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MEC PROGRAM PERSUAP: 2013 UPDATE

(PESTICIDE EVALUATION REPORT AND SAFE USE ACTION PLAN)

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(PESTICIDE EVALUATION REPORT AND SAFE USE ACTION PLAN)

Submitted to USAID/Morocco, Economic Growth Office - Assistance Objective 3: Reduced barriers to trade and investment

By DAI

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ACRONYMS

AFR	Africa Bureau, USAID
AI	Active Ingredient
ANE	Asia and Near East Bureau, USAID
BMP	Best Management Practice
BT	*Bacillus thuringiensis* (a bacteria that produces a toxin used as a pesticide)
BRC	British Retail Consortium
CEQ	Council on Environmental Quality (US Government)
CFR	Code of Federal Regulations
COP	Chief of Party
DDT	*Dichloro-Diphenyl-Trichloroethane*
EA	Environmental Assessment
EC	Emulsifiable Concentrate (pesticide formulation)
EMMP	Environmental Mitigation & Monitoring Plan
EPA	US Environmental Protection Agency (also known as USEPA)
EU	European Union
FAO	Food and Agriculture Organization (United Nations agency)
FDA	Food and Drug Administration (US)
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
GAP	Good Agriculture Practice
GDP	Gross Domestic Product
GUP	General Use Pesticide
Ha	Hectares
HT	Highly Toxic
IEE	Initial Environmental Examination
IGR	Insect Growth Regulator

IPM	Integrated Pest Management
IVM	Integrated Vector Management
IWM	Integrated Weed Management
M&E	Monitoring and Evaluation
MEC	Morocco Economic Competitiveness Project
MOA	Ministry of Agriculture and Maritime Fisheries, Morocco
MRL	Maximum/Minimum Residue Level/Limit
MSDS	Material Safety Data Sheet
MT	Moderately Toxic
NAT	Not Acutely Toxic
NEPA	National Environmental Policy Act (US)
PAN	Pesticide Action Network
PER	Pesticide Evaluation Report
PERSUAP	Pesticide Evaluation Report and Safe Use Action Plan
pH	log of Hydrogen concentration, measure of acidity
PHI	Pre-Harvest Interval
PIC	Prior Informed Consent (a treaty, relates to toxic pesticides)
POPs	Persistent Organic Pollutants (a treaty, relates to toxic persistent pesticides)
PMP	Pest Management Plan
PNT	Practically Non-Toxic
PPE	Personal Protection Equipment
RAP	Regional Agricultural Plans (Maroc Vert)
R&D toxin	Reproductive and Developmental toxin
Reg 216	Regulation 216 (USAID Environmental Procedures)
REI	Re-Entry Interval (safety period after pesticide spraying)
RUP	Restricted Use Pesticide
S&C	Standards and Certification
ST	Slightly Toxic

SUAP	Safe Use Action Plan
UC	University of California
UF	University of Florida
UN	United Nations
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USEPA	US Environmental Protection Agency (also known as EPA)
VHT	Very Highly Toxic
WHO	World Health Organization

EXECUTIVE SUMMARY

The purpose of this document is to conduct a Pesticide Evaluation Report (PER) and Safe Use and Action Plan (SUAP) in compliance with USAID's environmental regulations (Title 22 of the Code of Federal Regulations (CFR), part 216, or Regulation 216) on pesticide use on USAID-funded projects. The report begins with sections that evaluate background and risks across the inputs sector in Morocco. And, it promotes the use of Integrated Pest Management (IPM) and Good Agriculture Practices (GAPs).

It is the goal of this updated 2013 document to analyze new crops, pests, IPM tools and pesticides and make recommendations for actions to mitigate increased risks from pesticides. Before errors (such as human poisonings from pesticides) occur, it is the responsibility of the project implementers to put these mitigation recommendations into action, as soon as possible, with a budget targeted for this. Implementers will then monitor changes in risks, impacts and mitigation success using an EMMP (Environmental Mitigation and Monitoring Plan). Finally, the implementer will report positive or negative changes from mitigation success baselines in semi-annual reporting instruments.

USAID/Morocco prohibits the procurement with USAID-provided funds of pesticides rejected by this PERSUAP. The Mission also prohibits the use of pesticides rejected by this PERSUAP in the implementation of USAID-funded activities. However, it is important to note that for activities outside the scope of USAID projects, the Mission does not, nor would it be possible to, restrict the procurement or use, or both, of any pesticide by recipients of USAID funds or participants in USAID-funded activities, so long as the funds used to procure such pesticides are not provided by USAID and not used on a project demonstration site or activity.

PERSUAP FINDINGS THAT INDICATE RISKS FROM PESTICIDES

Field visits to project sites in Morocco in 2010 found cooperating farmers who will require inputs through their local farm input stores which sell some pesticides, seeds, fertilizers and farm tools. For this study, it was assumed that in order for project staff and beneficiaries using USAID resources to properly, safely and correctly provide advice to cooperating farmers and demonstration farms, at minimum, they should understand:

- Primary crop pests impacting each project-supported crop
- IPM tools and tactics used by the target farmers to prevent primary crop pests
- Pesticides used by target farmers for each primary crop pest
- Local/regional pesticide information
- Pesticide risk issues like relative toxicity and internationally restricted/banned pesticides
- PPE (Personal Protection Equipment) needed for specific pesticide uses

Some beneficiary farmers—especially those with large farms near Oujda—interviewed for this study do understand most of these issues sufficiently to mitigate risk significantly, but a sufficient number of others do not. Further, pesticides not registered by EPA and some highly toxic pesticides are found in the Morocco MOA's registered pesticide list.

Scarce quantities of PPE were found available in pesticide shops across the growing regions, and demonstration farmers visited had limited or no PPE. Common Best Management Practices (BMPs) for use of chemicals would dictate that Moroccan projects field staff recognize and correct these PPE deficiencies with their beneficiary farmers. Training is also significantly lacking. Beyond

recommending and procuring PPE, Moroccan Implementing Partners, demonstration farmers and their beneficiaries will need to be trained in pesticide safe use best practices.

On the other hand, Morocco has several initiatives to better rationalize the use of scarce resources like soil fertility and water with programs like Maroc Vert's and RAPs (Regional Agricultural Plans). The adoption of drip irrigation is a prime technology to conserve water. Soil tests will help determine exact nutrient requirements. And, the Ministry of Agriculture has developed a booklet containing pesticide regulations, registrations and recommended uses by crop-pest combination. Further, no counterfeit or pirated Chinese or Indian pesticide products—ubiquitous the world over—are found in Morocco, indicating a level of enforcement that is enviable.

Changes from 2010 to 2013

This 2013 version of the PERSUAP analyzes four new crops, two herb crops, sage and mint, one vine crop, grapes and one tree crop, olives. It analyzes four pests/diseases of herbs, five pests/diseases of grapes and four primary pests/diseases of olive. It also analyzes several additional pests/diseases of the crops listed in the 2010 PERSUAP. For each newly listed pest or disease, current IPM tools and pesticides are researched and presented for MEC beneficiaries. Finally, this 2013 PERSUAP update analyzes 328 pesticide active ingredients registered by MOA as of late 2012, early 2013.

During the past 2 years since the original PERSUAP was produced, MEC has published several guides for better crop/dairy production and pesticide use. In late 2012, MEC produced a guide to good milk production and processing practices. It notes the increased risks for contamination of milk with microbicides and antibiotics, which can be traced by importers with analyses for Maximum Residue Levels (MRLs). These risks, discussed below, were identified from extensive and excessive use of antibiotics in the dairy sector. Continuous and repeated sensitization through training is the most effective way to counter these risks.

For pesticides, from 2012 to 2013, a report titled "Diagnostic Report on the Use of Pesticides by Beneficiary Farmers on the MEC Grants Program" notes the use by MEC and adoption by beneficiaries of Good Agriculture Practices (GAP) and best practices of Tesco-Nature's Choice. These include use of improved resistant varieties, crop rotation and use of natural fertilizers as a means for reducing and organizing proper pesticide use. It also makes recommendations for more improvements. Record keeping has begun and improved for crop pests and pesticides applied.

Some farmers still use Class I RUP chemicals dichloropropene, metam sodium and chloropicrine to fumigate the soil, and some farmers still apply banned endosulfan and Class I methidathion to crops. Some farmers are still using Mocap containing ethoprop(hos), a RUP. Many pesticide storage facilities and empty container treatments remain substandard. Some farmers still do not use PPE (due to cost or inconvenience) and do not apply correct pesticide dosages, but many now use recommended single-use pesticide packets. Clearly, some progress has been made and more progress is needed on pesticide safety and training.

In late 2012, an Environmental Management Report was produced for MEC. It contains lists of pesticides not to be used on MEC demonstration farms. The report noted that, until December 2012, many of the recommendations contained in the 2010 report had not yet been implemented fully and that some no longer were relevant (such as the recommendation to send pesticide users to USA for training on RUP pesticides). By the 2013 cropping season, training and PPE were predicted to be available to beneficiaries. MSDSs were beginning to be collected for commonly used pesticides. Further, this report recommended that a list of rejected pesticides be attached to each grant agreement.

Environmental actions related to pesticide use include the following mitigation measures: Written training plan for pest management including Integrated Pest Management, proper timing of pesticide use to avoid environmental contamination, safe use of pesticides, and pesticide record-keeping. Signed commitment to not do not use pesticides prohibited for use on MEC funded activities.

During late 2012, MEC produced a report on training on the use of plant protection equipment. It contained necessary training on sprayer calibration and maintenance. Also in late 2012, MEC produced a report on Organic Farming regulatory, certification and inspection issues. The report discusses plant health products without mentioning pesticides.

THE PERSUAP STUDY FOCUS ON IPM, PMPS AND PESTICIDES

The practice of IPM – the use of which is considered to be a policy of USAID – is fully supported and promoted in Section 1.5 of this PERSUAP as well as in the required PER Section 3.3 Factor C analysis. Section 2.5 carries this theme further with focus on GAPs, many of which are important IPM precursors. Moreover, Annex 1 of this PERSUAP presents off-the-shelf IPM and GAPs researched and extended to farmers in other countries, particularly the USA and other developed countries for the very same or similar crop-pest combinations as those found at MEC project implementation locations. These IPM tactics (which include pesticides registered, recommended and used in the USA for the same crop-pest combinations) are presented for project field managers and beneficiaries to test and adopt, as is practical and desired.

Further, the crop-pest-GAP/IPM/pesticide information in Annex 1 is meant to provide project staff and beneficiary farmers with a solid starting point for developing their own locally-adapted Pest Management Plans (PMPs) for each crop. A guide for making detailed PMPs is provided in Annex 2, and it is expected that the implementing partners will work with demonstration farmers and farm managers to prepare PMPs and crop management posters or flyers to assist in the prediction and prevention of damage caused by specific pests and crop production constraints.

Annex 7 compiles all of the AIs in pesticides (natural and synthetic) registered as of early 2013 in Morocco. Project decision-makers—especially those who interface at the field level with beneficiary demonstration farmers—are encouraged to look at the label of potential pesticide choices to determine the AIs contained in them. Then, use this Annex 7 as a quick reference guide to attributes of—and issues with—each chemical.

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

Results from the Regulation 216 analyses of Morocco registered pesticide active ingredients are provided below, with discrete, stand-alone lists of those unrestricted for procurement and use (list 1), those that may be procured and used with special conditions (list 2), and those rejected for procurement and use (list 3) on USAID projects or by USAID project beneficiaries.

Regulation 216.3 (b)(1)(i), notes "When a project includes assistance for procurement or use, or both, of pesticides registered for the same or similar uses by USEPA without restriction, the Initial Environmental Examination for the project shall include a separate section…". That separate section has become a PERSUAP.

The interpretation of "without restriction" is that approved pesticide products will not be Restricted Use Pesticides (RUP), regardless of RUP criteria or basis (the reason they are designated as RUPs). It is important to note that RUP products may be designated as such, by EPA, due to either: 1 – Inordinate risk (hazard) to users; or 2 – Inordinate risk to the environment; or 3 – Sometimes both. Regulation 216 considers this distinction and deals with it in subparts (ii) and (iii). Thus, RUP pesticides are to be rejected for procurement and use by USAID projects and their implementers.

Rejected pesticides in list 3 provide the reason for rejection, including pesticides not EPA registered, designated by EPA as RUP, Class I chemicals too toxic for untrained and unprotected people (the majority of USAID beneficiaries) to procure and use, known carcinogens regardless of dose and known water pollutants.

Regulation 216 goes on to state: "In those cases where the evaluation of the proposed pesticide use in the Initial Environmental Examination indicates that the use will significantly affect the human environment [not EPA registered, RUP, Class I, carcinogen regardless of dose, water pollutant], the Threshold Decision will include a recommendation for the preparation of an Environmental Assessment or Environmental Impact Statement, as appropriate."

Thus, any project desiring to procure or use any of the pesticides that were rejected in this analysis (list 3, below) or with conditions other than those in list 2, below, will need to write a Scoping Statement and an Environmental Assessment, or EA. This EA would go into greater detail about proposed uses of a desired chemical or chemicals, relative risks, and appropriate mitigation measures required, if available and appropriate.

List 1: 2013 Unrestricted Pesticides Accepted for use on MEC (in green in Annex 7)

2013 Unrestricted Miticides/Acaricides Accepted for use on MEC

- abamectin/avermectin
- acequinocyl
- amitraz(e)
- clofentezine
- cotton oil
- dicofol
- essence of girofle (clove oil)
- etoxazole
- farnesol
- fenazaquin
- geraniol (geranium extract)
- hexythiazox
- milbemectin
- mineral oil
- nerolidol
- parafin oil
- propylene glycol (monolorate)
- pyridaben(e)
- rotenone
- spirodiclofen(e)
- spiromesifen
- tau fluvalinate
- tebufenpyrad

2013 Unrestricted Insecticides Accepted for use on MEC

- acetamiprid
- allyl isothiocyanate (mustard oil)
- azadirachtin (neem extract)
- *Bacillus thuringiensis*-BT
- beta cypermethrin
- bifenzate

- buprofezin(e)
- capsaicin/chili pepper extract
- carbaryl
- chlorantraniliprole (rynaxypyr)
- chlorfenapyr
- chlorpyrifos (methyl)
- chromafenozide
- cinnamaldehyde
- cyflumetofen
- dimethoate
- dioctyl sulfosuccinate sodium
- essence of orange (limonene)
- ethofenprox
- flubendiamide
- imidacloprid
- indoxacarb
- d-limonene/limonene
- lufenuron
- malathion
- metaflumizone
- methoxyfenozide
- milbemectin
- mineral oil (white)
- mono potassium phosphate
- mono+dipotassium phosphate
- novaluron
- Paecilomyces fumosoroseus
- parafin mineral oil
- permethrin(e)
- petroleum oil
- phosmet
- pirimicarb
- pirimiphos-methyl
- pymetrozine
- pyriproxyfen(e)
- Quillaja saponaria extract
- spinosad(e)
- spinetoram
- spirodiclofene
- spiromesifen
- sulfur (sulphur)
- tau fluvalinate
- thiacloprid
- thiamethoxam
- trichlorfon

2013 Unrestricted Fungicides Accepted for use on MEC

- alkyldimethylbenzyl ammonium chloride
- ascorbic acid/Vitamin C

- azoxystrobin(e)
- *Bacillus subtilis*
- boscalid (nicobifen)
- carbendazim(e)
- carboxin(e)
- chlorothalonil
- copper (metalic)
- copper hydroxide
- copper oxide
- copper oxychloride
- copper sulfate
- cymoxanil
- cyproconazole
- difenoconazole
- dimethomorph
- famoxate (famoxadone)
- fenamidone
- fenarimol
- fenbuconazole
- fenhexamid
- fludioxonil
- fluopicolide
- folpet
- fosetyl aluminum
- hymexazol
- imazalil
- iprodione
- kresoxim-methyl
- limonene/d-limonene
- mancozeb(e)
- mandipropamid(e)
- mefenoxam (metalaxyl-M)
- metalaxyl
- metconazole
- metiram (zinc)
- mono+dipotassium salts of phosphoric acid
- myclobutanil
- neem oil
- potassium bicarbonate
- propamocarb HCl
- propiconazole
- prothioconazole
- pyraclostrobin(e)
- pyrimethanil
- quinoxyfen
- oils (vegetables-soy)
- spiroxamine
- sulfur (sulphur)
- tebuconazole
- tetraconazole
- thiabendazole

- thiophanate methyl
- thiram(e)
- triadimenol
- triasulfuron
- *Trichoderma harzianum*
- trifloxystrobin(e)
- triflumizole
- triticonazole
- ziram(e)
- zoximide

2013 Unrestricted Herbicides Accepted for use on MEC

- 2 4 D amine salt
- 2 4-D dimethylamine salt
- 2 4 D ester
- 2 4 D ethyl hexylester
- 2 4 D isooctyl ester
- 2 4 D isopropylamine salt
- aminopyralid
- bentazon(e)
- clethodim(e)
- clodinafop-propargyl
- clopyralid
- cyhalofop-butyl
- desmedipham(e)
- dicamba
- dimethenamid-P
- ethofumesate
- fenoxaprop-p-ethyl
- fluazifop-p-butyl
- flucarbazone sodium
- flumetsulam
- foramsulfuron
- glufosinate ammonium
- glyphosate
- glyphosate, isopropylamine salt
- iodosulfuron methyl sodium
- linuron
- MCPA
- mesosulfuron-methyl
- mesotrione
- metamitron(e)
- metribuzin(e)
- metsulfuron-methyl
- nicosulfuron
- oxadiazon
- oxyfluorfen(e)
- pendimethalin(e)
- phenmedapham(e)

- pinoxaden
- propoxycarbazone sodium
- propyzamide
- prothioconazole
- quizalofop-p-tefuryl
- rimsulfuron
- salflufenacil
- sulfosulfuron
- terbuthylazine
- tralkoxydim
- tribenuron methyl
- thifensulfuron-methyl
- triasulfuron
- trifluralin

2013 Unrestricted Rodenticide Accepted for use on MEC

- brodifacoum

2013 Unrestricted Nematocides Accepted for use on MEC

- dazomet
- Paecilomyces lilacinus Strain 251

2013 Unrestricted Molluscicides Accepted for use on MEC

- metaldehyde

2013 Unrestricted Soil Treatments (for nematodes, insects, fungi, weeds) Accepted for use on MEC

- allyl isothiocyanate (mustard oil)
- *Beauveria basiana*
- capsaicinoids (chili pepper extract)
- dazomet

2013 Unrestricted Microbicides/Bactericides Accepted for use on MEC

- acibenzolar-s-methyl
- chlorine
- didecyldimethyl ammonium chloride
- dazomet
- prohexadione-calcium

List 2: 2013 Pesticides Conditionally Accepted for use on MEC (as long as MEC and beneficiaries follow conditions, in yellow in Annex 7)

2013 Insecticides Conditionally Accepted for use on MEC (with condition that the website http://www.pesticideinfo.org/List_ChemicalsAlpha.jsp be searched to ensure that no RUP or Class I formulations of conditionally accepted pesticides are used, and that likely carcinogens are used only with PPE)

- abamectin(e)
- aluminum phosphide (only to be used by certified trained and protected spray services)
- beta cyfluthrin(e)
- bifenthrin(e)
- carbofuran
- chlorpyrifos (ethyl)
- cypermethrin(e)
- deltamethrin(e)
- diazinon
- diflubenzuron
- emamectin benzoate
- esfenvalerate
- fenthion
- flonicamid
- gamma cyhalothrin
- lambda cyhalothrin(e)
- tefluthrin
- zeta cypermethrin

2013 Fungicide Conditionally Accepted for use on MEC (with condition that the website http://www.pesticideinfo.org/List_ChemicalsAlpha.jsp be searched to ensure that no RUP or Class I formulations of conditionally accepted pesticides are used, and that likely carcinogens are used only with PPE)

- captan(e)

2013 Herbicide Conditionally Accepted for use on MEC (with condition that the website http://www.pesticideinfo.org/List_ChemicalsAlpha.jsp be searched to ensure that no RUP or Class I formulations of conditionally accepted pesticides are used, and that likely carcinogens are used only with PPE)

- acetochlor
- amitrol (aminotriazole)
- pyroxsulam

2013 Molluscicide Conditionally Accepted for use on MEC (with condition that the website http://www.pesticideinfo.org/List_ChemicalsAlpha.jsp be searched to ensure that no RUP or Class I formulations of conditionally accepted pesticides are used, and that likely carcinogens are used only with PPE)

- methiocarb (mercaptodimethur)

2013 Soil Treatments Conditionally Accepted for use on MEC (with condition that the website http://www.pesticideinfo.org/List_ChemicalsAlpha.jsp be searched to ensure that no RUP or Class I formulations of conditionally accepted pesticides are used, and that likely carcinogens are used only with PPE)

- chlorpyrifos (ethyl)
- fosthiazate

List 3: 2013 Pesticides Rejected for purchase or use on MEC (in red in Annex 7)

2013 Miticides/AcaricidesRejected for purchase or use on MEC (with reason for rejection)

- acrinathrin (not EPA registered)
- cyhexatin (not EPA registered)
- fenbutatin oxide (RUP)
- flufenzin(e) (not EPA registered)
- formetanate (Class I, too toxic)
- halfenprox (not EPA registered)
- propargite (RUP, Class I, too toxic)
- teflubenzuron (not EPA registered)
- tetradifon (not EPA registered)

2013 InsecticidesRejected for purchase or use on MEC (with reason for rejection)

- acrinathrin (not EPA registered)
- alanycarb (not EPA registered)
- alphacypermethrin (not EPA registered)
- azinphos-methyl (RUP, Class I, too toxic)
- cyromazine (known water pollutant)
- dichlorvos (DDVP) (Class I, too toxic)
- flufenoxuron (not EPA registered)
- formetanate (RUP, Class I, too toxic)
- granulosis virus (not EPA registered)
- maltodextrin(e) (not EPA registered)
- mercaptodimethur/methiocarb(e) (RUP, Class I, too toxic)
- methamidophos (not EPA registered)
- methidathion (RUP, Class I, too toxic)
- methomyl (RUP, Class I, too toxic)
- phenthoate (not EPA registered)
- phosalone (not EPA registered)
- thiocyclam hydrogen oxalate (not EPA registered)
- *Verticillium lecanii* (not EPA registered)

2013 FungicidesRejected for purchase or use on MEC (with reason for rejection)

- ametoctradin (not EPA registered)
- *Aureobasidium pullulans*(not EPA registered)
- benalaxyl (not EPA registered)
- benalaxyl-M (not EPA registered)

- bitertanol (not EPA registered)
- bixafen (not EPA registered)
- bupirimate (not EPA registered)
- cyflufenamide (not EPA registered)
- dimoxystrobine (not EPA registered)
- dinocap (not EPA registered)
- epoxiconazole (not EPA registered)
- fentin hydroxide (Class I, too toxic)
- fluopyram (not EPA registered)
- fluquinconazole (not EPA registered)
- flusilazole (not EPA registered)
- flutriafol (not EPA registered)
- guazatine acetate (not EPA registered)
- hexaconazole (not EPA registered)
- iminoctadine tris (albesilate) (not EPA registered)
- iprovalicarb(e) (not EPA registered)
- laminaire (laminarine) (not EPA registered)
- maneb (not EPA registered)
- mepanipyrim(e) (not EPA registered)
- meptyldinocap (not EPA registered)
- ofurace (not EPA registered)
- ortho-phenylphenol (not EPA registered)
- picoxystrobin(e) (not EPA registered)
- procymidone (not EPA registered)
- propamocarb (not EPA registered)
- propineb(e) (not EPA registered)
- proquinazid(e) (not EPA registered)
- tolclofos-methyl (not EPA registered)
- tolylfluanid (not EPA registered)
- *Trichoderma viride*(not EPA registered)
- tricyclazole (not EPA registered)
- valiphenal/valinalate (not EPA registered)

2013 Herbicides<u>Rejected for purchase or use</u> on MEC (with reason for rejection)

- ammonium thiocyanate (not EPA registered)
- cloquintocet-mexyl (not EPA registered)
- cycloxydim(e) (not EPA registered)
- diclofop-methyl (RUP, Class I)
- florasulam (not EPA registered)
- furilazole (not EPA registered)
- haloxyfop-R-methyl ester (not EPA registered)
- isoxaflutole (RUP)
- lenacil(e) (not EPA registered)
- mefenpyr diethyl (not EPA registered)
- metosulam (not EPA registered)
- paraquat (RUP, Class I)
- propaquizafop (not EPA registered)
- prosulfocarb(e) (not EPA registered)
- s-metolachlor (known water pollutant)

2013 RodenticidesRejected for purchase or use on MEC (with reason for rejection)

- chloralose (alpha) (not EPA registered)
- strychnine sulfate (not EPA registered)

2013 NematocidesRejected for purchase or use on MEC (with reason for rejection)

- chloropicrin (RUP)
- DMDS (dimethyl disulfide) (RUP)
- ethoprop(hos) (RUP, Class I)
- metam ammonium (not EPA registered)
- metam potassium (RUP, Class I)
- metam sodium (RUP, Class I)
- methyl bromide (RUP, Class I)
- phenamiphos/fenamiphos (RUP, Class I)
- sodium tetrathiocarbonate (not EPA registered)

2013 Soil TreatmentsRejected for purchase or use on MEC (with reason for rejection)

- cadusafos (not EPA registered)
- carbofuran (RUP, Class I)
- carbosulfan (not EPA registered)
- chloropicrin (RUP)
- 1, 3 dichloropropene (DCP) (RUP, Class I)
- ethoprop(hos) (RUP, Class I)
- fenamiphos/phenamiphos (RUP, Class I)
- metam ammonium (not EPA registered)
- metam potassium (RUP, Class I)
- methyl bromide (RUP, Class I)
- oxamyl (RUP, Class I)
- sodium tetrathiocarbonate (not EPA registered)

2013 Microbicides/Bactericides Rejected for purchase or use on MEC (with reason for rejection)

- *Aureobasidium pullulans (not EPA registered)*
- *formaldehyde (known carcinogen)*

2013 PERSUAP RECOMMENDATIONS FOR MITIGATING RISKS

2013 Immediate Actions Required for Safety	
1. MEC do repeated IPM, Safe Pesticide Use and Livestock/Dairy Antibiotic Use training & certification, for all project implementers and beneficiary farmers (see Annex 8)	2. Obtain *or subsidize*recommended PPE for all project implementers and beneficiary farmers who will use pesticides (see PPE websites referred to herein)

3. MEC Project ensure that implementers and beneficiary farmers do use only pesticide containing AIs shaded green or yellow (with conditions below in List 2) in Annex 7 and do not procure or use on demonstration farms pesticides containing the Active Ingredients shaded red in Annex 7	4. MEC Project make efforts to obtain, as available, copies of the Material Safety Data Sheets (MSDS) for all of the pesticide products commonly used by beneficiary farmers on MEC Project-sponsored crops and demo farms

2013 Continuous Actions Required for Safety and BMPs	
5. As Government of Morocco registers pesticides each year, MEC Project check the list of registered pesticides to obtain new pesticide registrations & regulatory changes, and amend this PERSUAP with the changes	6. MEC Project implementers ensure that farmers on demo farms use PPE and apply pesticides only during the appropriate times of day (late afternoon, low wind, no rain)
7. For all demonstration farms and activities, MEC Project implementers continue to introduce pesticide record-keeping concepts and tools following GlobalGAP procedures	8. MEC Project ensure that implementers and farmers on demo farms use pesticides following all safe use practices and pesticide label instructions and warnings

2013 Program Management Actions on Compliance	
9. MEC Project monitor beneficiary farmers for their understanding and use of IPM and pesticide best practices	10. MEC Project report on monitoring in Annual Reports to USAID, under a heading titled "Environmental Mitigation and Monitoring"
11. MEC Project implementers report to USAID on any changes in Morocco pesticide regulations and registrations	12. MEC Project annually amend this PERSUAP to contain new IPM tactics and any new pesticides registered or available
13. MEC Project write the names of pesticides that cannot be used on USAID-funded sites into any future grant or sub-contract	14. MEC Project environmental staff draft an EMMP containing pesticide issues identified in the SUAP, with ways to mitigate these

SECTION 1: INTRODUCTION

1.1 USA AND USAID ENVIRONMENTAL REGULATIONS

The following table provides milestones in the development of USA and USAID environmental regulations, first for the USA, and then adapted for US-supported projects in other countries.

Year	Cause	Year	Effect
1940s	Rush to develop synthetic pesticides in USA	1947	USA Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) enacted; United States Department of Agriculture (USDA) given responsibility for regulating the production and sales of pesticides
1960s	Large-scale environmental issues became apparent in the USA	1970	USA National Environmental Policy Act (NEPA) signed into law January 1[1]; USA EPA (Environmental Protection Agency) created July 9[2]
1972	Following EPA's formation, FIFRA underwent a major revision	1972	FIFRA transferred the responsibility for pesticide regulation from USDA to the EPA
1972-73	Pakistan malaria reaches epidemic proportions[3]	1975-76	USAID & WHO (World Health Organization) launch Malaria Control Program in Pakistan[4]
1975-76	Over 2,800 Pakistan malaria spray personnel poisoned (5 to death) by insecticide mishaps[5]	1975-76	Law suit brought by a coalition of environmental groups against USAID for lack of environmental procedures for overseas projects

[1] http://www.epa.gov/history/topics/nepa/01.htm

[2] http://www.epa.gov/history/org/origins/reorg.htm

[3] http://www.emro.who.int/rbm/CountryProfiles-pak.htm

[4] Malaria control and long-term periodicity of the disease in Pakistan, *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 1980, Volume 74, Issue 5, Pages 624-632, J.de Zulueta, S.Mujtaba, I.Shah; http://linkinghub.elsevier.com/retrieve/pii/0035920380901534

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

1975-76	Law suit brought against USAID	1976	USAID, in response to law suit, drafts Part (Regulation) 216, Agency Environmental Procedures in Title 22 of the CFRs (Code of Federal Regulations)
1976-79	Revised regulations on NEPA issued by the President's Council on Environmental Quality (CEQ)	1979	Executive Order No. 12114 of January 1979, on the application of the NEPA to extraterritorial situations—Regulation 216 updated

In 1972, after FIFRA transferred the responsibility for pesticide regulation to the EPA, the old emphasis on strict regulation of production and sales of pesticides was shifted more toward a new emphasis on protecting the environment and public health. In addition to developing best practices for the safe use of pesticides, the law required examining pesticide acute and chronic health risks, ground water contamination, and environmental impacts.

1.2 REGULATION 216

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

Regulation 216.3 (b)(1) subpart (i), notes "When a project includes assistance for procurement or use, or both, of pesticides registered for the same or similar uses by USEPA without restriction, the Initial Environmental Examination for the project shall include a separate section…" That separate section has become a PERSUAP.

The interpretation of "without restriction" is that approved pesticide products will not be Restricted Use Pesticides (RUP), regardless of RUP criteria or basis (the reason they are designated as RUPs). It is important to note that RUP products may be designated as such, by EPA, due to either: 1 – Inordinate risk (hazard) to users; or 2 – Inordinate risk to the environment; or 3 – Sometimes both. Regulation 216 considers this distinction and deals with it in subparts (ii) and (iii). Thus, unless an EA is written (see below), RUP pesticides are to be rejected for procurement and use by USAID projects and their implementers.

Pesticides rejected by a PERSUAP include pesticides not EPA registered, designated by EPA as RUP, Class I chemicals too toxic for untrained and unprotected people (the majority of USAID beneficiaries) to procure and use, known carcinogens regardless of dose, and known water pollutants.

Regulation 216 goes on to state: "In those cases where the evaluation of the proposed pesticide use in the Initial Environmental Examination indicates that the use will significantly affect the human environment [not EPA registered, RUP, Class I, carcinogen regardless of dose, water pollutant], the Threshold Decision will include a recommendation for the preparation of an Environmental Assessment or Environmental Impact Statement, as appropriate."

Thus, any USAID project desiring to procure or use any of the pesticides that were rejected in a PERSUAP analysis, in this case those listed below in list 3, or with conditions other than those in list 2, will need to write a Scoping Statement and an Environmental Assessment, or EA. This EA would go into much greater detail about proposed uses of a desired chemical or chemicals, relative risks, and appropriate mitigation measures required, if available and appropriate.

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

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

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

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

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

1.4 INTEGRATED PEST MANAGEMENT—USAID POLICY

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

A good definition of IPM from OECD[6] as follows:

> "Integrated pest management (IPM) is an approach to the management and control of agricultural pests which relies on site- and condition-specific information to manage pest populations below a level that causes economic injury and that minimises risks to humans and the natural environment.

[6] http://stats.oecd.org/glossary/detail.asp?ID=1379

Although any among a wide range of pest control agents may be used (including chemical sprays), IPM generally stresses the use of alternatives, such as crop rotations, mechanical cultivation, and biological agents, where such methods are deemed to be effective."

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

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

IPM can include possible pest management techniques and tools including:

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

1.5 MOROCCO 2013 PERSUAP UPDATE METHODOLOGY

During January and February 2013, consultant collected updated information on crops, pests, IPM, 2013 registered pesticides, pesticide and antibiotic risks, and mitigation of those risks. The findings are presented in this 2013 PERSUAP update report.

SECTION 2: BACKGROUND

2.1 COUNTRY BACKGROUND

Morocco sits on the northwestern corner of Africa, across the Gibraltar Straights from Spain. It is bordered on the south by Western Sahara and Mauritania and on the east by Algeria.

According to Encyclopedia of Nations[7] "Some 9,895,000 ha (24,451,000 acres), or 22.1% of the total land area, is arable (excluding the southern provinces). About 43% of arable land is devoted to cereals, 7% to plantation crops (olives, almonds, citrus, grapes, dates), 3% to pulses, 2% to forage, 2% to vegetables, 2% to industrial crops (sugar beets, sugar cane, cotton) and oilseeds, and 42% was fallow. The bulk of the indigenous population carries out traditional subsistence farming on plots of less than five hectares (12 acres). A temperate climate and sufficient precipitation are especially conducive to agricultural development in the northwest. In 2001, agriculture (together with forestry and fishing) accounted for 16% of GDP."

"Morocco is essentially self-sufficient in food production. Recently, an irregularity in rainfall has necessitated the importation of grains during drought years. As a result of the worst drought in decades, Morocco's cereal crop in 1995 was only one quarter of the average annual amount during the previous 10 years. Pulse, vegetable, and citrus production were also devastated. However, in 1996 Morocco received the highest levels of rainfall in 30 years, leading to record grain production. The principal export crops are citrus fruits and vegetables. The estimated output of principal crops (in thousands of tons) in 1999 was as follows: sugar beets, 3,233; wheat, 2,154; barley, 1,474; sugarcane, 1,373; tomatoes, 857; potatoes, 1,148; oranges, 874; olives, 386; corn, 136; broad beans, 100; garbanzos, 28; sunflowers, 49; and peanuts, 40."

"The government distributed some 500,000 hectares (1,235,500 acres) of farmland formerly owned by European settlers to Moroccan farmers in the late 1960s and the 1970s. To encourage Moroccans to modernize the traditional sector, the Agricultural Investment Code of 1969 required farmers in irrigated areas to meet the minimum standards of efficiency outlined by the government or lose their land. These standards applied to all farms of five hectares (12 acres) or more."

"Dams and irrigation projects were begun under French rule and have continued since independence. In traditional areas, irrigation is by springs and wells, diversion of streams, and tunnels from the hills, as well as by modern dams and reservoirs. There are dams and irrigation projects on most of the country's major rivers, including the Sebou River in the northwest, which, along with its tributaries, accounts for some 45% of Morocco's water resources. Continued widespread variation in rainfall continues to produce serious droughts and occasional flash floods. In January 1994, the Kuwaiti Economic Development Fund agreed to lend $60 million to the Moroccan government to help finance an irrigation project in the Haouz and Tassaout region of southern Morocco, which will provide irrigation services for 200,000 small farmers. Morocco had 1.29 million irrigated hectares (3.2 million acres) of agricultural land in 1998."

[7] http://www.nationsencyclopedia.com/Africa/Morocco-AGRICULTURE.html

Agricultural Situation

Agriculture represents 15 percent of the GDP and thus impacts heavily on the economy as a whole. Nearly 40 percent of the labor force is in agriculture. Grains account for over 60 percent of agricultural production and area planted to wheat has expanded dramatically over the last 20 years because of the government support.

Moroccan agricultural production depends heavily on rainfall as less than 10 percent of the arable land is irrigated. Agriculture can be divided in three major sectors: 1) Modern, private, irrigated, highly capitalized, and export oriented farms producing mostly fruit and vegetables 2) Agriculture within reorganized large scale dam-irrigated perimeters producing mostly dairy, sugar crops, seeds, fruit and vegetables mostly for the local market 3) Rain-fed agriculture with more favorable land in the northwest (growing mostly grains, olives, pulses, red meat and dairy) and less favorable land in the south and east (growing mostly grains and non-intensive sheep production).

For many commodities (wheat, dairy products, corn, soybeans, sugar), Morocco will continue to depend on imports even during years when rain is plentiful. In contrast, for other commodities such as feed, pulses, dairy cattle, the import market will fluctuate dramatically depending on rainfall.

The lack of clear agricultural policy and the prevalence of small farms (75 percent are less than 12 acres, with an average herd of four cows per farm) complicated inherited land status, and the increasing land prices pose serious challenges to agricultural policy makers. Policy makers struggle with the conflicting underlying principles of economies of scale and capitalization requirements necessary to modernize the agriculture sector and the desire to alleviate poverty and maintain the social structure of the traditional rural society.

Agriculture suffers from the lack of public investment in research and development, marketing infrastructure, weak institutional capacity including lack of an effective extension service to transfer suitable technologies to small holders, lack of market information, and weak farmer organization in most sectors.

A new minister of agriculture was appointed in late 2007 and it appeared that he had a mandate to revitalize Moroccan agriculture, and encourage investment, both foreign and domestic.

Agricultural Trade

Morocco imports each year some $2 billion in agricultural products and exports about the same value mostly to Europe. The United States exported on average $290 million over the last five years consisting mostly of bulk commodities including corn, wheat, feed, soybeans, and soybean meal. Trade with Morocco has grown sharply over the last four years. The US share of the consumer oriented product market has been very small mostly because of the high freight compared to the EU origin.

Morocco's exports to the United States, while historically low, also grew under the FTA to $130 million, but still not a significant share of the total as Europe is Morocco's principle market.Because of its proximity to Europe, Morocco's trade is overwhelmingly concentrated on the EU market (over two-thirds of exports). On average, Morocco exports some $1.3 billion dollars of agricultural and food products to the EU and imports some $726 million from the EU per year.

Moroccan agricultural exports consist mostly of seafood, fruit (citrus), and vegetables (tomatoes). US-Morocco FTA provides the United States with an important competitive edge, especially in the medium and long term. Since its implementation in January 2006, the FTA has already resulted in the United States recapturing significant market share in many products and in an introduction of many new products to Morocco from the United States. The situation is likely to improve as the preference becomes substantial with the progressive phasing down of duties.

The absence of direct shipping lines between Morocco and the United States and the relatively low income are likely to continue to result in Morocco being mostly a market for bulk commodities (grains, feed, semi-finished products). However, because of the high duties on most commodities, some importers might start sourcing from the United States as soon as the preferential duties permit.

MEC Regions

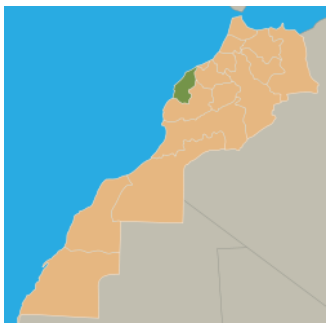
Activities in support of improved water use for sustainable agriculture will focus on the Doukkala and the Oriental regions.

Doukkala-Abda Region is situated in west-central Morocco. It covers an area of 13,285 km² and has a population of 1,984,039 (2004 census). The capital is Safi (south of Rabat, on Coast).

The region is made up into the following provinces:

- El Jadida Province
- Safi Province

They represent the two natural regions of Doukkala and Abda.



Map: Doukkala-Abda Region

Doukkala is divided in three sub-regions, parallel to the seacoast.

- The "Oulja[8]", along the beach, with garden-crops.
- The "Sahel", some 20 km inside, a stony region, only suitable to sheep grazing.
- The rich plain, with wheat, sugar beets, and intensive cattle breeding.

The plain is subject to flooding. "Warar", a temporary natural lake between Sidi Bennour and Arbaa Od Aamran only fills in rainy years. Its largest surface was noted in 1916, 1966 and 2008. The only mountain to be seen is "Jbel Lakhdar", at the border with the plain of Rahamna.

Oriental Region is situated in northeastern Morocco, bordering Algeria and the Spanish enclave of Melilla. It covers an area of 82,900 km² and has a population of 1,918,094 (2004 census). The capital is Oujda, which is 50km South of Mediterranean, on the Algeria border.

The region is made up into the following prefectures and provinces:

- Berkane Province
- Figuig Province

[8] http://en.wikipedia.org/wiki/Doukkala

- Jerada Province
- Nador Province
- Prefecture of Oujda-Angad
- Taourirt Province

Map: Oriental Region

2.2 PROJECT BACKGROUND

The Morocco Economic Competitiveness (MEC) program was launched in December 2009. The mandate for USAID's Morocco Economic Competitiveness program is to reduce barriers to trade and investment in Morocco, through intense engagement in target regions, which have been defined as Oriental and Doukkala-Abda. MEC defines competitiveness as "sustained increases in productivity." Whether at the national, regional, value chain, or enterprise level, competitiveness depends on the capacity to innovate and upgrade. Taking into account global environmental trends like climate change, degradation, and water scarcity, it is reasonable to assume that tomorrow's competitiveness will be closely linked to environmental sustainability. This may include: adopting new technologies for more efficient resource use; re-thinking business models to value conservation, and investments in new approaches to industrial design, production and the treatments of waste.

Based on an analysis of constraints and opportunities in the target regions, MEC interventions will seek to achieve increases in productivity through:

- Reduced transactions costs for businesses investing in Morocco
- More efficient water use
- Innovation (leading to efficiency and/or upgrading) at key points in the value chain
- Improved training and utilization of Morocco's human resources

The MEC program will seize the opportunity to work at the regional level to identify tangible, short-term improvements to trade and investment: through simplification and removal of regulatory roadblocks affecting business, by contributing to increased productivity in high-potential agricultural and export sectors, and through the implementation of a privately-led, market driven approach to the development and deployment of human resources. Practical, visible, tangible benefits from regional activities will contribute to –and at times, may even initiate - change processes taking place in the longer term and at a larger (national) scale.

The draft Performance Management Plan for MEC defines the anticipated results over the life of the program. The impact target objectives are as follows:

- Reduced non-tariff barriers to trade and investment in target regions, which includes an increase in total production and net value of agriculture products that use water more efficiently in the MEC target regions. This includes opportunities to impact inputs choice and quality.
- Trade and investment improved
- Water used sustainably for agricultural growth, which includes a number of policies and/or regulatory instruments enacted to encourage more efficient use of water resources by farmers and businesses, and number of hectares under improved irrigation practices, like drip.
- Workforce development strengthened, which includes training, including training and employing of new employees and young adults, on agriculture inputs like pesticides.

To date, MEC has submitted an Annual Work Plan and Performance Management Plan, containing the above elements. Further training is being planned for agriculture best practices, which would include pesticide safe use training.

2.3 EVALUATION OF MOROCCO PESTICIDE RISKS

Morocco has an impressive, annually updated, booklet of Morocco pesticide regulations as well as registered pesticides broken down by type or use. In addition, it contains superb information on specific pests of all major crops in Morocco, and which pesticides to use for them. Unfortunately, it does not cover non-pesticide pest management options or IPM. This PERSUAP helps fill this gap.

No pesticides are manufactured in Morocco, although some are formulated (mixed and packaged) in Casablanca. Quality Italian backpack sprayers are available. Very little safety equipment (PPE) is available, and any quality equipment that is available is relatively expensive, generally afforded by the largest farms only.

Also impressive is the fact that no counterfeit or pirated Chinese or Indian pesticides were found in any of the agriculture input stores. This shows that Morocco has strong abilities and resources for enforcing pesticide regulations, which is noteworthy in Africa. And, the agriculture input stores visited were all very clean and neat, without open containers, pesticide smell or evidence of subdividing pesticides into smaller unlabelled containers, common in other African countries.

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

Antibiotic Resistance

Overuse of antibiotics and microbiocides is highlighted in 2013 as a major risk to production and trade in livestock products, especially milk. Antibiotic resistance is a form of drug resistance whereby some or, less commonly, all sub-populations of a microorganism, usually a disease-causing bacteria, are able to survive after exposure to one or more antibiotics; pathogens resistant to multiple antibiotics are considered multidrug resistant (MDR).

Excessive use of antibiotics on livestock leads to intense selection pressure for disease-causing microbes to evolve resistance, not to mention wasting valuable inputs and polluting the environment. Antibiotics also accumulate in meat and milk, which are then consumed by humans. Repeated exposure to these antibiotic residues and resistant bacteria threatens human health, and can damage

trade in these meat and milk products.

Repeated training of farmers may help reduce overuse of antibiotics. Tighter control by government authorities may also limit access to antibiotics. Ironically, the lever that may cause farmers to reduce the use of antibiotics may be the loss of export markets as they test and begin to reject antibiotic-laden milk and meat products from Morocco.

2013 Factors that indicate *increase* risks from pesticides:

- Insecticide endosulfan, a highly politicized cotton chemical recommended for addition to international POPs and PIC lists, and being phased out in the USA, is still readily available
- Many beneficiary farmers have limited knowledge and understanding of the pesticide sector in Morocco, and to some extent the IPM measures to use to prevent or reduce these pests
- Lack of knowledge by many farmers of the acute and especially chronic human health risks of individual pesticides or classes of pesticides
- Many demonstration and small-scale farmers and farm workers have not had sufficient training in best practices for safe pesticide use (PPE, transport, storage, application, and disposal).
- Most beneficiary farmers will not have access to, nor will they be able to afford, and will not use recommended PPE for pesticide application
- Many farmers cannot positively identify specific crop pests beneficial predators, diseases and parasites of pests
- Overuse, improper applications, and routine use of the same pesticides or antibiotics increases risk of the development of pesticide resistance among pests
- Lack of knowledge of when to use a specific pesticide during the life cycle of the pest leads to ineffective pest control, waste of funds, and potential human hazards
- Due to small scale of farm operations (many 2 ha or less), farmers do not have the same economies of scale and resources available in highly-developed countries to manage risk

2013 Factors that *reduce* risks from pesticides

- MEC is working with farmers that are organized under GlobalGAP, which has requirements for safe pesticide use.
- MEC has produced a study of safe pesticide use from 2012 to 2013.
- MOA is well organized with annually updated pesticide regulations, registrations and crop-pest recommendations.
- IPM tactics combined reduce pesticide use. Some IPM precursor tactics and tools, like soil testing, use of manure and mineral fertilizers, drip irrigation and raised-bed production are being used by some farmers, as are IPM tactics such as use of pheromone traps, resistant varieties, certified clean and pesticide-treated seed, mulching to control weeds, and crop residue clean up.
- There are numerous 'natural' pesticide products registered for use in Morocco (see Annex that contain Plant and Spice extracts: capsaicinoids (chili pepper extracts); cinnamaldehyde (cinnamon oil); citronellol (citronella oil); clove oil; ememectin benzoate (botanical extract); limonene (essence of orange); neem/azadirachtin (neem tree oil); pyrethrum (Chrysanthemum extract); rotenone (tropical root extract); Bacterial extracts abamectin,

milbimectin and spinosad; and Bacteria *Aureobasidium pullulans*; *Bacillus thuringiensis*-BT; *Bacillus subtilis*; *Beauveria basiana*; *Paecilomyces fumosoroseus*; *Paecilomyces lilacinus (251)*; *Verticillium lecanii*; and *Trichoderma harzianum*., as well as sulfur and copper products.

- Some pesticide sellers understand the most important crop production pests, pesticides/dosages to use against the pests, risks that come with pesticide use, and the need for PPE
- There is no field evidence of pesticide misuse leading to poisonings of domestic animals or environmental poisoning (like fish kills)
- Various development project activities will involve demonstrations to farmers by well-trained staff, so there is a possibility for the transfer of IPM and safe pesticide use practices

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

2.4 CLIMATE CHANGE AND MOROCCO

According to several reports found on the internet, climate change will impact Morocco in important ways, not the least of which is the increasing demand for, and lack of, fresh water for household, industrial and agricultural use. Resulting water shortages could spark regional conflicts. Diseases such as malaria have increased in recent years and are moving steadily northward in their range.

A 2009 World Bank/FAO report[9]notes "All climate projections point at the development of more arid conditions in the Mediterranean region. Climate projections are based on representations of the world as it might be to the year 2100. The Intergovernmental Panel on Climate Change (IPCC) refers to these representations of the future as *scenarios*, which lead, each one, to very different trajectories for worldwide greenhouse gas emissions. It should however be well understood that the scenarios are neither predictions nor forecasts. The scenarios are families of possible futures; they cover the range of atmospheric conditions which will result from our policy choices, ranging from drastic measures for emissions reduction which would follow rapid adoption of renewable energy, to an acceleration of fossil fuels use, in particular in developing countries."

It goes on to detail "Climate projections on Morocco show gradually increasing aridity because of reduced rainfall and higher temperatures. It is necessary to keep in mind that climate models best predict averages rather than extreme values. This means that if aridity increases, on average, as predicted, there can nonetheless be certain years, sporadically, that will be very rainy. Increased aridity will thus have negative effects on agricultural yields, especially from 2030 onwards. All crops will not be equally vulnerable to climate change. One can note that rainfed crops (non-irrigated) will be particularly affected by climate change."

"If irrigation water continues to be available in sufficient quantities, irrigated crop yields will continue to increase in spite of climate change. It is suggested that the increase in temperature, coupled with irrigation sufficient to satisfy crop water needs, will further the growth of cultivated plants and thus increase harvests of most crops. However, even in the event of increased aridity of the Moroccan climate, the availability of irrigation water is an assumption which still remains to be verified.

[9] ftp://ext-ftp.fao.org/SD/Reserved/Agromet/WB_FAO_morocco_CC_yield_impact/report/WB_Morocco_20091013.pdf

Generally speaking, agricultural yields will remain more or less stable up to 2030, and then will drop rather quickly beyond this date. All the agro-ecological zones will not be affected in the same way by climate change. The *Favorable* and *Intermediate* agro-ecological zones will be most vulnerable to climate change."

2.5 GOOD AGRICULTURE PRACTICES, IPM FOR PROJECT CROPS AND NATURAL RESOURCES TO PROTECT

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

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

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

- Quality hybrid pest- and constraint-resistant treated seed;
- Proper land preparation and tillage such as sowing in raised-bed plantings;
- Soil fertility testing, monitoring and management;
- Water and soil moisture testing and management to avoid salinity, bacterial and chemical contaminants, and soil-borne diseases;
- Nutrient management through use of combinations of biological and mineral fertilizers;
- Organic matter management through use of manures, composting, and mulching;
- Proper pesticide choice, storage, use and disposal.

Natural resources need to be protected because they provide critical services to farmers and their crops. These services are detailed below.

Environmental Services Provided to Farmers by Natural Resources

Critical Resource	Beneficial Function
Diverse forest cover	Fruits/nuts/medicines, increase biodiversity, reduce erosion, increase soil fertility, recreation/tourism, purify air, mitigate floods/droughts & maintain watersheds
Quality clean water	Crop irrigation/nutrition, processing agricultural produce, bathing/drinking water services
Rich soil microbial/chemical health	Pest management and plant nutrition services

Fish	Human food, ecosystem web functioning and services
Honeybees	Crop pollination services, proper ecosystem web functioning services
Birds	Field pest management services, proper ecosystem web functioning services
Reptiles	Field pest management services, proper ecosystem web functioning services
Amphibians	Proper aquatic ecosystem web functioning and services
Earthworms	Proper soil fertility and friability services
Mollusks	Human food and aquatic ecosystem services
Crustaceans	Human food and aquatic ecosystem services
Aquatic insects	Proper aquatic ecosystem web functioning and services
Plankton	Proper aquatic ecosystem web functioning and services

SECTION 3: PESTICIDE EVALUATION REPORT

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

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

3.1 FACTOR A: USEPA REGISTRATION STATUS OF THE PROPOSED PESTICIDE

Morocco Economic Competitiveness Project activities are effectively limited to mentioning during training, promoting, recommending or permitting on demonstration farms or activities pesticides containing active ingredients (AIs) in products registered in the host country and in the US by the EPA for the same or *similar* uses. Emphasis is placed on "similar use" because a few of the crops and their pest species found overseas are not present in the US, and therefore pesticides may not be registered for the exact same use, but often are registered for similar pests and pest situations.

The USEPA now categorizes pesticides as either "registered" or "not registered." Moreover, some pesticide AIs and products containing them are labeled as Restricted Use Pesticides (RUPs). In the USA, the pesticides and active ingredients that are labeled RUPs can only be sold to and used by certified applicators or persons under

THE 12 PESTICIDE FACTORS

Factor A. *USEPA Registration Status of the Proposed Pesticides*

Factor B. *Basis for Selection of Pesticides*

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

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

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

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

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

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

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

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

Factor K. *Provision for training of users and applicators.*

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

their direct supervision, and only for those purposes covered by the applicator's certification (such as for row crops, or tree crops, or structural pests and so on).

It is important to note that in many cases EPA's intent for restriction is based upon a large scale of synchronous pesticide use and production found in the USA, often hundreds or thousands of hectares, where pesticide errors can magnify risks and impacts. In developing countries like Morocco, scale is often no more than 2 hectares, with scattered and asynchronous pesticide applications that are much less likely to lead to the same magnitude of errors and impacts. Thus, USAID considers such RUP pesticides very carefully, with an eye on EPA's intent and issues of scale.

The USEPA classifies pesticides according to actual toxicity of the formulated products, taking–formulation types and concentrations into account, thus generally making the formulated product less toxic than the active ingredients alone. This method of classifying acute toxicity is more accurate and representative of actual risks encountered in the field. By contrast, the WHO acute toxicity classification system is based on the active ingredient only (see Annex 6 for a comparison of USEPA and WHO acute toxicity classification systems), and although WHO deals primarily with pesticides used in health applications (e.g., indoor residual spraying for elimination of malaria vectors), the classification has been adopted more generally by the UN to include agricultural pesticides.

Annex 7 of this PERSUAP lists and analyzes all AIs in all pesticides registered by Morocco as of late 2012, early 2013. It provides the current (early 2013) EPA registration status for each AI and shows if that AI is contained in any (all, most, half, few) EPA registered RUP products. It also shows the WHO acute toxicity for each AI, and the EPA acute toxicity *range* for products containing each AI. Furthermore, Annex 7 compiles existing (early 2013) scientific information on serious human chronic health issues with each pesticide AI, such as potential, likely or known carcinogen (PC, LC, KC), endocrine disruptor (ED), reproductive/developmental (RD) toxin,or a likely causal factor in the development of Parkinson's Disease (P).

Issue: Products containing active ingredients not EPA-registered

Annex 7 lists pesticide AIs in products found in Morocco that are not registered by EPA in any products. These are shaded in red, and cannot be used with MEC resources or on MEC demonstration activities, unless an EA is requested and produced. Products and AIs that are not registered by EPA are *not permitted* for use on USAID-supported projects (and therefore cannot be promoted during training or used on Morocco Economic Competitiveness Project demonstration farms). They are either cancelled for use in the USA, have issues, or have insufficient market demand, and have thus not been through EPA's battery of environmental and human health tests.

Recommendations for Mitigation

- MEC Project's beneficiaries do not use pesticide products containing these active ingredients that are not EPA registered.

Issue: Restricted Use Pesticides (RUPs

Annex 7 lists 2013 Morocco registered pesticide AIs, some of which are shaded in redbecause most of the pesticide products containing them are RUPs, and cannot be promoted during training or used on Morocco Economic Competitiveness Project demonstration activities or farms).

Recommendations for Mitigation

- MEC Project's beneficiaries do not use pesticide products that are RUP. For pesticide AIs that contain any of the AIs highlighted in yellow in Annex 7 or in List 2 in the Executive Summary, compare Morocco pesticide formulations with those registered by EPA (and not RUP or Class I or known carcinogen or ground water pollutant) to choose appropriate products. Use http://www.pesticideinfo.org/List_ChemicalsAlpha.jsp to do the searches.

Additional Recommendations for Mitigation

- Do training on GAPs/IPM, the production and use of pest management plans and safe pesticide use and management. Training will introduce beneficiary farmers to: Pesticides not permitted for use, those the project can recommend, and those that might be used with significant training and certification; IPM philosophy, tools and tactics; and Safe Pesticide Use practices including use of basic PPE.
- Get all project offices copies of commonly-used pesticide MSDSs to keep on-hand, with a source of exact information on risks and risk mitigations for each product, and what measures to take in case of an accidental spill, fire or poisoning. MSDS information can also be used during training.
- As this PERSUAP is amended, Morocco Economic Competitiveness Project Managers will need to report to USAID changes to less toxic products on the list of pesticides recommended to USAID.

3.2 FACTOR B: BASIS FOR SELECTION OF PESTICIDES

This procedure generally refers to the practical, economic and/or environmental rationales for choosing a particular pesticide. In general, best practices and USAID – which promote IPM as policy – dictate that the *least toxic* pesticide that is effective is selected. Up until recently, the bases for selection of pesticides have most often been availability, efficacy, and price; not environmental or human safety. Farmers have wanted a pesticide that has rapid knock-down action to satisfy the need to defeat the pest quickly and visibly – they want to see the pest immediately drop on its back with legs twitching and flailing in the air as it dies.

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

As of 2013, Morocco farmers are still using highly toxic soil fumigants, which increase risks of poisoning. USAID resources cannot be used for these increased risk activities.

Issue: Most farmers do not consider factors such as:

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

Recommendations for Mitigation

- Choose and use pesticides with low human and environmental risk profiles (see decision matrix in Annex 7, MSDSs, and pesticide labels), as practical
- Morocco Economic Competitiveness Project staff be aware of biological and naturally derived pesticides, as practical, such as those listed in Annexes 4 and 5, and that are available.

- During training courses, include training on pesticide selection factors based on findings and recommendations of this report, material found in MSDSs and pesticide labels, and material found on pest management websites (like UC Davis IPM site found at: http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html) which can emphasize the importance of pesticide selection factors safety and environment.

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

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

The susceptibility of crop plants to pests and diseases is greatly influenced by the general health of the plant, as discussed above in Section 2.5. Therefore, good crop management practices can strongly affect IPM, and good agronomic or cultural practices are the most basic and often the most important prerequisites for an effective IPM program. A healthy crop optimizes both capacity to prevent or tolerate pest damage while maintaining or increasing yield potential.

Issue: Most Morocco farmers are not aware of all of the IPM tactics available

Among the tactics used include resistant varieties, sanitation, raised-bed, proper water management, monitoring, hand-picking pests, trap crops, crop rotation, proper fertilization, deep plowing, soil solarization, and taking advantage of some naturally-occurring parasites. The analysis shows that there are opportunities as well as areas for improvement among Morocco Economic Competitiveness Project field staff and demonstration farmers.

Annex I shows a Crop-Pest-IPM-Pesticide matrix for each potential crop to be assisted by Morocco Economic Competitiveness Project, most major pests of each crop and a list of tools and tactics used for the same pests in developed countries, and recommended to be tried and adopted. In conclusion, some of the beneficiary farmers, whether or not they understand the IPM philosophy fully, do know about, and use some GAP and IPM tools and tactics. However, there is room for improvement as many tools/tactics remain unused, if not unknown.

Recommendations for Mitigation

- Morocco Economic Competitiveness Project field staff assist with the production of crop and pest-specific Pest Management Plans (PMPs) using the attached Annex I containing Crop-Pest-IPM-Pesticide suggestions for all major pests on all crops, organized by crop phenology or seasonality, and developed into field technical flyers or posters
- During training and field visits by Morocco Economic Competitiveness Project field staff, enhance understanding of, and emphasis on, IPM philosophy, tools and techniques for each crop-pest combination, with synthetic pesticide use as a last resort and choice of least toxic alternatives

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

This section examines how the pesticides are to be applied, to understand specific risks with different application equipment available and application methodologies, and the measures to be taken (repeated training especially of younger future farmers, use of PPE) to ensure safe use for each

application type. Pesticides can and do enter the body through the nose and mouth as vapors, through the skin and eyes by leaky sprayers, mixing spillage/splashing and spray drift, and mouth by accidental splashing or ingestion on food or cigarettes.

Field visits show that most project pesticides will be applied, on smaller farms, by hand-pumped backpack sprayers (liquids) or by hand (powders and granules), or on larger farms, by tractor-pulled tank-pump-hose-power sprayer nozzle. In general, PPE is available and used on larger farms. However, it is not generally used on smaller farms. One farm laborer observed applying pesticides on tomatoes, and not using PPE, felt that he had been exposed sufficiently that he had become immune to the pesticides. Beneficiary farmers supported by Morocco Economic Competitiveness Project should be incentivized to buy and use PPE, even if a subsidy needs to be applied for affordability.

Issue: Leaky back-pack sprayers

Hand-pump backpack sprayers, used by the poorest farmers among others, can and do eventually develop leaks at almost every junction (filler cap, pump handle entry, exit hose attachment, lance attachment to the hose and at the lance handle) and these leaks soak into exposed skin. Clothing serves to wick and holds these pesticides in contact with skin, and concentrates them use after use, until washed.

Recommendations for Mitigation

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

Issue: Pesticide granules and powders applied by hand

Most farmers that use pesticides formulated as granules or powders apply these by hand, without benefit of gloves. In general, very toxic soil pesticides like carbofuran are formulated as Granules in order to make them safer by lessening the risk of inhalation from spraying, and hold the pesticide near the soil. However, if farmers do not use gloves when applying these, as they most often do not, they countermand the safety factor. Gloves should be used for these Granular applications.

Recommendations for Mitigation

- Morocco Economic Competitiveness Project ensures that farmers that use powders or granules do so only with gloves.

Issue: Morocco farmers do not use PPE

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

1. Appropriate PPE (especially carbon cartridge respirators necessary for filtering organic chemical vapors) equipment is generally not available at all and if it is available, it is too expensive.

2. Farmers and workers either discredit or do not completely understand the potential health risks associated with pesticides. Since they have not associated health problems with pesticide exposure they continue to take risks;

3. Climatic conditions (particularly heat) make it uncomfortable to use the safety equipment (despite the fact that it is recommended that many pesticides should be applied very early in the morning when it is cool and there is a lack of wind and rain);

4. Farmers may not understand either the warning labels or pictograms provided on the pesticide labels.

Most pesticide containers, on each pesticide label, either list or put pictograms showing PPE that is recommended for use of that certain product.

Recommendations for Mitigation

- Training under Morocco Economic Competitiveness Project should include descriptions of health risks to spray operators, their families, and their village (see risks for each pesticide AI in Annex 7).
- Training should include advice on minimizing discomfort from wearing PPE, like spraying in early morning before it becomes hot, or late in the afternoon.
- Ensure that (i.e., budget for) protective clothing (carbon-filter respirator mask, gloves, frequently-washed long-sleeved shirt and pants or Tyvec outfit, boots, and goggles if indicated on the pesticide label) recommended for the most commonly-used pesticides are available to farmers and farm workers involved with pesticide use. General examples of PPE to be used for different types of pesticide are found in the following website: http://www.epa.gov/oppfead1/safety/workers/equip.htm.
- Provide training on the need for exclusion times and zones for areas that are being or have been sprayed. Include information about sensitive populations (pregnant women, children, elderly and sick).
- Put into place sprayer equipment maintenance procedures, proper spray techniques that reduce sprayed area walk-through, as well as frequent washing of application clothing.
- Considering illiteracy issues, training should use and explain pictogram representations. Some general mitigation measures to ensure safe pesticide use are contained in Chapter 13 of the following website: http://pdf.usaid.gov/pdf_docs/PNADK154.pdf.
- Set out a schedule for, and budget for, repeated training in safe handling and use of pesticides – including aspects such as types and classes of pesticides, human and environmental risk associated with pesticides, use and maintenance of PPE, understanding information on labels and proper disposal of packaging. Ensure that training 'sticks' by developing a system to certify trained farmers for safe use.

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

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

The pesticide matrix in Annex 7 contains information on acute and chronic human and environmental toxicological risks for every pesticide AI found in Morocco. USAID-supported projects must be limited to EPA-registered pesticides, and decisions should be biased toward those pesticides with lower human and environmental risks. Nevertheless, pesticides are poisons, and nearly all of them present acute and/or long-term toxicological hazards, especially if they are used incorrectly. For instance, the WHO estimates that about 220,000 acute pesticide poisoning occur per year

globally[10]. And, in the Benin cotton sector, farmers are routinely poisoned to death by cotton insecticide endosulfan diverted to use and its subsequent residues on vegetables[11].

Issue: Pesticide Active Ingredients on POPs and PIC lists

The Persistent Organic Pollutants (POPs) and Prior Informed Consent (PIC) Treaties which list banned and highly regulated chemicals, respectively, were not known when Regulation 216 was written, so there is no language directly governing their use on USAID projects. Nevertheless, they present high risks to users and the environment. It is thus prudent that they be discussed. The following websites contain current lists of all POPs and PIC chemicals: http://www.pic.int; http://www.pops.int.

Endosulfan has been nominated for addition to the POPs list (2009) and the recent (June 2010) phase out and ban in the USA will hasten this decision.

Recommendations for Mitigation

- None of these POPs or PIC chemicals, listed on the POPs and PIC websites, and including endosulfan, should be used on Morocco Economic Competitiveness Project beneficiary demonstration farms.

Issue: Class I pesticides, Known Carcinogens, Known Water Pollutants

Annex 7 lists pesticide AIs in products found in Morocco that are contained in most or all EPA registered products containing that AI. These are shaded in red, and cannot be used with MEC resources or on MEC demonstration activities. Products and AIs that are not registered by EPA are *not permitted* for use on USAID-supported projects (and therefore cannot be promoted during training or used on Morocco Economic Competitiveness Project demonstration farms).

Recommendations for Mitigation

- MEC Project's beneficiaries do not use pesticide products that are Class I, known carcinogens, or known water pollutants. For pesticide AIs that contain any of the AIs highlighted in yellow in Annex 7 or in List 2 in the Executive Summary, compare Morocco pesticide formulations with those registered by EPA (and not Class I or known carcinogen or ground water pollutant) to choose appropriate products. Use http://www.pesticideinfo.org/List_ChemicalsAlpha.jsp to do the searches.

Issue: Morocco Economic Competitiveness Project use of lower toxicity pesticides registered by EPA

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

Recommendations for Mitigation of Human Toxicological Exposures

Most pesticide poisonings result from careless handling practices or from a lack of knowledge regarding the safer handling of pesticides. Pesticides can enter the body in four major ways: through

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

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

the skin, the mouth, the nose, and the eyes. Chapter 13 in the resource http://pdf.usaid.gov/pdf_docs/PNADK154.pdf contains measures to reduce risks of exposure via oral, dermal, respiratory and eyes. The time spent learning about safer procedures and how to use them is an investment in the health and safety of oneself, one's family, and others.

- Train farmers and provide posters/flyers on pesticide safe-use BMPs. For each group of farmers to be trained, identify the pesticides most likely to be used on their specific crops, and then identify the human health risks associated with each by using information on pesticide labels, in the attached Annex 7, and on MSDSs.
- Provide training on, and follow basic first aid for pesticide overexposure. Train farm managers and farmers on basic pesticide overexposure first aid, while following recommendations found in Chapter 13 of http://pdf.usaid.gov/pdf_docs/PNADK154.pdf, as well as any special first aid information included on labels and MSDSs for commonly-used pesticides.

Recommendations for Mitigation of Exposures to Environmental Resources

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

Do's

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

Don'ts

- Do not spray over ponds and drainage ditches
- Never wash equipment or containers in streams or where rinse water could enter ponds or streams
- Do not use pesticides with potential or known groundwater risks near drinking water sources, or where the water table is less than 2 meters, and on sandy soils with high water tables
- Do not apply pesticides in protected parks
- Do not use aerial applications near sensitive habitats
- Do not spray when wind speeds are more than 8 to 10 mph
- Do not apply granular pesticides in fields known to be frequented by migratory waterfowl

- Do not apply insecticides from 10 am to 4 pm when honeybees are foraging; insecticides are best applied early in the morning when it is cool with no wind or rain, and when honeybees do not forage

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

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

Issue: Lack of knowledge and information on pesticide effectiveness

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

Resistance of pests to pesticides used on Morocco Economic Competitiveness Project crops will likely occur with increased use. Many farmers over- and under-dose and use non-selective pesticides, all of which increases chances for resistance development. At some point, Morocco Economic Competitiveness Project field staff and demonstration farmers may begin to note that some products no longer work well to control pests in their field, and will likely begin to blame pesticide manufacturers for a weaker product. This could be the development of insecticide resistance, and it could be the result of improper dosing. Farmers should be trained to monitor for the development of insecticide resistance, and Morocco Economic Competitiveness Project implementers should be on the lookout for it during their field visits.

Recommendations for Mitigation

- Through training, Morocco Economic Competitiveness Project field staff increase local knowledge on pesticides available, possibly effective, and present the lowest risk
- Teach farmers to rotate pesticides to reduce the build-up of resistance
- Monitor resistance by noting reduction in efficacy of each pesticide product

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

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

Annex 7 shows the relative known risks to the types of terrestrial and aquatic organisms referred to above for each pesticide AI found in pesticide products registered in Morocco, so that informed product choices can be made if the pesticide is to be used in or near sensitive areas or resources. Most critical are risks to fish, honeybees and birds as well as aquatic organisms.

Issue: Biodiversity, conservation and protected or endangered species

Critical natural resources to be conserved, with listings of the services they provide, are included above in Section 2.5. A Biodiversity Assessment for Morocco has been performed by Ecodit, Inc in 2008[12]. Refer to that document for details on critical resources negatively impacted by agricultural activities and pesticides use and misuse.

Issue: Pesticide Persistence

The effect of each pesticide on non-target ecosystems will depend on how long it stays in the environment, or rather its rate of 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 with exposure to soil microbes and natural chemicals, sunlight and water, there are half-lives for exposure to each of these factors. In the soil, types and numbers of microbes present, water, oxygen, temperature, pH, and soil type (sand, clay, loam) all affect the rate of breakdown. Most pesticides also break down, or photo-degrade, with exposure to light, especially ultraviolet rays. Lastly, pesticides can be broken down, or hydrolyzed, with exposure to water.

Recommendations for Mitigation

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

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

In general, in addition to element G above, this requirement attempts to protect natural resources from the dangers of pesticide misuse and contamination, especially of groundwater resources.

Climate

The climate is Mediterranean in the North and in some mountains (West of the Atlas), which becomes more extreme towards the interior regions. The terrain is such that the coastal plains are

[12] http://pdf.usaid.gov/pdf_docs/PNADN679.pdf

rich and they comprise the backbone for agriculture, especially in the North. Forests cover about 12% of the land while arable land accounts for 18%. 5% is irrigated.

In the Atlas (Middle Atlas), there are several different climates: Mediterranean (with high humidity), Maritime Temperate (with moderate humidity) that allow different species of oaks, moss carpets, junipers, Atlantic cedars and many other plants to form extensive and very rich humid cloud forests. On the east side of Atlas mountains, the climate changes, due to the barrier/shelter effect of these mountainous system, turning it very dry and extremely warm during the summer (that can last several months), especially on the lowlands and on the valleys facing the Sahara. The Sahara is visible in the Draa Valley, where it is possible to find oases, sand dunes and rocky desert landscapes. The climate in this region is hot desert days with cool nights.

Geography

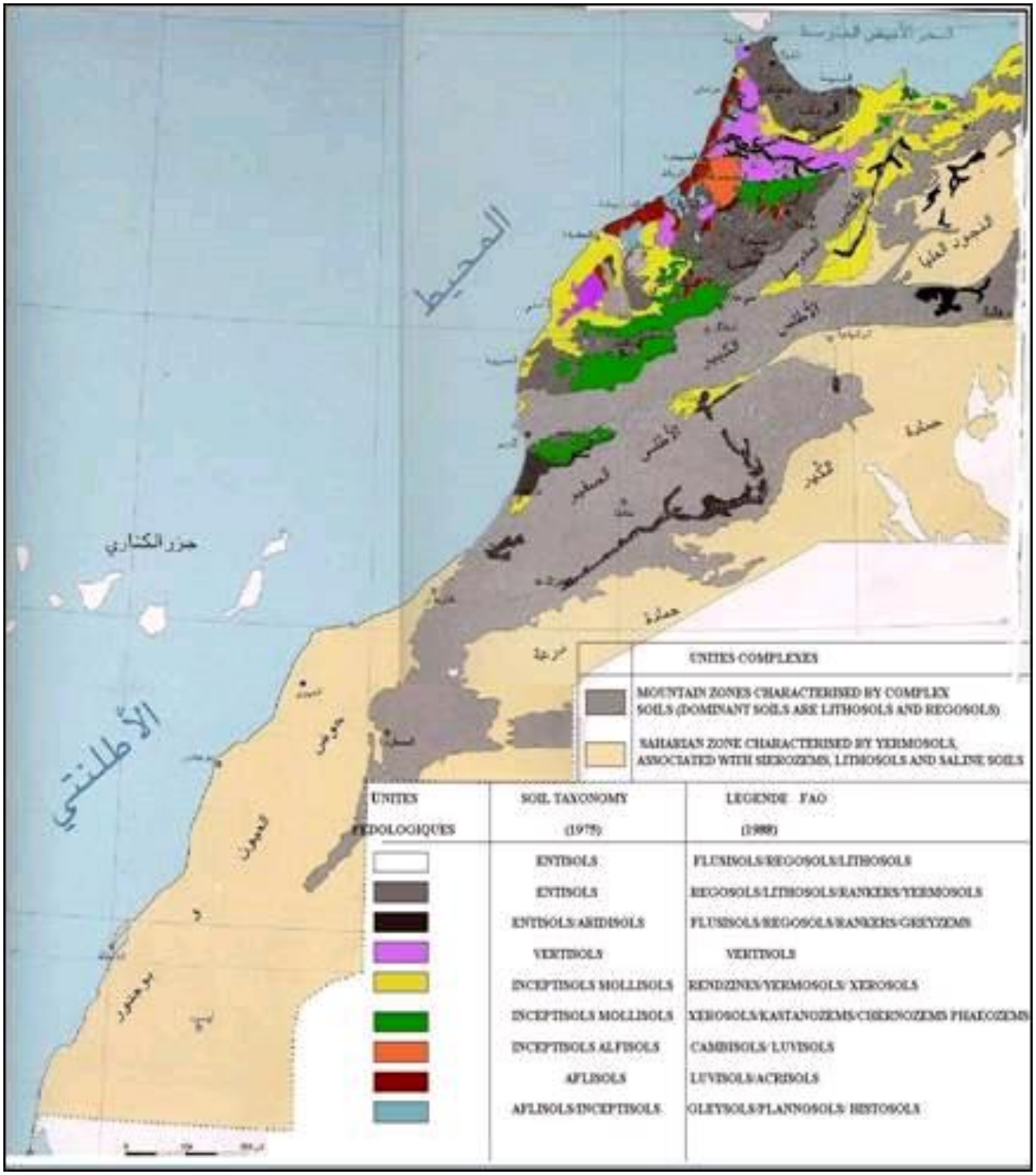
The northern coast and interior are mountainous with large areas of bordering plateaus, intermontane valleys, and rich coastal plains. A large part of Morocco is mountainous. The Atlas Mountains are located mainly in the center and the south of the country. The Rif Mountains are located in the north of the country.

Hydrology

As can be expected, the Atlas Mountains in the south center of Morocco and the Rif Mountains in the north give rise to both above as well as underground river systems. All pesticides should be kept at least 20 meters from water sources.

Soils

The major soil types include: i) yermosols, lithosols, regosols and sierozems which are the dominant type because of mountainous topography and the large area of the Saharan and arid zones; ii) rendzinas; iii) xerosols; iv) vertisols; v) gleysols; and vi) saline soils. See soil map below:



Issue: Pesticide Soil Adsorption, Leaching and Water Contamination Potentials

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

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

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

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

Recommendations for Mitigation

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

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

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

Issue: Natural pest controls availability

Morocco's MOA has registered several natural pesticide products, as follows:

- There are numerous 'natural' pesticide products registered for use in Morocco (see Annexes 4 and 5 that contain Plant and Spice extracts: capsaicinoids (chili pepper extracts); cinnamaldehyde (cinnamon oil); citronellol (citronella oil); clove oil; ememectin benzoate

(botanical extract); limonene (essence of orange); neem/azadirachtin (neem tree oil); pyrethrum (Chrysanthemum extract); rotenone (tropical root extract); Bacterial extracts abamectin, milbimectin and spinosad; and Bacteria *Aureobasidium pullulans*; *Bacillus thuringiensis*-BT; *Bacillus subtilis*; *Beauveria basiana*; *Paecilomyces fumosoroseus*; *Paecilomyces lilacinus (251)*; *Verticillium lecanii*; and *Trichoderma harzianum*., as well as sulfur and copper products.

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

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

Recommendations for Mitigation

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

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

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

Issue: Limited resources to control pesticides

Still, as of 2013, the Ministry of Agriculture in Morocco has somewhat limited research and extension services, due to fiscal tightening. The list of pesticides available contain some very highly toxic chemicals that should not be handled by illiterate, untrained, unprotected and often unaware small-holder farmers like those found throughout Morocco. Most farmers do not have access to and cannot afford PPE in order to follow GAPs.

Issue: Illegal Products from Neighboring Countries

"Leaky" country border crossings, such as through Algeria, could be likely sources of pesticides that are not officially registered in Morocco. Further south, in West Africa in general, some PIC chemicals have been found in formal and informal markets, as have some POPs chemicals. However this study found none of these during site visits.

Issue: Disposal of Pesticide Containers

Some Moroccan farmers retain empty and partially-full plastic pesticide containers. Before disposal, the standard practice has been to triple-rinse the containers, puncture them to discourage re-use, and bury or burn them. Burning plastic bottles and single-use pesticide sachets can lead to the formation of toxic (and POPs) furans and dioxins, and is not recommended. GlobalGAP and other S&C systems require that empty pesticide containers are triple rinsed over a pesticide soak pit with layered soil, lime and carbon, or a bio-active pit, and then properly stored in plastic drums in the field or storage shed, to await disposal or recycling. There are no pesticide container recycling activities occurring anywhere in Morocco. The website http://www.epa.gov/oppfead1/labeling/lrm/chap-13.htm provides recommended pesticide disposal options.

Recommendations for Mitigation

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

3.11 FACTOR K: PROVISION FOR TRAINING OF USERS AND APPLICATORS

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

Issue: Farmers need intensive and repeated training

Training in Safe Pesticide Use and GAP/IPM are of paramount importance for Morocco Economic Competitiveness Project farmers and farm laborers using pesticides. Agriculture activities supported by the Morocco Economic Competitiveness Project should focus strongly on providing GlobalGAP, IPM and safe pesticide use training. In 2013, additional and refresher training are superb means for affecting beneficiary farmer behavior, now, as they continue to expand their agricultural opportunities, and before risky behaviors become further set.

Recommendations for Mitigation

- Implement GAP, IPM and Pesticide Safe Use training for Morocco Economic Competitiveness Project staff and beneficiary farmers.
- Use Annex I to produce and promote the use of Pest Management Plans for farmers to anticipate and better manage primary pests.

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

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

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

Issue: Morocco Economic Competitiveness Project and Farm Record-Keeping

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

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

Issue: Monitoring by Morocco Economic Competitiveness Project Field Staff and Farmers Should Detect:

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

- Any incidences of water pollution.
- Fish, bird, wildlife or honeybee kills.

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

Issue: Morocco Economic Competitiveness Project Planning and Reporting

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

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

Recommendations for Mitigation

- Morocco Economic Competitiveness Project to follow all of the above best practices in monitoring, record keeping, evaluation/analyses and reporting.
- Site managers/agronomists should develop a record-keeping system, which is also a requirement for GlobalGAP and other international market-driven produce certification systems. It is highly recommended that records are kept in an electronic format for easy editing, updating and modification.
- Using Annex 9, Morocco Economic Competitiveness Project staff should put plans for monitoring the environmental and human health impact of production activities, following recommendations found in this PERSUAP into the Annual Action Plans.
- Morocco Economic Competitiveness Project staff keeps records on the implementation of the recommendations found in this PERSUAP, and report on them in Quarterly and Annual Reports, under a heading titled "Environmental Impact Mitigation and Best Practices".

SECTION 4: PESTICIDE SAFE USE ACTION PLAN (SUAP) FOR MOROCCO ECONOMIC COMPETITIVENESS PROJECT

ACTION PLAN TITLE: ACTIONS TO INCREASE AWARENESS OF AND MITIGATE PESTICIDE RISKS ON MOROCCO ECONOMIC COMPETITIVENESS PROJECT SITES

Action Plan Objectives: Reduce risks from pesticides

On the following Action Plan Matrix, insert the start and end dates for each activity or action with the names of those responsible for each action, and a budget. Once this is action plan is completely filled, and actions are under way or done, it can be transmitted to AID to show Regulation 216 compliance progress.

Actions	Start	End	Who	Budget
Reiterating Pesticide Restrictions				
Ensure that beneficiary farmers do not use locally-available insecticides containing banned endosulfan for treating their crops				
Ensure that demonstration farmers do not use pesticide products containing active ingredients shaded in red in Annex 7				
For use of RUP exceptions, ensure that a Morocco Economic Competitiveness Project staff member receives RUP training/certification (on-line or through a US State Extension Service) to teach mitigation to beneficiary farmers				
Annually check and obtain information on new pesticide registrations				

Pesticide Risk Awareness and Mitigation				
Provide annual training for project staff and beneficiary farmers using the training topic list in Annex 8				
Ensure that farmers and farm associations each have 1 or 2 sets of PPE for the group to share; assign responsible PPE caretakers				
Ensure that farmers use PPE and apply pesticides only early in the morning or late afternoon when there is no wind or rain				
Annually test and certify pesticide users on knowledge of human safety and environmental protection				
Good Agriculture Practices/IPM				
Test pest-specific crop-pest-IPM-pesticide information in Annex 1 with beneficiary farmers for field use, validation, modification or adaptation				
Use information in Annex 1 to produce crop-specific production PMPs, and then field reference guides or posters for farmers to use to anticipate and manage pests				
Test artisanal and commercially-available natural chemicals listed in Annexes 1, 4 and 5 respectively, as available				
Follow GlobalGAP standards and website http://www.epa.gov/oppfead1/labeling/lrm/chap-13.htm for empty container disposal and pesticide record-keeping				
Project Management Responsibilities				
Define and assure safe use practices				
Define appropriate methods of pesticide handling, storage, transport, use and disposal				

Keep copies of the current list of pesticide AIs analyzed by this PERSUAP at all project sites				
Collect and keep copies of MSDSs for each commercial pesticide that beneficiary farmers use at all project sites				
Keep copies of prohibited pesticide products containing active ingredients shaded in red in Annex 7 at all project sites				
Keep PERSUAP recommendation implementation records and report on them in Annual Reports, under a heading titled "Environmental Compliance and Best Practices"				
Provide for enforcement				

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

Action Plan Discussion:

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

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

ANNEX 1. MATRIX OF 2013 USAID MEC SUPPORTED CROPS WITH MAJOR PESTS, PREVENTIVE IPM TOOLS AND CURATIVE IPM TOOLS

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
For all crops		
For all crops and pests	• Do soil tests for soil structure, pH, macronutrient & micronutrient levels for precision soil amendment targeting • Regularly test soil moisture levels in order to manage soil-borne diseases and reduce amount of irrigation water needed, use drip irrigation • Use raised-bed production to better manage water use, soil moisture and speed seedling growth • Use minimum and no-tillage, cover crops, terracing and contour plowing to conserve soil • Use organic mulches and cover crops to suppress weeds, conserve irrigation water, manage soil moisture, and thus protect soil from rapid salinization • To add nitrogen and structure to the soil, rotate with nitrogen-fixing legume crops, use inter-planting with legumes, green manures and agroforestry techniques Make and use compost; this will increase soil organic matter and nutrition, decrease soil-borne pathogens, sequester carbon, hold moisture and decrease	• A combination of natural pesticides (extracts from plants, bacteria, spices like chilies and garlic, horticultural oils, soaps, particle films like diatomaceous earth and kaolin, sulfur and copper compounds, bio stimulants and elicitors of plant resistance).

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
	need for increasingly more expensive synthetic nitrogen fertilizers derived from fossil fuels	
Potato (pomme du terre)		
Click beetle/Wire worm (*Agriotes* species)	• Avoid fields with a history of wireworm damage. • Avoid planting strawberries in fields immediately following clover, grass, pasture, or weedy alfalfa. • Summer fallow will reduce wireworm numbers by drying the soil. • Low-lying, sandy fields tend to have the most problems, and click beetles seem to return to the same fields to lay eggs. • Use good soil tillage practices.	• Wireworms are difficult to control without use of Class I chemicals (the most toxic).
Potato tuber worm moth (teigne) (*Phthorimaea operculella)*	• Use pheromone traps. • Shallow setting varieties are generally more susceptible than varieties that set tubers deep. • Any practice that reduces the exposure of tubers to egg-laying female moths will reduce tuberworm damage. • Prevention of soil cracking in the beds will reduce tuberworm damage. Thus, Furrow-irrigated fields have a much greater potential to become infested than sprinkler-irrigated fields (cracking of the soil is less severe under sprinkler irrigation than with furrow irrigation). • Prompt, thorough harvest and sanitation are also essential. • Sanitation: Destroy cull piles and volunteer potatoes. Piles of cull potatoes provide a year-round breeding site for tuberworm.	• Use natural sprays of the Entrust formulation of spinosad. • Use synthetic insecticides containing indoxacarb (Avaunt) or novaluron (Rimon).
Tomato plant borer, *Tuta absoluta*	• Use resistant varieties. • Rotation with non-solanaceous crops. • Adequate fertilization. • Dor proper irrigation. • Sanitation: Destruction of infested plants and of post-harvest plant debris.	• Can use pesticides containing abamectin, permethrin, cartap hydrochloride
Late blight (*Phytophthora*	• Use tolerant varieties. • Drain the growing area adequately before planting.	• Use synthetic fungicides containing azoxystrobin, copper sulfate, mancozeb, chlorothalonil, dimethomorph,

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
infestans)	• Follow proper planting date; do not plant late. • Farmers use sticks and lines to raise tomato plants and fruit into the air to aerate the plant and raise the leaves and fruit away from the soil.	pyraclostrobin.
Early blight (*Alternaria solani*)	• Maintain good soil drainage.	• Can use fungicides containing azoxystrobin, propiconazole or iprodione.
Root Knot Nematodes (*Meloidogyne* species)	• Use of resistant cultivars and grow healthy plants (use appropriate seed, spacing, watering, weeding and fertilizer) • Use Soil solarization using plastic. • Use crop rotation, deep plowing, fallowing and avoid mono cropping. Rotate with broccoli, cauliflower, sorghum, Sudan grass, rape, and mustard seed which are resistant to nematodes. • Sanitation: Remove and compost crop debris. • Use of organic fertilizer particularly chicken manure and composts to add organic matter and soil structure to sandy soils • Growing flax, a tropical herb, is good for controlling root knot nematodes. • African and French marigold (*Tagetes minuta* and *T. patula*, respectively) plowed under the soil also suppress and reduce nematodes. Plant and plow into soil 2 months later.	• Management of nematodes is difficult, especially in sandy soils. • Botanical and homemade water extracts of basil, garlic and neem seed may be effective controls. • Two new commercialized products, once registered for use, can be used as effective nematode controls: the microbe *Myrothecium verrucaria* and natural soil biopesticide labeled as Promax (containing extracts of tomatillo oil and thyme oil)
Tomato (tomate)		
Tobacco white fly (*Bemisia tabaci*) and Greenhouse whitefly (*Trialeurodes vaporariorum*)	• Controlled in nature by hymenopteran parasitoids (*Encarsia* species), lady beetles and minute pirate bugs. • Monitoring crops and establishment of a pesticide program after finding 1 white fly per 10 plants, spraying may be used. • Yellow sticky traps may reduce populations but cannot prevent the spread.	• Spray natural solutions of insecticidal soap, horticultural oil, neem oil or *Beauveria bassiana* if the infestation is heavy. • Treat soil with synthetic systemic insecticides containing imidacloprid or thiamethoxam (do not use during flowering). • Spray with synthetic insecticides containing acetamiprid (do not use during flowering).

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Aphids (*Aphis* species and *Myzus* species)	• Aphids are attacked by a number of common predators and parasitoids and are susceptible to a fungal disease that commonly attacks aphids. Common predators include green lacewing, lady beetles and larvae, and Syrphid fly larvae. • Use yellow sticky traps to monitor. • Keep fields, ditch banks, and fence lines weed-free. • Sanitation: Clean weeds from field and field margins. Disc under or compost all crop residues after harvest. • Do not plant next to cotton.	• Can use natural insecticides containing neem, vegetable and mineral oils, or soaps. • Can use synthetic insecticides containing imidacloprid or thiamethoxam.
Red spider mite (*Tetranychus* species)	• Spider mites have many natural enemies that often limit populations; predacious mites and some insect feeds on spider mites, eg (*Phytoseiulus persimilis* and *Amblyseius spp*); the major predator mites commercially available for purchase and release. • Do weed control in and around field. • Adequate irrigation is important because water-stressed trees are most likely to be damaged.	• Broad-spectrum insecticide treatments for other pests frequently cause mite outbreaks, so avoid these when possible. • Natural insecticidal soaps or agricultural oils and neem extracts can be used for management (apply especially on the undersides of leaves). • Use of synthetic insecticides containing abamectin.
Tomato plant borer, *Tuta absoluta*	• Use resistant varieties. • Rotation with non-solanaceous crops. • Adequate fertilization. • Dor proper irrigation. • Sanitation: Destruction of infested plants and of post-harvest plant debris.	• Can use pesticides containing abamectin, permethrin, cartap hydrochloride
Alternaria, *Alternaria solani*	• Use of tolerant varieties. • Use of raised-bed planting system. • Maintain good soil drainage.	• In addition to copper sulfate, rotate fungicides containing chlorothalonil, triazole fungicides (epoxiconazole, tebuconazole, propiconazole, etc.) and strobilurin fungicides (azoxystrobin, tryfloxystrobin, pyraclostrobin)
Bacteriose (Bacterial	• Use raised-bed production and monitor soil moisture • Sufficiently drain the growing field	• Can use combinations of copper hydroxide with mancozeb (which increases the efficacy

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
blights), *Xanthomonas spp.* *Pseudomonas spp.*	• Monitor the field frequently and remove dead and dying plants that are full of inoculum.	of copper).
Late blight (*Phytophthora infestans*)	• Use tolerant varieties. • Drain the growing area adequately before planting. • Follow proper planting date; do not plant late. • Farmers use sticks and lines to raise tomato plants and fruit into the air to aerate the plant and raise the leaves and fruit away from the soil.	• Use synthetic fungicides containing azoxystrobin, copper sulfate, mancozeb, chlorothalonil, dimethomorph, pyraclostrobin. •
Gray mold (Botrytis cinerea)	• Sanitation: Remove and destroy plants severely infested. • Avoid unnecessary late irrigations. • Keep the tops of beds dry when fruit is present.	• Can use natural fungicides containing neem oil, *Bacillus subitlis*, or potassium bicarbonate. • Can use synthetic fungicides containing chlorothalonil or iprodione
Fusarium blight, *Fusarium oxysporum*	• Use tolerant varieties and raised-bed production. • Sufficiently drain the growing field and monitor soil moisture. • Use sticks and lines to raise plants and fruit into the air to aerate the plant and raise the leaves and fruit away from the soil.	• Use fungicides containing dimethomorph, fenamidone,copper sulfate, metalaxyl, mancozeb and chlorothalonil.
Oïdium (Powdery mildew) *Oidiumlycopersici*	• This powdery mildew is generally not severe in coastal fields and control measures are usually not warranted. Greenhouse-grown tomatoes, however, can suffer to the point of severe economical damage. • Use of resistant seeds. • Transplanting healthy plants. • Crop monitoring. Early disease detection is important for successful powdery mildew control. • Conduct a thorough year-end clean up and dispose of all crop debris off-site or by burning, burying in a landfill, or better—composting. • Pruning old and dead leaves, branches.	• Registered fungicides, such as sulfur, may be required to control the disease in the greenhouse. Begin applications when the disease first appears. • If necessary, use protectant products in the following fungicide families: copper, mancozeb, azoxystrobin, metalaxyl, clorotalonil, or these in combination with fosetyl-aluminum.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Bell pepper (poivron)/ Paprika		
Acariens (Spider mites) *Tetranychus urticae*, *T. cinnabarinus*, *T. evansi*	• Use adequate irrigation. • Remove heavily infested plants. • Crop monitoring • Adequate irrigation is important because water-stressed plants are most likely to be damaged. • Destroy weeds and host crops in and near field. • Sanitation: Clean plants and debris from previous crops.	• Sprays of water, insecticidal oils, or soaps can be used for management. • Oils and soaps must contact mites to kill them so excellent coverage, especially on the undersides of leaves, is essential and repeat applications may be required. • Use synthetic miticides containing abacmetin, diafenthiuron or dicofol.
Mineuse (leaf miners), *Agromyzid spp*	• Natural enemies, especially parasitic wasps naturally reduce populations of leaf miners. • Sanitation: Post-harvest, disc under crop residues. • Do not plant next to spinach. • Destroying vegetation along fencerows and ditch banks surrounding long bean fields helps to reduce influx of bean leafhoppers. • Crop monitoring. Is important that farmer inspects the entire area to locate the presence of pests.	• Use natural sprays of azadirachtin and spinosad. • If needed, sprays of abamectin, cyromazine and pyrethrin may be used.
Noctuelles (Night moths, armyworms, cutworms), *Spodoptera spp* *Agrotis spp*	• Check for cutworms in weeds around the edges of the field before planting. Remove weeds from field margins and plow fields at least 10 days before planting to destroy larvae, food sources, and egg-laying sites. • After the crop is up, check for a row of four or more wilted plants with completely or partially severed stems. If you find damaged plants, look for cutworms by digging around the base of plants and sifting the soil for caterpillars. • If substantial numbers of cutworms are found, baits can be used for control • Do weed control near and in field.	• Can use natural insecticides containing BT kurstaki &aizawai products or spinosad. • Can use synthetic insecticides containingcarbaryl, indoxacarb for control.
Puceron (Aphids), various species	• Use of resistant seeds. • Crop rotation. • Crop monitoring before spraying.	• If needed, use products containing imidacloprid, acetamiprid (not during flowering) or pymetrozine.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Aphis spp	• Cleaning and disinfecting machinery and tools. • Integrated crop management. • Host freed periods conserve natural enemies. • Use pesticides only when it necessary after a monitoring program. • Plant away the alternate host plants. • Destroy weeds and host crops as soon as possible, including the head rows.	
Thrips, various species	• Monitor using blue sticky traps. • Crop monitoring for thrips. • Transplanting healthy plants. • Destroy weeds and alternate host crops. • Sanitation: Clean plants and debris from previous crops.	• The following natural insecticides may control thrips: *Beauveria bassiana*, *Trichoderma harzianum*, abamectin, neem extract, potash soap and spinosad. • Can use synthetic insecticides containing acetamiprid, imidacloprid, thiamethoxam, or permethrin.
Fusariose (Fusarium)	• Use of resistant seeds. • Crop monitoring • Transplanting health plants. • Use raised-bed. • Destroy weeds and host crops. • Sanitation: Clean plants and debris from previous crops.	• Can use Silvacur (tebuconazole), Stratego (trifloxstrobin + propiconazole), thiabendazole, Ridomil (mancozeb) and Rovral (iprodione)
Oïdium (Powdery mildew)	• Use of resistant varieties. • Transplanting healthy plants. • Pruning old leaves, branches. • Crop monitoring. Early disease detection is important for successful powdery mildew control. • Improve greenhouse climate to reduce relative humidity and increase air circulation • Conduct a thorough year-end clean up and dispose of all crop debris off-site or by burning, burying in a landfill, or composting.	• If necessary, use protectant products in the following fungicide families: copper, mancozeb, azoxystrobin, metalaxyl, dithiocarbamatos, clorotalonil, and fosetyl-aluminum.
Beans: Green beans (haricot vert), White bean (haricot blanc), Faba beans (feve)		

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Acariens (Spider mites) *Tetranychus urticae*, *T. cinnabarinus*, *T. evansi*	• Use crop rotation. • Use adequate irrigation. • Spider mites have many natural enemies that often limit populations. • Adequate irrigation is important because water-stressed plants are most likely to be damaged. • Control measures include scouting the fields and removing severely affected plants. • Apply water to pathways and other dusty areas at regular intervals. Water-stressed trees and plants are less tolerant of spider mite damage.	• Use an insecticidal soap or horticultural oils can be used for management. Oils and soaps must contact mites to kill them so excellent coverage, especially on the undersides of leaves, is essential and repeat applications may be required. • Broad-spectrum insecticide treatments for other pests frequently cause mite outbreaks, so avoid these when possible. • Use of malathion or neem extract.
Mineuse (leaf miners) *Agromyzid spp*	• Natural enemies, especially parasitic wasps naturally reduce populations of leaf miners. • Sanitation: Post-harvest, disc under crop residues. • Do not plant next to spinach. • Destroying vegetation along fencerows and ditch banks surrounding long bean fields helps to reduce influx of bean leafhoppers. • Crop monitoring. Is important that farmer inspects the entire area to locate the presence of pests.	• Use natural sprays of azadirachtin and spinosad. • If needed, sprays of abamectin, cyromazine and pyrethrin may be used.
Tobacco white fly (*Bemisia tabaci*)	• Controlled in nature by hymenopteran parasitoids (*Encarsia* species), lady beetles and minute pirate bugs. • Monitoring crops and establishment of a pesticide program after finding 1 white fly per 10 plants, spraying may be used. • Yellow sticky traps may reduce populations but cannot prevent the spread.	• Spray natural solutions of insecticidal soap, horticultural oil, neem oil or *Beauveria bassiana* if the infestation is heavy. • Treat soil with synthetic systemic insecticides containing imidacloprid or thiamethoxam (do not use during flowering). • Spray with synthetic insecticides containing acetamiprid (do not use during flowering).
Noctuelles (Night moths, armyworms, cutworms),	• Monitor fields regularly. • Encourage populations of natural parasites and predators to build. • Do weed control near and in field.	• Use *Bacillus thuringiensis* spray to control.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Spodoptera spp *Agrotis spp*		
Puceron (Aphids), various species *Aphis spp*	• Common predators of aphids in beans include lady beetles, syrphid flies, and green lacewings. These and parasitoids generally keep aphid populations under control. • Monitor the crop regularly with yellow sticky traps.	• Aphid controls in beans are seldom necessary, but if it is desired use spot treatments of natural insecticides containing neem seed extract or oil or synthetic insecticides containing malathion or dimethoate.
Thrips, various species	• Use bright yellow or blue sticky board traps placed in field (spread used motor oil on plastic, thick cardboard or wood painted yellow). • Prune off and remove heavily infested plant parts.Predators that control thrips include minute pirate bugs and lacewings. • Thrips populations tend to build up on weeds. Cultivating nearby weedy areas before beans emerge will reduce the potential of a thrips problem when the weeds begin to dry out. Cultivating weedy areas after bean emergence will increase thrips problems. • Keep plants well irrigated. Lack of water increases the susceptibility of plants to thrips damage.	• Botanical and homemade extracts of garlic, neem seed extract and soap sprays are effective.
Anthracnose	• Use resistant varieties. • Plant certified seed grown in areas unfavorable for anthracnose. • Use furrow rather than sprinkler irrigation because of the importance of water for disease development. • Bean debris in infected fields should be removed and composted or plowed under immediately after harvest. • Because the fungus is primarily a pathogen of common bean (but also infects lima bean and scarlet runner bean) crop rotations of 2 to 3 years are effective.	• No fungicides are recommended.
Oïdium (Powdery mildew)	• Use resistant varieties. • Irrigation should be properly scheduled so as to prevent powdery mildew. • Plant in sunny areas as much as possible, provide good air circulation, and	• Oil and sulfur-based pesticides may be used.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
	avoid applying excess fertilizer. A good alternative is to use a slow-release fertilizer.	
Rouille (Rust),	• Planting should be done during the correct planting period. • Use resistant seed. • Use rotations. • Rotate away from any bean for two years. Plow debris under right after harvest. • **Maintain good air circulation.**	• **Apply a fungicide when weather conditions are favorable for disease development. Use copper, mancozeb, chlorothalonil or sulfur.**
Pourriture gris (Gray mold), *Botrytis cinerea*	• Buy high-quality seed of recommended varieties. • Treat the seed before planting. • Plant in a light, well-drained, well-prepared, fertile seedbed at the time recommended for your area. • If feasible, for greenhouse seedling production, sterilize the seedbed soil before planting, preferably with heat. Steam all soil used for plantbeds at 180 F (81 C) for 30 minutes or 160 F (71 C) for one hour. • Avoid heavy soils, heavy seeding, overcrowding, poor air circulation, planting too deep, over-fertilizing (especially with nitrogen), and wet mulches. • Strive for steady vigorous plant growth, not a soft luxuriant growth. Fertilize plants on the basis of a soil test.	• No fungicides are recommended.
Nematodes, various species	• Use resistant cultivars. • Clean soil from equipment with water and disinfectant before moving from infested to non-infested fields. • Management of nematodes in beans requires a careful integration of several cultural practices, including choice of cultivar, crop rotation, sanitation, and fallow. • Growing small grains during the winter followed by a fallow period during the summer helps to reduce root knot nematode populations. • Clean fallow and green manure will help to reduce populations of root knot nematodes.	• No pesticides are recommended.
Peas (petit pois)		

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Mineuse (leaf miners) *Agromyzid spp*	• Natural enemies, especially parasitic wasps naturally reduce populations of leaf miners. • Sanitation: Post-harvest, disc under crop residues. • Do not plant next to spinach. • Destroying vegetation along fencerows and ditch banks surrounding long bean fields helps to reduce influx of bean leafhoppers. • Crop monitoring using yellow and blue sticky traps. Is important that farmer inspects the entire area to locate the presence of pests.	• Use natural sprays of azadirachtin and spinosad. • If needed, sprays of abamectin, cyromazine and pyrethrin may be used.
Cucurbits: Zucchini (courgette), Cucumber (concombre), Cantaloupe (melon), Watermelon (pasteque)		
Acariens (Spider mites) *Tetranychus urticae*, *T. cinnabarinus*, *T. evansi*	• Adequate irrigation is important because water-stressed plants are most likely to be damaged. • The major predator mites commercially available for purchase and release are the western predatory mite and *Phytoseiulus.*	• Use an insecticidal soap or oil can be used for management. Pesticides containing abamectin may also be used. • Sulfur sprays (not for use on sulfur sensitive varieties).
Mineuse (leaf miners) *Agromyzid spp*	• Natural enemies, especially parasitic wasps naturally reduce populations of leaf miners. • Sanitation: Post-harvest, disc under crop residues. • Do not plant next to spinach. • Destroying vegetation along fencerows and ditch banks surrounding long bean fields helps to reduce influx of bean leafhoppers. • Crop monitoring using yellow and blue sticky traps. Is important that farmer inspects the entire area to locate the presence of pests. • Use crop rotation.	• Use natural sprays of azadirachtin and spinosad. • If needed, sprays of abamectin, cyromazine and pyrethrin may be used.
Mouche blanche (White fly),	• Use resistant varieties. • Maintain good field sanitation. • Controlled in nature by hymenopteran parasitoids (*Encarsia* species), lady	• Spray natural solutions of insecticidal soap, horticultural oil, neem oil or *Beauveria bassiana* if the infestation is heavy.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Bemisia tabaci, *Aleyrodes spiraeoides*	beetles and minute pirate bugs. • Yellow sticky traps may be used to monitor for white fly and to reduce populations, but cannot prevent the spread. • Key cultural controls to prevent the buildup of this pest include the use of host-free periods, row covers in the low deserts, silver reflective mulches, noninfested transplants, and good field sanitation. • When possible, plant cucurbits at least one-half mile upwind from other key whitefly hosts such as cole crops and cotton.	• Treat soil with synthetic systemic insecticides containing imidacloprid or thiamethoxam (do not use during flowering). • Spray with synthetic insecticides containing acetamiprid (do not use during flowering).
Noctuelles (Night moths, armyworms, cutworms), *Spodoptera spp* *Agrotis spp*	• Cultural controls such as weed management by cultivation, irrigation management, and field sanitation are acceptable to use for an organically grown crop. • At least 2 weeks before planting eliminate weeds both within and around the field. • Irrigate to speed germination and emergence of the crop. • Do crop rotation. • Sanitation: Remove crop residues at end of season.	• Can use BT *kurstaki &aizawai*products, spinosad product: Entrust, indoxacarb and carbaryl.
Puceron (Aphids), various species *Aphis spp*	• Monitor with yellow sticky traps. • Avoidance of moisture stress on the crop necessary. • Preserve habitat for beneficials around the field and keep dust down to encourage parasitism and predation. • Avoid overfertilizing with nitrogen. • Fields infested with melon aphid should be disced or plowed under as soon as harvest is complete. • Control weeds along ditch banks, roads, in farmyards, 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. • Silver plastic reflective mulches repel white flies	• Organic: Biological and cultural controls and sprays of rosemary oil(first check to see if the plant can become damaged, insecticidal soaps, and certain oils are acceptable for use in an organically grown crop. Rosemary oil is less disruptive of beneficials than soaps and narrow range oils.
Thrips, various species	• Discing weeds before they flower can lessen attraction of the field to thrips. Do not disc after weeds have flowered, as thrips will move from flowers to	• Unnecessary thrips treatments can cause spider mite buildup.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
	crop plants. • Monitor with yellow or blue sticky traps placed in field from seedling through flowering period to determine the magnitude of the thrips population. Be sure to determine that thrips-related damage is occurring and consider treating only if the population is causing serious damage to shoot tips, flowers, or fruit.	• Can apply insecticides containing spinetoram or spinosad.
Anthracnose	• Use resistant varieties. • Use crop rotation. • Use of clean seed. • Inspection of transplants. • Avoid sprinkler irrigation and keep the tops of the beds dry.	• Fungicides are rarely needed.
Mildiou (Blights/mildews)	• Use resistant/tolerant varieties. • Avoid overhead irrigation.	• Apply a treatment when disease symptoms first occur and repeat if symptoms worsen. • Can use fungicides containing mancozeb or propamocarb.
Oïdium (Powdery mildew)	• Use resistant varieties. • Follow good sanitation practices • Control weeds. • Carefully monitor fields, even those with powdery mildew resistant varieties.	• Apply a treatment when disease symptoms first occur and repeat if symptoms reappear. • 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, myclobutanil, pyraclostrobin, pyraclostrobin/boscalid, trifloxystrobin, and trifumizole).
Pourriture grise (Charcoal rot), *Macrophomina phaseoli*	• Use crop rotation to non-host plant. • Use resistant varieties. • Leach drip-irrigated fields once per year to reduce salinity. • Avoidance of drought stress throughout the growing season • Sanitation, destruction of infected plant tissue before the pathogen reproduces at the end of the growing season will prevent a buildup of soil inoculum.	• For seed treatment, use synthetic pesticides containing carboxin + thiram (Vitavaks 200 FF). • For plant disease, use synthetic pesticides containing triadimefon (Bayleton).

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Noctuelles (Night moths, armyworms, cutworms), *Spodoptera spp* *Agrotis spp*	• Use pheromone traps. • Sanitation: keep past-season crop residue and weeds in field and surrounding areas to a minimum to lessen the attraction of the field. • Parasitic wasps generally keep populations under management. • Manage irrigation properly.	• Sprays of *Bacillus thuringiensis* or the Entrust formulation of spinosad.
Nematodes, various species	• Rotation with nonhost crops can reduce nematode population levels, even though this is difficult with root knot nematodes because of their wide host range. • Deep plowing, fallowing, and solarization can further reduce nematode population levels. • Special attention must be paid to weed control, both in nonhost rotations as in fallowing. Many common weeds are hosts to root knot nematodes. • Striving for optimum growing conditions by addressing plant stress factors such as soil moisture, nutrition, insect pests, and other diseases may minimize nematode damage.	• Nematodes are difficult to control without highly toxic chemicals.
Onion (l'oignon)		
Adventices (weeds)	• Use of irrigation or rain to stimulate weed seed germination before planting onions or garlic. The emerged seedlings are then killed by shallow cultivation or an organic herbicide. • To prevent the buildup of weed seed in the soil, cultivate weeds before they set seed in rotation crops. • After harvest, clean cultivate the field or plant a green manure crop to limit weed infestations. • Use integrated weed management. • Can use deep plowing. • Can use cover crops, plastic or organic mulches. • Can use soil solarization with clear plastic.	• Glyphosate and 24D may be used to control perennial weeds the season before planting.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
	• For small farms, use hoe weed removal.	
Mildiou (Blights/mildews) *Peronospora destructor,* *Alternaria porri* *Stemphylium vesicarium*	• Use resistant cultivars. • Use certified disease-free bulbs, sets, and seed. • Use a 3-year rotation away from *Allium* crops in fields where the disease has occurred. • Destroy volunteer *Allium* plants in and around the field and buildings. • Locate onion fields where there is good air movement to promote rapid drying of foliage. • Heat treatment of bulbs at 35, 40 °C for 4 to 8h reduce the disease significantly. • Eliminate residue, planting on dry season, avoid irrigation on hot moments of the day. • Crop rotation. • Practice good soil drainage.	• Bulb dipping with metalaxyl. • Can spray fungicidescontaining metalaxyl + mancozeb followed by oxadixyl + copper oxychloride or chlorthalonil.
Pourriture de bulbes (Bulb rot), *Botrytis allii*	• During the growing season, minimize damage to bulbs caused by insects and diseases. • Avoid heavy or late applications of nitrogen fertilizer. • Harvest onions and garlic only when the crop is mature and necks are well cured. • Handle the crop with a minimum of bruising or wounding. Avoid late-season irrigation to allow the tissue to dry before harvest. The neck tissue must be well cured before the crop is stored. Healthy onions that are properly stored are seldom affected. Store bulbs at temperatures of 41°F (5°C) or less with low relative humidity and good circulation.	• Can use fungicides containing mancozeb, ferbam, maneb, chlorothalonil, trimastan.
Turnips (navet)		
Taupins (Wireworms), *Agriotes, Limonius and*	• Plant treated seed and avoid planting crops highly susceptible to wireworms in a field that has been recently in sod.	• Use insecticides containing imidacloprid, thiamethoxam or acetamiprid (but do not spray during turnip flowering).

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Ctenicera spp.		
Root maggots, *Delia radicum*	• Practice crop rotation, and grow the current year's crop as far as possible from fields used for rutabagas or cole crops in the previous year. • Do not grow crops of early and late turnips close together or near early broccoli, cabbage, cauliflower or other cruciferous crops. Separate them by at least 200 meters.	• Use insecticides containing imidacloprid, thiamethoxam or acetamiprid (but do not spray during turnip flowering).
(Puceron de navet) Turnip aphid, Various species	• Spray only if aphids are so numerous as to cause wilting of leaves during dry weather. • Predators such as ladybird beetles and their larvae may control aphid aphids.	• Use insecticides containing imidacloprid, thiamethoxam or acetamiprid (but do not spray during turnip flowering).
Club root,	• Grow resistant varieties. • Avoid fields known to be infested and practice a rotation of 7 years once infestation has been encountered. • Do not use manure from animals fed on infected crops on land intended for rutabagas or any cole crop. Put manure back on the fields that contained the infected roots and do not grow any cole crop on the field for at least 7 years. • Maintain high soil calcium and magnesium soil test levels and a pH over 7.2.	• No chemicals are recommended.
Carrot (carotte)		
Puceron (Aphids), various species	• Carrots planted adjacent to infested cotton or melons are at risk of becoming infested with this aphid particularly in fall following cotton defoliation or termination of the melon crop. Carrots should be planted a safe distance from both, if possible. • The presence of bloated mummies indicates parasite activity. Predators such as green lacewing larvae, lady beetles, and syrphid fly larvae prey on many aphid species. • Monitor fields for aphids weekly during spring and summer by examining the	• Can use insecticides containing imidacloprid (but do not use during flowering).

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
	upper and lower surfaces of leaves. Also, look for evidence of predators and parasites and their impact on aphid populations. Treatment is rarely required. • Sanitation is important in curbing the spread of the viruses that these insect vector. • Disc all crop residues under as soon as harvest is complete. Keeping fields, ditch banks, and fence lines weed free may also help in reducing virus inoculum.	
Alternariose *Alternaria dauci*	• Use tolerant or resistant cultivars. • Planting *Alternaria*-indexed seed or treating seed in a hot water bath is very important. • Turn under carrot residue by tillage or plowing to hasten decomposition of debris. • Practice 2-year rotations: avoid continuous carrot culture. • Do not plant new fields near existing fields with blight symptoms. • In areas with rainy weather, furrow irrigation may aid in disease reduction.	• Foliar sprays of *Bacillus subtilis*are acceptable for use on organically grown produce
Oïdium (Powdery mildew), *Erysiphe polygoni*	• Use tolerant cultivars. • Maintain good plant vigor.	• Sprays of sulfur and *Bacillus subtilis* are acceptable for use on organically grown produce
Artichoke (artichaut)		
Puceron (Aphids), various species	• The presence of bloated mummies indicates parasite activity. Predators such as green lacewing larvae, lady beetles, and syrphid fly larvae prey on many aphid species. • Destroy crop residue immediately after harvest. • Avoid other aphid-favored crops, such as lettuce, in adjacent upwind fields	• Sprays of neem seed extract and oil are acceptable for use on organically certified crops.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Aphis spp, *Capitophorous elaeagni*		
Mildiou (Blights/mildews) *Leveillula taurica, Erysiphe cichoracearum*	• Look for early symptoms, check weekly to monitor progress of the disease. • Destroy crop residue immediately after harvest.	• Fungicides are not needed unless the disease becomes severe. • If needed, use fungicides with azoxystrobin or myclobutanil.
Ramulariose (Ramularia Leaf Spot) *Ramularia cynarae*	• Use resistant varieties. • Destroy crop residue immediately after harvest.	• Use a fungicide application when flower bract infection follows leaf infection. • If needed, use fungicides with azoxystrobin or myclobutanil.
Cole Crops: Cauliflower (chou-fleur)		
Puceron (Aphids), various species *Brevicoryne brassicae*, *Aphis spp*,	• Cabbage aphids have many natural enemies and these can sometimes control low populations • Sanitation: Destroy crop remnants immediately after harvest and remove or control alternate hosts, including mustards and related weeds, around field borders. • Use rogueing (removal and destruction) of infested plants from the field can be an effective technique early in the crop cycle.	• Sprays of insecticidal soap can give partial control. Soap sprays, however, may be phytotoxic under some conditions. For most effective control, apply during foggy conditions.
Diamond-back moth,	• Various predators such as ground beetles, true bugs, syrphid fly larvae, and spiders can be important factors in controlling populations.	• Sprays of *Bacillus thuringiensis* and the Entrust formulation of spinosad are

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Plutella xylostella	• Natural enemies and insecticides applied to control other pests generally keep the diamondback moth under satisfactory control in most fields but keep records of diamondback moth during monitoring for other caterpillars.	organically acceptable management tools.
Cabbage looper, *Trichoplusia ni*	• Be sure to monitor for natural enemies (*Trichogramma* egg parasites, Tachnid fly parasitoids and wasp parasites); if looper populations are close to treatment thresholds but you find a significant percentage of parasitized or disease-killed individuals, delay treatment for a few days to see if these natural controls will bring populations down on their own. • Use of nocturnal overhead sprinkler irrigation to dislodge and repel pests. • Use of pheromone misters and emitters to disrupt mating. • Use of floating row screen or mesh covers to exclude egg-laying moths. • Use of organic herbal repellents like those extracted from garlic (Cropguard, Garlic Barrier) or red chili peppers.	• Sprays of *Bacillus thuringiensis* and the Entrust formulation of spinosad are organically acceptable management tools. • Use of organic botanical insecticides like neem, pyrethrin. • Use of synthetic pesticides containing indoxacarb, spinetoram, emamectin benzoate, chlorantraniliprole, flubendiamide.
Citrus: Orange, lemon, Clementine (d'agrumes)		
Spider mites (acaros), *Tetranychus spp.*	• Use regular monitoring for outbreaks. • Spider mites have many natural enemies that often limit populations. Broad-spectrum insecticide treatments for other pests frequently cause mite outbreaks, so avoid these when possible. • Adequate irrigation is important because water-stressed plants are most likely to be damaged. • Apply water to pathways and other dusty areas at regular intervals. Mid-season washing of trees with water to remove dust may help prevent serious late-season mite infestations. • Use sanitation; remove damaged and heavily infested plant parts. •	• Always monitor before treatment with miticides. • Insecticides applied during hot weather usually appear to have the greatest effect on mites, causing dramatic outbreaks within a few days. • Use an insecticidal soap or horticultural oils for management. Oils and soaps must contact mites to kill them so excellent coverage, especially on the undersides of leaves, is essential and repeat applications may be required. Pesticides containing abamectin may also be used. • Use products containing lambda-cyhalothrinor dicofol.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Ceratite (Fruit fly), *Ceratitis capitata*	• Pheromone traps are used to monitor and make management decisions. • Extremely high fly populations can occur in fruited varieties of landscape trees and in unmaintained ornamental situations. These can be a significant source for invasion of commercial groves. Prevent fruiting on landscape trees in spring by using a chemical like "Fruit Stop" or destroy fruit on the ground in fall to reduce this invasion pathway. • An areawide approach is needed to reduce fly densities where commercial plantings are near ornamental or unmaintained trees. • Fruit fly adults feed on honeydew. Reducing black scale populations may reduce a food source needed during high summer temperatures. • The use of GF-120 Fruit Fly Bait, sprays of kaolin clay, and mass trapping are acceptable for use in an organically certified crop. • Sanitation: Remove old fruit remaining on trees following harvest and destroy all fruit that are on the ground by either burying at least 4 inches deep or composting.	• Use horticultural mineral oils, Insect Growth Regulators (IGRs) and bait sprays • Use insecticides containing malathion or dimethoate. •
Cochenilles (Mealy bugs), *Planococcus citri*, *Pseudococcus* spp	• Conserving their natural enemies and reducing ant populations and dust problems assist with manage mealybugs. Treatment is rarely required. • Numerous parasites impact mealy bug populations • Release of the mealy bug parasite *Cryptolaemus montrouzieri*, is acceptable in organically managed citrus groves.	• No insecticides are recommended.
Mineuse (leaf miners) *Agromyzid spp*	• Use resistant varieties. • Do weed control in and around field. • Use of biological control by parasitic wasps. • Use Yellow and/ or blue sticky traps for monitoring or mass trapping.	• Use an insecticide containing abamectin or chlorantranilpole.
Red citrus scale (Pou de Californie), *Aonidiella*	• Numerous parasites impact red citrus scale populations. • Releases of mass-reared *Aphytis melinus* parasites can be useful in groves with insufficient biological control.	• The insect growth regulator insecticides containing pyriproxyfen and buprofezin are safe for parasitic wasps, predatory mites,

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
aurantii	• Do pheromone trap monitoring.	spiders, and lacewings but are quite toxic to vedalia beetles, which are needed for cottony cushion scale control. • Can use insecticides containing spirotetramat,thiamethoxam, narrow range and petroleum oil sprays.
Puceron (Aphids), various species *Toxoptera aurantii* *Aphis gossypii* *Aphis spiraecola*	• A number of coccinellid and syrphid predators, parasites and fungal diseases usually keep aphid populations below damaging levels. • A moderate aphid population (about 40% of growth flushes infested) can be considered beneficial on mature trees because aphids and their honeydew provide a good food source for natural enemies of other pests early in the season when other hosts are not available. • On newly established trees and on new growth flushes on mature trees, it is not uncommon for aphids to cause curling of leaves and produce honeydew. Treatment is usually not warranted because citrus can tolerate extensive leaf curling without yield effects.	• Treatments, if needed, can include narrow range oils, pyrethrin and imidacloprid.
Phytophthora gummosis, root rots *Phytophthora* spp *Phytophthora citrophthora* *P. parasitica*	• Plant trees on a berm or high enough so that the first lateral roots are just covered with soil. • Management of Phytophthora root rot involves the use of resistant rootstocks, irrigation management, fungicides, and fumigation. When replanting or establishing new plantings, choose resistant rootstocks where possible, but also consider tolerance to other diseases, nematodes, and cold. The most tolerant rootstocks are trifoliate orange, swingle citrumelo, citrange, Alemow, and sour orange. • In addition to improving the growing conditions, the disease spread can be halted 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. • Provide adequate soil drainage and avoid over irrigation. If destruction of feeder roots is minimal, corrective action may include increasing irrigation intervals, switching to alternate middle row irrigation or a different irrigation	• Copper and limonene treatments are acceptable for use on organically certified citrus.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
	system such as minisprinklers, and installing subsoil tiles.	
Pourriture brune (Brown rot), *Phytophthora spp.*	• Plant resistant citrus stock. • Brown rot management relies on prevention. Pruning tree skirts 24 or more inches above the ground can significantly reduce brown rot.	• For root rots, fungicides containing copper, limonene, Bordeaux mix (zinc sulfate, hydrated lime, copper sulfate), and fosetyl aluminum can be used. • One spray of copper fungicide between October and December before or just after the first rain may provide protection throughout the wet season. • When rainfall is excessive, repeat the spray in January or February. Spray the skirts to about 4 feet above ground. Spraying the ground underneath the trees also reduces brown rot infections.
Nematodes Various species	• Using a resistant rootstock is recommended whether or not nematodes are present. • If the site was previously infested with nematode pests of citrus, preplant fumigation may be necessary to reduce nematode population levels. When replanting a citrus orchard, a preplant treatment is recommended even if a resistant rootstock is used. • In established orchards, treat when sampling indicates more than 400 female citrus nematodes are present in 1 gram of roots in February to April or more than 700 in 1 gram of roots during May and June. • Before planting or replanting a citrus orchard, obtain a professional soil analysis; the analysis will help you determine the potential for nematode damage and plan a management strategy. In an established orchard, a soil analysis will confirm visible symptoms that may be present. • Good sanitation practices are essential to avoid nematode infestations. Use certified nematode-free material for planting. Rotation with annual crops for 1 to 3 years before replanting citrus helps to reduce citrus nematode	• Most nematocides are highly toxic, and are not recommended.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
	populations.	
Small Grains/Cereals: Wheat (de blé), Barley (l'orge)		
Puceron (Aphids), various species *Aphis spp*	• A number of coccinellid and syrphid predators, parasites and fungal diseases usually keep aphid populations below damaging levels. • Plants stressed for water or nutrients are more susceptible to and suffer greater damage from aphids, so maintain adequate soil moisture and fertilization. • Use regular monitoring, yellow sticky traps • Use resistant varieties • Field disking and destruction of crop residues are important for control of aphid pests of leafy vegetables to reduce their migration into nearby crops.	• Treatments, if needed, can include narrow range oils, pyrethrin and rotenone
Charbon nu on seed (Wheat covered smut and loose smut) *Tilletia caries* and *Tilletia foetida, Ustilago hordei* *Ustilago tritici , Ustilago nuda, Ustilago nigra*	• Use certified smut-free seed. • Hot water treatment can eliminate smut fungi from contaminated seed, but it must be used carefully to avoid reducing seed vitality.	• For covered smut, treatment of seed with contact-type fungicides will control covered smut because the fungus is on the outside of the seed. • For loose smut, seed treatment with systemic fungicides is necessary because loose smuts are borne internally in seed. • For seed treatment, use synthetic pesticides containing carboxin + thiram or tebuconazole.
Fusariose (Root rot) *Fusarium* spp.	• Follow good cultural practices: • Plant late in the fall to avoid excessively warm soil conditions; • Provide adequate nitrogen but avoid excessive fertilization; • Irrigate to avoid moisture stress; and rotate out of grain, or use oat, which is not affected.	• There are no recommended chemical treatments for this disease. •
Septorioses	• Use resistant cultivars. • Sanitation: remove and destroy crop residues by burning, burial or composting.	• Although normally not economical, foliar fungicides can be used to control disease outbreaks and provide partial disease control.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Septoria tritici (Mycosphaerella graminicola)	•	Applications should be made between tillering and heading with the objective being to protect the flag leaf. Depending on the weather conditions from tillering to early dough stage, one or more applications may be needed with mancozeb or propiconazole.
Weeds	• Deploy integrated weed management. • Use certified weed-free seed. • Use crop rotation. • Use preirrigation (first rain to germinate weed seeds and remove them by tilling before planting). • Adequate drainage is essential for fields planted to small grains. Excessive moisture in low areas creates and aggravates problems, such as stand loss, loss of soil nutrients, reduced oxygen supply, and root diseases. • Chiseling the soil before seedbed preparation greatly enhances drainage and root development.) • Under dryland conditions, primary fall tillage with a disk, chisel plow, or moldboard plow, usually follows as soon after the first autumn rainfall to eliminate germinating winter weed seedlings.	• Use post-emergent herbicides such as glyphosate.
Oïdium (Powdery mildew)	• Resistant cultivars of barley and wheat are available. • Crop rotation, elimination of crop residue, and control of volunteer grains and weed hosts reduce inoculum survival from one season to the next.	• Although normally not economical, foliar fungicides containing propiconazole can be used to control disease outbreaks and provide partial disease control. To protect the flag leaf, applications should be made between tillering and heading.
Rouille brune et jaune (Brown and yellow rust), *Puccinia recondita* (wheat) *Puccinia hordei* (barley)	• Resistant cultivars of barley and wheat are available.	• In the event that new races of the fungus render current sources of resistance obsolete, fungicides such as propiconazole can be applied at 4 oz per acre to control disease outbreaks. Applications should be made between tillering and heading to protect the

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Puccinia coronata (oats)		flag leaf.
Sugar beet (betterave à sucre)		
Taupins (Wireworms), *Agriotes spp*	• In fields known to contain wireworm larvae, fallow during summer with frequent tillage (springtooth or disk). • Replanting can sometimes reduce damage from wireworm infestations to the crop when it is in the seedling stage. • Rotate to nonhost crops if possible. • Do not plant a susceptible host crop following a crop that has had a heavy infestation of wireworm without fallowing/tilling or applying a pesticide.	• Use synthetic seed treatment imidacloprid • Spray systemic insecticides containing imidacloprid, thiamethoxam or .
Cutworm (Vers gris) *Agrotis spp*	• Cutworms are attacked by a number of predators, parasites, and diseases. Many of these natural control agents are not effective on pale western and black cutworms because of their subterranean nature. It is not known if any of these natural enemies can control cutworm populations, but their presence should be noted. • Cutworms often build up in rotation crops preceding sugarbeet, such as alfalfa and cereals. If surveys indicate the presence of substantial numbers of cutworm in these crops, sugarbeet should not be planted. • Spring plowing and discing are also useful in reducing cutworm numbers. Keep fields weed-free, especially eliminating grassy weeds that serve as alternate host for cutworms. Cutworms may also build up in high numbers if grassy weeds are prevalent in the crop preceding sugarbeets. • Monitor for cutworms during stand establishment by looking for plants lying on their sides that have been chewed at the soil surface or that are completely missing. If plants are missing completely, gently dig in the area where a seedling would have been expected to try to find the intact root system as evidence of cutworm damage.	• If needed, can apply insecticides containing BT or methoxyfenozide.
Tortoise beetle, (La casside)	• Some entomopathic nematodes and other parasitoids attack Cassid beetles • Keep fields weed free. • Replant heavily damaged fields.	• Can use insecticides containing deltamethrin or lambda-cyhalothrin.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Cassida vittata	• No economic thresholds are available but consider treatments, especially on young plants, if damage reaches a moderate level.	
Prodenia (Armyworm), *Spodptera littoralis*	• Because of their ability to reach high numbers and cause severe defoliation, armyworms need to be monitored closely, particularly during the mid- and late summer. • Control is attained through a combination of beneficial insects and a viral disease coupled with periodic insecticide applications. • Armyworm larvae are often attacked sufficiently by natural parasitoids, predators, viral and bacterial diseases	• Organically Acceptable Methods:Biological control and sprays of BT and the Entrust formulation of spinosad are acceptable for use on organically certified sugarbeets.
Nematodes, Cyst and Root Knot	• Use of resistant cultivars and grow healthy plants (use appropriate seed, spacing, watering, weeding and fertilizer) • Use soil solarization using plastic. • Use crop rotation and fallow, deep plowing, fallowing and avoid mono cropping. Rotate with broccoli, cauliflower, sorghum, Sudan grass, rape, and mustard seed which are resistant to nematodes. • Sanitation: Remove and compost crop debris. • Use of organic fertilizer particularly chicken manure and composts to add organic matter and soil structure to sandy soils • Growing flax, a tropical herb, is good for controlling root knot nematodes. • African and French marigold (*Tagetes minuta* and *T. patula*, respectively) plowed under the soil also suppress and reduce nematodes. Plant and plow into soil 2 months later.	• Management of nematodes is difficult, especially in sandy soils. • Botanical and homemade water extracts of basil, garlic and neem seed may be effective controls. • Two new commercialized products, once registered for use, can be used as effective nematode controls: the microbe *Myrothecium verrucaria* and natural soil biopesticide labeled as Promax (containing extracts of tomatillo oil and thyme oil) •
Cercosporiose *Cercospora beticola*	• Varieties vary considerably in resistance, with the highest yielding current varieties having the least resistance. • Growers planting sugarbeets in late fall or early spring for an early fall harvest are most likely to be affected by Cercospora and should use a more resistant variety if possible. • To effectively eliminate inoculum from a field, plant sugarbeets in a 3-year rotation with nonhosts and plow to incorporate crop residues. Avoid planting a new sugarbeet field adjacent to fields planted to beets the previous season.	• Fungicide treatments are generally not economic.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
	• When sprinkler irrigation is used, run sets so that windblown mist does not keep leaves wet for longer than 24 hours.	
Pourriture molle des raciness *Sclerotium rolfsii*	• Management can be best achieved by reducing inoculum buildup through crop rotation. Suggested crops to include in a rotation are alfalfa, wheat, barley, corn, or susceptible crops that do not require irrigation during warm weather conditions. • Do not rotate beets with beans or other highly susceptible crops and avoid frequent irrigations during hot weather. • Yield losses can be reduced through application of nitrogenous fertilizers that promote vigorous growth. • Additionally, in fields where Sclerotium root rot has been identified, harvest early.	• There are no chemical control methods for managing this disease.
Font de semis et pourriture laterale (Rhizoctonia root and crown rot) *Rhizoctonia solani*	• There may resistant varieties available • Follow good tillage, irrigation, and fertilization practices to promote good crop growth and adequate soil drainage. • Plant sugarbeet in rotation with corn or small grains, and when cultivating, avoid throwing dirt into plant crowns.	• No fungicides are recommended.
Adventices (weeds)	• Use integrated weed management. • Can use deep plowing. • Can use cover crops or organic mulches. • Use of irrigation or rain to stimulate weed seed germination before planting onions or garlic. The emerged seedlings are then killed by shallow cultivation or an organic herbicide. • To prevent the buildup of weed seed in the soil, cultivate weeds before they set seed in rotation crops. • After harvest, clean cultivate the field or plant a green manure crop to limit weed infestations.	• Preplant application of glyphosate. • Postemergence application of herbicides containing clethodim, desmidipham, triflusulfuron or clopyralid.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Sugar cane (canne à sucre)		
Adventices (weeds)	• Use integrated weed management. • Can use deep plowing. • Can use cover crops or organic mulches. • Use of irrigation or rain to stimulate weed seed germination before planting onions or garlic. The emerged seedlings are then killed by shallow cultivation or an organic herbicide. • To prevent the buildup of weed seed in the soil, cultivate weeds before they set seed in rotation crops. • After harvest, clean cultivate the field or plant a green manure crop to limit weed infestations.	• Use post-emergent herbicides such as glyphosate.
Capers (câpres)[13]		
Viruses, various, transmitted by leafhoppers	• Control leafhoppers and grassy weeds and monitor during the summer to determine the need to treat. • Predation by spiders can provide significant reduction of leafhopper populations. • Use resistant plant varieties and avoid staggered planting	• Can spray with carbaryl.
Fusariose (Fusarium), *Fusarium spp*	• Use of sterilized soil. • Avoidance of excessive watering.	• No fungicides are recommended.

[13] http://www.globalsciencebooks.info/JournalsSup/images/0712/EJPSB_1%282%29170-179o.pdf

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Sclerotium, Sclerotium rolfsii	• Seed treatments with fungicides provide protection against seedling diseases. • Plant high quality seed (preferably certified seed) with 85% germination or more. • Increase seeding rate if a history of the disease exists.	• Use of copper hydroxide provides some control. • Can use applications of fungicides containing mancozeb.
Mouche de flor (Bud fly)[14], *Capparimyia savastani*	• Do a monitoring program. • Canopy management by pruning heavily infested parts. • Biological control by parasitic wasps.	• Application of agricultural narrow range oil/dormant oil or malathion.
Cumin		
Depressaria (Purple carrot seed moth), *Depressaria depressana*	• Control wild umbelliferous plants near field. • Use crop rotation and intercropping. • Add nitrogen fertilizers. • Harvest on time. • Rapid threshing of seeds after harvest.	• Use insecticides containing deltamethrin.
Puceron (apids), Various species	• Use and increase the density of sticky yellow and blue traps. • Weed management to avoid alternative hosts for aphids. • Avoid the broad-spectrum insecticides to minimize natural enemies' destruction.	• Application of agricultural narrow range oil/dormant oil or garlic oil.

[14] http://www.globalsciencebooks.info/JournalsSup/images/0712/EJPSB_1%282%29170-179o.pdf

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Mildiou (Blights/mildews) *Alternaria spp*	• Use disease-free seed. • Use crop rotation and intercropping. • Monitor and manage soil moisture.	
Blueberries (bluet, myrtille)		
Tordeuses (Leaf rollers), Various Tortricid species	• Use pheromone traps to monitor populations and trap adult moths. • Several species of parasitic wasps and flies provide natural control. • Use disease and insect resistant varieties. • Mulch around plants. • Can use mating disruption pheromones. • Use proper sanitation, clean up last crop residues/berries. • Remove leaf litter and dead grass from area.	• Use insecticides containing BT, spinosad, spinetoram or malathion
Mouche de bluet (Blueberry fruit fly), *Rhagoletis mendex*	• Predators (lady beetles, lace wings) control much of the fly population. • Use pheromone traps to monitor and reduce populations.	
Leafhoppers and apids Various species	• Use yellow sticky traps to monitor and control leafhoppers and aphids. • Use mulch around plants.	
Weeds	• Regularly mow weeds between rows. • Use mulches around plants.	

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Raspberries (frambois)		
Tordeuses (Leaf rollers), Various Tortricid moth/ caterpillar species	• Use pheromone traps to monitor populations and trap adult moths. • Several species of parasitic wasps and flies provide natural control. • Use disease and insect resistant varieties. • Mulch around plants. • Can use mating disruption pheromones. • Use proper sanitation, clean up last crop residues/berries. • Remove leaf litter and dead grass from area.	• use insecticides containing BT, spinosad, spinetoram or malathion.
Botrytis (Botrytis fruit rot), *Botrytis cinerea*	• Use resistant stock. • Use proper pruning and nitrogen fertilizers. • Pruning and/or using a training system to open the canopy, proper fertilization, weed control, resistant cultivars, and proper harvest techniques are all acceptable for use in an organically certified crop.	
Mildiou (downy mildew), *Peronospora sparsa*	• Use pathogen-free stocks. • Destroy wild hosts such as rose. • Once the planting is established, remove suckers and weeds to reduce humidity at the base of the plant. • Remove and destroy old fruiting canes after harvest. • Reducing moisture in the hedgerow by pruning can be key in managing downy mildew.	• Use fungicides containing copper and fosetyl-aluminum.
Loquat (néflier du Japon)[15]		
La mouche des fruits	• Till soil around base of tree to kill pupae.	

[15] http://www.hort.purdue.edu/newcrop/morton/loquat.html; http://edis.ifas.ufl.edu/mg050

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
(Caribbean and Mediterranean fruit flies), *Anastrepha suspense* *Ceratitis capitata*	• Sanitation, remove and compost or dispose of all dropped fruit.	
Carpocapse (Coddling moth), *Cydia pomonella*	• Cover clusters with paper or cloth bags. • Sanitation, remove and compost or dispose of all dropped fruit.	
échelles arbre, pucerons (Scales, aphids) Various species	• Cover clusters with paper or cloth bags. • Sanitation; removal and destruction of heavily infested branches and plant parts.	• Can use dormant oils and neem oil. • Can use insecticides containing spinosad.
La brûlure (bactérien) de poire (Pear blight), *Bacillus amylovorus*	• Maintain a weed-free zone one meter around the base of the tree. • Mulch around tree base. • Sanitation; removal and destruction of heavily diseased branches and plant parts. • Excessive nitrogen application may increase the susceptibility of loquat trees to fire blight.	
Olives (Olivier)		
Olive Peacock leaf	• Use more resistant or tolerant varieties. • Disease is inactive during hot and dry spells.	• Can use Bordeaux mix or fixed copper, applied yearly.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
spot/scab, Oeil de paon (*Spilocaea oleagina*)	• Prune off and destroy heavily diseased parts.	
Glover's scale/Long scale, cochenille serpette(*Lepidosaphes gloverii*) and Black olive scale, cochenille noire d'olivier (*Saissetia oleae*)	• Several natural parasites parasitize scales and control them naturally. • Prune to open up canopy. • Control ants that tend scales using field bait (sugar and boric acid) traps.	• Use narrow range horticultural oil.
Olive fruit flies (*Bactrocera* and other species)	• Use baited sticky traps to determine presence and relative numbers of fruit flies. • Mass trapping can also be used to remove flies from orchard. • Sanitation: Remove and destroy leftover and damaged fruits at end of season. Remove or burry dropped infested fruits.	• Spray kaolin clay dust film particles. • Spray insecticide containing spinosad.
Grapes (Vignoble)		
Powdery midlew, Oidium (*Erisiphe necator*)	• Use resistant varieties. • Sanitation: Clean up and destroy seasonal refuse.	• Use organic natural sulfur, *Bacillus subtilis*, *Bacillus pumilis*, narrow range oil, potassium bicarbonate, or Harpin protein. • Use fungicides containing tebuconazole, fenarimol, myclobutanil, triflumizole, azoxystrobin, trifloxystrobin, kresoxim-methyl.
Downey mildew (*Plasmopara viticola)*	• Preventive management consists of effective soil drainage. • Reduce sources of overwintering inoculum. • In a vineyard that depends on sprinkler irrigation, extend the interval between irrigations as long as possible.	• For prevention, use fungicides containing mancozeb, maneb, and copper compounds. • For treatment, use fungicides containing copper hydroxide, azoxystrobin, pyraclostrobin, kresoxim-methyl,

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
		mefenoxam, trifloxystrobin.
Pourriture gris, Gray mold/bunch rot (*Botrytis cinerea*)	• Use resistant varieties. • Remove basal leaves and basal lateral shoots after berry set.	• Can use natural fungicides containing narrow range oil or Bacillus subtilis. • Can use synthetic fungicides containing fenhexamid, cyprodinil, iprodione, pyraclostrobin, captan or mancozeb.
Vine moth (Eupoecilia ambiguella) and Grape leaf roller (several species)	• Use pheromone traps. • Monitor and spray.	• Can use natural sprays containing BT or spinosad.
Sheep/cattle		
Tiques (ticks), Various species	• Check animals routinely for ticks, and remove ticks by hand. • Some local aromatic desert shrubs provide extracts that can be used as tick repellents.	• Can use spray-on amitraz or pour-on deltamethrin.
Herb: Sage		
Late blight (*Phytophthora infestans*)	• Blights can be minimized by maintaining optimum growing conditions, including proper fertilization, irrigation, and management of other pests. • Use tolerant varieties and raised-bed production. • Drain the growing field adequately before planting. • Follow proper planting date; do not plant late. • Use scouting/monitoring and spot treatments with fungicides, if needed.	• Use synthetic fungicides containing azoxystrobin, cymoxanil + mancozeb, copper sulfate, mancozeb, metalaxyl, chlorothalonil, dimethomorph, pyraclostrobin.
Tobacco white fly	• Controlled by hymenopteran parasitoids (*Encarsia* species), lady beetles and minute pirate bugs.	• Spray solution of insecticidal soap and/or horticultural oil if infestation is heavy.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
(*Bemisia tabaci*) and Greenhouse whitefly (*Trialeurodes vaporariorum*)	• Do weed control in and around field. • Yellow sticky traps may reduce populations but cannot prevent the spread. • Aluminum foil or silver reflective mulches can repel whiteflies.	• Use of synthetic insecticides containing azadirachtin/neem oil, *Beauveria bassiana*, thiamethoxam or acetamiprid.
Herb: Mint		
Tobacco white fly (*Bemisia tabaci*) and Greenhouse whitefly (*Trialeurodes vaporariorum*)	• See whitefly recommendations above under sage.	• See whitefly pesticide recommendations above under sage.
Red spider mite (*Tetranychus* species)	• Spider mites can be controlled using predacious mites (*Phytoseiulus persimilis* and *Amblyseius spp*). • Do weed control in and around field. • Adequate irrigation is important because water-stressed trees are most likely to be damaged.	• Broad-spectrum insecticide treatments for other pests frequently cause mite outbreaks, so avoid these when possible. • Natural insecticidal soaps or agricultural oils and neem extracts can be used for management (apply especially on the undersides of leaves). • Use of synthetic insecticides containing abamectin.
Alfalfa dairy cattle forage and silage (Luzerne)		
Noctuelles (Night moths, armyworms, cutworms), *Spodoptera spp*	• See controls above for armyworms and cutworms.	• See controls above for armyworms and cutworms.

Primary Pests	Preventive IPM tools	Curative IPM tools (Natural & Synthetic Pesticides)
Agrotis spp		
Maize dairy cattle forage and silage (le maïs)		
Sesamie (Stem borers) Various species	• Natural enemies include parasitoids Braconid family of parasitic wasps, wasps of the genus Cotesia, and Tachinid fly larvae. Predators include ground beetles, lacewing larvae and adults, praying mantis and weaver ants. • Use borer-resistant varieties. • Use crop rotation and intercrop maize with cowpea. • Plow deeply and harrow. • Plant early at the beginning of rains or within 2 weeks. • Monitor plants for larva's presence 2-4 weeks after sowing. Select 100 plants randomly across the field. If more than five plants are infested with stalk borer larvae (out of 100 monitored plants), then control measure is necessary. • Intercropping with pulses (cowpea, groundnut) in alternate rows reduces stem borers. • Embark on stalk management in dry season cut and destroy stalks.	• Seed dress with insecticides. • One can spray products containing BT toxin or spinosad between the egg stage and leaf-feeding stage (before they bore into the stem).

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

ANNEX 2. GUIDELINES FOR PEST MANAGEMENT PLANS (PMPS) FOR MOROCCO CROPS AND BENEFICIARIES

What is a PMP?

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

Who are the PMP's intended audiences and users?

- Farm land preparation and crop production decision-makers
- Farmers
- Farm managers

Why is a PMP being done?

PMP Objectives:

- Prevent or reduce pest damage risk to agricultural production
- Protect the health of farmers, farm family members, laborers and community members from pesticide risks
- Maintain economically sound practices
- Reduce environmental pollution and degradation risks
- Enhance the overall quality and quantity of biodiversity on the sustainable farm work environment
- Respond to foreign market demand for the use of agriculture sector best management practice standards, also called Good Agriculture Practices (GAPs) which include IPM measures, to achieve farm and produce certification
- Comply with local, regional, donor and international laws, conventions, and regulations

Organization of the PMP

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

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

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

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

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

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

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

- Photographs of each pest, life stages
- Photographs of plant or livestock damage
- Description of the pest, life cycle and survival strategies[16]:
- Description of damage symptoms

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

- Best Prevention Practices
    - Use any and all of the above GAPs including IPM
    - Country or region-specific information
- Best Management Practices
    - Focus on prevention (above)
    - Country or region-specific information

Information on PMP-recommended pesticides:

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

Pesticide essential information needed

- Active Ingredient (AI) name
- Product Trade names (with EPA and WHO Acute Toxicity Classifications in parenthesis)
- Amounts to use per hectare
- PHI
- Special comments on best application methods and frequency
- Specialized training/certification/permits for use of RUPs
- Any resistance management strategies needed
- Pesticide application record sheet
- Guidelines for reducing spray drift
- Re-entry interval (REI): field safe re-entry period after spraying
- Maximum residue levels (MRL) permitted by markets
- Pesticide precautions with use including
- Reading the label
- Legal responsibilities and permitted registration uses
- Permit requirements for possession and use
- Recommended and obligated use of PPE and best practices
- First aid and antidotes
- Transportation best practices
- Storage best practices
- Safe use best practices
- Container disposal best practices

- Leftover pesticide disposal best practices
- Protection of non-pest animals, plants, endangered species and water body quality
- Protect natural enemies & honeybees: http://www.ipm.ucdavis.edu/PMG/r58431011l.html
- Posting signage in treated fields
- Some chemicals not permitted on processed crops
- Potential for phytotoxicity (crop injury) on some crops
- Documentation and record-keeping on farms

Information needed on Natural Enemies of Pests:

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

Additional Information Needed:

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

ANNEX 3. ELEMENTS OF IPM PROGRAM

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

Step 1: Learn and value farmers' indigenous IPM tactics. Most farmers are already using their own forms of GAPs and IPM, many of which are novel, self-created, adapted for local conditions, and many of which work well. These local tools and tactics need to be well understood and taken into account when making PMPs. Accurate assessments of these farmer's GAP and IPM technologies, as well as an understanding of actual losses due to different constraints in farmers' fields are required before designing a crop production and pest management program. S&C farmers will have records of historical pesticide use and trends, as well as information on current use of artisanal or local IPM tactics.

Step 2: Identify key pests for each target crop. Although perhaps up to ten species of pests may impact a crop and yields at different plant growth stages, generally only two or three are considered serious enough to spend money controlling. Farmers should be encouraged to monitor their population size, their life cycle, the kind of damage they cause and actual losses. Note that crop loss figures based on farmers' perceptions of damage and loss are often overestimated.

Step 3: Evaluate all management options. Use of best management practices, preventive measures, and "organic" options to control pest impacts may eliminate the need for synthetic pesticides.

Step 4: Choose IPM methods, identify Needs and Establish Priorities.

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

Step 5: Do effective activities and training to promote IPM.

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

Learning-by-doing/discovery training programs

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

Smallholder support and discussion groups

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

Educational material

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

Youth education

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

Food market incentives (especially important in the last decade)

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

Step 6: Partner successfully with other IPM implementers.

The following design steps are considered essential.

Articulate the partnership's vision of IPM

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

Confirm partner institutions' commitment

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

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

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

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

Step 7: Monitor the fields regularly.

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

Step 8: Select an appropriate blend of IPM tools.

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

Step 9: Develop education, training, and demonstration programs for extension workers.

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

Step 10: Monitoring, Record-Keeping and Evaluation (M&E).

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

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

ANNEX 4. NATURAL PESTICIDES THAT HAVE BEEN COMMERCIALIZED:

Insecticides

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

Fungicides

Bacillus subtilis	microbial

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

Nematocides

Myrothecium verrucaria	microbial
tomatillo oil + thyme oil extracts (Promax[17])	botanical + spice extracts—soil biopesticide

Molluscicide

iron phosphate	inorganic

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

ANNEX 5. BOTANICAL PESTICIDES, REPELLENTS, AND BAITS REGULATED BY USEPA

Name	Other Names	Use	Toxicity	EPA Tracking Number
Allium sativum	Garlic	Repels insects	Low	128827
Allyl isothiocyanate	Oil of Mustard	Kills & repels insects	Questionable	004901
Anise Oil	Repels vertebrates	Low	004301	
4-allyl anisole	Estragole	Kills beetles	Low	062150
Azadirachtin	*Azadirachta indica* Neem tree extract	Kills & repels insects	Low, IV	121701
Bergamot		Repels vertebrates		129029
Canola Oil	*Brassica Napus B. Campestris*	Kills many insects	Low	011332
Capsaicin	*Capsicum frutescans*	Repels vertebrates	Low, III	070701
Castor Oil		Repels vertebrates	Low	031608
Cedarwood Oil		Repels moth larvae	Low	040505
Cinnamaldehyde	*Ceylon and Chinese* cinnamon oils	Kills insects, fungi & repels vertebrates*	Low	040506
Citronella Oil		Repels insects & vertebrates	Low	021901
Cloves, Crushed			Low	128895
Dihydroazadirachtin	Neem tree extract	Kills & repels insects	III-IV	121702

	Azadirachta indica			
Eucalyptus Oil		Repels insects, mites fleas & mosquitoes	Low	040503
Eugenol	Oil of cloves	Kills insects**	Low	102701
Geraniol	Oil of rose isomeric w/ linalool	Repels vertebrates**	Low	597501
Geranium Oil			Low	597500
Indole	from all plants	Trap bait: corn rootworm beetles	Low	25000-
Jasmine Oil			Low	040501
Jojoba Oil		Kills & repels whitefly kills powdery mildew	Low	067200
Lavandin Oil		Repels clothes moth	Low	040500
Lemongrass		Repels vertebrates	Low	040502
Linalool	Oil of Ceylon isomeric w/geraniol	Repels insects, ticks, mites & spiders	Low	128838
Maple lactone		Roach trap bait	Low	004049
Methyl salicylate	Oil of wintergreen	Repels moths, beetle & vertebrates	May be Toxic in large quantity	76601-
Mint	Herb	Kills aphids	Low	128892
Mint Oil		Kills aphids	Low	128800
Mustard Oil		Repels insects, spiders & vertebrates	Low	004901
Neem Oil		Kills whitefly, aphids	Low	025006
1-Octen-3-ol	From clover, alfalfa	Trap bait: mosquitoes	Low	69037-

Orange		Repels vertebrates	Low	040517
p-Methane-3,8 diol	*Eucalyptus sp.*	Repels biting flies, mosquitoes	Low	
2-Phenylethyl-propionate	From peanuts	Kills insects, ticks, mites & spiders	Low	102601
Pyrethrum	*Chrysanthemum sp.*	Stored products use	III	
Red pepper	Chilli	Repels insects	Low	070703
Rosemary	Herb		Low	128893
Rotenone	*Derris sp., Tephrosia*	Controls ticks	III	
Ryania	*Ryania speciosa*	Kills thrips, codling moth, corn borers		
Sabadilla	*Schoenocaulon sp.*		III	
Sesame Oil	*Sesamum indicum*	Pyrethroid synergist	Low	
Soybean Oil	Soja	Kills insects, mites	Low	031605
Thyme	Herb	Controls aphids	Low	128894
1,2,4 Trimethoxy-benzene	From squash	Trap bait: corn rootworm, cucumber beetles	Low	40515-
Verbenone	From pine trees	Repels bark beetles	Low	128986

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

ANNEX 6. 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 or 'technical' ingredient)

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

ANNEX 7: ANALYSES OF ACTIVE INGREDIENTS IN PESTICIDES REGISTERED IN MOROCCO

Introduction to Annex 7

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

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

See Annex 7 Matrix, below.

Key to matrix:

- WHO Acute Toxicity Classes: O = Obsolete; Ia = Extremely Hazardous; Ib = Highly Hazardous; II = Moderately Hazardous; III = Slightly Hazardous; U = Unlikely to present acute hazard in normal use
- EPA Acute Toxicity Classes: I = Extremely Toxic; II = Highly Toxic; III = Moderately Toxic; IV = Slightly Toxic
- Chronic Human Toxicity: KC = Known Carcinogen; PC = Possible Carcinogen; ED = Endocrine Disruptor Suspect; RD = Reproductive & Development Toxin; P = Parkinson's
- Ecotoxicity: PNT = Practically Not Toxic; NAT = Not Acutely Toxic; ST = Slightly Toxic; MT = Moderately Toxic; HT = Highly Toxic; VHT = Very Highly Toxic

Red shading: Do not promote, procure or use on USAID-supported activities.

Yellow shading: Do additional research to find products not RUP, not Class I, not carcinogen, not water pollutants.

Green shading: Permitted for use on and by USAID projects, but with PPE.

Morocco MEC Pesticide Active Ingredients in Products Registered

Active Ingredients	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	Ecotoxicity								
								fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Miticides/Acaricides																
abamectin/avermectin	microbial	yes	no	none	II, III	RD	no data	ST	HT	PNT				HT	VHT	VHT
acequinocyl	unclassified	yes	no	none	III	none	no data	MT	MT	MT		MT		HT		
acrinathrin	synthetic pyrethroid	**no**	no	U	IV	ED	no data	MT	ST	MT		MT		MT		
amitraz(e)	formamdine	yes	no	III	II	PC, RD	no data	MT	PNT	ST	ST			NAT		ST
clofentezine	tetrazine	yes	no	U	III	PC, ED	no data	ST	PNT	ST						ST
cotton oil	biological	yes	no	none	IV	none	no data									
cyhexatin	organotin	**no**	no	none	**I**	RD	no data	VHT		ST	VHT					VHT
dicofol	organochlorine	yes	no	III	III	PC, ED	no data	HT	NAT	ST		MT	MT	HT	MT	MT
essence of girofle (clove oil)	biological	yes	no	none	none	none	no data									
etoxazole	IGR	yes	no	none	III	none	no data	MT	MT	MT		MT		HT		
farnesol	biological pheromone	yes	no	none	II	none	no data	MT								
fenazaquin	inorganic	yes	no	none	II	none	no data	HT								
fenbutatin oxide	organotin	yes	**most**	U	III	ED, RD	no data	VHT	NAT	MT		MT		HT		VHT
flufenzin(e)	unclassified	**no**	no	none	none	none	no data									
formetanate	formamadine	yes	no	**Ib**	**I**	none	potential	MT	HT	HT		ST		HT		MT
geraniol (geranium extract)	botanical	yes	no	none	II	none	no data	MT								
halfenprox	synthetic pyrethroid	**no**	no	none	none	ED	no data	HT	ST	MT		MT		HT		
hexythiazox	IGR	yes	no	U	III	PC	no data	HT	NAT	MT		MT		MT		
milbemectin	microbial	yes	**one**	none	II, III	none	potential	HT	HT	MT		MT		HT		
mineral oil	petroleum/parafin	yes	no	none	III	none	no data	NAT								
nerolidol	biological pheromone	yes	no	none	II	none	no data	MT								
parafin oil	petroleum	yes	no	none	III	none	no data	NAT								
propargite	unclassified	yes	**most**	none	**I**	PC, RD	no data	HT	PNT		HT			NAT		HT
propylene glycol (monolorate)	glycol	yes	no	none	III	none	no data	NAT					ST	NAT		NAT
pyridaben(e)	unclassified	yes	no	II	II & III	none	no data	VHT	HT	ST		MT		HT		VHT
rotenone	botanical	yes	no	II	III	none	no data	HT	HT	HT	HT		MT	MT	MT	MT
spirodiclofen(e)	keto-enol	yes	no	none	III	PC	no data	MT	HT	NAT		NAT	MT	MT	MT	
spiromesifen	keto-enol	yes	no	III		none	no data	HT	ST	MT		MT				
tau fluvalinate	synthetic pyrethroid	yes	no	U	III	ED, RD	no data	HT	MT	ST		MT		HT		
tebufenpyrad	pyrazole	yes	no	III	II	none	no data	HT	MT	MT		MT		HT		
teflubenzuron	insect growth regulator	**no**	no	U	IV	none	no data	ST	MT	ST	ST	HT	HT	HT	HT	HT
tetradifon	bridged diphenyl	**no**	no	U	III	none	no data	MT	MT	NAT	MT	NAT	ST	ST		MT

Morocco MEC Pesticide Active Ingredients in Products Registered

Active Ingredients	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	Ecotoxicity								
								fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Insecticides																
abamectin(e)	microbial	yes	**some**	none	II, III	RD	no data	ST	HT	PNT				HT	VHT	VHT
acetamiprid	chloro-nicotinyl	yes	no	none	III	none	no data	NAT	MT	HT				NAT		
acrinathrin	pyrethroid	**no**	no	U	IV	ED	no data	MT	ST	MT		MT		MT		
alanycarb	carbamate	**no**	no	II	none	none	no data	MT	HT	NAT				MT		
alphacypermethrin/alphamethrin(e)	pyrethroid	**no**	no	none	II, III	PC	no data	HT	HT	PNT			MT	VHT	VHT	VHT
aluminum phosphide	inorganic	yes	**all**	none	**I**	none	no data	HT	HT	HT				MT		
allyl isothiocyanate (mustard oil)	botranical	yes	no	none	III	none	no data	VHT								
azadirachtin (neem extract)	botanical	yes	no	none	III	none	no data	ST	NAT	NAT	MT				MT	
azinphos-methyl	organophospate	yes	**most**	**Ib**	**I**	none	potential	HT	HT	MT	MT	HT	MT	VHT	VHT	MT
Bacillus thuringiensis-BT	microbial	yes	no	none	III	none	no data		PNT	NAT	NAT		ST	ST		
beta cyfluthrin(e)	pyrethroid	yes	**some**	II	II, III	ED	no data	VHT	HT	PNT			ST		VHT	VHT
beta cypermethrin	pyrethroid	yes	no	none	II, III	PC	no data	HT	HT	ST				HT		
bifenthrin(e)	pyrethroid	yes	**some**	II	II, III	PC, ED, RD	no data	VHT	HT	MT				HT		
bifenzate	hydrazine carboxylate	yes	no	none	III	none	no data	HT	MT	MT		MT				
buprofezin(e)	IGR	yes	no	U	III	PC	no data	MT	ST	MT	NAT	MT				
capsaicin/chili pepper extract	botanical	yes	no	none	III	none	no data									
carbaryl	carbamate	yes	no	II	III	PC, ED	potential	MT	HT	PNT	MT	VHT	ST	HT	HT	MT
carbofuran	carbamate	yes	**most**	**Ib**	**I**, II	ED	potential	MT	HT	HT	ST	MT	MT	HT	HT	VHT
chlorantraniliprole (rynaxypyr)	anthranilic diamide	yes	no	none	IV	none	no data	NAT	MT	MT		MT		HT		
chlorfenapyr	pyrazole	yes	no	II	III	PC	no data	HT	HT	HT						
chlorpyrifos (ethyl)	organophospate	yes	**some**	II	II, III	ED	no data	HT	HT	HT	MT	PNT	MT	VHT	HT	MT
chlorpyrifos (methyl)	organophospate	yes	no	U	I, III	none	no data	MT	HT	MT	MT			VHT	VHT	MT
chromafenozide	IGR, ecdysone mimic	**no**	no	none	none	none	no data	MT	MT	ST		MT				
cinnamaldehyde	botanical (spice)	yes	no	none	III	none	no data									
cyflumetofen	bridged diphenyl	**no**	no	none	none	none	no data	MT		MT		MT		HT	HT	
cypermethrin(e)	pyrethroid	yes	**some**	none	II, III	PC	no data	HT	HT	PNT			MT	VHT	VHT	VHT
cyromazine	triazine	yes	no	U	III	none	**known**	MT	ST	MT		MT		MT	NAT	
deltamethrin(e)	pyrethroid	yes	**cotton**	II	II, III	none	no data	HT	MT		VHT		NAT		VHT	VHT
diazinon	organophosphate	yes	**some**	II	II, III	ED, RD	potential	MT	HT	VHT	MT	MT	MT	HT	HT	HT
dichlorvos (DDVP)	organophospate	yes	no	**Ib**	**I**	PC, ED	no data	MT	HT	HT				HT		
diflubenzuron	benzoyl urea IGR	yes	**some**	U	III	none	no data	ST	NAT	PNT	NAT		NAT	NAT	ST	MT
dimethoate	organophospate	yes	no	II	II	PC	potential	ST	VHT	VHT	HT	MT	VHT	HT	VHT	MT

Morocco MEC Pesticide Active Ingredients in Products Registered

Active Ingredients	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	Ecotoxicity								
								fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Insecticides																
dioctyl sulfosuccinate sodium	unclassified	yes	no	none	III	none	no data	ST								
emamectin benzoate	botanical	yes	**yes**	none	I, III	none	no data	HT	MT				HT	HT	HT	
esfenvalerate	pyrethroid	yes	**some**	II	II, III	ED	no data	VHT	HT	ST	VHT		ST	HT		
essence of orange (limonene)	botanical	yes	no	none	III	none	no data	MT						MT	ST	
ethofenprox	pyrethroid	yes	no	U	III	PC, RD	no data	HT	HT	MT		MT		HT		
fenthion	organophospate	yes	**half**	II	II	none	potential	MT	MT	VHT	VHT		HT	HT	VHT	VHT
flonicamid	pyridine	yes	**some**	none	II, III	none	no data	MT	MT	MT						
flubendiamide	benzene dicarboxamide	yes	no	none	III	none	no data	HT	NAT	MT		MT		HT		
flufenoxuron	benzoyl urea	**no**	no	U	III	none	no data	HT	ST	MT		MT		HT		
formetanate	formamadine	yes	no	**Ib**	**I**	none	potential	MT	HT	HT		ST		HT		MT
gamma cyhalothrin	pyrethroid	yes	**some**	III	I, II, III	ED	no data	HT	HT	ST				HT		
granulosis virus	biological	**no**	no	none	none	none	no data									
imidacloprid	chloro-nicotinyl	yes	no	II	II, III	none	potential	NAT		MT					VHT	
indoxacarb	oxadiazine	yes	no	O	III	none	no data	MT	HT	HT		NAT		MT		
lambda cyhalothrin(e)	pyrethroid	yes	**some**	II	II, III	ED	no data	VHT	HT	PNT		VHT	VHT	VHT	VHT	
d-limonene/limonene	botanical citrus extract	yes	no	none	III	none	no data	NAT					MT	MT	ST	VHT
lufenuron	benzoyl urea	yes	no	none	III	none	no data	MT	ST	MT		MT		HT	ST	
malathion	organophospate	yes	no	III	II, III	PC, ED	potential	MT	HT	MT	HT	ST	VHT	MT	VHT	HT
maltodextrin(e)	polysaccharide	**no**	no	none	none	none	no data									
mercaptodimethur/methiocarb(e)	carbamate	yes	**half**	**Ib**	**I**, III	none	potential	HT	HT	MT	MT	MT	MT	MT	HT	HT
metaflumizone	semicarbazone	yes	no	none	III	none	no data	MT	NAT	NAT				MT		
methamidophos	organophospate	**no**	no	**Ib**	**I**	none	potential	ST			ST			VHT		MT
methidathion	organophospate	yes	**half**	**Ib**	**I**, II	PC	potential	MT	ST	HT		ST	ST	HT	VHT	ST
methomyl	carbamate	yes	**two**	**Ib**	**I**, III	ED	potential	MT	HT	HT	ST	HT	ST	HT	VHT	HT
methoxyfenozide	diacylhydrazine	yes	no	U	III	none	potential	MT	MT	ST		ST			HT	MT
milbemectin	microbial	yes	**one**	none	II, III	none	potential	HT	HT	MT		MT		HT		
mineral oil (white)	petroleum/parafin	yes	no	none	III	none	no data	NAT								
mono potassium phosphate	inorganic	yes	no	none	III	none	no data									
mono+dipotassium phosphate	inorganic	yes	no	none	III	none	no data									
novaluron	benzoyl urea IGR	yes	no	none	II, III	none	no data	MT	MT	MT		MT		HT		
Paecilomyces fumosoroseus	microbial	yes	no	none	III	none	no data									
parafin mineral oil	petroleum	yes	no	none	III	none	no data	NAT								
permethrin(e)	pyrethroid	yes	no	II	III	PC, ED	no data	VHT	VHT	PNT	ST	ST	ST	VHT	MT	MT

petroleum oil	mineral oil	yes	no	none	III	none	no data	NAT								
phenthoate	organophospate	**no**	no	II	II	ED	no data	HT	HT	MT			MT	HT	VHT	VHT
phosalone	organophospate	**no**	no	II	II	none	potential	HT	PNT	ST			MT	HT		

Morocco MEC Pesticide Active Ingredients in Products Registered

								Ecotoxicity								
Active Ingredients	**Class**	**EPA Registered**	**Restricted Use Pesticide**	**WHO Acute Toxicty Class**	**EPA Acute Toxicity Classes**	**Chronic Toxicity**	**Groundwater contaminant**	**fish**	**bees**	**birds**	**amphibians**	**worms**	**Mollusks**	**Crustaceans**	**Aquatic Insects**	**Plankton**
Insecticides																
phosmet	organophospate	yes	no	II	**I**, II, III	PC	potential	MT	VHT	MT		NAT	ST	HT	MT	HT
pirimicarb	carbamate	yes	no	II	II	none	no data	NAT	PNT		ST				MT	
pirimiphos-methyl	organophospate	yes	no	III	III	none	no data	MT	HT	MT						
pymetrozine	triazine	yes	no	III	III	PC	potential	MT	ST	MT		MT		MT		
pyriproxyfen(e)	IGR (JH mimic)	yes	no	U	II, III	none	no data	MT	MT	MT		MT		MT		VHT
Quillaja saponaria extract	botanical	yes	no	none	II	none	no data									
spinosad(e)	microbial	yes	no	U	III	none	no data	MT	HT	PNT		ST			HT	MT
spinetoram	unclassified	yes	no	none	III	none	no data	MT		NAT		MT		MT		
spirodiclofene	keto-enol	yes	no	none	II	PC	no data	HT	NAT	MT		MT		HT	HT	
spiromesifen	keto-enol	yes	no	none	III	none	no data	HT	ST	MT		MT				
sulfur (sulphur)	Inorganic	yes	no	U	III	none	no data	NAT	NAT	NAT	NAT					NAT
tau fluvalinate	pyrethroid	yes	no	U	III	ED, RD	no data	HT	MT	ST		MT		HT		
tefluthrin	synthetic pyrethroid	yes	**corn seed**	Ib	III	ED	no data	VHT	HT	PNT			HT	HT	HT	HT
thiacloprid	chloro-nicotinyl	yes	no	II	II	PC	no data		MT	ST		MT			VHT	ST
thiamethoxam	neonicotinoid	yes	no	none	III	PC	no data	PNT	HT	PNT		PNT	PNT	PNT	PNT	
thiocyclam hydrogen oxalate	nereistoxin	**no**	no	II	none	none	no data	HT	MT	HT	HT			HT		
trichlorfon	organophospate	yes	no	II	II, III	PC	no data	ST	PNT	HT	ST	ST	MT	MT	MT	ST
Verticillium lecanii	microbial	**no**	no	none	none	none	no data	MT	NAT							
zeta cypermethrin	pyrethroid	yes	**some**	**Ib**	II, III	PC, ED	no data	VHT	VHT	NAT		NAT	VHT	VHT	VHT	

Morocco MEC Pesticide Active Ingredients in Products Registered

Active Ingredients	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	Ecotoxicity								
								fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Fungicides																
alkyldimethylbenzyl ammonium chloride	quaternary ammonium	yes	no	none	**I**	none	no data	HT				MT	MT	HT	MT	HT
ametoctradin	triazolopyrimadine	**no**	no	NT	none	none	no data	HT	MT	MT		NAT		MT	NAT	
ascorbic acid/Vitamin C	organic acid		no	none	none	none	no data									
Aureobasidium pullulans	biological	**no**	no	none	none	none	no data									
azoxystrobin(e)	strobin	yes	no	U	III	none	potential	MT	MT	MT		MT		MT		VHT
Bacillus subtilis	bacterial	yes	no	U	III, IV	none	no data	NAT	ST	NAT		NAT		NAT		
benalaxyl	xylylalanine	**no**	no	U	none	none	no data	MT	MT	ST		MT		MT		
benalaxyl-M	phenylamide	**no**	no	U	none	none	no data	MT	ST	ST		MT		MT		
bitertanol	azole	**no**	no	U	none	none	no data	MT	PNT	PNT		PNT		MT		MT
bixafen	pyrazole	**no**	no	none	none			HT	MT	MT		MT		MT	MT	
boscalid (nicobifen)	carboximide (anilide)	yes	no	none	II, III	PC	no data	MT	MT	MT		MT		MT		
bupirimate	pyrimidinol	**no**	no	U	III	none	no data	MT	MT	ST		MT		MT		
captan(e)	thiopthalamide	yes	no	none	**I**, II, III	**LK at hi doses**	no data	HT	NAT	PNT	MT		MT	NAT	MT	MT
carbendazim(e)	benzimidazole	yes	no	U	III	PC, ED	no data	MT	NAT	ST	ST			ST		HT
carboxin(e)	oxathiim	yes	no	U	III	RD	no data	MT	MT	NAT		MT		NAT		
chlorothalonil	chloronitrile	yes	no	none	**I**, II	PC	potential	VHT			HT		ST	VHT	MT	MT
copper (metalic)	inorganic	yes	no	none	II, III	none	no data	MT			VHT	HT	HT	MT		HT
copper hydroxide	inorganic	yes	no	II	II, III	none	no data	HT	MT	MT		MT	HT	NAT	HT	HT
copper oxide	inorganic	yes	no	none	I, III	none	no data	NAT								
copper oxychloride	inorganic	yes	no	none	II, III	none	no data	MT	MT	MT		MT				
copper sulfate	inorganic	yes	no	II	**I**, III	none	no data	MT	HT	PNT	HT	HT	VHT	ST		ST
cyflufenamide	amide	**no**	no	none	none	none	no data	MT	MT	MT		MT		MT	MT	
cymoxanil	unclassified	yes	no	III	III	none	no data	MT	MT	ST		MT		MT	MT	ST
cyproconazole	azole	yes	no	III	III	PC	no data	MT	MT	MT		MT				MT
difenoconazole	azole	yes	no	III	III	PC	no data	MT	MT	ST		MT		MT		HT
dimethomorph	morpholine	yes	no	U	III	none	no data	MT	MT	MT		MT				ST
dimoxystrobine	strobilurin	**no**	no	none	none	none	no data	HT	MT	MT		MT		HT	MT	
dinocap	dinitrophenol	**no**	no	III	III	RD	no data	HT	MT	ST		MT		HT		VHT

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Active Ingredients	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	Ecotoxicity								
								fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Fungicides																
epoxiconazole	triazole	**no**	no	none	none	PC	no data	MT	MT	MT		MT				
famoxate (famoxadone)	oxazole	yes	no	U	III	none	no data	HT	MT	ST				HT		
fenamidone	unclassified	yes	no	none	II, III	none	no data	MT	MT	MT		MT		MT		
fenarimol	pyrimidine	yes	no	U	III	ED	potential	MT	MT	MT			ST	MT	MT	
fenbuconazole	triazole	yes	no	U	III	PC, ED	no data	MT	MT	ST		MT		MT		HT
fenhexamid	hydroxyanilide	yes	no	U	III	none	potential	MT	MT	MT		MT		MT		MT
fentin hydroxide	organotin	yes	**half**	II	**I**	**KC**, ED, RD	no data	MT	MT	HT		MT	HT	NAT		VHT
fludioxonil	phenylpyrrole	yes	no	U	III	none	potential	MT	MT	MT		MT		MT		
fluopicolide	benzamide	yes	no	none	III	none	no data	MT	MT	NAT		MT		MT		
fluopyram	benzamide	**no**	no	none	none	none	no data	MT	MT	MT		MT		MT		
fluquinconazole	triazole	**no**	no	none	none	none	no data	MT	MT	MT		MT		MT		
flusilazole	azole	**no**	no	III	III	none	no data	MT	MT	MT		MT		MT		
flutriafol	triazole	**no**	no	III	none	ED	potential	MT	MT	LT		MT		MT		
folpet	thiophthalimide	yes	no	U	II, III	PC	no data	HT	PNT	ST	HT	MT	ST	HT		MT
fosetyl aluminum	unclassified	yes	no	none	III	none	potential	NAT	ST	ST		MT		NAT		MT
guazatine acetate	guanidine	**no**	no	II	none	none	no data	MT	MT	MT		MT		MT		
hexaconazole	azole	**no**	no	U	IV	PC	no data	MT	HT	NAT		MT		MT	NAT	
hymexazol	unclassified	yes	no	U	II	none	potential	NAT			NAT			ST		ST
imazalil	imidazole	yes	no	II	II, III	PC, RD	no data	MT	NT	PNT						
iminoctadine tris (albesilate)	guanidine	**no**	no	II	none	none	no data			MT						
iprodione	dicarboximide	yes	no	U	III	PC	potential	MT	NAT	ST				HT		
iprovalicarb(e)	unclassified	**no**	no	U	none	**LC**	no data	MT	ST	MT		MT				
kresoxim-methyl	strobin	yes	no	U	III	PC	potential	ST	ST	ST		MT		MT		VHT
laminaire (laminarine)	polysaccharide carbo.	**no**	no	none	none	none	no data	MT	MT	MT				MT		
limonene/d-limonene	botanical	yes	no	none	II, III	none	no data	NAT				MT	MT	MT	ST	VHT
mancozeb(e)	dithiocarbamate	yes	no	U	III	PC, ED, RD	no data	MT	MT	ST	HT					NAT
mandipropamid(e)	mandelamide	yes	no	none	III	none	no data	MT	MT	ST		MT		MT		
maneb	carbamate	**no**	no	U	III	**KC**, ED, RD	no data	MT	NAT	PNT	ST			ST		HT
mefenoxam (metalaxyl-M)	phenylamide	yes	no	II	**I**, II, III	none	no data	MT	NAT	MT		MT		MT		
mepanipyrim(e)	anilinopyrimidine	**no**	no	U	none	**LC**	no data	MT	MT	NAT		MT		MT	MT	

Morocco MEC Pesticide Active Ingredients in Products Registered

Active Ingredients	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	Ecotoxicity								
								fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Fungicides																
meptyldinocap	dinitrophenol	**no**	no	none	none	none	no data	HT	MT	NAT	HT	MT	HT	HT		
metalaxyl	benzanoid	yes	no	III	II, III	none	potential	ST	PNT	PNT						ST
metconazole	triazole	yes	no	none	II, III	none	no data	MT	MT	MT		MT		MT		
metiram (zinc)	dithiocarbamate Zn	yes	no	U	III	PC, RD	no data	ST	PNT	ST		MT		MT		MT
mono+dipotassium salts of phosphoric acid	inorganic	yes	no	none	III	none	no data									
myclobutanil	azole	yes	no	III	III	R, D toxin	no data	MT	ST	MT		MT		MT		HT
neem oil	botanical	yes	no	none	III	none	no data	NAT					NAT		NAT	
ofurace	anilide	**no**	no	U	none	none	no data	MT	MT	NAT						
ortho-phenylphenol	phenol	yes	no	none	**I**, II, III	**LC**(hi dose), ED, RD	no data	MT					MT			HT
picoxystrobin(e)	strobin	**no**	no	none	none	none	no data	HT	NAT	NAT		HT		HT	NAT	
potassium bicarbonate	inorganic	yes	no	none	III	none	no data									
procymidone	unclassified	**no**	no	U		**KC**, ED	no data	MT	NAT		NAT		MT	MT	ST	MT
propamocarb	carbamate	**no**	no	U	III	none	no data	ST					NAT			NAT
propamocarb HCl	carbamate	yes	no	none	III	none	no data	MT	MT	MT		MT		MT		
propiconazole	azole	yes	no	II	II, III	PC, RD	potential	MT					MT	ST	MT	MT
propineb(e)	dithiocarbamate Zn	**no**	no	U		RD	no data	MT	PNT	PNT			MT	MT	MT	MT
proquinazid(e)	unclassified	**no**	no	III		none	no data	MT					MT	MT		MT
prothioconazole	triazolinthione	yes	no	none	III	none	no data	MT	MT	MT		MT		MT		
pyraclostrobin(e)	strobin	yes	no	none	II, III	none	no data	ST	MT	MT		MT		HT		
pyrimethanil	anilinopyrimidine	yes	no	U	III	PC, ED	no data	MT		PNT	MT		MT	MT	MT	
quinoxyfen	quinoline	yes	no	U	III	none	no data	MT	MT	NAT		MT		HT		
oils (vegetables-soy)	botanical	yes	no	none	III	none	no data									
spiroxamine	unclassified	yes	no	II	III	none	no data	MT	MT	MT		MT		MT		
sulfur (sulphur)	Inorganic	yes	no	U	III	none	no data	NAT	NAT	NAT	NAT					NAT
tebuconazole	azole	yes	no	III	II, III	PC	potential	MT	MT	MT		MT		MT	MT	HT
tetraconazole	azole	yes	no	II	III	PC	potential	MT	MT	MT		MT				
thiabendazole	azole	yes	no	U	III	PC, RD	no data	ST	NAT		MT	ST				ST
thiophanate methyl	benzamidazole	yes	no	U	III	PC, RD	potential	MT	PNT		NAT			ST		
thiram(e)	dithiocarbamate	yes	no	III	III	ED, RD	no data	HT	NAT	PNT	VHT	HT		NAT	HT	HT

Morocco MEC Pesticide Active Ingredients in Products Registered

Active Ingredients	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	Ecotoxicity								
								fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Fungicides																
tolclofos-methyl	chlorophenyl	**no**	no	U	III	none	no data	MT	MT	NAT		MT		MT		
tolylfluanid	sulfamide	**no**	no	U		PC	no data	MT	LT	HT		MT				
triadimenol	triazole	yes	no	III	II, III	PC	no data	MT	ST	MT		MT				
triasulfuron	sulfonylurea	yes	no	U	III	none	no data	NAT	MT	NAT		MT		MT		ST
Trichoderma harzianum	microbial	yes	no	U	III	none	no data									
Trichoderma viride	microbial	**no**	no	none	III	none	no data									
tricyclazole	azole	**no**	no	II	II	none	no data	MT	MT	MT	ST	MT				ST
trifloxystrobin(e)	strobin	yes	no	none	III	none	no data	ST	ST	MT		MT				
triflumizole	imidazole	yes	no	III	III	none	potential	HT	MT	ST				MT		
triticonazole	azole	yes	no	U	III	none	potential	MT	MT	MT		MT		MT		
valiphenal/valinalate	acylamino acid	**no**	no	none	none	none	no data	MT	MT	NAT		MT		MT		
ziram(e)	dithiocarbamate	yes	no	III	III	PC, ED, RD, P	no data	HT	NAT	MT	HT		MT			HT
zoximide	benzimide	yes	no	none	III	none	potential	MT	MT	MT		HT				
Herbicides																
2 4 D amine salt	chlorophenoxy	yes	no	none	none	PC	no data									
2 4-D dimethylamine salt	chlorophenoxy acid	yes	no	II	III	PC	potential	NAT			NAT		ST	NAT		NAT
2 4 D ester	chlorophenoxy acid	yes	no	none	none	PC	no data									
2 4 D ethyl hexylester	chlorophenoxy acid	yes	no	none	II, III	PC, ED, RD	potential	ST								MT
2 4 D isooctyl ester	chlorophenoxy acid	yes	no	none	III	PC	potential	ST								MT
2 4 D isopropylamine salt	chlorophenoxy	yes	no	none	II, III	PC	potential	NAT						NAT		
acetochlor	chloroacetanilide	yes	**some**	III	II, IIII	KC, ED	potential	MT	MT	ST		MT				MT
aminopyralid	pyridine	yes	no	none	III	none	potential	MT	MT	MT		MT		MT		
amitrol (aminotriazole)	triazole	yes	no	U	III	**LC** (hi dose), ED	potential	NAT	MT	NAT		MT		ST		ST
ammonium thiocyanate	inorganic	**no**	no	none	none	none	no data	MT				NAT		NAT		ST
bentazon(e)	benzothiazinone	yes	no	III	III	none	no data	NAT	MT	MT		MT	ST	MT		
clethodim(e)	cyclohexenone	yes	no	none	II, III	none	potential	MT	MT	MT		MT		MT		
clodinafop-propargyl	a propionic acid	yes	no	III	II, III	PC, RD	no data	HT	MT	MT						
clopyralid	pyridinecarbxilic acid	yes	no	none	II, III	none	potential	PNT		PNT	PNT				NAT	

Morocco MEC Pesticide Active Ingredients in Products Registered

Active Ingredients	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	Ecotoxicity								
								fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Herbicides																
cloquintocet-mexyl	herbicide safener	**no**	no	none		none	no data	MT	MT	MT		MT		MT		
cycloxydim(e)	cyclohexanone	**no**	no	U		none	no data									
cyhalofop-butyl	phenoxypropionate	yes	no	U	II	none	no data	MT	MT	NAT		MT		MT		
desmedipham(e)	bis-carbamate	yes	no	U	I, II, III	none	no data	MT	MT	MT		MT		MT		
dicamba	a benzoic acid	yes	no	III	II, III	RD	potential	ST			NAT			NAT		ST
diclofop-methyl	phenoxypropionate	yes	**all**	III	**I**, II	PC, RD	no data	HT	NAT	ST						
dimethenamid-P	chloroacetamide	yes	no	none	II, III	none	no data	MT	NAT	MT		MT		MT		MT
ethofumesate	benzofuran	yes	no	U	III	none	potential	ST	MT	MT		MT		MT		MT
fenoxaprop-p-ethyl	propionic acid	yes	no	none	I, II, III	none	no data	MT	ST	PNT		ST		MT		MT
fluazifop-p-butyl	propionic acid	yes	no	III	II, III	none	no data	MT	ST	PNT					ST	
florasulam	triazolopyrimidine	**no**	no	U	none	none	**known**	MT	MT	MT		NAT		NAT		
flucarbazone sodium	triazolone	yes	no	U	III	none	no data	MT	ST	MT		MT		ST		
flumetsulam	triazolepyrimidine	yes	no	U	III	none	no data	NAT	MT	ST				ST		NAT
foramsulfuron	sulfonylurea	yes	no	none	III	none	potential	MT	ST	MT		MT		MT		
furilazole	herbicide safener	**no**	no	none	none	PC	no data	MT	MT	MT				MT		
glufosinate ammonium	unclassified	yes	no	none	II, III	none	no data	NAT	NAT	MT		MT		NAT		ST
glyphosate	phosphonoglycine	yes	no	U	II, III	none	potential	ST	ST	NAT		PNT		MT		ST
glyphosate, isopropylamine salt	phosphonoglycine	yes	no	none	II, III	none	potential	ST			ST	NAT	ST	NAT	NAT	NAT
haloxyfop-R-methyl ester	a propionic acid	**no**	no	none		**KC**	no data	HT	MT	MT				MT		
iodosulfuron methyl sodium	sulfonylurea	yes	no	none	III	none	no data	NAT	PNT	PNT		ST				
isoxaflutole	isoxazole	yes	**all**	none	III	**KC**	no data	ST	MT	ST		MT		MT		MT
lenacil(e)	uracil	**no**	no	U	IV	none	no data	MT	MT	MT		MT		MT		
linuron	urea	yes	no	U	III	PC, ED, RD	potential	MT	NAT	MT		MT	ST	MT	ST	MT
MCPA	chlorophenoxy acid	yes	no	II	II, IIII	PC	no data	ST	PNT	NAT	ST		ST	NAT	NAT	ST
mefenpyr diethyl	unclassified safener	**no**	no	none		none	no data	MT	NAT	MT		MT		MT		
mesosulfuron-methyl	sulfonylurea	yes	no	none	II, III	none	no data	MT	MT	MT		MT		MT		
mesotrione	unclassified	yes	no	none	II, IIII	none	no data	NAT	MT	MT		MT		NAT		
metamitron(e)	triazinone	yes	no	III	III	KC, RD	potential	NAT	MT	MT		MT		MT		
metosulam	triazolopyrimidine	**no**	no	U	none	none	no data	MT	MT	MT		MT		MT		
metribuzin(e)	triazinone	yes	no	II	II, III	ED	potential	MT	NAT	MT		MT		ST		ST
metsulfuron-methyl	sulfonyl urea	yes	no	U	III	none	potential	NAT	MT	NAT		MT		NAT		
nicosulfuron	sulfonylurea	yes	no	U	II, III	none	potential	MT	MT	MT		MT		MT		

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Active Ingredients	Class	EPA Registered	Restricted Use Pesticide	WHO Acute Toxicty Class	EPA Acute Toxicity Classes	Chronic Toxicity	Groundwater contaminant	Ecotoxicity								
								fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Herbicides																
oxadiazon	oxidiazole	yes	no	U	II, III	KC, RD	no data	MT	MT	ST	MT	MT		ST		HT
oxyfluorfen(e)	diphehyl ether	yes	no	U	II, III	PC	no data	HT	PNT	PNT			HT		HT	HT
paraquat	bipyridylium	yes	**most**	II	**I**	P	potential	ST	NAT	MT	ST		ST	ST	NAT	ST
pendimethalin(e)	dinitroanaline	yes	no	III	III	PC, ED	no data	MT	NAT	ST				MT	MT	
phenmedapham(e)	bis-carbamate	yes	no	U	II, III	none	potential	ST	MT			MT	ST	MT		
pinoxaden	unclassified	yes	no	III	II, III	none	no data	MT	MT	NAT		MT				
propaquizafop	a propionic acid	**no**	no	U		none	no data	MT	MT	MT		MT		MT		
propoxycarbazone sodium	triazalone	yes	no	none	III	none	potential	MT	NAT	MT		MT		NAT		
propyzamide	benzamide	yes	no	U	IV	PC, RD	potential	NAT	NAT	MT		MT		MT		MT
prosulfocarb(e)	thiocarbamate	**no**	no	II	none	none	no data	MT	MT			MT		MT		
prothioconazole	azole	yes	no	U	III	none	no data	MT	MT	MT		MT		MT	MT	
pyroxsulam	triazolopyrimidine	yes	**half**	none	II, III	none	no data	MT	MT	MT		NAT		MT		
quizalofop-p-tefuryl	aryloxyphenoxypropionate	yes	no	II	III	none	no data	MT	MT	NAT		MT		MT		
rimsulfuron	sulfonylurea	yes	no	U	III	none	potential	NAT	MT	NAT		MT				NAT
s-metolachlor	chloroacetanilide	yes	no	none	III	PC, ED	**known**	MT	ST	MT		MT		MT		
salflufenacil	amide	yes	no	none	II, III	none	no data									
sulfosulfuron	sulfonylurea	yes	no	none	III	PC	no data	ST	MT	NAT		MT	NAT			NAT
terbuthylazine	triazine	yes	no	U	III	none	no data	MT	MT	MT		MT		MT		HT
tralkoxydim	cyclohexadione	yes	no	III	III	PC	potential	MT		NAT						
tribenuron methyl	sulfonylurea	yes	no		III	PC	no data	ST	MT	ST		MT				
thifensulfuron-methyl	sulfonylurea	yes	no	U	III	none	potential	MT	MT	NAT		NAT		NAT		
triasulfuron	sulfonylurea	yes	no	U	III	PC, RD	potential	MT	MT	NAT		MT		MT		
trifluralin	dinitroanaline	yes	no	U	II, III	PC, ED	no data	HT	PNT	PNT	MT	HT	ST	ST	ST	MT
Rodenticides																
brodifacoum	coumarin	yes	no	**Ia**	III	none	no data	MT				MT				
chloralose (alpha)	chlorinated acetal glucose	**no**	no	II	II	none	no data			HT						
strychnine sulfate	botanical	**no**	**some**		**I**	none	no data	MT								

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								fish	bees	birds	amphibians	worms	Mollusks	Crustaceans	Aquatic Insects	Plankton
Nematocides																
dazomet	unclassified	yes	no	III	III	none	potential	ST	PNT	ST		MT		HT		HT
chloropicrin	unclassified	yes	**most**	none	II	none	potential	VHT				MT		HT		
DMDS (dimethyl disulfide)	unclassified fumigant	yes	**most**	none	II	none	no data									
ethoprop(hos)	organophosphate	yes	**all**	**Ia**	**I**	**LC**	potential	MT	MT	HT		MT		MT		
metam ammonium	dithiocarbamate	**no**	no	none	none	none	no data									
metam potassium	dithiocarbamate	yes	**few**	II	**I**	PC, ED, RD	no data	ST	MT	MT				MT		MT
metam sodium	dithiocarbamate	yes	**half**	II	**I**	PC, RD		MT	MT	MT		VHT		VHT		HT
methyl bromide	halogenated organic	yes	**all**	NL	**I**	RD, ED	no data	MT	PNT		MT	MT	MT	MT	MT	MT
Paecilomyces lilacinus Strain 251	microbial	yes	no	none	III	none	no data									
phenamiphos/fenamiphos	organophosphate	yes	**some**	**Ib**	**I**	none	potential	HT	HT	HT		MT		VHT		MT
sodium tetrathiocarbonate	unclassified	**no**	no	none	**I**	none	no data	ST								
Molluscicides																
metaldehyde	aldehyde	yes	no	II	II, III	PC	potential	NAT	PNT	MT	PNT	PNT	PNT	PNT	PNT	PNT
methiocarb (mercaptodimethur)	carbamate	yes	**half**	**Ib**	**I**, III	none	potential	HT	HT	MT	MT	MT	MT	MT	HT	HT
Soil Treatments for nematodes, insects, fungi, weeds																
allyl isothiocyanate (mustard oil)	botranical	yes	no	none	III	none	no data	VHT								
Beauveria basiana	microbial	yes	no	none	III	none	no data	NAT	NAT	NAT		NAT		NAT		
cadusafos	organophosphate	**no**	no	**Ib**	none	none	no data	HT	HT	HT			HT	HT	HT	
capsaicinoids (chili pepper extract)	botanical	yes	no	none	III	none	no data									
carbofuran	carbamate	yes	**most**	**Ib**	**I**, II	none	potential	MT	HT	HT	ST	MT	MT	HT	HT	VHT
carbosulfan	carbamate	**no**	no	II	II	none	no data	HT	HT	HT		HT		HT		
chloropicrin	unclassified	yes	**most**	none	II	none	potential	VHT				MT		HT		
chlorpyrifos (ethyl)	organophospate	yes	**some**	II	II, III	ED	no data	HT	HT	HT	MT	PNT	MT	VHT	HT	MT
dazomet	unclassified	yes	no	III	III	none	potential	ST	PNT	ST		MT		HT		HT
1, 3 dichloropropene (DCP)	halogenated organic	yes	**all**	none	**I**, II	**KC**	known	MT	ST	MT		VHT	MT		MT	MT
ethoprop(hos)	organophosphate	yes	**all**	**Ia**	**I**	**LC**	potential	MT	MT	HT		MT		MT		
fenamiphos/phenamiphos	organophosphate	yes	**some**	**Ib**	**I**	none	potential	HT	HT	HT		MT		VHT		MT
fosthiazate	organophosphate	yes	**half**	none	**I**, II	none	no data	ST	HT	HT		MT				HT
metam ammonium	dithiocarbamate	**no**	no	none	none	none	no data									
metam potassium	dithiocarbamate	yes	**few**	II	**I**	PC, ED, RD	no data	ST	MT	MT				MT		MT
methyl bromide	halogenated organic	yes	**yes**	none	**I**	RD	no data	MT	PNT		MT	MT	MT	MT	MT	MT

oxamyl	carbamate	yes	**most**	**Ib**	**I**	none	no data	ST	HT	VHT		HT		ST		MT
sodium tetrathiocarbonate	unclassified	**no**	no	none	**I**	none	no data	ST								

Microbicides/Bactericides

acibenzolar-s-methyl	benzothiadiazole	yes	no	III	III	none	potential	MT	MT	MT		MT		MT		
Aureobasidium pullulans	microbial	**no**	no	none	none	none	no data									
chlorine	inorganic	yes	no	none	**I**	none	no data	HT			MT	MT	HT	HT	HT	HT
didecyldimethyl ammonium chloride	quaternary ammonium	yes	no	none	**I**	none	no data	HT				MT	MT	HT	MT	HT
dazomet	unclassified	yes	no	III	III	none	potential	ST	PNT	ST		MT		HT		HT
formaldehyde	organic	yes	no	none	**I**	**KC**	no data	NAT					NAT	NAT		ST
prohexadione-calcium	unclassified	yes	no	none	III	none	potential	MT	MT	MT		MT		MT		

ANNEX 8: PHASED TRAINING: PEST MANAGEMENT TOPICS AND SAFE PESTICIDE USE

PHASE 1: Train project staff and sector leaders on IPM & Safe Use of Pesticides as follows:

1. 22 CFR 216 compliance process and resulting pesticide lists (use lists 1, 2, and 3 from executive summary and Annex 7 to show any desired pesticides that can be used, used with conditions and cannot be used)
2. 22 CFR 216 required GAP and IPM concepts, tactics and tools found in Annex 1 that can reduce pesticide use and associated risks on specific pests of Pakistan IP target crops
3. PMPs—Pest Management Plans: Making and using these farm crop-management tools (use Annex 2)
4. Pest identification: How to recognize common important pests and diseases (use PMPs developed above)
5. Regulations: International, Local and American treaties and laws that guide pesticide use
6. Monitoring/Spot Treatments: The importance of frequent crop monitoring and use of spot treatments if needed (instead of crop-wide treatments)
7. Natural pesticides: Raise awareness of and promote the use of natural pesticides found in Annexes 1, 4, 5 and 7 as well as green-label synthetic pesticides with relatively low risks
8. REI—Re-Entry Intervals: Pesticide-specific risks associated with entering a sprayed field too soon after the spray operation
9. MRL—Maximum Residue Level: Risks associated with pesticide residues on human food
10. PHI—Pre-Harvest Interval: Pesticide-specific risks associated with harvesting a crop before pesticides have had a chance to break down
11. Vulnerable individuals: The importance of keeping children, pregnant women, elderly and infirm away from the field while spraying and kept out after spraying
12. Understanding pesticides: Types, classes, registration and acute toxicities of commonly-used pesticides (Annex 7)
13. MSDS: How to use MSDSs for pesticide-specific information on risks and risk reduction measures
14. Human and environmental risks: Risks associated with more commonly-used pesticides (use information from MSDSs and Annex 7)
15. When to spray: Early in the morning or late in the afternoon, without wind or rain
16. Use of recommended PPE: Why it is used (see product MSDSs, product labels and web reference below)

17. Safe Use: How to transport, store and use pesticides safely (see safe use web references below and MSDSs)
18. Choice and Maintenance of PPE, sprayers and spray nozzles
19. Preventing and monitoring for the development of pesticide resistance
20. Proper collection and disposal of pesticide rinsate and packaging (see disposal web reference below and MSDSs)
21. The use of pesticide spray buffer zones or organic production near national parks or headwaters leading to rivers that enter national parks
22. How to reduce and mitigate risks to critical environmental resources and biodiversity (found in PER Factors E and G)
23. Honeybees: Ensuring pesticide applicators notify beekeepers about spray activities, and spray early morning or late afternoon when no heavy winds or rain are present
24. Water Pollution: Raise awareness of pesticides (especially some herbicides) with high ground water contamination potential where water tables are high or easy to reach (use Annex 7 and MSDSs)
25. Exposure routes: Ways pesticides enter the body and ways to mitigate entry (see safe use web references below and MSDSs)
26. Basic first aid: Understanding how to treat pesticide poisonings (see first aid web reference below and MSDSs)
27. Record-keeping: Pesticide used, when used, which crop, how applied, who applied (see Annex 9)
28. Certification and trade issues that can be implemented by the Mission in consultation with the MEO (using trained specialists and Google-searched Global GAP, Organic, Fair Trade websites and guidelines)

PHASE 2: Trained (above) Sector Leaders (like lead farmers) train project beneficiaries on IPM & Safe Use of Pesticides as follows:

1. 22 CFR 216 compliance process and resulting pesticide lists (use lists 1, 2, and 3 from executive summary and Annex 7 to show any desired pesticides that can be used, used with conditions and cannot be used)
2. 22 CFR 216 required GAP (especially agribusiness projects that aim to export produce) and IPM concepts, tactics and tools found in Annex 1 that can reduce pesticide use and associated risks on specific pests of Morocco target crops
3. PMPs—Pest Management Plans: Using these farm crop-management tools (use Annex 2)
4. Pest identification: How to recognize common important pests and diseases (use PMPs developed above)
5. Regulations: International treaties (for projects that export), Local laws (for all) that guide pesticide use
6. Monitoring/Spot Treatments: The importance of frequent crop monitoring and use of spot treatments if needed (instead of crop-wide treatments)
7. Natural pesticides: Raise awareness of and promote the use of natural pesticides found in Annexes 1, 4, 5 and 7 as well as green-label synthetic pesticides with relatively low risks
8. REI—Re-Entry Intervals: Pesticide-specific risks associated with entering a sprayed field too soon after the spray operation

9. MRL—Maximum Residue Level (especially for agribusiness projects that aim at exporting produce): Risks associated with pesticide residues on human food
10. PHI—Pre-Harvest Interval: Pesticide-specific risks associated with harvesting a crop before pesticides have had a chance to break down
11. Vulnerable individuals: The importance of keeping children, pregnant women, elderly and infirm away from the field while spraying and kept out after spraying
12. Understanding pesticides: Types, classes, registration and acute toxicities of commonly-used pesticides (use Annex 7)
13. MSDS: How to use MSDSs (and pesticide label pictograms by illiterate beneficiaries/farmers) for pesticide-specific information on risks and risk reduction measures
14. Human and environmental risks: Risks associated with more commonly-used pesticides (use information from MSDSs and Annex 7)
15. When to spray: Early in the morning or late in the afternoon, without wind or rain
16. Use of recommended PPE: Why and how it is used (use product MSDSs, product labels and web reference below) with PPE demonstrations and subsidized PPE for beneficiaries
17. Safe Use: How to transport, store and use pesticides safely (use safe use web references below and MSDSs)
18. Demos on Choice and Maintenance of PPE, sprayers and spray nozzles
19. Preventing the development of pesticide resistance
20. Proper collection and disposal of pesticide rinsate and packaging (use disposal web reference below and MSDSs)
21. The use of pesticide spray buffer zones or organic production near national parks or headwaters leading to rivers that enter national parks
22. How to reduce and mitigate risks to critical environmental resources and biodiversity (use PER Factors E and G)
23. Honeybees: Ensuring pesticide applicators notify beekeepers about spray activities, and spray early morning or late afternoon when no heavy winds or rain are present
24. Water Pollution: Raise awareness of pesticides (especially some herbicides) with high ground water contamination potential where water tables are high or easy to reach (use Annex 7 and MSDSs)
25. Exposure routes: Ways pesticides enter the body and ways to mitigate entry (use safe use web references below and MSDSs)
26. Basic first aid: Understanding how to treat pesticide poisonings (use first aid web reference below and MSDSs)
27. Record-keeping (especially for agribusiness projects that aim at exporting produce): Pesticide used, when used, which crop, how applied, who applied (see Annex 9)
28. Certification and trade issues that can be implemented by the Mission in consultation with the MEO(using tained specialists and Google-searched Global GAP, Organic, Fair Trade websites and guidelines)

REPEAT TRAINING ANNUALLY

Web Safe Pesticide Use Training Resources

- General Mitigation of Potential Pesticide Dangers General Measures to Ensure Safe Use: http://pdf.usaid.gov/pdf_docs/PNADK154.pdf, Chapter 13

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

ANNEX 9. MONITORING FOR BEST PRACTICES ON MOROCCO BENEFICIARY FARMS

Name of NARS Staff Responsible for Monitoring Demonstration Farms:

Name of Demonstration Farmer: Crop: Date:

What are the major pests encountered by the farmer?:

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

Are pesticides used by demo farmer? Yes__ No__

How are pesticides applied? backpack sprayer__ other__

What are the names of the pesticides used?:

Which PPE does farmer have and use?

gloves__ overalls __ boots__ mask__ goggles__

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

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

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

Does the farmer understand the pesticide label information? Yes__ No__

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

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

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

Are pesticides applied during rain or windy conditions? Yes__ No__

Are women or children permitted to apply pesticides? Yes__ No__

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

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

Does the farmer wash clothes after applying pesticides? Yes__ No__

How does the farmer dispose of empty pesticide containers? puncture/burry__ burn__

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

Preventive and Curative GAP and IPM options:

Preventive	Preventive	Curative
• Soil nutrient, texture and pH testing	• Farmer ability to correctly identify pest predators, parasites and diseases	• Mechanical insect control by hand picking
• Pest resistant/tolerant seed/plant variety	• Weekly field scouting to assess pest levels/damage	• Farmers make & apply local artisanal plant extracts (neem, pyrethroid, garlic, chili, other)
• Early/late plantings or harvestings to avoid pests	• Use of trap crops to trap and destroy pests	• Weed control by machine cultivation, hoe or hand
• Seed treatment with pesticides	• Removal/pruning of diseased or heavily infested plants/tree branches	• Purchase and release of predators or parasitoids to control major pests
• Soil moisture testing	• Planting parasite-attracting plants on field margins	• Use of pheromone traps to reduce overall pest levels
• Raised-bed production or mounding	• Put baits and use other practices to encourage predator/parasite build-up	• Use of pheromone inundation to confuse pest mating
• Irrigation and drip irrigation	• Use of pheromone traps to monitor pest levels	• Spot treatment of pest hotspots with insecticides, miticides or fungicides
• Use of natural fertilizers (manure, compost)	• Inter-planting crops with aromatic herbs (celery, cilantro, parsley, dill or local plants) that repel pests	• Area spraying (complete field coverage) using synthetic and natural insecticides, miticides or nematocides
• Use of purchased mineral fertilizers	• Mulching with organic materials or plastic to control weeds	• Use of synthetic and natural fungicides or bactericides
• Combinations of organic and mineral fertilizers	• Plant living barriers or bamboo/tree barriers on windward edge of field	• Use of herbicides for weed control
• Crop rotation	• Exclude insect pests by using vegetable tunnels and micro-tunnels	• Farm use of a locked storage building for pesticides
• Use of green manure crops	• Use of biodiversity or energy conservation practices	• Farmer use of pesticide in-ground compost trap for depositing and capturing spilled or leftover pesticides
• Farmer ability to correctly identify pests and their damage	• Crop stalks, residue and dropped fruit destruction or composting at end of season	• Farmer use of receptacle for empty pesticide bottle disposal

PERSUAP References:

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

Websites: Website references used to develop the PERSUAP

International Treaties and Conventions:

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

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

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

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

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

Pesticide poisonings:

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

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

IPM and PMP websites:

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

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

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

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

Pesticide Research Websites:

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

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

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

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

Ecotoxicity:

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

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

Safety:

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

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

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

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

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

Personal Protection Equipment (PPE):

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

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