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Inma Agribusiness Program

Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP)

Inma AGRIBUSINESS PROGRAM

September 2007

This report was produced for review by the United States Agency for International Development (USAID). It was prepared by a consortium led by The Louis Berger Group, Inc.

Contract No. 267-C-00-07-00500-00

PERSUAP

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September 2007

The *Inma* Agribusiness Program is made possible by the support of the American people through the United States Agency for International Development (USAID). Inma is implemented by a consortium led by The Louis Berger Group.

LIST OF ACRONYMS

ACIAR	Australian Center for International Agricultural Research
AID	US Agency for International Development (also known as USAID)
ANE	Asia and Near East Bureau of USAID
ARDI	Agriculture Reconstruction and Development Program for Iraq
ASTF	Arab Science and Technology Foundation
BEO	Bureau Environmental Officer
CABI	British Consortium for Overseas Pest Management
CAS	Chemical Abstract Service
CFR	Code of Federal Regulations
CGIAR	Consultative Group for International Agricultural Research
CPC	Crop Protection Compendium
DAI	Development Alternatives International
DCHA	Democracy, Conflict & Humanitarian Assistance (part of USAID)
DPR	California Department of Pesticide Regulation
EA	Environmental Assessment
EC	Emulsifiable Concentrasse (a pesticide formulation)
ENCAP	Environmental Assessment Capacity Building Program (Africa Bureau)
EPA	US Environmental Protection Agency (also known as USEPA)
EUREPGAP	European Good Agricultural Practices (also known as EUROGAP)
EXTOXNET	Oregon State University Ecotoxicology Network Pesticides Website
FAO	Food and Agriculture Organization (part of UN)
G	Granular (a pesticide formulation)
GEF	Global Environment Fund (of UN)
GOI	Government of Iraq
GUP	General Use Pesticide
ICARDA	International Center for Agricultural Research in the Dry Areas
ID	Identification
IEE	Initial Environmental Examination
INMA	in Arabic: “Growth”
IPM	Integrated Pest Management
IR	Intermediate Result (part of USAID strategic planning process)
IRMP	Iraq Marshlands Restoration Project
IVM	Integrated Vector Management
MEO	Mission Environmental Officer
NGO	Non-Governmental Organization
NRI	Natural Resources Institute (British Assistance)
OECD	Organization for Economic Cooperation and Development
OP	Organophosphate (a class of pesticides)
PAHO	Pan American Health Organization
PAN	Pesticide Action Network
PC Code	Pesticide Chemical Code
PER	Pesticide Evaluation Report
PERSUAP	Pesticide Evaluation Report and Safe Use Action Plan
PIC	Prior Informed Consent (a treaty, relates to pesticides)

POP	Persistent Organic Pollutants (a treaty, relates to toxic pesticides)
PUC	Pesticide Use Checklist
PVO	Private Volunteer Organization
Reg. 216	Regulation 216 (USAID Environmental Procedures)
REO	Regional Environmental Officer
RUP	Restricted Use Pesticide
S	Solution (a pesticide formulation)
SO	Strategic Objective (part of USAID strategic planning process)
SUAP	Safe Use Action Plan
TB	Tuberculosis
UN	United Nations
UNEP	United Nations Environment Program
UNFAO	United Nations Food and Agriculture Organization
UNWHO	United Nations World Health Organization
USAID	United States Agency for International Development
USEPA	US Environmental Protection Agency (also known as EPA)
VOA	Voice of America
WHO	World Health Organization
WP	Wettable Powder (a pesticide formulation)

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1. Pesticides have been used for many years on staple crops in Iraq or the Fertile Crescent; in fact some of the very first pesticides ever used, like sulfur (killed plant diseases), oils (killed insects—and sometimes people) and salt (killed weeds) were from Mesopotamia over 4,500 years ago. Crop constraints continue and so does the killing. There is some very limited experience with the philosophy and practice of integrated pest management (IPM) in Iraq, even though crops have been grown here for millennia. This PERSUAP has evaluated proposed and available pesticides and additional IPM measures in Iraq that can be used to manage pests of most crops grown in Iraq.

2. This PERSUAP recognizes the following crops produced in different parts of Iraq and pests of each crop.

DATE PALM

Diseases
Bayoud disease, *Fusarium oxysporum forma specialis albedinis*
Black scorch disease, *Ceratocystis paradoxa*
Diplodia disease, *Diplodia phoenicum*
Graphiola leaf spot, *Graphiola phoenicis*
Khamedj disease, *Mauginiella scattae*
Lethal yellowing
Bending head
Blacknose

Insects
Red Palm Weevil, *Rhynchophorus ferrugineus*
White scale, *Parlatoria blanchINMAi*
Red scale, *Phoenicococcus marlatti*
Caroub moth (Ver de la Datte), *Ectomyelois ceratoniae*
Rhinoceros beetle, *Oryctes rhinoceros*
The African palm weevil, *Rhynchophorus phoenicis*

Weeds
Haifa grass, *Imperata cylindrica*
Bermuda grass, *Cynodon dactylon*
Cyperus spp.
Chenopodium spp.
Juncus spp.
Johnson grass

ONION

Purple blotch, *Alternaria porri*
Root rots
Thrips, *Thrips tabaci*

Bollworm
Budworm, *Heliothis virescens*
Armyworm, *Spodoptera* species

FRENCH BEANS

Root rot, *Fusarium* species
Fruit borer
Aphids

PEAS

Powdery mildew
Pod borer

CAULIFLOWER

Fusarium wilt
Aphids
Diamond-back moth

CUCUMBER

Powdery mildew
Downy mildew
Aphids, green peach aphid
Fruit fly (vinegar flies), Drosophila spp.

CANOLA (RAPESEED)

Armyworm
Aphids

COTTON

Bollworms/Armyworms/Budworms, various species

APPLE

Coddling moth, *Cydia (Laspeyresia) pomonella*
San Jose Scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Green Apple Aphid, *Aphis pomi*
European Red Mite, *Panonychus ulmi*
Apple Lygus bug
Scab of apple, *Venturia inaequalis*
Powdery mildew, *Podosphaera leucotricha*
Sooty blotch

PEAR

Codling moth, *Cydia (Laspeyresia) pomonella*
Leafroller moth, *Platynota stultana*
Pear Psylla, *Cacopsylla (Psylla) pyricola* (secondary pest after coddling moth spray)
Scab of pear, *Venturia pirina*
Fireblight, *Erwinia amylovora*
Fruit fly, Rhagoletis pomonella
Pear Rust, *Gymnosporangium libocedri*

PEACH/APRICOT/PLUM

Oriental fruit moth, *Grapholitha molesta*
Green Peach Aphid, *Myzus persicae*
Stem borers
Peach Twig borer, *Anarsia lineatella*
Termites
Root rots
Powdery mildew
Shot hole disease, *Clasterosporium carpophilum*
Leaf curl, *Taphrina deformans*
Gummosis (canker)

CITRUS

Citrus canker
Citrus Die Back (transmitted by Asian Citrus Psyllid, *Diaphorina citri*)
Citrus Leaf-miners, *Phyllocnistis citrella*
San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Red Mite, *Panonychus citri*
Black spot, *GuignINMAa citricarpa*

WALNUT

Bacterial blight, *Xanthomonas campestris pv. juglandis*
Stem borer
Termites

GRAPES

Downy mildew, *Plasmopara viticola*
Powdery mildew,
Jassids (leafhoppers, vectors of disease)

BARLEY

Common bunt (Tilletia caries)
Stinking smut (Telletia foetida)
Loose smut (Ustilago tritici)
Stem rust (Puccinia graminis tritici)
Leaf rust (Puccinia recondita)
Suni bug or Sun Pest (Eurygaster spp), protease-injecting sucking bugs

Aphids (Aphis spp), sucking bugs
Leafhoppers, sucking bugs
Ants, chewing insects
Multiple weed species, Narrow-leaf weeds; Broad-leaf weeds
Rats, mice, moles, shrews and voles.

WHEAT

Sunn pest (*Eurygaster spp*.), aphids
Loose smut (*Ustilago tritici*); Cover smut or Karnal bunt (*Tilletia indica*); Rust (*Puccinia rapsodiinblus*).
Narrow-leaf weeds; Broad-leaf weeds; All weeds.
Rats, mice, moles, shrews and voles.

RICE

Rice blasts (*Magnaporthe grisea & Pyricularia grisea*), Sheath Blight, *Rhizoctonia solani*
Stem borers, several species; Aphids, several species; Rice Leaf roller; Grasshoppers, several species
Barnyard grass (*Echinochloa oryzicola*); Water grass (*Panicum crus-galli*); Cockspur grass (*Echinochloa crus-galli*);
Giant marine rat, mice, submarine mole, shrews and voles.

MAIZE

Stem rots (Charcoal, Diplodia, Fusarium, Gibberella, Nigrospora, and Anthracnose); Leaf blights
Stem borers; Sucking insects (aphids, mites, leafhoppers); Stem borers; Cutworms; Silk beetles
Annual weeds; Annual broad-leaf weeds; and some perennial weeds.
Rats, mice, moles, shrews and voles.

SORGHUM

Stem borer (*Busseola fusca and others*).
Rats, mice, moles, shrews and voles.

TOMATO

Tomato leaf miner (*Liriomyza spp.*); American bollworm (*Helicoverpa armigera*); White fly (*Bemisia tabaci & other spp*.); Aphid (multiple species).
Grey mold (*Botrytis cinerea*); General soil fungi; Alternaria stem canker (*Alternaria alternata f.sp lycopersici*); Fusarium crown rot and wilt (*Fusarium oxysporum f. sp. Lycopersici)*; Rhizoctonia damping off (*Rhizoctonia solani*); Blights (early *Alternaria solani*, late *Phytophthora infestans*); Septoria leaf spot (*Septoria lycosperisici*).
Nematodes: Root-knot nematode (*Meloidogyne spp.*), Tallywhacker nematode (*Rockyodooba boolongus*)

POTATO

Early blight, *Alternaria solani;* Late blight, *Phytophthora infestans;* Mosaic Diseases Caused By Potyviruses; Black scurf, *Rhizoctonia spp*.
Cutworm, Agrotis ipsilon; Armyworm; White grubs; Aphids, Green peach aphid: *Myzus persicae*; Potato aphid: *Macrosiphum euphorbiae; and* Jassids (leafhoppers)
Root-knot nematode (*Meloidogyne spp.*)

3. This PERSUAP approves for use on INMA crops:

Insecticides
Abamectin 18% EC (Vertimec) Syngenta
Carbaryl 10% D (Sevin) Generic
Carbaryl 85% WP (Sevin) Generic
Cyromazine 75% WP (Trigard, *an IGR*) Syngenta
Deltamethrin 1.25% ULV (Decis) Generic
Deltamethrin 2.5% EC (Decis) Generic
Diazinon 60% EC (Diazinon) Generic
Diazinon 10% G (Diazinon) Generic
Lambda Cyhalothrin 5% EC (Karate) Syngenta
Lambda Cyhalothrin (Warrior) Syngenta
Lufenuron 50% EC (Match, *an IGR*) Syngenta
Thiamethoxam 25% WG (Actara) Syngenta
Thiamethoxam 35% FS (Cruiser, *Seed Treatment*) Syngenta

Herbicides
Clodinafop propargyl + Cloquintocet-mexyl 10% EC (Topik) Syngenta
Dicamba 4% EC (Banvel) Syngenta
Dicamba + Triasulfuron 70% WG (Lintur) Syngenta
Glyphosate 48% SL (Touchdown) Generic
Glyphosate 36% SL (Groundup) Generic
Iodosulfuron-methyl-Na + Mesosulfuron-methyl + Mefenpyr diethyl 15% WG (Chevalier) Bayer Crop Science
Propanil 34% EC (Stam F34) Dow AgroSciences
S-Metolachlor + Atrazine 66% SC (Primagram Gold) Syngenta
Tribenuron-methyl 75% DF (Granstar) DuPont
Trifluralin 48% EC (Triflan) Generic

Fungicides
Cyprodinil + Fludioxinil 62.5% wg (Switch) Syngenta
Difenoconazole 3% WS (Score, *Seed Treatment*) Syngenta
Difenoconazole 25% EC (Score) Syngenta
Mancozeb 70% WP (Ridomil M72) Syngenta
Tebuconazole 2% DS (Raxil, *Seed Treatment*) Bayer Crop Science

All are actively EPA-registered and registered by Iraq for use by farmers if safety conditions for use are followed, and training (and some oversight) is provided. Do not rinse pesticide spray or safety equipment in or near open water. Do not use Phostoxin in enclosed areas—use only in

the open in the field for rodent control, not for stored grain pest control without training and safety equipment.

4. This PERSUAP also accepts use of additional low environmental impact EPA-approved pesticides:

* Spinosad (Tracer or Spintor, a bacterial extract) Dow Agrosciences
* *Bacillus thuringiensis* Valent Biosciences or Certis Company, or other products containing *Bt* for control of moth and butterfly larvae.
* Revancha 80 SL (extract of *Mimosa tenuflora*) fungicide and bactericide
* Biocontrol Marigold 75 SL (extract of *Tagetes spp*.)
* Citronol 20 SL (extract of citric seeds) fungicide and bactericide
* Allium 98 SL (extract of *Allium sativum*) systemic repellent
* Quasinol 75 SL (extract of *Quassia amara*) insecticide and larvicide
* Kanelite 30 SL (extract of *Cinnamomum zeylanicum*) contact acaricide
* Trichoderma, a biological fungicide
* Pyrethrum, a mix of natural pyrethrins extracted from Chrysanthemum flowers.
* Neem tree extracts, or azadirachtin
* Rotenone (root juice)
* Insecticidal soaps and oils.

5. Pesticides *Conditionally* Accepted (Condition=Users absolutely must receive training and a dual cartridge respirator with agreement to use them)

Aluminium (Aluminum) Phosphide
Zinc Phosphide

6. This PERSUAP rejects advising or use by INMA beneficiaries of the following:

Chinosol 50% SL (Beltanol) Probelte—not registered by USEPA.
Carbendazim 50% WP (Bavistin) BASF—not registered by USEPA.
Carbofuran 5% G (Furadan)—no longer registered by USEPA
Fenitrothion 50% EC (Sumithion) Sumitomo—RUP
Atrazine 50% WP (K & Z) Generic—RUP
Oxamyl 24% L (Vydate, *also a nematicide*) DuPont—RUP

7. No pesticides other than those listed above under numbers 3, 4 and 5 may be used by INMA beneficiary's crops in Iraq, unless the PERSUAP is amended to include additional, EPA-approved (and ideally Iraq-approved) for same or similar use, pesticides.

8. USAID recognizes and promotes—*as official policy*—Integrated Pest Management, or IPM.

Many IPM tactics that reduce pest risk are relatively simple agriculture best management practices (BMPs), such as:

- scouting, traps and monitoring to catch and manage pest outbreaks early;
- good plant health maintenance through water, soil, and nutrient management (raised-bed, plastic mulches, regulated drip irrigation/fertigation; plant, soil, nutrient, and water analyses);
- cultural practices like use of resistant varieties, pest avoidance through early/late plantings/harvestings, crop rotation, pruning, crop residue destruction, and destruction of pest refuge plants near field;
- biological control methods like parasite/predator enhancement through border plantings of favored refugia plants, use of pheromone releases for mating disruption, parasite releases, and microbial agent sprays (for larger farms);
- and mechanical control through exclusion netting or trapping.

CONCLUSIONS

Increased risks to human health and environment from pesticide use exist in Iraq due to several factors, key of which are:

- difficulty in enforcement of pesticide regulations;
- lack of affordable, comfortable PPE in pesticide shops;
- no use of PPE by people mixing and applying toxic pesticides;
- lack of good plant health, soil health, and water management practices;
- little or no understanding of IPM theory or principles;
- substandard quality pesticide products from small regional companies finding their way into local markets;
- pesticide product subdivision, or adulteration, with fillers, into smaller quantities and unapproved containers;
- illiteracy leading to inability to read or comprehend pesticide labels and safety warnings;
- poor quality labels on some products;
- inability to properly identify pests, their population levels, and economic thresholds;
- inadequate knowledge about pesticides and their dangers;
- need for more selective pesticides;
- children and women might apply pesticides or enter the field during the no-entry period;
- improper mixing and dosage leading to resistance buildup; among others.

These are the reasons that USAID requires compliance through a PERSUAP, with recommendations for IPM and safety training and use of safety equipment, among others, to begin to reduce risk and change attitudes and behaviors, which are difficult and take time to achieve. To reduce these risks, the following recommendations are provided.

Recommendations: The PERSUAP recommends the following actions for safer use of pesticides:

Immediately,

9. Hire an International IPM and pesticide safety consultant with extensive experience with USAID Environmental Assessments to come to Jordan (bring the INMA project staff to Amman) and provide training for project staff, and produce a quick reference guide for all of the pesticides to be used on each crop and anticipated pest.

10. Begin to investigate the potential use of more biological and organic pesticides, as practical.

11. Begin to write simple IPM plans for each of the crops to be protected, *noting that INMA has never used large quantities of pesticides in its activities, and promotes practical IPM strategies wherever possible.*

12. Produce simple safe use training materials and posters.

13. Continue to procure protective clothing and safety equipment for all pesticide handlers, mixers, and people who apply pesticides.

Continuously,

14. Rotate pesticides to reduce the build-up of resistance, as practical.

15. Monitor for resistance by noting reduction in efficacy of each pesticide product.

16. Monitor the health of laborers using organophosphorous compounds, if large quantities are applied.

By November 1, 2007,

17. Perform additional training in safe use of pesticides, IPM, and environmental protection, as needed for people not yet trained.

18. During training, administer the Pesticide Use Checklist (PUC) for NGOs/PVOs. Use this information for improved pesticide management.

By Summer 2008,

19. As practical, phase out the use of Restricted Use Pesticides (RUP) and do not recommend to farmers or the general public.

By End of Project or for further Project Extension

20. Annually update changes to pesticides lists and communicate these changes to USAID.

SECTION 1: INTRODUCTION TO INMA PERSUAP

1.1 PURPOSE AND SCOPE FOR AN IEE/PERSUAP FOR INMA

It was the death of 5 Pakistani Ministry of Health workers in 1976 during USAID anti-malaria spray campaigns that led USAID to develop regulations that dictate risk reduction to protect human health and safety, and environmental protection. In addition to the 5 deaths, about 2,800 sub-lethal poisonings occurred that season. These could have been avoided with simple risk awareness and reduction training, protective gear, along with knowledge of pesticide sourcing and testing. The environmental regulations that were codified by USAID to mitigate such risks are referred to as Regulation 216.

US GOVERNMENT REGULATION 216 COMPLIANCE

The US Government's Title 22, Code of Federal Regulations, Part 216, also known as 'Regulation 216', finds that certain environmental compliance procedures and a process must be followed on overseas projects to:

- 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, and
- comply with the law

Now, following 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). And because of risk concerns presented by pesticides, the USAID environmental regulations require that at least the 12 factors outlined in the Pesticide Procedures described in 22 CFR 216.3 (b)(1)(i) (a through l) be addressed in the IEE for any program that includes assistance for the procurement or use of pesticides. The Asia Near East Bureau asks that these factors be examined in a particular type of technical analysis document, termed a "Pesticide Evaluation Report and Safer Use Action Plan" (PERSUAP), which is submitted as an attachment to a short summary IEE (the IEE itself can be very brief, with the analytical work contained in the attached PERSUAP).

The PERSUAP focuses on the particular circumstances of the program in question, the pesticide system within which the program operates, the risk management choices available, and how a risk management plan would be implemented in the field. Further details about what to include in a PERSUAP are given below.

In the USA, when the Environmental Protection Agency (EPA) registers pesticides for use, it specifies the manner in which the product can be "safely" used (that is, with an acceptably small

risk), including safety equipment needed when applying the pesticide, how to apply it, the allowed uses, storage, transport, and disposal. But the context in which EPA makes these registration decisions is important to note. An extensive system of capabilities and resources exist in the USA that help give EPA confidence these specifications will be followed and the product will be used appropriately. These include a 97% literacy rate—meaning most of the population can read labels (contrast this with only 47% adult literacy for the population of Iraq, with most of the literacy occurring in big cities away from agricultural areas); close control by EPA over the content of the pesticide label; training requirements and programs for those pesticide products that require applicator certification—like for many EPA acute toxicity class I or II pesticides and Restricted Use Pesticides (RUP); worker protection requirements; occupational safety regulations; and relatively effective federal, state and local enforcement mechanisms.

In Asian countries, a local-level analysis and evaluation such as a PERSUAP is needed for pesticide use because farmers and other field workers in these countries are unlikely to have a high rate of literacy or training in order to adequately understand risks of using pesticides, and implement means to reduce these risks. They may not be able to read or understand pesticide labels even if they are present. And, like in 1976, dangerous formulations of pesticides containing very toxic byproducts, or adultered products with unknown or low quality components may enter the country and be used by unsuspecting project staff or recipients.

In allowing the use of certain pesticides in its overseas programs, USAID cannot rely on the same societal capabilities and resources that the USEPA does to assure appropriate use of the product. The preparation of a PERSUAP gives an I-LED program manager the opportunity to consider practical actions by which to *reduce the risks* of using pesticide products in a program in Iraq, taking into consideration the context in which the products will be used, the particular elements of the program, and the different capacities of the partners and stakeholders involved.

WHO PREPARES A PERSUAP?

Recipients of USAID funds are responsible for due diligence so that their activities do not harm the environment or human health. Thus, they assist with collecting local information and hire a pesticide system expert familiar with USAID regulations and developing country pesticide issues to analyze the information and recommend best practices for reducing risks and complying with US law. A PERSUAP analyzes the pest management choices available in the context of the larger pesticide system in the country, and identifies risks and ways to reduce these risks.

At the AID field mission, the Cognizant Technical Officer (CTO) and Mission Environmental Officer (MEO) are generally responsible for assuring that environmental review requirements for their programs are met, including tracking and approving IEE/PERSUAPs, and monitoring progress of the projects in meeting recommendations and timelines. Once the IEE/PERSUAP is reviewed and accepted by the CTO and MEO, it is recommended for approval by the Mission Director (MD), who then submits the document to the Bureau Environmental Officer (BEO) in Washington for approval and tracking.

COMPONENTS OF AN ACTIVITY-LEVEL PERSUAP

A PERSUAP basically consists of two parts, a “PER” and a “SUAP.” The Pesticide Evaluation Report (PER) section addresses the background and pesticide system in Iraq to inform stakeholders and partners of the levels and types of risk likely to be found, and sets the stage for the specific pesticide analysis. It then analyzes integrated pest and pesticide management options in Iraq by vetting these through Regulation 216’s special section on Pesticide Procedures with 12 informational elements. Note that the use of Integrated Pest Management is USAID Policy, thus it is emphasized throughout the analyses, and must be a focus of all assistance programs that donate pesticides or advice on pesticides.

The Safer Use Action Plan (SUAP) puts the conclusions reached in the PER into recommendations for plans of action, including assignment of responsibility to appropriate parties connected with the pesticide program. This PERSUAP supporting a pesticide IEE for agriculture activities for local consumption and markets in Iraq is being submitted specifically to address uses of pesticides, as listed below.

1.2 BACKGROUND AND INMA PROJECT DESCRIPTION

Agriculture is Iraq's largest employer, the second largest contributor to GDP, and an effective engine for promoting stability through private sector development, poverty reduction, and food security. The revival of a dynamic, market-driven agricultural sector will strengthen private business, increase income and employment opportunities, and help meet the food requirements of the Iraqi people. From 2003 through the fall of 2006, USAID's Agriculture Reconstruction and Development Program for Iraq (ARDI) restored veterinary clinics, introduced improved cereal grain varieties, and repaired agricultural equipment, and trained farmers and ministry staff. USAID recently initiated a new agriculture program, INMA. The new program will extend the production improvements made by ARDI by working at the provincial level to support the development of agribusinesses and agricultural markets, improving farmer livelihoods. INMA will Complement USAID's other economic growth programs.

INMA: REVITALIZING IRAQ'S AGRIBUSINESS SECTOR

Complementing USAID's other economic growth programs, USAID's new agriculture program, INMA, will work in the provinces to support the development of agribusinesses and agricultural markets, improving farmer livelihoods and energizing Iraq's single largest source of employment and second largest value sector. Valued at $343 million, INMA is a three-year project with two one-year option periods.

Meaning "growth" in Arabic, INMA will help build meaningful linkages between farmers, agribusinesses, financial services, and domestic and international markets. Technical advisors will support national and local government agencies as they adapt to the rapidly evolving legal, regulatory, and public service needs of a free market economy. By promoting public-private partnerships and dialogue, INMA will stimulate local and national policy-making that underpins free market economic growth.

Helping Iraqis transform local economies, INMA will work in close coordination with Provincial Reconstruction Teams and other provincial initiatives on the development of agribusinesses and value-added processing. Specifically, INMA will:

- Improve agricultural quality and productivity. INMA will train farmers on modern technical practices to achieve better yields for their crops and more productive livestock.
- Restore soil and water management systems. Program efforts will also support farmers as they restore poorly functioning drainage facilities and improve irrigation practices.
- Increase the competitiveness of Iraqi agribusinesses. INMA will assist Iraqis as they improve food grades and standards for sanitary and phytosanitary certification protocols, inspection procedures, and compliance criteria.
- Increase domestic and foreign partnerships. INMA advisors will support the Iraqi private sector as it establishes needed linkages with foreign enterprises and international markets.

1.3 COUNTRY BACKGROUND

Between Iran and Kuwait, with borders on Syria, Saudi Arabia, Jordan and Turkey, Iraq is a Middle East country, also bordering the Persian Gulf in the South. It is mostly broad plains; reedy marshes along Iranian border in south with large flooded areas; mountains along borders with Iran and Turkey. The climate is mostly desert; mild to cool winters with dry, hot, cloudless summers; northern mountainous regions along Iranian and Turkish borders experience cold winters with occasionally heavy snows that melt in early spring, sometimes causing extensive flooding in central and southern Iraq. Primary agricultural products have included wheat, barley, rice, vegetables, dates, cotton, cattle, sheep, and poultry. In fact, parts of Mesopotamia were known by Roman Soldiers as the "Green Zone" long before the present time due to fertile river-side alluvial soils covered with green vegetation and swaying palms, owing to very tranquil surroundings.

Iraq has abundant resources of land and water, which has made agriculture one of the largest sectors of the country's economy, providing employment for up to 40 percent of the labor force when supporting agri-businesses are included. However, over the last 20 years agricultural production has dropped dramatically due to unsustainable efforts at wheat self-sufficiency, government control of wheat input and marketing systems, the supply of imported food under the oil-for-food program, reduction in personal incomes, and a lack of general support to agricultural development by the government.

Over half of Iraq's food requirement is currently imported. Although all Iraqis are entitled to receive a monthly food ration of basic commodities, elements of the ration are not always provided on time, and poor families often sell some of the ration in order to obtain income for other necessities. A large proportion of the population is thus affected by food insecurity, while the imported food for the ration continues the oil-for-food program disincentive to local food production, particularly wheat and rice.

While water supply in rivers and dams is adequate, distribution systems for irrigation are inefficient, and water quality is reduced due to saline drainage water entering the system from agricultural lands, and urban and industrial effluent.

The agriculture sector holds tremendous potential for the future however. Twenty seven percent of Iraq's total land area is suitable for cultivation, over half of which is rain-fed while the balance is irrigable. The U.S. Department of Agriculture (USDA) estimates that only half of this irrigable land is currently under cultivation, leaving room for tremendous growth. This lack of resource utilization is attributed to a lack of farm machinery, equipment, water shortages, low technology uptake, and a lack of profit incentive. The cost of the annual food rations provided to Iraqis is estimated at over $4 billion per year. Wheat, barley, and chickpeas are the primary staple crops. Iraq was once self-sufficient in agriculture and was also the world's number one exporter of dates. Research and training activities are needed to initiate market liberalization, competitive production, and phasing out of state subsidies.

USAID's goals are to work in conjunction with Iraqi ministries, the private sector, and higher education institutions to revitalize agricultural production, stimulate income and employment generation, nurture rural initiatives, and rehabilitate the natural resource base.

1.4 PRIORITY GEOGRAPHIC PLACES OR AREAS OF PROJECT INTERVENTION

The INMA Program for Iraq will cover relatively large areas of the country. Each input is thus used over a range of climate, soil, hydrology, geography, flora, and fauna conditions. Climatic conditions are outlined below.

The climate in Iraq is similar to that of the extreme southwest United States with hot, dry summers and cold winters. Roughly 90% of the annual rainfall occurs between November and April, most of it in the winter months from December through March. The remaining six months, particularly the hottest ones of June, July, and August, are dry.

The mountains of the north and northeast are characterized by warm summers and cold winters. Precipitation occurs mainly in winter and spring, with minimal rainfall in summer. Annual precipitation ranges from 40 to 100 cm. Temperatures range from daily means of 40F (5C) in the winter to 100F (38C) in the summer.

The rolling upland (foothill) region to the north and northeast has is basically no precipitation in the summer and showers in the winter. The winter rainfall normally averages about 38 cm. Temperatures range from daily means of 40F (5C) in the winter to 110F (43C) in the summer.

The alluvial plain of the Tigris and Euphrates rivers in the centre and southeast receives most of its precipitation in the winter and early spring. The average annual rainfall for this area is only about 10 to 17 cm. Temperatures range from daily means of 40F (5C) in the winter to 110F (43C) in the summer.

1.5 USAID DEVELOPMENT PARTNERS INVOLVED IN PROJECT AND INFLUENCED BY PERSUAP

INMA will work primarily through the Ministry of Agriculture (MOA), NGOs and business and farmer associations, and directly with farmers.

1.6 STUDY METHODOLOGY

Consultant was contacted in July of 2007 by ARD about the need for a PERSUAP for INMA crops. The SOW for this job is attached as Attachment 1. Information requests for crops, pests and pesticides were sent to the INMA project staff to begin the process. It was decided to do this study without a field trip to Iraq; rather it would be done with information requests to Iraqi colleagues and through web searches.

The USAID Environmental Procedures for pesticide “use” (as provided by USAID Environmental Procedures: Text of Title 22, Code of Federal Regulations Part 216, Reg. 216), suggest that all projects involving assistance for the procurement or use, or both, of pesticides shall be subject to the procedures prescribed in 22 CFR 216.3 (b)(1)(i)(a-l). “Use” is interpreted broadly to include the handling, transport, storage, mixing, loading, application, clean up of spray equipment, and disposal of pesticides, as well as the provision of fuel for transport of pesticides, and providing technical assistance in pesticide management.

"Use" is said to occur if training curricula include information on safer pesticide use even if it does not involve actual application of pesticide. It also applies if pesticide procurement is facilitated by credit or loans. USAID also strongly encourages including instruction in IPM and alternatives to pesticides in any training on pesticide use as defined above. Under this approach, pesticides are considered a tool of 'last resort' and pesticide choice should as far as feasible be the 'least toxic' choices. In contrast, support to limited pesticide research and pesticide regulatory activities are not subject to scrutiny under the pesticide procedures.

This definition of "use" applies throughout this PERSUAP document.

The USAID pesticide procedures also indicate that 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 (IEE) 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.

The rationale for a PERSUAP- type of environmental review (as opposed to a full-scale Environmental Assessment) is that the affected projects are reviewed and an IEE approved for all other activities in the programs. The IEE approves Categorical Exclusions and Negative Determinations with Conditions as appropriate to each case, with deferrals for pesticide use pending completion of PERSUAPs. The other rationale is that the pesticides are used under tight management, with well laid conservation practices, guided by trained and experienced members of staff who implement actions in the SUAP.

Pesticides are defined as synthetic *or natural product-derived* chemical products intended to kill, control, and repel insects, plant diseases, weeds, and other pest organisms. Attachment 3 includes natural plant-derived pesticides that EPA has in the past evaluated.

The PERSUAP analysis will cover those pesticides proposed for use by the project that are, at minimum: registered by USEPA for the same *or similar* uses without restrictions; registered by the local government, if possible; available in the country; and alternate pesticide choices available in the region that could be used if registered and imported. It will also specifically list project-proposed pesticides that are *rejected for use* by the study, with reason(s) for rejection.

SECTION 2: CROPS, PESTS AND PESTICIDES

2.0 CROPS

Dates
Onion
French beans
Peas
Cauliflower
Cucumber
Canola (rapeseed)
Cotton
Apple

Pear
Peach/apricot/plum
Citrus
Walnut
Grapes
Barley
Wheat
Rice
Maize
Sorghum
Tomato
Potato

2.1 PEST CHALLENGES/PRODUCTION CONSTRAINTS OF EACH CROP

DATE PALM

Diseases
Bayoud disease, *Fusarium oxysporum forma specialis albedinis*
Black scorch disease, *Ceratocystis paradoxa*
Diplodia disease, *Diplodia phoenicum*
Graphiola leaf spot, *Graphiola phoenicis*
Khamedj disease, *Mauginiella scattae*
Lethal yellowing
Bending head
Blacknose

Insects
Red Palm Weevil, *Rhynchophorus ferrugineus*
The African palm weevil, *Rhynchophorus phoenicis*
White scale, *Parlatoria blanchINMAi*
Red scale, *Phoenicococcus marlatti*
Caroub moth (Ver de la Datte), *Ectomyelois ceratoniae*
Rhinoceros beetle, *Oryctes rhinoceros*

Weeds
Haifa grass, *Imperata cylindrica*
Bermuda grass, *Cynodon dactylon*
Cyperus spp.
Chenopodium spp.
Juncus spp.
Johnson grass

ONION

Purple blotch, *Alternaria porri*
Root rots
Thrips, *Thrips tabaci*

Bollworm
Budworm, *Heliothis virescens*
Armyworm, *Spodoptera* species

FRENCH BEANS

Root rot, *Fusarium* species
Fruit borer
Aphids

PEAS

Powdery mildew
Pod borer

CAULIFLOWER

Fusarium wilt
Aphids
Diamond-back moth

CUCUMBER

Powdery mildew
Downy mildew
Aphids, green peach aphid
Fruit fly (vinegar flies), Drosophila spp.

CANOLA (RAPESEED)

Armyworm
Aphids

COTTON

Bollworms/Armyworms/Budworms, various species

APPLE

Coddling moth, *Cydia (Laspeyresia) pomonella*
San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Green Apple Aphid, *Aphis pomi*
European Red Mite, *Panonychus ulmi*
Apple Lygus bug
Scab of apple, *Venturia inaequalis*
Powdery mildew, *Podosphaera leucotricha*
Sooty blotch

PEAR

Codling moth, *Cydia (Laspeyresia) pomonella*
Leafroller moth, *Platynota stultana*
Pear Psylla, *Cacopsylla (Psylla) pyricola* (secondary pest after coddling moth spray)
Scab of pear, *Venturia pirina*
Fireblight, *Erwinia amylovora*
Fruit fly, Rhagoletis pomonella
Pear Rust, *Gymnosporangium libocedri*

PEACH/APRICOT/PLUM

Oriental fruit moth, *Grapholitha molesta*
Green Peach Aphid, *Myzus persicae*
Stem borers
Peach Twig borer, *Anarsia lineatella*
Termites
Root rots
Powdery mildew
Shot hole disease, *Clasterosporium carpophilum*
Leaf curl, *Taphrina deformans*
Gummosis (canker)

CITRUS

Citrus canker
Citrus Die Back (transmitted by Asian Citrus Psyllid, *Diaphorina citri*)
Citrus Leaf-miners, *Phyllocnistis citrella*
San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Red Mite, *Panonychus citri*
Black spot, *GuignINMAa citricarpa*

WALNUT

Bacterial blight, *Xanthomonas campestris pv. juglandis*
Stem borer
Termites

GRAPES

Downy mildew, *Plasmopara viticola*
Powdery mildew,
Jassids (leafhoppers, vectors of disease)

BARLEY

Common bunt (*Tilletia caries*)
Stinking smut (*Telletia foetida*)
Loose smut (*Ustilago tritici*)
Stem rust (*Puccinia graminis tritici*)
Leaf rust (*Puccinia recondita*)

Suni bug or Sun Pest (*Eurygaster spp*), protease-injecting sucking bugs
Aphids (*Aphis spp*), sucking bugs
Leafhoppers, sucking bugs
Ants, chewing insects
Multiple weed species, Narrow-leaf weeds; Broad-leaf weeds
Rats, mice, moles, shrews and voles.

WHEAT

Sunn pest (*Eurygaster spp*.), aphids
Loose smut (*Ustilago tritici*); Cover smut or Karnal bunt (*Tilletia indica*); Rust (*Puccinia rapsodiinblus*); Web smut (*Daeigtininer situaslius*).
Narrow-leaf weeds; Broad-leaf weeds; All weeds.
Rats, mice, moles, shrews and voles.

RICE

Rice blasts (*Magnaporthe grisea & Pyricularia grisea*), Sheath Blight, *Rhizoctonia solani*
Stem borers, several species; Aphids, several species; Rice Leaf roller; Grasshoppers, several species
Barnyard grass (*Echinochloa oryzicola*); Water grass (*Panicum crus-galli*); Cockspur grass (*Echinochloa crus-galli*);
Giant marine rat, mice, submarine mole, shrews and voles.

MAIZE

Stem rots (Charcoal, Diplodia, Fusarium, Gibberella, Nigrospora, and Anthracnose); Leaf blights
Stem borers; Sucking insects (aphids, mites, leafhoppers); Stem borers; Cutworms; Silk beetles
Annual weeds; Annual broad-leaf weeds; and some perennial weeds.
Rats, mice, moles, shrews and voles.

SORGHUM

Stem borer (*Busseola fusca and others*).
Rats, mice, moles, shrews and voles.

TOMATO

Tomato leaf miner (*Liriomyza spp.*); American bollworm (*Helicoverpa armigera*); White fly (*Bemisia tabaci & other spp*.); Aphid (multiple species).
Grey mold (*Botrytis cinerea*); General soil fungi; Alternaria stem canker (*Alternaria alternata f.sp lycopersici*); Fusarium crown rot and wilt (*Fusarium oxysporum f. sp. Lycopersici)*; Rhizoctonia damping off (*Rhizoctonia solani*); Blights (early *Alternaria solani*, late *Phytophthora infestans*); Septoria leaf spot (*Septoria lycosperisici*).
Nematodes: Root-knot nematode (*Meloidogyne spp.*), Tallywhacker nematode (*Rockyodooba boolongus*)

POTATO

Early blight, *Alternaria solani;* Late blight, *Phytophthora infestans;* Mosaic Diseases Caused By Potyviruses; Black scurf, *Rhizoctonia spp*.
Cutworm, Agrotis ipsilon; Armyworm; White grubs; Aphids, Green peach aphid: *Myzus persicae*; Potato aphid: *Macrosiphum euphorbiae; and* Jassids (leafhoppers)
Root-knot nematode (*Meloidogyne spp.*)

2.2 PESTS OF STORED PRODUCTS, IF APPLICABLE

Grain Moth, *Sitotroga cerealella*
Rice Moth, *Corcyra cephalonica*
Indian Meal Moth, *Plodia interpunctella*
Almond Moth, *Cadra cautella*
Khapra Beetle, *Trogoderma granarium*
Rice weevil, *Sitophilus oryzae*
Rust-red Flour Beetle, *Tribolium castaneum*
Laser grain Borer, *Rhizopertha dominica*
Pulse Beetle, *Callosobruchus chinensis*

Rodents (Rats, Mice, Shrews, Voles and Moles)

2.3 HISTORY OF MAGNITUDE OF PEST PROBLEMS IN COUNTRY

Information on Iraq's crop losses is very hard to come by, since the country has been relatively closed to the outside world for the past 15 years. Little has changed since 2005 when the very successful ARDI project, which was served by very competent and knowledgeable staff, accomplished a lot toward understanding and assisting the agriculture of Iraq. Drought has been responsible for large losses in the past. Sunn pest also could also result in upwards of 100% losses in wheat and barley in the absence of controls, according to the FAO. Wheat and barley are unquestionably Iraq's most important food crops. Both are vulnerable to fungus and crop losses ranging from 10 to 30 per cent if seeds are not treated. Flour produced from infected grain is grey in color and contains toxins that make it unfit for human consumption. In past years, Iraqi farmers were given treated seeds as well as fungicides to cover any additional needs.

2.4 HISTORY OF IPM & CROP PROTECTION RESEARCH AND DEVELOPMENT RELEVANT TO CROPS, PESTS, PESTICIDES IN THIS STUDY

From 2005 to 2007, the ARDI Project, with the very talented and capable Tony Treen, provided numerous crop protection, pesticide safety, and IPM courses for farmers and Iraqi government officials. Before then, there were very few IPM courses or programs implemented in Iraq in the past 15 years. FAO, NRI, ACIAR and ICARDA have worked on IPM for various pests, including sun pest in the Middle East, which will benefit Iraq. The USA has also recently contributed to the production of IPM proposals through the Arab Science and Technology Foundation (ASTF) at http://www.astf.net/site/news/news_dtls.asp?news_id=1030&ogzid=10000 .

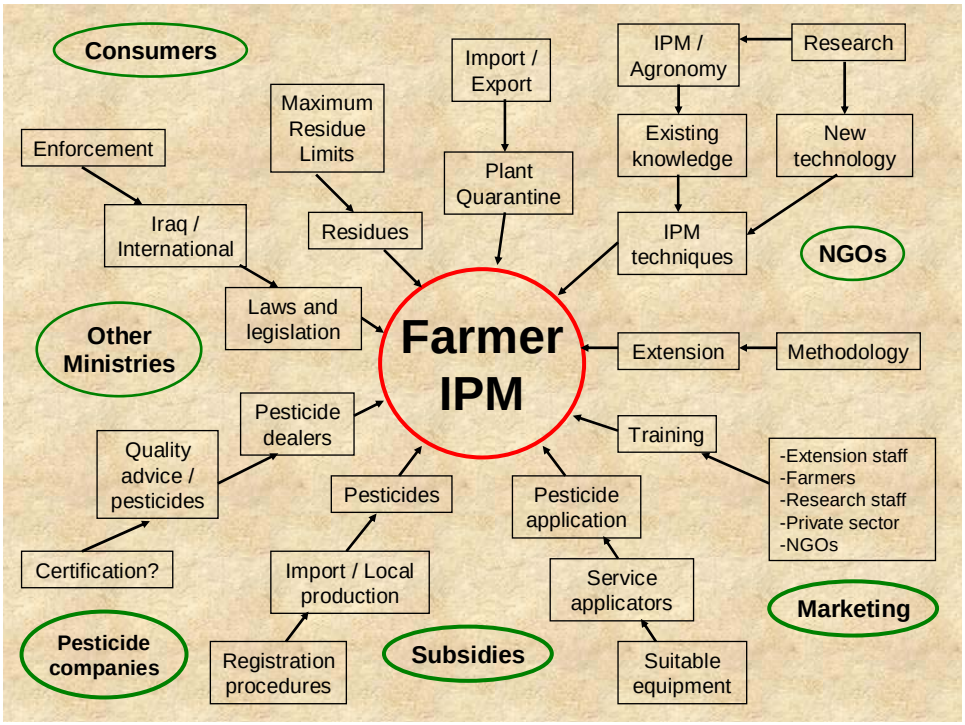
Most of the IPM theoretical training and knowledge exists in Iraq through well-educated individuals in government, universities, and international projects. Most farmers and farm laborers have not had such formalized training. General IPM tactics are summarized below.

GENERAL IPM TACTICS

The philosophy and practice of IPM makes use of combinations of the following tactics: cultural (use of resistant varieties, crop rotation, variation in time of planting or harvesting, crop refuse destruction, pruning, planting trap crops), mechanical (hand destruction, exclusion by barriers, trapping), physical (heat, cold, humidity, traps, sound), and biological (introduction and/or protection of imported or indigenous natural enemies of pests, propagation and dissemination of microbial control agents).

IPM can also include use of: natural chemical methods (by using attractants including pheromones, repellents, sterilants and growth inhibitors), genetic methods (propagation and release of sterile or genetically incompatible pests), and regulatory means (plant and animal quarantines, suppression and eradication programs) to the extent possible while permitting the safe integration of pesticides with farmers' traditional cropping and pest management systems. Below is a diagram produced by Tony Treen showing all the possible issues revolving around—and influencing—farmer IPM.

FIGURE 1: ISSUES IMPACTING FARMER IPM



2.5 VIABLE AND PRACTICAL IPM OPTIONS TO USE, TO TEST AND TO POTENTIALLY INTEGRATE

SPECIFIC IPM TACTICS

Attachment 2, found at the end of this report, contains practical IPM methods that may be used for many of the pests found on crops in Iraq. These are techniques and technologies being used on crops in developed and developing countries around the world and are proposed because they work.

Note that many of the farm field best management practices (BMPs) or good agriculture practices (GAP) for most crops recommend relatively easy-to-implement activities like use of:

- scouting, traps and monitoring to catch and manage pest outbreaks early;
- good plant health maintenance through water, soil, and nutrient management (raised-bed, plastic mulches, regulated drip irrigation/fertigation; plant, soil, nutrient, and water analyses);
- cultural practices like use of resistant varieties, pest avoidance through early/late plantings/harvestings, crop rotation, pruning, crop residue destruction, and destruction of pest refuge plants near field;

- biological control methods like parasite/predator enhancement through border plantings of favored refugia plants, use of pheromone releases for mating disruption, parasite releases, and microbial agent sprays (for larger farms);
- and mechanical control through exclusion netting or trapping.

2.5 PESTICIDES ACCEPTED FOR USE BY THE INMA PROJECT

Insecticides
Abamectin 18% EC (Vertimec) Syngenta
Carbaryl 10% D (Sevin) Generic
Carbaryl 85% WP (Sevin) Generic
Cyromazine 75% WP (Trigard, *an IGR*) Syngenta
Deltamethrin 1.25% ULV (Decis) Generic
Deltamethrin 2.5% EC (Decis) Generic
Diazinon 60% EC (Diazinon) Generic
Diazinon 10% G (Diazinon) Generic
Lambda Cyhalothrin 5% EC (Karate) Syngenta
Lambda Cyhalothrin (Warrior) Syngenta
Lufenuron 50% EC (Match, *an IGR*) Syngenta
Thiamethoxam 25% WG (Actara) Syngenta
Thiamethoxam 35% FS (Cruiser, *Seed Treatment*) Syngenta

Herbicides
Clodinafop propargyl + Cloquintocet-mexyl 10% EC (Topik) Syngenta
Dicamba 4% EC (Banvel) Syngenta
Dicamba + Triasulfuron 70% WG (Lintur) Syngenta
Glyphosate 48% SL (Touchdown) Generic
Glyphosate 36% SL (Groundup) Generic
Iodosulfuron-methyl-Na + Mesosulfuron-methyl + Mefenpyr diethyl 15% WG (Chevalier) Bayer Crop Science
Propanil 34% EC (Stam F34) Dow AgroSciences
S-Metolachlor + Atrazine 66% SC (Primagram Gold) Syngenta
Tribenuron-methyl 75% DF (Granstar) DuPont
Trifluralin 48% EC (Triflan) Generic

Fungicides
Cyprodinil + Fludioxinil 62.5% wg (Switch) Syngenta
Difenoconazole 3% WS (Score, *Seed Treatment*) Syngenta
Difenoconazole 25% EC (Score) Syngenta
Mancozeb 70% WP (Ridomil M72) Syngenta
Tebuconazole 2% DS (Raxil, *Seed Treatment*) Bayer Crop Science

All are actively EPA-registered and registered by Iraq for use by farmers if safety conditions for use are followed, and training (and some oversight) is provided. Do not rinse pesticide spray or safety equipment in or near open water. Do not use Phostoxin in enclosed areas—use only in the open in the field for rodent control, not for stored grain pest control without training and safety equipment.

2.6 ADDITIONAL LOW ENVIRONMENTAL IMPACT PESTICIDES THAT MAY BE USED BY INMA CLIENTS:

* Spinosad (Tracer or Spintor, a bacterial extract) Dow Agrosciences
* *Bacillus thuringiensis* Valent Biosciences or Certis Company, or other products containing *Bt* for control of moth and butterfly larvae.
* Revancha 80 SL (extract of *Mimosa tenuflora*) fungicide and bactericide
* Biocontrol Marigold 75 SL (extract of *Tagetes spp*.)
* Citronol 20 SL (extract of citric seeds) fungicide and bactericide
* Allium 98 SL (extract of *Allium sativum*) systemic repellent
* Quasinol 75 SL (extract of *Quassia amara*) insecticide and larvicide
* Kanelite 30 SL (extract of *Cinnamomum zeylanicum*) contact acaricide
* Trichoderma, a biological fungicide
* Pyrethrum, a mix of natural pyrethrins extracted from Chrysanthemum flowers.
* Neem tree extracts, or azadirachtin
* Rotenone (root juice)
* Insecticidal soaps and oils.

2.7 PESTICIDES CONDITIONALLY ACCEPTED (Condition=Users absolutely must receive training and a dual cartridge respirator with agreement or certification to use them)

Aluminium (Aluminum) Phosphide
Zinc Phosphide

2.8 THIS PERSUAP REJECTS ADVISING OR USE BY INMA BENEFICIARIES OF THE FOLLOWING:

Chinosol 50% SL (Beltanol) Probelte—not registered by USEPA.
Carbendazim 50% WP (Bavistin) BASF—not registered by USEPA.
Carbofuran 5% G (Furadan)—no longer registered by USEPA
Fenitrothion 50% EC (Sumithion) Sumitomo—RUP
Atrazine 50% WP (K & Z) Generic—RUP
Oxamyl 24% L (Vydate, *also a nematicide*) DuPont—RUP

SECTION 3: IMPACTS OF INTERNATIONAL TRADE & MARKETS, CERTIFICATION SCHEMES, CODES OF CONDUCT, SPS BARRIERS, WTO MEMBERSHIP

3.0 INTERNATIONAL TRADE IN THE GENERAL AGRICULTURAL/HORTICULTURAL PRODUCTS BY THE COUNTRY WITH SPECIFIC EMPHASIS ON PROJECT-TARGETED COMMODITIES

In the future, as Iraqi markets improve and reach to regional and international markets happens, this section will become more important. At this early stage, the INMA project is focused on food security and is not immediately looking at export markets for Iraqi produce. This builds on the very successful ARDI project, which had very talented and knowledgeable staff to promote this effort to reach markets outside Iraq.

3.1 REGIONAL OR INTERNATIONAL TRADE IN THE PROJECT COMMODITIES

Since 2005, some informal and formal trade in agricultural produce in the region have begun, this is in spite of 20 years of limited or hindered trade. In the past, Iraq was a leader in the export of high quality dates, and was food self-sufficient. Food processing and fertilizer production are primary industries in Iraq, along with petroleum, chemicals, textiles, construction materials, and metal fabrication/processing.

Export commodities are broken down as follows: crude oil (83.9%), crude materials excluding fuels (8.0%), food and live animals (5.0%). In 2007, the primary international export partners were: US 51.9%, Spain 7.3%, Japan 6.6%, Italy 5.7%, Canada 5.2%. USAID is also proceeding with projects that will provide 16,000 loans to micro-, small-, and medium-size businesses by the end of 2005.

3.2 CODES OF CONDUCT THAT APPLY TO TARGET COMMODITIES OR SYSTEMS, WITH RATES OF IMPLEMENTATION SUCCESS WHERE THEY DO APPLY

As the Iraqi horticultural markets mature, codes of conduct will become common and will assist with reaching outside markets. At present (2007), according to the Food and Agriculture Organization, over the past twenty years, there has been growing public awareness of environmental and social issues in agricultural production and trade. Several food safety crises and animal disease epidemics have intensified concerns over intensive agricultural practices. Consumers have now become more knowledgeable about labor conditions and about the problems faced by small farmers due to low commodity prices.

As of 2007, for all international players, there are an increasing number of company codes of conduct, some of which reach far down the commodity chain to producers. In addition, consumers' concerns have given rise to any number of certification and/or labeling initiatives, some led by NGOs and others led by the business sector. Social and environmental certification and labeling are market-oriented mechanisms; they use market incentives to encourage management improvements above the minimum level required by law, to implement

laws that are otherwise difficult to enforce, or to suggest a framework where formal laws may not exist. They very often refer to international treaties and conventions, sometimes translating them into verifiable standards for direct implementation by producers and/or traders. With this approach, voluntary certification programs are complementary to (inter) governmental regulatory frameworks and to labor unions, but do not—and can not—replace these.

Three relevant conventions and codes of conduct on pesticides and pesticide use include:

* International Code of Conduct on the Distribution and Use of Pesticides, of which the Revised Version was adopted by the United Nations FAO Council in November 2002.

* The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. Under the PIC procedure, the secretariat provides all participating countries with detailed information on the risks the chemicals pose, allowing them to decide whether to accept future imports. If any country does choose to ban or restrict substances on the PIC list, which contains presently 31 chemicals, exporting countries are advised and must immediately inform their exporters, industry and customs departments.

* The Stockholm Convention is a global treaty to protect human health and the environment from persistent organic pollutants (POP). POP are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to humans and wildlife. In implementing the Convention, Governments will take measures to eliminate or reduce the release of POP into the environment.

The new Iraqi government is not yet party to any of these agreements. Neither is Iraq party to conventions on biodiversity such as the International Plant Protection Convention (IPPC), the Convention on Biological Diversity (CBD), or the International Treaty on Plant Genetic Resources (ITPGR). However, Iraq does participate with the UN FAO (which helps administer the International Code of Conduct on the Distribution and Use of Pesticides) and UN WHO (which sets pesticide safety standards); and is an observer to the World Trade Organization (WTO), which deals with sanitary and phytosanitary (SPS) issues including pest risk assessments (PRA), for trade.

Current 2007 searches on the World Wide Web reveal no significant social and environmental standard-setting and certification programs in Iraq for the tropical horticulture sector. In the future, these could include codes of conduct for Iraqi agriculture, fruits, or horticulture sectors and produce/grocery industries. Codes would aim to reduce pesticide risks, manage the introduction of invasive species, enhance ethical trade and trading relationships, provide intra-sector communications mechanisms, and encourage commitments to non-legal dispute resolution procedures. Iraq's industries can—in the immediate future—endorse these types of voluntary systems to be set up.

3.3 STATUS OF PESTICIDE REGULATIONS IN THE EUROPEAN UNION

As of 2007, and according to http://www.pesticideinfo.org/Docs/ref_regulatoryEU.html, "the European Community (EC) has established a harmonized legal framework for the regulation of

pesticides in all member countries of the EC. The Commission of the European Communities, in collaboration with member countries of the EC, is responsible for the registration of pesticide active ingredients (also referred to as active substances) for use in all EC member countries. Individual member countries, called Member States, are responsible for the registration in their country of specific pesticide products (active ingredient percentage by weight plus inert ingredients) containing active ingredients authorized for use by the Commission. This dual authority of the EC and its member states is granted by the Council of the European Community under Council Directive 91/414/EEC, adopted on July 15, 1991 and effective July 25, 1993 (1). Standards and regulations for the classifications, labeling, and packaging of pesticides are set by Council Directive 67/548/EEC of June 27, 1967 (2)." Directive 91/414, once fully implemented (which will still take several years), is expected to reduce the 834 existing active ingredients to approximately 250-300, and will also set EU standard MRL for these pesticides on produce. The effect on Iraq will be to limit the range of pesticides that can be used on produce destined for export to the EU, and set the MRL allowed for this produce. Together with produce certification systems, such as EUREPGAP, this will promote the use of IPM and reduce pesticide use in Iraq. However, export of produce is unlikely to occur within the INMA timescale.

3.4 EU REGISTRATION STATUS OF PROPOSED PESTICIDES ACTIVE INGREDIENTS (THERE ARE CURRENTLY 834 EXISTING EU-REGISTERED PESTICIDE ACTIVE INGREDIENTS.)

As of 2007, these and new active substances along with minimum residue levels (MRL) and average daily intakes (ADI) can be located at the following 2 websites:
http://europa.eu.int/comm/food/plant/protection/evaluation/index_en.htm;
http://europa.eu.int/comm/food/plant/protection/evaluation/existactive/list1-28_en.pdf)

All of the pesticides proposed for this INMA project, as well as those additional low impact pesticides suggested for this report are registered by the EU. Since no products from this project will likely be exported, minimum residue levels (MRL) for export will not be considered at this time.

3.5 EXPORT MARKETS STANDARDS, AUDITING AND CERTIFICATION (EUREPGAP, ISO 14001, ORGANIC, EU MINIMUM RESIDUE LEVELS, ETC.) SCHEMES APPLICABLE TO THE PROJECT, CROPS, AND PESTICIDES

National Standards and Codes:
As of 2007, there are as yet no national Iraqi standards or codes of conduct or practice that address social or environmental standards or certification in tropical agriculture or horticulture. Iraq is, however, beginning to consider pesticide registration and regulation issues. INMA has already started work with pesticide dealers in respect of forming an association with a Code of Conduct for members, and intend to develop something similar for pesticide importers, re-packagers and distributors in the future.

Economic Partnership Agreements (EPA):
High levels of violence in Iraq throughout 2007 have inhibited the development of mature EPA in and with Iraq. EPA aim to establish new WTO-compatible trading arrangements progressively removing barriers of trade between EU and certain groups or blocks of developing countries

(like the Africa, Caribbean, and Pacific Group—ACP Group) countries which would build on the regional integration initiatives of Group states and promote sustainable development and contribute to poverty eradication in the Group countries.

Apparently there are no fresh produce trade associations in Iraq with which to form or become part of an EPA.

Organic Production:
Organic production is a holistic management of the agro-ecosystem, emphasizing biological processes, soil health, and minimizing the use of non-renewable resources. This includes maintenance of soil fertility through the use and recycling of organic materials. The use of synthetic fertilizers and pesticides is prohibited. The International Federation of Organic Agriculture Movements (IFOAM) has formulated IFOAM Basic Standards, on which organic certifiers can base their standard, with a view of international harmonization. The International Organic Accreditation Service (IOAS) accredits certification bodies that have organic certification programs that comply with the IFOAM standards. During the last revision of the IFOAM Basic Standards, the standards for ecosystem management were strengthened. There are ongoing discussions on whether the standards should also include criteria for labor conditions and other social issues, to which currently only a very general reference is made.

With the growing market for organic products, many countries have developed national organic regulations to be able to protect producers and consumers against misleading organic claims. The FAO/WHO Codex Alimentarius Commission has formulated guidelines for labeling of organically produced food, with a view to harmonizing national regulations.

As of 2007, Iraq has yet to develop national organic regulations for either use in-country or for export. Iraq does have the Zakho Small Villages Projects (ZSVP-Iraq) that is a member of IFOAM.

Fair Trade Initiatives:
The fair trade initiatives try to provide better market access and better trading conditions to small farmers. This includes a price premium for producers to be invested in social and environmental improvements. For larger production units an additional aim is to improve the conditions for workers. The Fairtrade Labeling Organizations (FLO) International is an umbrella organization of 17 national fair trade labeling initiatives, but producers and traders are also represented on the board. FLO has developed production criteria, both socially and environmentally oriented, differentiated for smallholder production and plantations. In addition, it has developed standards for trade, with which traders licensed by FLO have to comply. Complementary to the generic standards, there are product specific standards. Currently FLO standards exist for coffee, tea, cocoa, cane sugar, honey, fresh fruit, fruit juices, bananas, and rice. Standards for wine and cut flowers are being developed. From January 2003 the certification unit will be a legally independent certification body.

As of 2007, Iraq does not yet deal internationally in any of the FLO International crops.

3.6 EXPORT CERTIFICATION AUTHORITIES/AUDITORS/COMPANIES PRESENT IN THE COUNTRY OR REGION

As of 2007, Iraq has no export certification authorities/auditors/companies present due to high levels of violence and fear that are severely constraining the Iraqi business environment and markets. The region, however, does have these certification schemes, provided below.

Turkey has the following certification and/or certified groups: Alterna Agricultural Products Ltd.; Arslanturk S.A.; Bugday Society for Supporting Ecological Livelihood; Ecocert Turkiye; Ege Ihracatci Birlikleri Genel Sekreterligi; ETKO - Ekolojik Tarim Kontrol Organzasyonu; Gürsel Tonbul Ciftlik Isletmesi; ISIK - Isik Tarim Ürünleri San Ve Tic A.S.; Organik Tarim Ürünleri Sanayi ve Ticaret A.S.; ORYA / CITY FARM - Orya Organik Yasam Gida Tekstil Turizm San. Ve Tic. A.S.; Rapunzel Organik Tarim Ürünleri ve Gida; and Selim Uludag Organic Farm.

Jordan has the APN - Arab Group for Protection and Nature. The KAFA'A water reuse project includes project sites that are ISO 14001 (dates) and EurepGAP (vegetables) certified. Jordan also has a vegetable producer and exporter (Mazen Aodeh) who uses IPM technologies for greenhouse pest control.

Saudi Arabia has Aljuraiban Organic Farm; Rashed Est. For Trading and Agriculture; and Watania Agriculture.

4.0 COUNTRY PESTICIDES PROFILE

The very successful ARDI project, which had very knowledgeable staff, was able to go out into the country side and collect extensive information on the pesticide system in Iraq. Much of this information is included in this report, with detailed 2006 and 2007 updates. With ARDI support, Iraq began to develop the same level of pesticide regulatory, monitoring, and control frameworks that almost all other countries have, even developing ones. Further, it began to have effective implementation of the existing framework. The pesticide sector is still somewhat of a free-for-all, at one end of which are some reputable companies following their own or international pesticide guidelines, while at the other end are companies who import fraudulent products simply to make money at the expense of retailers and farmers. Government regulatory and monitoring institutions, with ARDI support, have begun to have some impact in supervising the sector.

The 2007 areas for improvement include: Registration procedures and documentation; Registration trial and data requirements; Pesticide and residue analysis facilities; The container label; Monitoring of products in the market; Liaison with customs etc regarding import procedures and control; and The issue of pesticide registration and recommendation information on a regular or continuous basis.

4.1 PESTICIDE IMPORT INCLUDING INFORMAL/ILLICIT IMPORT

According to 2007 FAO statistics, from 1992 to 2003 Iraq imported about 5 million dollars worth of pesticides per year. Reputable products currently come from Europe, the US, Japan, Turkey and Jordan. Less reputable pesticides currently come from Syria and Iran as well as from Turkey and Jordan. Fraudulent, re-labeled, and expired (and re-labeled) products come from almost anywhere, but are largely smuggled or channeled through Syria and Iran.

The general situation in Iraq makes prevention and control of smuggled products, as well as monitoring the products in the market, extremely difficult. INMA is working on this through the pesticide registration, monitoring and control activities. This will not be sufficient on its own, so INMA is also working with pesticide dealers, part of this activity being to persuade them that selling sub-standard pesticides to farmers is bad business in the longer term. The INMA demonstration plot programs emphasize to farmers that they should use products from reputable suppliers. INMA is also involved in developing a national agricultural extension program, and this point will also be included in that as part of IPM education.

The history and current violent situation in Iraq makes overall control of the pesticide sub-sector extremely difficult. Much work will be required, not only in the framework of legislation, regulatory bodies, implementation of the regulations, distribution, retail sales, and use by farmers, but also general attitude changing at all levels, particularly to the implementation of regulations.

4.2 PESTICIDE IN-COUNTRY PRODUCTION

From 1958 to 1990, Iraq had the capability to produce various chemicals including organophosphate pesticides and *Bacillus thuringiensis* biopesticides, however these may no longer exist after the war due to their potential dual use as factories for producing Sarin and Anthrax, according to various websites. One such factory was likely near Baghdad. There are currently no significant pesticide manufacturers operating in Iraq.

4.3 PESTICIDE PACKAGING, REPACKAGING & LABELING QUALITY

Most 2007 reputable products come ready-packed, so re-packaging is probably part of the fringe market. INMA has already started work with pesticide dealers in respect of forming an association with a Code of Conduct for members and developing something similar for pesticide importers, re-packagers and distributors. At that stage, INMA will have more information on the activities of these companies.

Pesticides from reputable suppliers have good quality labels. Those from less reputable suppliers are variable, some being good, others are not so good.

4.4 PESTICIDE DISTRIBUTION/RETAIL SALES LIKE IN IRAQ, WITH MAJOR DISTRIBUTION/RETAIL SUPPLY COMPANIES

As of 2007, following the highly successful DAI-managed project ARDI, legal distribution is largely through licensed importers. Little information exists at present, except that they are largely small local companies. There is also an illegal distribution network. INMA activities will have to shore up registration and regulation of pesticides and this should help to restrict this type of distribution.

Syngenta is the largest importer and has an office in Baghdad—in spite of the violence, and imports and distributes its own products. It also has a network of agents and retailers around the country. Agents largely supply only Syngenta products, and receive training in safe handling

and use, plus updates on new products. Retailers sell Syngenta products together with those sourced from other suppliers.

4.5 PESTICIDE TYPES AND TOXICITIES AVAILABLE

As with most developing countries, there are an excessive number of active ingredients and products registered for use in Iraq. Furthermore, certain registered active ingredients are extremely toxic, and should not be available to farmers (although the formulation, use and possible alternatives also need to be taken into consideration). There is a need to register more pesticides that are IPM and environmentally friendly.

4.6 CURRENT PESTICIDE CONSUMPTION IN THE AGRICULTURE SECTOR IN GENERAL AND PROJECT CROPS IN SPECIFIC

A 2007 Iraq government list shows 259 active ingredients and 522 products registered for agriculture, public health and veterinary uses. The government is currently in the process of reducing these numbers and sending trainees to regional pesticide registration harmonization meetings. Due to poor registration enforcement, many products from dubious sources and with wanting label information are available in the open market. According to FAO statistics, Iraq imported about 5 million dollars worth of pesticides per year from 1992 to 2001. These declined somewhat after the US attacked Iraq. Otherwise, due to Iraq's international isolation for the past several years, it is very difficult to locate pesticide use data for Iraq on the World Wide Web.

4.7 PESTICIDES USED IN THE INMA DEMONSTRATION PLOT PROGRAM BASED ON IRAQ MINISTRY OF AGRICULTURE EXTENSION SERVICE RECOMMENDATIONS

Since the new government in Iraq is in its formative years, the extension service is being remodeled. ARDI made great strides in this effort and INMA will need to make more strides assisting with this and other efforts.

Table 1. Iraq Ministry of Agriculture Extension Service pesticide recommendations for wheat, rice, maize, sorghum, tomato & soybean

WHEAT

General pesticide use conditions:

- Winter wheat: Sowing Oct-Nov, harvesting May-July.
- Rain grown.
- Country wide.
- Mountain valleys, rolling foothills, alluvial plain.
- Coarse, medium, and fine soils.

Used on demo plots	Yes
Pest	Loose smut, Cover smut
Pesticide	Tebuconazole
Trade Name	Raxil
Manufacturer	Bayer Crop Science
Formulation	2% DS
Application rate	150 g / 100 kg seed
Selection criteria	Wheat seed provided by research, ready treated with product Available Effective Reputable manufacturer Distributed to farmers by MoA Dithane is alternative, but not always available, and only controls Cover smut
Registered in Iraq	Yes, but not wheat
Application method	Seed dressing Seed treatment machine – 1 ton/hr

Used on demo plots	Yes
Pest	All narrow leaf weeds
Pesticide	Clodinafop propargyl + Cloquintocet-mexyl
Trade Name	Topik
Manufacturer	Syngenta
Formulation	10% EC
Application rate	600 - 800 ml / ha, 200-300 l water / ha
Selection criteria	Available Effective Reputable manufacturer Provided by MoA

Registered in Iraq	Yes
Application method	Mixed with Lintur Post emergence Tractor mounted boom sprayer Manual knapsack sprayer with lance Application in morning

Used on demo plots	Yes
Pest	Broad leaf weeds
Pesticide	Dicamba + Triasulfuron
Trade Name	Lintur
Manufacturer	Syngenta
Formulation	70% WG
Application rate	120 - 160 g / ha, 200-300 l water / ha
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes
Application method	Mixed with Topik Post emergence Tractor mounted boom sprayer Manual knapsack sprayer with lance Application in morning

Used on demo plots	Yes
Pest	Broad leaf weeds
Pesticide	Tribenuron-methyl
Trade Name	Granstar
Manufacturer	DuPont
Formulation	75% DF

Other products	Tacostar – 75% WP - Jiangsu Yangnong Chemical Co Ltd, China
Application rate	10 g / ha (Label instructions give 16-20 g/ha); 270 l water / ha
Selection criteria	Available Effective Reputable manufacturer Provided by MoA
Registered in Iraq	Yes
Application method	Post emergence Tractor mounted boom sprayer Manual knapsack sprayer with lance Application in morning

Used on demo plots	Yes
Pest	Sunn pest
Pesticide	Lambda Cyhalothrin
Trade Name	Karate
Manufacturer	Syngenta
Formulation	2.5% EC
Application rate	2.0 – 4.0 ml / l water, 270 l water / ha
Selection criteria	Available Effective Reputable manufacturer Distributed to farmers by MoA
Registered in Iraq	Yes, but not wheat
Application method	Spray threshold: 4-7 nymphs / sq.m.; 1-2 adults / sq.m. Tractor mounted boom sprayer Motorized knapsack mistblower Manual knapsack sprayer with lance

Used on demo plots	Yes

Pest	Rodents
Pesticide	Aluminium Phosphide
Trade Name	Phostoxin
Manufacturer	Detia Degesch
Formulation	Tablet
Other products	Quickfos - Detia Degesch, Germany Celphos – Excel Industries Ltd, India
Application rate	Field: 1-2 tabs / rat hole
Selection criteria	Available Effective Follow-on treatment, if necessary, to aluminum phosphate bait
Registered in Iraq	Yes
Application method	Tablets placed in holes, holes sealed.

Used on demo plots	No – may be used in future
Pest	Sunn pest
Pesticide	Deltamethrin
Trade Name	Decis
Manufacturer	Bayer Crop Science
Formulation	2.5% EC
Application rate	0.5 - 1.0 ml / l water
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes
Application method	Tractor mounted boom sprayer Motorized knapsack mistblower Manual knapsack sprayer with lance

Used on demo plots	No – May be used in future
Pest	Sunn pest
Pesticide	Fenitrothion
Trade Name	Sumithion
Manufacturer	Sumitomo
Formulation	50% EC
Application rate	1.0 - 1.25 ml / liter water
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes
Application method	Tractor mounted boom sprayer Motorized knapsack mistblower Manual knapsack sprayer with lance

Used on demo plots	No – may be used in future
Pest	All weeds
Pesticide	Glyphosate
Trade Name	Roundup
Manufacturer	Monsanto
Formulation	48% SC
Application rate	Annual weeds: 4.0 l/ha Perennial weeds: 10.0 l/ha
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes

Application method	Pre-planting Tractor mounted boom sprayer Manual knapsack with lance

RICE

General pesticide use conditions:

- Sowing May-June, harvesting November.
- Irrigated
- Country wide, but mainly in centre and south.
- Rolling foothills, alluvial plain.
- Medium and fine soils.

Used on demo plots	Yes
Pest	Barnyard grass, Water grass, Cockspur grass
Pesticide	Propanil
Trade Name	Stam F34
Manufacturer	Dow AgroSciences
Formulation	34% EC
Application rate	10 liters / ha
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes
Application method	Manual knapsack sprayer Post emergence Field drained to expose weeds, treatment applied, field re-flooded after 2 days

Used on demo plots	Yes – In south
Pest	Rice Blast
Pesticide	Mancozeb + Fosetyl-Al

Trade Name	Ridomil M72
Manufacturer	Syngenta
Formulation	70% WP
Application rate	2.0 – 3.0 g / liter water *(this rate from MoA recommendations)*
Selection criteria	Available Effective Reputable manufacturer Alternatives are mancozeb, captan
Registered in Iraq	Yes
Application method	Manual knapsack sprayer with lance

MAIZE

General pesticide use conditions:

- Sowing March, harvesting August.
- Rain grown
- Country wide.
- Mountain valleys, rolling foothills, alluvial plain.
- Coarse, medium, and fine soils.

Used on demo plots	Yes – In south
Pest	Sucking insects
Pesticide	Thiamethoxam
Trade Name	Cruiser
Manufacturer	Syngenta
Formulation	35% FS
Application rate	1.4 l / 100 kg seed
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes

Application method	Seed ready-treated by Syngenta when supplied to farmers

Used on demo plots	Yes
Pest	Annual weeds
Pesticide	Atrazine
Trade Name	Atrazine
Manufacturer	Atrazine: K&Z
Formulation	50% WP
Application rate	4.0 kg/ha
Selection criteria	Available Effective
Registered in Iraq	Yes
Application method	Pre-emergence Manual knapsack sprayer with lance

Used on demo plots	Yes
Pest	Stemborer
Pesticide	Diazinon
Trade Name	Generic, 11 products registered in Iraq
Manufacturer	Generic
Formulation	10% G
Application rate	6.0 kg/ha
Selection criteria	Available Effective
Registered in Iraq	Yes
Application method	Hand applied to funnel with shaker

Used on demo plots	No – may be used in future
Pest	Annual broad leaf weeds, some perennials
Pesticide	S-Metolachlor + Atrazine
Trade Name	Primagram Gold
Manufacturer	Syngenta
Formulation	66% SC
Application rate	3.0 – 4.0 l/ha
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes
Application method	Pre-emergence Manual knapsack sprayer with lance

SORGHUM

General pesticide use conditions:

- Sowing March, harvesting August.
- Rain grown
- Country wide.
- Mountain valleys, rolling foothills, alluvial plain.
- Coarse, medium, and fine soils.

Used on demo plots	Yes
Pest	Stemborer
Pesticide	Diazinon
Trade Name	Generic, 11 products registered in Iraq
Manufacturer	Generic
Formulation	10% G

Application rate	6.0 kg/ha
Selection criteria	Available Effective
Registered in Iraq	Yes
Application method	Hand applied to funnel with shaker

TOMATO

General pesticide use conditions:

- Winter crop, central and north: Sowing late August, harvesting?
- Winter crop, south, under plastic: Sowing August-September, harvesting November onwards.
- Summer crop, south and central: Sowing February-March, harvesting May onwards.
- Summer crop, north: Sowing April, harvesting June onwards.
- Irrigated (largely drip).
- Country wide.
- Rolling foothills, alluvial plain.
- Coarse, medium, and fine soils.

Used on demo plots	Yes
Pest	Root knot nematode
Pesticide	Carbofuran
Trade Name	Furadan
Manufacturer	FMC
Formulation	5% G
Application rate	10 – 12.5 kg / ha
Selection criteria	Effective Available Reliable manufacturer **WHO Class Ib**
Registered in Iraq	Yes

Application method	By hand, with gloves and mask

Used on demo plots	Yes
Pest	Grey mould
Pesticide	Carbendazim
Trade Name	Bavistin
Manufacturer	BASF
Formulation	50% WP
Application rate	1.5 – 2.0 g / liter water
Selection criteria	Effective Available Reputable manufacturer
Registered in Iraq	Yes – but not tomato
Application method	Manual knapsack sprayer with lance

Used on demo plots	Yes
Pest	Soil fungi
Pesticide	Trichoderma harzianum (Mitosporic fungus)
Trade Name	Biocont - T
Manufacturer	Al-Baraka, Jordan
Formulation	WP
Application rate	0.5 kg / cu.m. peat moss
Selection criteria	Available Effective
Registered in Iraq	No
Application method	Mixed with water, then mixed with peat moss for seedling trays

Used on demo plots	No
Pest	Soil borne fungi – Alternaria, Rhizoctonia, Fusarium
Pesticide	Chinosol
Trade Name	Beltanol
Manufacturer	Probelte
Formulation	50% SL
Application rate	1.0 ml / sq.m.
Selection criteria	Available Effective
Registered in Iraq	Yes
Application method	Manual knapsack sprayer 100 litre barrow sprayer with petrol pump and lance

Used on demo plots	No
Pest	Grey mould (Botrytis)
Pesticide	Cyprodinil + Fludioxinil
Trade Name	Switch
Manufacturer	Syngenta
Formulation	62.5% WG
Application rate	60 - 100 g / 100 l water
Selection criteria	Available Reputable manufacturer
Registered in Iraq	Yes, but not tomato
Application method	Manual knapsack with lance

Used on demo plots	No
Pest	*Blight – Early or Late or both?*
Pesticide	Difenoconazole
Trade Name	Score
Manufacturer	Syngenta
Formulation	25% EC 3% WS
Application rate	EC: 30 - 50 ml / 100 l water WS: Seed dressing, 200 g / 100 kg seed
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes
Application method	Manual knapsack sprayer with lance

Used on demo plots	No
Pest	Tomato leaf miner
Pesticide	Cyromazine
Trade Name	Trigard
Manufacturer	Syngenta
Formulation	75% WP
Application rate	10 - 30 g / 100 l water
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes
Application method	Manual knapsack sprayer with lance

Used on demo plots	No
Pest	American bollworm (Helicoverpa armigera)
Pesticide	Lufenuron
Trade Name	Match
Manufacturer	Syngenta
Formulation	50% EC (5% EC?)
Application rate	40 - 80 ml / 100 l water (0.5 - 1.0 ml / litre water?)
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes
Application method	Manual knapsack with lance

Used on demo plots	No
Pest	Tomato leaf miner, also active against mites
Pesticide	Abamectin
Trade Name	Vertimec
Manufacturer	Syngenta
Formulation	18% EC (1.8% EC?)
Application rate	300 - 450 ml / ha (0.25 - 0.50 ml / litre water ?)
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes
Application method	Manual knapsack sprayer with lance

Used on demo plots	No
Pest	White fly, aphid
Pesticide	Thiamethoxam
Trade Name	Actara
Manufacturer	Syngenta
Formulation	25% WG
Application rate	40 g/100 litre water
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes, but not on tomato
Application method	Manual knapsack sprayer with lance

Used on demo plots	No
Pest	Root knot nematode
Pesticide	Oxamyl
Trade Name	Vydate
Manufacturer	DuPont
Formulation	24% L
Application rate	150 ml / 100 liter water
Selection criteria	Available Effective Reputable manufacturer **WHO CLASS Ib**
Registered in Iraq	Yes
Application method	

Used on demo plots	No
Pest	Early blight, also Septoria leaf spot
Pesticide	Difenoconazole
Trade Name	Score
Manufacturer	Syngenta
Formulation	25% EC
Application rate	EC: 0.5 ml / 100 litre water
Selection criteria	Available Effective Reputable manufacturer
Registered in Iraq	Yes
Application method	Manual knapsack sprayer with lance

SOYA BEAN

NB.

- Soya bean not included in Iraq pesticide manual – no registrations / recommendations available.

- Soya bean were considered for an INMA program, but now seems unlikely that this will be implemented.

General pesticide use conditions:

Used on demo plots	
Pest	*Registered on wheat for broad leaf weeds.*
Pesticide	Dicamba
Trade Name	Banvel?
Manufacturer	Syngenta?

Formulation	4% EC
Application rate	1.5 l/ha
Selection criteria	
Registered in Iraq	Yes, but not on Soya
Application method	

Used on demo plots	
Pest	*Recommended for annual grasses in cotton, sunflower.*
Pesticide	Trifluralin
Trade Name	Generic (Treflan)
Manufacturer	Generic
Formulation	48% EC
Application rate	2.4 l/ha
Selection criteria	
Registered in Iraq	Yes, but not on Soya
Application method	

Used on demo plots	
Pest	*Recommended for Worm on apple, citrus, fig, tomato.*
Pesticide	Carbaryl
Trade Name	Generic
Manufacturer	Generic
Formulation	85% WP 10% D
Application rate	WP: 1.0 g/litre water D: 2.0 kg/ha

Selection criteria	
Registered in Iraq	Yes, but not on Soya
Application method	

4.8 COUNTRY'S PESTICIDE REGISTRATION AND REGULATION SYSTEM AND SPECIFIC REGISTRATION STATUS OF PROPOSED PESTICIDES

INMA only uses products from reputable manufacturers, and emphasizes such use to farmers. Due to the highly unusual and extenuating circumstances present in Iraq and since the new government and regulations are in flux at the moment, *it seems reasonable to permit* products that are not officially "registered" by the GOI, but that are from reputable companies, recognized as a standard products world-wide for the pest or disease in question, and are widely available in the market.

Some of the unregistered products that are available and useful are largely the pesticides imported and used by FAO, which has been taken as a de facto 'registration'. INMA has started work with the Iraq Pesticides Registration Committee on reviewing and improving the pesticide registration and other processes. They consider this important for several reasons. The registration system in Iraq is weak and needs strengthening - at present it does not match those of other countries in the region, or international standards. For example, it is too easy to register a pesticide simply by paying the fees.

4.9 COUNTRY'S ABILITY TO ENFORCE REGULATIONS ON DISTRIBUTION, STORAGE, USE, & DISPOSAL OF PESTICIDES

Registration enforcement is poor in Iraq due to its recent history. In addition, FAO in the past supplied non-registered products and formulations, or promoted products for non-registered uses, particularly in the north. These FAO recommendations are now widely used and are effectively considered to be "registrations", although not having passed through the MOA Baghdad registrations system.

4.10 COUNTRY'S ADOPTION OF FAO'S PRIOR INFORMED CONSENT (PIC) PROCEDURES

Iraq is a member of FAO. All pesticide donations fall under provision of the PIC scheme and are thus supposed to follow the PIC procedures. INMA is doing a fine job of implementing the spirit of the PIC procedures.

4.11 CURRENT PESTICIDE STORAGE, HANDLING AND SAFETY PROCEDURES IN THE SECTOR BEING STUDIED

Pesticides are only used by INMA on demonstration plots. The largest plots are for wheat (approx 1 hectare), other crops have smaller plots. Pesticides for wheat demonstrations are supplied by the MOA, those for other demonstrations by INMA.

Neither INMA nor farmers store demonstration plot pesticides. INMA supplied pesticides are purchased on an immediate needs basis for the demonstration plots in an area, and are applied within two days of purchase. Any unused undiluted product is given to the agricultural research station.

Protective clothing (gloves, boots, mask, goggles) are issued to farmers whose field is used as a demonstration plot. Mixers and applicators wear PPC during operations.

The actual amounts of pesticide used in the INMA demo plots are thus extremely low and unlikely to contaminate water sources to any discernable extent. As noted above, wheat demonstration plots are the largest, at 1 ha. Other plots are much smaller, and may be as little as 200 square meters.

4.12 GENERAL HISTORY OF IPM & SAFETY TRAINING RECEIVED BY ALL PESTICIDE USERS IMPACTED BY PROJECT

There have been very few IPM courses or programs implemented in Iraq in the past 15 years. FAO, NRI, ACIAR and ICARDA have worked on IPM for various pests, including sunn pest in the Middle East, which will benefit Iraq. The USA has also recently contributed to the production of IPM proposals through the Arab Science and Technology Foundation (ASTF) at http://www.astf.net/site/news/news_dtls.asp?news_id=1030&ogzid=10000 .

Most of the IPM theoretical training and knowledge exists in Iraq through well-educated individuals in government, universities, and international projects. Most farmers and farm laborers have not had such formalized training. INMA can provide IPM training along with safer use training.

INMA has provided five day training courses for 119 pesticide dealers. Topic headings in the course consist of: Dealing with farmers; Principles of pest management; Biological control; Pesticides and formulations; Pesticide label; Transport, mixing and disposal; Toxicity, health and safety, Environmental aspects; Storage and sales; Local, regional and international pesticide regulations. INMA has also assisted in the establishment of a national pesticide dealer association, one of whose objectives is to provide training to its members. INMA will continue to support this activity, including Training of Trainers and provision of source training materials.

INMA is assisting the MoA in Baghdad and Erbil to develop the agricultural extension systems. Support to farmers for improved crop production practices will include IPM. Training materials need to be further developed for this activity.

NGO's and other partner organizations assisting the implementation of INMA activities complete the Pesticide Use Checklist for PVOs and NGOs when potential pesticide 'use' may occur.

The possibility of implementing a farmer education program on safe pesticide use through an NGO is being assessed. If successful, this could be used as a template for additional NGO farmer education programs.

4.13 PROVISIONS MADE FOR TRAINING OF USERS AND APPLICATORS

All pesticides are applied under the direct supervision of INMA personnel, who have received training in safe use or have an agronomy / pest management background. Safe pesticide use is emphasized during application and during farmer field days. Training topics include: hazards of pesticides, protective clothing, drift avoidance, disposal of empty containers, etc.

4.14 OBSOLETE PESTICIDES IN THE COUNTRY WITH WAYS TO AVOID MORE

Al Suwaira Pesticide Warehouses, for 30 years, stored, mixed and dispatched pesticides including organochlorine compounds like DDT, Lindane and heptachlor. According to http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=457&ArticleID=5023&l=en, there are currently 100 cubic meters of obsolete unusable pesticides at this facility alone. According to FAO, in 2000, there are 232 metric tons of obsolete pesticides remaining in Iraq (http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/003/x8639e/x8639e05.htm).

According to FAO, the reasons for pesticide accumulations that become obsolete include: Banning of pesticides that are still kept in stores; Aggressive pesticide sales, promotions and distributions by the Chemical Industry; Prolonged storage of products with a short shelf-life; Difficulties in forecasting outbreaks of pests; Inappropriate assessment of pesticide requirements; Insufficient application capacity; Inappropriate formulations or substandard containers; Excessive donations by donors such as for emergency locust campaigns—these are usually inappropriate because they are not received when needed most (i.e. late arrival of donations or out of season delivery), or are uncoordinated with similar donations from various sources; Inadequate storage facilities; Lack of staff trained in storage management (i.e. poor stock taking and lack of records); Ineffective distribution or poor marketing systems for pesticides (government or private sector or both); and lack of awareness of the inherent dangers of pesticides.

Ways to avoid the accumulation of more obsolete pesticides are: Reduce pesticide use, where possible by giving priority to IPM in plant protection programs and reducing the amount of pesticides by careful selection of products; Avoid overstocking of pesticides by keeping pesticide stocks as low as possible; Review the role of the government in pesticide distribution; Anticipate the effects of changes in pricing policies; Avoid inappropriate products by ensuring in advance that products are effective and providing detailed specifications when procuring or requesting pesticides; Ensure proper handling, storage and stock management by avoiding damage during transport, ensuring proper storage, determining whether older products can still be used; Reduce surplus stocks and other not directly usable stocks; Anticipate the effects of banning products; Ensure safety in private sector stores; Reduce pesticide use and thereby reduce the need for large pesticide stocks; Reduce stocks through better selection of products; Provide appropriate products and quantities; Ensure that the supplier delivers the correct product; and Ensure coordination among donor agencies to avoid over-donations.

Attachment 2 at the end of this document provides guidelines for proper disposal of pesticides and pesticide containers.

4.15 PROVISIONS MADE FOR MONITORING THE USE AND EFFECTIVENESS OF THE PESTICIDE

This is one issue that will need to be emphasized in the future for the MOA, as an element of a good pesticide registration and regulation program. INMA will be assisting in this regard and will note any reduction in effectiveness of the pesticide choices used on the projects.

5.0 SUMMARY OF ACCEPTED PESTICIDES BY IMPORTANT REGULATION 216 ELEMENTS

Table 2. Synoptic analysis and summary of the INMA-Proposed and Additional Pesticides available in Iraq, by categories, including registration in the US and Iraq, target pests, summaries of IPM measures, toxicological and environmental hazards, and special concerns.

Generic name of Pesticide (or accepted common name)/EPA and Iraq ACB Status	IPM program	Tcal and Environmental Hazards	Primary concerns
1. Insecticides (including Miticides)			
Abamectin 18% EC (Vertimec) Syngenta. Registered-USEPA. Toxicity Class IV CAUTION; Registered in Iraq. Controls spider mites, leaf miners. Uses: Tomato, citrus, avocado, mango, pear, peach, apricot, pistachio, sweet pepper, hot pepper, pineapple, cucumber, eggplant, broccoli, artichoke.	Constant monitoring of crops by trained scouts to detect presence of pests. Use minimum effective dosages. Use resistant plants. Conservation of natural enemies for biological control.	A mix of natural avermectins (derived from a soil bacterium). EC concentrations may cause eye and skin irritation. Pupil dilation, vomiting, convulsions, tremors, coma. Not readily absorbed through skin. Possible teratogenic and reproductive effects. Can kill fish, crustaceans, and aquatic invertebrates. Highly toxic to bees. Harms mollusks, aquatic plants and zooplankton.	Potential impacts to bees, fish, aquatic invertebrates, and aquatic plants. **Special concern:** kills fish, bees, aquatic invertebrates, and aquatic plants. **Do not use near water. Spray early morning to avoid bees.**
Bacillus thuringiensis (Dipel, Condor, Deliver, Foray, etc.) Valent Biosciences, Certis Corp. Registered-USEPA Toxicity Class III-slightly toxic; **not yet registered in Iraq.** For use on moth larvae on all	Constant monitoring by trained scouts to detect armyworms, bollworms, and caterpillars. Not likely for pests to	Very safe by acute oral or dermal contact. An eye irritant. Practically non-toxic to humans and animals by acute exposure. No known mammalian chronic health effects. No reproductive effects; non-mutagenic; non-teratogenic; an unlikely carcinogen; not an endocrine disruptor. No known effects on non-target organisms from normal use. Not toxic to birds, fish, aquatic invertebrates, earthworms, bees,	Potential impacts to humans.

crops.	develop resistance to Bt, but rotating pesticides is still encouraged.	domestic/wild mammals, aquatic plants, and beneficial arthropods, except possibly predatory mites and insects used for biocontrol of weeds.	
Carbaryl 10% D (Sevin) Generic, *and* Carbaryl 85% WP (Sevin) Generic**;** Registered-USEPA Toxicity Classes I DANGER to Class III CAUTION (depending upon percent of active ingredient present in formulation). Only Formulations of Toxicity Class II and III being proposed for use in INMA project; Registered in Iraq. Used on maize, dry beans, French beans, cocoa, roses, and chrysanthemums against defoliating worms, blister beetles, and maize/sorghum stalk borers.	Constant monitoring by trained scouts to detect the presence of insect pests. Minimum effective dosages used. Insecticides rotated on a regular basis to prevent resistance. Use resistant varieties. Use bacterial Bt spray to kill moth larvae.	Skin, eye, ingestion hazards. May affect the lungs, kidneys, liver, and nervous system with chronic use. Highest risk to public is from residues in food. No reproductive or fetal effects, although lowered sperm counts and sperm morphological abnormalities have been noted. Possibly evidence of minimal teratogenic effects. Unlikely to be mutagenic. Potential carcinogen. Possible endocrine disruptor. Moderately toxic to fish and aquatic invertebrates, highly toxic to earthworms and bees, and many non-target insects, and beneficial arthropods. Practically non-toxic to birds. Moderately toxic to livestock and domestic and wild animals. Slightly toxic to aquatic plants.	Potential impacts to humans, fish, aquatic invertebrates, earthworms, bees, non-target insects, livestock, and other domestic and wild mammals. **Special concern:** impacts to pesticide applicators and others who handle pesticide, public, earthworms, bees, non-target insects including beneficial arthropods. **Mitigation: Training of handlers on how to minimize risk to non-target ecosystems and organisms.**
Cyromazine 75% WP (Trigard, *a triazine IGR insecticide and miticide*) Syngenta. Registered-USEPA Class III CAUTION. Registered in Iraq. Can be used on many vegetables	Destroy leaf miner-infested seedlings prior to planting. Parasitic wasps often control naturally. Investigate use of	PAN bad-actor pesticide due to ground water contamination. Irritation of eyes, skin and respiratory tract. Known ground water pollutant. Slightly toxic to fish.	**Primary and special concern:** Ground water contaminant.

and fruits, including tomato. Controls leaf miners.	a bacteria-dervied product called Spinosad. Rotate sprays with abamectin.		
Deltamethrin 1.25% ULV (Decis) Generic, and Deltamethrin 2.5% EC (Decis) Generic; Registered-USEPA. Toxicity Class I DANGER-Poison, Highly Toxic; Registered in Iraq. Used for Sunn pest, cutworms on all grasses, leafhoppers, desert locust outbreaks.	Insecticide sprays used as last resort and based on pest densities rather than calendar-based. Decision thresholds for target pests follow IPM principles. Trained scouting crews regularly monitor for pests.	Eye and skin irritant. Salivation, seizure, convulsions, diarrhea, headache, paralysis, tremors, vomiting, death. Kills honey bees, predatory mites, amphibians, crustaceans, mollusks, and zooplankton. Relatively not toxic to birds. Harms aquatic plants, earthworms, phytoplankton and nematodes. Not likely groundwater contaminant.	Potential impacts to humans, honey bees, aquatic organisms, and beneficial arthropods. **Special concern:** Risks to honey bees, and beneficial arthropods.
Diazinon 60% EC (Diazinon) Generic, and Diazinon 10% G (Diazinon) Generic, a non-systemic organophosphate insecticide: Registered-USEPA. Toxicity Classes II & III Slightly to moderately toxic. WARNING or CAUTION, Registered in Iraq. Used on many crops for stem boring, sucking and leaf eating insects like corn and sorghum borers, leafhoppers and ants.	Monitor pest levels carefully, set pest threshold level for spraying, use resistant varieties, rotate insecticides. For moth larvae like those found in maize and sorghum, use a Bt product. Destroy stalks after harvest.	An organophosphate that inhibits acetylcholinesterase. Causes death at high dose levels. Acute symptoms include: weakness, headaches, tightness in chest, blurred vision, nonreactive pinpoint pupils of eye, salivation, sweating, nausea, vomiting, diarrhea, abdominal cramps, and slurred speech. For poisoning, rinse eyes, skin, and mouth; remove contaminated clothes, call doctor, get fresh air and rest. Chronic symptoms include: possible developmental	**Death at high doses.** Monitor cholinesterase levels of sprayers over time. **Special concerns:** Careful when using near water; kills fish and other aquatic organisms. To avoid killing bees, do not spray when plant is in flower, do spray late afternoon/early evening, be careful of drift. Avoid using near birds,

		toxin. Kills birds, bees and fish. Highly toxic to crustaceans, aquatic insects, nematodes and zooplankton. Moderately toxic to mollusks, amphibians, and worms.	where they feed or where they roost; kills birds.
Fenitrothion 50% EC (Sumithion) Sumitomo. Registered-USEPA. Toxicity Class II WARNING; Registered in Iraq. Restricted Use Pesticide (RUP). Remove from use by end of project, or do not recommend to farmers. General Use Pesticide (GUP). General broad-spectrum insecticide used in Iraq for Sunn pest control.	Insecticide sprays used as last resort and based on pest densities rather than calendar-based. Decision thresholds for target pests follow IPM principles. Trained scouting crews regularly monitor for pests.	An organophosphate that inhibits acetylcholinesterase. Causes death at high dose levels. Do not spray if weather inversion is present. Acute symptoms include: weakness, headaches, tightness in chest, blurred vision, nonreactive pinpoint pupils of eye, salivation, sweating, nausea, vomiting, diarrhea, abdominal cramps, and slurred speech. For poisoning, rinse eyes, skin, and mouth; remove contaminated clothes, call doctor, get fresh air and rest. Chronic symptoms include: suspected endocrine disruptor. Kills bees and fish. Highly toxic to crustaceans and aquatic insects. Moderately toxic to birds, mollusks, amphibians, nematodes, zooplankton, and earthworms.	Monitor cholinesterase levels of sprayers over time. **Special concerns: Death at high doses.** Careful when using near water; kills fish and other aquatic organisms. To avoid killing bees, do not spray when plant is in flower, do spray late afternoon/early evening, be careful of drift.
Lambda Cyhalothrin 5% EC (Karate) Syngenta, and Lambda Cyhalothrin (Warrior) Syngenta **:** Registered-USEPA. Toxicity Class II WARNING; Registered in	Constant monitoring by trained scouts to detect insect pests. Minimum	Strong irritant to eyes and skin. Convulsions, cough, labored breath/shortness of breath, abdominal pain. Suspected endocrine disruptor. Contact with skin causes tingling, numbness, tremors, and paralysis.	Potential impacts to humans, fish, many aquatic organisms, beneficial arthropods.

Iraq. Bugs like Sunn pest, aphids and spider mites on all fruit and nut trees; and cutworm on all grasses.	effective dosages used. Insecticides rotated regularly to prevent resistance.	Kills fish, aquatic insects and zooplankton. Highly toxic to honey bees. Harms amphibians, earthworms, crustaceans, mollusks, nematodes and phytoplankton. Slightly to non-toxic to birds.	**Special concern:** Do not use near water. Harm to pesticide handlers, aquatic invertebrates, tadpoles, earthworms, honeybees, beneficial arthropods.
Lufenuron 50% EC (Match, *a benzoylurea IGR*) Syngenta. Registered-USEPA Class III CAUTION. Registered in Iraq. Normally used to kill termites, fleas and ticks.	For American bollworm control, try Bt and Spinosad. Monitor fields carefully for presence of bollworm.	May irritate eyes, skin, and mucous membranes. May cause coughing and shortness of breath, nausea, vomiting, diarrhea, and headache. Not a likely water pollutant.	Very few risks from use.
Spinosad; Registered-USEPA. Toxicity Class IV CAUTION; Registered in Iraq. Kills pests, especially white flies, on citrus, avocado, mango, cactus, pineapple, broccoli, cucumber, tomato, grapes, peppers; thrips on onion, bean, peppers; aphids on grapes, tomato, cucumber, eggplant, broccoli, artichoke, potato, cactus, pear, peach, apricot, pistachio.	Crop monitoring for pests and action thresholds established. Non-chemical control measures are used such as crop rotation, use of certified seed, and good sanitation.	Not toxic orally or dermally, or via inhalation. No body organs affected. No reproductive effects; non-mutagenic; non-teratogenic; non-carcinogenic; not a known endocrine disruptor. Highly toxic to bees. Moderately to slightly toxic to fish. Slightly to highly toxic to aquatic invertebrates. Non-toxic to birds, livestock/domestic mammals, aquatic plants, beneficial arthropods. No data on earthworms.	Potential impacts to humans, bees, fish, aquatic invertebrates. **Special concern**: bees, aquatic invertebrates.
Thiamethoxam 25% WG (Actara) Syngenta, and Thiamethoxam 35% FS (Cruiser, *Seed Treatment*)	Biological controls are available for use against	Carcinogen. Low acute oral, dermal and inhalational toxicity. It is not a skin irritant and is not allergic to skin.	Potential impacts to honey bees, and some beneficial insects.

Syngenta. Registered-USEPA. Toxicity Class III CAUTION; Registered in Iraq. Used against aphids and whiteflies on tomato, maize, alfalfa, clover, millet, sorghum, corn, beans, and pistachio.	aphids, white flies. Try insecticidal soaps and horticultural oils against aphids. Constant monitoring by trained scouts to detect insect pests. Rotate pesticides on a regular basis.	Highly toxic to honey bees. Toxic to predatory bugs and parasitic wasps. Slightly toxic to fish and birds. Nontoxic to earthworms.	**Special concerns:** bees and non-target organisms.
Generic name of Pesticide (or accepted common name)/EPA and Iraq ACB Status	IPM program	Toxicological and Environmental Hazards	Primary concerns
2. Herbicides			
Atrazine 50% WP (K&Z) Generic**; Classified as a RUP based on potential to leach into and contaminate ground and surface water; and inhalation hazard, eye irritation potential, and skin rashes in workers.** Remove from use by end of project, or do not recommend to farmers. USEPA Toxicity Class III; Registered in Iraq. Atrazine is a selective triazine herbicide used to control broadleaf and grassy weeds in corn,	Crop rotation, early and thorough land preparation, hand & mechanical weeding, and use of this chemical only when previously weeded fields are cultivated. Focus on prevention, ID and map their location and populations in the	Irritant to eyes, mucous membranes, and respiratory passages. Moderately toxic if ingested. May affect lungs, kidneys, liver, spleen, brain, ovaries, endocrine organs, and heart. No reproductive effects expected. Non-mutagenic; non-teratogenic; possible human carcinogen; disrupts endocrine system function. Slightly to practically non-toxic to birds. Slightly toxic to aquatic invertebrates, earthworms, and domestic/wild mammals. Highly toxic to aquatic plants. Moderately to slightly toxic to fish. Practically non-toxic to bees. Danger to neighboring crops.	Potential impacts to humans, aquatic plants, fish (via ingestion of contaminated plants), livestock, neighboring fields. **Special concern: Pesticide poisoning of handlers and aquatic ecosystems** **Livestock should be kept out of treated fields and not fed crop forage within 21 days of application**.

sorghum, sugarcane, pineapple, Christmas trees, and other crops, and in conifer reforestation plantings. It is also used as a nonselective herbicide on non-cropped industrial lands and on fallow lands.	field. Determine the critical weed-free period for each crop and use control during this time.		
Clodinafop-propargyl + Cloquintocet-methyl 10% EC (Topik) Syngenta **Clodinafop propargyl is a plant growth regulator.** ***Cloquintocet-methyl is a safener****.* Registered-USEPA as Discover; Registered in Iraq. Listed in MSDS as Discover ng, 6.3% Toxicity Class III CAUTION, or Discover 22.3% Toxicity Class II WARNING. 12 hour restricted entry after spray. Post-emergence weed control in wheat.	Use this chemical only when previously weedy fields are cultivated. Use crop rotation, early and thorough land preparation, and mechanical & hand weeding.	Likely carcinogen. Wear coveralls, gloves, and boots. High toxicity to fish, do not use near open water. High acute aquatic toxicity.	Primary concern is water contamination. **Special concern:** Use care near open water and water tables. Kills fish.
Dicamba 4% EC (Banvel) Syngenta; *and* **Dicamba + Triasulfuron** 70% WG (Lintur) Syngenta. Registered-USEPA. Toxicity Class III CAUTION; Registered in Iraq. Used as broad leaf control.	Proper land preparation; hand weeding.	Reproductive toxin. Inhalation causes cough, labored breathing, vomiting, and weakness. Irritation of eyes and skin. Possible ground water contaminant. Can kill fish, crustaceans and amphibians. Slightly toxic to phytoplankton.	Potential impacts to aquatic organisms. Special concern: Ground water contaminant.

Glyphosate 48% SL (Touchdown) Generic, *and* Glyphosate 36% SL (Groundup) Generic; Registered-USEPA Toxicity Class II-IV depending on route of exposure; registered in Iraq. Used for all weeds on wheat, maize and runner beans.	Control of perimeter weeds around fields. Effective herbicide that can be used with conservation tillage by small-scale and large-scale commercial growers.	Eye and skin irritant. Slightly toxic if ingested or inhaled. May affect blood and pancreas. Unlikely to have reproductive effects in humans. Non-teratogenic. Little mutagenic risk to humans. Most studies show it is non-carcinogenic; however, some studies show increased tumors. Insufficient evidence to conclude it is carcinogenic. Not an endocrine disruptor. Relatively non-toxic to birds and aquatic plants. Practically non-toxic to fish, however, toxicity increases with water temperature. May be toxic to aquatic invertebrates. Moderately toxic to amphibians, beneficial arthropods, and earthworms. Relatively safe for domestic/wild mammals. Potentially harmful to adjacent crops.	Potential impacts to humans, amphibians, beneficial arthropods, earthworms, and adjacent crops. Special concern: aquatic organisms.
Iodosulfuron-methyl-Na + Mesosulfuron-methyl + Mefenpyr diethyl 15% WG (Chevalier) Bayer Crop Science. Sulfonylurea herbicides, and Mefenpyr diethyl as an herbicide safener. **Iodosulfuron-methyl-Na** Registered-USEPA; Tribute® class III CAUTION. **Mesosulfuron-methyl** Registered-USEPA; Osprey®: class III CAUTION. Silverado®: class II WARNING. Registered in Iraq. Winter wheat foliar treatment.	Proper land preparation; hand weeding. Focus on prevention, ID and map their location and populations in the field. Determine the critical weed-free period for each crop and use control during this time.	Iodosulfuron-methyl-Na, Mesosulfuron-methyl: very low acute toxicity. No carcinogenicity or teratogenicty; not developmental, endocrine, or reproductive toxins. There is no evidence of water contamination. Ecotoxicological data is lacking.	Very few potential impacts.

Propanil 34% EC (Stam F34) Dow AgroSciences. An acetanilide post-emergence herbicide with no residual effect. Registered-USEPA. Toxicity Class III CAUTION; Registered in Iraq. General Use Pesticide (GUP). Post-emergence herbicide. It is used against numerous grasses and broad-leaved weeds in rice, potatoes, and wheat.	Proper land preparation; hand weeding. Focus on prevention, ID and map their location and populations in the field. Determine the critical weed-free period for each crop and use control during this time.	Possible carcinogen. Toxicity due to its potential to irritate eyes and skin. Also, dizziness, nausea, headache, vomiting. No reproductive, teratogenic, or mutagenic affects. Propanil may be moderately to highly toxic to a wide range of aquatic species. Kills fish. May kill crustaceans, amphibians, mollusks and aquatic plants. Moderately toxic to birds. And, it is a potential water pollutant. Nontoxic to honeybees.	Potential concern is as a carcinogen and potential ground water contaminant. Special concern as an aquatic pollutant and toxin. Use care around open water.
S-Metolachlor + Atrazine 66% SC (Primagram Gold) Syngenta. **Atrazine is Classified as a RUP (restricted use pesticide) based on potential to leach into and contaminate ground and surface water; and inhalation hazard, eye irritation potential, and skin rashes in workers.** Remove from use by end of project, or do not recommend to farmers. Atrazine has been classified as a Restricted Use Pesticide (RUP) due to its potential for groundwater contamination. Both Registered-USEPA. Toxicity Class III CAUTION. Registered in Iraq.	Proper land preparation; hand weeding. Focus on prevention, ID and map their location and populations in the field. Determine the critical weed-free period for each crop and use control during this time.	Metolachlor is slightly toxic via ingestion and skin exposure. While metolachlor is not readily absorbed by the skin, repeated dermal exposures may create skin sensitization, especially among those who work with metolachlor. Metalochlor is a possible carcinogen, but it is unlikely to be teratogenic, mutagenic, or affect reproduction. Atrazine is slightly to moderately toxic to humans and other animals. It can be absorbed orally, dermally, and by inhalation. Symptoms of poisoning include abdominal pain, diarrhea and vomiting, eye irritation, irritation of mucous membranes, and skin reactions. At very high doses: excitation followed by depression, slowed breathing, incoordination, muscle spasms, and hypothermia.	Potential concern with metalochlor as a carcinogen and a water contaminant. Special concerns: Atrazine is a RUP. Both chemicals are implicated for ground water contamination. Do not use near drinking water sources.

Metolachlor is usually applied to crops before plants emerge from the soil, and is used to control certain broadleaf and annual grassy weeds in field corn, soybeans, grain sorghum, stone fruits, and nut trees. Atrazine is a selective triazine herbicide used to control broadleaf and grassy weeds in corn, sorghum, sugarcane, pineapple, and other crops.		Metolachlor is slightly to non-toxic to birds and bees. It is moderately toxic to fish. And, it is a known ground water contaminant. Atrazine is relatively non-toxic to birds, bees, moderately toxic to fish, and slightly toxic to amphibians, crustaceans, and aquatic insects.	
Tribenuron-methyl 75% DF (Granstar—also known as Express®) DuPont. A sulfonylurea herbicide. Registered-USEPA. A General Use Pesticide (GUP). Toxicity Class III CAUTION. Registered in Iraq. A general use terrestrial herbicide for wheat and barley.	Focus on prevention, ID and map their location and populations in the field. Determine the critical weed-free period for each crop and use control during this time.	Irritation to skin and eyes. Possible carcinogen. Non-toxic to fish. A data gap exists for additional ecotoxicological information.	Primary concern is possibilities for health impacts.
Trifluralin 48% EC (Triflan—also known as Treflan®) Generic. A dinitroaniline herbicide. Registered-USEPA. A General Use Pesticide (GUP). Toxicity	Focus on prevention, ID and map their location and populations in the field.	Practically non-toxic. Possible irritation to eyes, but not skin. Prolonged or repeated skin contact with trifluralin may cause allergic dermatitis. Possible carcinogen and endocrine disruptor.	Potential concerns for aquatic contamination and development of resistance. Special concerns for toxicity

Classes II WARNING and III CAUTION, depending upon product. Registered in Iraq. Trifluralin is a selective, pre-emergence dinitroaniline herbicide used to control many annual grasses and broadleaf weeds in a large variety of tree fruit, nut, vegetable, and grain crops, including soybeans, sunflowers, cotton, and alfalfa. Trifluralin is almost exclusively a single-application, ground-applied or soil-incorporated treatment.	Determine the critical weed-free period for each crop and use control during this time.	Trifluralin is very highly toxic to fish and other aquatic organisms. Practically non-toxic to birds and bees. Kills amphibians, worms, insects, and mollusks. It persists a long time in the environment and is transported great distances as vapor and on dust particles. For these reasons, and others, Sweden, Denmark, Norway, and the Netherlands have stopped its use. Extensive use in UK and USA has caused several weed species to become resistant. (http://www.pan-uk.org/pestnews/Actives/Triflura.htm).	to fish and aquatic animals. Use care around open water.
Generic name of Pesticide (or accepted common name)/EPA and Iraq ACB Status	IPM program	Toxicological and Environmental Hazards	Primary concerns
3. Fungicides			
Chinosol 50% SL (Beltanol L®) Probelte Company. A quinoline based fungicide and microbicide also known as 8-Hydroxyquinoline sulfate. Registered in Iraq. **Not Registered by USEPA—All uses cancelled. Should not be used by the project or recommended to farmers.** Requested for fungal control in tomatoes.	Crop rotation to avoid spores. Sanitation-remove diseased plant parts. Use mulch, fertilizer. Cultural methods-avoid overcrowding. Use resistant varieties. Avoid overhead sprinklers. Water in morning.	A mutagen. All uses cancelled by EPA.	Should not be used by INMA project or by farmers. Use other fungicide options like mancozeb for fungal control in tomato.

Cyprodinil + Fludioxinil 62.5% wg (Switch) Syngenta. A systemic, preventative, curative fungicide. Registered-USEPA. Toxicity Classes III and IV CAUTION; Registered in Iraq. Many fungi controlled on field crops, vegetables, herbs, and fruit.	Crop rotation to avoid spores. Sanitation-remove diseased plant parts. Use mulch, fertilizer. Cultural methods-avoid overcrowding. Use resistant varieties. Avoid overhead sprinklers. Water in morning.	Slight eye irritant. Non-irritant to skin. Not a skin sensitizer. Not toxic to bees, birds, beneficial arthropods and earthworms. Toxic to algae and fish. Fludioxinil is a potential water pollutant. Do not apply within 25 meters of bodies of water such as lakes, reservoirs, rivers, permanent streams, natural ponds, marshes or estuaries.	Potential for water pollution
Difenoconazole 3% WS (Score, *Seed Treatment*) Syngenta, *and* Difenoconazole 25% EC (Score) Syngenta. An azole systemic fungicide. Registered-USEPA. Toxicity Class III CAUTION. Registered in Iraq. Used for soil-borne and foliar diseases and used as seed treatment on spring and winter wheat, corn, rye, canola, garlic and barley. Controls or suppresses Smuts, bunts, Aspergillis, Fusarium, Penicillium, Septoria, Cochliobolus, Pyrenophora, Pseudocercosporella, and Gaeumannomyces.	Crop rotation to avoid spores. Sanitation-remove diseased plant parts. Use mulch, fertilizer. Cultural methods-avoid overcrowding. Use resistant varieties. Avoid overhead sprinklers. Water in morning.	Possible carcinogen. Absorbed through skin. Use boots, gloves, and coveralls. Practically non-toxic to birds. Toxic to fish and aquatic invertebrates. Do not apply within 25 meters of bodies of water such as lakes, reservoirs, rivers, permanent streams, natural ponds, marshes or estuaries.	Potential concern with chronic human health issues. **Special concern** with fish and aquatic animals.

Mancozeb 70% WP (Ridomil M72) Syngenta. Registered by USEPA. Toxicity Class IV CAUTION. Registered in Iraq. Products may contain manganese. Classified as a General Use Pesticide (GUP). For control of rice blast disease.	Crop monitoring for fungal diseases and may be able to develop action thresholds for spraying. Non-chemical control measures are used such as good sanitation, and hand removal of diseased leaves and plant parts. Fungicide is rotated to prevent resistance.	May cause irritation of nose, throat, eyes, and skin. Ingestion causes nausea, diarrhea, vomiting. Can affect thyroid gland. USEPA listing as probable human carcinogen. On list of pesticides that are potentially hormone disruptors. Unlikely to produce reproductive effects; non-teratogenic; inconclusive mutagenicity but data suggest non-mutagenic or weakly mutagenic. Kills amphibians, fish and zooplankton. Moderately to highly toxic to aquatic invertebrates. Not toxic to bees or beneficial arthropods. Moderately toxic to aquatic plants. Domestic/wild mammals not to be grazed in treated areas. Relatively non-toxic to birds.	Potential impacts to humans, fish, aquatic invertebrates, and grazing animals. **Special concern**: toxicity to fish and aquatic invertebrates, and grazing animals; and potential carcinogenic action in humans.
Tebuconazole 2% DS (Raxil, *Seed Treatment*) Bayer Crop Science. An azole fungicide. Registered-USEPA. Toxicity Class III CAUTION. Registered in Iraq. Tebuconazole is a fungicide for the control of smuts, bunt, seed rots and seedling blights on barley, oats and wheat as a seed treatment and for the control of Fusarium Head Blight on wheat as a post-emergent treatment.	Use disease-free seed and systemic fungicides. Use mulch, fertilizer. Cultural methods-avoid overcrowding.	Possible carcinogen. Harmful if swallowed, absorbed through skin or inhaled. Causes substantial but temporary eye damage. Use coveralls, gloves, goggles, and boots. No carcinogenicity or teratogenicty; not developmental, endocrine, or reproductive toxins. Potential water contaminant. Toxic to fish and aquatic invertebrates. Do not apply by ground within 10 meters of bodies of water such as lakes, reservoirs, rivers, permanent streams, natural ponds, marshes or estuaries.	Potential for health impacts to eyes and longer-term exposure for cancer risk. **Special concern** as a ground water contaminant. Kills fish and aquatic animals. Use care around drinking water sources and open water.

Generic name of Pesticide (or accepted common name)/EPA and Iraq ACB Status	IPM program	Toxicological and Environmental Hazards	Primary concerns
4. Rodenticide/Stored Products			
Aluminium Phosphide (Phostoxin) Generic**; Classified as a RUP due to acute inhalation toxicity of phosphine gas.** USEPA Toxicity Class I DANGER; registered in Iraq Seed and grain treatment: maize seed, dry bean seed; used to protect seed and grain during storage against rodents.	Used as fumigant for stored seed, ensuring a healthier crop from the healthy pest-free seeds, requiring less pesticide after seed is sown. Fumigant for stored grain. Stored products are further protected from infestation by good sanitation and cleanliness, and use of secure storage facilities.	Contact is only via inhalation. No significant entry orally or dermally. May affect lungs, liver, kidneys, nervous system, and circulatory system. Since food products are not treated, no concerns relative to dietary exposure. Highly toxic via inhalation. Not likely to have reproductive effects under normal use. Non-teratogenic; non-mutagenic; non-carcinogenic; not an endocrine disruptor. It is toxic to all animals and plants. Highly toxic to fish, aquatic invertebrates, bees.	Potential impacts to humans, all animal and plant life. **Special concern: pesticide handlers, bystanders, any other animal life that may breathe the gas may die**. According to USEPA: May be purchased and used only by certified applicators. In INMA project, not to be used by smallholders and growers directly. Only to be used by trained staff of Iraq seed companies and commercial contract fumigators.
5. Nematicides			
Carbofuran 5% G (Furadan) FMC. A carbamate nematicide/ insecticide/miticide. Registered-	Monitor nematode populations. Rotate crops. Use	A high toxicity carbamate pesticide that inhibits cholinesterase and may cause: malaise, muscle weakness, dizziness, and sweating; headache,	Potential for acute health damage to applicators. Use safety equipment.

USEPA Toxicity Class II WARNING. Restricted Use Pesticide (RUP). Remove from use by end of project, or do not recommend to farmers. Registered in Iraq. For use against root knot nematode in tomatoes.	resistant varieties. Weed fields. Cultural-plough out plants after harvest or pull and burn stem/roots.	salivation, nausea, vomiting, abdominal pain, and diarrhea; miosis with blurred vision, incoordination, muscle twitching and slurred speech. In more severe cases, may cause: central nervous system depression (coma, seizures and hypotonicity), hypertension, cINMAorespiratory depression, and death. Potential ground water contaminant. Moderately to highly toxic to aquatic organisms: fish, crustaceans, mollusks, insects, and earthworms. Granule formulation is not considered toxic to bees, but is toxic to birds (keep domestic fowl away from field) that mistake granules for seeds.	Special concern for high toxicity. Potential ground water contaminant. Toxic to birds—use care around domestic birds, do not permit chickens to forage in field.
Oxamyl 24% L (Vydate L, *also a insecticide & miticide*) DuPont, a carbamate. Registered-USEPA. Toxicity Class I DANGER-Poison, Highly Toxic; Registered in Iraq. Restricted Use Pesticide (RUP)—to be used only by highly trained applicators. Remove from use by end of INMA project, and do not recommend to farmers. Used on cotton, bell peppers, tomato, onions, celery, most vegetables and fruits. Controls nematodes, leafhoppers, aphids, whiteflies, thrips, beetles, borers, leaf miners, and bugs.	Monitor nematode populations. Rotate crops. Use resistant varieties. Weed fields. Cultural-plough out plants after harvest or pull and burn stem/roots.	Inhibits cholinesterase. Antidote is atropine sulfate by intravenous. Highly toxic by ingestion or inhalation. Formulation also contains 35-45% methanol—a poison. May be fatal or cause blindness if swallowed. Do not breathe vapors or spray mist, or get in eyes, on skin or clothing. Causes weakness, blurred vision, headache, nausea, muscle tremors, and abdominal cramps. Must use coveralls, boots, gloves, goggles, hat, and a respirator with cartridge. Highly acutely toxic to birds and mammals. Marine pollutant. Kills fish and crustaceans. Do not allow to enter water.	Primary concern: Toxic to people, inhibits cholinesterase. **Special concerns:** Highly toxic by ingestion or inhalation. Highly toxic to birds, mammals, and fish.

5.1 PESTICIDE EVALUATION REPORT: ADDRESS PESTICIDE CHOICES, ISSUES AND RECOMMENDATIONS ACCORDING TO THE 12 REGULATION 216 PESTICIDE PROCEDURES

PESTICIDE PROCEDURES ELEMENT A: USEPA REGISTRATION STATUS OF THE PROPOSED PESTICIDES.

Pesticides are registered in the U.S. as formulated products and also by the technical active ingredients. "Registration status" possibilities of the active ingredients and the formulated products include never registered, active registration, and cancelled registration.

USAID is effectively limited to using pesticide active ingredients registered in the U.S. by the U.S. Environmental Protection Agency for the same *or similar* uses. Emphasis is placed on *similar use* because many of the pests found overseas are not present in the USA, and therefore pesticides may not be registered for the exact same use, but often are registered for similar pests and pest situations. In addition, host country pesticide registration procedures must also be identified and followed.

As of 2007, all but two of the pesticides proposed for use by INMA are registered for same or similar use by the US EPA (see Table 2). These two *non-registered* pesticides are fungicides Chinosol 50% SL (Beltanol) Probelte and Carbendazim 50% WP (Bavistin) BASF that were proposed for use on tomato. As practical, these two fungicides should be replaced by other fungicides that are registered in the USA for same or similar use.

Relative safety to human health is an added benefit associated with the use of GUP (General Use Pesticides) proposed by the INMA project. GUP pesticide use should be promoted, as all GUP pesticides are considered relatively safer than most RUP (Restricted Use Pesticides), and an S for safety is granted as a selection criteria. Furthermore, safety consideration is not granted to pesticides considered in the USA to be RUP (Restricted Use Pesticides), or to those with a very high (EPA class I— highly toxic) toxicity rating.

PESTICIDES THAT ARE RUP SHOULD BE RAPIDLY PHASED OUT OF USE ON INMA IN IRAQ, IF PRACTICAL

Fenitrothion 50% EC (Sumithion) Sumitomo (0.02ppm)—Restricted Use Pesticide (RUP). In the 1990s, well-trained farmers in South Africa were killed by fenitrothion use during a weather inversion, where the spray concentrated near the ground and the truck-mounted sprayer. Replace by end of project and do not recommend to farmers. In the meantime monitor use closely and ensure use of safety equipment and safe use methods.

Atrazine 50% WP (K & Z) Generis—Restricted Use Pesticide (RUP). Has the potential to leach into and contaminate ground and surface water. Replace by end of project and do not recommend to farmers. In the meantime monitor use closely and ensure use of safety equipment and safe use methods.

Carbofuran 5% G (Furadan) FMC—Restricted Use Pesticide (RUP). Carbofuran is a very high toxicity product and potential ground water contaminant. Replace by end of project and do not recommend to farmers. In the meantime monitor use closely and ensure use of safety equipment and safe use methods.

Oxamyl 24% L (Vydate, *also a nematicide*) DuPont—Restricted Use Pesticide (RUP). A highly toxic pesticide. Replace by end of project and do not recommend to farmers. In the meantime monitor use closely and ensure use of safety equipment and safe use methods.

RECOMMENDATIONS

* *For INMA to use these products in the short term, users will require immediate (before the next spraying season-October 2007) training in pesticide safe use and IPM, if this has not yet occurred.*

* *Before the end of the INMA project, or during the present phase of the projects, all RUP pesticides are not used and are replaced by less toxic alternative products, as practical.*

* *Update the changes to the list of pesticides proposed for use and communicate these changes to USAID*

INMA Project Managers will need to report changes to less toxic products on the list of pesticides recommended to USAID as this PERSUAP is amended.

* *Produce a quick reference guide for all of the pesticides to be used on each project for each type of plant and anticipated pest, with use rates, safety measures, environmental concerns, and minimum reentry periods*

A quick reference guide will be useful for pesticide applicators to refer to in the field as they make pesticide choice decisions.

PESTICIDE PROCEDURES ELEMENT B: BASIS FOR SELECTION OF PESTICIDES.

This generally refers to the economic and environmental rationale for choosing a particular pesticide. In general, the least toxic pesticide that is effective is selected.

The bases for selection of each pesticide are provided in INMA pesticides tables found in Table 1 of this document. As of 2007, the most common factors are availability, effectiveness (efficacy) and a reputable manufacturer. Price, human safety, and environmental safety are other factors that will influence the choice of pesticides. In general, INMA has chosen the least toxic products of those available and avoids very toxic products unless no alternative exits. At some point, economic analyses will need to be done to show the sustainability of each pesticide in a normal farmer's production program.

ECONOMIC ANALYSIS

In general, as of 2007, for most common crops pesticides cost, in total, about 5 times the costs of labor in most countries. If the cost for labor is one fifth of the total cost, with another one-fifth for other inputs like fertilizer, a savings of three-fifths will be realized by farmers who do not extensively use pesticides. Manual labor, including armed bodyguards for farmers, combined with IPM measures found in Attachment 2, is therefore cost-favorable to the use of pesticides to control pests in all INMA crops.

RECOMMENDATIONS

* *Continue to choose least toxic pesticides, as practical*

* *Intend to use more biological and organic pesticides, as practical*

Table 2 shows two products available in Iraq that are derived from natural sources: abamectin, which is a mixture of insecticidal and miticidal compounds called avermectins produced by fermentation from the soil bacterium *Streptomyces avermitilis*; and spinosad, a mix of new insecticidal compounds called spinosyns produced by fermentation of the soil actinomycete microorganism *Saccharopolyspora spinosa*.

Pyrethrum, a mix of natural chemicals called pyrethroids, can be extracted from chrysanthemum flowers, and provides good general pest control. Extracts from Neem trees are effective insecticides that are commercially available. Spore extracts from the bacterium *Bacillus thuringiensis* are effective against worm or caterpillar larvae of moth and butterfly pests. Insecticidal soaps and oils are effective against relatively sedentary pests like scales, mealybugs, aphids and mites. A list of botanical products studied and registered by EPA is attached at the end of this report.

PESTICIDE PROCEDURES ELEMENT C: EXTENT TO WHICH THE PROPOSED PESTICIDE USE IS, OR COULD BE, PART OF AN IPM PROGRAM.

USAID policy promotes the development and use of integrated approaches to pest management (IPM) whenever possible. This section discusses the extent to which the proposed pesticide use is incorporated into an overall IPM strategy, and if not, how it can be.

For every crop that will be grown in Iraq with INMA assistance, Attachment 2 provides examples of IPM techniques that can be tried and integrated with each pesticide in Iraq for different types of pests. IPM makes use of combinations of the following tactics: cultural (use of resistant varieties, crop rotation, variation in time of planting or harvesting, crop refuse destruction, pruning, planting trap crops), mechanical (hand destruction, exclusion by barriers, trapping), physical (heat, cold, humidity, traps, sound), and biological (introduction and/or protection of imported or indigenous natural enemies of pests, propagation and dissemination of microbial control agents).

IPM can also include use of: natural chemical methods (by using attractants, repellents, sterilants and growth inhibitors), genetic methods (propagation and release of sterile or genetically incompatible pests), and regulatory means (plant and animal quarantines, suppression and eradication programs) to the extent possible while permitting the safe integration of pesticides with farmers' traditional cropping and pest management systems.

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

- IPM is more effective then synthetic pesticides *in the long run*
- IPM is less damaging to essential soil health and nutrient cycling
- IPM generally requires less capital investment
- IPM can be used preventatively to eliminate or minimize the need for "responsive" controls (that is, applying pesticides after a pest outbreak occurs and much damage already has been done).

RECOMMENDATIONS

* *Enhance understanding of and emphasis on Integrated Pest Management (IPM) philosophy and techniques, with pesticide use as a last resort*

* *IPM plans can be written for each of the crops to be protected, by pests, as practical*

An attachment outlining a general approach to IPM program planning and design is found at the end of this report.

PESTICIDE PROCEDURES ELEMENT 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 and the measures to be taken to ensure safer use.

Pesticides will be applied starting in 2007 by way of several types of applicators, but primarily by hand-pumped backpack sprayers. INMA should ensure that protective clothing (gloves, mask, goggles, in addition to Tyvec protective suits) are issued to farmers whose field is used as a demonstration plot. Mixers and applicators wear PPC during operations.

The following are some general measures that can be used to ensure safe pesticide use.

MITIGATING POTENTIAL PESTICIDE DANGERS; MEASURES TO ENSURE SAFE USE

If there are no feasible alternatives to pesticides, take the following measures to mitigate and reduce their risks to human health and the environment. Note that risk is a function of both toxicity and exposure. Reducing risk means (1) selecting less toxic pesticides and (2) selecting pesticides that will lead to the least human exposure before, during and after use.

Reduce exposure time or the degree of exposure

Before using

Transport:

- separate pesticides from other materials being transported

Packaging:

- follow national and international norms and guidelines
- use packaging (small containers) adapted to local needs
- eliminate the re-use of packaging materials

Storing:

- develop strict guidelines for village-level storage
- ensure permanent, well-marked labeling
- follow and respect national norms
- use appropriate language and approved pictograms

Formulating:

- use appropriate type and concentration

During use

Training from 2007 on:

- should be continuous
- should identify level and audiences (distributors, farmers, transporters, etc.)

Use application equipment:

- should be adapted to user needs and possibilities
- should assure maintenance and availability of parts and service

Use protective equipment and clothing:

- should be adapted to local climatic conditions
- should be adapted to user needs and resource possibilities
- should eliminate exposure rather than just reduce it, if at all possible

Focus on "buffer zones" around the following:

- housing
- environment: water, sensitive areas

After using

- know, enforce, respect exclusion or reentry periods after application
- assure proper cleaning and rinsing off of:
  - applicators' preparation and application equipment
  - applicators' clothing
  - storage containers
- develop a workable monitoring and evaluation system for:
  - adherence to national and international policies regarding pest management and pesticides
  - health effects on applicators, the local population, and domestic animals
  - efficacy on target pests
  - impacts on environment: water, soils, etc.
  - elimination of pesticide leftovers and containers

RECOMMENDATIONS

* *Immediate (before the next 2008 season) training in safe handling and use*

Project staff who will use of oversee the use of pesticides require training in safe handling and use of insecticides. Very little of this training has been provided in the past in Iraq, although INMA is beginning to rectify this.

* *The production of safe use training materials and posters*

One way to remind applicators of safety issues is through the production and use of high quality training materials and safe use posters. These should be adapted or borrowed from other Arabic-speaking countries for use in Iraq. The ARDI project sure did a fine job with this.

* *During 2007, administer the Pesticide Use Checklist (PUC) for NGOs/PVOs*

Translate into Arabic and administer during training the PUC to all project participants to gather baseline data on their understanding of safe pesticide issues. A copy of the PUC is attached at the end of this report as Attachment 5.

* *Continued procurement and use of protective clothing and safety equipment*

Protective clothing and safety equipment needs to continue to be provided for all pesticide handlers, users, applicators, and others present while application occurs.

PESTICIDE PROCEDURES ELEMENT 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 data associated with the proposed pesticide. In addition to hazards, this section also discusses measures designed to mitigate any identified toxicological hazards, such as training of applicators, use of protective clothing, and proper storage.

The acute and chronic human and environmental toxicological hazards are listed for each pesticide in Table 2. Primary and Special Concerns are also outlined for each pesticide. Use precautions outlined in Table 2 for each pesticide. There are several ways to mitigate exposure to humans. Some of the best examples are outlined below.

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. 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. Pesticides can enter the body in four major ways: through the skin, the mouth, the nose, and the eyes. A checklist is given below to help avoid these various routes of overexposure to pesticides.

To avoid dermal (skin) exposure

- Check the label for special instructions or warnings regarding dermal exposure
- Use recommended protective clothing and other equipment as listed on the label
- Do not re-enter the area until deposit has dried or re-entry interval is past

To avoid oral (mouth) exposure

- Check the label for special instructions or warnings regarding oral exposure
- Never eat, drink, or smoke, chew tobacco while working with any pesticide
- Wash thoroughly with soap and water before eating, drinking, smoking, or chewing tobacco
- Do not touch lips to contaminated objects (such as nozzles)
- Do not wipe mouth with contaminated hands or clothing
- Do not expose food, beverages, drinking vessels, or cigarettes to pesticides
- Wear a face shield when handling concentrated pesticides

To avoid respiratory (lungs) exposure

- Read the label to find out if respiratory protection is required
- If respiratory protection is required, use only an approved respiratory device
- Stay upwind during application

To avoid eye exposure

- Read the label to find out if eye protection is required
- If eye protection is required use goggles to protect eyes or a face shield to protect eyes and face
- Keep pesticide container below eye level when pouring

In addition to these common sense measures, there is a way to ensure protection against exposure to pesticides by the type of clothing required for different classifications of pesticides (the classification of each pesticide by EPA toxicity class I, II, III, or IV, and signal word DANGER, WARNING, CAUTION). Toxicity class and signal word is provided for each INMA pesticide in Table 2. Good protection is achieved by following the protective clothing and equipment guide.

The EPA system for determining toxicity of pesticides (as well as the WHO system) is included as Attachment 7 to this PERSUAP.

BASIC FIRST AID FOR PESTICIDE OVEREXPOSURE

Get medical advice quickly if you or any of your fellow workers have unusual or unexplained symptoms during work or later the same day. Do not let yourself or anyone else get dangerously sick before calling a physician or going to a hospital. It is better to be too cautious than too late.

First aid is the initial effort to help a victim while medical help is on the way. If you are alone with the victim, make sure the victim is breathing and is not being further exposed to the poison before you call for emergency help. Apply artificial respiration if the victim is not breathing.

Read the first aid instructions on the pesticide label, if possible, and follow them. Do not become exposed to poisoning yourself while you are trying to help. Take the pesticide container (or the label) to the physician. Do not carry the pesticide container in the passenger space of a car or truck.

Basic first aid procedures are in Attachment 8 to this PERSUAP.

RECOMMENDATIONS

* *Get training in proper use of protective equipment and safe use of pesticides*

All project farmers who handle, supervise, or spray pesticides will require safe use training if not already received.

* *Develop or adapt posters on use of safety equipment*

For many projects using pesticides, posters exist to remind users of safety concerns and equipment. Such posters, in Arabic, should be ordered and posted where pesticide workers can see and review them. This can be done as part of a training program.

* *Avoid damage to environment through training to avoid non-target ecosystems*

IPM and safe use training should components or training modules on how to mitigate exposure of non-target organisms to pesticides.

PESTICIDE PROCEDURES ELEMENT F: EFFECTIVENESS OF THE REQUESTED PESTICIDE FOR THE PROPOSED USE.

This section of the PERSUAP requires information similar to that provided in item b, but more specific to the actual conditions of application. This section also considers the potential for the development of pest resistance to the proposed insecticide.

All of the pesticides chosen for the project were selected based upon effectiveness as one of the primary criteria, from farmer and international experience. As little pesticide use is expected on these pilot projects, resistance will likely not be an issue.

RECOMMENDATIONS

* *Rotate pesticides to reduce the build-up of resistance*

* *Monitor resistance by noting reduction in efficacy of each pesticide product*

Project staff can monitor the kill rate of the pesticides for any reduction in efficacy, communicate with neighboring farmers and extension agents, to determine when pesticide rotation is called for.

PESTICIDE PROCEDURES ELEMENT G: COMPATIBILITY OF THE PROPOSED PESTICIDE USE WITH TARGET AND NON-TARGET ECOSYSTEMS.

This section examines the potential effect of the pesticide on organisms other than the target pest (for example, the effect on bee colonies in the spray area). Non-target species of concern also include birds, fish, aquatic organisms, and beneficial insects. The potential for negative impact on non-target species should be assessed and appropriate steps should be identified to mitigate adverse impacts.

The effect of each insecticide on non-target ecosystems will depend on how long it stays in the environment, or rather its rate of break-down, 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 also have a significant half-life. Since pesticides break down in soil, light, 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. Lastly, pesticides can be broken down, or hydrolyzed, with exposure to water.

Table 2 addresses the potential impact of each pesticide on aquatic organisms, fish, birds, bees, beneficial insects, and ground water contamination. Please refer to this table to see the impacts and suggestions for mitigating these impacts.

Since pests and pesticide use will likely be low on the project pilot sites, there should be little impact to non-target organisms. However, since water and groundwater are a limited resource in some parts of Iraq, all attempts must be made to reduce contamination. And, botanical and biological pesticides should be promoted on these pilot projects.

RECOMMENDATIONS

* *Investigate the use of botanical and biological controls*

The geography (islands of green crop in a sea of sand and desert) and cropping methods in Iraq are very amenable to the use of biological controls. If any greenhouse production will be done in the future with tomatoes, biological controls work quite well. The project could investigate their use.

* *Apply pesticides early in the morning before bees forage*

* *Apply pesticides at least 35 meters from drinking water sources and open water*

PESTICIDE PROCEDURES ELEMENT H: CONDITIONS UNDER WHICH THE PESTICIDE IS TO BE USED, INCLUDING CLIMATE, FLORA, FAUNA, GEOGRAPHY, HYDROLOGY, AND SOILS.

In general, this requirement attempts to protect endangered species, forests, and parks from the dangers of pesticide misuse as well as protect soil and water resources from contamination.

Since there are as yet no national parks in Iraq, there is no imperative to closely manage the use of pesticides near such areas. However, Iraq has 81 mammal species, 7 of which are

considered endangered. INMA can therefore take measures to protect these species if they occur near project plots.

PESTICIDE ADSORPTION AND LEACHING 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 proposed for use on the INMA project by checking each pesticide on the PAN website: http://www.pesticideinfo.org. The water solubility, soil adsorption and natural breakdown rates, if available, are included at the bottom of 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 an adsorption coefficient of less than 1,900 have the *potential* to contaminate groundwater. And, 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 detailed environmental, hydrological, and soil conditions at the project pilot sites are likely included in the official Project Papers for INMA. Look at these documents to find details. Further, potential for surface and ground water contamination for each pesticide are addressed in Table 2 for each proposed pesticide. Look to this table to determine contamination potential and use with care.

GROUNDWATER CONTAMINATION ISSUES AND DISCUSSION

Most of the proposed pesticides are not potential ground water contaminants. Further, the arid conditions under which the pesticides will be used indicate that they will be rapidly evaporated upon application. In the highlands, the distance to ground water tables is likely great, and many of the soils contain a highly impermeable calcium layer. There is much closer proximity to surface water via rivers and canals in the Iraqi Marshlands in the South of the country. Do not apply pesticides near or in water.

RECOMMENDATIONS

* *Continue to utilize pesticides with low ground water contamination potential*

As one of the criteria for selection of pesticides, determine the potential for risk of surface and ground water contamination at each site, and choose pesticides based upon little contamination potential.

* *Investigate and promote the use of biological pesticides to replace synthetic pesticides*

Lists of botanical and biological pesticides are included in this report. Investigate their usefulness and availability in Iraq.

PESTICIDE PROCEDURES ELEMENT I: AVAILABILITY OF OTHER PESTICIDES OR NON-CHEMICAL CONTROL METHODS. This section identifies other options for control of pests and their relative advantages and disadvantages.

Non chemical methods (IPM Techniques) are listed under element c above and in Attachment 2. There is a 2002 list of some 237 active ingredients and 522 products registered in Iraq for agriculture, public health and veterinary uses. There are many to choose from in the future if resistance to a pesticide develops—as long as they are EPA-approved for same or similar use.

Only two products from biological sources are identified being useful on project sites, Spinosad and Abamectin, are derived from microbial organisms. There are no other biological or botanical products being anticipated by the project. There are international and local companies that can provide support in biological controls, should the project so choose. And, these companies specialize in many, if not most of the pests encountered in Iraq.

BIOLOGICAL CONTROL AGENTS

Biological 'pesticides' are available commercially from two large international companies, Koppert of Holland and Biobest of Belgium, and one regional company called BioBee right next door in Israel. The Dutch company 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. Their website is: 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.

The Israeli company, BioBee (a local/regional subsidiary of Koppert), provides biological controls for aphids, spider mites, thrips, leaf miners, mealy bugs, and white flies. Their website is: http://www.bio-bee.com/english/welcome.html.

RECOMMENDATIONS

* *Research and try more 'biological pesticides'*

All the resources are provided in this PERSUAP to do this. The websites given provide direct links to companies producing biological 'pesticides' and an attachment to this PERSUAP provides botanically extracted products.

PESTICIDE PROCEDURES ELEMENT 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 could result in greater harm to the environment.

The country of Iraq is at an historic crossroads, with a new MOA being formed, and assistance from USAID, to lead environmental management in the region. As it evolves, implementation and compliance will improve during the length of the INMA project. The project can take

advantage of and contribute to this progress with the use of progressive pest control tactics and safe use of pesticides.

RECOMMENDATIONS

* *Continue to work with the MOA and as appropriate the MOE as they implement environmental compliance*

INMA staff can continue to work closely with the MOA and eventually MOE to stay abreast of developments in the regulation and registration of pesticides.

PESTICIDE PROCEDURES ELEMENT K: PROVISION FOR TRAINING OF USERS AND APPLICATORS.

USAID recognizes that 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.

Training in IPM and Safe Use are of paramount importance for Iraqis using pesticides. This is especially true due to the dearth of training received to date.

The following training elements were implemented by ARDI:

- Training of extension staff trainers (16) has been completed with a 9 week course on communication skills and participatory extension methods. It is planned for these will train 180 field extension staff by September 2006. *By mid June 2006, 111 field extension staff had been trained.* IPM and safe pesticide use will be included in training and farmer activities where appropriate.

- 119 pesticide dealers had been trained by May 2006, including safe pesticide handling and use and IPM principles. A pesticide dealer association has been established, and INMA will support the training objectives of the association.

- An orchard development extension program, implemented through NGOs, for 330 farmers.

- Other field days for farmers include IPM and safe pesticide use where appropriate.

- The possibility of implementing a farmer education program on safe pesticide use through an NGO is being assessed. If successful, this could be used as a template for additional NGO or MoA farmer pesticide education programs.

RECOMMENDATIONS

* *Continue to implement Pesticide Safe Use training for MOA, staff and farmers*

This is only a start. USAID may consider, as part of many new agreements with the Government of Iraq, to lead efforts at training research staff and extension agents to train farmers. There are also some excellent opportunities to introduce new biological control technologies for enhanced export and trade in organic and Minimum Standard Levels of pesticides to the European market.

PESTICIDE PROCEDURES ELEMENT L: PROVISION MADE FOR MONITORING THE USE AND EFFECTIVENESS OF EACH PESTICIDE. Evaluating the risks and benefits of pesticide use should be an ongoing, dynamic process.

INMA project staff will monitor pesticide efficacy and effects to the environment on an on-going basis and switch to alternative pesticides as the need arises. Program site managers will monitor for efficacy against pests and impact on beneficial organisms.

A Pesticide Application Record has been produced for use when pesticides are applied under direct INMA activities. This includes provision for follow-up monitoring of the application.

RECOMMENDATIONS

* Simple monitoring plans will be drawn up by site managers

Site managers will be responsible for drawing up simple monitoring plans, to collect data on reduction in efficacy and any other known environmental impacts leading to a change to a new or different pesticide. This will be reported to USAID, as a small section, along other reporting requirements.

Mitigation and Monitoring: This should focus on efficient use of pesticides, and human health and safety measures. Below are issues important to USAID/Iraq, with responses by INMA. The monitoring and mitigation program should cover:

IPM as a whole: Large quantities of pesticides are not supposed to be applied when pesticide use is well linked to good IPM practices (e.g. well regulated cultural practices, etc.).

INMA has never used large quantities of pesticides in its activities, and promotes practical IPM strategies wherever possible.

Disposal of waste from pesticide use, that includes: (i) Empty pesticide containers to discourage their use for domestic purposes (e.g. storage of food and drinks, etc.), through burning, burying, perforation, etc.; (ii) Liquid effluents from the washing of pesticide application equipment and protective clothing; and, (iii) Expired pesticides to prevent environmental degradation and danger to human health and safety (H &S), due to inappropriate disposal.

INMA does not use large amounts, never stores pesticides, disposes of containers safely. All activities with stakeholders (farmers, MoA staff, and pesticide dealers) emphasize safe disposal of containers, washings, and excess spray mix. However, INMA does not have direct control over the actual activities of third parties.

Monitoring how the pesticides are being used will assist in identifying those pesticides that are about to expire.

INMA does not use large amounts, never stores pesticides, disposes of containers safely. Given the current situation, it is impossible for INMA to monitor pesticide use nationwide. Even under normal circumstances, it would be major undertaking to monitor how pesticides are actually being used in order to determine which are about to expire. INMA is working from the other end, with pesticide dealers - one aspect of training is stock monitoring and record keeping

and first-in, first-out stock procedures - and also with the MoA on pesticide registration and monitoring procedures. Section 4.14 (above) also notes various means by which build-up of obsolete stocks can be avoided. INMA is working on many of these points with the public and private sectors.

An effective method for disposal of expired pesticides should be identified so that problems like those that occurred in countries like Rwanda and Mozambique do not occur in Iraq, due to accumulation of large amounts of expired pesticides.

Please see Section 4.11 above, and comments above. INMA is not in a position at present to initiate work on determining the amounts of expired pesticide in public and private sectors, and identifying suitable methods for disposal. However, INMA is working with pesticide dealers and farmers to minimize pesticide use, ensure only quality pesticides are supplied to farmers, and improve pesticide registration procedures (Prevention is better than cure).

Training Program: The training materials should be prepared for both the extension staff and the farmers. The materials should focus on efficient use of pesticides, and human health and safety measures. The environmental assessment training program (ENCAP) that is being implemented by a partner of USAID has a component on Pesticide use as required by Regulation 22CFR216.

Training materials are available for pesticide dealers and have been provided during training. These will be provided to the Pesticide Dealer Association for when they begin their own training program (with INMA support).

Training of farmers falls under the general extension program, and materials need to be developed for overall crop production practices, including IPM as part of this.

INMA is currently also looking at an NGO implemented program on pesticide safety for farmers. If this proves successful, it could be used as a template for further activities. INMA will check the ENCAP site to see what may be transferable to Iraq.

6.0 SAFER USE ACTION PLAN (SUAP) ELEMENTS (TO BE PUT INTO ACTION PLANS BY PROJECT PARTNERS)

For each of the 12 elements of the PER, and for each pesticide listed in Table 2, there are recommended mitigation procedures or actions that will need to be completed in order to increase the safety of pesticide use to both the environment and all its organisms (non-targets), water resources, and human health. What follows is a plan, including the recommendations, with timeline, for doing all of these.

Immediately,

* *Produce a quick reference guide for all of the pesticides to be used on each crop and anticipated pest*

A quick reference guide with toxicity, safety equipment required, safe use, and environmental cautions, will be useful for pesticide supervisors and applicators to refer to as they make pesticide choice decisions. Begin to compile lists of pest species (by species and genus name) present in Iraq (use pest species and genus lists from neighboring countries as a start).

* *Begin to investigate the potential use of more biological and organic pesticides*

Bacterial products such as spore extracts from the bacterium *Bacillus thuringiensis* are effective against worm or caterpillar larvae of Lepidopteran (moth and butterfly) pests, like cutworm. Botanical extracts such as pyrethrum, a mix of natural chemicals called pyrethroids, can be extracted from chrysanthemum flowers, and provide good general pest control. Extracts from Neem trees are effective insecticides that are commercially available. A list of botanical products studied and registered by EPA is attached at the end of this report.

* *Begin to write simple IPM plans for each of the crops to be protected*

For each pesticide proposed, Table 2, in column 2, has IPM recommendations for practical ways to reduce the use of the pesticides. For each crop and pest, fold these recommendations, as appropriate, into simple IPM plans with timelines. Consult Table 2. As pilot demonstration sites, INMA has the opportunity to serve as a model for further cropping initiatives, and IPM should be a part of a rational approach to reducing pesticide use while protecting crops and expanding markets. A detailed IPM plan outline is included as an attachment at the end of this report.

* *Produce simple safe use training materials and posters*

One way to remind applicators of safety issues is through the production and use of high-quality training materials and safe use posters. These should be adapted or borrowed from other Arabic-speaking countries for use in Iraq.

* *Continue to procure protective clothing and safety equipment*

Protective clothing and safety equipment needs to be provided for all pesticide handlers, users, applicators, and others present while application occurs. The INMA projects will need to have safety equipment on hand for use during application beginning in October 2007.

Continuously,

* *Rotate pesticides to reduce the build-up of resistance*

* *Monitor resistance by noting reduction in efficacy of each pesticide product*

Project staff can monitor the kill rate of the pesticides for any reduction in efficacy; communicate with neighboring farmers and extension agents, to determine when pesticide rotation is called for. Site managers will be responsible for drawing up simple monitoring plans, to collect data on reduction in efficacy and any other known environmental impacts leading to a change to a new or different pesticide. This will be reported to USAID, as a small section, along other reporting requirements.

* *Reduce exposure of laborers to organophosphorous compounds by substituting them for other not as toxic compounds*

Organophosphorous (OP) poisoning can be severe and there are chronic effects. Best to reduce it through the use of alternatives.

By November 1, 2007,

* *Training in safe use of pesticides, IPM, and environmental protection*

INMA project participants, including staff, associated staff, farmers, laborers, and extension agents involved in project implementation require train-the-trainer training in environmental protection and safe pesticide clothing, handling, calibration, use and disposal.

Training can occur via a train-the-trainer format, whereby supervisors are trained for 2-3 days, followed by training for actual applicator and laborer staff for the following 2-3 days.

* *During training, administer the Pesticide Use Checklist (PUC)*

Translate into Arabic and administer during training the PUC to all project participants, including NGOs/PVOs, to gather baseline data on their understanding of safe pesticide issues.

By Summer 2008,

* *Phase out the use of Restricted Use Pesticides (RUP) and do not recommend to farmers*

The following pesticides are actively registered for use in the USA, but only as Restricted Use Pesticides (RUP).

Fenitrothion 50% EC (Sumithion) Sumitomo (0.02ppm)—Restricted Use Pesticide (RUP
Atrazine 50% WP (K & Z) Generis—Restricted Use Pesticide (RUP).
Carbofuran 5% G (Furadan) FMC—Restricted Use Pesticide (RUP).
Oxamyl 24% L (Vydate, *also a nematicide*) DuPont—Restricted Use Pesticide (RUP).

For individuals to be able to use these products in the USA, they must submit to rigorous training on safe use, reduction of water contamination, and environmental protection. Such

training does not yet exist in Iraq and most people using pesticides in Iraq, especially the laborers who are in the most contact with pesticides, have likely received minimal or no training. Therefore, RUP pesticides should be rapidly phased out in favor of less toxic alternatives.

By End of Project or for further Project Extension

* *Annually update changes to pesticides lists and communicate these changes to USAID*

USAID Project Managers will need to report changes to less toxic products on the list of pesticides recommended for monitoring purposes. This INMA IEE and PERSUAP will be amended by USAID to reflect these changes.

ATTACHMENT 1: TERMS OF REFERENCE/SCOPE OF WORK

WORK DESCRIPTION

Dr. Alan Curtis Schroeder hereinafter referred to as the "Consultant," will work in Arlington, VA for ARD, Inc. in support of the U.S. Agency for International Development-funded Inma Agricultural Program activity, Contract No. 267-C-00-07-00500-00.

The Scope of Work for this assignment is found below.
The PMS consultant will, with the assistance of project field staff in Iraq, be responsible for the following:
• Acquiring and synthesizing information on Iraq's ability to regulate or control the acquisition, distribution, usage, storage and disposal of pesticides;
• Reviewing information on the restrictions on use of pesticides (e.g. information from the Iraqi Ministry of Environment (or equivalent body);
• Investigating the conditions under which various pesticides will be used (climate, flora, fauna, geography, hydrology, soils, near water bodies etc); and
• Acquiring information on the extent to which the pesticide use is part of an integrated pest management program.

Specifically the Consultant will:
• Review a list of potential pesticides to be procured/used under the programs, and review US EPA status of the pesticides.
• Contact Mission MEO, appropriate Iraqi Ministries and appropriate USAID/ANE staff (including the BEO and MEO) to review compliance requirements and pest management options and develop an agreed upon definition of "assistance for procurement or use of" pesticides.
• Assess the overall capabilities and limitations of the USAID/Iraq Agriculture Reconstruction and Development for Iraq Project to affect pesticide management, relative to the more common pesticide use problems affecting the targeted farmers.
• Provide the Project with an algorithm for comparing and contrasting the economics of use of the various alternative pesticides;
• Recommend/outline a training program, including a plan to train participants who will be implementing the recommendations of the study.
• Following a description of the proposed usage and expected benefit of the requested pesticides, address each of the following factors listed under 22 CFR 216.3(b)(1)(i):
-- The USEPA and Iraqi registration status of the requested pesticides
-- Extent to which the proposed pesticide is part of the integrated pest management
-- The proposed method of application, including availability of appropriate application and safety equipment;
-- Any acute or long term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazard;
-- The effectiveness of the pesticide for the proposed use;
-- Compatibility of the proposed pesticide with target and non- target ecosystems;
-- The availability and effectiveness of other pesticides or non chemical control methods;
-- Provisions made for monitoring the use and effectiveness of the pesticide;
-- Iraq's ability to regulate or control the distribution, storage, use, and disposal of the pesticide; and
-- Provisions made for training of users and applicators, and outline a training plan for participants and extension officers

Deliverables:

1) A Draft PERSUAP that will be submitted to USAID for review. Based on comments received from USAID, the Consultant will:
2) Prepare and submit a Final PERSUAP, which address the comments, suggestions and concerns of USAID (especially those of the ANE Bureau Environment Officer and the Mission Environment Officer)
10. Background and Objectives:
All USAID activities are subject to evaluation via, an Initial Environmental Examination (IEE). Because of risks associated with pesticide use, the USAID environmental regulations require that at least the 12 factors outlined in the Pesticide Procedures described in 22 CFR 216.3 (b)(1)(i) (a through l) be addressed in the IEE for any program that includes assistance for the procurement or use of pesticides. USAID has asked that these factors be examined in a particular type of document, termed a "Pesticide Evaluation Report and Safer Use Action Plan" (PERSUAP), which is submitted as an attachment to the IEE. The PERSUAP that constitutes the focus of this assignment will focus on the particular circumstances of the Project, the risk management choices available, and how a risk management plan will be implemented in the field.

When the USEPA registers pesticides for use in the United States, it specifies the manner in which the product can be "safely" used (i.e., with an acceptably small risk), including safety equipment needed when applying the pesticide, how to apply it, the allowed uses, etc. An extensive system of capabilities and resources exist in this country that help give EPA confidence these specifications will be followed and the product will be used appropriately. In allowing the use of certain pesticides in its overseas programs, USAID cannot rely on the same societal capabilities and resources as USEPA to assure appropriate use of the product. The preparation of a PERSUAP provides the opportunity to consider practical actions by which to reduce the health hazards and risks associated with pesticide use, taking into consideration the context in which the products will be used, the particular elements of the program, and the capacities of the partners involved.

WHO PREPARES A PERSUAP?

Program managers are generally responsible for assuring that environmental review requirements for their programs are met, including the drafting of PERSUAPs. As for all environmental reviews, guidance and assistance for PERSUAPs is available from the appropriate Mission Environmental Officer (MEO), Regional Environmental Officer (REO), the ANE Bureau Environmental Officer (BEO), or the BEO/DCHA if Title II (PL 480) funds are involved. PERSUAPs may be drafted by consultants with experience dealing with PERSUAPs, in addition to experience with Regulation 216, Environmental Assessments (EA), Programmatic EA (PEA), and Supplemental EA (SEA).

COMPONENTS OF AN ACTIVITY-LEVEL PERSUAP

A PERSUAP consists of two parts, a "PER" and a "SUAP". The Pesticide Evaluation Report (PER) section addresses the 12 informational elements required in the Agency's Pesticide Procedures. The Safer Use Action Plan (SUAP) puts the conclusions reached in the PER into a plan of action, including assignment of responsibility to appropriate parties connected with the pesticide program.

This analysis for the Inma Program will cover those pesticides proposed for use by the USAID/Iraq Agriculture Reconstruction and Development for Iraq Project projects that are:
• Registered by USEPA for the same or similar uses without restrictions

• Also registered by the government of Iraq
• Available in Iraq

* The purpose of the short term rapid response LOE pool is to give the project access to necessary resources based on current programmatic, logistical or operational need. The STTA LOE pool is to be used to support operational, administrative and technical requirements of the project on an as needed basis. This STTA pool will be provided to our subcontractors on an as needed basis to provide services as required by the project, not exceed their budget. It is designed to be used in any capacity necessary to ensure programmatic and operational continuity to the project. All assignments are to be short term, less than one year of performance. STTA level of effort can be utilized either in country or remotely (i.e. other than Iraq) to get necessary work done to further the progress of the Inma project. This LOE was included in our original budget submission and was clearly identified in our RFP response under Project Management as an LOE resource to be utilized in any capacity on an as needed basis. Positions are to be identified based on the required needs of the project and the proposed average of $425 is for estimating purposes only. The rate will be based on the actual rate of the employee, not to exceed the maximum rate to date of $594.62 per day (in accordance with our Corporate policies and or SF1420). The Rapid Response STTA LOE will recruit a range of experienced technical assistance providers.

ATTACHMENT 2: A LIST OF VIABLE AND PRACTICAL IPM OPTIONS TO TRY IN IRAQ AND TO POTENTIALLY INTEGRATE INTO AN IPM SYSTEM APPROACH TO PEST MANAGEMENT

CROPS AND PESTS IPM

Note Well: For all crops and pests, one of the best sources of IPM methods that work and are used in the USA (in California—the state with the widest diversity of agriculture production) is the university site: http://www.ipm.ucdavis.edu/. For fruit, Washington State, Michigan State, Cornell, and Florida are other university systems to search.

Note also that many of the farm field best management practices (BMPs) for most crops recommend relatively easy-to-implement activities like the use of:

- scouting, traps and monitoring to catch and manage pest outbreaks early;
- good plant health maintenance through water, soil, and nutrient management (raised-bed, plastic mulches, regulated drip irrigation/fertigation; plant, soil, nutrient, and water analyses);
- cultural practices like use of resistant varieties, pest avoidance through early/late plantings/harvestings, crop rotation, pruning, crop residue destruction, and destruction of pest refuge plants near field;
- biological control methods like parasite/predator enhancement through border plantings of favored refugia plants, use of pheromone releases for mating disruption, parasite releases, and microbial agent sprays (for larger farms);
- and mechanical control through exclusion netting or trapping.

The following is a listing of many of the recommended IPM practices (BMPs) for each I-LED crop, for the most common pests. Most techniques are relatively universal—they will work in many countries for the same or very similar species.

DATE PALM

Bayoud disease, *Fusarium oxysporum forma specialis albedinis*

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CULTURAL CONTROL

Since the factors that favor high yield in date palms (irrigation, fertilization, etc.) are the same that favor the growth of the fungus, cultural techniques are not advised. However, a significant reduction in the amount of irrigation can retard the advance of infection, that is stopping irrigation between the months of May and October, during the hot season in the northern hemisphere.

Since the contamination occurs mainly by root contact, disease-free palms can be isolated by digging a trench of 2 m deep around them. Water should be provided by a trough bridging the rest of the grove to this isolated plot. Under these conditions these palms can be protected for more than 10 years.

Prophylactic measures

The essential task is to prevent the movement of contaminated plant material from an infected palm grove to a healthy one. This material, as has been previously mentioned, consists mainly of offshoots, palm fragments, manure and infected soil, and artifacts made from these materials. Legislation preventing the conveyance of contaminated vegetative material from one country to another, or from one region to another, has been passed by various countries such as Algeria, Egypt, Iraq, Libya, Mauritania, Saudi Arabia, Tunisia and USA.

GENETIC CONTROL

The only productive means of controlling bayoud disease lies in continued research into resistant varieties. Many resistant cultivars have already been obtained in Morocco from three sources: selection of bayoud-resistant varieties from those already existing (local and introduced), selection of high-quality, and resistant clones from the natural population of the date palm, and creation of resistant and high quality varieties through a hybridization program.

In addition, the present success of date palm propagation by in vitro culture will make it possible to rehabilitate the Moroccan and Algerian palm groves that have been destroyed by bayoud. It will also be possible to reconstitute the palm groves presently threatened by Bayoud and create new date-growing areas with the help of high quality, resistant varieties.

In conclusion, bayoud disease is an epiphytic disease for which there is no known cure at present. Only preventive measures could protect healthy date plantations from this disease.

Therefore, the following measures are imperative:
- Forbid the introduction of offshoots and all other plant material (palm fragments, artifacts made from date material, manure and infected soil) originating from bayoud infected countries or regions.
- Forbid the import of seeds and unprocessed products of symptom less carriers such as Alfalfa (Lucerne) and Henna from bayoud-infected countries or regions.
- Adopt legislation preventing the conveyance of the above plant material.
- Immediately report cases where symptoms similar to the ones caused by the bayoud appear.
- Information on bayoud and other major diseases and pests is necessary for the success of all above actions and must be available to all date growers.

Black scorch disease, *Ceratocystis paradoxa*

Good sanitation is the first step in the control of black scorch. The affected fronds, leaf bases and inflorescences should be pruned, collected and immediately burned. The pruning cuts and surrounding tissues should be protected by spraying with Bordeaux mixture, lime-sulphur solution, copper sulphate lime mixture, dichlone, thiram or any new copper-based fungicides. Under a severe attack, affected palms are to be removed and burnt.

Diplodia disease, *Diplodia phoenicum*

Since the fungus usually enters the palm through wounds made during pruning or cutting when removing the offshoots, one precaution is to disinfect all tools and cut surfaces. Dipping or spraying the offshoots with various chemicals (benomyl, Bordeaux mixture, methylthiophanate, thiram and other copper-based fungicides), has been found effective against the disease.

Graphiola leaf spot, *Graphiola phoenicis*

Control measures include leaf pruning coupled with treatment with Bordeaux mixture.

Genetic tolerance has been found in some varieties (Barhee, Adbad, Rahman, Gizaz, Iteema, Khastawy, Jouzi and Tadala).

Khamedj disease, *Mauginiella scattae*

Transmission of the disease from one palm to the next occurs through the contamination of male inflorescences during the pollination period. The infection of the young inflorescence occurs early and happens when the spathe is still hidden in the leaf bases. The fungus penetrates directly into the spathe and then reaches the inflorescences where the fungus sporulates abundantly.
The frequent appearance of the disease in neglected date plantations indicates that good sanitation and efficient maintenance is the first step in the control of Khamedj disease. The collection and burning of all infected inflorescences and spathes should be followed by treating the diseased palms with the following fungicides after the harvest and one month before the emergence of spathes: a bordeaux mixture or a copper (1/3), sulphate-lime (2/3) mixture or a 3 % dichlone spray or a 4 % thirame spray at the rate of 8 liters per palm or with benonyl and tuzet at the rate of 125 g/hl.

Some varieties are particularly susceptible to Khamedj disease: Medjool, Ghars, Khadrawy and Sayer. Others manifest a good capacity for resistance: Hallawi, Zahdi, Hamrain and Takermest

Lethal yellowing

The causal agent is a mycoplasma-like organism. It is believed that the pathogen is disseminated by wind-born arthropod vectors. Removal of diseased palms and their offshoots, quarantine measures, the use of tolerant types of palms and the treatment with antibiotics are the main control measures.

Bending head

Thielaviopsis paradoxa and *Botryodiplodia theobromae* Pat are fungi commonly isolated from declining palms. Efficient maintenance and appropriate sanitation of the date plantation is the first control measure. Diseased parts of infested palms are to be collected and burnt in order to limit the spread of the disease.

Blacknose

Use resistant varieties and sanitation to manage this disease.

White scale, *Parlatoria blanchardii*

The natural enemies of Parlatoria blanchardii are: Hemisarcoptes malus, Chrysoperla vulgaris, Cardiastethus nazarenus, Coccinellidae (29 species), Nitidulidae (5 species), Mycetaeidae (1 species), Aphytis mytilaspidis, Cybocephalus nigriceps, Cybocephalus rufi frones, Chilocorus bipustulatus var. iraniensis and Chilocorus sp.

Natural enemies and pruning normally keep pest populations at tolerable levels. In the 1970s the coccinellid Chilocorus bibustulatus var. iraniensis was introduced into Mauritania and Morocco, but permanent establishment failed and efforts were discontinued. In the 1980s, attempts were made to introduce the coccinellids into northern Sudan, but they were not successful either. In 1993 the coccinellids were released in Oman, but there is no information on their establishment. The introduction of coccinellids is currently being investigated in Tunisia.

Chemical control appears to be conducted occasionally in young plantations. Mineral oils are also used.

Red scale, *Phoenicococcus marlatti*

Since the scale is a sucking insect, the use of ultracide or dimenthoate when the pest is mobile is also recommended (Djerbi, 1994). Infested offshoots could also be subjected to a temperature of 50°C for 65 hours in an insulated room. General predators, such as Pharoscymnus anchorago (Fairmaire), are considered as active predators.

Caroub moth (Ver de la Datte), *Ectomyelois ceratoniae*

Taking into account the moth's life cycle, it is recommended to protect the fruit bunches, to clean the plantation from wind-fallen fruits and to fumigate harvested and stored dates. The use of pheromone traps will not only help to determine the emergence of moths but also to estimate the population level. The rate of infestation could be lowered by spraying the infested fruits with *Bacillus thuringiensis*.

Rhinoceros beetle, *Oryctes rhinoceros*

The adult beetles should be attracted and destroyed by putting up mercury-vapor light traps at regular intervals in infested plantations. The light trap is based on the fact that some insects are very active at night and are attracted by the light. This method of mechanical control is presently included in Integrated Pest Management. The degree to which insects are attracted varies according to the type of traps as well as to the nature and power of light. It was shown that the mercury-vapor light is the best tool to attract insects.

The advantages of using light traps are:
- to obtain information on the number of captured species;
- to predict the occurrence of an outbreak of an insect-pest; and
- to use it as a mechanical control method since it can reduce the number of insects as well as production losses.

The insect collector should be half filled with diesel, kerosene or paraffin.

The Red and African Palm Weevils, *Rhynchophorus phoenicis*

The following control measures are highly recommended: quarantine, plantation sanitation, chemical treatment, regular surveys, pheromone mass trapping and the use of nematodes. Furthermore, the control of the red (RPW) and African palm weevils (APW) requires all these steps which are of equal importance. Not respecting even one of these measures will lead to infestation of date plantations.

QUARANTINE

It is imperative that all imports of date palm offshoots from infested areas (Middle East and Asia) to uninfested areas be prohibited. Other imports of palms into uninfested areas are to be carefully screened and put in quarantine so as not to introduce another species of *Rhynchophorus* or even another strain of *R. phoenicis* into the region. Even within the sub region of a sub continent the movement of palm plant material must be monitored through effective quarantine regulations.
Plantation sanitation
Prevention of the infestation is essential, and the practice of good cultural techniques will protect the date plantation from infestation by weevils. Date palms are not to be stressed and appropriate irrigation and fertilization programs are to be respected. Removal of offshoots is to be properly implemented and the cut surface on the mother palm treated with PVC paint or a copper sulphate product. Soil is to be put around the base of the palm to protect the cut.
Over 80 % of weevil infestation occurs at the base near the offshoots or where offshoots have been removed. Palms that are stressed or damaged are vulnerable to attack and semi-chemicals emanating from these palms attract adult weevils.

Sanitation measures, such as the removal of dead palms or palms beyond recovery, are essential, as they are the ideal breeding places for the rhinoceros beetles that generally pave the way for entry of the palm weevil into young palms. Wounding of the palms, like cutting steps into the stem to facilitate climbing should be avoided. When the leaves are pruned, the grubs may tunnel their way into the stem through the cut end of the periole where eggs will be laid. Treatment of cut surfaces with PVC paint will ensure the control of infestation. Heavily infested date palms that can not be saved and the first infested palms of a healthy plantation are to be uprooted, burnt and buried outside the plantation to a depth of one meter. Growers must make sure that all weevils in the destroyed palm are killed. Many people do not like to be aggressive with phytosanitation, because of the investment in the palms, but the cost - if a weevil epizootic gets going - can accumulate to the loss of the whole plantation. Cut stumps and useless parts of the palm need to be destroyed in order to kill the early stages of the weevil. The holes and cuts made by the rhinoceros beetle constitute a favorable entry point to the weevil. These rhinoceros beetles must be attracted and destroyed by putting up mercury vapor light traps at regular intervals in the plantation.

REGULAR SURVEYS

Infected and non infested areas need to be regularly surveyed, not only to detect and record new weevil infestations, but also to assess the health of uninfested plantations and the effectiveness of the adopted control measures. The frequency of these surveys depends on the life cycle of the weevil. Check once a month during cold months, and twice a month during the early part of the warm season and summer time.

PHEROMONE MASS TRAPPING

The trapping and destroying of adults is a recent method of controlling the weevil. In the Middle East, where the attack by RPW is severe on date palm, pheromone-baited traps have been used for monitoring and for the reduction of the weevil population. It is worth mentioning that this mass trapping is successful only when combined with good sanitation and chemical control measures. It allows the reduction of the weevil population and the numbers of flying adults. The use of pheromones started in UAE in 1993 and in Oman and the Kingdom of Saudi Arabia in 1994. Pheromone/food traps need to be placed where infestation is suspected/confirmed at one (1) trap for each 100 meters. Traps need to be placed in the ground. The best trapping results are obtained if:
- the pheromone lure contains pheromone and plant produced synergists;
- food (such as date palm stem pieces, date fruit, sugar cane, bananas and apples) is kept wet by frequent addition of water; and
- traps are shaded to keep them wet.

USE OF NEMATODES

The natural enemies of the weevil do not play a significant part in the control of its populations. However, in the Middle East the use of an entomopathogenic nematode (*H. indicus*) of *Heterorgabditis species* or *Steinernema sp*. is being investigated. Third stage infective juveniles of the nematode in a symbiosis with *Xeonorhabdus* bacteria attack the weevil (grub stage only).

GRAINS

RICE

Note that rice diseases and insects are studied by the International Rice Research Institute (IRRI) and they should be used as a source of knowledge and information about IPM for these.

Sheath Blight, *Rhizoctonia solani*
http://www.knowledgebank.irri.org/factsheets/HowToGrowRice/Pest_Management/Diseases/fs_sheathBlight.pdf provides IPM tips, as follows:

"Prevent sheath blight by:

• Healthy Soil = Strong Rice. If possible, right after harvest, turn over the soil and apply compost. Applying the right fertilizer (for your field's soil type) at the right time makes your rice strong and healthy.
• Varietal resistance. No rice cultivars have been identified as resistant to sheath blight.
• Select good seeds. Do not use seeds that are half-filled, discolored or misshaped. Separate good seeds from bad seeds by hand, by wind, and/or by water (Note: bad seeds float).
• Seed treatment. If sheath blight is a recurring problem, treating seeds with fungicides may help. See a crop protection specialist for guidance on the selection and application of a fungicide. Do not touch treated seeds with bare hands. Treated seeds are poisonous and must not be eaten by humans or animals.
• Cultural methods. Reduce plant density in fields that suffer sheath blight. Drain fields at maximum tillering for a few days. Deep plow to bury infested plant residues. Crop rotation with beans may reduce fungal disease incidence.
• Sanitation. Remove weeds and sick plants from your field."

“Control sheath blight by:

If sheath blight appears, the only control methods available are removing and destroying the affected plant, or applying fungicide. Neither option is particularly useful for most rice farmers. Pulling and destroying plants is laborious and impractical on a large scale. Destroying plants is likely to reduce yields more than the sheath blight itself within a single season. The only real benefit of pulling and destroying (burning, not burying) plants is to prevent the further spread of the disease into future crops. Fungicides are not readily available in Asia. Most rice farmers in Asia lack the knowledge and equipment to use fungicides safely.”

Rice Blast, *Pyricularia grisea*,

According to http://www.ipm.ucdavis.edu/PMG/r682100611.html,

“Cultural Control
Blast is favored by excessive nitrogen fertilization, aerobic soils, and drought stress. High nitrogen rates and nitrate nitrogen increase rice susceptibility to the disease. Extended drain periods may also encourage the disease by aerating the soil, by converting ammonium to nitrate, and by causing drought stress to rice.

Use proper seed sampling and testing to identify and avoid the use of blast-infested seed in areas where blast is not a problem. This may help limit the introduction of the disease into noninfested areas.

Water seeding is recommended to reduce or eliminate disease transmission from seed to seedlings. Drill seeding is not recommended because it may allow seed transmission, nitrate formation, and result in drought stress.

Continuous flooding is recommended to limit blast development. Avoid field drainage, especially for extended periods because it allows the formation of nitrate and may cause drought stress. Some studies in other areas suggest that shallow water is more favorable to blast development than deeper water.”

Resistant Varieties
Use blast-resistant varieties of rice, if available and cost-effective.

“Monitoring and Treatment Decisions
Monitor to determine the need for treatments. Throughout the season, examine plants in several locations throughout the field for the presence of leaf lesions; intensify monitoring as plants approach the boot stage. If blast lesions are present and increasing just before the boot stage, a treatment may be justified. When making a treatment decision, consider disease progress, crop growth stage, environmental conditions, and rice variety. For example, there is a greater risk of neck and panicle blast infections occurring when growing one of the more susceptible cultivars and long periods of leaf wetness and warm night temperatures occur. Use a protectant fungicide so that the panicles is protected as it emerges from the boots. Because rice blast is a multiple cycle disease, fungicide applications to control leaf blast early in the season are generally ineffective in reducing the incidence of neck blast and yield losses.”

Stem borers, several species

http://www.knowledgebank.irri.org/factsheets/HowToGrowRice/Pest_Management/Insects/fs_stemBorer.pdf states that:

"Stem borers can destroy rice at any stage of the plant from seedling to maturity. If the plant is young, the center leaves of the damaged tillers turn brown and die. This condition is called deadheart. If the damage occurs after the spikelets form, then the panicles turn white - a condition known as whitehead. Although damage often looks very bad, control is often not economic. Also by the time damage is evident, it is too late to apply control measures. Stem borers can have a significant impact on the yield of traditional rices, however, as tillers lost to deadheart are often not replaced.

• Preserve Biological Control Agents! - To conserve natural enemies do not apply broad spectrum insecticides (e.g. methyl parathion).
• Clip the tip of the leaf blades before transplanting – The eggs of yellow stem borers are laid near the tip of the leaf blade. Clipping the seedling before transplanting reduces the transfer of eggs from the seed bed to the field.
• Plant later than usual to avoid yellow stem borer moths.
• Plant stem borer resistant varieties - For example, IR36, lR32, IR66, and IR77 have varying degrees of resistance to some stem borer species.
• Spread straw in the sun to kill resident stem borer larvae.
• Skim stem borer larvae on floating leaves off of the water with a net.
• Plow and flood the field after harvest.

About chemical control
Chemical control of stem borers is generally not recommended as stem borers are quite difficult to control with insecticides. The caterpillars are only vulnerable to many foliar sprays in the short time between hatching from the egg and entering a stem. Systemic insecticides, which go inside the plant, are the only reliable form of chemical control for stem borers after the borers have entered the stem, but by then it is generally too late to save the rice stem anyway. Like all pesticides, the benefits of using an insecticide must be weighed against the risks to health and the environment. Indiscriminate insecticide use can disrupt existing biological control, resulting in pest resurgence or outbreaks. Before using a pesticide contact a crop protection specialist for suggestions, guidance, and warnings specific to your situation. Always read pesticide labels carefully."

Aphids, several species

Maintain plant health with good management, but take care to not over-fertilize. Monitor for aphids using yellow sticky traps to determine economic injury levels. Spray only when these levels are reached.

According to http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7404.html,

"Insecticidal soap, neem oil, and narrow-range oil (e.g., supreme or superior parafinic-type oil) provide temporary control if applied to thoroughly cover infested foliage. To get thorough coverage, spray these materials with a high volume of water and target the underside of leaves as well as the top. Soaps, neem oil, and narrow range oil only kill aphids present on the day they are sprayed, so applications may need to be repeated. Predators and parasites often become abundant only after aphids are numerous, so applying nonpersistent insecticides like soap or oil may provide more effective long-term control. Although these materials do kill natural

enemies that are present on the plant and hit by the spray, because they leave no toxic residue, they do not kill natural enemies that migrate in after the spray."

Biological Control
"Natural enemies can be very important in the control of aphids, especially in gardens not sprayed with broad-spectrum pesticides (organophosphates, carbamates, and pyrethroids) that kill natural enemy species as well as pests. Usually natural enemy populations do not appear in significant numbers until aphids begin to be numerous."

Cultural Control
"Before planting vegetables, check surrounding areas for sources of aphids and remove them. Aphids often build up on weeds such as sowthistle and mustards, moving onto crop seedlings after they emerge. Check transplants for aphids and remove them before planting.
Where aphid populations are localized on a few curled leaves or new shoots, the best control may be to prune these areas out and dispose of them. In large trees, some aphids thrive in the dense inner canopy; pruning these areas out can make the habitat less suitable."

Rice Leaf roller

Use *Bacillus thuringiensis* spray to control.

Grasshoppers, several species

Use *Metarhizium anisopliae* spray to control.

MAIZE

Rust

Use rust resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate maize with other crops.

Loose smut, *Ustilago avenae*

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate maize with other crops.

Head smut, *Sporisorium holci-sorghi*

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests). Rotate maize with other crops. Destroy smutted plant parts by removal and burning.

Stem rot (Charcoal, Diplodia, Fusarium, Gibberella, Nigrospora, and Anthracnose).

According to http://ipm.uiuc.edu/pubs/iapmh/04chapter.pdf,

"Plant hybrids with good stalk rot resistance and stalk strength. Maintain adequate nitrogen, phosphorus, and potassium fertility. Control corn borers and corn rootworms. Scout fields at 30 to 40% moisture for lodging potential. Walk a zigzag pattern through the field, pushing random

plants about 5 inches from the vertical. If more than 10 to 15% lodge, schedule the field for early harvest."

Leaf bights

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate maize with other crops.

Stem borer

Monitor. Use *Bacillus thuringiensis* spray to control.

Cutworm

Monitor. Use *Bacillus thuringiensis* spray to control.

Silk beetle

Monitor frequently and spray insecticide only when action threshold is reached.

WHEAT

Rust

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate wheat with other crops.

Smut

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate wheat with other crops.

Kernel bunt

Use resistant or tolerant varieties or hybrids, maintain soil and plant health (test these with lab tests), destroy infected residue. Rotate wheat with other crops.

Armyworms

Use *Bacillus thuringiensis* spray to control.

Aphids
See aphids above under Rice.

BARLEY & SORGHUM

Same as above for maize.

VEGETABLES

POTATO

Early blight, *Alternaria solani*

According to http://www.ipm.ucdavis.edu/PMG/r607101311.html,

Management
Early blight can be minimized by maintaining optimum growing conditions, including proper fertilization, irrigation, and management of other pests. Grow later maturing, longer season varieties. Fungicide application is justified only when the disease is initiated early enough to cause economic loss. When justified, apply fungicides as soon as symptoms appear; continued protection requires application at 7- to 10-day intervals.

Late blight, *Phytophthora infestans*
Scouting procedures & set action thresholds (The number of pests or level of pest damage requiring action to prevent damage from exceeding tolerable levels).

Mosaic Diseases Caused By Potyviruses

According to http://www.ipm.ucdavis.edu/PMG/r607101411.html,

Management
“Use seed certified free from viruses or with very low incidence of infected tubers. Use resistant cultivars where possible.”

Black scurf, *Rhizoctonia spp*.

According to http://www.potatodiseases.org/rhizoctonia.html,

Monitoring and control
“Currently it is not possible to completely control Rhizoctonia diseases, but severity may be limited by following a combination of cultural and crop protection strategies. Effective management of this disease requires implementation of an integrated disease management approach and knowledge of each stage of the disease. Although the most important measures are cultural, chemical controls should also be utilized.”

Cultural control
“One of the keys to minimizing disease is to plant certified seed free of sclerotia. If more than 20 sclerotia are visible on one side of washed tubers, consider using a different seed source. Tuber inoculum is more important than the soil inoculum as the primary cause of disease. Seed growers should plant only sclerotia-free seed.
Following practices that do not delay emergence in the spring minimizes damage caused to shoots and stolons and lessens the chance for infection. Planting seed tubers in warm soil (above 46°F) and covering them with as little soil as possible speeds spout and stem development and emergence reduces the risk of stem canker. Plant fields with coarse-textured soils first because they are less likely to become waterlogged and will warm up faster.

Rhizoctonia does not compete exceptionally well with other microbes in the soil. Increasing the rate of crop residue decomposition decreases the growth rate of Rhizoctonia. Residue decomposition also releases carbon dioxide, which reduces the competitive ability of the pathogen. Since the fungus is not an efficient cellulose decomposer, soil populations are greatly reduced by competing microflora and less disease is observed.

Potatoes should be harvested as soon as skin is set so minimal bruising will occur. The percent of tubers covered with sclerotia increases as the interval between vine kill and harvest is lengthened. Vine removal or burning also reduces the amount of fungus overwintering and thus the amount of inoculum available to infect future potato crops. Do not dump infested tubers on future potato fields as they can become sources of inoculum."

Biological control
"There is growing evidence that a 'bio-fumigation' treatment based on incorporating a mustard cover crop is one way to reduce Rhizoctonia incidence. Mustard residues when incorporated into the soil release cyanide-containing compounds that fumigate the soil, but at the same time they also release carbon and nutrients that are the feedstock for soil organisms. Incorporating green cover crop tissues provides energy that supports the complex web of soil organisms that compete with parasite and disease organisms. Thus mustards, and related 'brassica' plant species such as oil-seed radish, do not leave a soil void of organisms. Instead, these cover crops tend to tip the balance in the favor of beneficial organisms and against parasites and pests.

It is important to maximize growth of the cover crop using a high seed rate (15 lb. acre or more) and irrigation to improve establishment if rainfall is insufficient. A tiny seed such as mustard cannot be drilled too deep. It appears to establish well if broadcast and harrowed or irrigated into sandy soil. The bio-fumigation benefits of mustard residues are maximized if they are incorporated at or just before flowering. We suggest that residues be mowed and incorporated while still green. Mustards are rapid growing species and can become a weed in a subsequent crop, so it is important not to let this cover crop produce seed."

Cutworm, Agrotis ipsilon

According to http://www.ipm.ucdavis.edu/PMG/r607300511.html,

Management
"Cutworms are not an annual problem, nor are they a problem in every field. Weed control in and around the field before planting will reduce cutworm problems through reduction of early season host plants. Treatment thresholds have not been established. Monitor the field to detect cut plants and foliar feeding early in the season. Later in the season, inspect plants for foliage damage. Also, shake the plants over a beating cloth placed in the row and inspect the beds and furrows for larvae, and inspect shallow set and exposed tubers for damage. Treatment is necessary where worms are abundant and before the tubers are damaged."

Armyworm

Monitor. Use *Bacillus thuringiensis* spray to control.

White grubs

White grub is generally much more of a problem in fields that have been out of production for several years. No good IPM tactics.

Aphids, Green peach aphid: *Myzus persicae*; Potato aphid: *Macrosiphum euphorbiae*

According to http://www.ipm.ucdavis.edu/PMG/r607300611.html,

Management
"Management of green peach aphid and potato aphid involves an integrated program of reducing overwintering populations, controlling weeds in and around the field, and the use of foliar sprays. Monitor to schedule spray treatments."

Biological Control
"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*. Most materials available for aphid control are highly disruptive of natural enemy populations."

Cultural Control
"Weeds along ditch banks, roads, in farm yards, and other noncultivated areas contribute directly to the aphid problem. In northern areas, mustards serve as early season host plants where aphid population's increase before spreading to other host plants, including commercial potatoes.

It is also important to control nightshades and volunteer potatoes because these plants are reservoirs for potato leafroll virus. Rogue infected potato plants to reduce the incidence of infection and spread of the disease within a field. For maximum effectiveness remove the diseased plant, the three plants on each side of the diseased plant in the same row, and the three closest plants in adjacent rows. Rogueing is most important in seed fields. Plant disease-free seed to reduce the incidence of potato leafroll virus."

Monitoring and Treatment Decisions
"Inspect fields weekly during aphid migrations. Aphids are first found on those plants along the edge of the field toward the prevailing wind, usually the north or west edge of the field. Growers should make general observations to determine if aphids are present. Sample weekly throughout the growing season. Heavy populations normally occur late in the spring. In seed potato production, a preventive program using insecticide applications at 2 to 3 week intervals may be necessary." If there are established sampling methods and population thresholds in Iraq, use these for making treatment decisions.

Jassids (leafhoppers)

Keep weeds controlled in and around the field.

Colorado potato beetle, *Leptinotarsa decemlineata*
Use plant varieties that are resistant to potato beetle.

TOMATO

Blights
Same as above for blights of potato.

Root rot, *Fusarium and Phytophthora spp*

In the field, planting disease-free transplants is the only recommended management practice for this disease. Limit spread of infested soil by cleaning equipment between fields. Provide good drainage and prevent flooding. Avoid wide fluctuations in soil moisture, which predisposes plants to infection. Keep tops of bed dry to avoid buckeye rot of the fruit. Planting cereals as a rotation crop may reduce the level of infestation in the soil. Resistant varieties are not yet commercially available.

Fruit rot (water mold), *Pythium ultimum* and other species

According to http://www.ipm.ucdavis.edu/PMG/r783101511.html,

"Avoid late-season irrigation, especially when threat of rainfall increases. Avoid wetting the top of beds when fruit is ripening. Shorter furrow irrigation runs and higher beds may lessen risk."

Cutworm, Variegated cutworm: *Peridroma and Agrotis spp.*

According to http://www.ipm.ucdavis.edu/PMG/r783301511.html,

Management
"Destroy plant residues before planting, especially when tomatoes follow a good host crop for the cutworms. Monitor fruit in combination with the beet armyworms damage sample or take a separate sample of the fruit touching the ground to detect damage are important strategies in managing these pests.

Cultural Control
"Cutworm incidence is often associated with residue of host plants remaining in the field before seeding. As most cutworm species have a wide host range, tillage at least 2 weeks before planting will help destroy plant residue that could harbor larvae. Herbicides will provide similar control of host plant material. Because cutworm damage is often localized within a field, reseeding affected areas of a field rather than treating the whole field might prove economical."

Organically Acceptable Methods
"Cultural control is an organically acceptable management tool."

Monitoring and Treatment Decisions
"Treat only when the presence of cutworms is detected. Cutworms are usually localized within a field, so consider marking the areas where damage is observed and treating only those areas."

Armyworm, Spodoptera spp.

According to http://www.ipm.ucdavis.edu/PMG/r783300311.html,

Management
"Beet armyworms are sometimes kept under control by natural enemies and a polyhedrosis virus. Take fruit samples to determine need for treatment."

Biological Control
"A nuclear polyhedrosis virus often reduces populations in fall and winter. *Hyposoter exiguae* is the most important parasite of beet armyworm. General predators such as bigeyed bugs and minute pirate bugs feed on eggs."

Organically Acceptable Methods
"Biological control and sprays of the Entrust formulation of spinosad and *Bacillus thuringiensis ssp. aizawai* are acceptable for use in an organically certified crop."

Monitoring and Treatment Decisions
"In processing tomatoes, begin sampling fruit when it has reached 1 inch or more in diameter. Treatment is not necessary prior to this size as the damaged fruit will fall from the plant and little yield loss will occur. Pick at least 100 fruit at random while walking through the field, being careful not to select red fruit when the majority of fruit are green. If damaged fruit are found, determine the amount of damage present and the size and species of the worms. Count fruit as damaged if it has any hole deeper than 0.1 inch (2.5 mm), if the hole is contaminated with feces, or if any larvae are present in the fruit. The treatment threshold is 3.25% damaged fruit. A sequential sampling technique is available to help reduce the number of samples required to reach a treatment decision.

In fresh market tomatoes, begin sampling when fruit appears. Pheromone traps are useful for determining when major flights occur, but not for predicting damage. A 5-minute timed search is useful in determining the need for treatment. On average, if one or more larvae or egg masses are found in 5 minutes, treatments may be justified. Picking large numbers of fruit each week and assessing percent damage may not be economically feasible. Ground applications provide maximum effectiveness of the pesticide."

Aphids

According to http://www.ipm.ucdavis.edu/PMG/r783301711.html,

Management
"Monitor potato aphids from 6 to 8 weeks before harvest as well as the level of parasitism and the activity level of predators. Treatments may be necessary if natural enemy activity is low and populations are increasing."

Biological Control
"Naturally occurring parasites and predators of the potato aphid are common and can provide control. Monitor the proportion of aphid mummies relative to unparasitized aphids and the numbers of predators such as lady beetles, lacewing larvae, and syrphid larvae. If the proportion of mummies is increasing or predators appear to be gaining control and aphid populations are not yet damaging, avoid sprays that will disrupt these natural enemies."
Tolerant Varieties
"There is considerable difference in tomato variety susceptibility to potato aphid feeding. Varieties containing the MI gene, which confers resistance to nematodes, have been reported to be more tolerant of potato aphid infestations. However, this resistance no longer appears to be as effective as it once was, particularly against the pink form of the potato aphid."

Organically Acceptable Methods
"The use of tolerant varieties, biological control, and sprays of herbal oils, pyrethrin, or

insecticidal soap are acceptable for use on an organically certified crop. Repeated applications may be necessary for control."

Monitoring and Treatment Decisions
"Monitor potato aphids from bloom to early fruit set by picking the highest open flower on 30 plants selected at random throughout the field. Record on a monitoring form (100K, PDF) the presence or absence of potato aphids on each leaf, while noting natural enemies. Treatment is warranted if 50 to 60% or more of the leaves are infested. During late fruit set, combine monitoring for potato aphid with monitoring for tomato fruitworm : pick the leaf below the highest open flower on 30 randomly selected plants from throughout the field. Record observations on a monitoring form (100K, PDF). If 50% of these leaves are infested during the period 6 to 8 weeks before harvest, the resulting loss is about 1 ton per acre. Good spray coverage is important in controlling high populations. Ground sprays using hollow-cone nozzles or air-assist sprayers will provide the best canopy penetration. Higher spray volumes are also helpful."

Jassids (leafhoppers)

Keep weeds controlled in and around the field.

Tomato fruitworm (fruit borer), *Helicoverpa (Heliothis) zea*
Careful monitoring for eggs and small larvae, treat before large numbers of larvae enter fruit, where they are protected from sprays, biocontrol agents Trichogramma parasitic wasps and other natural enemies often destroy significant numbers of eggs, so monitor for these (presence and quantity), sprays of Bacillus thuringiensis and the Entrust formulation of spinosad.

Alternaria, *Alternaria alternata f. sp. lycopersici*
Use resistant tomato varieties.

Phytophthora, *Phytophthora parasitica* and *P. capsici*
Provide good soil drainage and prevent flooding. Avoid wide fluctuations in soil moisture. use crop rotation. Resistant varieties are not yet commercially available.

Fusarium, *Fusarium oxysporum f. sp. lycopersici*
Use resistant tomato varieties. Monitor for and control root knot nematode infestations—nematode feeding reduces plant resistance to Fusarium wilt. Use crop rotation to reduce inoculum level.

ONION

Onion maggot, *Delia antiqua*
Monitor adult fly populations with yellow sticky traps. High organic matter and fresh manure in the soil attract the flies. Avoid planting fields that have high un-decomposed organic matter, such as ones that were just pasture or weedy. Don't repeatedly plant onion after onion; Rotate onion with other crops.

Mole cricket, *Gryllotalpa spp*
Biological control using parasitic wasps, flies and nematodes has worked well in Florida.

Purple blotch, *Alternaria porri*

Maintain soil moisture using raised bed production and drip irrigation. Monitor and spray when needed.

Root rots

Maintain soil moisture using raised bed production and drip irrigation. Monitor and spray when needed.

Thrips, *Thrips tabaci*

According to http://www.ipm.ucdavis.edu/PMG/r584300111.html,

"Biological Control
Natural enemies, including predaceous mites, minute pirate bugs, and lacewings are often found feeding on thrips. These beneficials are very susceptible to insecticide sprays, however, and may not be important in fields where insecticides have been used.

Cultural Control
Avoid planting onions near grain fields, if possible, because thrips numbers often build up in cereals in spring. Overhead irrigation and rainfall provide some suppression of thrips populations, but treatments are often still necessary.

Organically Acceptable Methods
Biological and cultural controls as well as sprays of the Entrust formulation of spinosad are acceptable for use on organically certified crops.

Monitoring and Management Decisions
Although thrips feeding during the early bulbing stage is the most damaging to yields, thrips must be controlled before onions reach this stage so that populations do not exceed levels that can be adequately controlled. Onions can tolerate higher thrips populations closer to harvest; however, in the case of hand-topped onions, thrips can be extremely annoying to harvest crews and treatment closer to harvest may be desirable."

Bollworm

Use mating disrupting pheromone release. Use BT spray when first instar larvae are present.

Budworm, *Heliothis virescens*

Biological Control
Many predators and parasites combine to substantially maintain Heliothis populations at low levels. Insecticide sprays for other pests will disrupt this natural control.

Organically Acceptable Methods
Biological controls, cultural practices that promote early harvest, and sprays of Bacillus thuringiensis are acceptable for use on organically grown onions.

Armyworm, *Spodoptera* species

Monitor. Use *Bacillus thuringiensis* spray to control only when pest is present.

FRENCH BEANS

Root rot, *Fusarium* species

Cultural Control
Long-term (3 years) crop rotation out of beans may reduce soil inoculum. Provide optimal growing conditions, avoiding stress caused by excess water, prolonged drought, soil compaction, etc. Although no bean line is immune, some cultivars are more tolerant to the disease than others.

Fruit borer

Scout and monitor. Use *Bacillus thuringiensis* spray to control only when pest is present.

Aphids

See above under aphids.

PEAS

Powdery mildew

According to http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7406.html,

Use Resistant Varieties
"In some cases, varieties resistant to powdery mildew may be available. If available, plant resistant varieties of cantaloupe, cole crops, cucumber, melons, peas, pumpkins, and squash. If you plant more susceptible varieties, you may need to take control measures.

Cultural Practices
Plant in sunny areas as much as possible, provide good air circulation, and avoid applying excess fertilizer. A good alternative is to use a slow-release fertilizer. Overhead sprinkling may help reduce powdery mildew because spores are washed off the plant. However, overhead sprinklers are not usually recommended as a control method in vegetables because their use may contribute to other pest problems."

Pod borer

Scout and monitor. Use *Bacillus thuringiensis* spray to control only when pest is present.

Leaf miner, *Liriomyza species*

According to http://www.ipm.ucdavis.edu/PMG/r584300511.html,

Use Biological Control
"Natural enemies, especially parasitic wasps, are commonly found reducing leafminer numbers. These parasitic wasps are very susceptible to insecticide sprays, however, and may not be important in fields where insecticides have been used.

Cultural Control
Leafminers attack a wide variety of crops. Close proximity to crops such as lettuce, celery, or spinach will increase the potential for damage by leafminers in other crops like peas. It is also important that fields being planted to peas that were previously in one of these susceptible crops be worked thoroughly and that sufficient time be allowed to pass before planting into these fields to allow pupae in the soil to emerge.

Organically Acceptable Methods
Biological controls are often effective in controlling this pest in organically grown onion and garlic crops. Supplemental or inundative releases of parasites are rarely economically justified. Cultural controls as described above are critical. Neem products are allowed as restricted use materials.

Monitoring and Management Decisions
Because large populations of adults do not always lead to large larval populations, make management decisions based on the level of larval infestations on the plants."

CAULIFLOWER

Fusarium wilt

According to http://www.ipm.ucdavis.edu/PMG/r108100611.html,

Known infested fields should be planted to cauliflower only in winter or early spring. Some cauliflower cultivars may be more tolerant to Verticillium wilt than others. Avoid introducing the pathogen into clean fields. Planting broccoli, a non-host of V. dahliae, may help reduce pathogen levels; decaying broccoli residue, when disced into the soil, either gives off natural chemicals that can kill V. dahliae or alters the soil microflora so that V. dahliae survival is reduced.

Aphids

According to http://www.ipm.ucdavis.edu/PMG/r108300811.html,

Management
"Cultural practices and biological control agents can reduce aphid infestations and delay or prevent the need for pesticide use. Try to delay using insecticides for as long as possible while maintaining yields and quality. Most fields require at least one application against aphids at preheading; however, if you can delay applications until just before head formation, you will save the expense of additional applications and may also be able to maintain the natural enemies that will keep caterpillar pests, including loopers, imported cabbageworms, armyworms, and diamondback moths, below economically damaging levels.

Biological Control
Cabbage aphids have many natural enemies and these can sometimes control low populations; however, short crop life, use of pesticides for other pests, the tendency for the aphids to be deep within the head, and various other factors make it difficult for natural enemies to keep rapidly rising aphid populations from reaching economic levels. Important natural enemies include lady beetles, syrphid fly larvae, fungal diseases, and the parasitic wasp, Diaeretiella

rapae. Protect habitat for natural enemies so that they can survive and increase their population levels.

Cultural Control
Destroy crop remnants immediately after harvest and remove or control alternate hosts, including mustards and related weeds, around field borders. Infestations on Brussels sprouts can start in seedling beds, so be sure transplants are clean before taking them to the field. Roguing (removal and destruction) of infested plants from the field can be effective early in the crop cycle.

Organically Acceptable Methods
Biological and cultural control are organically acceptable, as well as sprays of insecticidal soap, which can give partial control. Soap sprays, however, may be phytotoxic under some conditions, especially in Brussels sprouts and cabbage. For most effective control, apply during foggy conditions.

Monitoring and Treatment Decisions
Check each field at least twice a week. A sequential sampling program is available for Brussels sprouts. Sample upwind field borders and edges next to other crucifers first; this is where aphids tend to appear first. If no aphids are found, you may not need to take field samples. Take field samples in a zigzag pattern. Remember to check all quadrants of the field because aphid populations are often clumped.

Cabbage, broccoli, and cauliflower. Check for cabbage aphid in the youngest, highest, and innermost leaves of young plants. After heading, check the flowering parts of broccoli and cauliflower and pull back wrapper leaves of cabbage. Also check for natural enemies. Broccoli and cauliflower crops can tolerate up to 100 aphids per plant up to heading. Once heads begin to form, cabbage aphids must be controlled even if only a few are present. Because of the overlapping growth of their leaves, cabbage crops require more careful management and have less tolerance for aphids even during the early vegetative stages; treat as soon as 1 to 2% of plants are infested with one or more aphids. After treating, recheck fields frequently and treat if populations reappear."

Diamond-back moth

According to http://www.ipm.ucdavis.edu/PMG/r108301311.html,

Management
"Natural enemies and insecticides applied to control other pests keep the diamondback moth under satisfactory control in most fields, but keep records of diamondback moth as you monitor for other caterpillars.

Biological Control
Natural enemies often effectively control diamondback moth. *Ichneumonid* wasps are often effective parasites and *Trichogramma* wasps may attack diamondback eggs. Various predators such as ground beetles, true bugs, syrphid fly larvae, and spiders can be important factors in controlling populations. Microbial diseases are not known to be a significant mortality factor.

Organically Acceptable Methods
Biological control and sprays of Bacillus thuringiensis and the Entrust formulation of spinosad are organically acceptable management tools.

Monitoring and Treatment Decisions
Check fields during the seedling stage, at thinning, and just before heading. Also, record diamondback larvae numbers when you make your twice-weekly samples for other caterpillar pests. In cabbage fields, regularly monitor wrapper leaves for damage after heading. Adult moths frequently migrate from fields being harvested or disced under, so carefully check border rows if populations were high in adjacent fields. No treatment levels have been developed for diamondback moth; however, treatment may be required if significant injury to growing points is occurring."

CUCUMBER

Powdery mildew

According to http://www.ipm.ucdavis.edu/PMG/r116100711.html, "Plant resistant varieties, follow good sanitation practices, and control weeds. Carefully monitor fields, even those with powdery mildew resistant varieties, because there is recent evidence that plant resistance-breaking races are present. If multiple fungicide applications are needed to control powdery mildew, alternate materials with different modes of action especially if using fungicides with medium to high resistance potential (azoxystrobin-Quadris, myclobutanil-Rally, pyraclostrobin/boscalid-Pristine, trifloxystrobin-Flint, and trifumizole-Procure). Apply a treatment when disease symptoms first occur and repeat if symptoms reappear."

Downy mildew

According to http://www.ipm.ucdavis.edu/PMG/r116101611.html, "Use resistant cucumber varieties. There are low levels of resistance in some varieties of melons and watermelons. Avoid overhead irrigation. Apply a treatment when disease symptoms first occur and repeat if symptoms reappear."

Aphids, green peach aphid

According to http://www.ipm.ucdavis.edu/PMG/r116300611.html,

"Management
Silver reflective mulches have successfully been used to repel aphids from plants, thus reducing or delaying virus transmission. In some areas of the state, row covers have also been successfully used. Biological control can have a significant impact on aphid population so be sure to evaluate predator and parasite populations when making treatment decisions.

Biological Control
Naturally-occurring populations of the lady beetles may provide effective control in early spring. Releases of this beetle are not effective, however, because it generally does not remain in the field following release. Other general predators, such as lacewing and syrphid larvae, and parasitic wasps, including Aphidius, Diaeretiella, and Aphelinus species, also attack aphids. Biological control is not effective in reducing virus transmission by this aphid.

Cultural Control
Silver reflective plastic mulches applied at planting are effective in repelling aphids from plants,

thereby reducing or delaying virus infection. Mulches help plants get off to a healthy start, and are effective until expanding foliage covers the reflective surface. Mulches may need to be removed in the desert areas when summer temperatures are excessive for optimal growth of plants. However, in cooler areas, mulches have not caused plant damage in the summer; in fact, they improve soil moisture and nutrient retention, which may further aid plant productivity.

Control weeds along ditch banks, roads, in farm yards, and other noncultivated areas that contribute directly to the aphid problem. Planting a habitat for beneficial insects, such as sweet alyssum, around the field may be helpful. Delay planting until warm temperatures (80° to 85°F) occur and the spring flight of aphids is over. Do not over fertilize with nitrogen.

Organically Acceptable Methods
Biological and cultural controls and treatments of insecticidal soaps and certain narrow range oils are acceptable to use in an organically certified crop.

Monitoring and Treatment Decisions
The decision to treat for aphids is based mainly on visual counts; measurable thresholds have not been researched. It is important to treat early to insure that the aphids do not build up to high levels. Early treatment does not prevent virus introduction; treating, however, may help reduce spread of the virus if aphid colonies are present. Be aware, however, that parasites and predators, if present, may prevent an infestation from becoming established throughout a field, thus eliminating the need to treat."

Fruit fly (vinegar flies), Drosophila spp.

According to http://www.ipm.ucdavis.edu/PMG/r116302311.html, "Vinegar flies breed in any fermenting or decaying fruit but do not affect undamaged fruit. Remove or disc under damaged fruit to reduce the population. Harvest rapidly and early to reduce exposure of fruit to infestation. Sanitation is key to control."

OIL CROPS

CANOLA (RAPESEED)

IPM at: http://www.canola-council.org/berthabiological.aspx

Armyworm

Monitor and forecast presence. Control weeds in and around field. Use crop rotation, early swathing, and fall cultivation (except where soil is very susceptible to erosion).

Aphids

Monitor and forecast presence. Several beneficial insects, like the ladybird beetle and lacewing feed primarily on aphids. Aphid populations increase as aphid population's increase, usually in numbers sufficient to control the aphids. Application of pesticides is not economical, given that damage is usually limited to the last few pods formed, which contribute little to yield. Spraying may also reduce the numbers of beneficial insects which generally provide natural control of this insect.

FIBER CROPS

COTTON

Bollworms/Armyworms/Budworms, various species
Use BT cotton. Quickly destroy crop residue immediately following harvest. Plow-down requirements and cross disc or plow to a depth of at least 15 cm. Winter irrigate (flood field) in December and rotate to small grains or newly seeded alfalfa. Early spring irrigation to promote early moth emergence (before cotton squares). Use pheromone release/mating disruption.

FRUIT AND EDIBLE NUTS

APPLE

Coddling moth, *Cydia (Laspeyresia) pomonella*
Sanitation-remove infested & dropped apples, oil spray on apples when females fly, mass trapping, trunk banding, mating disruption, pruning for height.

San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Monitor & use degree-day models, biocontrol, dormant oil sprays.

Green Apple Aphid, *Aphis pomi*
Biocontrol, insecticidal soap, dormant oil spray.

European Red Mite, *Panonychus ulmi*
Monitoring & timing of dormant oil sprays, irrigate & reduce dust, abamectin bacterial product.

Apple Lygus bug

According to http://www.ipm.ucdavis.edu/PMG/r4300411.html,
"Management
The potential for a lygus bug population to cause damage is difficult to assess. Lygus bugs may be present in substantial numbers in the orchard and cause no damage; however, they can often cause damage and may attack fruit at any time from petal fall to harvest. Annual preventive treatments are costly and subject to failure because lygus bugs have been quick to develop resistance to chemicals. In orchards with a history of lygus damage, monitor fruit at least biweekly between petal fall and harvest to assess need for treatment.

Biological Control
The role of predators and parasites in controlling lygus in orchards has not been investigated, but in cotton and strawberries, beneficials have been shown to be helpful.

Cultural Control
Eliminate or suppress weed host plants before fruit forms on trees and thereafter throughout the growing season to minimize lygus populations. Yellow starthistle, Russian thistle, tarweed, sweet clover, wild mustard, lambsquarters, pigweed, shepherd's-purse, wild radish, and vetch

are important hosts. Do not mow cover crops or weeds when lygus bugs are present or they will move into the trees."

Scab of apple, *Venturia inaequalis*
Timing: early control with sulfur or lime-sulfur, monitoring/degree day-humidity modeling/prediction, fall foliar fertilizer application.

Powdery mildew, *Podosphaera leucotricha*
Timing: early control with sulfur or lime-sulfur, monitoring/degree day-humidity modeling/prediction, fall foliar fertilizer application, pruning off diseased parts.

Sooty blotch

PEAR

Codling moth, *Cydia (Laspeyresia) pomonella*
Sanitation-remove infested & dropped apples, oil spray on apples when females fly, mass trapping, trunk banding, mating disruption, pruning for height.

Leafroller moth, *Platynota stultana*
Sampling/monitoring, spray Bacillus thuringiensis (BT).

Pear Psylla, *Cacopsylla (Psylla) pyricola* (secondary pest after coddling moth spray)
Monitor, predict, and maintain low populations, biological control, resistant rootstock, sprays with dormant petroleum oil, insecticidal soap, azadirachtin, kaolin clay.

Scab of pear, *Venturia pirina*
Monitor, predict outbreaks with degree-day temperature/humidity model, Reduce or prevention of primary infections in spring, apply lime sulfur in delayed dormant period, cultivate leaves into soil.

Fireblight, *Erwinia amylovora*

According to http://www.ipm.ucdavis.edu/PMG/r603100211.html,

"Management
Fire blight development is influenced primarily by seasonal weather. Warm spring weather, accompanied by intermittent rain and hail, is ideal for disease development. Other influences on disease development are the varieties and rootstocks used in the orchard, location of the orchard, application of too much nitrogen fertilizer, heavy pruning, or over-irrigation. Management relies on maintaining trees in the proper range of vigor, applying blossom sprays of antibiotics or copper that are supplemented with the A506 bacteria, and most importantly, promptly finding, removing, and destroying blight strikes.

Blossom applications of copper materials or the antibiotic streptomycin and terramycin are necessary in pear-growing areas to reduce the spread of fire blight bacteria. The timing of the first application is critical…average daily temperatures or degree-hours are used to schedule fire blight sprays. For detailed information on these methods, see Integrated Pest Management for Apples and Pears, 2nd ed., UC ANR Publ. 3340.

Biological Control
The antagonistic bacteria *Pseudomonas fluorescens* (Blight Ban A506) is commercially available to prevent colonization of the blossoms by *Erwinia amylovora* during bloom. It is most effective when used in conjunction with antibiotic treatments such as streptomycin.

Cultural Control
One active overwintering canker located high in a tree can cause infection of surrounding trees, and a few such cankers per acre will render a preventive spring/summer spray program ineffective. Remove and destroy holdover cankers and diseased limbs by cutting at least 8 to 12 inches below signs of visible injury. This helps to stop disease movement in the tree and reduces the source for new infections. Be sure to sterilize pruning shears and saws whenever they come into direct contact with diseased tissues and periodically throughout pruning.

Organically Acceptable Methods
Organically acceptable methods include cultural and biological controls along with sprays of terramycin, streptomycin, some copper products, and Bordeaux.

Monitoring and Treatment Decisions
Several mean temperature and degree-hour models are available to assist in predicting infection periods and the need for control. All are based on the minimum and maximum temperature thresholds above and below which bacterial growth and subsequent infection ceases."

San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Monitor & use degree-day models, biocontrol, dormant oil sprays.

Fruit fly, Rhagoletis pomonella

According to http://www.ipm.ucdavis.edu/PMG/r603301911.html,

"Apple maggot is a minor pest of pears. If spray treatments are needed, they are aimed at the adult stage.

Biological Control
Because the apple maggot feeds within fruit, biological control agents have not been very effective.

Organically Acceptable Methods
Baited sprays such as GF-120 are organically acceptable.

Monitoring and Treatment Decisions
Emergence and dispersal of adult flies must be carefully monitored to effectively time treatments. Sticky traps, including yellow rectangles and red spheres, are used in other areas to monitor adults and time treatments. Unfortunately, only provisional economic thresholds are available for apple maggots, even in areas where it has long been a pest. You can detect the first emergence of adults by hanging yellow sticky traps in abandoned orchards or unsprayed apple trees in infested areas. To detect the beginning of egg laying, hang red sticky spheres in apple trees, then treat as soon as the first fly is found…some orchards are now being treated regularly for apple maggots, the first maggot spray is applied 7 to 10 days after the first fly has

emerged. Later sprays follow at 10-to 14-day intervals as long as adults are active and are being caught in traps."

Spinosad and Nu-Lure Insect Bait impregnated with phsomet are low-impact chemical controls.

Pear Rust, *Gymnosporangium libocedri*

Remove alternate host plants near orchard.

PEACH/APRICOT/PLUM

Oriental fruit moth, *Grapholitha molesta*
Degree-day & pheromone trap monitoring, mating disrupting pheromones and sprays of the "Entrust" formulation of spinosad, biological control & sunflower planting.

Green Peach Aphid, *Myzus persicae*
Dormant oil sprays.

Stem borers

For peach tree borer, pheromone traps are available to monitor adult emergence.

For shothole borer, according to http://www.ipm.ucdavis.edu/PMG/r602301511.html, "Maintaining healthy trees and preventing sunburn are the keys to preventing damage by shotholeborer. Painting the trees with white wash or a 50:50 mixture of white interior latex paint and water will help prevent sunburn and possibly inhibit egg laying. Avoid pruning during summer, and prune trees so that scaffolds are shaded to prevent sunburn. Remove horizontal scaffolds when pruning/thinning young trees.

Protect newly planted or newly grafted trees from sunburn by painting the trunk and graft with white interior latex paint or using tree wrappers around the trunk. If paint is used, be sure to mix it with water; undiluted latex paint can kill young trees. Thin the latex paint to a mixture of one-half water and one-half latex paint and paint the trunk from 2 inches below ground level to 2 feet above.

Prune to eliminate areas in older trees infested with shothole borer. Remove severely infested trees. Burn or remove all infested wood from the orchard before the growing season starts. Do not leave pruned limbs or stumps (healthy or infested) near orchards (for example, in woodpiles) as populations can emerge from these materials before they dry out, and beetles will then migrate into orchards. There are no insecticide treatments recommended for this insect."

Peach Twig borer, *Anarsia lineatella*

According to http://www.ipm.ucdavis.edu/PMG/r602300611.html, "Within an IPM program, the preferred management strategy for peach twig borer is well-timed treatments of environmentally sound insecticides around bloom time. These include Bacillus thuringiensis, spinosad (Entrust, Success), methoxyfenozide (Intrepid), and diflubenzuron (Dimilin). Bloom time applications integrate well with brown rot treatment, thus helping to cut application costs. Bloom sprays are

preferred over in-season sprays in an IPM program because they have less adverse impact on beneficials and nontarget organisms.

Alternatively, peach twig borer can be controlled with a spray in the delayed dormant season to kill overwintering larvae in the hibernacula. Organophosphates and pyrethroid insecticides have traditionally been used but these should be avoided because they pose surface water quality concerns and may pose some risks to raptors, aquatic invertebrates, beneficials, and other nontarget organisms. Dormant sprays of oil plus spinosad (Entrust, Success) or diflubenzuron (Dimilin) do not present these environmental problems. Dormant sprays of oil alone or oil combined with an insecticide, however, have the advantage of controlling some other stone fruit pests, especially mites and San Jose scale. (Oil alone does not control peach twig borer.) Mating disruption during the growing season can also be used to supplement dormant sprays."

Termite

Management:
Sanitation: destruction of infested plants
IGRs (insect growth regulators): Gentrol, Nyguard, Precor, Nylar, Hydroprene, Methoprene)
Baits: wood stakes treated with borates
Deep plowing, dig out queen, grinding fish bones and placing dry meal underground to attract ants that reduce termites, insecticide seed treatment.
Hand dig out nest to kill queen, insecticide poured into nest, use composted instead of fresh mulch.

Root rots

For *Armillaira* root rot, according to http://www.ipm.ucdavis.edu/PMG/r602100811.html, "Avoid planting peach orchards where forest or oak woodland has recently been cleared or where there is a history of Armillaria root rot. All rootstocks can be attacked by Armillaria mellea but some are less affected than others. Maintain the vigor of the trees to help resist Armillaria attack. Infested sites can be fumigated, but often this procedure will not prevent recurrence of the disease. Physical barriers to contain infection centers have been used successfully in orchards. Four-foot trenches are dug around the infection center and plastic tarp is laid inside the trench wall from bottom to top before the soil is replaced. The tarp prevents healthy roots from coming in contact with diseased ones, thus preventing spread of the disease."

For *Phytophthora* root rot, according to http://www.ipm.ucdavis.edu/PMG/r602101111.html, "The most effective ways to manage Phytophthora root and crown rot are to select a good planting site, select an appropriate rootstock, and properly manage irrigation water. Avoid over irrigating in spring and fall when soil temperatures are most conducive to disease development and water use by the tree is low.

Powdery mildew

According to http://www.ipm.ucdavis.edu/PMG/r602100511.html, "Management of powdery mildew on peaches focuses on protecting fruit from infections. Watch for the disease during routine monitoring. Avoid growing peaches near apple varieties that are highly susceptible to powdery mildew, such as Jonathan, Gravenstein, and Rome Beauty. If nearby apples are expected to cause mildew problems on peaches, control the disease on apples or apply a fungicide to peaches at jacket split."

Shot hole disease, *Clasterosporium carpophilum*
Sanitation.

Leaf curl, *Taphrina deformans*
Bordeaux mixture, pruning diseased parts.

Gummosis (canker)

According to
http://www.mobot.org/gardeninghelp/plantfinder/IPM.asp?code=58&group=21&level=s,

"1. Be careful not to damage trunks with lawn mowers or other yard and garden equipment. Fungal spores enter the tree through injured tissue where they germinate and penetrate the tissue. This is the primary mode of infection.

2. Take steps to prevent winter injuries. Plant in well-drained soils or amend soils to improve drainage as needed. Avoid planting in open or windy areas to reduce desiccation. Select winterhardy cultivars matched to your hardiness zone. Paint the lower branches and trunks of 1–3 year old trees with white latex paint to reduce cold damage.

3. Proper care and maintenance. Prevent insect boring damage by maintaining the health of the tree. Prune and dispose of diseased branches in late winter. Burn infected wood, if possible.

4. Plant more resistant varieties. None of these are immune, but fungal development is slower if the disease becomes established."

CITRUS

Citrus canker

According to http://www.ipm.ucdavis.edu/PMG/r107100411.html, "Management of Phytophthora gummosis focuses on preventing conditions favorable for infection and disease development. All scion cultivars are susceptible to infection under the right environmental conditions.

Cultural Control
Plant trees on a berm or high enough so that the first lateral roots are just covered with soil. Correcting any soil or water problems is essential for a recovery. In addition to improving the growing conditions, you can halt disease spread by removing the dark, diseased bark and a buffer strip of healthy, light brown to greenish bark around the margins of the infection. Allow the exposed area to dry out. You can also scrape the diseased bark lightly to find the perimeter of the lesion and then use a propane torch to burn the lesion and a margin of 1 inch (2.5 cm) around it. Recheck frequently for a few months and repeat if necessary.

Organically Acceptable Methods
Cultural controls and copper treatments are acceptable for use on organically certified citrus.

Monitoring and Treatment Decisions
Late stages of Phytophthora gummosis are distinct, but early symptoms are often difficult to recognize. Yet early detection and prompt management actions are essential for saving a tree.

If 50% or more of a trunk or crown region on a mature tree is girdled, it is more economical to replace the tree than to try to control the infection.

When establishing a new orchard, carefully check the lower trunk and rootstock of new trees for any symptoms of gummosis before you plant. When trees are wrapped in burlap, open and inspect a representative sample (at least 10% of the trees). When planting or replanting in soil infested with Phytophthora, or when a susceptible rootstock has to be used, fumigation may be helpful.

Inspect your orchard several times a year for disease symptoms. Look for signs of gumming on the lower trunk and crown, and for soil buildup around the crown; do not allow bud unions to get buried. Wrappers on young trees should be lifted or removed for inspection. When you detect gum lesions, check soil and drainage conditions. Systemic fungicides can control Phytophthora gummosis and copper sprays can be used to protect against infection."

Citrus Die Back (transmitted by Asian Citrus Psyllid, *Diaphorina citri***)**

Classical biological control using parasitoids of the psyllid vector should contribute to the suppression of psyllid populations.

Citrus Leaf-miners, *Phyllocnistis citrella*

According to http://www.ipm.ucdavis.edu/PMG/r107303211.html,

"Management
Mature Citrus Orchards (more than 4 years old). While the new flush of mature trees may be heavily damaged by citrus leafminer and look unsightly, yield and tree growth will be unaffected. Therefore, insecticide treatments are generally not needed for mature citrus orchards. Worldwide, citrus leafminer populations are fairly well-controlled by parasitic wasps. Do not spray citrus with broad-spectrum insecticides and avoid other practices that disrupt natural enemies whenever possible to encourage natural enemies. Citrus peelminer and leafminer share many of the same parasites including Cirrospilus and Pnigalio species.

Young Citrus Orchards (more than 4 years old). Because citrus leafminer can retard the growth of young trees, apply insecticides to nursery citrus trees and new plantings of citrus. Imidacloprid (Admire) applied through the irrigation for young trees or to the soil of potted citrus provides the longest period of control (1 to 3 months). The length of control depends on tree spacing and soil and irrigation conditions. Time applications of Admire to protect periods of flushing.
Foliar insecticides suppress citrus leafminer for shorter periods of time (several weeks) compared to Admire. Foliar treatments are effective for only 2 to 3 weeks because citrus leafminer adults lay eggs on new flush growth that was not present at the time of treatment. Oil has been shown to work as a temporary oviposition deterrent in nursery settings but should be used with care to avoid phytotoxicity. Diflubenzuron (Micromite) is effective primarily against eggs and larval stages."

San Jose scale, *Diaspidiotus (Quadraspidiotus) perniciosus*
Monitor, biocontrol, dormant oil sprays.

Red Mite, *Panonychus citri*

Keep trees irrigated or watered well, biological control, do not over-spray pesticides, natural viral control. Dicofol and pyridaben are less toxic to predators than other miticides. Oil sprays.

Black spot, *Guignardia citricarpa*
Prevent by spraying. No good IPM methods.

WALNUT

Bacterial blight, *Xanthomonas campestris pv. juglandis*

According to http://www.ipm.ucdavis.edu/PMG/r881100111.html, "Control of this disease depends on the application of protective sprays to newly developing nuts. In orchards with histories of walnut blight damage, protective treatments at 7- to 10-day intervals during prolonged wet springs are necessary for adequate protection. In areas or years with less intensive rainfall, spray intervals can be stretched, and weather reports can help with spray timing.

Make the first application when the first pistillate flower emerges. The pistillate flowers are the small nutlets that form after a few leaves emerge. Additional sprays should be applied as discussed above. Walnuts are susceptible to blight infections well beyond the pistillate bloom period whenever free moisture occurs. Additional sprays are often necessary, but they must be applied before rain for maximum benefit. The total number of sprays required depends on the judgment of the grower based on disease history and climatic conditions. The success of alternate row spraying during early bloom and leafing depends upon the ability of the machinery to deliver sufficient copper material with good coverage to trees of both target rows."

Stem borer

Prune out all badly infested wood and burn or remove it from the orchard before the growing season starts. Spraying for this insect is not recommended.

Fruit borer

According to http://www.ipm.ucdavis.edu/PMG/r881301111.html,

"A good sanitation program is essential for navel orangeworm management. There are three phases to the program:

Reduce overwintering populations by removing remaining nuts from trees and flailing or burning all crop waste containing nuts. This includes removing all mummy nuts found in the trees during the dormant period, all windfall and huller waste materials found in the field, and all waste materials cleaned up from bins, hulling and drying equipment, and buildings after harvest and dehydration.

Reduce damaged nuts that allow entry of naval orangeworm and population increase during the season by controlling both walnut blight and codling moth, especially second generation.

Harvest as early as possible. Use of ethephon to advance husk splitting is advantageous, particularly during heavy worm populations or prolonged dry falls.

Dry nuts immediately and either fumigate on the farm, if stored, or ship immediately to a facility where fumigation will be performed."

Termites
Same as above for termites.

GRAPES

Downy mildew, *Plasmopara viticola*

According to http://www.ipm.ucdavis.edu/PMG/r302101111.html,

"Preventive management consists of effective soil drainage and reduction of sources of overwintering inoculum. In a vineyard that depends on sprinkler irrigation, extend the interval between irrigations as long as possible.

Fungicides for use against downy mildew can be categorized as either preventive or curative. The preventive fungicides (mancozeb, maneb, and copper compounds) must be applied before an infection period begins. New growth following application will not be protected. Include a spreader/sticker agent to prevent the material from washing off with rain. In vineyards with a history of downy mildew, apply early season copper sprays as part of a preventive program, especially during wet springs."

Powdery mildew,

According to http://www.ipm.ucdavis.edu/PMG/r302100311.html,

"Season-long control is dependent upon reducing early-season inoculum and subsequent infection. Thus treatment must begin promptly and be repeated at appropriate intervals. Timing of the first treatment depends on fungicide used and growth stage. Frequency of treatment thereafter depends on fungicide choice and weather conditions. Monitor and use the risk assessment index (RAI) model to determine necessary spray intervals. Treatment may be discontinued for wine and raisin grapes when fruit reaches 12 Brix but should be continued up to harvest for table grapes.

All powdery mildew fungicides, with the exception of oil, are best used as protectants. Discontinue the use of soft chemistry products (sulfurs, biologicals, systemic acquired resistance products, and contact materials) when disease pressure is high because by themselves they will not provide adequate control. If eradication is necessary, a light summer oil may be used anytime in the season if there is no sulfur residue present (i.e. at least 2 weeks after a sulfur treatment). Basal leaf removal can improve coverage and efficacy of powdery mildew fungicides on clusters.

Organically Acceptable Methods
Sulfur, Serenade, Sonata, and Organic JMS Stylet Oil are acceptable on most organically certified grapes; check with your certifier for details.

Monitoring and Treatment Decisions
In spring, the overwintering cleistothecia produce ascospores, which are the primary source of infection. Ascospores are released when 0.1 inch of rain or irrigation is followed by 13 hours of leaf wetness when temperatures are between 50 and 80°F. Seven to 10 days after this initial infection, monitor vineyards for the presence of powdery mildew by collecting 10 to 15 basal leaves from 20 or so vines at random and examining the undersurface for powdery mildew spores. If spores are found, then monitor disease development by using the powdery mildew risk assessment index.

Resistance Management
Alternating fungicides with different modes of action is essential to prevent pathogen populations from developing resistance to fungicides. This resistance management strategy should not include alternating or tank mixing with products to which resistance has already developed. Do not apply more than two sequential sprays of a fungicide before alternating with a fungicide that has a different mode of action."

Jassids (leafhoppers, vectors of disease)

According to http://www.ipm.ucdavis.edu/PMG/r302300111.html,

"Although leafhoppers infest most vineyards, they may not require chemical treatment because vines can tolerate fairly high populations without harm, and predators and parasites may be able to maintain leafhopper populations below tolerance levels. Grape leafhopper populations may occasionally reach damaging levels and require treatment. If chemical control of leafhopper is necessary, wait until the second (summer) generation, whenever possible, before treating.

Biological Control
Egg parasites, including Anagrus epos and other Anagrus spp., are commonly found in vineyards during part of the season. These parasites may be more abundant in vineyards that are adjacent to prune, plum and almond orchards, and riparian areas where other leafhoppers that overwinter in the egg stage reside. Anagrus spp. can parasitize these eggs and survive the winter. After a leafhopper egg is parasitized it becomes visibly red. Unfortunately, this parasite is not as effective on variegated leafhopper eggs as it is on those of the grape leafhopper. Sulfur sprays applied for fungal control are very toxic to Anagrus spp.

General predators of grape leafhoppers include spiders, green lacewings (Chrysopa spp.), minute pirate bugs (Orius spp.), lady beetles (Hippodamia spp.), and predaceous mites. The predaceous mite, Anystis agilis, is an important predator of first instar nymphs. Although many growers have experimented with releases of lacewings for leafhoppers, control of economic populations has not been achieved in university field trials.

Cultural Control
Removing basal leaves or lateral shoots during berry set and the 2-week period following (before adult leafhoppers emerge), as recommended for Botrytis bunch rot management, will normally reduce peak leafhopper populations during the season by 30-50%. This coupled with Anagrus activity may preclude the need for insecticide treatment even when leafhoppers exceed the thresholds below. Time leaf removal to coincide with first generation nymphal development up to and including the 5th instar but just before adults are present. Also, leaf removal will improve coverage and efficacy of pesticides. In warmer growing areas, be careful not to remove excessive numbers of leaves, which can lead to sunburned fruit. Preventing overly vigorous vine growth will also help suppress leafhoppers.

If the vineyard is accessible before bud break and erosion is not a risk, remove weeds in vineyards and surrounding areas before vines start to grow in spring to reduce adult leafhopper populations that might disperse to new grape foliage.

Organically Acceptable Methods
Biological and cultural control methods, including basal leaf removal, assist in control. Narrow range oils, insecticidal soaps, or kaolin clay may give partial control when nymphs are small. Soaps may spot table grapes and should only be used before bloom on this crop.

Monitoring and Treatment Decisions
About 4 weeks after bud break, or whenever nymphs first appear, begin sampling for leafhoppers. Randomly select 20 vines in each block of the vineyard, each at least a few vines in from the end of the row."

ATTACHMENT 3: PESTICIDE DISPOSAL OPTIONS

PESTICIDE DISPOSAL

In 2007, if one ends up with excess pesticide concentrate, dilute it as directed on the label; then apply it to an area listed on the label. You can dispose of excess pesticide mix by applying it to an area listed on the label. Do not apply more than is recommended. You can also store leftover pesticide until you are able to take it to a hazardous-waste collection site.

An empty pesticide container is not as empty as you might think; a significant amount of pesticide residue can remain inside of it. Triple-rinse an empty container of liquid pesticide before you toss it into the trash. Here's how: First, when you are down to the last amount of pesticide concentrate, drain the pesticide container into your spray tank for at least 30 seconds.

Fill the empty container one-fifth to one-fourth full of water and rinse thoroughly. Use this rinse water as dilution water for the pesticide concentrate in the sprayer. If the dilution rate allows you to pour all the rinse water into the sprayer, drain it into the sprayer for at least 30 seconds.

Follow the procedure in Steps 2 and 3 two more times. Then spray the pesticide mixture on areas listed on the label. Do not exceed the label's application rate.

CONTAINER DISPOSAL

All empty pesticide containers must be destroyed, and never re-used. It is extremely dangerous to use them for anything else. Consult the pesticide label, the manufacturer, or the manufacturer's representative for specific recommendations regarding container cleanup and disposal. The following are general guidelines. There are two basic methods for cleaning pesticide containers prior to disposal. Both require that the container be turned upside down and allowed to drain into the spray tank for at least 30 seconds, followed by adding water to the container and rotating it well to wet all surfaces, then draining it again into the spray tank as an additional dilutent.

- Triple Rinse Method: Add a measured amount of water or other specified dilutent so that the container is one-fifth to one-fourth full. Rinse container thoroughly, pour into a tank, and allow to drain for 30 seconds. Repeat three times. The water rinsate can be used to mix with or dilute more of the same pesticides or it can be sprayed on the target crop.
- Pesticide Neutralization Method: Empty organophosphate and carbamate containers can be neutralized by adding alkaline substances. The following procedure is recommended for 200-liter barrels. Use proportionally less material for smaller containers.

1. Add 20 liters of water, 250 milliliters of detergent, and one kilogram of flake lye or sodium hydroxide.
2. Close the barrel and rotate to wet all surfaces.
3. Let stand for 15 minutes.
4. Drain completely and rinse twice with water. The rinsate should be drained into a shallow pit in the ground located far away from wells, surface water, or inhabited areas.

Containers cleaned by any of the above methods are still not safe to use for any other purpose. Glass containers should be broken and plastic or metal containers punctured or crushed. Containers can then be buried in an isolated area at least 50 cm below ground surface.

Container Type	Disposal Statements
Metal Containers (non-aerosol)	Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of container in a sanitary landfill, or by other procedures approved by state and local authorities.
Paper and Plastic Bags	Completely empty bag into application equipment. Then dispose of empty bag in a sanitary landfill or by ncineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.
Glass Containers	Triple rinse (or equivalent). Then dispose of in a sanitary andfill or by other approved state and local procedures.
Fiber Drums with Liners	Completely empty liner by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of liner in a sanitary andfill or by incineration if allowed by state and local authorities. If drum is contaminated and cannot be reused, dispose of it in the manner required for its liner.
Plastic Containers	Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary andfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.
Compressed Gas Cylinders	Return empty cylinder for reuse (or similar wording).
Foil outer pouches of water soluble packets (WSP)	Dispose of the empty outer foil pouch in the trash, as long as WSP is unbroken.

ATTACHMENT 4: BOTANICAL PESTICIDES, REPELLENTS, AND BAITS REGULATED BY EPA, AS EPA-LISTED

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 vertibrates	Low	004301
4-allyl anisole	Estragole	Kills beetles	Low	062150
Azadirachtin	*Azadirachta indica* Neem tree extract	Kills & repels insects	Low, IV	121701
Bergamot		Repels vertibrates		129029
Canola Oil	*Brassica Napus B. Campestris*	Kills many insects	Low	011332
Capsaicin	*Capsicum frutescans*	Repels vertibrates	Low, III	070701
Castor Oil		Repels vertibrates	Low	031608
Cedar wood Oil		Repels moth larvae	Low	040505
Cinnamaldehyde	*Ceylon and Chinese* cinnamon oils	Kills insects, fungi & repels vertibrates*	Low	040506
Citronella Oil		Repels insects & vertibrates	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 vertibrates**	Low	597501
Geranium Oil			Low	597500
Indole	from all plants	Trap bait: corn root-worm beetles	Low	25000-
Jasmine Oil			Low	040501
Jojoba Oil		Kills & repels whitefly	Low	067200

		kils powdery mildew		
Lavandin Oil		Repels clothes moth	Low	040500
Lemongrass		Repels vertibrates	Low	040502
Linalool	Oil of Ceylon isomeric w/ geraniol	Repels insects, ticks, mites & spiders	Low	128838
Maple lactone		Roach trap bait	Low	004049
Methyl salicylate	Oil of wintergreen	Repels moths, beetle & vertibrates	May be Toxic in large quantity	76601-
Mint	Herb	Kills aphids	Low	128892
Mint Oil		Kills aphids	Low	128800
Mustard Oil		Repels insects, spiders & vertibrates	Low	004901
Neem Oil		Kills whitefly, aphids	Low	025006
1-Octen-3-ol	From clover, alfalfa	Trap bait: mosquitoes	Low	69037-
Orange		Repels vertibrates	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
Rotenone	*Derris sp., Tephrosia*	Controls ticks	III	
Ryania	*Ryania speciosa*	Kills thrips, coddling 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: cornrootwo-rm, cucumber beetles	Low	40515-
Verbenone	From pine trees	Repels bark beetles	Low	128986

1. This table does not necessarily describe all plant oil active ingredients.
2. More detailed information available for most of the oils:
http://www.epa.gov/pesticides/reregistration/status.htm
3. Natural Source: Only one or a few sources are listed. Most of these chemicals are found in many different plants.
* attracts corn rootworm beetles, ** attracts Japanese beetles

ATTACHMENT 5: A GENERAL IPM PLANNING AND DESIGN PROTOCOL

The design of an IPM program in 2007 can be developed with all of the fundamental parts of any good management plan. The vital parts of a plan include a definition of the targeted primary (small or large-holder farmers) and secondary (marketers, processors, transporters, and consumers) beneficiaries, implementation partners (farmers, laborers, extension personnel, national, regional and international organizations), listed production constraints (problem identification) and IPM strategies for dealing with them.

ELEMENTS OF IPM PROGRAM

Since IPM is not generally an active part of crop production in Iraq, a basic understanding of the steps or elements needed in an IPM program is addressed below.

Step 1: Evaluate and use non-pesticide management options first.
Use both preventive and responsive/curative options that are available to manage pest problems. Farmers may prevent pests (and avoid requiring pesticides) by the way they select plants, prepare the site, plant and tend growing plants. Along with prevention, farmers may respond to or cure the problem via physical, mechanical or biochemical methods.

General Preventive Interventions:

Plant selection
- choose pest-resistant strains
- choose proper locally-adapted plant varieties
- diversify plant varieties or inter-crop plants
- provide or leave habitat for natural enemies

Site preparation and planting
- choose pest-free or pest-avoidance planting dates (e.g., early planting in rainy season avoids stem borers in cereals)
- enhance/provide shade for shade-grown crops
- assign crop-free (fallow) periods and/or rotate crops
- install buffer zones of non-crop plants and/or physical barriers
- improve soil health
- use and appropriate planting density
- rotate crops
- low-till, no-till

Plant tending/cultivation practices
- fertilize and irrigate appropriately
- remove weeds while small and before sowing crop

Responsive/Curative Interventions:

Physical/mechanical control
- remove or destroy diseased plant or plant parts & pests
- weed
- install traps

Biochemical control

- pheromones (very effective, but not currently easily accessible or economical, however, they are becoming more so)
- homemade botanical pesticides
- repellents

Biological control

- release or augment predators
- release or augment parasites/parasitoids
- release or augment microbial pesticides

Step 2: Assess IPM Needs and Establish Priorities. In planning IPM project consider crop protection needs, farmers' perceptions of pest problems, pesticide use history and trends, availability of IPM technology, farming practices, access to sources of IPM expertise, support for IPM research and technical assistance, and training needs for farmers and project field extension workers.

Next, identify strategies and mechanisms for fostering the transfer of IPM technology under various institutional arrangements, mechanisms, and funding levels. Define what is available for immediate transfer and what may require rapid and inexpensive adaptation and validation research. During the planning stages of an IPM program, the inputs from experienced IPM specialists will be extremely useful. If possible, set up an initial planning workshop to help define and orient implementation activities, and begin to assign individual responsibilities.

Step 3: Learn and value farmers' indigenous IPM tactics, and link with and utilize all local resources/partners. Most farmers are already using their own forms of IPM, many of which are novel, self-created, adapted for local conditions, and many of which work well. These include: mechanical and physical exclusion; crop rotation, trap crops, cover crops, and green manures; local knowledge of strategic planting or harvesting times; water, soil and fertilizer resource management; intensive intercropping with pest-repellent plants; leaving refuge habitat for natural enemies; soil augmentation and care leading to healthy nutrient cycling; transplanting; and weeding.

Accurate assessments of these farmer technologies, as well as of actual losses due to different constraints in farmers' fields are a must before designing a crop production and pest management program. Crop loss figures provided by small and large farmers alike, and thus projected and reported by international organizations, are often inaccurate, and thus overestimated.

Step 4: Identify key pests for each target crop. Although hundreds of species of organisms can be found in a crop at any one time, only a few of them may cause substantial crop losses, and be considered pests. Become familiar with the key pests of target crops, whether they are primary or secondary pests, how to positively identify them. Monitor their population size, the kind of damage that they cause, and their life cycle. These usually amount to a relatively small number of species on any one crop and can include any combination of insects, pathogens, weeds, diseases, and vertebrates. A few other species, known as secondary or occasional pests, attain damaging status from time to time; especially if over-spraying occurs and kills natural predators that naturally regulate their populations.

The vast majority of insect species found in any one crop are actually predators and parasites of the plant-feeding species. Many small-holder farmers are not aware of these distinctions and must be taught to correctly identify the more common beneficial species, as well as pests, found in their crops. Incorrect identification of beneficial insects, predators or neutral insect species,

may lead to unnecessary pesticide applications. This diagnostic phase requires sampling and careful observation. Usually, most key pests are fairly well known by local farmers and government extension personnel. However, a few species may be poorly known or understood because they occur at night, are hidden, or small. These include soil-inhabiting species such as nematodes and insect larvae (wireworms, white grubs, cutworms), mites, and pathogens (viruses, bacteria, mycoplasma, fungi). In addition, farmers usually do not understand the role of some insects as vectors of plant diseases.

Step 5: Do effective activities and training to promote IPM. A number of activities are very effective in promoting IPM in developing countries:

Learning-by-doing/discovery training programs
The adoption of new techniques by small- and large-holder farmers occurs most readily when program participants acquire knowledge and skills through personal experience, observation, analysis, experimentation, decision-making and practice. First, frequent (usually weekly) sessions are conducted for 10–20 farmers during the cropping season in farmers' fields by trained instructors or extension agents. Because these IPM training sessions take place in the farmers' own environment, (1) they take advantage of the farmers' own knowledge; and (2) the farmers understand how IPM applies to their own farms.

Of these IPM training sessions, four or five analyze the agro ecosystem. They identify and describe conditions such as soil type, fertility, and needs, weather, crop stage, each pest, their natural enemies, and relative numbers of both. Illustrations and drawings are provided, as necessary. Extensions apply a Socratic method, guiding farmers with questions to discover important insights and supplying information only when absolutely necessary.

Farmers may also experiment with insect zoos where they can observe natural predators of their pests in action and the impact of pesticide on both. Knowledge and skills necessary for applying IPM are best learned and understood through practice and observation, understanding pest biology, parasitism, predation and alternate hosts; identifying plant disease symptoms; sampling population size; and preparing seed beds.

Recovering collective memory
Pest problems often emerge because traditional agricultural methods were changed in one way or another, or lost. These changes can sometimes be reversed. This approach uses group discussions to try to identify what changes might have prompted the current pest problem.

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).

Demonstration project
Subsidized experiments and field trials at selected farms can be very effective at promoting IPM within the local community. These pilots demonstrate IPM in action and allow comparison with traditional synthetic pesticide-supported cultivation.

Educational material-Iraq
In many countries, basic written and photographic guides to pest identification and crop-specific management techniques are unavailable or out of date. Such material is essential. Videos featuring graphic pictures of the effects of acute and chronic pesticide exposure, and interviews

with poisoning victims can be particularly effective. A study in Nicaragua found videos to be the most important factor in motivating farmers to adopt IPM.

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.

Organic food market incentive
Promoting organic certification for access to the lucrative and rapidly growing organic food market can be a strong incentive to adopt IPM.

Step 6: Partner successfully with other IPM implementers. Many IPM project consist of partnerships between two or more organization, e.g., donors, governments, PVOs and NGOs. If these partnerships are not forged with care, the entire project may be handicapped. 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 important that partners articulate a common, detailed *vision* of IPM, centered on the crops and conditions the project will encounter.

Confirm partner institutions' commitment
Often, organizations make commitments they do not intend to (or are unable to) fulfill completely. 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 program. 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.** Large partner organizations should have staff with expertise in IPM who are assigned specifically to IPM work. In strong partnerships, these staff members are actively involved in the partnership.

Step 7: Monitor the fields regularly. The growth of pest populations usually is related closely to the stage of crop growth and weather conditions, but it is difficult to predict the severity of pest problems in advance. The crops must be inspected regularly to determine the levels of pests and natural enemies and crop damage. Current and forecast weather should be monitored. Farmers, survey personnel, and agricultural extension staff can assist with field inspections. They can train other farmers to be able to separate pests from non-pests and natural enemies, and to determine when crop protection measures, are necessary.

Step 8: Select an appropriate blend of IPM tools. A good IPM program draws from and integrates a variety of pest management techniques. IPM does not require predetermined numbers or combinations of techniques, nor is the inclusion or exclusion of any one technique required for IPM implementation. 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. When dealing with crops that are already being treated with pesticides, IPM should aim first at reducing the number of pesticide applications through the introduction of appropriate *action thresholds*, while promoting appropriate pesticide management and use practices and shifting to less toxic and more selective products and non-chemical control methods. In most cases, NGOs/PVOs will probably need to deal with low to moderate levels of pesticide use. Either way, an IPM program should emphasize preventive measures and protect a crop, while interfering as little as possible with the production process.

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: Monitor and Evaluate. First, develop data collection tools, and then collect baseline data at the beginning of the project to identify and determine the levels of all variables that will need to be tracked. These may include numbers and types of pests, predators, and soil microorganisms; relative numbers of all non-target animals (birds, lizards, etc.) that may be negatively impacted if pesticides are used; soil and water samples to determine levels of pesticide residue; soil samples to learn dominant soil types and to predict soil nutrition, requirements, and fertilizer/pesticide activities; pesticides, application and safety equipment available; and, amounts and type of training received by target audiences.

Develop methods for measuring the effectiveness of each IPM tactic used, and of their sum in reducing pest damage and crop losses. Also, develop methods for monitoring environmental health (maintaining and encouraging high levels of predators and soil microorganisms) and human health if pesticides are used. Kits are available for determining the level of cholinesterase-inhibiting pesticides to which farmers and applicators have been exposed. Make checklists for farmers to use when applying pesticides that indicate the type of application and safety equipment used, and the rates at which pesticides were applied.

ATTACHMENT 6: PESTICIDE USE CHECKLIST FOR PVOS AND NGOS

For the 2007 field season, and pre-2008 training, the following checklist is intended to assist in identifying potential environmental problems with pesticide use. It will also help in guiding project management to ensure that pesticides are not used inappropriately. Since pesticide use is mainly an issue with agricultural projects involving trees or food production, livestock projects, and health projects (control of mosquitoes, schistosomiasis pathogens, tsetse fly, etc.), particular care should be taken with those sectors. The same caution should be used anytime pesticides are employed as part of project activities in any sector.

1. Check off all ways in which pesticides will be used.

	By Project Staff	By Project Recipient	Others (Specify)
Demonstration	_____	_____	_____
Research	_____	_____	_____
Training	_____	_____	_____
Vector Control	_____	_____	_____
Others (list)	_____	_____	_____

2. Check the technical expertise of the people to be handling pesticides:

	Staff	Project Recipients	Others (specify)
Well-trained	_____	_____	_____
Moderately trained	_____	_____	_____
Not trained	_____	_____	_____
Others (explain)	_____	_____	_____

3. Pesticides are needed to manage pests on (check one or more):

_____ Crops
_____ Livestock
_____ Others; please specify: _____

4. Can your staff identify the main pest organisms?

_____Yes _____No

5. Do you know which pesticides are needed?

_____Yes _____No

Pesticide Use Checklist

6. List pesticides needed, indicating each commodity (crop type, livestock type, tree, etc.) and specify pests (name of specific insects, diseases, weeds, storage pests, etc.) needing control, using the format shown below.

Commodity	Pest	Pesticide Common Name	Trade Name

7. Pesticide Storage Facilities

a) Do you have a storage facility on the project site designated solely for pesticides?
_____Yes, describe:
_____No

b) Is the storage shed well lit, ventilated, and safe from flooding?
_____Yes _____No

c) Are pesticides kept away from food, feed, or water?
_____Yes _____No

d) Are storage facilities secure and kept locked when not in use?
_____Yes _____No

e) Are all pesticides kept in their original, labeled containers?
_____Yes _____No

f) Are warning signs posted outside the storage sheds?
_____Yes _____No

g) Are pesticides stored away from flammable/combustible materials?
_____Yes _____No

h) Is there a well-established procedure to clean up spills?
_____Yes, namely:
_____No

8. Safe Use of Pesticides

a) Do you have a place to mix the pesticides safely?
_____Yes, describe:
_____No

b) Do you have protective clothing (e.g. rubber boots, coveralls, gloves, masks, eye protection)?
_____Yes, describe:
_____No

c) Do you have measuring and mixing equipment?
_____Yes, describe:
_____No

d) Do you have a supervisor in the project designated to oversee all pesticide operations?
_____Yes, who?:_____;
Level of training? _____
_____No

e) Is your staff familiar with appropriate pesticide disposal procedures?
_____Yes _____No

f) Describe how you plan to dispose of pesticide containers:
metal? _____
glass? _____
plastic? _____
paper? _____
cardboard? _____

g) Is your staff familiar with first-aid procedures for pesticide poisoning?
_____Yes _____No

h) Are emergency procedures in place in case of accidental poisonings?
_____Yes: Briefly
describe_____
_____
_____No

i) Are there procedures for observing restricted entry intervals after applications?
_____Yes _____No

9. Application Equipment

a) Describe equipment you will be using to apply the pesticide.

b) Is there a trained person on the project whose job will be to maintain application equipment, including nozzles and sieves?
_____Yes _____No

c) Are spare parts available in local stores?
_____Yes _____No

Pesticide Use Checklist for
10. General Pest Management Concerns

a) Have you identified pesticide-related risks in your project area and analyzed whether pesticide use is justified, affordable, and can be adequately managed and supervised?
_____Yes _____No
_____N/A

b) Will your staff be training other people in pest management and pesticide use?
_____Yes, whom?
_____No

c) Are funds available for necessary materials, training methods, and follow-up included in your project paper?
_____Yes, estimated costs? _____
_____No

11. IPM approach

a) Is the project promoting the adoption of preventive, non-chemical management measures?
_____Yes _____No

If yes, indicate which (crop rotation, biocontrol, use of resistant cultivars, crop diversification, tillage, sanitation, manual weed destruction, etc):_____
_____

b) Are pesticides being applied only as last-resort measures and based on action threshold criteria? Are there pest monitoring procedures being used to determine the need for pesticide treatments?
_____Yes _____No

c) Can farmers and project extensionists readily distinguish pest from non-pest organisms? Can they recognize common beneficial species (pollinators, predators, and parasitoids)?
_____Yes _____No

Pesticide Use Checklist

12. Environmental Impact

a) Are there wildlife sanctuaries, preserves, or any other protected habitats in or near the project implementation area that might be affected by pesticide use?
_____Yes, namely:
_____No

b) Are there water bodies (lakes, lagoons, reservoirs, rivers, streams, estuaries, etc.) near the project areas
that might be subject to pesticide contamination through drift, runoff, or spills?
_____Yes. Describe:
_____No

c) Are wildlife and domestic animals protected from poisoned baits?
_____Yes. How?
_____No

13. Pesticide monitoring

Is there a system in place for tracking pesticide use activities, including frequency of applications, techniques,
chemicals used, doses, target pests, effectiveness, criteria for applying, and safe use practices?
_____Yes
_____No

14. Literature Needs

Have you included literature needs in your activity?
_____Yes
_____No

Pesticide Use Checklist

15. Check off areas where additional assistance may be needed:

	Consultancy	Training
Pest identification	_____	_____
Pesticide selection	_____	_____
Handling pesticides	_____	_____
(transport, mixing, loading,		

application, equipment clean up, disposal)		
Application equipment	_____	_____
IPM	_____	_____
Pesticide storage	_____	_____
Protective clothing	_____	_____
Measuring & mixing equipment	_____	_____
Training (designate activity)	_____	_____
Literature	_____	_____
Training materials	_____	_____
Other (specify)	_____	_____

ATTACHMENT 7: PROTECTIVE CLOTHING AND EQUIPMENT GUIDE

EPA RECOMMENDED WORKER PROTECTION STANDARDS

HANDLER PPE FOR WORKER PROTECTION STANDARD PRODUCTS				
Route of Exposure	**Toxicity Category by Route of Exposure of End-Use Product**			
	I DANGER	II WARNING	III CAUTION	IV CAUTION
Dermal Toxicity or Skin Irritation Potential[1]	Coveralls worn over ong-sleeved shirt and ong pants Socks Chemical-resistant footwear Chemical-resistant Gloves[2]	Coveralls worn over short-sleeved shirt and short pants Socks Chemical-resistant footwear Chemical-resistant Gloves[2]	Long-sleeved shirt and long pants Socks Shoes Chemical-resistant Gloves[2]	Long-sleeved shirt and long pants Socks Shoes No minimum[4]
Inhalation Toxicity	Respiratory protection device[3]	Respiratory protection device[3]	No minimum[4]	No minimum[4]
Eye Irritation Potential	Protective eyewear[5]	Protective eyewear[5]	No minimum[4]	No minimum[4]

1 If dermal toxicity and skin irritation toxicity categories are different, PPE shall be determined by the more severe toxicity category of the two. If dermal toxicity or skin irritation is category I or II, refer to the pesticide label/MSDS to determine if additional PPE is required beyond that specified in Table.
2 Refer to the pesticide label/MSDS to determine the specific type of chemical-resistant glove.
3 Refer to the pesticide label/MSDS to determine the specific type of respiratory protection.
4 Although no minimum PPE is required for these toxicity categories and routes of exposure, some specific products may require PPE. Read pesticide label/MSDS.
5“Protective eyewear” is used instead of “goggles” and/or “face shield” and/or “shielded safety glasses” and similar terms to describe eye protection. Eye glasses and sunglasses are not sufficient eye protection.

ATTACHMENT 8: TOXICITY OF PESTICIDES: EPA AND WHO 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

Basically, 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.

a) 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

b) WHO classification (based only on active 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	-	-

ATTACHMENT 9: BASIC FIRST AID FOR PESTICIDE OVEREXPOSURE

For Organophosphate or Carbamate Poisoning: Administer the antidote Atropine.

For Synthetic Pyrethroid Poisoning: DO NOT USE Atropine—this can kill a person!

Get medical advice quickly if you or any of your fellow workers have unusual or unexplained symptoms during work or later the same day. Do not let yourself or anyone else get dangerously sick before calling a physician or going to a hospital. It is better to be too cautious than too late.

First aid is the initial effort to help a victim while medical help is on the way. If you are alone with the victim, make sure the victim is breathing and is not being further exposed to the poison before you call for emergency help. Apply artificial respiration if the victim is not breathing.

Read the first aid instructions on the pesticide label, if possible, and follow them. Do not become exposed to poisoning yourself while you are trying to help. Take the pesticide container (or the label) to the physician. Do not carry the pesticide container in the passenger space of a car or truck.

Poison on skin
- Act quickly
- Remove contaminated clothing and drench skin with water
- Cleanse skin and hair thoroughly with detergent and water
- Dry victim and wrap in blanket.

Chemical burn on skin
- Wash with large quantities of running water
- Remove contaminated clothing
- Cover burned area immediately with loose, clean, soft cloth
- Do not apply ointments, greases, powders, or other drugs in first aid treatment of burns

Poison in eye
- Wash eye quickly but gently
- Hold eyelid open and wash with gentle stream of clean running water
- Wash for 15 minutes or more
- Do not use chemicals or drugs in the wash water; they may increase the extent of injury

Inhaled poison
- Carry victim to fresh air immediately
- Open all doors and windows so no one else will be poisoned
- Loosen tight clothing
- Apply artificial respiration if breathing has stopped or if the victim's skin is blue. If patient is in an enclosed area, do not enter without proper protective clothing and equipment. If proper protection is not available, call for emergency equipment from your fire department

Poison in mouth or swallowed

- Rinse mouth with plenty of water
- Give victim large amounts (up to 1 quart) of milk or water to drink
- Induce vomiting only if instructions to do so are on the label

Procedure for inducing vomiting

- Position victim face down or kneeling forward, Do not allow victim to lie on his back, because the vomit could enter the lungs and do additional damage
- Put finger or the blunt end of a spoon at the back of victim's throat or give syrup of ipecac
- Collect some of the vomit for the physician if you do not know what the poison is
- Do not use salt solutions to induce vomiting

When *not* to induce vomiting

- If the victim is unconscious or is having convulsions
- If the victim has swallowed a corrosive poison. A corrosive poison is a strong acid or alkali. It will burn the throat and mouth as severely coming up as it did going down. It may get into the lungs and burn there also
- If the victim has swallowed an emulsifiable concentrate or oil solution. Emulsifiable concentrates and oil solutions may cause severe damage to the lungs if inhaled during vomiting

ATTACHMENT 10: RECOMMENDED DISTRIBUTION

INMA Iraq

USAID/ANE/Washington

John Wilson
Barney Popkin

USAID Iraq
CTO
MEO
RLO
SO Team Leader
REO
Mission Director

ATTACHMENT 11: WEBSITES USED FOR PESTICIDE SEARCHES AND THIS PERSUAP

http://www.pesticideinfo.org (PAN most complete pesticides database)
http://extoxnet.orst.edu/pips/ghindex.html (Extoxnet Oregon State database)
http://www.epa.gov/ecotox/ (EPA Ecotox Database)
http://www.cdpr.ca.gov/docs/epa/m2.htm (link to OPP site)
http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg (EPA Registr.Eligib.Decisions)
http://www.epa.gov/pesticides/biopesticides/ai/all_ais.htm (EPA regulated biopesticides)
http://www.epa.gov/opppmsd1/RestProd/rupjun02.htm (EPA restricted use pesticides)
http://www.epa.gov/pesticides/health/tox_categories.htm (EPA Toxicity Classifications)
http://www.epa.gov/opppmsd1/PPISdata/index.html (EPA pesticide product information)
http://www.chemfinder.camsoft.com (chemical database & internet search, free & fee)
http://www.hclrss.demon.co.uk/index.html (compendium of pesticide common names)
http://www.agf.gov.bc.ca/pesticides/f_2.htm (all types of application equipment)
http://www.hclrss.demon.co.uk/class_insecticides.html pesticides classification and common names compendium

Electronic information on pesticides was collected by the consultant using several websites: www.epa.gov for compliance; www.who.int/ipcs/publications/pesticides
for WHO classification; www.kellysolutions.com for formulations registration status information; www.greenbook.net and www.cdms.com for efficacy information and Material Safety Data Sheets found on pesticide labels; as well as the PAN www.pesticideinfo.org and EXTOXNET http://extoxnet.orst.edu/pips/ghindex.html
Websites for specific toxicological, registration and environmental data.
http://www.foodaidmanagement.org/pdfdocs/usaiddoc/FldGuide2000Text1.PDF (good doc on outline of how to do environmental assessments, beyond compliance)

Hard copy information on toxicity class and nontarget hazard was referenced from technical manuals reviewed in the U.S. such as The Pesticide Manual by Tomlin (1997), Farm Chemical Handbook (2005), Agricultural Chemicals Books by Thomson (1995-8), The Agrochemicals Handbook by the Royal Society of Chemistry UK (1991), The UK Pesticide Guide by the British Crop Protection Council (1998), and The UK Pesticide Guide (1999).

CABI Site for Crop Protection Compendium (CPC)
http://www.cabi.org/compendia/cpc/index.htm to enter CABI CPC for crop/pest reccs.

Pesticide Toxicity to Honey Bees
http://www.entm.purdue.edu/Entomology/ext/targets/e-series/EseriesPDF/E-53.pdf
http://www.ohioline.osu.edu/hyg-fact/2000/2161.html (Ohio State Extension site)

Pesticide Toxicity to Natural Enemies (Beneficials)
http://www.ipm.ucdavis.edu/PMG/r108900111.html

Biological Pesticides List
http://www.koppert.com (a Dutch biologicals company doing business internationally)
http://www.biobest.be (a Belgian biologicals company doing business internationally)
http://www.epa.gov/pesticides/biopesticides/ai/all_ais.htm (EPA's biopesticide list)
http://www.bio-bee.com/english/welcome.html (a biopesticide company in Israel)

Minimum Residue Limits for Pesticides & Veterinary Drugs in Food
http://faostat.fao.org/faostat/collections?version=ext&hasbulk=0&subset=FoodQuality

PERSUAPs Sites
http://www.encapafrica.org/sectors/pestmgmt.htm (PERSUAPS guidance)

International Conventions
http://www.pops.int/ (POP website)
http://www.pops.int/documents/convtext/convtext_en.pdf (POP Convention text)
http://www.chem.unep.ch/pops/pdf/redelipops/redelipops.pdf (reduce & eliminate POP)
http://www.pic.int/ (PIC website)

Methyl-bromide site
http://www.epa.gov/ozone/mbr/harmoniz.html