Journal of Natural Science Review

Vol. 2, Special Issue, 2024
https://kujnsr.com
e-ISSN: 3006-7804

Roadmap for Integrated Pest Management in Afghanistan

Abdul Saleem Jamily[1], Mohammad Salim Rahimi[2]

[1,2]Department of Plant Protection, Agriculture Faculty, Kabul University, Afghanistan

✉Email: saleemjamilypp@gmail.com (corresponding author)

ABSTRACT

Integrated Pest Management (IPM) is a sustainable, science-based decision-making process broadly implemented in agriculture to identify and reduce risks from plant pests and their management-related strategies. In the IPM roadmap program, along with identifying strategic directions for research, implementation activities are essential to realize the full benefits of IPM adaptation. International markets demand high-quality agricultural products without pesticide residues or low Maximum Residue Limits (MRL). Meeting these market demands poses a challenge for growers, given the rise in production costs and the concurrent decline or instability in commodity prices. As the country's preferred method of tackling crop protection issues, the government has not adopted IPM as a national policy. The Roadmap for the IPM program identifies strategic directions for research, implementation, and measurement activities needed to realize the full benefits of IPM adoption. Their information and views on IPM approaches were collected through consultation with Afghan stakeholders. Based on these views and the facts stated above, this Roadmap has been developed for the country's agriculture sector.

ARTICLE INFO

Article history:
Received: May 23, 2024
Revised: June 11, 2024
Accepted: Nov 12, 2024

Keywords:
IPM; Pest; Pesticides; Roadmap

To cite this article: Jamily, A. P. A. S., & Rahimi, M. S. (2024). Roadmap for Integrated Pest Management in Afghanistan. *Journal of Natural Science Review*, *2*(Special Issue), 201–220.
https://doi.org/10.62810/jnsr.v2iSpecial.Issue.125

To link to this article: https://kujnsr.com/JNSR/article/view/125

Introduction

The diverse and ever-changing pest complex requires pest management skills and technologies on the part of producers, which will lead to increased production costs. Adopting new technologies such as hybrid varieties, GM Food, Tunnel and greenhouse technologies, and precision agriculture like drip irrigation will increase the cost of production. It will create complications for Afghan growers in the competitive production arena (Dhaliwal and Ramesh, 2014).

Pests are organisms (microbes, plants, or animals) that pose economic, health, aesthetic, or environmental risks. Pests are context-specific, so an organism that is a pest in one environment may be benign or beneficial in others. The two most important phrases used since the early 1980s regarding agricultural production systems are sustainable agriculture

and "IPM" (Integrated Pest Management). Applying the principles of IPM is essential in optimizing the sustainability of agricultural systems (Dhaliwal and Ramesh, 2014).

A pest management strategy can be considered the optimum mix of pest management tactics for a specific agroecosystem and the environment. Therefore, the main purpose of the IPM roadmap is to increase the adoption, implementation, and efficiency of effective, economical, and safe pest management practices, as well as to develop new practices where needed. This is accomplished through information exchange and coordination among researchers, technology innovators, educators, IPM practitioners, and service providers, including land and natural resource managers and agricultural producers. The Roadmap for the IPM program identifies strategic directions for research, implementation, and measurement activities needed to ensure that the full benefits of IPM adoption are realized in the agroecological system. Whereas the international markets for agricultural products demand high-quality agricultural products with no pesticide residues or low minimum residue level (MRL), thus growers are challenged with meeting these market demands in the face of increasing production costs coupled with decreasing or unstable commodity prices (Norris *et al*., 2012).

The primary objective of the Roadmap is to communicate with you and other stakeholders regarding the Crisis phase within our production and Protection system, elucidating its repercussions on health, the environment, and exports. Additionally, it seeks to raise awareness among stakeholders, encouraging their active involvement and soliciting feedback for future consultation endeavors. The perspectives of stakeholders play a crucial role in offering valuable insights and potential remedies to address the issue. It is essential to note that the Roadmap serves informational purposes, and its content is subject to modification as circumstances dictate.

This study aimed to develop an adaptive Integrated Pest Management (IPM) roadmap for the country's agriculture sector, as outlined in the IPM Roadmap 2018 and discussed effective implementation strategies. The primary objectives of the IPM program include (i) enhancing the economic benefits associated with the adoption of IPM practices, (ii) mitigating potential human health risks, and (iii) minimizing the undue adverse environmental effects resulting from pests and pest management practices.

National IPM program focus areas

The national IPM program will concentrate its endeavors on four specific domains:

Production agriculture;

1. Natural resources/recreational environments.
2. Residential/public areas.
3. Animal husbandry/Feeds and products.

Production agriculture. The production of agriculture exceedingly follows the main three goals of a successfully implemented IPM program:

- To advance IPM programs in prominent grain (cereal crops) and fiber crops to reduce negative off-target impacts on the environment, particularly water quality.
- Introducing IPM in fruits, vegetables, and other specialty crops needs additional program focus to help maintain high-quality produce.
- Protect agricultural workers and keep dietary pesticide exposure within acceptable safety limits.

Priorities in this area include developing and implementing economical, effective IPM programs for crops and commodities consumed by humans. Fruits and vegetables need high human labor and inputs but have fewer effective pest management alternatives than major acreage crops. Prioritizing this sector would have a major impact on economic benefits and protection of public health, including worker protection.

Natural resources/recreational environments. Natural environments such as groundwater, lakes, streams, parks, rangelands, grounds/athletic and sports facilities where pesticides are applied or could reach one way or another are as important as the agriculture production system. Greater IPM efforts are required to maintain functional and aesthetic standards in these environments within a framework designed to minimize unreasonable adverse environmental effects on natural areas and protect public health. The priority is developing and implementing IPM programs that reduce off-target impacts. This priority could have a major impact on reducing pesticide residues in water used for human consumption/irrigation and minimizing the effects of pesticides on non-target species (IPM roadmap, 2018).

Residential and public areas. The greatest general population exposure to pests and pesticides occurs where people live, work, and play. Initial IPM programs in these areas (IPM in residential areas/ Public buildings /Schools) must be focused. Priorities in this area include enhancing collaboration and coordination to expand these programs to other institutions and residential environments. There is broad agreement that expanding IPM programs in these areas would reduce potential human health risks and unreasonable adverse environmental effects from pest management practices (IPM roadmap, 2018).

Animal husbandry/Feeds and products. Pesticides and other chemicals are used directly for external pests and internal parasites on animals. Furthermore, the feeds treated with pesticides given to the animals and the products of such animals are of great concern (IPM roadmap, 2018).

National IPM program goals

1. To improve the economic benefits related to the adoption of IPM practices.
2. To reduce potential human health risks.
3. To reduce the unreasonable adverse environmental effects from pests and pest management practices.

The overall aim of the IPM roadmap and its achievement

The Roadmap for IPM aims to establish a coordinated and integrated approach to reduce the pesticide load in the production system, Natural resources, and residential areas. In order to achieve the aims, the initiative may focus on the following (IPM roadmap, 2018):

1. Improve knowledge about IPM by supporting;
    a. Research into the status of pests and trends of pest control.
    b. Research into the & monitoring the pollinators/Natural enemies (NE).
    c. Research into the economic importance of IPM.
    d. Research into the threats to pollinators /natural enemies of major crop pests.
    e. Research into certified production nurseries true to type and free of virus.
2. Tackle the cause of pesticide abuses;
    a. Supporting the maintenance and restoration of habitats of pollinators/ and natural enemies.
    b. Promoting pesticide use's risk reduction and impact on pollinators/NE and reducing MRL in the produce.
    c. Addressing the negative impact of pesticides on pollinator/ N.E, Human/animal, and environmental health.
    d. Educating for the arrangement of alternate/Bio-pesticides/ Bio-agents for growers.
3. Raise awareness and Improve collaboration/knowledge sharing;
    a. Facilitating engagement of all stakeholders in the adoption of IPM practices.
    b. Facilitating sharing of knowledge and good practices among stakeholders.
    c. Supporting collaboration among stakeholders about steps/actions taken for IPM.
    d. Supporting the development of National IPM Strategies.
    e. Supporting the development of National IPM regulation.

Methods and Materials

Consultation of the Stakeholders

Through consultation, the coordination committee collected the stakeholders' views on the IPM approaches through questionnaires and addressed the issues of higher MRL, pesticide residues in the feed, food, pest resistance to pesticides, loss or decline of pollinators, and NE of pests. It also endeavors to collect additional evidence and insights about the problem, its root causes, and mitigation approaches. The main stakeholders were PPQD staff, scientists, producers/farmers, exporters of goods, importers/dealers of pesticides, beekeepers, educational institutes, IPM practitioners, and the general public/consumers.

Consultation activities included:

1. Consultation of the Coordination Committee.
2. Workshops/seminars by experts dealing with:
    a. Pest ecology/pest management.
    b. Pesticide toxicology/Pesticide residue.
    c. Biodiversity, nature conservation, NE, biological control, pollinators.
    d. Host plant resistance, resistance management.
    e. Public health.

The information shared with the stakeholders through print and electronic media, brochures, handouts, etc., and their information and views on the IPM approach from the organizational level to fields (growers/consumers) were collected, analyzed, and used to develop the current IPM roadmap for the country's agriculture sector.

Proposed Pest Management Strategies

Essential requests for decision-making in IPM

IPM is a knowledge-intensive system with a lot of background information regarding the pest, abiotic and biotic factors, agroecosystem, and management tactics required for making decisions regarding the execution of IPM programs (Dhaliwal and Ramesh, 2014). Certain essential pre-requisites must be followed before deciding to employ the pest management option:

1. Correct identification of pests.
2. Life cycle.
3. Habits.
4. Host range.
5. Natural regulating factors.
6. Re-infestation.
7. Crop value.
8. Consumer pressure.
9. Survey and detection.
10. Selection of management Option.

There are different types of IPM models (Dent, 2000):

- Models are used to forecast pest abundance models to simulate plant growth and damage.

- Models to explain the interaction between pest and their natural enemies.
- These models have been of different types and forms, but they are now used in most areas of insect pest management, which says something about their utility.
- Models are representations of a system. They attempt to mimic the essential features of a particular system, where a system is taken as a limited part of reality.

Outlines of IPM guidelines for major crops/pests in Afghanistan

A. Journalized IPM guidelines

1. Best agriculture practices:

a. Select healthy -good quality seeds/ saplings.
b. Prepare land according to the crop/orchard requirement.
c. Maintain proper plant-to-plant and row-to-row spacing.
d. Adopt Good fertilizers and a/micro-nutrient management.
e. Add organic matter to the soil.
f. Go for good irrigation/ water management.
g. Initial information about the types of pests/ proper identification.
h. Monitoring the pests /damages.
i. Visit the field /orchards regularly / at least once a week.
j. Keep a proper record of the pest and treatment.
k. Clean culture/ maintain good hygiene in the orchard/field.
l. Adopt a good drainage system.
m. Maintain a good crop rotation system.

2. IPM components

a. Select resistant varieties/ stocks /grafts.
b. Encourage natural enemies.
c. Use Biological control agents, preferably the local/adoptive one.
d. Have a system for importing commercial natural enemies.
e. Use bio-pesticides.
f. Use plant-based pest control products.
g. Adopt the least toxic treatment/ pesticides.
h. Adopt safe use/ disposal of pesticides.

B. Pest specific guidelines

Cereal

1. Wheat

a. Sunn pest (*Eurygaster intergriceps*, *Aelia accuminata*, Dolycoris spp., and Carpocoris Spp.)- All four are found in Afghanistan on wheat/Barley.

i. Growing Resistance varieties.

ii. Egg parasitoids *(Trissolcus grandis* T.) can be reared on some alternative hosts, such as eggs of *Podisus maculiventris.*

iii. Local strains of *Beauvera bassiana* and *Metarhizium anisopliae*.

iv. Hand collection through sweep nets has been effective in many areas in Afghanistan.

v. Chemical control: lambda-cyhalothrin for over-wintering adults in Summer hibernating sites around the fields and early spring at winter hibernating sites – bushes/stones.

vi. IGR: Diflubezoran.

vii. Neem products (NeemAzal T/S) may be effective and must be tested.

b. Locust (Moroccan Locust-*Dociostaurus maroccanus)*

i. Monitoring in coordination with other departments and regional countries.

ii. Natural enemies are present, such as *Systoechus autumnalis* (Pall.).

iii. Fungi-*Metarhizium anisopliae (flavoviride) var. acridum* is a commercial product registered against locusts.

iv. Local predatory birds need to be encouraged and protected.

v. Barrier spray treatment with diflubenzuron (ULV) against gregarious hopper bands of the Moroccan locust.

c. Aphids: *Sitobion avenae*, *Schizaphis graminum*, *Rhopalosiphum padai*, and *Diuraphis noxia*)

i. Aphids are not a big problem in wheat in Afghanistan.

ii. Bio-control agents

1. Predators: Ladybird beetles /Syrphid flies/ *Chrysoperla cornea.*
2. Parasitoides: *Aphidius colemani*, *A. matricariae*, *A*.ervi. and *Diaeretiella rapae*.
3. Entomopathogenic Fungi: (Zygomycetes, Entomophthorales).

iii. Chemical: Not recommended. Soap solution, garlic extract, and Ginger + Garlic + Pepper extract are effective.

iv. In case of server infestation only - Permethrin is recommended.

d. Rust: Stem Rust: *Puccinia graminis tritici*, Leaf Rust: *Puccinia recondita* and Strip rust: *Puccinia striiforrmis.*

i. Grow for resistant varieties.
ii. Seed or fertilizer treatment can control stripe rust up to four weeks after sowing.
iii. Adopt Polyculture.
iv. During the growing season, crop monitoring is very important.
v. Avoid repeated use of fungicides with the same active ingredient in the same season.
vi. Foliar spray: Normally not recommended, but when the threshold exceeds 5% stem infection, spray: Propiconazole (250 g/L), Prothioconazole (210 g/L) + Tebuconazole (210 g/L).

e. Smut*: Ustilago tritici*

i. Grow Resistance varies where the disease is a serious issue.
ii. Always get Certified Seed.
iii. Hot water treatment of seeds (49-52 °C for 12 minutes) for control of loose smut of cereals.
iv. Seed Treatment (systemic fungicides): Caboxin and Triazoles are very effective.
v. Line sowing can decrease the infestation level.
vi. Fungicides: products containing azoles such as triadimenol, bitertanol, tebuconazole, prothioconazole, triticonazole and fluquinconazole.

f. Bunt: *Tilletia Caries* Wheat Bunt/Wheat Covered Smut/ Karnal Bunt (*T.indica*).

i. Use local resistant varieties resistant varieties.
ii. Use the right amount of seed, 28-30 kg/jerab.
iii. Use clean and disease-free seeds.
iv. Irrigate in the winter to cool the land and keep it humid.
v. Hot water treatment of the seed before sowing. (at 50C for 10 minutes).
vi. Removal of disease plant early in the season
vii. Biological control with soil application of *Trichoderma* spp.
viii. Seed dressing with theram @ 2gm/kg seed.
ix. Carboxin seed dressing is also effective.
x. Mancozeb and Propiconazole for foliar application.

Rice

g. Stem borer: *Scirpophaga incertula.*

i. Use less susceptible verities.

ii. Soak the seedling's root in 0.02% Chlorpyriphos for 12-14 hrs before transplanting.

iii. Use light traps for adults to catch & kill.

iv. Insecticides: Deltamethrin, Chlorpyrifos, Cartap, Fipronil, and Esfenvalerate – gave >90% control of stem-borers and reduced damage to less than 5.0%.

v. After harvest, destroy Rice stubbles as they provide a hiding place for hibernating larvae.

h. Bacterial Blight: *Xanthomonas oryzae pv oryzae.*

i. Remove the old infected stubbles, Straws, and weeds.

ii. Grow resistant varieties.

iii. Good water drainage and Water management.

iv. Use a balanced amount of fertilizer (especially Nitrogen).

i. Rice damping off: *Pythium. spinosum, P. irregular,* and *P. sylvaticum.*

i. Use disease-free seeds.

ii. Through fertilizer management, keep the plant healthy.

iii. Do not use too much seed for seedlings/nursery.

iv. Seed dressing with fungicides: Metalaxyl 28.35% @ 44 -90 g per 50 kg of seeds. Or Mancozeb 37% 2-4g per 1 kg of seeds.

j. Rice Blast: *Pyricularia grisea* Sacc

i. Adopt Crop rotation.

ii. Balance fertilizer application, not over-dose Nitrogenous fertilizers.

iii. Seed dressing: Isotianil SC 200 and its combination with Trifloxystrobin 500 SC.

iv. Foliar application of fungicides**:** benomyl, Benlate and tricyclazole, Conika 50% WP (Kasugamycin 5% + Copper Oxychloride 45% WP), Dhanucop Team (Tricyclazole 75% WP) and RIL-068/F1 48 WG (Kresoxim methyl 40% + Hexaconazole 8%.

k. Weeds: Various weeds are troublesome in Rice fields.

The SRI planting system and weeding by Rotary Weedser are the best practices for controlling the weeds in rice.

Vegetable

1. Potato

a. Aphids: *Myzus persicae* and *Microsiphum euphorbiae.*

i. Remove weeds from and around the fields.

ii. Remove alternate hosts in the vicinity if possible.

iii. Remove the volunteer potato plant.

iv. Biological Control: parasites and predators. Ladybird beetles and their larvae, lacewing larvae, and syrphid fly larvae. Parasitoids: *Aphelinus* and *Aphidious* spp.

v. For low infestation, use garlic extract, Ginger+ Garlic + Pepper extract. Prepare the solution and cover spray 3-4 times.

vi. Use local yellow traps to attract and kill aphids and white flies.

vii. If the infestation is very severe, spray with Confidor or Actara.

b. Colorado Potato Beetle: *Leptinotarsa decemlineata.*

i. Hand collection: collect immature and adult beetles and discard them in soapy water.

ii. Internal Quarantine should be set up to control further/ inter-provincial spread of the pest.

iii. Plowing and irrigating fields in December

iv. Crop rotation: rotate potato with alfalfa, maize, and/or wheat.

v. *Bacillius thuringiensis* var *tenebrionis* (Bt) is effective against small larvae (less than 1/4 inch) and should be applied at egg hatch or when larvae are first seen.

vi. Neem extract needs to be tested.

vii. Chemical spray: Deltamethrin @ 2 ml per liter of water, Imidacloprid.

c. Late Blight: *Phytophthora infestans.*

i. Good drainage and air movement will help reduce moisture levels in the canopy. 2-3 years of crop rotation will work, but care should also be taken to remove the alternate host.

ii. No potato tuber (small or large) shall be left in the soil.

iii. Only certified/disease-free seeds should be planted.

iv. Hilling: When Potato plants reach ~ 10 inches' height, bring soil around the stem from both/ sides.

v. Contact fungicides are effective.

vi. The pathogen has developed resistance to Metalaxyl/Mefenoxam in some areas/countries.

d. Wilt: *Verticillium dahlia V. albo-atrium*

i. Potato varieties with some level of resistance are available.

ii. Rotation of potatoes and other susceptible crops for 2 to 3 years. Legumes, Cereals, and grasses may help.

iii. Soil fumigation with 1,3-dichloropropene may be justified if fields have high levels of lesion nematodes.

iv. Fungicide treatment, if required, applies Aprova (Benzovindiflupyr) in a furrow.

1. Benzovindiflupyr or Mancozeb @3g/liter of water is to be applied around the plant.

2. Tomato

a. Tomato Fruit Borer (*Helicoverpa armigera*)

i. Light traps/ Pheromone traps (PH-462-IRR, Russell IPM).

ii. Apply Ginger+Garlic + pepper extract as a cover spray.

iii. Hand-collection larvae may reduce the infestation.

iv. Insecticides: Chlorpyrifos, Methomyl and Cypermethrin).

v. Collection and destruction of all infested fruits.

b. Early Blight: *Alternaria solani*

i. Remove all plants & debris after harvest.

ii. Remove the infected plants and destroy them properly.

iii. Bio-fungicide (Serenade) gives protection against the disease.

iv. Chlorothalonil (Fungonil, Daconil), Mancozeb or Maneb.

c. Root Rot: *Phytophthora parasitica* and *P. capsici:*

i. There are no practical control measures available for the disease as yet, although research has shown that certain soil-applied systemic chemicals have the potential to be short-term treatments for root rot.

ii. Soil water management is effective to a great extent.

iii. Chemical Control: Metalaxal %g or 50 Wp, Ethazol 5G.

d. Wilt (Verticillium wilt): *Verticilliurn albo-atrium*

i. The pathogen survives in the soil and can infect many species of plants.

ii. If available, plant-resistant varieties. Verticillium-resistance.

iii. Remove and destroy any infested plant material.

iv. In commercial production, soil fumigants are recommended.

3. Onion

a. Onion Thrips: *Thrips tabacci*

i. Biological Control: Predaceous mites, Pirate bugs, lacewings, and ladybird beetles are effective.

ii. Cultural Control: Avoid planting onions near grain fields.

iii. Regular monitoring is important for in-time plant protection measures. A rough ETL of 20-30 thrips per plant mid-season is established.

viii. At low infestation, use of non-chemical pest management methods

ix. Chemicals: Movento spirotetramat) 240Sc, Radiant (spinetroram) SC., Exirel ^{SE}(Cyantraniliprole), For Seed Production Lannate is recommended.

b. Onion maggots: *Delia platura*

i. Cultural Control: Avoid raw farm yard Manure application.

ii. Avoid early plantation in the season –wait until the soil warms up in spring.

iii. There are not many natural enemies or commercial ones.

iv. Yellow sticky traps should be used for early detection of the infestation.

v. Chemicals: Clothianidin / Imidacloprid, Chlopyrifos,

c. Downy mildew: *Peronospora destructor*:

i. Grow resistant varieties in areas with severe infestation /infection.

ii. Well-drained can reduce infection to a greater extent.

iii. Removal of volunteer plants and weed control are also effective.

iv. Avoid too late planting.

v. Physical Control: Dry-heat treatment of bulbs at 40°C for 8 hrs can destroy internal mycelium.

vi. Chemical: Not recommended; however, metalaxyl + mancozeb or oxadixyl + copper oxychloride could be applied in commercial production.

Fruits

1. Apple

a. Codling moth: *Cydia pomonella*

i. Clean culture: Collect all plant residues and infested fruits and bury them deep.

ii. Wrap a gunny bag or corrugated cardboard cartons around the tree trunk during larval development.

iii. Apply lime sulfur during the resting period after winter pruning.

iv. Use egg parasitoid; *Trichogramma*. *Trichogramma* cards should be installed under leaves.

v. Use light traps during the night. Install lights over water dishes.

vi. Using Isomate/coulure (pheromone) to disrupt the mating of male and female insects.

vii. Chemical controls like Emamectin benzoate, 2 cc in 1liter water and Lambda-cyhalothrin are used.

b. Wooly Apple Aphid: *Eriosoma lanigerum*

i. The Infested shoots should be cut and burned.

ii. Cleaning plant residues in the garden and deeply plowing the field.

iii. Flood the garden in the fall to avoid the insect population increasing.

iv. Keep the numbers of natural enemies, such as lady beetles and lacewings, high so they kill and eat the woolly apple aphids.

v. The most potential hymenopterous parasitoid, *Aphelinus mali,* shall be introduced and mass released.

vi. Apply chemicals such as imidacloprid (e.g. Confidor) with 1 cc in 1 liter of water early in the morning or evening. This can be repeated at 10-day intervals up to 3 times.

c. Apple Scab: *Venturia inaequalis*

i. Sulfur /lime sulfur application in the fall and late winter.

ii. Resistant varieties & stocks shall be made available.

iii. Proper spacing & pruning is important.

iv. Removal of fallen leaves and fruits is a key factor in managing the next year's infection.

v. Privative application of fungicides: Tebuconazole, Proppiconazole, Mancozeb.

d. Apple Canker: *Nectria galligena*

i. Grow resistant varieties

ii. Ensure good air movement through the orchard. Adopt a sound pruning system for the airflow.

iii. Remove pruned materials from the orchard and burn them.

iv. In the fall, spray copper fungicide at 10% leaf fall and repeat at 50% leaf fall in orchards with moderate to high canker incidence. Spray tebuconazole (Folicur) before the end of leaf fall, then spray tebuconazole (Folicur) or thiophanate-methyl (Cercobin).

v. Apply sprays of captan or pyraclostrobin + boscalid (Bellis) or cyprodonil + fludioxonil (Switch) to orchards.

2. Grapes

a. Downy Mildew: *Plasmopara viticola*

i. Collect all fallen leaves and small bushes of grapes and destroy them outside the field.

ii. Prune the vines in January. Sterilize the equipment well before and after the pruning using common bleach.

iii. Plants are healthy and vigorous.

iv. Lime sulfur spray in December /January.

v. Mancozeb applications in April, May, and June will be @ 3-4 g/liter of water.

b. Anthracnose*: Elsinoe ampelina*

i. Disease-free stocks and grafts.
ii. Sanitation: Purring in the dormant season the infected plant/parts
iii. Resistant Varieties:
iv. Urea sprays 1kg/20liter water in the autumn season for leaves decomposition.
v. Spray of lime sulfur @1 liter of lime sulfur per 9 liter of water.
vi. Spray Copper oxychloride @ 3-4 g/liter of water, 2-3 times in a season.

c. Cicada*: Tibicen* Species

i. Keep the mulberry plantation away from the grape orchards.
ii. Sandy soil makes it hard for the nymph to emerge.
iii. Collection by hand/ roasting & eating is common in some area.
iv. Deep hoeing for uprooting the nymph and encouraging the birds feeding.
v. Provide sufficient water to the vines.
vi. Remove and destroy eggs laid on branches in June.
vii. Chemical control: Thiodon and confidor provide limited control.

d. Mealybug: Grapes Mealybug (*Pseudococcus maritimus*),

i. Proper monitoring
ii. The trellising system harbor has mealier bugs than the ridge system for vine planting.
iii. Winter oil spray- Delay winter and early spring treatments.
iv. Clean cultivation:
v. Apply lime sulfur (1g/9-liter water) at the dormant stage.
vi. Chemicals control: IGR: Buprofezin, Systemic foliar application Spirotetramat, and Soil application of Imidacloprid.

3. Pomegranate

a. Carob moth/ Fruit Borer (*Ectomeylois ceratoniae)*

i. It is a pest in both fields and storage.
ii. Remove & destroy the un-harvested fruit from the trees.
iii. Sanitation by removal of infested fruits and branches.
iv. Bagging of young fruits to avoid egg laying by the female moth.
v. Pheromone traps for monitoring.
vi. Spray Spinosad, Chlorantraniliprole, Methoxyfenozide, Methomyl (lannate).

b. Aphids: *Aphis punicae* & *Aphis gossypii*

i. Monitoring the pests in the offshoots in winter.

ii. Water spray with blaster.

iii. Spray wheat flour (2 spoon/ 4 cups of water).

iv. Rosemary + peppermint oil spray.

v. Neem oil/ Azadirechtin.

vi. Biological control agents:

vii. Pyrethrins.

viii. Mineral oil.

ix. Spray Confidor foliar, Clothianidin.

4. Almond

a. Western Tent Caterpillar (*Malacosoma indica*) & Brown Tail moth (*Euproctis chrysorrhae*).

b. Black Veined White Butterfly (*Aporia crataegi)*

i. Biological control shall be encouraged.

ii. Hand collection of egg masses from leaves.

iii. Insectivorous birds shall be attracted to the orchards.

iv. Pesticides used for other pests will take care of this pest as well. However, spot treatment could be made with Permithrin, Cypermithrin in a severe infestation.

c. Shot hole (Stigmina/ *Wilsonomyces carpophilus)*

i. Spray lime sulfur @ 1litter /10 litter of water

ii. Pruning of dried and diseased shoots during the growing season.

iii. Space the trees for well aeration.

iv. When a few leaves on a tree have 2-3 holes, it is time to take action. (Spray copper oxychloride on the first sight of the symptoms).

5. Citrus

a. Cirus psylla: *Diaphorina citri*

i. Two popular hymenopterous parasitoids are *Tamarixia radiata* and *Diaphorencyrtus aligarhensis.*

ii. Predatory lady bird beetles Monitoring:/ sweepnet, yellow sticky cards.

iii. In spring, spray Confidor.

iv. After harvesting, spray Fenpropathrin (Danital 2.4 EC), Chlorpyrifos (Lorsban Advance), Dimethoate 400, Thiamethoxam (Actara).

b. Trestrizia Virus: CTV spread by aphids, particularly the brown citrus aphid (*Toxoptera citricidus)*:

i. Use stocks, e.g. Rough lime.

ii. Use resistant sections, e.g., Valencia oranges.

iii. Screened the nurseries to avoid aphids. Infestation.

iv. Control the aphids to avoid the spread of the disease (Atwal and Dhaliwal, 2014. CABI, 2019. Dhaliwaland and Ramesh,2014. MAIL, 2019).

IPM Tools and Tactics

Tools of IPM

The tools of the IPM are all the pest control methods; the only difference is that they (all or some of them) have to be integrated into a common pattern according to the situation's needs and the pest species. Here are the methods of arranging them in order of their complexities (Srivastava, 2014):

1. Cultural methods (agronomic practices)
    A. Crop rotation
    B. Crop location
    C. Trap crops
    D. Tillage
    E. Altered timings
    F. Clean cultures
    G. Soil manuring and fertilization
    H. Pruning and thinning
    I. Crop refuse and destruction
    J. Growing resistant plant varieties
    K. Management control
2. Mechanical methods
    A. Hand-picking and beating of branches
    B. Banding
    C. Wire gauge screens
    D. Trench digging
    E. Trapping
    F. Pest smashing, pest collecting device

G. Flooding and draining.

3. Physical methods

A. Cooling

B. Heating.

C. Radiant energies

4. Legal methods

5. Biological methods

6. Chemical methods

7. Genetic methods/resistance

IPM tactics

Three fundamentally different approaches to managing pests (Norris *et al*., 2012).

1. Manipulation of the pest organisms.
2. Manipulation of the host plants. The tactics used here are either increasing crop tolerance to pest attacks or changing the crop so the pest no longer attacks it.
3. Manipulating the environment. These tactics alter the environment so pest populations do not increase to damage levels.

Monitoring insect pests and natural enemies

Monitoring phytophagous insects and their natural enemies is a fundamental tool in IPM for making management decisions. Monitoring requires estimating insect distribution and abundance changes and information about the insects, life history, and the influence of important biotic (natural enemies) and abiotic (climatic) factors on pest populations. Depending on the objectives, monitoring may be undertaken area-wide or at the farm level (Ramesh and Dhaliwal, 2004).

Challenges

In theory, the IPM appears simple, but formulating various methods into a single schedule in practice is rather difficult. There are some challenges:

- Absence of Public awareness on IPM approaches as an alternative to pesticides.
- Nationwide identification of series pests and diseases for each crop and their threshold level is absent.
- The Pesticide Act has not been strictly implemented to avoid importing banned and hazardous pesticides.
- Boarder Quarantine stations have not been activated to strictly check the import and export of agricultural products to prevent pest spreads and introduction.

- The linkage between farmers and pesticide suppliers is not established to prepare a list of pesticides with all information then share with farmers.
- Pesticide laboratories are not equipped and activated to test pesticide quality and pesticide residue on crops and food materials to determine the MRL.
- The website and database for IPM have not been established yet.

Recommendations to Achieve an IPM Roadmap in Afghanistan

- The IPM Committee should have authorization to implement policy in Afghanistan.
- Capacity building for those working on the IPM implementation and plant protection program.
- Organizing workshops and short-term training courses for farmers in IPM and collecting their views and ideas.
- Biological Control Laboratories should be established at least at a zonal level to collect and rear bio-agents.
- Establish a national IPM Centre for Afghanistan for better implementation and coordination.
- Give farmers and all stakeholders awareness either through media or training courses on the identification and role of natural enemies in pest management and pollinators in fertilizing crops/fruits.
- Stop the distribution of prescriptions to farmers, identify the problem, and then issue recommendations for managing the pest.
- The IPM should be implemented by establishing and conducting Farmers Field School (FFS) by all IPM implementers.
- The government should have allocated a budget for IPM implementations and increased staff at provincial and district levels.
- To avoid climate change, a reforestation program should be planned and activated.
- To prepare the IPM policy, representatives of all linked ministries and stakeholders should be included, and a coordination committee should be established.
- IPM policymakers must have complete information on the Pesticide Act, Quarantine Act, and Plant Protection Act.
- In policy coordination among stakeholders, it is very important to be involved in policy.
- The policy should be made applicable and not be kept on paper only.
- The policy should include intervention, prevention, and regulation processes.
- The policy put limitations on pesticide importers.

- Disposal of pesticides should be considered and included in the policy.
- Guidelines for IPM should be prepared.
- Support those farmers or traders who produce organic products.
- The IPM subject should be included in the curriculum of the agricultural faculties and the Institute of Afghanistan.
- Implementation of all related conventions to which Afghanistan is a signatory of that.
- IPM demonstration plots should be established to demonstrate practically to farmers IPM approaches.
- The policy should pay high attention to the conservation and augmentation of natural enemies.
- A regulation should be drafted for IPM implementation.
- Temporary licenses should be given to traders who import pheromones and bio-pesticides.
- Lay out of research program on those plants which have pesticide properties.
- Monitoring and evaluation of IPM activities at central and provincial levels.
- Capacity building of government staff through higher studies (M.Sc. and PhD) in IPM.
- Organizing seminars and workshops at the provincial level to share IPM implementation approaches and collect problems and challenges from the field.
- A database must be established to get access to pests and diseases and management information.
- The policy should include introducing other simple and economical, environmentally, and ecological friendly methods and using locally made materials.
- PPQD of MAIL will be the leading authority for information collection, implementation, and decision-making.

Conflict of Interest: The author(s) declared no conflict of interest.

References

Atwal, A. S. and Dhaliwal, G. S. (2014). Agricultural Pests of South Asia and their Management. *Kalyani Publishers*, New Delhi, India.

CABI, Nationwide Insect Pest and Plant Diseases Survey in Afghanistan, 2019.

Dent, D., (2000) Integrated Pest Management (2 ed), CABI Publishing Press. The UK.

Dhaliwal, G.S., and A. Ramesh (2014) Integrated Pest Management (Concepts and Approaches. Kalyani Printings. India.

IPM roadmap, California, 2018.

MAIL, AAIP, Final Report on Plant Diseases and Pests in Afghanistan, 2019.

MAIL, AAIP, Pest Management Plan, 2016.

Norris, F.R., P. Edward and K. Marcos (2012) Concepts in Integrated Pest Management. Prentica-Hall, New Delhi, India.

Ramesh, A., and G.S Dhaliwal (2004). Integrated Pest Management (Concepts and Approaches). Kalyani Publishers, New Delhi, India.

Srivastava, K.P (2014) A Textbook of Applied Entomology (Methods of Insect Pest Control. Vol 1, Kalyani Publishers, New Delhi, India.