

In the state, insects, diseases and weeds cause damage to 7-25% crop every year of which 33% is caused by weeds, 26% by disease, 20% by insects, 7% in storage, 6% by rodents and 8% other factors. The damage due to these factors is 7% in pulses, 10% in jowar, 11.4% in wheat, 15% in sugarcane, 18.6% in paddy, 22% in cotton and 25% in oilseed. Farm protection chemicals are being used with the objective to control the losses due to above factors in crops, fruits and vegetables.

In the state, average consumption of insecticides is 279.60 gm per hectare which is lower than the national consumption of 288 gm per hectare. This includes 58.7% insecticides, 22.0% weed herbicides, 22% for disease control and 3.3% fumigants. Use of these chemicals not only develops resistance against insects, disease and weeds but also harms natural enemies of the insect. Residue of these chemicals also pollutes food matters, soil, water and air. To protect from harmful effect of pesticide chemicals, use of organic insecticide is very essential.

Bio Agents and Bio Pesticides

Bio agents and Bio Pesticides are organism such as insects, fungus, bacterial and vegetation based products which help in increase in production by protecting the crops, vegetables and fruits from insects and diseases. These Bio agents and Bio Pesticides dissolve in water in 20- 30 days, become part of organic process and cause no harm to health and environment.

Neem is natural pesticide in which Azadirachtin and selenin element is found which prevent the insects to eat the crop and thus save the crop from them. Neem oil, cake and leaves are used for plant conservation and insect control.

Benefits from Bio-pesticides

- As Bio pesticides are plants and animal based product, it mixes in soil and decomposes within a month and no part of it remains. That is why they are called eco friendly.
- Bio pesticides only hit targeted insects and disease whereas chemical pesticides kill friendly insects also.
- Use of bio pesticide does not develop resistance in insects/diseases whereas use of chemical pesticides develop resistance in insects/diseases due to which its use has become unviable.
- Use of bio pesticides do not change with biological nature of the insects whereas changes in biological nature of insect are seen in use of chemical pesticide. White flies and pod borer insects of gram has started causing harm to other crops also.
- After use of pesticides, pods, foods and vegetables can be used immediately after harvesting whereas in case of chemical fertilizers, this can be used after waiting for sometime to reduce the residual effects of chemical pesticides.
- As bio-pesticides are safe, harmless and eco friendly, the demand and price of tea, cotton, fruits, vegetable, tobacco and food grains, oil and pulses produced by the use of bio pesticides is increasing as a result of which the farmers are getting remunerative prices of their produce. By the use of

trichoderma bio pesticide which is non poisonous and harmless, the probability of committing suicide has become zero where as use of chemical pesticides is causing suicides in rural and urban areas. Bio pesticides are safe and harmless for environment, human and animals. Its use promotes organic farming which helps in maintaining ecological and environmental balance.

1. Trichogramma (Trichocard)

This is an egg parasite which survives by eating eggs of approximately 200 species of harmful insects of Lepidoptera family. The length of this insect is 0.4 to 0.7mm and its life cycle is as follows

Period of laying eggs	16 to 24 hours	Larva duration	2-3 Days
PUP pre-term	2 Day	Pupa period	2-3 Days
Total time period	8-10 Days (summer) 9-12 days (winter)		

Female trichogramma lays her eggs amongst eggs of harmful insects and the eggs grow there and complete their life cycle. The insect hatches the eggs and comes out. Trichogramma is supplemented in the form of cards. One card contains approximately 20,000 eggs. Trichogramma is used to destroy shoot borer, fruit borer and leaf folder insects of paddy, maize, sugarcane, sunflower, cotton, pluses, fruits and vegetables. It can prevent 80 to 90% loss.

Trichocard is applied in different crops 3-4 times at an interval of 10-15 days. As soon as, the eggs of harmful insects appear in the field, tie the small pieces of card immediately in different parts of the field on lower surfaces of leaves or at the joints of leaf and stem. Use 5 cards per hectare in normal crop and 10 cards per hectare in big crops such as sugarcane. Apply it in the evening in the field but do not spray chemical pesticides before, during and after its use.

Before its use in the field, keep trichocard at 5 to 10 degree centigrade in ice box or refrigerator. |

2. Trichoderma

Trichoderma is a soluble bio fungicide which is based on trichoderma viridi or trichoderma hargianum. It has been found useful in control of root and stem rot, ukatha (*Fusarium oxysporum*, *Sclerotia dialectamia*) which are fungal borne disease. It works effectively in control of diseases in paddy, wheat, pluses, sugarcane, cotton, vegetables and fruits.

The fungus of trichoderma sucks the protoplasm of the harmful fungus and destroys them. In addition to this, they secrete some poisonous substances in food competition which forms a wall around the seeds and save them from harmful fungus. Due to trichoderma, the germination of seeds is good and they are free from fungal borne diseases. Their growth in nursery is also very good.

Use of trichoderma is useful in following ways:

- Tuber/Corm/Rhizome/Nursery plant should be treated by soaking them in a solution by dissolving 5 gm trichoderma in 1 liter water and then sow/plant it.
- For seed treatment, mix 4 gm dry trichoderma per kg seed and then sow the seeds.
- For soil treatment, mix 1 kg trichoderma in 25 kg dung manure, sprinkle water on it, dry in shade for a week and then use in the field before sowing.
- Make a pit around the roots of perennial tree and mix 100 gm trichoderma directly in the soil or mixed with compost.
- To control fungal disease in standing crop, spray 2.5 kg per hectare trichoderma dissolved in 400-500 liter of water in the evening which can be repeated at an interval of 15 days, if required.

This is a bio product which is harmful for open wounds, respiratory system and eyes. Proper care should be taken at the time of its use. No chemical fungicide can be used before and after its use. The self life of trichoderma is 1 year.

3.N.P.V (Nuclear polyhydrosis virus)

N.P.V is bio pesticide of *Helicoverpa armigera* or *Spodaptera litura* which is available in liquid form. It contains virus. If the bollworm eats or comes in contact with it, the body of the bollworm swells in 2 to 4 days oozes white liquid and dies. Diseases infested and died bollworm are found hanging on the leaves and twigs.

N.P.V saves cotton, cauliflower, tomato, chilly, lady finger, peas, coconut, sunflower, arhar, gram, cereals, tobacco and flowers from harm. Prepare a solution of 1 ml N.P.V dissolved in 1 liter water before its use and spray 250-500 ml solution per hectare 2 to 3 times on the crops at an interval of 12 to 15 days. Spray in the evening and take care that first spray is done in early stage or in egg laying condition. Self life of N.P.V is 1 month.

4. Beauvaria bassiana

This is a fungus based product which controls different types of leafhoppers. This is effective in caterpillars of family *Lepidoptera* in which pod borer (*Heliothis*), *Spodaptera*, borer and furred caterpillar are included. It is beneficial in prevention of diseases caused by pod borer, leaf folder, leaf eating insects, termite in soil and white guider etc in different crops fruits and vegetables.

Method of use

- For soil treatment, use 2.5kg of *Beauvaria bassiana* per hectare mixed 25 kg dung manure at the time of last plough.
- For insect control in standing crops, spray 2.5kg per hectare of *Beauvaria bassiana* dissolved in 400-500 liter of water in the evening which can be repeated at an interval of 15 days if required. Its self life is 1 year.

5. Pseudomonas florescence

This bacterium has been found useful in gram. It is capable of preventing the crops from diseases caused by 3 fungus- *Fusarium oxysporum* species, *Rizoctonia solani* and *Pythium*.

Method of use

- **Seed treatment**

Soak the root of the plant in slurry of 500 gram dry dung manure dissolved in 2.5 liter of water and mixed with 500 gram *Pseudomonas* and then plant it. Mostly this type of treatment is done on the roots of vegetable crops such as cauliflower, tomato, brinjal, chilly, onions and roots of paddy plants.

- **Root treatment**

Make a sticky solution by dissolving 115 gram gur or 55 gram sugar by heating in 1.25 liter of water and then add 500 gram *Pseudomonas* culture in it to prepare a thick solution. This solution is sufficient for 10 kg seed. Mix the seed well with the solution, dry shade and then sow it.

- **Soil treatment**

According to the crops, spray 800 gram culture of *Pseudomonas* per hectare mixed with fine soil or sand in the field before sowing is beneficial.

6. Chrysoperla

Larva of green insect named *Chrysoperla* which is 1-1.3 cm long, having light colored transparent long wings, golden eyes, and 5 antenna eats eggs and larva of White flies, Zaisid, Thrips etc,. Its life cycle is as follows:

Egg period	3 to 4 days	Larva period	11 to 13 days
Pupa period	5 to 7 days	Maturity	35 days
Egg capacity	300 to 400 eggs -		-

The eggs of *Chrysoperla* are supplied with *Corseara* eggs, in wooden boxes filled with saw dust. Its larva develops into adult by eating *Corseara* eggs. In different crops, 50000 to 1 lac larva are 500 to 1000 adult per hectare controls the insects very well. Normally it should be used twice.

The eggs of *Chrysoperla* can be kept for 15 days at 10 to 15 degree temperature in refrigerator. Its life cycle starts at normal temperature.

7. Azadirachtin

This liquid vegetative bio pesticide is based on neem seed and pulp matter. Its odor and taste causes insect to run away, creates unwillingness to eat and reduces the number of eggs and larva by slowing down the life cycle and reproductive capacity.

Neem oil is effective in control of roundworm such as Zaisid, white flies, bollworm, cutworm and fruit borer insects which harms cotton, gram, paddy, arhar, oilseed crops and tomato. For control of insects in standing crop, spray 2.5 liter Azadirachtin (neem oil) 0.15% EC per hectare at an interval of 15 days in the evening.

8.B.T (Bacillus theuringensis)

BT 5% WP is a bacteria based bio pesticide which affects the insects immediately. It causes paralysis, rupture of intestine, hunger and infection and the insects die in 2-3 days. It is available in both powder and liquid form. Its use is effective in pea, gram, cotton, arhar, ground nut, sun flower, paddy, cauliflower, cabbage, tomato, brinjal, chilly and lady finger.

BT is used by spraying. Prepare the solution by dissolving 0.5-1.0 kg BT in 500-700 liter water and spray of the above solution in 1 hectare 2-3 times at an interval of 15 days is beneficial. Its self life is 1 year.

9. Ferroman trap

Ferroman trap is made up of plastic to trap male insects causing harm to the crops. Lure of female insect is put on the middle of the lid placed on the main part which is funnel shaped which attract male insect. A polythene bag is placed on the bottom of the funnel in which insects fell. Rubber band is removed from the lower mouth, trapped insects are removed and killed.

To know the presence of insects, 5-6 Ferroman trap is placed in the field per hectare and trap more insect, 15-20 trap per hectare is placed. It is placed 1-2 ft higher than the crop in the field with the handle on the funnel.

Lure is filled with special odor (Ferroman) of female insect. For different insects, different types of lure are used. Ferroman trap is placed by using different types of lure for cotton, gram, arhar, tomato, cauliflower, cabbage, moong, urad, ladyfinger and paddy. Lure works for 3-4 weeks.

Availability of Bio agents/pesticides

In the state, bio agent- trichocard, trichoderma and NPV is produced in 9 IPM laboratory of Department of Agriculture- Hardoi, Azamgarh, Varanasi, Urai(Jalaun), Bareilly, Mathura, Moradabad, Saini(Kausambi) and Kairana(Muzzaffarnagar), 3 laboratories of Agriculture University- Kanpur, Moodipuram(Meerut) and Faizabad and 2 laboratories of GOI- Lucknow and Gorakhpur. Chrysoperla is being produced in Meerut lab of Agriculture University. Production and sale of bio agents and bio pesticides is also being done by different firms in the state. There is no problem in its availability.

Thus, use of bio agents and bio pesticides can results in pure crop at low cost and high yield and sustained growth of agriculture can be ensured in healthy environment.

Soil treatment

S.No	Name of the insect	Effected crops	Prevention	Quantity per hectare
Underground Insect				
1	Termite	All Crops	ब्यूवेरिया बैसियाना अथवा दानेदार कीटनाशी अथवा क्लोरोपायरीफास 20% ई०सी०	2.5 kg 10-20 kg 2.5 Liters
2	White Gidaar	All Crops	ब्यूवेरिया बैसियाना अथवा मेटाराइजियम अथवा	2.5 kg 2.5 kg/ 500 ml 2.5

			क्लोरोपायरीफास 20% ई०सी० अथवा दानेदार कीटनाशी	Liters 10-20 kg
3	Nematodes	All Crops	Surplus	Surplus
4	Root of Curly	Paddy	Surplus	Surplus
5	Cutworms	Vegetables	Surplus	Surplus
6	Pumpkin Red Worm	Pumpkin Class Vegetables	chloropyriphus 20% of E. C. or Beauverdia Besiaan or Metarigium	2.5 Liters 2.5 kg/500 ml
7	Early Shoot Borer	Sugarcane	Granulated insecticide or chlorpyriphus 20% of E.C. or Metarigium	10-20 kg 2.5 kg 2.5 kg/500 ml
8	Lepidopterus Insect	Kharif	Granular Insecticide all Crops Beauveria Bissian or Metarigium	10-20 kg 2.5 kg or 2.5 kg/ 500 ml
9	Millibug		Ladyfinger, Cotton, Beauveria, Basin, Mango, jackal or Metarizium or chloropyriphus 1.5% DP	2.5 kg Surplus 2.5 kg/500 ml 20-25 kg/ 150-200 gram/tree

Soil Borne Disease

1	Khaira	Paddy	Zinc Sulphate	20-25 kg
2	Bacterial scorching / Leaf stripe disease	Paddy	Pseudomonas	2.5 kg/250 ml
3	False Smut / Sheath Blight	Paddy	Trichoderma or Pseudomonas	2.5 kg 2.5 kg/ 250 ml
4	Ultha	Pulses Crops, Sesame, Sugarcane, Vegetable Orchid and Forest Trees	Surplus	Surplus
5	Route, Rot Stumps, Collar Rot	Pulses Crops, Peanuts & Vegetables	Surplus	Surplus
6	Bacterial Wilt	Dalhan, Tilhan	Pseudomonas horticultural crops and vegetables	2.5 kg/250 ml
7	Dumping of Downhill Mildew	Vegetables	Tryikoderma or Pseudokoderma	2.5 kg 2.5 kg/ 250 ml
8	Downie Mildew	Jowar, Bajra Maize	Trichoderma or Pseudomonas	2.5 kg/250 ml