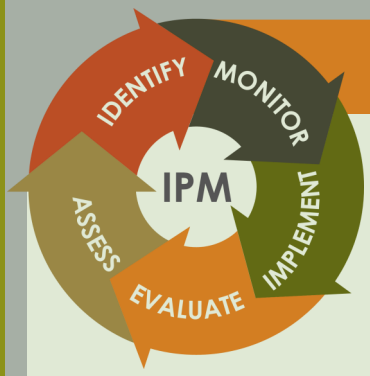
INTEGRATED PEST MANAGEMENT **IPM**

IPM at a Glance:

- IPM is a strategy to suppress pest populations and the damage they cause using a series of planned, integrated interventions.
- An IPM approach includes cultural practices to reduce pest populations, physical or mechanical controls, biological controls and a minimal use of agricultural chemicals
- Pests are managed by field measurement of economic thresholds that enable farmers to use chemicals only when justified by a economic yield and quality loss
- Farmers in NES can practice biological controls be fostering the natural predators and parasites in field margins and pastures
- Clean, sterilized seed can reduce the impact of seed and soil-borne pests

Yellow Rust on Wheat
(Photo Credit: i-APS)



WHAT IS IPM?

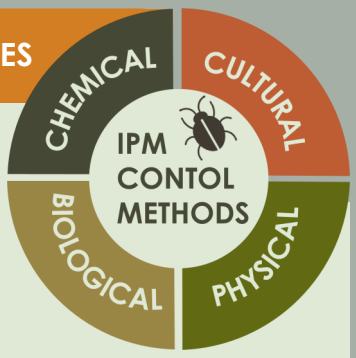
Integrated pest management (IPM) is a strategy to manage insects, plant diseases, weeds and other pest problems. The goal is to suppress pest populations to levels that do not cause economic damage to the crop. The IPM approach uses knowledge about pests and their life cycles, cultural practices, nonchemical methods and pesticides to manage pest problems and minimize the use of chemicals and their effect on the environment. Rather than employing regularly scheduled chemical treatments, IPM uses a combination of management practices to control pest damage, applying pesticides only when needed.

Implementation of an IPM approach requires increased management and record-keeping to understand the best methods that work for each farm. The approach includes five features:

- **Monitor** and scout wheat fields to determine the pest types and infestation level
- **Identify** pest populations in your field as accurately as possible
- **Assess** and consider the economic injury through yield and quality losses and develop an IPM plan for the tactics and methods to suppress pest populations in your field
- **Implement** the treatment strategy using cultural, mechanical, biological or chemical control measures
- **Evaluate** keep good records of pest infestations, control measures and their effectiveness to inform plans for next season[1]

In Syria, wheat IPM begins with seed cleaning and sterilization and uses multiple tools and approaches to suppress insects , weeds and plant diseases.

IPM MANAGEMENT PRACTICES



An IPM strategy employs multiple types of control measures to suppress pest infestations. While not all IPM management practices are readily available to cereal grain producers in NES, many aspects of IPM management can be used.

Cultural pest control is the use of good plant protection farming or cultural practices that make the crop environment less favorable to pests. This may be planting clean seed, planting and harvesting early, crop rotation, early maturing varieties.

Physical controls: are the use if direct and indirect controls that kill the pest or disrupt its physiology or life cycle. This includes tillage operations, cultivation, irrigation water management. In vegetable production plant covers provide a physical barrier to pest infestation.

Biological controls are the manipulation, conservation or introduction of natural enemies or pathogens of crop pests. For wheat production in NES, options may include planting buffer zones to allow development of natural enemies and the use of chemicals that do not kill parasites or predators of pests.

Chemical controls should be used only when necessary based upon economic thresholds and in addition to other pest management practices.

Other control options include the use of new varieties resistant to common pests and diseases and legal and regulatory control measures that such as quarantines and water management practices.[2]

ECONOMIC THRESHOLDS

IPM practices depend upon the identification of pests in the field and determining the level of infestation that will cause economic injury to the crop. Economic injury is the infestation level that will cause yield or quality losses that exceed the cost of controlling the pest. The economic threshold is the pest infestation, based upon field scouting, that will cause the economic injury. For example, the economic threshold for Sunn pest in northeast Syria is 1-2 adult insects per square meter. After scouting sections of a field, if the average count of adult Sunn pests in the sampled area is 1-2, then chemical application is warranted.[3]

Weeds in wheat are assessed by the number of weeds per meter. Because weed infestations in a field are variable, the field should be divided into sections to determine where herbicide treatment may be needed. Weed counts are managed on a scale. For Syria, if weed counts are None: Few; Common; Abundant; or Extreme. For NES, there should be verification of these scores but if a filed or portion of a field has more than 1 weed per 30 cm of row or more, then it is categorized as Abundant or Extreme infestation and chemical treatment is needed.

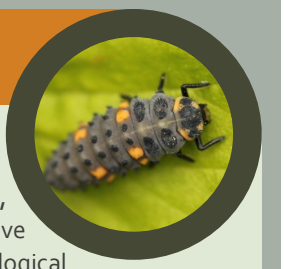
For plant diseases, economic injury levels change through the season but at the flag leaf stage, if the top two leaves are infected on 50 percent of plants in the sample, then foliar fungicide may be needed.[4]

CHEMICAL CONTROL MEASURES

When using an integrated pest management approach and it is determined that chemical pesticide application is required, it is important to identify the pests to be controlled and select an appropriate product. The chemical application should be made at the right time of the insect/disease/weed growth to ensure it is effective. As better weather data and analytics are available online, it will be possible to time pesticide applications based on weather data and pest development. For now, it is necessary to scout fields frequently to catch pests infestations early and at the time they are most susceptible to chemical applications. For example, one sprays insects during their pupation stage, applications will not be effective. If weeds get too large, they may not be fully controlled by herbicides. The following guidelines will assist farmers to manage chemical applications in wheat:

- Identify pests and select the best chemicals to control the pest infestation in your field
- Apply pesticides when target pests are most susceptible to chemical controls to be as effective as possible and to limit costs
- Use chemicals that have limited impact on the environment and beneficial species such as predators, parasites and pollinators
- Follow all label instructions for safe and effective use of pesticides and proper disposal of unused product and empty containers
- Use the correct rate of application, calibrate equipment and ensure it is in good working order

BIOLOGICAL CONTROLS



Biological controls are increasingly used to implement IPM strategies. Wheat farmers in NES have limited opportunity to rear and release predators that help control a growing number of pests, there are opportunities to engage biological systems to support pest control. First, in the selection of pesticides, farmers should purchase products that target the pest they want to control but have less impact on native species and natural predators. Secondly, there is a growing body of research that encourages natural biological controls be leaving natural buffers between fields that give habitat to birds and insects that help control field pests. Third, farmers can request agrochemical dealers to provide biological pesticides (i.e. neem oil and pyrethroids) that have fewer negative environmental impacts.

Additional control measures include genetic resistance. There have been limited new varieties developed in the past 20-30 years in NES. With the recovery of research and plant breeding capacity there may be opportunities to test new varieties showing resistance to pests and diseases. One opportunity for pest avoidance is planting early maturing varieties that can be harvested before the late season build-up of Sunn pest has the opportunity to damage yield and grain quality of wheat and barley.

[1] N.C. State Extension Publications. 2018. North Carolina Extension Gardener Handbook. Chapter 8. Integrated Pest Management. N.C. State Extension Publications, Raleigh, North Carolina

[2] The Cadmus Group. 2018. Pesticide Evaluation Report and Safe Use Action Plan: 2018 Syria Project/Programs. U.S. Agency for International Development. May, 2018

[3] Key Informant Interview. Agricultural Directorate, Al-Hasakeh Governorate. May, 2020

[4] Thomas-Murphy, J. 2020. IPM Practices for Small Grains. Cornell University College of Agriculture and Life Sciences. Ithaca, New York.

PEST MANAGEMENT APPROACHES FOR SOME COMMENT PESTS OF WHEAT IN NORTHEAST SYRIA (SEE NOTE 1)

INSECTS					
NAME OF PEST	**GENUS / SPECIES**	**ECONOMIC THRESHHOLD**	**DAMAGE**	**CULTURAL CONTROLS**	**CHEMICAL CONTROL RATE**
Sunn Pest **Sunnah bug**	*Eurygaster integriceps* Puton	1-2 adults/m2 6-8 nymphs/m2	Migrate to fields late in season. Suck on developing grain. Reduces yield and quality of developing grain	Plant and harvest early Plant early maturing varieties Leave natural buffers to give alternate hosts and predator habitat Plant high gluten varieties	Insecticide resistance is a growing problem. Use different pesticides (see Note 2) **Karate: Lambda Cyhalothrin 5%** (see Note 3) **Deltarin: Deltamethrin: 2.5 g/L EC** Alphacypermethrin: 10% EC Oxymatrin: 4L/ha ULV Dimethoate
Cereal Leaf Beetle	*Oulema melanapus* L.	1 larva/stem	Larva feed on upper leaf scraping green tissue giving a white appearance	Good stand establishment and agronomic practices	**Karate: Lambda Cyhalothrin: .5%** Pyrethroids (See note 2)
Wheat Ground Beetle **Zabrus /plant worm**	*Zabrus tenebrioides* (Goeze)	General rule 6-12 beetles per square meter No specific threshold	Adult beetles feed on sown seed and developing seed head. Larvae live in soil and emerge at night, pull seedling leaves into their burrow, also feed on developing roots. In monoculture wheat, may reach 50 larvae/ m2.	Wheat rotation with non-cereal grain crops. Remove wheat straw from field and till stubble to 20 cm depth. Control grass weeds and volunteer grain plants Use good agricultural practices Harvest as early as possible	1. Seed treatment: Imadicloprid Recommended if infestation is heavy 2. Pre-plant insecticide treatment **Dursban: chlorpyrifos** (restricted use pesticide, See Note 2) 3. Seedling spray if damage observed. Spray in early morning or evening. **Deltarin: Deltamethrin** (see Note 2) **Dursban: Chlorpyrifos** (see Note 2)
Aphids	*Rhopalosiphum maidis* Fitch *Diuraphis noxia*	Threshold depends on growth stage and aphid species Thresholds: 1 aphid/tiller at head emergence 7 aphids/tiller at medium milk stage	*R. maidis*—consume photosynthates; may vector viruses *D. noxia*—white to purple streaks and leaf rolling; reduced flour quality	Follow good agricultural practices that improve plant resistance to aphids. Use varieties with resistance when available	Simple controls: Insecticidal soaps : 15 ml/liter liquid dish soap Azadiractin (neem oil) products are safe and effective **Karate: Lambda Cyhalothrin: .022-.034 kg ai/ha** Acetamiprid

PLANT DISEASES					
NAME OF PEST	**GENUS / SPECIES**	**ECONOMIC THRESHHOLD**	**DAMAGE**	**CULTURAL CONTROLS**	**CHEMICAL CONTROL RATE**
Yellow Rust	*Puccinia striiformis* f. sp. *tritici*	Thresholds vary with conditions, variety, prices Generally 2-5% plants with symptoms	Favors cool temperatures and higher elevation. Yellow pustules form stripes on leaves. Cause plant stunting, yield loss	Follow good agricultural practices Use resistant varieties when available Spores spread by wind	**Amistar Xtra: Azoxystrobin 200 g/L + Cyproconazole 80 g/L Suspension Concentrate** (See Note 5) Other options: Pyraclostrobin, Trifloxystobin, Chlorothalonil
Loose Smut	*Ustilago tritici*	Seed born disease with no field treatment No set threshold If 1 percent of field infested, rotate with other crops for 2 years	Masses of black spores on seed head, no grain Spores wind borne infect other grain Field with 1% infection may have 10% following year	Use certified seed treated with fungicide Sterilize grain to be used as seed There is no resistance Crop rotation with non-cereal crops	Sterilize seeds with fungicide Stamina F3 Cereals is a mix of: Pyraclostrobin, Triticonazole, and Metalaxyl and is registered to control both smut and root rot Options currently available in NES: **Tebuconazole and Difenoconazole**
Common Root Rot	*Cochliobolus sativus* *Fusarium culmorum* *Fusarium graminaerum (Note 6)*	Seed and soil-borne disease. No threshold available	Mycelium in seed or soil May also attack roots and plant crown. Causes black lesions, stunting, reduced tillers and plant death	Use seed treated with fungicide Plow crop residue into soil Use adequate N-P-K fertilizer Plant seeds uniformly at 3-4 cm depth Rotate with non-cereal crops and control grass weeds	Sterilize seeds with fungicide. See list above.

WEEDS					
NAME OF PEST	**GENUS / SPECIES**	**ECONOMIC THRESHHOLD**	**DAMAGE**	**CULTURAL CONTROLS**	**CHEMICAL CONTROL RATE**
Wild oat **Snissila**	*Avena sterilis*	General rule for weed economic thresholds: ≥ 3 weeds per square meter	Compete with crops for light, water and nutrients Wild oat damage occurs within first 50 days Increased production costs to control	Clean seed of all weed seeds Avoid deep plowing (once buried wild oat seeds survive in soil for many years Clean equipment when moving to new fields Rotate with non-grass crops and control grasses	**Post-ermergence grass herbicide: Clodinafop –propargyl 240 g/l+ Cloquintocet methyl 60 g/l.** (see Note 7) Widely available for control of wild oat and other grasses in wheat
Wild mustard **Al-Khurdalat**	*Sinapus arvensis* L.		Compete with crops for light, water and nutrients	Cultural controls will be similar for these 3 broadleaf weeds . Use high quality seed that has been sterilized. Plant at recommended rates Plant 3-4 cm depth for uniform germination. Use recommended fertilizers Control weeds early by cultivation, roguing	Each herbicide listed below is a postemergence, broad spectrum , broadleaf weed herbicide. There are many products, these are available in NES **Granstar: Tribenuron methyl** **Banvel or Diablo: Dicamba** (see Note 8) **2,4-D Amine: many trade names** E.g : **Fluroxypyr** (see Note 9)
Milk Thistle **Al-Harfish**	*Silybum mariaunum* (L.) Garten		Compete with crops for light, water and nutrients		
Fujila or Harra	*Diplotaxis harra* (Forssk.) Boiss		Compete with crops for light, water and nutrients		

NOTES:

1. Pests were identified during key informant interviews with the Agricultural Directorate, Plant Protection Office in Al-Hasakeh and Deir-ez-Zor Governorates
2. Restricted use pesticides (RUP) require full environmental assessment prior to approval for use with USAID funding. Deltamethrin and Alphacypermetherin are not authorized by USAID Syria PERSUAP.
3. Trade names and/or active ingredients listed in bold indicate products available from retail outlets in NES. Other products are based upon the USAID PERSUAP or effective products on the market. There are many potential products for each pest, this list is not a comprehensive list of potential products.
4. Oxymatrin is plant extract from Sophora flavescens, a Chinese herb
5. One component of Amistar XTRA, Azoxystrobin,is not listed in the USAID PERSUAP
6. Multiple pathogens may cause common root rot and other forms of root rot.
7. Claudinofop-propargyl and Cloquintocet are not listed in the USAID PERSUAP
8. Dicamba should be sprayed at low pressure and low wind. May vaporize and drift to non-target plants causing unintended damage.
9. None of the three broadleaf herbicides we found available in local shops are listed in the USAID PERSUAP. Fluroxypry under the trade name, Starane Ultra, is one example of a newer class of herbicide listed in the PERSUAP. It was not listed for sale by retail outlets visited.