Control of Aphid populations in Bundelkhand Region

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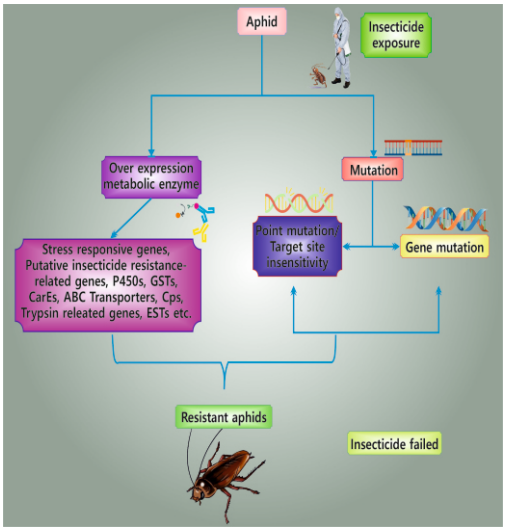

FIGURE 1. Illustration of the effects of insecticide exposure on aphids. The figure demonstrates how the insecticide fails and resistant aphids are produced.

KEYWORDS: Aphid, Predators, Parasites, Natural enemies, Microorganisms, Plant products.

Abstract

Rabi and Kharib crops are damaged by many pests which is the main pest Aphid. These have occurred on mustard, green gram, groundnut, papaya, peas, pepper, sesame, sorghum, soybean, tea, tomato, wheat, apple, cabbage, citrus and paddy crops. These were very dangerous for the grain yield of many crops. These may be controlled by early sowing of the crop, clean cultivation, and biological agents such as predators (Hudhud, Maina, Blue-Jay, Partridge, quail, Peacock, Paphiha, Owl, Bhujanga, Cuckoo, Crow, Sparrow, Kite, Bats, rats, Mole and Mongoose), parasites (see in table 1 and 2), natural enemies (see in table 2), microorganisms (Bacteria, Fungi & Virus), & natural plant products (Neem, Red Chilly, Pyrethrum, Garlic & Ash) and physical factors.

INTRODUCTION

Aphids (Aphis spp.) are plant-sucking bugs that occur throughout the world. These mainly occur on mustard, green gram, groundnut, papaya, peas, pepper, sesame, sorghum, soybean, tea, tomato, wheat, apple, cabbage, citrus, and paddy crops, etc. These are cosmopolitan insects pests and omnivorous also. There are various species of aphids which have special preference for certain crops. Some species feed cruciferous plants like cauliflower, cabbage, and knolkhol and also to other plants like peas, safflower, brinjal, and wheat in the Rabi season. These insects are supposed to be responsible for transmitting virus diseases of cardamom and papaya.

Aphids are among the most notorious pests of Indian crops. Major crops like maize, potato, rape-seed, cabbage, rai, peaches, plums, apples, and citruses all have depredation by one or several aphid species. They cause both direct and indirect injury to these crops. Crops are withering, leaf curl, gall formation, and death by sucking of plant sap. Transmission of viral disease by aphids is a more serious cause of crop loss although here the aphid injury is indirect.

Biological control measures of aphids are the main aspect of major importance. To manage the pest problem effectively, R&D strategies emphasize non-chemical approaches such as biological control and Integrated Pest Management. And, the research has yielded new technologies using naturally occurring enemies of insect pests (parasitoids, predators, and pathogens). More than 160 natural enemies have been studied for their utilization against insect pests (Singh, 1997), and some of these have even been standardized into technologies. Important ones are: Trichogramma, Bracons, Crysoperla carnea, Crytaemus montrouzieri, Bacillus thureingiensis, Bacillus sphaericus, Nuclear Polyhedrosis Viruses (NPV) and Trichoderma.

In addition, several plant products, such as azadirachtin (neem), pyrethrum, nicotine, e-tc. are also available as biopesticides. These are claimed to be effective against pests, particularly when used in conjunction with other methods of pest control, including chemical pesticides, agronomic practices, and mechanical control (Kishor, 1997; Chowdry and Seetharaman, 1997; Birthal et al., 2000; Birthal, 2003). As well as these populations are controlled by physical factors. As these pests live inside the stem of paddy plants and as they are capable of quick migration only controlling measures applied in a particular field will not help to control the damage done by these parasites. However, the following controlling measures may yield successful results which are discussed here.

Biological Control Methods for Aphid Pests:

The control of insect pests by the introductio-n, encouragement, and artificial increase of Biological agencies like predaceous and par-asitic insects, other animals, and diseases is termed Biological control. Biological control is regulated by the environmental factors wh-

-ich affect the stabilization of the pest population. Therefore, it is essential to determine the pest status of a species and prior information about the extent and how the stability of the pest population in the system is minimized to the non-economic level.

Biological methods for plant protection:

Diseases and pests: Under unfavorable conditions, the crops can become infested by a variety of diseases and pests. The following offers a list of causes :

1. Unsuitable site (too warm, too wet, water-logging, too dry)
2. Soil compression, caused by incorrect use of heavy machinery.
3. Degenerated and poor soil; lack of organic material.
4. Plants too close together.

Essentials of Biological Control Measure:

1. Consideration for the selection of a suitable natural enemy by the similarity in natural conditions which would helpin the establishment of selected natural enemy, degree of host specificity, and genetic races.
2. Biological agencies should have the ability to outnumber the host by higher reproductive potential, more number of females, short life span, and early maturity.
3. The perfect sense to locate the real host is essential for Biological control.

Principal requisites of Biological Control Measure:

1. The collection of predators and parasites from different places where they occur naturally in large numbers and releasing them at those places where they are needed and may do well.
2. The collection, storage, and handling of the host insects to kill them without killing the parasites and predators.
3. Importing predators, parasites, and diseases from abroad is an important method, generally under practice now, and is applied when some pests get entry on imported goods leaving their natural enemies there.

Certain problems of Biological Control measured by the Parasites:

Multiple parasitism, super parasitism, and susceptibility to hyperparasites reduce the effectiveness of the parasites :

1. Multiple parasitism: In this case single host insect is parasitized by the young ones of two or more different species of parasites. Thus, multiple parasites face inter-specific competition, as a result, the winner may get tired and would be able to have very low fecundity and fail to act for efficient Biological control.
2. Super parasitism: It is the parasitisation of an individual host by several individuals of a single parasitic species which results in the wastage of progeny and weakening of the parasites to compete the intra-specific competition.
3. Hyper parasitism: When a parasite of an insect pest is parasitized by another species of insect parasite the phenomenon is termed as hyper parasitism. It destroys the primary parasite before it can succeed in controlling the pest species.
4. Defense reaction: Before starting any Biological control programme it is very important to notice the defense reactions going on from the host side because proper defense reaction may cause the failure of the Biological agency employed.
5. Survival of parasites: The most important consideration is the problem of survival inside the host body without any immunological reactions.
6. Encapsulation of parasite: Commonly the parasite is tolerated by the host as a result the host gets destroyed by the same parasite. If parasitization occurs in the un-natural host, the phagocytic haemocytes encapsulate the parasite resulting in its death due to asphyxiation. However, the respected exposure of a host to the same parasite causes a reduction in the encapsulating ability of the host.

Precautions during Parasitic Operation:

While introducing a parasite into a new country or locality for the first time, it must be assured that :

1. It is never by any chance a plant feeder.
2. It is a parasite on the particular insect pest to be controlled or on the plant species.
3. It will not attack any of the primary p-arasites already present in the locality and so do more harm.

Significant Agents of Biological Control Measure:

(1) Vertebrate predators: In this category different types of animals are found to catch and devour insects viz. Fishes, frogs, toads, tortoises, snakes, lizards, birds (Hudhud, Maina, Blue-Jay, Partridge, quail, Peacock, Paphiha, Owl, Bhujanga, Cuckoo, Crow, Sparrow, and Kite) mammals (Bats, rats, Mole and Mongoose). Among the predatory vertebrates birds are the most important. It is clear from these examples that these natural enemies are doing as an autocidal control of insects in the natural but they are not being used as Biological control agents.

(2) Predatory and parasitic insects: They are also controlling the insects in nature. By seeing their effectiveness in nature some natural enemies are reared in the laboratories and utilized for the Biological control of insects.

Predators are those insects that catch and devour harmful insects while parasite makes their homes on or inside the body of the host pass their life cycle and finally destroy the host insect. Some of the predators and parasites are given below which have been successfully utilized (table 1).

Some of the facts are observed from the study and utilization of natural enemies in Biological measure control :

1. 50% of insects, controlled belong to the Homoptera (Coccids, mealybugs, aphids, jassids, and white flies) and the rest to the orders Coleoptera and Lepidoptera.
2. Success of the Biological control depends on the dominant natural enemy.
3. Four times more insects are controlled by parasites in comparison to predators.
4. Biological control is most successful in temperate regions in comparison to tropical and subtropical regions.

(3) Some Natural enemies imported: Natural enemies are found successful and have been imported from different parts of the world to measure control the insects as given against their name in Table 2.

(4) Use of Micro Organism: Very small and microscopic components used in Biological control are put into microorganisms. That's why it is called microbial control.

(I) Bacteria: Bacillus thuringiensis is succes-

-sfully used for the control of lepidopterous pests. Infected larvae are crushed and mixed into the soil where they parasitize and kill the larvae.

(ii) Fungi: The fungi may be utilized for the control of insects. These are being used for the control of injurious insects. These fungi attack the host body externally or internally where the spores germinate and cover the whole body and kill the host. Such as white muscardine fungus Beauveria bassiana has been successfully used for the chinch bug (Blessus luciferous) and Entomophthora aulicae for the brown-tail moth. Other fungi that are effective for the Biological control of insects are Isaria, Spororichum Aspergillus, etc.

(iii) Virus: Although the important role of virus diseases as a natural control factor has long been recognized. The inclusions of Entomogenous viruses are more effective as insect control agents than the noninclusion viruses.

(5) Use of some natural plant products:

Neem: Neem extracts can control early infestations of some aphids, but they are not efficient against all aphid species. For a reliable and satisfactory control neem extracts must be applied at an early stage of aphid attack. Usually, repeated spot sprays of affected plants are necessary to achieve control. Neem has a slow mode of action, and usually, effects are not visible 10 days after application.

Red Chilly: It repels aphids and ants.

Pyrethrum: Commercially available pyrethr--um sprays are effective against aphid infestations, but also kill predators. It is therefore recommended to inspect plants regularly and control early outbreaks before the insect becomes a big problem. Use spot sprays on infected plants.

Garlic: It also repels to aphids.

Ash: Ash can be used to effectively control aphids in vegetables. Ash should be dusted evenly onto infested parts of vegetables. Also, aphids can be controlled by spraying wood ash mixed with soapy water and or lime. Ahirwar et al. (2010) reported that the incidence of nymph and adult populations of sucking pests viz. jassid, Orosius albicinctus (Dist.), mirid bug, Nesidiocoris tenuis (Rent.) and whitefly, Bemisia tabaci (Gen.) was decreased significantly by natural and indigenous products viz. Neem oil (NO), Neem seed kernel extract (NSKE), Neem leaf extract (NLE), Garlic bud + Red pepper extract (GB + RPE), Cow urine (CU), and Cow butter milk (CBM) as compared to untreated plots.

Scope of Biological Control Measure:

1. Using agents is not toxic and does not leave any harmful residues.
2. The effect of Biological control is permanent type. Once introduced may work constantly in nature for several years.
3. They do not harm beneficial organisms like chemical control.
4. Some agents can easily be mass-produced economically and may be utilized.
5. It is free from resistant problems like insecticidal resistance.
6. Some agents may be used in combination with insecticides. If insects are saved from the attack of insecticides may be controlled by natural enemies.

Problems of Biological Control Measure:

1. Biological control agents have a narrow host range and control only a particular pest.
2. The effect is very slow and requires a long time for control.
3. Highly trained personnel are required because living agents are used.
4. More members of Biological control agents are required to use so much money and time is required.
5. Sometimes introduced agents are also parasitized by parasites that's why no success is achieved.
6. Some agents may have special environmental conditions for their development and multiplications and, therefore, require a waiting period.
7. Due to a lack of suitable environmental conditions the introduced parasites or predators do not adopt the prevailing conditions. More time is required to study the adaptability of that agent.

Physical Control Methods For Aphid population:

After giving Biological Control Measures of aphids some of the physical control measures are given as follows :

(1) Rotation of crop: If one paddy crop is followed by another crop other than paddy then the pest being monophagous, will not find host plants. A generation gap will be created and they will be destroyed due to want of food.

(2) Removal of weed grass: During adverse conditions, the pest takes shelter in weed grasses. So the farmers take care to remove all the weed grasses. Thus the pests will be destroyed.

(3) Burning of stubbles: As the larvae and pupae may remain within the stubbles they should be burnt before plowing.

(4) Light traps: From the beginning of cultivation light traps should be used to attract the pest and

kill them.

(5) Remove Cocoons: Cocoons could be found on the food surface, bin walls, or between bags. Remove cocoons around the crop by vacuuming. Infested materials with cocoons should be destroyed as aforementio--ned in the heat and cold treatment.

(6) Remove Eggs and Feeding Larvae: All eggs & larvae crops should be double-bagged, firmly sealed, and discarded outside the building.

(7) Capture the flying Adults using pheromo--ne of insect light traps (ILTs): Traps alone are not a control method. They are important tools for detecting, monitoring, and pinpointing stored product pests including rice moths. Proper placement of the traps is very crucial for a successful monitoring program and it depends on the understanding of the insect feeding, flying, and mating behaviors.

Field Sanitation and Management:

Growing healthy plants: Healthy plants can protect themselves better from pests and diseases than weak plants. Growers are strongly recommended to use compost in preference to manures, including liquid manures. Excess use of manures and mineral (artificial) fertilizers, particularly nitrogenous fertilizers, produces fleshy plant tissue attractive to aphids. Therefore their use should be avoided as far as possible.

Practice crop rotation: This may help to reduce aphid infestations, particularly of host-specific aphid species (they feed and develop only on one or few plant species).

Growing crops in mixed cropping: This involves plant diversity by growing diverse plants on the same land and at the same time. Common mixed cropping includes the use of

companion planting and intercropping. The mixture of plants needs to be carefully chosen.

Use trap crops: some crops are particularly attractive to pests and can be used to trap them and protect the main crop. Monitoring of the trap crops is very important. They can be removed and buried. Trap crops can be planted around the field to be protected, or interspersed among the rows.

Traps: Yellow sticky traps and yellow water traps are mainly used to monitor winged aphids. As the yellow colour attracts many insect species, including beneficial insects, use these traps only where necessary.

Water traps: Half-filled yellow pans or basins with soapy water are placed close to the plant but exposed enough so that aphids are attracted by the yellow colour. Water traps are mainly used to monitor winged aphids.

Sticky board traps: To make your sticky trap, spread petroleum jelly or use motor oil on yellow painted plywood, 6 cm x 15 cm in size and up. Place traps near the plants but far apart enough to avoid leaves sticking to the board. Sticky yellow traps are mainly used to monitor winged aphids.

Chemical control measures for the Aphids :

Insecticides are the chemicals that are used to kill the insects. They may be in the form of dust, sprays, and fumigants. The active ingredients of insecticides are not used necked as only a small quantity of the poison has to be uniformly and economically spread over a large area. To provide for this bulk, it is mixed with other substances, which may be dust, solvents, diluents, or agents for wetting, spreading, sticking, stabilizing, penetrating, emulsifying, etc. The selected insecticides were toxic to a very wide range of insects and comparatively harmless to higher animals and plants. The best insecticides have been chosen, which were most toxic to insects and least to plants and man. Greater precautions and care were taken during their applications.

The following steps utilized

(1) Use of insecticides: Insecticides are poisonous chemical substances that kill the pests. Before transplanting the baby plants should be rinsed with 0.1% DDT solution. Spraying of 0.025% parathion or 0.08% endrin at the rate of 60-80 gallons per acre protects the crop from the damage of Tryporyza.

(2) Before treatment, discard all infested products outside the building and remove food, water, and clothing materials from areas to be treated.

(3) Apply a space treatment with an EPA-approved non-residual insecticide to knock down the adult populations in warehouse and food processing facilities.

(4) Target feeding, breeding, and harborage areas using EPA-approved residual insecticides as crack, crevice, and spot treatments.

(i) Apply crack and crevice treatments in pantries, closets, baseboards, doorframes, window frames, and other similar places.

(ii) Apply a spot treatment to surfaces near food storage areas, in and around cabinets, under and behind machines, appliances, and furniture; remove shelf papers and treat where food is not present.

(5) If applicable, apply a perimeter treatment to prevent flying adults coming from outdoors.

(6) By Soap (fatty acids) spray :

a-Mix 1 tablespoon of dishwashing soap or 3 tablespoons of soap flakes (nondetergent) with 4 liters of water.

b-Add soap to water. Use mild soap or potash-based soap.

c-Start with a lower concentration and make adjustments to the strength after testing on a few infested plants.

d-Always try on a few infested plants before going into full-scale spraying. Soaps can cause the burning of leaves (phytotoxicity) on sensitive plants, like brassicas and certain ornamentals. Make 2 or 3 treatments in a 3 to 4-day interval for better efficacy.

e-Apply on the infested plants thoroughly, including the undersides of the leaves. Spray early in the morning or late afternoon to avoid phytotoxic effects on crops.

f-Precaution: Soap spray may injure foliage. Test these sprays on a few leaves before applying them to the entire plant. It may take 2 days for damage symptoms to appear.

Precautionary Measures

1. During the treatment, no people, food, or pets should be present in the room to be treated. Fish tanks should be covered and the air shut off. Plants will not be affected.
2. Do not enter the treated room or use before applied pesticides are dried.
3. Anyone with a respiratory condition should notify the property manager and the Guardian Pest Control Service Specialist.

Post Treatment Information

1. Follow-up evaluation is necessary 7-10 days after the treatment.
2. Follow prevention methods and keep monitoring to minimize the periodic space treatments.

Summary:

Thus, the present topic has concluded that Aphis spp occurs on mustard, green gram, gr-

Table:

Table 1: Predators and parasites of the host insect.

S. no.	Predator/Parasite	Host insect
1	*Rodolia cardinalis* (*Predatore*)	Cottony cushion scale (*Icerya purchasi*)
2	*Coccophagus gurneyi* (*Parasite*)	Cirtophilus mealybug
3	*Tetracnemus pretisus* (*Parasite*)	(*Pseudococcus gahani*)
4	*Anarhopus sydneyensis* (*Parasite*)	Long-tailed mealybug
5	*Tetracnemus perigrinus* (*Parasite*)	(*Pseudococcon-adonidum*)
6	*Pseudopycus utilis* (*Parasite*) mealybug	(*Pseudococcus-nipae*)
7	*Cyrtorhinus mundulus* (*Predator*)	Crops leaf hopper (*Perkinsiella saccharicida*)
8	*Microceromasia sphcnophori* (*Parasite*)	Crops weevil (*Rhabdoenemis obscura*)

Table 2: List of Imported predator/parasite & host insect/host animal.

S.no.	Imported predator/parasite	Host insect/host animal
1	*Rodolia cardinalis* (*Predator*)	Cottony cushion scale (*Icerya purchasi*)
2	*Aphelinus mali* (*Parasite*)	Wolly aphid (*Eriosoma-lanigerum*) potato tuber moth
3	*Bracon gelechae* (*Parasite*)	Potato tuber moth (Gnorimoschema operculella)
4	*Prospaltella Pemiciosi (Parasite)*	Sanjose scale
5	*Aphytis mytilaspidis(Parasite)*	*Quadraspidiotus-Perniciosus*
6	*Spoggosia bezziana (Parasite)*	Coconut caterpillar (*Nephantis serinopa*)
7	*Opius vandenboschi (Parasite)*	Fruitfly (*Dacus* spp.)
8	*Apanteles flavipes(Parasite)*	Jower stem borer (*Chilo partellus*)
9	*Telonomus nawai (Parasite)*	Castor semilooper (*Achoea janata*)
10	*Trichogramma minutum (Parasite)*	Crops and cotton borers
11	*Lixophaga diatraeae (Parasite)*	Crops borers
12	*Euglandina rosea (Predatory snail)*	Giant african snail (*Achetina fuliea*)
13	*Syngamia haemorrhoidalis*	Lantana weed

groundnut, papaya, peas, pepper, sesame, sorghum, soybean, tea, tomato, wheat, apple, cabbage, citrus, and paddy crops. Aphid populations are largely damaged by Rabi and Kharib crops. Whereby, the production of grain yield is very low. These may be significantly controlled by biological agents such as predators, parasites, natural enemies, microorganisms, & natural plant products, physical factors, and pesticides. Mostly, natural plant products, biological agents, and physical factors are very eco-friendly to crops and the environment.

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