yes	no	III	II, III	PC	no data	MT	ST	MT		MT			
trifloxystrobin	strobin	S	yes	no	none	III	none	no data	ST	ST	MT		MT			
triticonazole	azole	S	yes	no	U	III	none	no data	MT	MT	MT		MT		MT	
zineb/cyneb	dithiocarbamate		no	no	U	II, III	ED, RD	no data	MT	MT	MT	NAT	MT	NAT	ST	ST	ST
AIs in Georgia Registered Herbicides																
2 4 D	chlorophenoxy acid		yes	no	II	III	PC, ED	potential	ST	HT	MT	ST	NAT	NAT	NAT	ST	ST
2 4 D dimethylamine salt	chlorophenoxy acid		yes	no	II	III	PC	potential	NAT			NAT		ST	NAT		NAT
2 4 D ethyl hexylester	chlorophenoxy acid		yes	no	none	II, III	PC, ED, RD	potential	ST								MT
acetochlor	chloroaceta		yes	yes	III	II,	**KC**, ED	pote	MT	MT	ST		MT				MT

	nilide				IIII		ntial									
amidosulfuron	sulfonylurea	no		non e	non e	none	no data	NA T	MT	MT		MT		MT		
atrazine	triazine	yes	no	U	III	PC, ED	know n	ST	NA T	PN T	ST	ST	ST	ST	ST	ST
bentazon	benzothiazi none	yes	no	III	III	none	no data	NA T	MT	MT		MT	ST	MT		
carfentrazone (ethyl)	triaolinone	yes	no	III	III	none	no data	MT	NA T	NA T		MT		MT		MT
clodinafop-propargyl	a propionic acid	yes	no	III	II, III	PC, RD	no data	HT	MT	MT						
clomazone	isoxazolidin one	yes	no	II	III	none	no data	MT	MT	NA T		MT		MT		HT
dicamba	a benzoic acid	yes	no	III	II, III	RD	pote ntial	ST			NA T			NA T		ST
fenoxaprop-p-ethyl	propionic acid	yes	no	non e	II, III	none	no data	MT	ST	PN T		ST		MT		MT
fluazifop-p-butyl	propionic acid	yes	no	III	II, III	none	no data	MT	ST	PN T					ST	
foramsulfuron	sulfonylurea	yes	no	non	III	none	pote	MT	ST	MT		MT		MT		

				e			ntial									
glyphosate	phosphonoglycine	yes	no	U	II, III	none	potential	ST	ST	NAT		PNT		MT		ST
glyphosate, isopropylamine salt	phosphonoglycine	yes	no	none	II, III	none	potential	ST			ST	NAT	ST	NAT	NAT	NAT
glyphosate, trimesium salt	phosphonoglycine	no	no	none	III	none	potential	NAT								ST
haloxyfop R methyl	a propionic acid	no	no	none		KC	no data	HT	MT	MT				MT		
AIs in Georgia Registered Herbicides, continued																
								Ecotoxicity								
Active Ingredients	Class	Special Uses	EPA Registered	Restricted Use	WHO Acute Toxicity	EPA Acute Toxicity	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
imazethapyr	amidazolinone		yes	no	U	II, III	none	potential	NAT	HT	NAT		NAT		NAT		
iodosulfuron-methyl	sulfonylurea		yes	no	non	III	none	no	NA	PN	PN		ST				

				e			data	T	T	T					
ioxynil	hydroxybenzonitrile	no		II		none	no data	MT	MT	HT		MT	MT	MT	
isoxadifen ethyl	unclassified	no		none		none	no data								
linuron	urea	yes	no	U	III	**KC**, ED, RD	potential	MT	NAT	MT		MT	ST	MT	ST	MT
MCPA	chlorophenoxy acid	yes	no	II	II, IIII	PC	no data	ST	PNT	NAT	ST		ST	NAT	NAT	ST
metolachlor	chloroacetamide	yes	some	III	III	PC, ED	known	MT	ST	MT		MT		MT		
metribuzin	triazinone	yes	no	II	II, III	ED	potential	MT	NAT	MT		MT		ST		ST
metsulfuron-methyl	sulfonyl urea	yes	no	U	III	none	potential	NAT	MT	NAT		MT		NAT		
nicosulfuron	sulfonylurea	yes	no	U	II, III	none	potential	MT	MT	MT		MT		MT		
oxyfluorfen	diphehyl ether	yes	no	U	II, III	PC	no data	HT	PNT	PNT			HT		HT	HT
pendimethalin	dinitroanalin	yes	no	III	III	PC, ED	no	MT	NA	ST				MT	MT	

	e						data		T						
pinoxaden	unclassified	yes	no	III	I, II, III	none	no data	MT	MT	NAT		MT			
prometryn(e)	triazine	yes	no	U	III	RD	potential	MT	NAT	PNT	ST	NAT	NAT	ST	ST
quizalofop-p-ethyl	a propionic acid	yes	no	none	I, III	none	no data	MT	MT	MT		MT	MT		
quizalofop-p-tefuryl	phenoxypropionate	yes	no	II	III	PC	potential	MT	MT	NAT		MT	MT		
rimsulfuron	sulfonylurea	yes	no	U	III	none	potential	NAT	MT	NAT		MT			NAT
topramezone	benzoylpyrazole	yes	no		III	none	no data	MT	MT	MT		MT	MT		
triasulfuron	sulfonylurea	yes	no	U	III	**KC**, RD	potential	MT	MT	NAT		MT	MT		
tribenuron methyl	sulfonylurea	yes	no	none	III	PC	no data	ST	MT	ST		MT			
AIs in Georgia Registered Rodenticides															

aluminum phosphide	inorganic	F, W	yes	yes	none	I	none	no data	HT	HT	HT		MT
brodifacoum	coumarin	W	yes	no	Ia	III	none	no data	MT			MT	
flocoumarfen	coumarin		no		Ia		none	no data	HT		MT		MT
zinc phosphide	inorganic		yes	yes	Ib	**I**, II, III	RD	no data	HT	VHT	HT		

Disinfectants commonly used for processing fruits and vegetables and clean-up

									Ecotoxicity								
Active Ingredients	Class	Uses	EPA Registered	Restricted Use	WHO Acute Toxicity Class	EPA Acute Toxicity Class	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
chlorhexidine gluconate	organic		yes	no	none	III	none	no data	NAT								
chlorine	inorganic		yes	no	none	I	none	no data	HT			MT	MT	HT	HT	HT	HT
citric acid	acid		yes	no	none	III	none	no data	NAT								
cresol (-meta)	phenol (benzene)		yes	no	none	II	PC	no data	ST								ST
ethyl alcohol	organic		yes	no	none	II	RD	no data	NAT			NAT	NAT	NAT	NAT	NAT	
formaldehyde	organic		yes	no	none	I	KC	no data	NAT					NAT	NAT		ST

hydrochloric acid	acid		yes	no	none	I	none	no data	NAT						NAT		
iodine	inorganic		yes	no	none	I	none	no data	MT								HT
phenol	benzene		yes	no	none	II, III	none	no data	ST			ST	NAT	NAT	ST	NAT	ST
phosphoric acid	inorganic		yes	no	none	I	none	no data	ST								
potassium iodide	inorganic		yes	no	none	I	none	no data	NAT					NAT			
sodium hydroxide	base		yes	no	none	II, III	none	no data	NAT								
sulfuric acid	acid		yes	yes	none	I	none	no data	ST						ST		
AIs in Insecticides Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers																	
acephate	organophospate	G	yes	no	III	III	PC	potential	MT	HT	MT	ST	ST		ST		
amitraz	formamdine	V	yes	no	III	II	PC,	no	MT	PN	ST	ST			NA		ST

						RD	data		T				T			
Bacillus subtilis	microbial-natural		yes	no	U	IV	none	no data	NAT	ST	NAT		NAT		NAT		
benzyl benzoate	bridged diphenyl	W	yes	no	none	III	none	no data	MT		MT						MT
buprofezin	insect growth regulator		yes	no	U	III	PC	no data	MT	ST	MT	NAT	MT				
carbaryl	carbamate	G, V	yes	no	II	III	PC, ED	potential	MT	HT	PNT	MT	VHT	ST	HT	HT	MT
carbon dioxide	inorganic fumigant		yes	no	none	II	none	no data									
chili pepper extract/capsacine	botanical-natural		yes	no	none	III	none	no data									
chlorantraniliprole/ rynaxypyr	anthranilic diamide		yes	no		IV	none	no data	NAT	MT	MT		MT		HT		
clomazone	isoxazolidinone		yes	no	II	III	none	no data	MT	MT	NAT		MT		MT		HT
cryolite	inorganic		yes	no	U	III	none	no data	NAT					NAT	ST		
cymoxanil	unclassified		yes	no	III	III	none	no	MT	MT	ST		MT		MT	MT	ST

								data						
d-phenothrin	pyrethroid	G	yes	no	U	III	ED	no data	VHT	ST	HT	VHT	VHT	
diatomacous earth	inorganic mineral		yes	no	none	III	none	no data						

AIs in Insecticides Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers

								Ecotoxicity								
Active Ingredients	Class	Uses	EPA Registered	Restricted Use	WHO Acute Toxicity	EPA Acute Toxicity	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
diazinon	organophospate		yes	some	II	III	RD	potential	MT	HT	VHT	MT	MT	MT	HT	HT	HT
dinotefuran	nitroguanidine		yes	no	none	III	none	no data	MT	HT	MT						
dormant oil	mineral oil		yes	no	none	III	none	no data	NAT								
esfenvalerate	pyrethroid		yes	no	II	II, III	ED	no data	VHT	HT	ST	VHT		ST	HT		
fenitrothion	organophosphate		yes	no	II	II, III	ED	no data	MT	HT	MT	MT	MT	MT	VHT	HT	MT
flubendiamide	benzene dicarboxamide		yes	no	none	III	none	no data	HT	NAT	MT		MT		HT		

garlic extract (allicin)	botanical-natural		yes	no	none	III	none	no data	VHT	HT	HT	MT	MT	MT	VHT	VHT	ST
granulosis virus--coddling moth	microbial		yes	no	none	III	none	no data	NAT				MT				
hexaflumuron	insect growth regulator		yes	no	U	III	none	no data	HT								
insecticidal soap	fatty acids	G	yes	no	none	II, III	none	no data	MT								
kaolin clay/dust	inorganic		yes	no	none	III	none	no data									
metiram	dithiocarbamate		yes	no	U	III	PC, RD	no data	ST	PNT	ST		MT		MT		MT
methoprene	insect growth regulator		yes	no	III	IV	none	no data	ST	ST	NAT			ST	HT	VHT	MT
Methoxyfenozi-de	diacylhydrazine		yes	no	U	III	none	potential	MT	MT	ST		ST			HT	MT
novaluron	benzoyl urea		yes	no	none	II, III	none	no data	MT	MT	MT		MT		HT		
nuclea polyhedrosis virus/NPV	biological		yes	no	none	III	none	no data									

permethrin	synthetic pyrethroid		yes	no	II	III	PC, ED	no data	VHT	VHT	PNT	ST	ST	ST	VHT	MT	MT
phenothrin	synthetic pyrethroid		yes	no	U	III	ED	no data	VHT		ST				HT	VHT	VHT
pirimicarb	carbamate		yes	no	II	II	none	no data	NAT	PNT		ST				MT	
propoxur	carbamate	W	yes	no	II	II, III	PC	no data	MT	HT	VHT	ST	NAT	ST	HT	ST	MT
pymetrozine	triazine		yes	no	III	III	PC	potential	MT	ST	MT		MT		MT		
pyrethrins	botanical extract		yes	some	II	III	PC	no data	HT	HT	ST		MT		HT		
pyrethrum	botanical		yes	no	II	III	PC	no data	HT	HT	ST		MT		HT		
rotenone	botanical		yes	no	II	III	none	no data	HT	HT	HT	HT		MT	MT	MT	MT
spinetoram	unclassified		yes	no	none	none	none	no data	MT		NAT		MT		MT		
spirotetramat	keto-enol		yes	no	none	II, III	none	no data		MT	MT		MT		MT		

tebufenozide	diacylhydrazine		yes	no	U	III	none	potential	MT	ST	ST		MT			HT	MT
tralomethrin	pyrethroid		yes	no	II	III	ED	no data	VHT	HT	NAT				HT		
thiodicarb	carbamate	S	yes	no	II	II	PC	no data	MT	MT	PNT			MT	VHT		HT
trichlorfon	organophosphate		yes	no	II	II, III	PC	no data	ST	PNT	HT	ST	ST	MT	MT	MT	ST
AIs in Seed Treatment Bactericides Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers																	
									Ecotoxicity								
Active Ingredients	Class	Uses	EPA Registered	Restricted Use	WHO Acute Toxicity	EPA Acute Toxicity Class	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
sodium hypochlorite (Clorox)	inorganic disinfectant	S	yes	no	none	**I**, III	none	no data	HT		ST		MT	MT	MT	HT	MT
streptomycin sulfate	microbial	S, G	yes	no	none	III	RD	no data	NAT								

AIs in Seed Treatment Fungicides Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers																
Bacillus subtilis	microbial-natural	S	yes	no	U	III, IV	none	no data	NAT	ST	NAT		NAT	NAT		
carbathiin/carboxin	oxathiin	S	yes	no	U	III	RD	no data	MT	MT	NAT		MT	NAT		
imazalil	imidazole	S	yes	no	II	II, III	PC, RD	no data	MT	NT	PNT					
prothioconazole	triazolinthione	S	yes	no	none	III	none	no data	MT	MT	MT		MT	MT		
Streptomyces griseoviridis	microbial-natural	S	yes	no	none	III	none	no data								
thiram	dithiocarbamate	S	yes	no	III	III	ED, RD	no data	HT	NAT	PNT	VHT	HT	NAT	HT	HT
Trichoderma harzianum	microbial-natural	S	yes	no	U	III	none	no data								
AIs in Miticides/Acaricides Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers																
acequinocyl	unclassified		yes	no	none	III	none	no data	MT	MT	MT		MT	HT		

amitraz	formamdine		yes	no	III	II	PC, RD	no data	MT	PNT	ST	ST		NAT		ST
bifenzate	hydrazine carboxylate		yes	no	none	III	none	no data	HT	MT	MT		MT			
citronellol (geropon)	botanical		yes	no	none	II	none	no data	MT							
clofentezine	tetrazine		yes	no	U	III	PC, ED	no data	ST	PNT	ST					ST
cotton oil	biological		yes	no	none	IV	none	no data								
dicofol	organochlorine		yes	no	III	III	PC, ED	no data	HT	NAT	ST		MT	MT	HT	MT	MT
clove oil	biological		yes	no	none	none	none	no data								
d-phenothrin	pyrethroid	G	yes	no	U	III	ED	no data	VHT		ST				HT	VHT	VHT
etoxazole	insect growth regulator		yes	no	none	III	none	no data	MT	MT	MT		MT		HT		
farnesol	biological pheromone		yes	no	none	II	none	no data	MT							

fenpyroximate	pyrazole	yes	no	none	II	none	no data	HT	MT	MT	MT	HT	
geraniol	botanical	yes	no	none	II	none	no data	MT					
hexythiazox	insect growth regulator	yes	no	U	III	PC	no data	HT	NAT	MT	MT	MT	
milbemectin	microbial	yes	no	none	II, III	none	potential	HT	HT	MT	MT	HT	
narrow range oil	parafin oil	yes	no	none	III	none	no data	NAT					
nerolidol	biological pheromone	yes	no	none	II	none	no data	MT					
propargite	unclassified	yes	no	none	III	PC, RD	no data	HT	PNT	HT		NAT	HT

AIs in Miticides/Acaricides Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers, continued

Ecotoxicity

Active Ingredients	Class	Uses	EPA Registered	Restricted Use	WHO Acute Toxicity	EPA Acute Toxicity	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
propylene glycol	glycol		yes	no	none	III	none	no data	NAT					ST	NAT		NAT
pyridaben	unclassified		yes	no	II	II & III	none	no data	VHT	HT	ST		MT		HT		VHT
rotenone	botanical		yes	no	II	III	none	no data	HT	HT	HT	HT		MT	MT	MT	MT
spirodiclofen	keto-enol		yes	no	none	III	PC	no data	MT	HT	NAT		NAT	MT	MT	MT	
spiromesifen	tectronic acid		yes	no	none	III	none	no data	HT	ST	MT		MT				
sulfur	inorganic		yes	no	U	III	none	no data	NAT	NAT	NAT	NAT					NAT
tebufenpyrad	pyrazole		yes	no	III	II	none	no data	HT	MT	MT		MT		HT		

Ais in Nematocides Recommended in Annex 1 and that Could Become Registered and Used by Georgian

Farmers															
Bacillus pumilus	microbial		yes	no	none	III	none	no data							
chitin-protein	biological	G	yes	no	none	III	none	no data							
harpin protein	resistance elicitor		yes	no	none	III	none	no data							
Myrothecium verrucaria	microbial		yes	no	none	III	none	no data							
tomatillo oil + thyme oil extracts	soil biopesticide		exempt		none	none	none	no data							
Ais in Fungicides Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers															
Bacillus subtilis	bacterial		yes	no	U	III, IV	none	no data	NAT	ST	NAT	NAT		NAT	
Bordeaux mixture	inorganic		exempt		III		none	no data	HT	MT	MT	MT		MT	
bromuconazole	azole		yes	no	II	II, III	none	no data	MT	MT	ST	ST	MT	MT	MT
fenamidone	unclassified		yes	no	non	II, III	none	no	MT	MT	MT	MT		MT	

					e			data								
febuconazole	triazole		yes	no	U	III	PC, ED	potential	ST	PNT	ST			HT	HT	VHT	HT
fenoxaprop-p-ethyl	propionic acid		yes	no	none	II, III	none	no data	MT	ST	PNT		ST		MT		MT
ferbam	dithiocarbamate	G	yes	no	U	III	none	no data	HT	MT	MT	MT	MT	HT		HT	HT
hexythiazox	IGR		yes	no	U	III	PC	no data	HT	NAT	MT		MT		MT		
iprodione	dicarboximide		yes	no	U	III	PC	potential	MT	NAT	ST				HT		
mandipropamid	mandelamide		yes	no	none	III	none	no data	MT	NAT	MT		MT		MT		
mono- & di-K salt-phosporic acid	inorganic		yes	no	none	III	none	no data									
myclobutanil	azole		yes	no	III	III	RD	no data	MT	ST	MT		MT		MT		HT
oxycarboxin	oxathiin	G	yes	no	U	III	none	no data	ST	NAT	MT	ST			MT		HT
pendimethaline	dinitroanaline		yes	no	III	III	PC,	no	MT	NA	ST				MT	MT	

							ED	data		T								
phosphorous acid	inorganic		yes	no	U	III	none	no data	ST									
Ais in Fungicides Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers, continued																		
									Ecotoxicity									
Active Ingredients	Class	Uses	EPA Registered	Restricted Use	WHO Acute Toxicity	EPA Acute Toxicity	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton	
potassium bicarbonate	inorganic		yes	no	none	III	none	no data										
quintozene (PCNB)	substituted benzene	G	yes	no	none	III	PC, ED	no data	MT								VHT	
thiram (TMTD)	dithiocarbamate		yes	no	III	III	ED, RD	no data	HT	NAT	PNT	VHT	HT		NAT	HT	HT	
triflumizole	imidazole		yes	no	III	III	none	potential	HT	MT	ST				MT			
triforine	piperazine	G	yes	no	U	II, III	RD	no	NA	MT	NA		MT		MT			

							data	T		T					
ziram	dithiocarbamate	yes	no	III	III	PC, ED, RD	no data	HT	NAT	MT	HT		MT		HT
Ais in Herbicides Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers															
ametryne/amethrin	triazine	yes	no	III	III	RD	potential	ST	MT	NAT	MT		MT		ST
ametryne	triazine	yes	no	III	III	RD	potential	ST	MT	NAT	MT		MT		ST
aminopyralid triisopropanol-	pyridine	yes	no	III	IV	none	no data	MT	MT	ST		MT		MT	
-ammonium															
bensulfuron methyl	sulfonyl urea	yes	no	U	II, III	none	no data	NAT	MT	ST		MT		ST	NAT
bensulide	organophosphate	yes	no	II	II, III	none	potential	HT	MT	MT					MT
bentazon	benzothiazinone	yes	no	III	III	none	no data	NAT	MT	MT		MT	ST	MT	
bromoxynil	hydroxybenzo	yes	no	II	II	PC,	no	ST	MT	MT		MT	MT		VH

	nitrile					RD	data							T
butralin	dinitroaniline	yes	no	III	III	none	no data	HT	MT	NAT		MT	MT	VHT
chlorsulfuron	sulfonyl urea	yes	no	U	III	RD	potential	ST	MT	ST		MT	ST	HT
clethodim	Cyclohexenone	yes	no	none	II, III	none	potential	MT	MT	MT		MT	MT	
clopyralid	pyridinecarbxilic acid	yes	no		I, II, III	none	potential	PNT		PNT	PNT			NAT
cycloate	thiocarbamate	yes	no	III	III	RD	potential	MT	MT	MT	MT	MT		MT
diclofop-methyl	phenoxypropionate	yes	yes	III	I, II	PC, RD	no data	HT	NAT	ST				
s-dimethenamid	chloroacetamide	yes	no	none	II, III	none	no data	MT	NAT	MT		MT	MT	MT
EPTC + antidote	thiocarbamate	yes	no	III	II, IIII	RD	potential	MT	HT	MT			ST	ST
ethalfluralin	dinitroaniline	yes	no	U	I, II, III	PC	no data	MT	MT	MT		MT	MT	HT
ethofumesate	benzofuran	yes	no	U	III	none	pote	ST	MT	MT		MT	MT	MT

							ntial						
flumioxazine	dicarboximide	yes	no	none	III	none	no data	MT	MT	NAT	MT	MT	
fluroxypyr	pyridine	yes	no	U		none	no data	MT	MT	MT	MT	MT	NAT
fluroxypyr methyl (meptyl)	pyridine	yes	no	U	mixture	none	no data	MT	MT	MT	MT	HT	HT
halosulfuron-methyl	pyrazole	yes	no	U	III	none	potential	ST	MT	ST	ST	ST	NAT

Ais in Herbicides Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers, continued

								Ecotoxicity								
Active Ingredients	Class	Uses	EPA Registered	Restricted Use	WHO Acute Toxicity	EPA Acute Toxicity	Chronic Toxicity	Groundwater contaminant	fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
imazapic	imidazolinone		yes	no	none	III	none	no data	MT	MT	NAT				MT		
mecoprop-p (MCPP)	chlorophenoxy acid		yes	no	III	II, III	PC	potential	MT	MT	MT		MT				
perlargonic acid	plant growth regulator		yes	no	none	none	none	no data	MT		MT				MT		
phenmedipham	bis-carbamate		yes	no	U	III	none	potential	ST	ST	MT		MT	ST	MT		
propamocarb HCl	carbamate		yes	no	none	III	none	no data	MT	MT	MT		MT		MT		
pyraflufen-ethyl	phenylpyrazole		yes	no	none	III	PC	no data	MT	MT	MT		MT		Mt		

pyrithiobac/pyrothiobac-sodium	pyrimidinyloxybenz.	yes	no	U	II	PC	potential	NAT	MT	NAT			NAT		
sethoxydim	cyclohexadione	yes	no	III	II, III	none	potential	ST	MT	ST	MT	MT	ST	ST	ST
sulfosulfuron	sulfonylurea	yes	no	none	III	PC	no data	ST	MT	NAT		MT	NAT		NAT
thidiazuron (Plant Growth Regltr)	urea	yes	no	U	III	none	no data	MT	NAT	NAT			MT		MT
thifensulfuron-methyl	sulfonylurea	yes	no	U	III	none	potential	MT	MT	NAT		NAT		NAT	
tralkoxydim	cyclohexadione	yes	no	III	III	PC	potential	MT		NAT					
trifluralin	dinitroanaline	yes	no	U	II, III	PC, ED	no data	HT	PNT	PNT	MT	HT	ST	ST	ST	MT
AI in a Molluscide Recommended in Annex 1 and that Could Become Registered and Used by Georgian Farmers															
iron phosphate	inorganic	yes	no	none	III	none	no data								

APPENDIX 8: PESTICIDE ACTIVE INGREDIENTS NOT TO BE USED ON USAID/GEORGIA ASSISTANCE PROJECTS OR BY BENEFICIARIES

PRIOR INFORMED CONSENT (PIC) PESTICIDES AND INDUSTRIAL CHEMICALS (HTTP://WWW.PIC.INT)

PIC Chemicals (40 chemicals, composed of: 29 pesticides—including 4 severely hazardous pesticide formulations—and 11 industrial chemicals)

Pesticides:

- 2,4,5-T and its salts and esters
- Aldrin
- Binapacryl
- Captafol
- Chlordane
- Chlordimeform
- Chlorobenzilate
- DDT
- Dieldrin
- Dinitro-ortho-cresol (DNOC) and its salts (such as ammonium salt, potassium salt and sodium salt)
- Dinoseb and its salts and esters
- 1,2-dibromoethane(EDB)
- Ethylene dichloride
- Ethylene oxide
- Fluoroacetamide
- HCH (mixed isomers)

- Heptachlor
- Hexachlorobenzene
- Lindane
- Mercury compounds including inorganic mercury compounds, alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds
- Monocrotophos
- Parathion
- Pentachlorophenol and its salts and esters
- Toxaphene
- Tributyltin compounds

Severely Hazardous Pesticide Formulations:

- Dustable powder formulations containing a combination of: benomyl at or above 7 per cent, carbofuran at above 10 per cent, thiram at or above 15 per cent.
- Methamidophos (Soluble liquid formulations of the substance that exceed 600 g active ingredient/l)
- Phosphamidon (Soluble liquid formulations of the substance that exceed 1000 g active ingredient/l and mixtures of (E)&(Z) isomers, (Z)-isomer, and (E)-isomer
- Methyl-parathion (emulsifiable concentrates (EC) at or above 19.5% active ingredient and dusts at or above 1.5% active ingredient)

Industrial Chemicals:

- Asbestos Crocidolite
- Asbestos Actinolite
- Asbestos Anthophyllite
- Asbestos Amosite
- Asbestos Tremolite
- Polybrominated biphenyls (PBBs, hexa- octa- and deca-)
- Polychlorinated biphenyls (PCB)
- Polychlorinated terphenyls (PCT)
- Tetraethyl lead
- Tetramethyl lead
- Tris (2,3-dibromopropyl) phosphate

PERSISTENT ORGANIC POLLUTANTS (POPS) PESTICIDES AND CHEMICALS (HTTP://WWW.POPS.INT)

Pesticides:

- Aldrin
- Chlordane
- Dichloro-Diphenyl-Trichloroethane (DDT)
- Dieldrin
- Endrin—*not on PIC list*
- Heptachlor
- Hexachlorobenzene
- Mirex—*not on PIC list*
- ToxapheneLindane

Industrial Chemicals:

- Polychlorinated Biphenyls (PCBs)
- Alpha hexachlorocyclohexane
- Beta hexachlorocyclohexane
- Chlordecone
- Hexabromobiphenyl
- Hexabromodiphenyl ether and heptabromodiphenyl ether (commercial octabromodiphenyl ether)
- Pentachlorobenzene
- Perfluorooctane sulfonic acid, its salts and perfluorooactane sulfonyl fluoride
- Tetrabromodiphenyl ether and pentabromodiphenyl ether (commercial pentabromodiphenyl ether)

Combustion (burning of plastics) Products:

- Dioxins—*not on PIC list* (formed by burning chlorine-based hydrocarbon chemical compounds, like any of the above chemicals)
  Furans—*not on PIC list* (formed by burning pentose compounds, especially plastics)
- * DDT may continue to be used for malaria control in interior residual spraying (IRS)

Also, note that pesticide endosulfan has been recommended by POPs 2010 Review Committee for addition to POPs treaty and targeted for global elimination.

Pesticide AIs not to be used in any products on any USAID projects (with exceptions):

- Insecticides containing the following AIs:
  - alpha cypermethrin/alphamethrin (not EPA registered; RUP)
  - aluminum phosphide (RUP, Class I)
  - bifenthrin (RUP for all EC formulations on only cotton due to toxicity risk to fish and aquatic organisms; OK for non-cotton uses, but do not use near open water)
  - bromopropylate (not EPA registered)
  - carbosulfan (not EPA registered)
  - chlorpyrifos-ethyl (EC formulations; all other formulations OK, but use safety equipment)
  - cypermethrin (not EPA registered)
  - deltamethrin (RUP only for use on cotton; all other uses OK, but use care near open water)
  - diazinon (RUP only for small fruits and berries; all other uses OK)
  - diflubenzuron (RUP only for all uses with Wettable Powder formulations due to risk to wildlife; all other formulations OK)
  - ehtoprop(hos) (Known Carcinogen)
  - fenazaquin (not EPA registered)
  - fenoxycarb (Known Carcinogen)
  - fensulfothion (not EPA registered)
  - fenthion (not EPA registered)
  - fenvalerate (not EPA registered)
  - lambda cyhalothrin (RUP for products named Karate; find other pesticide products containing lambda-cyhalothrin which are not RUP at: http://www.pesticideinfo.org/List_Products.jsp?Rec_Id=PC35463&Chem_Name=Cyhalothrin,%20lambda&PC_Code=128897)
  - methamidophos (not EPA registered; RUP; Class I toxin)
  - metam sodium (RUP; Class I; known carcinogen)
  - methomyl (do not use Class I products; use Class III products, do not use RUP products, see http://www.pesticideinfo.org/List_Products.jsp?Rec_Id=PC35109&Chem_Name=Methomyl&PC_Code=090301,%20549400)

  - methyl bromide (RUP; Class I toxin; Ozone depleting chemical)
  - phosalone (not EPA registered)
  - phosmet (Class I formulations; Classes II and III OK)
  - pirimiphos methyl (Class I toxin)
  - zeta cypermethrin (Some RUPs; Class I formulations, Classes II and III OK if not RUP, for products which are exceptions—not RUP, see http://www.pesticideinfo.org/List_Products.jsp?Rec_Id=PC38283&Chem_Name=Cypermethrin,%20zeta&PC_Code=129064)

- Miticides/Acaricide containing the following AIs
  - bifenthrin (RUP only for EC on cotton; all other formulations and crops OK, but do not use near water)
  - bromopropylate (not EPA registered)
  - carbosulfan (not EPA registered; Class I)
  - lambda cyhalothrin (RUP for products named Karate; find other pesticide products containing lambda-cyhalothrin which are not RUP at: http://www.pesticideinfo.org/List_Products.jsp?Rec_Id=PC35463&Chem_Name=Cyhalothrin,%20lambda&PC_Code=128897)
  - Nematocide containing the following AIs
  - ehtoprop(hos) (Known Carcinogen)
  - metam sodium (Class I toxin)
  - oxamyl (RUP; Class I)
  - Molluscicide (slugs/snails) containing the following AI:
  - metaldehyde (RUP)
  - Fungicide containing the following AIs:
  - aluminum phosphide (RUP, Class I)
  - benalaxyl (not EPA registered)
  - benalaxyl-M (not EPA registered)
  - bitertanol (not EPA registered)
  - captan (known carcinogen)
  - chlorothalonil (do not use Class I products; do not use concentrations of more than 50% due to eye injury risks)
  - cyneb/zineb (not EPA registered)
  - diniconazole (not EPA registered)

- dithianone (not EPA registered)
- dodemorph (not EPA registered)
- epoxiconazole (not EPA registered)
- flusilazole (not EPA registered)
- flutriafol (not EPA registered)
- folpet (known carcinogen)
- hexaconazole (not EPA registered)
- iprovalicarb (not EPA registered)
- Maleleuca alternifolia (not EPA registered)
- metam sodium (RUP; Class I; known carcinogen)
- methyl bromide (RUP; Class I toxin; Ozone depleting chemical)
- penconazole (not EPA registered)
- pencycuron (not EPA registered)
- propineb (not EPA registered)
- proquinazid (not EPA registered)
- tolyfluanid (not EPA registered)
- zineb/cyneb (not EPA registered)
- Herbicides containing the following AIs
- acetochlor (RUP; carcinogen)
- alachlor (RUP; carcinogen)
- amidosulfuron (not EPA registered)
- atrazine (known water pollutant)
- glyphosate--trimesium salt (not EPA registered)
- haloxyfop-R-methyl (not EPA registered; known carcinogen)
- isoxynil (not EPA registered)
- isoxadifen ethyl (not EPA registered)
- linuron (known carcinogen)
- metolachlor (known water pollutant)

- Field Rodenticides

- aluminum phosphide (RUP, Class I)
- flucoumarfen (not EPA registered)
- zinc phosphide (RUP, Class I)

ANNEX 9. TRAINING TOPICS AND SAFE PESTICIDE USE WEB RESOURCES

- GAP and IPM concepts, tactics and tools found in Annex 1 that can reduce pesticide use and associated risks on specific pests of Georgia IP target crops
- PMPs—Pest Management Plans: Making and using these farm crop-management tools
- Pest identification: How to recognize common important pests and diseases
- Regulations: International, Local and American treaties and laws that guide pesticide use
- Monitoring/Spot Treatments: The importance of frequent crop monitoring and use of spot treatments if needed (instead of crop-wide treatments)
- Natural pesticides: Raise awareness of and promote the use of natural pesticides found in Annexes 1, 4, 5 and 7 as well as green-label synthetic pesticides with relatively low risks
- REI—Re-Entry Intervals: Pesticide-specific risks associated with entering a sprayed field too soon after the spray operation
- MRL—Maximum Residue Level: Risks associated with pesticide residues on human food
- PHI—Pre-Harvest Interval: Pesticide-specific risks associated with harvesting a crop before pesticides have had a chance to break down
- Vulnerable individuals: The importance of keeping children, pregnant women, elderly and infirm away from the field while spraying and kept out after spraying
- Understanding pesticides: Types, classes, registration and acute toxicities of commonly-used pesticides
- MSDS: How to use MSDSs for pesticide-specific information on risks and risk reduction measures
- Human and environmental risks: Risks associated with more commonly-used pesticides (use information from MSDSs and Annex 7)
- When to spray: Early in the morning or late in the afternoon, without wind or rain
- Use of recommended PPE: Why it is used (see product MSDSs, product labels and web reference below)
- Safe Use: How to transport, store and use pesticides safely
- Maintenance: of PPE and sprayers

- Monitoring for the development of pesticide resistance
- Proper collection and disposal of pesticide rinsate and packaging (see disposal web reference below and MSDSs)
- The use of pesticide spray buffer zones or organic production near national parks or headwaters leading to rivers that enter national parks
- How to reduce and mitigate risks to critical environmental resources and biodiversity (found in PER Factors E and G)
- Honeybees: Ensuring pesticide applicators notify beekeepers about spray activities, and spray early morning or late afternoon when no heavy winds or rain are present
- Water Pollution: Raise awareness of pesticides (especially some herbicides) with high ground water contamination potential where water tables are high or easy to reach (use Annex 7 and MSDSs)
- Exposure routes: Ways pesticides enter the body and ways to mitigate entry
- Basic first aid: Understanding how to treat pesticide poisonings (see first aid web reference below and MSDSs)
- Record-keeping: Pesticide used, when used, which crop, how applied, who applied

Web Safe Pesticide Use Training Resources

- General Mitigation of Potential Pesticide Dangers General Measures to Ensure Safe Use: http://pdf.usaid.gov/pdf_docs/PNADK154.pdf, Chapter 13
- EPA Recommended Worker Protection Standards: http://www.epa.gov/oppfead1/safety/workers/equip.htm (all types of PPE)
- http://www.cdc.gov/nasd/docs/d001701-d001800/d001797/d001797.html (respiratory PPE)
- Routes of Pesticide Exposure and Mitigation of Risks:
- http://pdf.usaid.gov/pdf_docs/PNADK154.pdf, Chapter 13
- Basic First Aid for Pesticide Overexposure:
- http://pdf.usaid.gov/pdf_docs/PNADK154.pdf, Chapter 13
- International PIC & POPs Lists:
- PIC Pesticides and Industrial Chemicals (http://www.pic.int)
- POPs Pesticides and Chemicals (http://www.pops.int)
- Pesticide Disposal Options:
- http://www.epa.gov/oppfead1/labeling/lrm/chap-13.htm

APPENDIX 10. MONITORING FOR BEST PRACTICES ON GEORGIA BENEFICIARIES

Name of NARS Staff Responsible for Monitoring Demonstration Farms:

Name of Demonstration Farmer: Crop: Date:

What are the major pests encountered by the farmer?:

Which of the *attached* **Preventive and Curative GAP and IPM** tools and tactics are used by farmer?

Are pesticides used by demo farmer? Yes__ No__

How are pesticides applied? backpack sprayer__ other__

What are the names of the pesticides used?:

Which PPE does farmer have and use? gloves__ overalls __ boots__
mask__ goggles__

Has the farmer had Georgia IPM and Safe Pesticide Use training? Yes__ No__

Are there any empty pesticide containers scattered in the field? Yes__ No__

Are there signs that the backpack sprayer has leaks? Yes__ No__

Does the farmer understand the pesticide label information? Yes__ No__

Is the pesticide stored safely out of the house or away from kids? Yes__ No__

Does the farmer use gloves for mixing the pesticide with water? Yes__ No__

What time of the day is/are the pesticides applied? _____

Are pesticides applied during rain or windy conditions? Yes__ No__

Are women or children permitted to apply pesticides? Yes__ No__

Is there any evidence that empty pesticide containers are used to store water?

Yes__ No__

Does the farmer rinse equipment away from streams and open water?

Yes__ No__

Does the farmer wash clothes after applying pesticides? Yes__ No__

How does the farmer dispose of empty pesticide containers?

puncture/burry__ burn__

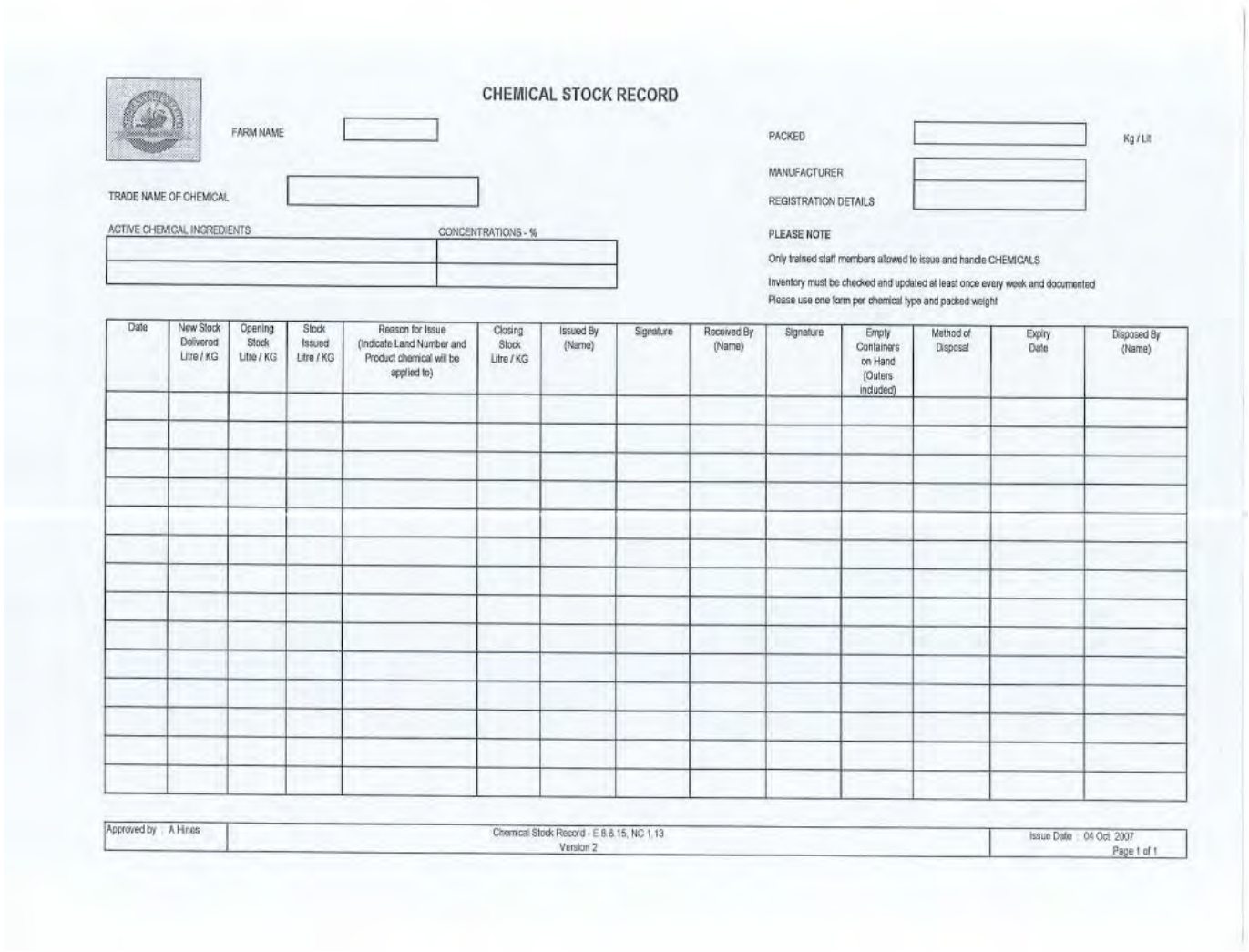
Is there any evidence that pesticides are becoming less effective? Yes__ No__

Preventive and Curative GAP and IPM options:

Preventive	Preventive	Curative
• Soil nutrient, texture and pH testing	• Farmer ability to correctly identify pest predators, parasites and diseases	• Mechanical insect control by hand picking
• Pest resistant/tolerant seed/plant variety	• Weekly field scouting to assess pest levels/damage	• Farmers make & apply local artisanal plant extracts (neem, pyrethroid, garlic, chili, other)
• Early/late plantings or harvestings to avoid pests	• Use of trap crops to trap and destroy pests	• Weed control by machine cultivation, hoe or hand
• Seed treatment with pesticides	• Removal/pruning of diseased or heavily infested plants/tree branches	• Purchase and release of predators or parasitoids to control major pests
• Soil moisture testing	• Planting parasite-attracting plants on field margins	• Use of pheromone traps to reduce overall pest levels
• Raised-bed production or mounding	• Put baits and use other practices to encourage predator/parasite build-up	• Use of pheromone inundation to confuse pest mating
• Irrigation and drip irrigation	• Use of pheromone traps to monitor pest levels	• Spot treatment of pest hotspots with insecticides, miticides or fungicides

• Use of natural fertilizers (manure, compost)	• Inter-planting crops with aromatic herbs (celery, cilantro, parsley, dill or local plants) that repel pests	• Area spraying (complete field coverage) using synthetic and natural insecticides, miticides or nematocides
• Use of purchased mineral fertilizers	• Mulching with organic materials or plastic to control weeds	• Use of synthetic and natural fungicides or bactericides
• Combinations of organic and mineral fertilizers	• Plant living barriers or bamboo/tree barriers on windward edge of field	• Use of herbicides for weed control
• Crop rotation	• Exclude insect pests by using vegetable tunnels and micro-tunnels	• Farm use of a locked storage building for pesticides
• Use of green manure crops	• Use of biodiversity or energy conservation practices	• Farmer use of pesticide in-ground compost trap for depositing and capturing spilled or leftover pesticides
• Farmer ability to correctly identify pests and their damage	• Crop stalks, residue and dropped fruit destruction or composting at end of season	• Farmer use of receptacle for empty pesticide bottle disposal

APPENDIX 11: FARM AND PROJECT RECORD KEEPING ASSOCIATED WITH PESTICIDE USE



CHEMICAL STOCK RECORD

FARM NAME

PACKED Kg / Lit

MANUFACTURER

REGISTRATION DETAILS

TRADE NAME OF CHEMICAL

ACTIVE CHEMICAL INGREDIENTS | CONCENTRATIONS - %

PLEASE NOTE

Only trained staff members allowed to issue and handle CHEMICALS

Inventory must be checked and updated at least once every week and documented

Please use one form per chemical type and packed weight

Date	New Stock Delivered Litre / KG	Opening Stock Litre / KG	Stock Issued Litre / KG	Reason for Issue (Indicate Land Number and Product chemical will be applied to)	Closing Stock Litre / KG	Issued By (Name)	Signature	Received By (Name)	Signature	Empty Containers on Hand (Outers included)	Method of Disposal	Expiry Date	Disposed By (Name)

Approved by : A Hines | Chemical Stock Record - E 8.6.15, NC 1.13 Version 2 | Issue Date : 04 Oct. 2007 Page 1 of 1

CHEMICAL APPLICATION INSTRUCTIONS - JOVAC

DATE | PRODUCT

LAND NUMBER | BLOCK NUMBER

CHEMI CHEMICAL PRODUCT(S) TO BE APPLIED	ACTUAL DOSAGE PER LAND	Water Vol.	Har. Int. day	Target	INSTRUCTIONS FOR APPLICATION

APPLICATION MACHINERY TO BE USED | Foliar Application | INSTRUCTION GIVEN BY (NAME) | SIGNATURE

WHO EXECUTED THE INSTRUCTION

NAME | SIGNATURE | Time of Spray Start | Finish

SUITABLE AND CLEAN PROTECTIVE CLOTHING

Gloves | Boots | Raincoa | Overall | Nose/ Mouth | Respirator | Eye Pro.

SPECIAL INSTRUCTIONS WHEN HANDLING CHEMICALS

Handling Dry Concentate | Handling Liquid Conc. | Water After Use | Keep Locked No Children | Chemical Are Dangero.

PROTECTIVE CLOTHING ISSUED TO

Name		Name		Name	
Signature		Signature		Signature	
Name		Name		Name	
Signature		Signature		Signature	

WAS THERE EXCESS SPRAY MIX? YES | NO

APPROXIMATE QUANTITY ____ Liters

WHAT HAVE YOU DONE WITH THE EXCESS SPRAY MIX? | EXECUTED BY (NAME)

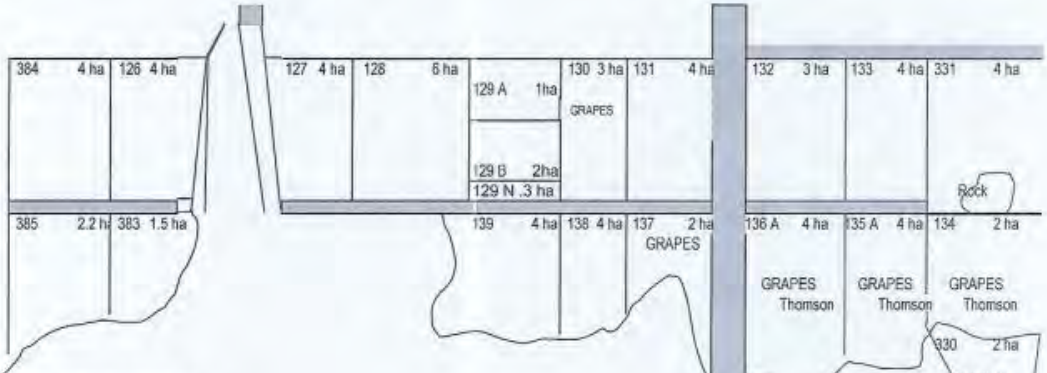
Spray Washing YES / NO

Lit of water

Location: Washing Disposal Area

Weather Conditions

Rain	Dry	Clody	Tempture	Sunny	Wind YES / NO



1.- Control Card for Pesticides Use.- This card will stay with farmer, to keep a record on the use of pesticide by crop.

Save the Children

CONTROL FORM FOR THE USE OF PERTICIDES

GENERAL DATA			
FARMERS NAME			
Community:	**Municipality:**	**Province:**	**Altitude:**
USE OF PESTICIDES - 1st TREATMENT			
CROP:		**SURFACE:**	
Pest to be treated	Name of material	Date and time of application	Quantity used
Environmental conditions:			
Justification for use			
Other recommended control measures			
Result of application			
NAME AND SIGNATURE OF IG AND NRM SUPERVISOR:			
USE OF PESTICIDES - 2nd TREATMENT			
CROP:		**SURFACE:**	
Pest to be treated	Name of material	Date and time of application	Quantity used
Environmental conditions:			
Justification for use			
Other recommended control measures			

PERSUAP REFERENCES:

Baker EL, Zack M, Miles JW, Alderman L, Warren M, Dobbins RD, Miller S, Teeters WR. 1978. Epidemic malathion poisoning in Pakistan malaria workers. The Lancet, January: 31–33.

WEBSITES: WEBSITE

International Treaties and Conventions:

POPs website: http://www.pops.int

PIC Website: http://www.pic.int

Basel Convention: http://www.basel.int/

Montreal Protocol: http://www.unep.org/OZONE/pdfs/Montreal-Protocol2000.pdf

Pakistan malaria poisonings: http://pdf.usaid.gov/pdf_docs/PNACQ047.pdf.

Pesticide poisonings:

http://www.panna.org/resources/panups/panup_20080403

http://magazine.panna.org/spring2006/inDepthGlobalPoisoning.html

IPM and PMP websites:

http://www.ipm.ucdavis.edu/

http://edis.ifas.ufl.edu/pg058

http://www.ipmcenters.org/pmsp/index.cfm

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/154769/Cotton-pest-management-guide-1.pdf

Pesticide Research Websites:

http://extoxnet.orst.edu/pips/ghindex.html (Extoxnet Oregon State database with ecotox)

http://www.agf.gov.bc.ca/pesticides/f_2.htm (all types of application equipment)

http://www.greenbook.net/Search/AdvancedSearch (pesticide Material Safety Data Sheets)

http://www.epa.gov/pesticides/reregistration/status.htm (EPA Registration Eligibility Decisions)

Ecotoxicity:

http://www.ohioline.osu.edu/hyg-fact/2000/2161.html (pesticide toxicity to honeybees)

http://wihort.uwex.edu/turf/Earthworms.htm (pesticide toxicity to earthworms)

Safety:

http://www.epa.gov/oppbppd1/biopesticides/ingredients/index.htm (EPA regulated biopesticides)

http://www.ipm.ucdavis.edu/index.html (IPM, PMPs and pesticide recommendations)

http://edis.ifas.ufl.edu/pdffiles/PI/PI07300.pdf (Restricted Use Pesticides)

http://www.epa.gov/pesticides/health/ (EPA Health & Safety)

http://www.epa.gov/opppmsd1/PPISdata/index.html (EPA pesticide product information)

Personal Protection Equipment (PPE):

http://www.epa.gov/oppfead1/safety/workers/equip.htm (all types of PPE)

http://www.cdc.gov/nasd/docs/d001701-d001800/d001797/d001797.html (respiratory PPE)

The Law Of The Georgian Republic About chemicalization and plant protection: http://www.libertas-institut.com/de/Mittel-

Osteuropa/Law%20about%20Chemicalization%20and%20Plant%20Protection.pdf

Resolution on Licensing of Activities for Manufacturing and Sale of Chemicals (in agrochemistry) (No. 467 of 1997): http://faolex.fao.org/docs/texts/kyr16699.doc

Decree implementing Government Decree No. 467 on licensing of activity on production and sale of chemicals (in agrochemical part) (No. 173 of 1997): http://faolex.fao.org/docs/texts/kyr16578.doc

Regulations regarding registration tests and registration of pesticides in the Georgian Republic:

http://faolex.fao.org/docs/texts/kyr16668.doc;

http://faolex.fao.org/docs/pdf/kyr16668anx.pdf

USAID Economic Prosperity Initiative (EPI)
6 Samghebro St.

Tbilisi, Georgia

Phone: +995 32 43 89 24/25/26

Fax: +995 32 43 89 27