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Beneficial Insects and their Value to Agriculture

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Abstract

There are many insects found on agriculture land those are not threat to the crop production but beneficial to the farmers in different aspects, as Natural enemies, Pollinators, productive insects, Scavengers, weed killer and Soil builders. In present scenario the motive of the farmers is single sided, to gain only maximum profit, ignoring the impact on the beneficial insects, environment and human health. Insecticide can be a important crop production tool to maximize yield but Heavy and indiscriminate use of chemicals also exposes farmers to serious health risks, resulted in negative consequences for the insect those are beneficial to the farmers. Fields shared by many beneficial insects, positively affect the crop yield so careful decision should be taken to manage the insect pest and awareness among the farmers towards the beneficial insects.

Keywords: Beneficial insects, Crop production, Natural enemies.

Introduction

Beneficial insects provide regulating ecosystem services to agriculture such as Pollination and the natural regulation of plant pests. It aims to enhance insect-derived ecosystem services from a conservation perspective (i.e. enhancing beneficial insects in agricultural landscapes that provide ecosystem services to crops. Human cultures and civilizations have been maintained in countless ways through these beneficial insects, they regulate the pest population of many harmful pest species, produce natural products, and they also dispose the waste and recycle the organic nutrients. It should be consider in Thought that how much we depend on them for our survival and what kind of life would be without insects.

Requirements for Enhancing Beneficial Insects

The generalized intensification of agriculture and the use of broad-spectrum pesticides decrease the diversity of natural enemy populations and increase the likelihood of pest out breaks. Indeed, pesticide use has been shown to be associated with a large decrease in natural pest control services. Thus, enhancement of agro ecosystem appears to be one of the best ways in which we can decrease the use of chemical pesticides for pest and disease control. And it will increase the sustainability of crop production[1].

Role of Beneficial Insects As

Pollinators: Insect pollinators are flower visiting Insects that forage on flowering plants to obtain plant-provided food (nectar, pollen). Flower-visiting insects have the potential to transfer male gametes (contained in pollen) to the female gametes while foraging, resulting in pollination. Insect-mediated pollination is an essential step in reproduction for the majority of the world's flowering plants, including numerous cultivated plant species *i.e.* Sunflower, Cucurbitaceous vegetables, Alfalfa, Coriander, Cardmom, Gingelly, Apple etc. Many crops depend on pollination for seed production and fruit set to achieve good yield. Globally, an estimated 35% of crop production is a result of insect pollination.

The *Apis meliffera* L. (European honey bee) is responsible for the pollination servicesin majority of crops. Non-*Apis* bees also are important pollinators of crops, especially for crops in which honey bees are inefficient pollinators (e.g. alfalfa, squash). A few non-*Apis* species are managed for crop pollination. Examples of managed non-*Apis* species include bumble bees, *Bombus impatiens* Cresson (Hymenoptera: Apidae) managed for cranberry (*Vaccinium* spp.) and greenhouse tomato (*Solanum lycopersicum* L.) pollination. Although bees are considered the most effective insect-pollinator of most plant species, other insects have been recognized for their contributions to pollination.

Flower visiting flies (Diptera) have been documented as proficient pollinators of several crops including carrot (*Dacus carota* L.), mustard (*Brassica* spp.), leek, (*Allium ampeloprasum* L.), and almond (*Prunis dulcis*).

Weevil *Elaeidobius kamerunicus* (Coleoptera: Curculionidae) plays great role in pollination of Oil palm. Fig wasps are responsible for the pollination in both Smyra and Capri Fig Plantation[2].

Natural Enemies: Insect predators and parasitoids that attack and feed on other insects, particularly on insect pests of plants are considered natural enemies. Through this type of feeding, natural enemies contribute to a type of pest regulation referred to as natural biological control. Natural enemies responsible

nearby 33% of the natural pest control in cultivated systems.

Predaceous natural enemies belong to several insect orders and are generally characterized as free-living, mobile, larger than their insect prey, and are able consume several preys throughout their life cycle. But the parasitoids mainly belong to two orders Hymenoptera and Diptera, and their host ranges are considered to be more specialized than that of predator. Free-living adult parasitoids seek out a host, and depending on the parasitoid species, parasitize different life stages of their host (i.e. egg, larva, and pupa, adult). Parasitoids can lay an egg (solitary) or several eggs (gregarious) on or within their host and the immature parasitoid(s) feed on their host to complete development, kill their host, and emerge as free-living adult. In agricultural landscapes, natural enemies have the potential to prevent crop pests from reaching economically damaging levels (table-1).

Predators and parasitoids can suppress or delay pest population growth by contributing to pest mortality that is most vulnerable to herbivores. When diverse populations of natural enemies are present, pest control became more effective due to differing phenology.

Beyond natural biological control, natural enemies can be manipulated as part of integrated pest management programs through the importation and establishment of exotic natural enemy species (classical biological control), direct manipulation of populations (augmentative biological control), and, more pertinent to this research, through manipulation of their environment (conservation biological control)[3].

Weed Killers: So many insects feed upon unwanted weeds just the same manner they do with the cultivated crops. In many cases the occurrence of these insects has contributed much towards eradication of the weeds.

Soil Builders: Insects which live in soil make tunnels, creating channels for smaller organisms, water, air, and roots to travel through. Insects improves soil aeration, and earthworm activity can enhance soil nutrient cycle, the soil physical properties, such as soil structure and tilth and activity of other beneficial soil organisms. Small Dung beetles makes tunnel walls with dung and also make dung balls that helps in maintaining the quality of the soil. Excreta of insets also enrich the soil. Examples- Beetles, Ants, Cut-worms, Larvae of flies, Crickets, Termites, Wasps etc

Scavengers: Insects which feed on dead and decaying matter of plants and animals are called as scavengers. Insects (scavengers and decomposers) help in the biochemical cycling of the nutrients. Examples: Bark beetle, water scavenger beetle, Termites, Ants etc[4]

Some Beneficial Insects and Their Pictures: i. Honey bee, ii. Silk worm larvae, iii. Lac insect, iv. Assassin bug, v. Hover fly, vi. Aphidius calamani, vii. Syrphid fly, viii. *Zygogramma bicolorata, ix.* Termites, x. Dragon fly, xi. Praying mantis, xii. *Trichogramma sp*., xiii. Damselfly, xiv. *Coccinella sp., xv. Chrysoperla carnea.*

Some Products from Beneficial Insects

Production if Honey and Bee Wax: From thousands of year *Apis meliffera* L. (Honey bees) are important for gaining Honey and bee wax**.** And honey was the only sweetener, viscous fluid, produced by honeybees. It is collected from nectar from nectories at base flowers. Also collected from nectar secreted by plant parts other than flowers known as extra floral nectories. It is also collected from fruit juice, cane juice etc. In present, the developing markets are available for the other two products (Bee pollen and royal jelly) from honey. The bee pollen collect by pollen trap from ingoing pollen foragers. It is rich protein source. Bee pollen is a "complete" and good supplement in diet. It is available in health food stores. The royal jelly is secreted by gland of nurse bees when the glands are fully active. It is very nutritious food and is fed to the young workers larvae and queen larvae and adult. Royal jelly is milky and light pale in color. And it is also a good ingredient of some expensive skin care products, which helps in reducing wrinkles and works as anti aging.

Production of Silk: A unique natural fiber silk cloth, which usually derives from silkworm, *Bombyx mori*. This "domestic" silk is famous for its finishing and light colors. The silk can also harvest from the many other species e. i. Antherea spp., that found in the India, Japan and China's forests. The silk provided by willed spp e.i. Eri, Muga, Tussah and Yamamai are heavier and dark in color hence they are less valued than that of *Bombyx mori*. Silk can be dyed, spun, in to thread and woven in to fabric. Cloth of Silk is warm in winters, cool in summers, light in weight, and resistant to wrinkling.

Production of shellac: laccifer lacca, is a scale insect that secret a hard encrustation over the body as a protective covering. It is of brown color usually and these insects grow on acacia trees in India and Burma. Scale insects present on twigs are heated to extract the resins and then purify. One gram of Lac is extracted from Up to 200 insects. In present the synthetic material such as Polyurethane and vinyl has been taken place of Lac, even after Lac is still in use as dyes, inks, polishes, sealing waxes, and as stiffening agents in the fabrication of felt hats. It is animal originated and commercial resin.

Production of Cochineal: Cochineal pigments use in Painting: A scale insect Dacylopius coccus found in Mexico and Central America on prickly pear cacti. Cochineal pigment is extracted from these scale insects. For the first time it was used by Aztec Indians as medicines, body paints and as textile dye. The cochineal pigment was important for the intensity and permanency of colors. It was very costly because of its scarcity, so it was used in only the finest fabrics. Now a day's aniline dyes have taken place of Cochineal in textile industries which is very economic. But the cochineal pigment is still giving the colors in foods, beverages, cosmetics (lipsticks) and art product.

Table-1
Natural enemies and their use

Predator/ Parasitod	Group	Beneficial insect or Invertebrate	Pest attacked	Impact on pest
Predators	Beetles (Coleopter)	Ladybirds (Family Coccinellidae), Red and Blue beetles (*Dicranolaius bellulus*), Green carab beetles (*Calosoma schayeri*), Green soldier beetles (*Chauliognathus pulchellus*)	Aphids, mites, thrips, mealybugs, moth eggs including *Heliothis* spp. and larvae.	Able to handle a wide range of prey and are immediately effective. Some species (e.g. ladybirds) both the adult and larvae are predatory.
Predators	Bugs (Hemiptera)	Assassin bugs (Family Reduviidae), Bigeyed bugs (*Geocoris lubra*), brown smudge bugs (*Deraeocoris signatus*), Damsel bugs (*Nabis kingbergii*), glossy shield bug (*Cermatulus nasalis*), Pirate bug (*Orius spp.*), Apple dimple bug (*Campylomma liebknectic*), Spined predatory shield bug (*Oechalia*), Broken backed bug (*Taylorilygus pallidulus*)	Aphids, Diamondback moth, eggs of and larvae of *Heliothis* spp., cutworms (*Spodoptera litura*), false loopers	Pierces pest using mouthparts and then sucks out interior. Depending on the species of predatory bug, adults, larvae or eggs may be attacked.
Predators	Predatory Larvae	Hoverfly larvae (Family Syrphidae),	Aphids	Larvae spear aphids with jaws and suckout internal juices. Adult hoverfly are not predacious.
Predators	Mites (Acarina)	Predatory mites from different Families- e.g. Anystidae, Bdellidae, Erythraeida, Parasitidae and Cunaxidae	Blue Oat mite, Lucerne flea, Red-legged earth mite,	Predacious on other mite species and Lucerne fleas (*Sminthurus viridis)*
Predators	Lacewings	Green (*Mallada signatus*) and brown (*Micromus tasmaniae*) Lacewings	Aphids, moth larvae and eggs, whitefly, thrips, mites and mealybugs.	Larvae insert jaws into soft-bodies insects and eggs and suck out contents. Larvae of both Brown and green lacewings are predatory. Adult brown lacewings feed on heliothis eggs and mites.
Predators	Spiders	Variety of species including wolfspiders, nightstalking spiders, orbweavers, tangle web spiders, flower spiders, jumping spiders and lynx spiders.	Predators or a range of insect pests.	Pest species are consumed.
Parasitoids	Aphid Parasitoids	*Trioxys Complanatus, Aphidius ervi*, *Lysiphlebus testaceipes*, *Aphidius colemani*	Aphids	Wasp inserts egg into aphid. The developing larvae eventually killing the aphid "mummy" as the adult wasp emerges.
Parasitoids	Caterpillar Parasitoids	Hymenoptera: Numerous parasitic wasps including Banded caterpillar parasite (*Ichneumon promissorius*), Two-toned caterpillar parasite (*Heteropelma scaposum*) (Family Ichneumonidae), *Microplitis demolitor*, *Cotesia spp.* (Family Braconidae)	Heliothis and other moth larvae	Female lays eggs in host pupae as the parisitoid larvae develop in the host it causes the death of the pupa.
Parasitoids	Caterpillar Parasitoids	Sorghum midge parasites (*Eupelmus australiensis*, *Aprostocetus diplosidis*, *Tetrastichus* spp.)	Sorghum midge	Wasp lays eggs in midge larvae and emerges at pupal stage.
Parasitoids	Caterpillar Parasitoids	Tachinid flies	Heliothis, looper, armyworm, grasshopper and other larvae	Female lays eggs in host pupae as the parisitoid larvae develop in the host it causes the death of the pupa.

Parasitoids	Helicoverpa Egg parasitoids	Hymenoptera: *Trichogramma* (Family Trichogrammatidae) and *Telenomus* (Family Scelionidae) egg parasitoids	Helicoverpa and other Lepidoptera	Tiny wasps that parasitise Lepidopteran
Parasitoids	Whitefly Parasitoids	*Eretmocerus* spp. and *Encarsia* spp. including *Encarsia Formosa*	Whitefly	Small parasitoid wasps that attack whitefly nymphs.
Parasitoids	GVB egg Parasitoids	*Trissolcus basalis*	Green vegetable bug	Small black wasp that parasitises GVB; doesn't distinguish between eggs of pests and beneficials and will also parasitise eggs of predatory shield bugs.

Table-2
Weed Killers

Weed	Scientific name	Biotic agent / insects
Prickly pear	*Opuntia dilleni*	*Dactylopius opuntiee*
Congress grass or Carrot weed	*Parthenium hysterophorus*	*Zygogramma bicolorata*
Lantana weed	*Lantana camara*	*Ophiomyia lantanae*
Siam weed	*Choromoloena odorata*	*Pariuchaetes pseudoinsulata*
Water fern	*Salvinia molesta*	*Cryptobagus singularis*

Production of Tannic Acid: Tannic acid first produced by an abnormal pant growth found on oak trees in Asia known as Allepo gall. Tiny wasps (Family Cynipidae) secrete some chemical and in response of it the tree produces gall tissues. Tannic acid is a chemical compound used in the dying, in leather industries, for tanning and in the manufacture of some inks. It can also be extracted economically from Quebracho tree, hence there is no commercial market for oak gall is present today.

Insects as Food: Human ancestors were used to get nutrition from Insects. Even today, the insects are being used by people as food in many countries. High in protein and low in fat dried grasshopper are sold in village markets of Mexico. Insects are mixed with flour to make tortillas and can be fried or ground into meal. Wood-boring beetle's larvae can be boiled or roasted over a fire. And there is long list of nutritive edible insects e.g. Ants, bees, termites, water grubs, caterpillars, flies, crickets, katydids, beetle larvae, and nymphs of dragon fly are among the list. And in Thailand the pupa of silkworm are used as food for human being.

Insects as Medicines

Since ancient times Insects derived products have been widely used in medicines (table-3). Maggots and honey showed healing property in chronic and post surgical wounds. And honey is also being used to treat burns and combining with bee wax it found curative for the dermatological disorders. Another product of honey is royal jelly is used to treat post menopausal symptoms. A derivative of blister beetle Cantharidin being used in treating Skin diseases[5].

Table-3
Some insects and their products as medicine

Insects / insect products	Uses
Maggots	Wounds Healing
Honey	Wounds Healing, skin disease, infection
Royal-jelly	Post Menopausal symptoms
Been and Ant venom	Joints pain
Propolis	Infection
Canthiridine	Skin Diseases

Garden attracts many beneficial insects: The larva of many beneficial insect predators e.g. Predators such as hover flies, lacewings, lady beetle, and parasitic wasps feed on large number of harmful insect pests. But adult of these feed on pollen and nectar. Provide adults with food and habitat in your garden with a variety of plants will encourage the production of all life stages of insect predators and will help in reducing undesirable insect pests naturally.

Variety of plantings can be create to provide habitat and food for different insect species and life stages- eggs, larvae, pupa and adults. Many small flower plants including yarrow, sunflower, alyssum, asters, cosmos, mints, lobelia, basil, stonecrops, thyme, parsley, dill, borage and many other herbs are preferable. In garden eco-system natural predator consume their food from pests present. Pesticides kill many beneficial insects. So Eliminating use of pesticide encourage beneficial insects[6-8].

Additional Highly Attractive Plants: Aster family plants, Cosmos, zinnia, small sun flowers, daisy coneflower, Bok choy, cabbage, mustard, broccoli, and radish allowed to flower, Many herbs are allowed e.g. Lavender, Chamomile, rosemary, basil, borage, horehound. Some Mints- pennyroyal, bergamot, wood betony, thyme, Carrot family plants: angelica, coriander, parsley, dill, fennel, anise. Sage family plants – scarlet sage, Cleveland sage. Pea family plants: Vetch, clover. Buck wheat. Fern leaf yarrow and other yarrows. *Allium tanguticum*, lavender globe lily. *Achillea filipendulina*, common yarrow. *Aster sp.*, asters (sun, low growing)

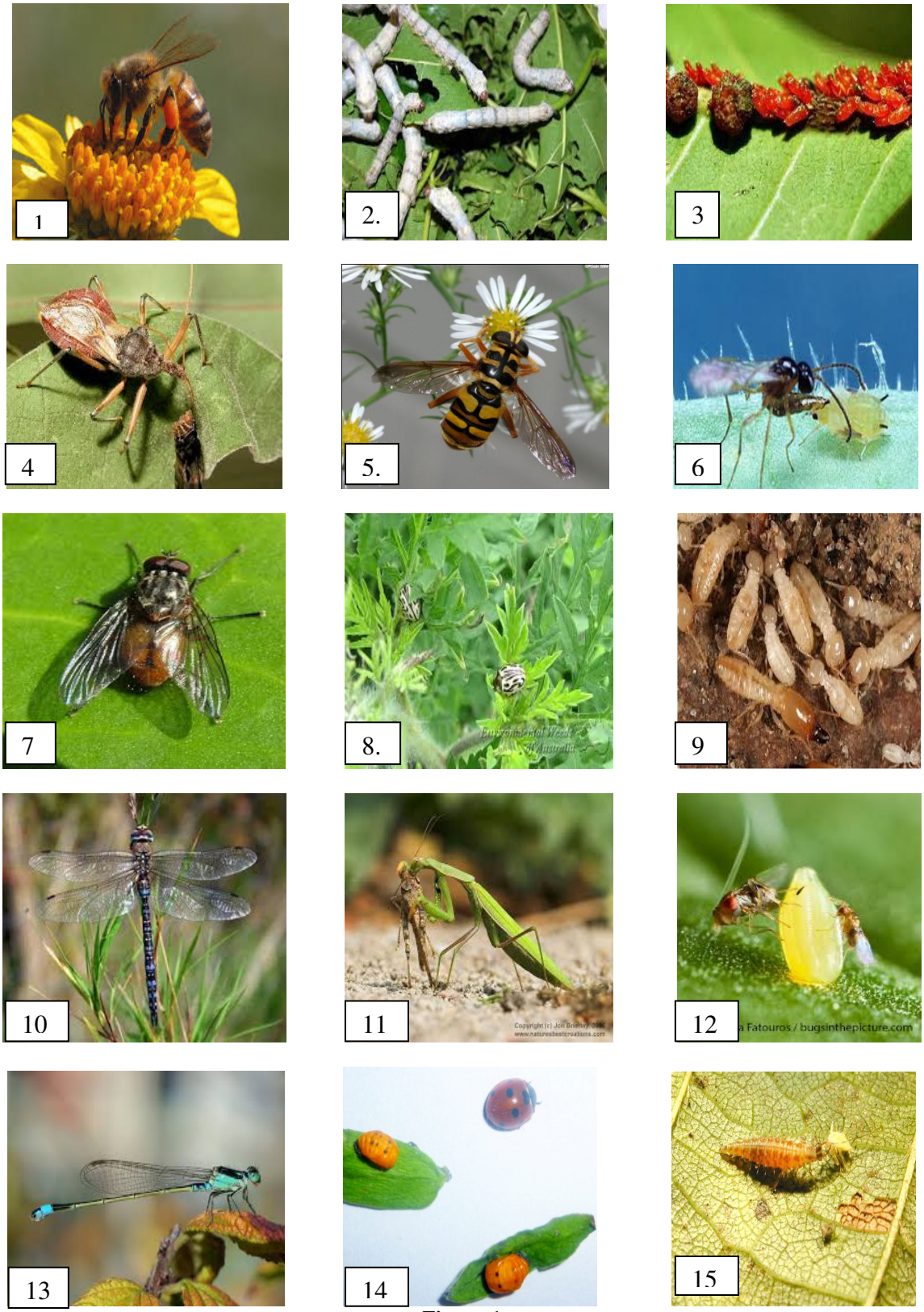

Figure-1
Some Beneficial Insects

Conclusion

Above description shows the economic importance and use of beneficial insects. Lack of awareness among the farmers about these insects and their benefits they use different management practices to kill them along with the insect-pests. We should have broad principles for supporting the beneficial insects and more specific management practices. Training and program should be run for the awareness among the farmers about the beneficial insects and activities likely to harm them, limited use of broad spectrum insecticides, habitat conservation in the form of larger patches of remnant vegetation for their survival. Better understanding of the benefits can make conservation more effective and more harmonious land use with effective crop production.

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