

**زانکۆی سەلاحەددین-هەولێر**

 **Salahaddin University-Erbil**

**Efficiency of different colored pan traps for collecting flower visiting insects from floricultural plants in Erbil Province-Kurdistan region - Iraq**.

**Research Project**

 **submitted to the department of Plant Protection in partial fulfillment of the requirements for the degree of bachelors in - College of Agricultural Engineering Sciences**

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بِسْمِ اللهِ الرَّحْمنِ الرَّحِيمِ

الْحَمْدُ لِلّهِ الَّذِي هَدَانَا لِهَـذَا وَمَا كُنَّا لِنَهْتَدِيَ لَوْلا أَنْ هَدَانَا اللّهُ

صدق اللَّهُ العظيم

[الأعراف: 43]

**Certificate**

This research has been written under my supervision and submitted for the award of the BSc degree in Agriculture Engineering Science-Plant Protection with my approval as a supervisor

Signature Name : Lecturer Dr. Srwa Kareem Hamad

Date: 23. Nov. 2023

**Dedication**

I dedicate my research to my parents for their endless love, support and encouragement throughout my pursuit for education. I hope this achievement will fulfill the dream they envisioned for me.

Student Name: Hamza Rtwan Mulood

Date: 23. Nov. 2023

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**Abstract**

Using three distinct coloured pan traps (yellow, white, and blue), the quantity of flower visiting insects from floricultural plants was examined at two separate sites within Erbil Province, Kurdistan area, Iraq. There were reports of four insect orders. The most prevalent insect order found was the order Hymenoptera, which was followed in order by the orders Diptera, Lepidoptera, and Coleoptera. At both study sites, the colour of the pant trap had an impact on the number of insects that visited flowers, primarily those in the order Hymenoptera. The highest number of flower visiting insects was observed in yellow traps followed by white and blue traps respectively suggesting that the majority of flower visiting insects are attracted to yellow pan traps which could be an effective method for sampling and monitoring flower visiting insects mainly hymenopteran specimens in this type of habitat.

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**1.Introduction**

Floriculture is a branch of ornamental horticulture that is concerned with the cultivation and commercialization of flowers and decorative plants, as well as flower arrangement. Floriculture is commonly thought of as a greenhouse sector because flowers and potted plants are mostly produced in plant-growing structures in temperate areas; however, many flowers are cultivated outdoors (Kamenetsky, 2004; Britannia, 2016). Floriculture production consists mostly of cut flowers, pot plants, cut foilage, seeds, bulbs, tubers, rooted cuttings, and dried flowers or leaves. Rose, carnation, chrysanthemum, gargera, gladiolus, gypsophila, liastris, nerine, orchids, archilea, anthurium, tulip, and lily are the most important floricultural crops in the international cut flower trade. Green houses are used to raise floriculture crops such as gerberas and carnations. The open field crops are chrysanthemum, roses, gaillardia, lily marygold, aster, tuberose (Apeda, 2016).

Flower-visiting insects are critical to the operation of natural ecosystems as well as the agricultural services they provide, such as crop pollination and pest management (Kremer and Chaplin-Kramer, 2007). The majority of adult insects that visit flowers are bees, wasps, flies, butterflies, and moths (Schuh and Mote 1948). The strawberry spittle bug is a fairly frequent pest of many plants in Oregon; in fact, there are few plants on which it is not found in the Willamette Valley. Its attacks are most severe on perennial plants. Occasionally it injures annuals, shrubs, and other woody plants. (Ramadevi *et al* 2005) indicated that there are two families of orthoptera were found in the nursery seedlings and reported as a harmful insects which can cause damage to leaves and shoots of these seedlings. (Ojiako , *et al* 2012) studied that the variegated grasshoppers (*Zonocerus variegatus* L.), houseflies (*Musca domestica* L.) and the red wood ants (*Formica rufa* L.) were the major insects in the nursery. They obtain nutrition from floral nectar and pollen and a few from petal tissue. Occasionally, adults from other orders also feed on floral food. In many instances they ensure the pollination of the plants they visit. In addition to food, flowers are frequented to collect fragrances, to seek shelter, prey, larval hosts and mates (Krenn *et al*., 2005)

It is unfortunate that many flower visiting insects are exposed to harm or danger and their populations are declining due to several factors such as habitat destruction and the fragmentation of the natural and semi-natural landscapes which are main threats to biodiversity decline of flower visiting insects (Rathcke, 1993). The decline in the abundance of flower-visiting insects is a threat to ecological processes and to the services these insects provide. Colour is an important visual behavior and attractant for many flower-visiting insects. As a result, coloured pan trapping is an efficient approach that may be used to quantitatively sample assemblages of flower visiting insects in a simple and cost-effective manner.(Vrdoljak and Samways, 2012). It has been used for sampling and collecting flower visiting insects in various ecosystems such as forest ecosystems (Campbell and Hanula, 2007), desert landscape (Wilson *et al*.,2008), flowering crop canopies and potato field crops (Boiteau, 1990).

**The aims of the study is to:**

1- Identify the flower visiting insects available on floricultural plants within Erbil province at the order level

2- Examine the effects of colour on pan trap catches and determine which colour might provide better estimates of flower visiting insects in our region when sampling with multi-colour sets of pan traps.

**2. Literature review**

**2.1 Palaeontology**

In many studies that an evolutionary and ecological predisposition towards insect-mediated spore dispersal has existed since Devonian time, long before the explosive radiation of angiosperms and higher orders of Insecta in the Cretaceous and thereafter (Smart and Hughes., 1973). Mid-Devonian spores with highly complex ornamentation suggest animal dispersal, since the spines and retrorse hooks may have functioned as mechanical attachments to the setae of arthropods. At the same time, heterospory becomes evident. This suggests the need for the small microspores to be moved to the larger, more or less immobile megaspores so that fertilization of the gametes (ultimately derived from them) may occur. By the end of the Devonian, megagametophytes and attached tissues resembling seeds are well known (Chaloner *et al*., 1977); they are also found in Carboniferous Pteddosperms. In some Pteridosperms what appears to have been a pollination droplet, as in conifers, has been fossilized in a pollen chamber of an "ovule" with a large micropyle (Tylor.,1981). Pollen was probably the first food reward consumed by spore-dispersing arthropods; these may have been Collembola and Arachnida (Kevan., 1973). Nectar may have been a nutritive substance to help spore (pollen) germination; perhaps it was consumed by small arthropods (fortuitously carrying pollen to the micropyle) as a later (Carboniferous) development. An important group of plants over this long period were the Cycadoidea, including Cycadales (of which there are extant insect: visited representatives) and the Mesozoic Bennettitales. (Leppik., 1960) suggested that anthological relationships may have existed between the Cycadoidea and insects, although as (Smart and Hughes., 1973) indicate, there is little direct evidence of any insect/plant relationships. Some Bennettitales (e.g. Williamsonia) probably had showy inflorescences and attracted insects. Insect visitors to modem Cycadaceae (Baker and Hurd., 1968) provide circumstantial evidence for entomophilous cross-pollination. It is tempting to suggest that the Bennettitales suffered in competition for pollinators with the angiosperms; in any case they became extinct in the Cretaceous (Baker and Hurd.,1968). Recent studies (Crepet., 1979) have elucidated Eocene relationships of Coleoptera, Diptera, Hymenoptera, and Lepidoptera and their respective flower types by inductive reasoning from extant interactions.

**2.2. Anthophilous insects**

Many kinds of insects can be found on flowers. (Proctor and Yeo., 1973) provide an extensive account of the important insect orders and the sorts of flowers they visit.

**2.2.1. Coleoptera**

Coleoptera are considered to be the most primitive pollinators (Proctor and Yoe., 1973). Their importance in evolution may have been as "mess-and-soil" pollinators associated with heavily constructed, open bowl-shaped flowers, often with characteristic aminoid or fermenting fruit scent (e.g. Magnolia) (Leppik., 1977). In such flowers, the beetles imbibe floral secretions (including nectar if present), eat pollen, and chew on floral parts or special food bodies. Many flowers, often spedalized and not exhibiting the syndrome of cantharophily, are visited, and some beetles seem restricted to floral diets as adults. The predatory Adephaga are not flower visitors but, among the Polyphaga, notable flower visitors are Elateddae, Scarabeidae, Cleddae, Nitidulidae, Chrysomelidae, Staphylinidae, Meloidae, and Cerambyddae. (Miiler., 1883) indicated that Mordellidae, Oedemeddae, and many Melyridae are exclusively anthophilous as adults. Clearly, flower visiting has arisen several times in the Coleoptera. Associated with this habit are structural adaptations that include forward projection of the mouthparts by up-tilting of the head and associated elongation of the prothorax and neck. Maxillary setae may also be elongated. These modifications allow the beetles to reach deeper nectaries and extract nectar more readily (Miiler., 1883).

* + 1. **Diptera**

 The Diptera, with their suctorial or lapping mouthparts, are also considered to be primitive pollinators (Thien., 1980).

 In most families of the Nematocera the proboscis is short, but variable, in form, and the flowers visited by these primitive flies have readily accessible and exposed nectar in tubes that are short (e.g. ,4chillea, Senecio, Polygonura, various Cruciferae) or somewhat hidden (e.g. Salix). Most of these insects are small (Mycetophilidae, Cecidomyidae, Simuliidae, Chironomidae, Ceratopogonidae, etc). Fungus gnats are important in the pollinate of flowers in Californian redwood forests (Mesler, *et al* ., 1980). Even the large Tipulidae are restricted by their short mouthparts to similar flowers. Nematocera with longer proboscides, e.g. Culicidae and Bibionidae, may also visit such flowers in addition to flowers with deeper tubular corollas (e.g. Scrophulariaceae, Compositae, Labiatae). Mostly, these insects seek nectar (Hocking., 1953), although some feed on pollen, e.g. Bibio, Scatopse, Sciara, and Atrichopogon (Downes., 1971).

 The Brachycera contain a wider variety of flower visitors. They visit many of the same flowers as the Nematocera. Additionally, there are members of long-tongued families that visit deeper-tubed flowers. Most Brachycera seem to feed on flowers as adults. Among the most specialized are the Bombyliidae, which have long, sucking mouthparts especially suitable for visiting tubular flowers. Bombylius major has a proboscis about 10 mm long, and in B. discolor it is up to 12 mm. (Knoll., 1921) studied the behavior of *Bombylius spp*. on blue tubular flowers of *Muscari spp*. Bombylius has also been recorded feeding on nectar of Viola, Primula, Cardamine, Vacciniura, and other open flowers. Not all Bombyliidae have long, specialized mouthparts; Anthorae and Phthiria have short probiscides with labellae appropriate to lapping at open flowers. The Empididae are frequent flower visitors.

least 20 species of flowers are visited by *Empis tessellata* in Britain (Hobby Aand Smith., 1961). The Empididae are also important flower visitors in the Arctic (Kevan., 1973). There are also numerous records of Stratiomyidae, Dolichopodidae, Lonchopteridae, Phoridae (Feinsinger and Swarm., 1978), and others as flower visitors.

 Among the Cyelorrhapha, the Aschiza include the most important anthophilous Diptera, the Syrphidae. These flies feed on nectar and pollen of a wide variety of flowers worldwide (Miiler., 1883).

 The Calypterae (Schizophora) are generally larger and constitute important group of anthophiles. The parasitic Tachinidae have long proboscides and are frequent flower visitors, especially of Compositae. The Calliphoridae have shorter proboscides and frequent more open flowers. These flies prefer to feed on carrion and excrement, but may visit flowers, especially after overwintering or emergence. They can discriminate some colors and appear to prefer yellow flowers (Kugler., 1956).

 The Muscidae is a large family with many well-known anthophiles. Scatophaga visits flowers for nectar and for prey. Other Muscidae are not specialized in anthophilous habit. Many have short proboscides and are general visitors to open flowers. Their role in pollination is often discounted, despite their abundance and visiting behavior. Anthomyiidae are wellknown flower visitors; some have long proboscides. They feed on nectar and pollen; the latter may be the protein staple for adults of some species (Kevan., 1973).

 Some sapromyophilous flowers attract a wide variety of dung and carrion flies by releasing skatoles or aminoids. Among these are the remarkable Raffleia flowers, which are up to 1 m across, desert Stapelias, a number of Araceae, and some Orchids that have colors appropriate to the odors. Some also have light windows towards which visiting insects crawl, as in Ceropegia (Linsley et Al., 1937).

* + 1. **Lepidoptera**

 Most Lepidoptera feed extensively on floral nectar as adults, although they may also feed on a variety of other liquids. Some Micropterigidae feed directly on pollen. A few butterflies soak pollen in nectar and feed on the "soup". The proboscid tip is sometimes set with rasping spines used for piercing fruits, flowers, or animals’ skins. Lepidoptera with proboscides of extreme lengths are known, e.g. the sphinx moth *Xanthopan morgani*, with the longest known proboscis, is the putative pollinator in Madagascar of Angraecum sesquipedale, an orchid with a 25-30 cm spur. In the European hawk moth *Macroglossa stellatarum* visual stimuli are the most important in foraging on flowers.

 Butterflies are frequent diurnal visitors to flowers. The flowers they visit are often brightly colored, may or may not be strongly scented, and have long tubular corollas that are frequently equipped with extended petal lobes forming a landing platform (e.g. Phlox, Primula). A platform is also provided by the capitulum in Compositae. Butterflies generally land to feed, rather than hovering as do many moths. The flowers frequently have proboscis guides or other structures designed to assure that the proboscis touches the sexual parts of the flower so that pollination may be effected.

* + 1. **Hymenoptera**

The most important order of anthophiles is the Hymenoptera. The Symphyta, have short mouthparts and show no special adaptations to anthophily, but they are frequently found on flowers with easily accessible nectar, especially yellow ones such as Ranunculus and Compositae. Many visit flowers of their larval host plant, e.g. Salix, Symphoricarpos, Rubus, Scabiosa, where they may lay eggs. They feed on nectar, pollen, or floral parts and become heavily dusted with pollen. Although sawflies are mostly generalist flower visitors, some have specialized pollination relationships with orchids (Coleman., 1932).

 Among the Apocdta, the Parasitica have short mouthparts and frequently are visitors to many open flowers, especially white ones (Kevan., 1973). Although they appear as general visitors, some are quite restricted in their anthophily (Emden and Van., 1963). The Parasitica often visit flowers also frequented by Brachycera. Several specialized relationships are worthy of mention, e.g. the pollination of *Cryptostylis spp*. (Orchidaceae) by *Lissopimpla semipunctata* (Ichneumonidae) through pseudocopulation (Coleman., 1938).

 Among the Aculeata, only the bees have elongated proboscides. They are the most highly adapted of all Insecta to anthophily. There are a number of anthophilous families of wasps, most of which are predatory as larvae and adults. Nevertheless, the adults also visit flowers extensively (Spradubry., 1973). Although generally medium to large in size, their mouthparts are short and they feed only on open or short tubular flowers, a habit they share with Parasitica and Brachycera. Members of the Sphecidae and Pompilidae feed on nectar for themselves, whereas the social Vespidae (e.g. Vespula) also do so in order to feed the larvae (Brain and Brain., 1952).

The Formicidae are frequent flower visitors, but their role in pollination is not fully understood. They have been invoked as pollinators for *Herniaria ciliolata* in Britain( Proctor and Yeo., 1973), and for Polygonum cascadense and other flowers in western North America (Hiekman, 1974), including some alpine examples (Proctor., 1973). A problem with ant pollination is that ants must often walk through vegetation as they go from plant to plant. Nevertheless, the ant pollination syndrome can be characterized: the plants pollinated are low, often sprawling and intermixed; they grow in poorly vegetated places, yet are often in dense populations themselves and have small non-showy flowers with little, but accessible, nectar (Wyatt., 1981). For plants not meeting at least some of these criteria, ant visits are probably not effective in pollination. In fact, some plants have sticky "ant barriers" as in Silene or *Boerhaavia annulata* (Nyctaginaceae). Extrafloral nectaries, as in Vicia, Prunus, Helianthella, Paeonia, and others, may keep ants from the flowers. In some flowers these nectades attract ants that protect the flower bud from ovipositing or herbivorous insects (Inouye and Taylor., 1979).

Of all the Insecta, the Apoidea are the most important and highly adapted for anthophily. They are highly diverse structurally and behaviorally, as well as taxonomically. Their mouthparts are well adapted for imbibing nectar, their bodies well adapted for collecting pollen; they learn floral intricacies readily and are behaviorally adept at manipulating flowers. Bees are almost entirely vegetarian, both as adults and larvae, and they provision cells with pollen and nectar for their larvae or their own overwintering or both. Many of the flowers visited are closely coadapted to these features, for their own reproduction.

* + 1. **Minor Groups**

Most anthophilous insects are Holometabola. However, among the lower orders, flower visiting is often common. Collembola have been recorded from flowers all over the world (Kevan., 1978); they ingest pollen nectar or both. Their flower visiting appears to be limited to short, perhaps critical, periods of their lives. Some phasmids also mimic flowers and thus gain protection from predation (Annandale., 1902). Although blattids are infrequently recorded as flower visitors (Proctor and Yeo, 1973), they may be pollinators in the tropical forest canopy (Perry, 1978). Tettigoniids, especially Conocephalus, may be common and destructive visitors to flowers where they feed on the anthers, pollen, or other floral parts (Shuster., 1974).

 Thrips are notorious as flower visitors and dwellers. Some thrips have especially adapted asymmetrical mouthparts for piercing pollen grains from which they suck the protoplast (Grinfeld , 1959). No doubt they imbibe nectar too.

 The Heteroptera are the most conspicuous and common of the non-holometabolous anthophiles. The Nabidae, Miridae, Lygaeidae, Coreidae, and Pentatomidae are commonly found on flowers with easily accessible nectar, such as the Compositae and Umbelliferae (Porsch., 1958). Some Phymatidae use flowers as places to ambush prey (Balduf ., 1941). In the case of the Heteroptera, there is little information on the importance of the anthophilous habit to either the insects or the plants.

**2.3 Insects and floral attractants**

The ecology of physiological coadaptation is exemplified in the appreciation insects have for their environment. Anthophilous insects are finely attuned to their habitat in vision, olfaction and taste, tactile sense, and appreciation of time. This extends especially to their appreciation of the attractive features of flowers.

**2.3.1. Color and Color Vision**

In general, insect vision extends from ultraviolet at ca 300 nm (UV) yellow-orange at ea 650 nm. Their visual spectrum is shifted about 100 nm to the shorter wavelength end of the color spectrum as compared with humans. Within this spectrum, many insects show peaks of sensitivity in the UV, blue-green, and yellow. Some insects, notably Bombus and Apis, have trichromatic color vision with the above primary colors. Trichromatic vision has been shown in *Dielephia elpenor* (Sphingidae) (Sctdecht., 1979). Some flies appear to be deuteranopic (i.e. color-blind, analogous to red-green colorblindness in humans) (Snyder and Miiler., 1972). They confuse blue through yellow, but distinguish UV. Some insects with only black and white, or tonal vision, may not distinguish any wave bands. Nevertheless, most insects show similar sensitivities to wave bands across the spectrum. The relative sensitivities (highest to U-V, less to blue, and least to yellow) correlate negatively with the solar or daylight spectrum, i.e. where there is the least amount of daylight (i.e. in UV) the insect eye compensates by being most sensitive. (Goldsmith and Bernard., 1974) reviewed the subject of insect vision, and the physiological studies have been placed in context with daylight, floral coloration, and pollination (Kevan., 1983). With these concepts in mind, we can erect a naming scheme for colors as insects may see them, and we can measure colors according to a logical adaptation of the trichromatic color naming system used for colorimetry in the human visual system (Kevan., 1983).

 Ultraviolet is clearly an important wave band, a primary color to highly evolved pollinators such as bees and even to deuteranopic flies. It is also highly stimulating to totally color-blind insects, yet is invisible to humans. Nonetheless, other wave bands must be considered when attempting to understand floral colors as insects may see them (Kevan., 1978). Some flowers reflect LW and other wave bands strongly, others weakly, and others not at all. These reflective patterns may change over time, so that colors and color patterns provide flower visitors with clues as to the age of the flowers and the presence of food rewards, e.g. in Aesculus hippocastanura in which orange nectar guides on white petals turn red as the flower ages (Kugler., 1936).

 Other flowers also change in color with age. Brown-centered, older inflorescences of ragwort (Seneciojacobaea) are ignored by hover flies visiting younger, yellow-centered inflorescences. The fading in banner petals of a loco weed (Oxytropis splendens) signals fewer bumble bee visits (Laverty., 1980). The reproductively receptive and insect-rewarding flowers of Lotus scoparius are yellow but turn orange after pollination, and then are no longer visited (Jones., 1983). Flowers that appear similarly colored to people may appear very differently colored to insects. On a community basis, floral colors are more distinct and more diverse to insects than to people (Kevan., 1978). This is obviously important; it enables insects to recognize appropriate food sources more readily; it serves the plant by encouraging consistency of visitor type or individual and thus aids appropriate pollen transfer. Recall, too, that the visual acuity of insects, even those that are highly developed optically, (e.g. bees) is almost an order of magnitude less than ours. Hence, what we may recognize by outline pattern, an insect must recognize just as readily, or more so, by coloration and color pattern.

 Nevertheless, bees and other insects are also influenced by the shapes, outline forms, and outline lengths of flowers (Kevan., 1983).

 It is now possible to discuss insect preferences for floral colors. That the bees’ favorite color is blue is an old idea, but bees are well known to visit flowers of any color, and they may not bother to discriminate between color morphs of flowers growing together. Certainly blue, purple, and mauve flowers are more frequented by bees than by other insects, but then flowers of these colors are frequently strongly structurally adapted to bee pollination, e.g. Pedicularis, Trifolium, Penstemon, and Mertensia. (Knoll., 1921) demonstrated the relationship of blue coloration and pollination by Bombyliidae. Other purple and mauve flowers are associated with more advanced butterflies; again the flowers are structurally adapted to butterfly pollination (e.g. Dianthus and Phlox). The association of butterflies with pinkish flowers (Miiler., 1883) and with red flowers (Proctor and Yeo., 1973) is well known. Nocturnally blooming flowers are often white or pale in color and heavily scented. Night-flying moths are attracted from a distance by scent and at close range by the more reflective and contrasting white on a background of dark foliage. By contrast, many diurnally blooming white flowers have exposed nectar and are visited by an array of daytime visitors, e.g. many short-tongued insects such as parasitic Hymenoptera, flies, and beetles. Yellow flowers are often highly reflective and attract an almost unlimited variety of visitors. Some unspecialized visitors, e.g. Coleoptera, Diptera, Lepidoptera, may show preferences for yellow (Kevan , 1983). Red flowers are mostly associated with bird pollination, yet some butterflies have red-sensitive vision and some visit red flowers. Some red flowers visited by other insects have UV reflective patterns, e.g. Papaver. The UV reflective patterns on Ophrys flowers (pollinated by pseudocopulation by male Gorytes wasps) offer a "super-normal" visual image mimicking the female Gorytes wasps with more UV than the model. The male wasps are first attracted to the flowers by their mimetic pheromone scent (Kullenberg., 1975). Other mimetic patterns are important in attracting dung- and carrion-seeking insects to flowers mimicking those rewards in both color and scent.

**3. Material and method**

The survey is conducted at Erbil Park (Floricultures) from the beginning of October 2023 to the mid of April 2024 using pan traps. Two different park were selected as a study area; one at the city center is Sami Abdulrahman park and the second is Hawar Park near Bnaslawa . The sampling station was selected using Randomized Complete Block Design (RCBD) because it is Complete flexibility. Can have any number of treatments and blocks. Provides more accurate results in the forested ecosystem due to grouping , relatively easy statistical analysis even with missing data. And allows calculation of unbiased error for specific treatment (Fleiss., 2011 )and at each study site, three different coloured pan traps (Yellow, White and Blue ) and (the control group is not find because the study depends on colures which each colour has its own impact that can compere individually )were installed each with three replicates (blocks) to provide an even coverage of the studied area. In each block the three different coloured pan traps were installed, these comprised of plastic bowls set side by side with a distance of 5 meters between them and at the upper margin of each trap, a small hole was made in order to prevent flooding of the traps by the irrigation system. The traps were half full of water with the addition of drop of dish wash which prevents escape the catch. It is also nontoxic to mammals and thus was not a hazard to visitors. The pan traps were emptied every two days. The collected samples were kept in 70% ethanol and then transported and kept in laboratory for identification.

 

 **Figure 1. Colored pan traps for collecting specimens**

**4. Results**

 In total, 365 insects approach provides a better estimate of the scale of the problem, even if it doesn’t show the specific details. For example, whether the insects are getting smaller or fewer in number, the decline would have just as big an impact on some forests or fields products. insects were collected at both study sites (208 site 1 and 157 site 2) belonging to four Insect orders. The colour of pan trap affected the abundance of each insect order throughout the study period at both study sites. In general, the greatest insect number was observed in yellow pan traps followed by white and blue traps respectively (Figure 2).

The order Hymenoptera was the most abundant insect order collected in yellow pan traps at both study sites followed by the order Diptera, Lepidoptera and Coleoptera at both sites (Figure 3).

The order Hymenoptera was the most abundant insect taxa collected at both study sites, whereas the composition of other insect order were lower for the orders Lepidoptera , Diptera and Coleoptera respectively (Figure 4,5 ).

Figure 2: Total number of insects collected for each trap colour at both study sites.

Figure 3: The average number of each insect order collected per trap colour.

Figure 4: The average number of each insect order collected per trap colour at site one.

Figure 5: The average number of each insect order collected per trap colour at site two

Although the highest insect number was found primarily at yellow pan traps, however, there were variations in the response of each insect order to trap colours as well as differences in the study sites (Figure 4 and 5). Overall, the order Hymenoptera was more attractive to yellow pan traps at site one and white pan trap at site 2 while the response of other insect order changed depending on each study site. In table (1) The results of this research shows that the highest mean number of all insect orders was found in yellow colour in comparison with white and blue colour.

**Table (1) representing Mean of flower visiting insects**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date | Insect order | Blue | Yellow | White |
| 08/10/2023 | **Hymenoptera** | **7** | **11** | **13** |
|  | **Lepidotera** | **6** | **14** | **1** |
|  | **Dipter** | **2** | **54** | **22** |
|  | **Coleoptera** | **0** | **2** | **0** |
| 15/10/2023 | **Hymenoptera** | **6** | **5** | **12** |
|  | **Lepidoptera** | **0** | **0** | **2** |
|  | **Diptera** | **4** | **4** | **10** |
|  | **Coleoptera** | **0** | **1** | **0** |
| 25/10/2023 | **Hymenoptera** | **16** | **14** | **21** |
|  | **Lepidoptera** | **8** | **11** | **12** |
|  | **Diptera** | **13** | **9** | **9** |
|  | **Coleoptera** | **0** | **0** | **1** |
| 01/03/2024 | **Hymenoptera** | **0** | **4** | **2** |
| 07/03/2024 | **Lepidoptera** | **1** | **1** | **0** |
|  | **Hymenoptera** | **0** | **1** | **0** |
| 13/03/2024 | **Hymenoptera** | **6** | **5** | **12** |
|  | **Lepidoptera** | **0** | **0** | **2** |

 mean. 3.818. 7.409. 6.136

**5. Discussion**

There was a considerable information gap regarding flower visiting insects in the Iraqi Kurdistan region in general and Erbil province in particular which most of these insects are known as pollinators or ecosystem services. The present survey is a contribution to knowledge of the abundance of flower visiting insects at the order level in urban areas mainly floriculture and their response to various coloured pan traps. Based on the data obtained from this study, the current survey shows that the abundance of flower visiting insects could be affected by sampling methods ( Saunders and Luck 2013) indicated that Coloured pan trapping is a simple and efficient method for collecting flying insects, yet there is still discussion over the most effective bowl colour to use for particular target groups (e.g. pollinator and visitor insects ) Most published pan trap studies have been conducted to investigate the effects of habitat on pan trap Since many flower visiting insects are active during the day and attractive to various colures of flowers, coloured pan traps were used an effective method of sampling Despite variations in the response of each insect order to each trap colour, yellow and white pan traps collected highest number of insects in comparison with other traps with the first one being the most effective particularly for Hymenoptera (Figure 3 and 4). This is also agreement with studies for example (Khalil *et al,* 2019) found that colour plays an important role in determining the species richness and composition of pan trap catches, with colour sets that included high reflectance yellow and white generally having catches with the highest species richness. Similarly, Gonçalves *et al*., (2012) used Malaise and pan traps to survey bee species surveyed along an altitudinal gradient in Ubatuba, Brazil. They found that the subfamily Apinae is the most abundant and species rich with 32 species collected during their study. Gollan *et al*., (2011) compared the use of yellow and white pan traps in surveys of bee fauna in New South Wales and found that in all surveys, yellow pan traps collect significantly larger number and greater diversity of bees than white pan traps. Sadeghi Namaghi and Husseini,( 2010) found that, in the yellow pan trap, *Episyrphus balteatus* was the key species representing about 45% of all specimens collected in the agroecosystems of Neyshabur, Iran. The other taxa (Figure 3 and 4) were found in relatively low numbers and their response to trap colours varied at both study sites. This could be related to various factors for example, the presence of the order Lepidoptera and coleoptera could refer to the fact that these insects are mostly jumping therefore, their presence in the traps are mostly by accident than being a response to trap colour and the presence of other insects in the traps could refer to their predator and prey behaviour not pollination which are predators or mutualism between aphids and ants moreover individuals were found inside the traps which they fall inside the colour traps to obtain the nutrition’s and food sources (Khan *et al.,* 2016) . These insects caught in the traps in their response to these factors which may have fallen from the plants by accident in to the traps not by their physical response . (Kevan 1979) cleared that The importance of measuring floral colors as insects might see them is often ignored. Ultraviolet, only one of the wavebands visible to insects that they depend on broad spectrums and wave length , is often recorded in vacuo, without reference to the insect visual spectrum, without quantification, and without reference to background coloration and ambient lighting. Such oversights may lead to serious errors in interpreting the functional significance of floral colors and color patterns. The efficiency of pan traps is still not well studied, and may be closely dependent on the local vegetation type or on abiotic factors such as water availability. In addition, pan traps can be positioned close to flowers in open areas of vegetation, possibly increasing sampling rates(Gonçalves *et al.,* 2012).

**6. Conclusions**

 This study confirms that coloured pan traps is an important attractant for many flower visiting insects (anthophiles). Consequently, coloured pan trapping is an efficient technique that can be easily and cost-effectively used to quantitatively sample assemblages of anthophiles. However, colour preferences of anthophiles is an important source of bias that needs to be considered in pan trap surveys. By drawing sub samples comprised of different colour combinations from a database of pan trap surveys in the lowlands of the Cape Floristic Region, we examine the effects of colour on pan trap catches and determine which combinations of colours might provide better estimates of diversity when sampling with multi-colour sets of pan traps (Vrdoljak, *et al.,* 2012.) could be reliably used for sampling and monitoring flower visiting insects from floricultural plants in urban areas with the yellow pan traps being the most effective particularly for the Hymenopteran specimens.

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