INTENSIVE APPLICATION OF IPM FOR INCREASING PRODUCTION OF PULSE CROPS

Sensitivity to weather aberrations and pest complex numbering 200 in pulses pose innumerable problems towards realizing the economic yields, leading to imports. *Helicoverpa armigera*, a major insect-pest on pulses has been reported to cause losses to the tune of 45 thousand million per annum. Indiscriminate use of chemical pesticides has further compounded the pest management due to development of resistance to pesticides besides causing environmental pollution leading to human health hazards. Pulses are highly sensitive to attack by a wide range of pests (diseases, insects and weeds) both in the fields as well as storage conditions. Most of the pests attack the crop at reproductive (flowering & pod) stage causing direct losses to the tune of 70%. In absence of resistant varieties, insect-pest and diseases are the major bottlenecks in realizing higher yields. In order to manage pest situations without compromising yield levels while keeping the cost of cultivation within limits, optimization of crop protection measures in crop production has attracted the attention of planners, scientists as well as pulse growers. The solution to a greater extent lies in the adoption of Integrated Pest Management (IPM) for managing pests. Hence, Department of Agriculture and Cooperation (DAC), New Delhi supported present studies under the ambit of National Food Security Mission.

Integrated Pest Management strategies

Pigeonpea

- Adopt field sanitation by removing undecayed plant/crop residues to prevent foliar diseases (powdery mildew and *Cercospora* leaf spot).
- Adopt soil application of Sulphur @ 20 kg/ha (e.g., through SSP, Gypsum or elemental) and Zn as ZnSO4, which will lead to healthy crop and impart general resistance.

- Select fields with no water logging or provide with good drainage system or follow ridge sowing to reduce the incidence of *Phytophthora* blight. Use certified seed of recommended variety having resistance/tolerance to key insect pests/diseases.
- Adopt recommended plant to plant and row distance as per chosen variety and location. Advocate larger row to row space in the late as well as transplanted pigeonpea.
- Treat the seeds with biofertilizers (PSB + Rhizobium+ Zn solubilizing bacteria) as per recommended dosages, giving preference to local resources such as State bio-control lab as well as University. Treat seeds with recommended dose of locally available Trichoderma formulations (10g/kg of seeds), to prevent seedling from soil borne and vascular diseases (e.g., *Sclerotium* soft rot and *Fusarium* wilt), nematodes at vegetative stage.
- Once the crop attains bud forming stage install pheromone traps @ 5/ha for monitoring of pod borer (*H. armigera*) adults in the field. Conventional light traps may also be installed. Crop needs to be surveyed for presence and stages of larvae. In case of high infestation in terms of catches (2-5 adult) per week or 1 larvae per plant (ETL) follow spray schedule. This spray schedule will hold good for *Maruca* web as well as leaf folders, which infest at vegetative and flowering stages.
- Spray with either 5% crude neem seed extract or with neem oil (3000 to 5000 ppm) will act as anti-feedant as well as repellent to most insectpests.
- Spray 450 LE of *Ha*NPV admixed with UV retardant (e.g., Ranipal), if the infestation by *H. armigera* larvae is on increase.
- Spray some ovicide (e.g., Profenophos or Chlorpyriphos).
- If the infestation by larvae (pod borer or webber or blue butterfly) is causing higher damage spray green label pesticides e.g., Emamectin benzoate or Chlorantraniliprole (Rynaxypyr) to save the crop. Repeat spray if necessary.
- During green pod stage look for damage caused by pod-fly in the immature pods and spray with insecticides e.g., dimethoate.
- Watch for early morning foggy weather for flower drops and examine closely for black spots. In case of black spots on petals and pedicle, spray with

fungicide e.g., Carbendazim; else if dropped flowers are free of spots irrigate the crop and spray with hormones e.g., NAA (@1.5ml/ha), which will further prevent flower drops.

- Harvested grains should be dried on cemented floor to prevent excessive moisture, which otherwise will help bruchids to survive during storage.

Chickpea

- Adopt field sanitation by removing un-decayed plant/crop residues to prevent soil borne diseases (e.g., wilt, black rot and soft rot).
- Adopt soil application of Sulphur @ 20 kg/ha (e.g., through SSP, Gypsum or elemental Zn as ZnSO4), which will lead to healthy crop and impart general resistance.
- Use certified seeds of recommended variety having resistance/tolerance to key insect-pests and diseases.
- Adopt recommended plant to plant and row distance as per chosen variety and location. Advocate larger row to row and plant to plant space to prevent foliar (Ascochyta) and floral (Botrytis) diseases. Advocate inter-cultivation of "Coriander/Linseed" at every 10th row to build up natural enemies.
- Treat the seeds with biofertilizers (PSB + Rhizobium+ Zn solubilizing bacteria) as per recommended dose, giving preference to local resources such as State bio-control lab as well as University. Treat seeds with recommended dose of locally available Trichoderma formulations (10g/kg of seeds), which will prevent seedling as well as vascular diseases (e.g., Sclerotium soft rot and Fusarium wilt), nematodes at vegetative stage.
- Install inanimate bird perches @ 20/ha to encourage predatory bird population.
- Once the crop attains bud forming stage install pheromone traps @ 5/ha for monitoring of *H. armigera* adults in the field. Adult catches will help in getting ready for monitoring-based spray schedules. Conventional light traps may also be installed. Followed by adult catches, crop need to be surveyed for presence and stages of larvae. In case of higher catches (2-5 adults) per week or 1 larvae per meter row (ETL) adopt plant protection interventions.

- Spray with either 5% crude neem seed extract or with neem oil (3000 to 5000 ppm), which will act as anti-feedant as well as repellent to most of insect-pests.
- Spray with 250 LE of *Ha*NPV admixed with UV retardant (e.g., Ranipal), if the infestation by larvae is still on increase.
- Spray some ovicide (e.g., Profenophos or Chloropyriphos).
- If the infestation by larvae (pod borer) is still on increase and larvae beyond 3rd instar are visible spray with green label pesticides e.g., Emamectin benzoate to save the crop. Repeat spray if necessary.
- Watch for early morning foggy weather for flower mottling and drying and examine closely for cottony growth. In case of cottony growth on petals and pedicles spray with fungicide e.g., Carbendazim.
- Harvested grains should be dried on cemented floor to prevent excessive moisture, which otherwise will help bruchids (Callosobruchus spp.) to survive during storage.

Mungbean and Urdbean

- Advocate field sanitation, deep summer ploughing and augmentation of de-oiled neem cake @ 5 q/ha.
- Apply balanced dosages of fertilizer, including K to assure pest tolerance in crop.
- Use varieties with resistance for foliar diseases (yellow mosaic virus, powdery mildews).
- Seed treatment with Carbendazim @ 1g/kg seed or *Trichoderma* (4 g/kg seed) + carboxin (1 g/kg seed) for disease management and imidacloprid or thiomethoxam 70WS @ 5g/kg seed for early stage insect pest management or soil application of Imidacloprid 0.3G @15kg/ha for longer effect against sucking insects-pests.
- Intercropping with sorghum, sesame and finger millet as per ratio recommended for the particular location. Adopt regular monitoring of the crop for the occurrence of diseases and pests.
- Use pheromone trap (only in podborer endemic areas) for insect monitoring. With moth catches of 4-5 per trap for 3-4 nights spray as recommended.

- First spray of Profenophos 50EC @ 2ml/l of water.
- If insect-pests continue to prevail apply second spray with NSKE (5% w/v).
- Spray 0.05% Carbendazim @ 5 g a.i./10 l water if powdery mildew, anthracnose or *Cercospora* leaf spot infection is observed to have initiated on the crop (not at advanced stage of disease).

Lentil

- Advocate field sanitation, deep summer ploughing and augmentation of deoiled neem cake @ 5 q/ha.
- Apply balanced use of fertilizer, including K to assure pest tolerance in crop.
- Use varieties with resistance to foliar rust.
- Seed treatment with Carbendazim @ 1g/kg seed or *Trichoderma* (4 g/kg seed) + Carboxin (1 g/kg seed) for disease management and Imidacloprid 70WS @ 5g/kg seed for early stage insect pest management.
- Seed treatment with Carbendazim (1g a.i./kg seed) + Thiram (2 g/kg seed), or Trichoderma (4 g/kg seed) + Carboxin (1 g/kg seed).
- Timely sowing as per recommendation for the particular location to avoid rust.
- Intercropping or mixed cropping with linseed or mustard as per ratio recommended for the particular location.
- Regular monitoring of the crop for presence of diseases as well as sucking insect-pests.
- Foliar spray of Profenophos 50 EC @ 2 ml/l water or Dimethoate 30 EC @ 2 ml/l water in case of aphid infestation.
- Foliar spray of Wettable Sulphur (2 g/l water) or Mancozeb (2 g/l water) against rust (number of sprays depend on the disease severity, progress of disease).

Yield and economics of IPM

The implementation of IPM with the holistic crop health approach has led to increased pulse production (15-20%) due to reduction in pest incidence/intensity at field level across the centres. "National Pest Reporting and Alert System" led to timely action against insect-pests and diseases, thus improving the economic benefits. Due to monitoring system in place identification of the powdery mildew, *Batocera*, *Cercospora* leaf spot disease, *Macrophomina blight* in pigeonpea and powdery mildew, rust and

leaf malformation in chickpea were noted as emerging pest problems in southern and central India.

Crop/ location	% increase in yield	BC Ratio
Pigeonpea		
Gulbarga	66.5	3.4
Bidar	168.2	4.0
Anantapur	64.5	2.1
Naigaon	41.6	3.0
Badnapur	110.7	5.6
Parbhani	8.8	3.4
IIPR, Kanpur	8.0	2.8
Jabalpur	87.4	2.9
Chickpea		
Gulbarga	86.2	2.6
Badnapur	101.0	2.5
Bidar	197.0	2.4
Anantapur	23.8	2.0
Naigaon	89.6	1.8
Parbhani	37.5	1.8
Kanpur	38.4	3.1
Lohardaga	13.1	2.8
Jabalpur	29.2	2.3
Mung and Urd bean		
Badnapur	93.0	4.5
Lentil		
Jabalpur	48.3	4.4
Lohardaga	14.4	2.1

The B:C ratio indicates that IPM farmers have been benefited more economically in comparison to non-IPM due to savings accrued by less spray and vigorous crop health due to INM provided under IPM kit.

The mean value of output on IPM farmer was about 10% higher than NIPM farms. The cost per unit output under different technological options is an indicator of their economic efficiency. The economic analysis clearly indicated that IPM strategies with focus on timely intervention can pay dividends in the long run and will also help in reducing impact of climate change.

Environmental benefits

Use of eco-friendly chemical pesticides has helped in promotion of beneficial insects, viz., spiders, coccinellids and *Chrysoperla*. Spiders are very effective in minimizing the

population of insect-pests. Since it is very difficult to rear, they were conserved by minimizing the chemical pesticide sprays. Build-up of lady bird beetles (*Coccinella*) and the occurrence of green lacewing (*Chrysoperla*) could be observed for 45 days of crop growth. They feed on jassids and eggs of lepidopteran insects. While the population of spiders and *Chrysoperla* was more during peak flowering than pod development stage, coccinellids were more during the later stage. Population of beneficial was more in IPM as compared to NIPM fields across all the taluks and seasons. Spider population was more in IPM as compared to NIPM. The occurrence of green lacewing (*Chrysoperla*) could be observed for 45 days of crop growth.

Ecological benefits

With growing awareness on the environment, all government agencies are emphasizing on sustainability through eco-friendly technologies. Hence, an attempt has been made to analyze the impact of IPM strategies on environment and farm workers. The benefit incurred to the environment was assessed based on total EIQ, farm workers, honey bees as pollinators, consumers as well as natural defenders. IPM strategies have reduced use of chemical pesticides leading to improvement in ecological niche.