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Essential Services by Pollen Vectors to Ecosystem Impacted by Incidents of Pesticides Toxicity Alongside Pollinators Protection and Conservation

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Abstract

Indeed, pollen vectors provide an essential service to ecosystem termed as pollination, which is responsible for providing with a wide variety of crop production, food, increasing outputs of the leading food crops as well as many plant-derived medicines worldwide. At least one-third of the world's agricultural crops mainly horticultural plants depend upon pollination provided by insects and other animals such as birds, rodents and bats. This article is helpful to recognize the characteristics of pollen vectors, their requirements for food and shelter, pesticide toxicity incidents, protection against mortality and conservation of biotic pollinators agents. Pollination is the transfer of pollen from the male parts of a flower to the female parts of a flower of the same species, which results in fertilization of plant ovaries and the production of seeds. Pesticides are substances used to eliminate unwanted pests, but, unfortunately pollen vectors are greatly affected by insecticides. The main insect pollinators are bees that are the best known and widely managed pollinators, and there are also many other animal species that contribute some level of pollination services to crops and serve very important in natural plant communities. Pollinator communities, both wild and managed, have been declining over the last half century and stand at critical point in their own survival as pesticide uses in agricultural and urban areas increased. Research has shown that the pesticides can damage individual's navigation, learning, food collection, lifespan, resistance to disease and fertility in pollinators. Now more than ever, it is critical to consider practices that can benefit pollinators by providing of habitats free of pesticides, full of nectar and pollen resources, and with ample potential nesting resources. The pollen adheres to the vector's body parts such as face, legs, mouthparts, hair, feathers and moist spots; depending on the particular vector. Such transport is vital to the pollination of many plant species, and certainly, more nectar and pollen sources provided by more flowering plants and trees will help to improve their health and numbers. Increasing the number of pollinator-friendly gardens and landscapes facilities might help to revive the health of bees, butterflies, birds, bats and other pollinators. Agrochemicals should never be sprayed on flowering crops especially if bees are active and the plants require pollination, conserving and restoring of natural habitat, growing flowering plants preferred by pollinators, promoting mixed farming systems, establishing nectar corridors for migratory pollinators, providing habitats alongside cropland for pollinator nests and food, discouraging misuse of agrochemicals, and encouraging of integrated pest management practices are imperative.

Keywords

Pollen, Attracting Pollinators, Ecology, Conservation, Ecosystem Service

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1. Introduction

Pollination is a keystone process in both human managed and natural terrestrial ecosystems. It is an essential service that depends to a large extent on the symbiosis between the pollinated and the pollinator species. In many cases, it is the result of intricate relationships between plants and animals, and the reduction or loss of either will affect the survival of both. Pollination is critical for food production and human livelihoods, and directly links wild ecosystems with agricultural production systems. Human activity, based on the assumption that pollination is a free and abundantly available ecological service, has put a large pressure on pollinators by both increasing of their demand and removing their habitat. A pollinator is the biotic agent (vector) that moves pollen from the male anthers of a flower to the female stigma of a flower to accomplish fertilization or syngamy of the female gametes in the ovule of the flower by the male gametes from the pollen grain. Horticulture has rapidly expanded over the last decades, while the landscape become more uniform due to intensive agriculture and lack of pollination has increased awareness of the value and management requirements of this service [1].

2. Importance of Pollinators

Pollinators are responsible for pollination that is an important ecosystem service for agriculture that contributes to the global economy and accounts for agricultural production. Pollinators play a significant role in the food production process for several key crop types (notably fruits and certain vegetables), consequently, bees (including the honey bee) and other pollinators provide ecosystem services beneficial to human nutrition, health and wellbeing. Most crops grown for their fruits (including vegetables such as squash, cucumber, tomato and eggplant), nuts, seeds, fiber (such as cotton), and hay (alfalfa grown to feed livestock), require pollination by insects. Pollinating insects also play a critical role in maintaining natural plant communities and ensuring production of seeds in most flowering plants. Within flowering plants when pollen is transferred from an anther to a stigma, it may be transferred within one flower or between two flowers. If the flowers are on two different individual plants, the flower has been cross pollinated, whereas if the flowers are on the same individual, or if the anther and stigma are in the same flower, the flower has been self-pollinated. Flowers that are self-pollinated and can produce viable seeds are self-compatible. Flowers that are self-pollinated, but the pollen does not function properly on the carpels of the same plant are termed as self-incompatible. Cross pollination is believed to be an advantageous for the plant because the seeds produced by the flower will contain another source of genetic material, which may contain genes that are advantageous to the survival of the seedlings. Plants that self-pollinate are said to be inbreeding, whereas plants which only cross pollinate are said to be outcrossing. However, most plant species are not strictly inbreeding or outcrossing, but a combination of the two categories. Pollinators have evolved with native plants, which are best adapted to the local growing season, climate and soils. Most pollinators feed on specific plant species, hummingbirds sip nectar from long, tubular honeysuckle flowers, while green sweat bees prefer more open-faced sunflowers. Non-native plants may not provide pollinators with enough nectar or pollen, or may be inedible to butterfly or moth caterpillar [2, 3, 4].

3. Types of Pollinators

Bees, butterflies, moths, hummingbirds, beetles, wasps and even flies pollinate flowers, but bee species pollinate flowers more often than any other group including birds and butterflies.

3.1. Insect Pollinators

Pollinators come in many sizes, shapes, colors, behaviors and they also can be related to each other, sometimes closely, sometimes not so. Many flowers attract insects with the promise of sugary liquid called nectar, and their smell and bright petals are kind of like neon sign advertising fresh nectar to any passing pollinators. In return for the gift of nectar, the flower deposits pollen on whatever pollinators come to visit such as insects. Pollen is like to the sperm of plants and it is the way that plants spread their genes and mate with other plants in the same species. Pollination by insects often occurs on plants that have developed colored petals and a strong scent to attract insects such as bees, wasps and occasionally ants (Hymenoptera), beetles (Coleoptera), moths and butterflies (Lepidoptera), and flies (Diptera). Primary pollinators are native bumble bees, sweat bees, mining bees, wasps, butterflies and moths, while honey bees also play a critical role in pollinating of crops. Bees are adapted to collect and carry pollen so they have finely branched hair where the pollen gets trapped. These hairs make the bees to look like they are wearing a tiny, fuzzy coat. This is especially noticeable on their thorax where the wings are attached. Bee's legs are also hairy and have a special shape to hold the pollen together in small pellets during flight [5, 6].

3.1.1. Honey Bees *Apis mellifera* Linnaeus

In the context of species population decline, no pollinator receives greater media attention than the honey bee as provider of honey and other bee products. Other the most important function of honey bees to provide for us is the pollination service they provide for fruits, vegetables, wild flowers and garden plants. A honey bee in contrast with the stingless honey bee, is any bee that is a member of the genus Apis primarily distinguished by the production and storage of honey and the construction of perennial and colonial nests from wax. These are far better than other insects because of several factors. First, they depend on flowers not only for nectar as the energy source, but also for pollen as their protein source. This causes them to forage for pollen, resulting in better pollen transfer. Secondly they have specialized morphology to enable pollen transfer and collection. Their hairs are branched (plumose), enabling pollen to be trapped in hairs. They also have specialized pollen baskets on their hind legs enabling them to carry too large loads of pollen, on each leg. For comparison, wasps only forage occasionally on flowers because they are meat eaters so they have no demand for pollen, their hairs are straight, not as effective in carrying pollen and they have no pollen baskets. Honey bees have 'flower constancy' or fidelity, which is they tend to visit the same type of flowers on a single trip or a single day. This makes them more efficient because they do not visit plant A and then switch to plant B. They use dance communications to enable others in the nest to find the same food sources quickly, recruiting a large foraging force to the same crop if it is a profitable source of nectar or pollen. Bees can transfer pollen to one another inside the hive, resulting in better pollen mixing from different trees or varieties. The most important factor for honey bees as an ideal pollinator is the fact that they are managed and have a large population [7, 8].

3.1.2. Solitary or Social Bees

Bees are a diverse group of insects and these can be organized into two groups based on their nesting lifestyle including solitary or social. Many bee species are solitary (each female produces offspring in her own nest) with only one generation of bees produced per year. However, other species nest communally (several females share a nest) or have elaborate social structures with division of labor within the colony (usually with a single queen and many workers). These kinds of bees produce multiple generations per year. This means that bees that produce multiple generations each year need food resources (pollen and nectar) across most of the growing season to produce strong colonies. Providing of plants in a landscape with overlapping bloom periods will help these bees to survive and prosper [9, 10].

i. Social Bees Bumble Bee (Bombus)

Bumble bees are the bombers of bees, because of their chunky size; they can fly in cooler temperatures and at lower light levels than many other bees including the honeybee. Thus, queen bumble bees are the earliest to emerge in spring in search of the first flowers of the season. An individual queen starts a colony in the spring after it wakes from hibernation. It produces wax from glands in her body to make pot-like cells in which to lay its eggs and store nectar and pollen for its brood as half-black bumble bee (*Bombus vagans*). The young emerges in a few weeks as female worker bees. As fall arrives, most bees die and only newly-mated queens overwinter to establish new ones. Bees prefer blue, purple and yellow flowers, and sweet fragrances. They see ultraviolet colors found on the flowers such as buttercups and black-eyed Susans. Golden currant, serviceberry and chokecherry flower early in March and attract bumble bees and mason bees colonies.

ii. Solitary Bees Green Sweat Bee (Agapostemon)

These small, brilliantly colored, metallic green bees are hard to miss in a garden and these are commonly called sweat bees because they land on peoples to lick up salty human sweat. They show different degrees of sociality, in some species, females build and nest alone; in others, females nest communally and share a common nest entrance, but construct individual nest cells like apartments of buildings. Leaf-cutter bee (Megachile) pugnacious bees carry pollen on their tummies. Leaf-cutter bees and other solitary bees seldom sting and they construct their nests in tunnels in the ground, under stones, or in existing holes in dead wood. A female bee cuts circular leaf pieces to line its nest chambers, which are shaped like thimbles end to end, lays an egg and provisions it with pollen and nectar. Orchard mason bee (*Osmia lignaria*) is robust, metallic blue and most commonly appears early in spring when trees and shrubs flower. It builds nest cells in pre-existing narrow tunnels such as beetle burrows in trees, crevices between stones, hollow centers of plant stems and abandoned wasp or bee nests. In the nest tunnel, the female builds a series of horizontal chambers, females carry pollen on the undersides of their abdomens and provisioning each with pollen, nectar and an egg, then seals the chamber with mud and emerges in spring.

3.1.3. Butterfly or Moth

A butterfly antenna is a single filament with a club at the tip, while a moth antenna can be broad and feathery or tapered to a point. Butterflies are brightly colored and moths are more often colored in muted grays and browns. When resting on a flower, rock, etc., moths keep their wings flat open or folded around their body, while butterflies fold their wings up above their bodies when resting. Monarchs and skippers are just two conspicuous examples of the many butterflies (Lepidoptera) that visit flowers for nectar. As well, they use plants as hosts to provide food for their larvae. Hummingbirds are also pollinators, being particularly associated with red, tubular flowers with copious amounts of energy-rich nectar. By growing a bounty of native flowering plants in garden, there can be attracted a variety of the butterfly species [11].

i. Two-tailed Tiger Swallowtail (*Papilio multicaudata* Kirby)

It is a large butterfly (6″ wingspan) and males can often be seen patrolling for females along streams, canyons and narrow roadways. A good pollinator garden contains food not just for adult butterflies, but for their caterpillars to eat the plant's leaves while growing into adult butterflies. Silvery blue (*Glaucopsyche lygdamus* Doubleday) male butterflies can often be seen puddling, which is sipping up soil salts and minerals in mud puddles. Female blue butterflies lay eggs only on lupine and once they hatch, the caterpillars eat the leaves, flowers and seedpods, and produce a sugary secretion or honeydew, which is eaten by ants.

ii. White-lined Sphinx Moth (*Hyles lineata* Fabricius)

Although many moth species pollinate flowers, the sphinx or hawk moth is probably the one most familiar because it is active by day. They are great flyers and some have tongues longer than their bodies. These large moths fly upwind, tracking the airborne fragrance trail to a cluster of flowers. Their caterpillars, called tobacco and tomato hornworms, are well known to gardeners. Sphinx moths, also called hummingbird moths, prefer pale or white flowers that open in the evening and have a strong, sweet smell. They pick up pollen on their legs and wings.

3.1.4. Flower Beetle (Typocerus)

Beetles are also common on flowers as other pollinators, their forewings are thick and strong (they have 2 pairs like bees and wasps), modified for protection of the 2 membranous wings underneath. When a beetle wants to fly, it has to open its elytra first and use its hind wings to fly. Beetles present the greatest diversity of insects and pollinators. Regular flower visitors include soldier beetles and flower beetles. They feed on pollen and even chew on flowers, but in this mess and soil pollination process they pick up pollen and carry it to other flowers.

3.1.5. Flower or Hover Fly (Syrphid)

Flower or hover flies (Syrphidae) resemble bees and wasps, having color patterns and flight behavior that closely mimics them. Flies have only 1 pair of wings whereas bees and wasps have 2, and fly's antennae are short and stubby, barely sticking out, unlike those of a bee or a wasp. These flies help in pollinating of many flowers, and are beneficial to gardens because the larvae of most species prey on aphids and other small unwanted insects. Because they are so abundant, flies are important pollinators even though they transport less pollen than bees. Hover flies mimic bees and wasps in coloration and behavior to avoid predators, and flies feed on the same flowers preferred by bees, such as golden currant, rabbit brush and sunflowers.

3.1.6. Pollen Wasps (Pseudomasaris)

Yellow jackets and hornets are important predators and scavengers, helping to control pests and recycle organic materials, but can also be a threat to humans due to their ability to sting repeatedly in defense of their nests. These species are beneficial to humans for pest control and some critical roles in pollinating of crops. In addition, thousands of small wasp species are parasites of other insect pests, particularly aphids and caterpillars. Pollen wasps can be identified from other wasps by their clubbed antennae, they are solitary nesters and their hard mud nests attached to rocks or twigs might be found. These pollinators can be attracted to the many flowering native plants [12].

3.1.7. Fig Wasps

Fig wasps of the superfamily Chalcidoidea spend their larval stage inside figs, and most are pollinators, but others are herbivores. The non-pollinators belong to several groups within the superfamily Chalcidoidea, while the pollinators are in the family Agaonidae. While pollinating fig wasps are gall-makers, the remaining types either make their own galls or usurp the galls of other fig wasps. In the beginning of the life cycle, a mature female pollinator wasp enters the immature fruit (actually a stem-like structure known as a syconium) through a small natural opening, the ostiole and deposits its eggs in the cavity. Forcing its way through the ostiole, it often loses its wings and most of antennae. To facilitate passage through the ostiole, the underside of the female's head is covered with short spines that provide purchase on the walls of the ostiole. In depositing of eggs, the female also deposits pollen it picked up from its original host fig. This pollinates some of the female flowers on the inside surface of the fig and allows them to mature [13, 14].

3.2. Non-Insect Pollen Vectors

Insects are not the only ones that pollinate plants, but many are exclusively pollinated by bats, birds and rodents, which will feed on the nectar of night blooming, large, bell-shaped plants. The animals that are enticed by the perfume of plants or by its beautiful colors are known as vertebrate pollinators. They visit flower after flower, sipping on the nectar and picking up or depositing pollen. This mutual relationship benefits both the plants and the pollinators, and keeps both of them very happy [15]. A number of non-insect pollen vectors are specially adapted for gathering pollen and nectar from both wild and agricultural plants [16, 17].

3.2.1. Mammals Pollinators

Mammals generally thought of as significant pollinators are some rodents, bats and marsupials, and some even are specialized in such activities. A particular type of flower has adapted to being pollinated by gerbils, mice and rats. The flowers borne near the ground are very sturdy and have a yeasty smell. These attract to rodents at night, which feast on their jelly-like nectar. Plant species of genus Protea in particular *Protea humiflora*, *P. amplexicaulis*, *P. subulifolia, P. decurrens* and *P. cordata* are adapted to pollination by rodents particularly cape spiny mouse *Acomys subspinosus* Waterhouse and elephant shrews *Elephantulus edwardii* A. Smith. Most flower-pollinating bats are small, sharp-snouted animals with long tongues that can be stuck out very far and have special projections (papillae), and in some cases, a soft brush-like tip-devices that enable them to rapidly pick up the copious pollen and nectar soup that bat flowers offer. Normally, it is a bat's head that becomes dusted with pollen and transfer of the precious powder to the pistils of other flowers takes place. Examples include the white saguaro cactus (Carnegiea) flowers and the century plant, the large flowering spike of which makes the flowers easily accessible high in the air. Some bananas (Musa spp.), are also bat pollinated. Plants adapted to use by bats or moths as pollinators typically have white petals and a strong scent, whereas plants that use birds as pollinators tend to develop red petals and rarely develop a scent (few birds rely on a sense of smell to find plant-based food).

3.2.2. Hummingbirds Pollinators

Pollination performed by vertebrates such as birds is particularly through hummingbirds, sunbirds, spider hunters and honeyeaters. Rufous, Calliope and Black-chinned hummingbirds breed within nest in willow-dominated areas within forested habitats. Hummingbird fiercely defends its feeding areas and can attack much larger birds including great horned owls. Sap wells created by red-naped sapsuckers supply many animals with a quick energy boost. Hummingbirds need lots of insects (protein) in their diet and can nab insects stuck in sap wells. The hummingbirds are specialized on nectar feeding and they play an important role in pollination. These colorful, migratory birds serve as a link between plant populations by visiting of flowers and moving pollen over great distances. To attract hummingbirds to the garden, provide them with nectar starting in early spring. It is thought that hummingbirds prefer colored flowers, however, they can feed on any flower that produces abundant nectar.

4. Problematic with Pollinators

A decline in pollinating insect numbers has been linked to factors including harmful parasites, climate change, habitat loss, pollution, pesticides, diseases, insufficient food, alien invasive species, and even mobile telephone signals. Where the honey bee is concerned, the parasitic Varroa mite has been identified as the single biggest specific threat to honey bee populations [18]. Further problems are caused by a lack of an appropriate foraging habitat in the modern agricultural landscape during some summer periods [19, 20].

4.1. Pesticide Toxicity to Pollen Vectors

Pesticides are an important part of modern farming and the proper use of pesticides helps to ensure for having a safe, abundant and inexpensive supply of food and fiber if used judiciously. Pesticides improve crop yields and quality, and help to make farming profitable. However, the improper use of pesticides can harm to the environment and wildlife. As stewards of the land and its natural resources, farmers should strive to use pesticides properly in order to minimize environmental risks. There are some ways to reduce the amounts of pesticides used, and to use them more efficiently, without compromising with agricultural yields or profits. Actual damage to bee populations is a function of toxicity and exposure to the compound, in combination with the mode of application. Contact pesticides come up into the stem, leaves, nectar and pollen of treated plants. Dust and wettable powder pesticides tend to be more hazardous to bees than solutions or emulsifiable concentrates of contact pesticides [21-25].

4.2. Collapse of Colony

Colony collapse disorder is the name given to the mysterious decline of adults honey bee populations from the hive around the world. It appears to have multiple interacting causes, including pathogens and a range of evidence points to sublethal pesticide exposures as important contributing factors [26, 27]. Neonicotinoids are a particularly suspect class of insecticides, especially in combination with the dozens of other pesticides found in honey bee hives is characterized by the sudden loss of bees. Many possible explanations for disorder have been proposed, but no one primary cause has been found, and there has been indicated that a combination of factors may be causing decline of honey bee populations, including pesticides, predators and parasites, all of which have been found at high levels in affected bee hives [28].

5. Pollinators Protection

In order for pesticides to protect crops from pests and disease, they must be biologically active. The biologically active compounds in a pesticide are formulated to influence the health or behaviour of target pest species in order to prevent or minimize damage to a treated crop. Due to the potential for exposure of non-target organisms (bees, for example) to biologically active products, a comprehensive body of legislation exists to evaluate the safety of products and to describe regulations that ensure that the correct application of pesticides does not cause unacceptable effects to non-target organisms. The honey bee has been selected as a representative pollinator species in the pesticide registration process, and a plant protection product (pesticide) shall only be approved when it has no unacceptable acute or chronic effects on colony survival and development, by taking into account effects on honey bee larvae and honey bee adults behaviour. Risk management includes measures such as the prevention of application during periods of honey bee flight, prohibiting application when the crop is in flower, limiting application rates, mulching flowering ground cover before application and for seed treatments comply with all regulations of seed coating quality and dust monitoring practices. Seed treatment represents one of the most efficient and environmentally friendly delivery systems for pesticides for certain crops and pests. Less than 1% of a given area is treated compared to the whole area in a spray application, only insects that feed on the plants are exposed, and potential drift exposure to water bodies and beneficial insects (which help to manage pests) is reduced. Furthermore, water use, fossil fuels and therefore greenhouse gas emissions, are reduced as well as the number of tractor operations required is also reduced [29].

6. Preventing of Pesticide Kills

Bees and other insects may be harmed if they consume nectar or pollen containing pesticides. Reduce bee poisoning from pesticides by avoiding or applying of any pesticides, including insecticides and fungicides, during bloom on ornamental plants that attract bees, like heather, lavender, linden, rhododendron and rose. Apply pesticides only after flower petals have fallen and when ornamental plants are less attractive to bees. This can reduce the risk to bees coming in contact with pesticides. When it is must to spray ornamental plants that are in bloom, it is recommended to choose a pesticide that is less toxic to bees. Further, insecticides should only be used after flower petals have fallen, because they may be highly toxic to bees for several days after application. Avoid applying the neonicotinoid insecticides by soil drench or tree injection methods to plants known to attract bees. These methods may contaminate nectar and pollen for up to several years after the insecticide is applied. If it is must to use soil drench or tree injection to apply the neonicotinoid insecticides, do it after flower petals have fallen and use the lowest possible effective dosage to help in reducing of the risk to bees. Also, try to select an insecticide that offers the shortest persistence in ornamental plants while still controlling the pest. When buying ornamental plants that are known to attract bees, always try to buy plants that are not treated with insecticides. For more advice on pesticide use and protecting of bees, consider contacting local helping branch and educate yourself [30, 31].

6.1. Apply of Pesticides in the Evening

Many pesticides are extremely toxic to honey bees and other beneficial insects. Honey bees are attracted to blooming flowers of all types. If at all possible, do not spray blooms directly with pesticides. If the bloom needs to be sprayed, apply the pesticides in the evening hours. Honey bees forage during daylight hours when the temperatures are above 55-60°F. As the sun begins to set, they return to their hives for the evening. Thus, spraying pesticides in the evening hours can greatly reduce honey bee mortality because the bees are not in the fields [32-33].

6.2. Choose of Appropriate Formulation

The appropriate choice of formulation is another way to avoid honey bee pesticide kills. Pesticides come in different formulations: dusts (D), wettable powders (WP), soluble powders (SP), emulsifiable concentrates (EC), solutions (SL) and granules (G). Solutions, emulsifiable concentrates and granules are the best formulations to use. Solutions and emulsifiable concentrates dry quickly and do not leave a powdery residue unlike the dusts and wettable powders. Granulars are similar to dusts, but are larger in particle size. They are applied into the soil or broadcast on the surface of the ground. They are seldom used on blooming plants and are essentially non-hazardous to bees. On the other hand, dusts and wettable powders can adhere to the thousands of tiny hairs found on the body surface of the honey bee. These dust particles are then transferred back to the hive and stored along with the pollen. This can cause an entire colony to collapse if the pollen is fed to the queen or the brood [34, 35].

6.3. Use of Less Toxic, Rapidly Degradable Pesticides

Using of less toxic pesticides that degrade rapidly is also important in reducing honey bee mortality for pesticide toxicity and residual time. Many of the newer pesticides being marketed today have a faster residual time, which is the time required to reduce the activity of the chemical to safer levels for bee activity. When these pesticides are sprayed in the fields, it takes only a few hours for them to degrade as opposed to a few days or weeks [36].

6.4. Alter of Application Method

The method of application can also change the risk of pesticide poisoning. Aerial applications have the highest potential risk for causing bee kills. Most bee kills occur when the pesticide drifts or moves from the target area into the apiary or onto crops attractive to the bees. The outcome of drift can be catastrophic. Spraying during windy days greatly increases the risk of drift. Using of granular formulations, soil treatments or equipment that confines the spray to the intended target can help to reduce the risk of drift from pesticides [37-39].

6.5. Establish of Apiaries in Safe Locations

The location of apiary is probably the most important factor in eliminating the risk of pesticide poisoning. The farther colonies are away from fields or orchards that are treated with pesticides, the better chance the bees have against pesticide poisoning. Establish apiaries at least 4 miles away from crops being treated with toxic materials and subjected to drift. However, if apiary is already located in an agricultural area where pesticides use is high; moving of bees may be the best insurance against future pesticide kills since preventing honey bees from foraging on pesticide-contaminated flowers is almost impossible. If moving is impossible, covering of colonies with a well-ventilated screen to restrict honey bee flight during peak foraging hours may be only course of action. However, this method has dangerous side effects and could lead to higher mortality than would have occurred from pesticide exposure. Colonies may have difficulty in controlling of their hive temperature when confined and can easily overheat, so care must be taken. Providing of water inside the screen can allow the bees to reduce temperatures. Do not keep the colony covered for more than two days. Covering the colonies with large wet burlap sacks and providing them with shade is another method for preventing of overheating [40-41].

7. Evaluation Criteria and Goals

Such factors include continuing education to farmers or ranchers that train and educate managers and workers about lower risk materials and strategies to reduce pesticide usage, IPM planning and establishing of new plantings, select of varieties and site locations to minimize pesticide applications and environmental impacts, weather monitoring to prevent pesticides from leaving the cropping system, crop monitoring or field scouting in order to assess the effectiveness of pesticide reduction strategies, lowest effective application rates or reducing of application rates to reduce the material applied per acre, pesticide selection and resistance management and rotate the materials used, record keeping of pesticide applications, tabulate toxicity rankings to demonstrate success in reducing toxicity, application equipment calibration and pesticide drift management in order to prevent over-applications of pesticides, hazardous material storage and disposal to prevent environmental contamination and dispose of empty pesticide containers properly, and elimination of high toxicity pesticides [42].

8. Conservation of Pollen Vectors

Pollinator conservation is essential for agriculture ornamental production and natural landscapes. There are a number of things that can be done to help conserve pollinators in an area for healthy ecosystem. Pollinators require both nectar and pollen for completion of their life cycles. Planting of native and heirloom trees, shrubs and flowers, which bloom from April to September, can create a consistent food supply to the pollinators, so that they may complete their life cycles successfully. Minimize the use of broad-spectrum pesticides, as these are toxic to bees and include neonicotinoids, pyrethroids, organophosphates and others. When spray is necessary, farmers must choose a biorational chemical (safer to beneficials) and spray in early evening when most of pollinators are less active. Planting of insect and disease-resistant varieties, proper irrigation and nutrition management, and allowing beneficial insects and spiders to visit plants may reduce the need for pesticides. Provide or preserve nesting sites for native bees depending on species, as bees may nest in the ground, in cavities, or in wood. Tunnel nests can be constructed with bamboo sticks or wooden blocks. Ground covers (such as Ajuga, squill, crocus, clover and creeping Charlie) are also good bee plants. Visit a local plant nursery and select plants that are hardy for a local zone. At present there exists only a broad concept of what is needed for pollinators conservation. But, although additional research is needed to understand the specific details and bring pollination awareness and management into rural development and land management practices, there is already sufficient general knowledge to initiate activities that conserve and sustainably manage pollinators within agroecosystems. The generally accepted measures include conserving and restoring of natural habitat, growing flowering plants preferred by pollinators, promoting mixed farming systems, establishing nectar corridors for migratory pollinators, providing habitats alongside cropland for pollinator nests and food, encouraging integrated pest management, and discouraging misuse of agrochemicals [43-

46].

9. Vision for the Future

In future vision, farmers and ranchers might rely on biologically intensive and ecologically sensible pest management practices. By using a biologically based system of Integrated Pest Management (IPM) and a system wide approach, producers can increase their bottom line through reduced reliance on expensive chemical inputs. It is believed that IPM practices will continue to gain value and recognition in the marketplace, as food buyers increasingly support suppliers of goods, which work to preserve the environment and reduce health hazards [47, 48].

10. Conclusion

Honey bees, bumble bees, mason bees and other pollinating insects pollinate our fruit and vegetable gardens, native plants, and are critical for environment and economy. Some pesticides, including those in the class of neonicotinoids, may pose a potential risk to bees and other insects that are benefit to us. Some crops treated with the wrong conditions (in bloom, using a dust formulation, with large numbers of bees in the field) have been responsible for disastrous kills. It appears that habitat loss and pesticide poisoning account for much of the population declines. The proper use of pest control products can help to maintain healthy ornamental plants. Risk can be further reduced by preventing of environmental contamination and dispose of empty pesticide containers, properly use of lowest effective application rates or reducing application rates, and elimination of high toxicity pesticides. Biologists fear that several butterfly and bumble bee species have been disappeared from parts of their range. So, we can do our part to support pollinators by creating pollen vector friendly gardens and protecting of wildlife habitat.

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