

## IMPACT OF ALFALFA FLOWER COLOR AND PERIOD OF THE DAY ON ACTIVITY OF FREE POLINATORS

Bojan Anđelković<sup>1</sup>, Goran Jeftić<sup>1</sup>, Mića Mladenović<sup>2</sup>, Nebojša Nedić<sup>2</sup>, Ratibor Štrbanović<sup>1</sup>,  
Jordan Marković<sup>1</sup>

### Abstract

For the successful production of alfalfa seed it is necessary to provide satisfactory pollination, which is one of most important factors in the alfalfa seed production. The aim of this study was to determine the visitation of pollinators in relation to the coloration of alfalfa flower (dark purple and light purple) as well as the period of the day (08:00-09:00am, 11:00-12:00am and 14:00-15:00pm). The experiment was conducted in experimental field of the Institute for forage crops in Globoder, Kruševac, Serbia, in the period of two years. Three of the most important genera of free alfalfa pollinators (*Osmia spp.*, *Megachile spp.*, and *Bombus spp.*) were observed. The insects of genus *Osmia* were the most frequent visitors to the light purple flowers in both years, while insects of genus *Megachile* were the most frequent on the dark purple flowers. It was determined that the period of day was the most significant of studied factors, as the pollinators were most active in midday. On the contrary, the least activity was determined in morning period for all pollinators.

**Key words:** *Osmia*, *Megachile*, *Bombus*, alfalfa, pollination

### Introduction

Alfalfa (*Medicago sativa* L.) is one of the most important forage crops that are bred in Serbia. Pedersen et al., 1956, have presented that 46.7% of flowers can grow (germinate) pods therefore it is possible to realize up to 2000kg $ha^{-1}$  of seed yield which is rarely achieved in production primarily due to poor fertilization of flowers and insufficient presence of adequate pollinators. Alfalfa is largely self-fertile, but for mechanical reasons, flowers require insect visitations for pollination (reviewed in Bohart 1957, Richards, 1996). When a visiting insect inadvertently “trips” the flower, the sexual column snaps upward, sometimes striking the bee and the flower can no longer be pollinated if once tripped, (Cane, 2002).

Commercial pollination of alfalfa is distinctive for an additional reason: both in Europe and the United States, most of the seed is produced using bees other than the honey bee, *Apis mellifera* L. A large number of authors have proved that honey bee is not as effective in pollination of alfalfa, primarily due to the anatomy of the alfalfa flower. Many other pollinator species are significantly more effective in pollination of alfalfa (Stanisavljević et al., 2003). However, these free pollinators have their shortcomings due to their dependence on meteorological conditions and anthropogenic factors, and alfalfa is grown on large areas where there is no natural habitat for spontaneous pollinators.

The alfalfa leafcutter bees of genus *Megachile*, (most common is *Megachile rotundata* P.), are solitary bees that do not build colonies or store honey, but are very efficient pollinator of alfalfa, carrots and some other vegetables. While these bees do not store honey, females do collect pollen which they store in the cells of their nests.

<sup>1</sup> Institute for Forage Crops, Kruševac – Globoder, e-mail: bojan.andjelkovic.ikbks@gmail.com

<sup>2</sup> Faculty of Agriculture, Zemun, Belgrade

The pollinators of genus *Osmia* (*Osmia cornuta* Latreille is the most common), are a solitary, spring-flying mason bees. They forage for pollen and nectar for their brood.

Insects of genus *Bombus* are known to be good pollinators due to their long proboscis. They pollinate by "buzzing", meaning that they disperse pollen by vibrating their wings as they fly, (Stanisavljević et al., 2003).

The aim of this study was to determine the number of different pollinators on the alfalfa crops, in relation to flower color and the period of day.

## Materials and methods

The experiment was conducted in experimental field of the Institute for forage crops in Globoder during 2008 and 2009. Three different genera of pollinators were studied (*Osmia*, *Megachile*, and *Bombus*). The experiment lasted for 7 days in each year of study. Based on the color of the flowers, alfalfa plants were set in two groups (light purple flowers and dark purple flowers). The counting of the pollinators was done in three periods of a day (08:00-09:00am, 11:00-12:00am and 14:00-15:00pm). The average temperatures were 16.2°C, 22.4°C and 27.6°C, respectively, in the first year, and 15.3°C, 24.2°C and 28.1°C in the second year. The experiment was set as completely randomized plan. Statistical data analysis was done using the computer program Costat.

## Results and discussion

In the first year, lighter colored flowers had slightly more visits (average 1.02 insect per plant) than the darker flowers (average 0.84 insect per plant). Similar results were determined in the second year. Again, the pollinators preferred lighter flowers (average 1.10 insect per plant) in contrast to darker flowers (average 1.02 insect per plant).

Table 1. The number of pollinators in relation to flower color and time of the day in 2008

Pollinator	Light flower color				Dark flower color			
	08:00am	11:00am	14:00pm	Average	08:00am	11:00am	14:00pm	Average
<i>Megachile</i>	0.05	1.52	1.76	1.11	0.05	2.14	1.38	1.19
<i>Osmia</i>	0	2.24	2.57	1.60	0.14	1.52	1.14	0.93
<i>Bombus</i>	0	0.62	0.43	0.35	0.1	0.57	0.48	0.38
Average	0.02	1.46	1.59	1.02	0.10	1.41	1.00	0.84

Table 2. The number of pollinators in relation to flower color and time of the day in 2009

Pollinator	Light flower color				Dark flower color			
	08:00am	11:00am	14:00pm	Average	08:00am	11:00am	14:00pm	Average
<i>Megachile</i>	0,1	1,86	2,1	1,35	0,19	2,29	1,9	1,46
<i>Osmia</i>	0	2,14	2,52	1,55	0,19	1,57	1,9	1,22
<i>Bombus</i>	0,05	0,52	0,62	0,40	0,1	0,62	0,43	0,38
Average	0,05	1,51	1,75	1,10	0,16	1,49	1,41	1,02

The insects of genus *Osmia* were the most frequent visitors to the light purple flowers in both years (average 1.60 and 1.56), while insects of genus *Megachile* were the most frequent in the dark purple flowers (average 1.19 and 1.46). On the contrary, the lowest number of visitors to both color variants in both years was determined for the insects of genus

*Bombus* (average 0.35 and 0.38 in the first year and 0.40 and 0.38 in the second year), (Tables 1 and 2).

In relation to the time of day, most of the studied pollinators showed greater activity in the afternoon counting (14:00-15:00pm), when temperatures were the highest. This is due to the physiological adaptations of insects, as they show greater activity as the temperature increases, so these results were expected. In the study by *Jevtić et al. (2005)*, it is shown that the temperature is not the only factor that may influence the pollination.

The time of the day was statistically very significant in both years for all pollinators except for *Bombus* in 2008, where the time of day did not show significance at all. The lowest activity for all pollinators was determined in the morning counting (08:00am), (Tables 3. and 4.).

*Megachile* had the highest activity on dark flowers, though their activity was highest in the second period (11:00-12:00am) in both years.

*Osmia* showed increased activity in the second period in 2008, and in the third period in 2009. In both years, *Osmia* mostly visited light colored flowers.

*Bombus* was the most active in the second period of day in the both years. Considering flower coloration, *Bombus* had greater affinity toward darker flowers in 2008 and toward lighter in 2009.

## Conclusion

The pollinator behavior is highly influenced by the period of day, which was statistically significant in all cases except for *Bombus* in 2008. The highest activity of pollinators was determined in midday in both years, while the pollinators were least active in the morning. *Megachile* and *Osmia* were the most frequent pollinators in all variants, while *Bombus* species were the rarest visitors, both regarding both flower color and period of the day.

## References

- BOHART, G. E. (1957): Pollination of alfalfa and red clover. *Annu. Rev. Entomol.* 2: 355-380.
- CANE, J. H. (2002), Pollinating Bees (*Hymenoptera: Apiformes*) of U.S. Alfalfa Compared for Rates of Pod and Seed Set, *J. Econ. Entomol.* 95(1): 22-27.
- DYLEWSKA, M., B. JABLONSKI, S. SOWA, BILINSKI M., WRONA S., (1970): An attempt of determination of the number of bees (*Hym., Apoidea*) needed for adequate pollination of alfalfa, *Pol. Pismo Entomol.* 40, 371-398.
- JEVTIĆ G., RADOVIĆ JASMINA, LUGIĆ Z. (2005): Uticaj medonosne pčele (*Apis mellifera carnica* Poll.) i pospešivanja oprašivanja na prinos i kvalitet semena lucerke (*Medicago sativa* L.). *Selekcija i semenarstvo* Vol. 11, br. 1-4, 63-68.
- RICHARDS, K. W. (1996): Comparative efficacy of bee species for pollination of legume seed crops, pp., *The conservation of bees.* Academic, New York: 81-103.
- STANISAVLJEVIĆ LJ., KRUNIĆ M., BRAJKOVIĆ M., JEVTIĆ G., (2003): Značaj medonosne i drugih vrsta pčela ya oprašivanje gajenih biljaka, *Zbornik plenarnih i naučnih radova, XI Naučno savetovanje sa međunarodnim učešćem:* 82-88.