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Species composition of major pollinators in agricultural agrocenoses

Yanko Dimitrov[1*], Nedyalka Palagacheva[1], Plamen Zorovski[1], Stoyan Georgiev[2], Rositsa Mladenova[3] and Zheko Radev[1]

[1]*Agricultural University, Plovdiv 4000, Bulgaria*
[2]*Field Crops Institute, Chirpan 6200, Bulgaria*
[3]*Syngenta Bulgaria Ltd., Sofia 1784, Bulgaria*
[*]*Corresponding author:* dimitrov_ento@abv.bg

Abstract

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In the recent years, the number of insect pollinators has declined significantly. This, on the one hand, is explained by urbanization, which reduces the blooming resources available to pollinators and on the other, the widespread use of pesticides for pests control in industrial farming.

Considering this, the preservation and restoration of plant strips in and around arable land is essential to provide a wide variety of flowering species, which serve as food resources, nesting and hibernate sites for pollinators.

With the aim of associating the earlier pollinators in the crop, it was betting field experience with different grass mixtures of different species composition, and time of sowing at the Experimental field of the Agricultural University in Plovdiv, Bulgaria.

From 1055 numbers of pollinators registered in grass mixtures, the highest number was from genus *Megachile* – 500 number, honey bee (*Apis mellifera* L.) – 303 and Flower flies – 214.

Keywords: pollinators; mixed grass; flowers; color; agrocenoses

Introduction

The integrated approach to tackling crop pests requires restricting the use of chemical agents, using the resource of the natural environment. This resource can be considered in two aspects. The first one is the construction of sustainable food chains in agrocenoses, and the second one is the impact of entomofauna on the quality and quantity of the yield.

The enrichment of agrocenoses with insects leading to environmental sustainability includes: creating favorable conditions for their appearance and development, stimulating their activity by building landfills for multiplication and using the methods and pests that do not have a negative impact on their vital activity and reproduction.

Pest control systems on crop plants are built over time. This leads to the loss of habitat and disturbance of the balance in the environment shift towards integrated plant protection and organic farming.

The International Convention on Biological Diversity identifies pollination as a key service in the ecosystem that is threatened globally (Abrol, 2012).

According to the Food and Agriculture Organization from 100 crops, which provide 90% of the world‘s food – 71% are pollinated by honey bees.

The importance of insects, such as pollinators, is mentioned in works a number of authors Kevan, (1972), Roubik (1995), Proctor et al. (1996) Klein et al. (2007), Ollerton et al. (2011). It has been shown that the yields of insect-pollinated plants are 10-15 times greater in bee’s participation than without them. The plants are 80% pollinated by honey bees and only 20% of the remaining insects. Thus, from the visit of the honey bees, the yield increases with the 50-60%

of the sunflower, 60-80% of the fruit trees, 250% of the sainfoin, 300% of the red clover and 500% of the vegetable crops (Donchev et al., 1958).

According to a number of authors Watanabe (1994), Williams (1994), Delaplane & Mayer (2000), Galai et al. (2008), Hung et al. (2018) the honey bee (*A. mellifera*) is the best pollinator on crop plants. The species *Osmia* and *Megachile* are used for pollination of fruit, vegetable and field crops. Representatives of the genus *Megachile* are important pollinators of legumes crops (Bohart, (1960), Suzanne & Batra, (1967), Williams, (1996).

Studies show, that the increase in the number of habitats on farms is crucial for rebuilding the populations of wild bees and for the maintenance of good pollination of cultivated crops (Kennedy et al., 2013).

Carvell et al. (2004) recommend the creation of additional resources of native perennial wild flowers and grass species in the fields. Flower beds on the edge of arable fields can provide bee food throughout the season if the right colored flowering species are selected.

In Germany, wild colored strips are advertised as a flowering landscape. In Sweden, experiments have shown that flower colors strip can improve diversity and abundance of bees and are suitable for inclusion in intensive agricultural areas (Haaland & Gyllin, 2012).

In England, color flower mixes contain at least four main families of plants that attract bees (Potts et al., 2009; Carvell et al., 2007).

It has been found that some flowering plants, such as: claw, phacelia and others enable the useful entomofauna, build its genetic products to maximize reproductive capacity. These crops influence the attraction of flower colors, which is particularly important for her orientation and concentration of beneficial species and pollinators.

On the behavior of insects pollinators influences have a number of factors, whichever color and light are essential (Hakim & Muis, 2016).

One of the first color effects studies was by Exner & Exner (1910). At this stage, little is known about ultraviolet reflection of color. Knuth (1891a, 1891b) examines several colors with respect to the insect sight in the ultraviolet rays.

According to a number of authors Mcalpine (1965), Hocking (1968) and Kevan (1972), the colors are attractors for attracting insect pollinators.

Later Ari Utami et al. (2014) are trapped the insects in two colors: red and white. The results obtained show that insects prefer white in comparison with the red one and explain it with the wavelength of the two colors. The red color wavelength ranges from 625 to 40 μm and white between 300-400 μm.

According to Donchev et al. (1958) the bees distinguish four colors: yellow, bluegreen, blue and ultraviolet. As far as the last color is concerned, the vision of the honey bees is more perfect than that of the human being, as the ultraviolet light-emitting color is unknown to the human eye.

Between insects only the beards differ in the red color. Bees often visit the red poppy, but its coloring is perceived not as red, but as ultraviolet.

To the white color the bees also have unequal treatment with man. They perceive the white color as colored by the absorbed ultraviolet rays.

Establishing the colors that attract insects and their plants make it possible to build colored flowering strip to attract pollinators to agricultural agrocenoses.

Material and Methods

Studies have been carried out at the Experimental field of the Agricultural University in Plovdiv, Bulgaria. They hit two grass mixtures: Laitamag (Hungary) and of Agricultural University in Plovdiv, including species: white mustard (*Sinapis alba* L.), white clover (*Trifolium repens* L.), phacelia (*Phacelia tanacetifolia* Bentham), crimson clover (*Trifolium incarnatum* L.), Egyptian clover (*Trifolium alexandrinum* L.), red clover (*Trifolium pretense* L.), wild oast (*Avena sativa* L.), alfalfa (*Medicago sativa* L.), buckwheat (*Fagopyrum esculentum* Moench), sainfoin (*Onobrychis viciifolia* Scop.) and coriander (*Coriandrum sativum* L.). The experimental design was used with 4 replications for each flower strip.

To establish the species composition the pollinators were used standard entomological methods (entomological bag, yellow plates and one square meter). In interval of 7-10 days observations were made throughout the growing season. The collected insects were put in plastic bags and were determined in the laboratory.

Results and Discussion

As a result of the experiments, were found 1055 pollinators. The highest density species was registered of genus *Megachile* – 500, followed by the honey bee (*Apis mellifera* L.) – 303 and Flower flies 214 number. Other pollinators: *Ceratina cucurbitina* Rossi, *Anthidium manicatum* L., *Macropis europaeae* Warn., *Halictus scabiosae* Rossi, *Melitta leporina* Panzer, *Lasioglossum xanthopus* Kirby and *Andrena flavipes* Panzer were recorded at negligible density (Table 1).

The appearance and multiplication of pollinators in grass mixtures are directly related to the conditions of the environment. The first species were found in early of April, with a sustained increase in the mean daily temperature above 14°C

Table 1. Species of the pollinators found in mixed grass during the study period

Species	Number
Megachile sp.	500
Apis mellifera L.	303
Fam. *Syrphidae*	214
Ceratina cucurbitina Rossi	14
Anthidium manicatum L.	7
Macropis europaeae Warn.	6
Halictus scabiosae Rossi	5
Melitta leporina Panzer	3
Lasioglossum xanthopus Kirby	2
Andrena flavipes Panzer	1
Total:	1055

and beginning of flowering of the plant species included in the grass mixture.

From them which the earliest blooms white mustard – from early of April to the beginning of May, observed one-story flowering with a dominant yellow colored.

No pollinators were identified in the crops, despite the availability of insect attraction information of the yellow color (Table 2).

Table 2. Flowering of the species in the mixed grass – time of flowering and color of flowers

Color of flower	Time of flowering		
	April	May	June
Yellow (white mustard)	←	→	
Purple (phacelia)		←	→
White (coriander, white clover, Egyptian clover)			← →

From the end of April to the end of May, the phacelia blooms, as a result of which an upper purple colored floor is formed. The honey bee (*Apis mellifera* L.) was increased his number in the mixed grass with predominantly purple color during the study period. At the beginning of May, *A. mellifera* registered a high density – 143 numbers. At that time more than 70% of the phacelia were open, new flower buds were visible. The phacelia blooms for a long time and attracts with its purple colors the honey bee. By blossoming the phachelia the density of *A. mellifera* began to decline and single individuals were recorded at the beginning of June (Figure 1).

Since the beginning of June, the white color is formed when the Egyptian clover, the white clover and the coriander. This resulted in the emergence of the following pollinators: the genus *Megachile* and Flower flies.

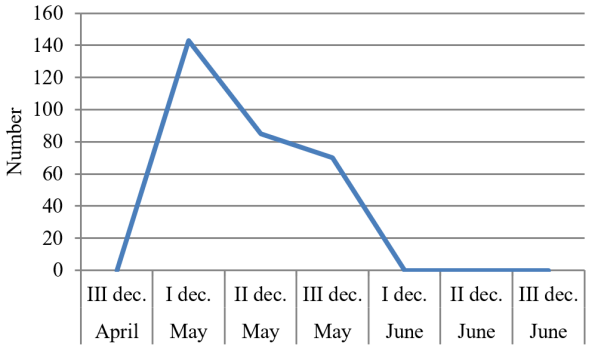

Fig. 1. Multiplication of the honey bee (*A. mellifera*) in the purple color

The first species were registered at the beginning of May. Their density was low – 12 number of genus *Megachile* and 14 numbers in the flower flies, which remains in the period of blooming.

Gradually, with warming of weather and the occurrence of full blooming of the coriander, the white clover and the Egyptian clover, their numbers began to increase. Genus *Megachile* peaks were established in the third decade of May – 207, and in the case of the Flower flies earlier – during second decade of May respectively – 142, when the white color is formed in the mixed grass. At the end of June, one unit was reported (Figure 2).

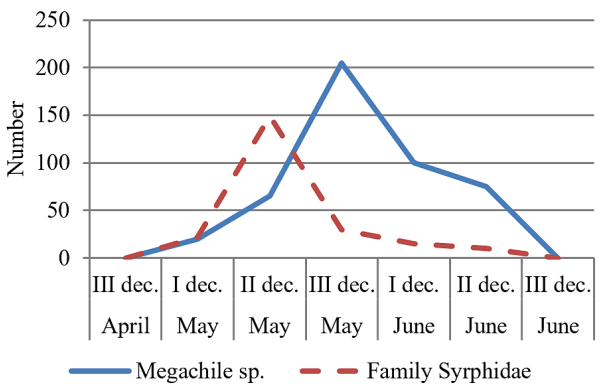

Fig. 2. Multiplication the population in white color

Conclusions

The formation of flower colors strip in and around arable land should include plants with purple and white colors attracting major pollinators, such as phacelia, white clover, Egyptian clover and coriander.

An appropriate period for growing flowering species to attract pollinators is from the beginning of April to the end of June.

Plants with purple color attract mainly the honey bee – *Apis mellifera* L.

Plants with white color (coriander, Egyptian clover and white clover) attract predominantly genus *Megachile* and Flower flies.

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