

# Integrated Pest Management

Pests, diseases and weeds can cause yield reductions, which makes pest control indispensable in agricultural production. Integrated Pest Management (IPM) is a sustainable approach to pest, disease and weed management involving environmentally-friendly crop production methods that reduce the use of chemical pesticides (insecticides, fungicides, herbicides).

In Afghanistan poor plant production practices exacerbate pest-related problems. This leads to poor plant growth and renders crops more vulnerable to pest attacks. IPM is effective not just at controlling pests, diseases and weeds, but also at improving the growth and productivity of crops in a sustainable manner. To apply IPM successfully, farmers require a broad understanding of the entire production system (IPM-AF, 2014).

## Principles of IPM

The FAO defines IPM as “the careful consideration of all available pest control measures that discourage the development of pests and keep the use of pesticides to levels that are **economically** justified and reduce or minimise the risks to human health and the environment” (FAO, 2014).

IPM is an ecosystem approach that does not seek to eradicate pests - but rather to manage them. IPM is a knowledge-intensive approach and requires a broad understanding of the crops, pests, natural enemies and weeds. The IPM process usually follows the steps mentioned below (FAO, 2014 and World Bank, 2011):

### Box 1: Cultural methods of pest prevention

**Cultural methods** contribute to a balanced ecosystem through following measures:

- Crop rotation
- Intercropping
- Field sanitation
- Resistant/tolerant crop varieties
- Sowing, planting and harvesting dates
- Water/irrigation management
- Soil and nutrient management
- Cultivation practices to attract beneficial insects
- Use of trap crops that attract the pests

### 1. Prevention

Suppress and prevent pests from becoming a threat by establishing a healthy and balanced ecosystem through applying a wide range of **cultural methods** (see Box 1). For many pests prevention measures can be very effective, and pests will not become a nuisance.

### 2. Identify and monitor pests

Identify occurring pests and monitor them with adequate methods and tools (e.g. traps for insects). A comprehensive understanding of the pest cycles is a prerequisite to observe pest occurrence in the field and later take adequate measures.

### 3. Sustainable pest management

Apply when needed (based on the results from the monitoring) biological and mechanical pest control measures (see Box 2). Biological and mechanical pest control methods can be effective for controlling pest populations. These methods are often labour-intensive, however, so prevention and cultural methods are very important.

### 4. Economic injury level

At the time the pest population exceeds the economic injury level - the point where the cash loss of the reduction in yields exceeds the costs

### Box 2: Sustainable pest control methods

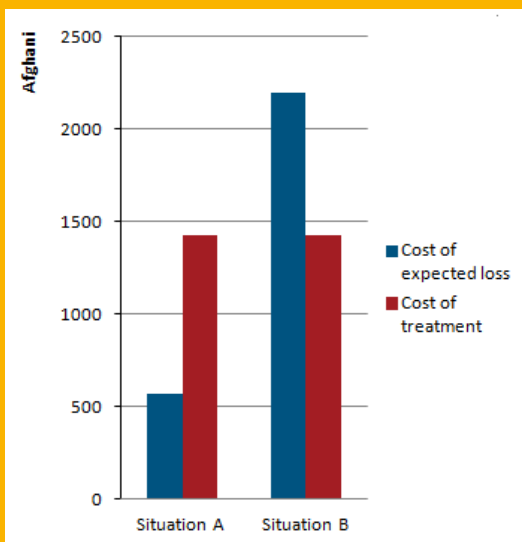
**Mechanical methods** remove or destroy the pests mechanically:

- Manual picking of insects
- Burning of infested plants
- Weeding operations
- Soil preparation to destroy pests and hinder weeds

**Biological methods** control pests in an eco-friendly manner:

- Release of natural enemies (predators, parasites or pathogens) to control pests
- Pest and weed control through animals (ducks, geese, goats etc.)
- Apply natural pesticides (Bio-pesticides)
- Apply biological preparations (e.g. Neem, see Figure 1)

### Box 3: Economic injury level



Why would anyone spend 1425 Afs for pesticides to control pests that will cause a reduction of yield of only 570 Afs?

The economic injury level defines the point at which the cost of pesticides pays off. The economic injury level is calculated for each pest beforehand and expressed in a **biological threshold**, usually the number of insects/area or plant.

**Situation A:** The treatment costs are higher than the expected loss due to reduced yields. Pest control is not profitable.

**Situation B:** The expected loss because of reduced yields is higher than the cost of pest control. Pesticide use pays off.

for chemical pest control - the application of pesticides becomes **economically** profitable (see Box 3).

### 5. Chemical pest control

If all other measures have no effect chemical pest control, mainly the use of pesticides (insecticides, herbicides, fungicides) comes into action, but only if the economic threshold is likely to be surpassed. Chemical pest control needs special attention to **safety precautions** to avoid health hazards to farmers, and environmental contamination. For further information on the proper use of pesticides refer to: <http://afghanag.ucdavis.edu/pest-management/pest-management-1>

### 6. IPM monitoring and learning

Monitor the success of the applied measures and strengthen and share.

IPM has been shown to be successful for various crops and in many countries. However, the following drawbacks exist:

- Knowledge-intensive approach: training in pest identification, monitoring and control is required and best organised through Farmer Field Schools;
- Labour-intensive and therefore time-consuming approach;
- There is often a lack of access to and availability of certain assets (trap crop seeds, natural enemies, products to prepare bio-pesticides etc.);
- Success can be weather-dependent.

- › **Neem** (*Azadirachta indica*): against many insect pests and as neem cake against nematodes
- › **Pyrethrum** (*Chrysanthemum cinerarifolium*): against most insects and mites
- › **Fish bean** (*Tephrosia vogelii*): against caterpillars, mites
- › **Chili** (*Capsicum frutescens*): against many insect pests
- › **Tobacco** (*Nicotiana spp.*): against all insects and mites (very toxic for humans)
- › **Mexican and African marigold** (*Tagetes spp.*): repellent effects against insect pests, effects against nematodes
- › **Garlic** (*Allium sativum*): anti-feedant for insect pests
- › **Wild basil** (*Ocimum suave*): repellent effect on insects

Figure 1: Biological preparations used for pest control (FiBL, 2011)

### Box 4: Resistant or tolerant varieties

**Resistant:** Ability of a variety to **restrict** the damage of a pest through various plant mechanisms.

**Tolerant:** Ability of a variety to **withstand** the damage of a pest.

**Susceptible:** Inability of a variety to restrict the damage of a pest

## Sustainable IPM practices

### Pests

Pests - now in a more specific sense - include all types of animal pests in particular insects: caterpillars or weevils that make holes or feed on leaves; aphids that suck plant sap, causing curled leaves; larva and fruit flies that often cause damaged or rotten fruits; and many others. There are many more animals - namely mites, nematodes, mammals and birds - that can all cause severe crop reductions. All these pests play an important role in the ecosystem, however, and should therefore not be eradicated, but managed to avoid their becoming a nuisance for agricultural production. Preventive measures are key to establishing a healthy and balanced ecosystem (USDA&UC Davis, 2013 and FiBL, 2011):

**Prevention measures:** proper soil, water and crop management (to enhance plant health and preventing the introduction and spreading of pests); crop rotation (reduces the development of high pest populations); intercropping (to distract pests or to attract natural enemies); field sanitation (remove and destroy pest hosts), timing of sowing and harvesting (avoid crop and pest co-occurrence); trap crops (attract the pest).

**Sustainable practices:** Collect and destroy insects manually, through soil preparation practices or with insect traps (pheromone, bait, light and colour). Apply bio-pesticides and natural preparations to reduce the pest.

## Diseases

Diseases are caused by fungi, bacteria or viruses. Fungi cause the vast majority of diseases and are responsible for most cases of spotting, cankering, blighting, wilting, scabbing and rotting on different plant parts. Bacteria result in the breakdown of the cell wall and thus rotting; viruses mostly cause leaves or other green parts to change colour. Disease management is crucial and involves the following measures (USDA&UC Davis, 2013 and FiBL, 2011):

**Prevention measures:** Proper soil, water and crop management to enhance plant health and prevent the introduction and spread of diseases; crop rotation (avoid soil-borne diseases); seed treatment (to avoid seed-borne diseases); resistant crop varieties; field sanitation (remove and burn infected plants); timing of sowing and harvesting (avoid crop and disease co-occurrence).

**Sustainable practices:** Apply bio-pesticides and natural preparations to reduce diseases.

## Weeds

A weed is any plant that is undesirable or troublesome in the field because it reduces crop yields and quality through competition for nutrients, light and water, or in some cases through an allelopathic effect. Moreover, weeds can be hosts for insects and diseases aggravating their effects. On the other side, weeds also provide cover for the soil and reduce erosion as well as provide a habitat for beneficial organisms (USDA&UC Davis, 2013 and FiBL, 2011):



**Prevention measures:** Limit the introduction, development and multiplication of weeds through: crop rotation and intercropping (suppresses weeds); variety selection (fast-growing to cover the soil quickly); timely sowing (suppresses weeds); quality seeds (free of weed seeds); proper soil management (avoid weed seed to germinate); and undersowing, mulching and pasturing. All these methods make a substantial contribution to weed management. The successful implementation of these preventive methods saves considerably on labour for later weeding operations.

**Sustainable practices:** Weeding operations, including manual (and mechanical) weeding by pulling up the weeds, or digging or cutting them with weeding tools (e.g. hoe). The main idea is to remove weeds from the field, or pull them out and let them wilt in the sun.

## IPM in wheat

The major wheat pests in Afghanistan are Moroccan locust and sunn pest, rust and bunt diseases, and prevalent weeds such as wild oats. The following table gives a summary of prevention and sustainable pest management for these important pests.

**Table 1: Pests in wheat production and sustainable control measures**

Pests				
	<p><b>Moroccan Locust</b> (<i>Dociostaurus maroccanus</i>) ملخ مراکشی</p> 		<p><b>Sunn pest</b> (<i>Eurygaster and Aelia spp.</i>) کفشک</p> 	
	<p><a href="http://afghanag.ucdavis.edu/b_field-crops/wheat-1/field-crop-fact-sheets/FS_Insect_Moroccan_Locust.pdf">http://afghanag.ucdavis.edu/b_field-crops/wheat-1/field-crop-fact-sheets/FS_Insect_Moroccan_Locust.pdf</a></p>		<p><a href="http://www.icarda.org/sites/default/files/Sunnpest.pdf">http://www.icarda.org/sites/default/files/Sunnpest.pdf</a></p>	
<b>Economic injury level</b>	2-5 nymphs/m <sup>2</sup>		3 overwintered adults/m <sup>2</sup> 8 nymphs/m <sup>2</sup>	
<b>Cultural</b>			<ol style="list-style-type: none"> <li>1. Plant wheat early</li> <li>2. Use early maturing varieties</li> <li>3. Harvest wheat early</li> <li>4. Attract and encourage natural enemies by planting shrubs, trees, medicinal flowers next to wheat fields</li> </ol>	
<b>Mechanical</b>	<ol style="list-style-type: none"> <li>1. Ploughing of the field in winter months to destroy the eggs</li> <li>2. Trapping and bury young locust with shallow trenches</li> </ol>		<ol style="list-style-type: none"> <li>1. Collect insects by hand in early season</li> </ol>	
<b>Biological</b>	Bio-pesticides		?	

Diseases	Weeds
<b>Rust</b> ( <i>Puccinia spp.</i> ) مرض سرخی گندم <b>Bunt</b> ( <i>Tilletia spp.</i> ) سیاه قاق گندم <a href="http://www.ipm.ucdavis.edu/PMG/r730100611.html">http://www.ipm.ucdavis.edu/PMG/r730100611.html</a> 1. Cultural methods 2. Use of resistant varieties 3. Seed treatment (for bunt)	Various weeds, e.g. wild oats <a href="http://ipm-af.org/wp/wp-content/uploads/2013/12/SWI-poster.pdf">http://ipm-af.org/wp/wp-content/uploads/2013/12/SWI-poster.pdf</a> 1. Cultural methods 2. Manual weeding

## IPM in potato

There are several important potato pests such as white flies, aphids, potato tuber worm, wireworms and the very problematic Colorado beetle. Moreover, bacterial and fungal diseases predominate in potato cultivation. Weeds are also a major concern. For a better understanding of the pests and their control methods please refer to:

1. [http://afghanag.ucdavis.edu/a\\_horticulture/row-crops/potatoes/potatoes#pest-management](http://afghanag.ucdavis.edu/a_horticulture/row-crops/potatoes/potatoes#pest-management)
2. <http://www.ipm.ucdavis.edu/PMG/selectnewpest.potatoes.html>
3. <http://www.vegetableipmasia.org/docs/Ecological%20Guide/All%20about%20potatoes%20ecoquide%202006.pdf>

Farmer Field Schools (FFS) are a good way to introduce IPM. Figure 1 shows a FFS on IPM in wheat. This [manual on FFS for potato IPM](#) is very useful:



Figure 2: FFS on wheat IPM in Afghanistan (IPM-AF, 2014)

### Box 5: Intercropping (companion planting)

Intercropping is a useful IPM strategy in vegetable and horticulture production. Intercropping contributes to pest prevention by establishing a diverse ecosystem that attracts natural enemies and/or distracts pests.

This [manual on companion planting](#) in vegetable gardening is very useful:

## IPM in vegetables and horticulture

This is too big a topic to cover here due to the huge variety of vegetables, fruit and nut trees. The following links are useful for IPM in vegetable and horticultural production:

1. <http://www.ipm.ucdavis.edu/PMG/GARDEN/veggies.html>
2. [http://afghanag.ucdavis.edu/a\\_horticulture](http://afghanag.ucdavis.edu/a_horticulture)

Author(s): Mohammad Sharif and Tina Roner, April 2014

### Further reading and references

- FAO, 2014: Online information: <http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/ipm/en/>
- FAO, 2002: From Farmer Field School to Community IPM, available at: <http://www.fao.org/docrep/005/ac834e/ac834e00.htm#Contents>
- FiBL, 2011: African Organic Training Manual, Module 4: Pest, Disease and Weed Management, available at: <http://www.organic-africa.net/1309.html?&L=0>
- IPM-AF, 2014: Integrated Pest Management Project in Afghanistan, see <http://ipm-af.org/>
- USDA&UC Davis, 2013: Afghan Agriculture Portal, available at: <http://afghanag.ucdavis.edu/>
- World Bank, 2011: online information: <http://web.worldbank.org>



2014. This document is made available under a [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International license](#)

This publication has been made possible through financial support of Swiss Agency for Development and Cooperation SDC. The content, however, is the sole responsibility of HELVETAS Swiss Intercooperation.

Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra  
Swiss Agency for Development and Cooperation SDC