EFFECT OF BEES-POLLINATORS IN BUCKWHEAT (*Fagopyrum esculentum* Moench) CROPS

Jurgis Racys, Renata Montviliene

Department of Apiculture, Lithuanian Institute of Agriculture,
58344 Akademija, Kedainiai district, Lithuania, E-mail: bitinsk@lzi.lt

Received 16 December 2004; accepted 19 May 2005

Summary

The aim of the present study was to investigate the effects of bee pollination of buckwheat crops on the seed productivity and plant development. Six plots each 4 m^2 in size were arranged in a buckwheat field. Four plots in the field were isolated by a net. Nucs with bees were placed in two of the plots (one per plot). Plant productivity, height of plants and number of branches per marked plant were measured. The plants attractive to insects were identified by counting all insects present in blossoms in an area of 100 m in length and 1 m in width.

The tests conducted at the Lithuanian Institute of Agriculture during 1999-2001 showed that bees and other insect pollinators affect not only seed productivity but also development of plants. The plants visited by pollinators were shorter in height than the plants grown in the isolated plots. The insufficiently pollinated plants had 16.8-19.6% more side branches. The length of flowering period of the plants visited by pollinators was 10.0-16.5% shorter. The nectar production of buckwheat depends on the weather conditions rather than on plant density. The tested plants secreted in average 89.8 kg/ha of nectar (from 10.9-160.2 kg/ha), which is 36.1 kg/ha biological sugar. Bees were the main pollinators, they accounted for 81% of all insect-pollinators. The honeybees in wet periods did not fly but bumblebees visited blossoms even in bad weather. The buckwheat plants intensively visited by pollinators produced 21.7--41.4% higher seed yield compared with the seed yield obtained in isolated areas.

Keywords: buckwheat, pollination, productivity, attractiveness, length of flowering period.

INTRODUCTION

Buckwheat is a xenogamous plant. The main pollinators apidae insects were: solitary bees, bumblebees and mostly honeybees. The wind also partly pollinated buckwheat. A blossom flowers for one day, so it is important to pollinate it. The bees--pollinators are important in buckwheat production since they increase its productivity (Jabłoński 1993). The bees usually visited buckwheat crops from 8 a.m. to 1 p.m. A single visit of a blossom by a bee increases plant productivity by 25-30% (Grigorenko 1979). 3-4 insect visits are enough to pollinate one blossom. When bees visit blossoms 5 and more times, the productivity of plants decreases (Bjorkman 1995). Insufficiently pollinated buckwheat plant flowers 10-12 days longer but the grains are larger (Fiodorov 1970), but some experimental evidence suggests that normally pollinated buckwheat develops 1.9-8.5% larger grains than isolated plants (Blontskaja 1976, Elagin 1967). The tests of Russian researchers Avetisjan (1982), Naumkin (1987) show that the bees-pollinators increase the buckwheat productivity and viability.

The nectar productivity of buckwheat depends on kind, fertilization and growth conditions and varies from 6 to 362 kg/ha (Burmistrov and Nikitina 1990, Gluchov 1974, Elagin 1967).

The bees of most races visit buckwheat crops when the distance to flowering

Journal of Apicultural Science

plants is not more than 500 meters, however, Dark European bees can cover longer distances to the crop. Other races choose plants which grow even further (McGregor 1976, Levčenko1981).

MATERIAL AND METODS

The experiment was carried out at the Lithuanian Institute of Agriculture during the period 1999-2001 with the aim of studying the effect of insect pollinators on buckwheat seed productivity and plant development. It involved 3 treatments and 3 replications. The size of the experimental plot was 4 m^2. The first and the second replications were isolated from insect pollinators. The third treatment involved the plots with Carnica bees in nucs.

The height of 25 marked plants was measured every 5 days. The new blossoms were counted every other day.

The nectar productivity was examined by sampling by micropipette primarily when 5-10% of blossoms came into flower and when the blossoms intensively produced nectar. Sugar content was measured by a refractometer. The activity of insect-pollinators was assessed during the day every two hours on a plot of 100 x 1 meters. The attractiveness of buckwheat to bees was estimated by the amount of honey collected from buckwheat and other plants during buckwheat blossoming. The honey composition of bee colonies present near the buckwheat field was identified according to the number of pollen (Louveaux at al. 1978). The crop productivity was determined by weighing the seed obtained per plot. The period of flowering estimated according to hydrothermal regime was humid in 1999, and dry in 2000.

RESULTS AND DISCUSSION

The plants of the first replication – plots free of insects-pollinators were 4.96 cm (19.6%) shorter than isolated ones and 4.26 cm (16.8%) shorter than in plots with nucs. The largest increase in plant height during the flowering period occurred in 2001 – the height of isolated plants increased by 10.6 cm. The greatest number of branches was identified on plants in isolated plots – 6.4 branches per plant, in freely insect-visited plots – 5.8 branches per plant, and in the plots with nucs – 5.7 branches. The highest number of blossoms per plant was found in the isolated plot – 39.3, with bees – 33.8 and freely visited plots – 33.4. The nectar productivity was subject to the weather conditions during buckwheat flowering. The greatest amount of nectar – 0.312 mg or 0.11 mg biological sugar per plant was produced in 2000. The smallest amount of nectar 0.013 mg or 0.007 mg biological sugar was obtained in the droughty summer of 2001, but the nectar concentration was high – 50.6%.

The main insect pollinators were honeybees from 72.1% in 1999 to 94.9% in 2000. The bumblebees accounted for

Table 1

Composition of insects (%) pollinating buckwheat in Dotnuva

Insects-pollinators	1999	2000	2001	Average
Honeybees	72.1	94.9	86.3	84.4
Bumble bees	6.4	3.1	10.0	6.5
Others	21.5	2.0	3.7	9.1
Total	100	100	100	100

Table 2

The effect of pollination on buckwheat seed productivity

Indicators	Free for insects	%	Insulated	%	With bees	%
Number of seeds per plant	57.4	100	44.9	76.5	33.6	56.8
1000 seeds weight (g)	25.3	100	29.1	115.1	24.4	96.7
1 plant grain yield (g)	1.45	100	1.35	88.8	0.81	55.1

3.1% to 10.0% of all pollinators. The other pollinators as is shown in Table 1 varied from 2.0% to 21.5% of buckwheat visitors.

The attractiveness of buckwheat to insect-pollinators depends on the weather conditions. The number of seeds per plant is shown in Table 2.

As is shown in Figure 1 not pollinated plants flower longer, one plant has more blossoms than a plant visited by insects. The average number of blossoms was 16.5% higher on plants isolated from insects. The number of blossoms on plants freely visited by insects and in isolated plots with bees was practically the same.

The nectar productivity of buckwheat varied subject to the weather conditions during flowering period. In 2000 when the weather was cool and wet the nectar productivity was the highest and amounted to 0.3123 mg/plant or 0.111 mg biological sugar. The lowest amount of nectar 0.0128 mg/plant or 0.007 mg biological sugar was secreted by plants in 2001, when the air humidity was sufficient but the temperature was very high, and the nectar contained 50.6% of sugar.

The largest amount of biological sugar – 56.9 kg per hectare was secreted in 2000. The lowest content of biological sugar in nectar was secreted in 2001, it was only 6.1 kg/ha. As shown in Table 3 the nectar productivity depended more on the weather conditions rather than on flowering intensity.

The composition of honey collected by bee colonies kept near the buckwheat field was checked in the summers of 1999 and 2000. In 1999 the honey collected from buckwheat had a low content of buckwheat nectar, as little as 9.9%. In 2000 the amount of buckwheat nectar in the honey increased to 32.6%. The data of Table 4 shows the composition of honey.

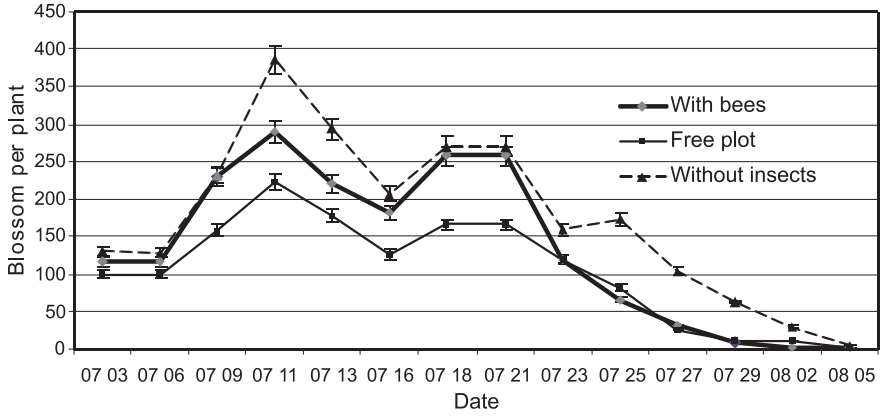

Fig. 1 Intensity of buckwheat flowering

Table 3

The nectar productivity of buckwheat 1999-2001

Year	Blossom per m^2	Mg per blossom		Nectar productivity			
		nectar	biological sugar	g/m^2		kg/ha	
				nectar	biological sugar	nectar	biological sugar
1999	79411	0.1237	0.057	9.82	4.53	98.2	45.2
2000	51303	0.3123	0.111	16.02	5.69	160.2	56.9
2001	85180	0.0128	0.007	1.09	0.61	10.9	6.1
$\bar{x}$	71965	0.1496	0.058	8.98	3.61	89.8	36.1

Table 4

The palinological composition (%) of honey collected by bee colonies kept near buckwheat fields in 1999-2000

1999		2000	
Plants name	%	Plants name	%
Trifolium pratense L.	64.3	*Fagopyrum esculentum* Moench	32.6
Trifolium repens L.	9.9	*Salix* L.	35.5
Fagopyrum esculentum Moench	9.9	*Brassica napus var. oleifera*	27.0
Brassica napus var. oleifera	4.9	*Rubus idaeus* L.	3.2
Salix L.	6.7	*Centaurea cyanus* L.	1.7
Carum carvi L.	4.3	Honeydew elements was present	
Total	100.0	Total	100.0

CONCLUSIONS

1. The buckwheat plants freely visited by insects-pollinators were 16.8-19.6% shorter than the plants isolated from pollinators.
2. Insufficiently pollinated buckwheat had 10.6-17.5% more branches per plant as compared to those freely visited by insects.
3. Insect-pollinators shortened buckwheat flowering period by 16.5%.
4. Secretion of nectar was mostly affected by the agro climatic conditions rather than by blossom density of the crop.
5. During the experimental period buckwheat flowers produced from 6.13 to 56.9 kg/ha of biological sugar.
6. Bees account for 72.1% to 94.9% of buckwheat insect-pollinators.
7. Under the effect of insect-pollinators buckwheat set 16.5% to 26.8% more seed than in isolated plots.
8. 1000 seeds weight in isolated plots was 7.8%-25.3% higher than in insect-pollinated crops.
9. Insect-pollinators increased the seed productivity of buckwheat by 17.4-19.7%.

REFERENCES

Avetisjan G. (1982)- Pčelovodstvo. *Kolos*, Moskva, 319.

Bjorkman T. (1995)- The Role of Honey Bee (*Hymenoptera: Apidae*) in the Pollination of Buckwheat in Eastern North America. *Journal of Economic Entomology*, 88:1739-1745.

Blontskaja V. (1976)- Pčely i grečicha. *Pčelovodstvo*,12:13-15.

Burmistrov A., Nikitina A. (1990)- Medonosnye rastenija i ich pylca. Moskva, *Rosagropromizdat*,: 49.

Elagin I. (1967)- Grečicha i pčely. *Pčelovodstvo*, 7: 20-22.

Elagin I. (1977)- Problemy grečichi. *Nauka i zizn*, 5:72-77.

Fiodorov A. (1970)- Pčely i biologičeskie osobennosti nektaroproduktivnosti. *Pčelovodstvo*, 5:8-10.

Gluchov M. (1974)- Medonosnye rastenija. Moskva. *Kolos*, 304.

Grigorenko V. (1979)- O kratnosti poseščenija pčelami grečichi. *Pčelovodstvo*. 10:18-19.

Jabłoński B. (1993)- Ogródek pszczelarski. *Puławy, ISK*: 53

Levčenko I. (1981)- Dalnost poliotov medonosnoi pčely pri opylenii entomofilnych kultur. Pčeloopylenie entomofilnych kultur i medonosnaja baza. *Buxaresta – Apimondia*: 116-121.

Louveaux J. Maurinio A. Vorwohl G. (1978)- Methods of melissopalynology/ International Commission for Bee Botany of IUBS. *Bee World* 59(4):139-157.

McGregor S. (1976)- Buckweat [Insect Pollination of Cultivated Crop Plants]. - Washington. 119-122.

Naumkin V. (1987)- Pčely na grečiche. *Pčelovodstvo*. 1:10-11.

WPŁYW OWADÓW ZAPYLAJĄCYCH NA UPRAWY GRYKI (*Fagopyrum esculentum* Moench)

Racys J., Montviliene R.

Streszczenie

Celem przedstawionej pracy było zbadanie wpływu zapylania upraw gryki przez pszczoły na plon nasion i rozwój roślin. Na polu z gryką założono sześć poletek, każde o wielkości 4m^2. Rodziny pszczele umieszczono na dwóch poletkach (jedna rodzina na poletko). Oznaczano produktywność roślin, wysokość roślin i liczbę rozgałęzień przypadających na jedną roślinę pomiarową. Atrakcyjność roślin dla owadów identyfikowano licząc wszystkie owady obecne na kwiatach w kwaterach o długości 100 m i szerokości 1 m.

Badania przeprowadzone w Litewskim Instytucie Rolniczym w latach 1999-2001 wykazały, że pszczoły i inne owady zapylające mają wpływ nie tylko na wysokość plonu nasion, ale także na rozwój roślin. Rośliny odwiedzane przez owady zapylające były niższe niż rosnące na poletkach izolowanych. Rośliny zapylone w niedostatecznym stopniu miały od od 16.8 do 19.6% więcej odgałęzień bocznych. Długość okresu kwitnienia u roślin odwiedzanych przez owady zapylające była o 10,0 do 16,5% mniejsza. Wytwarzanie nektaru przez grykę zależy od przebiegu pogody, a nie od zagęszczenia roślin. Badane rośliny wytwarzały przeciętnie 89,8 kg/ha nektaru (od 10,9 do 160,2 kg/ha), co stanowiło 36,1 kg biologicznego cukru na ha. Pszczoły były głównymi zapylaczami stanowiąc 81% wszystkich owadów zapylających. W okresach deszczowych pszczoły nie latały, ale trzmiele odwiedzały kwiaty nawet przy złej pogodzie. Rośliny gryki intensywnie odwiedzane przez owady zapylające wytworzyły od 21,7 do 41.4% wyższy plon nasion niż rośliny na kwaterach izolowanych.

Słowa kluczowe: gryka, zapylanie, produkcyjność, atrakcyjność, długość okresu kwitnienia.