Scientific Papers. Series A. Agronomy, Vol. LV-2012
ISSN Online 2285-5793; ISSN-L 2285-5785

STUDIES CONCERNING NECTAR SECRETION AT RAPESEED (*Brassica napus* L. ssp. *oleifera* D.C.)

Nicoleta ION[1], Viorel ION[2], Răzvan COMAN[1], Adrian Gheorghe BĂŞA[2]

[1]Research and Development Institute for Beekeeping Bucharest, 42 Ficusului Blvd., District 1, Bucharest, Romania, Phone: +4021.232.50.60, Fax: +4021.232.02.87,
E-mail: nicoleta.ion@icdapicultura.ro, razvan.coman@icdapicultura.ro
[2]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd., District 1, Code 011464, Bucharest, Romania, Phone/Fax: +4021.318.04.66,
E-mail: viorelion@agro-bucuresti.ro; adibasa@yahoo.com

Corresponding author e-mail: nicoleta.ion@icdapicultura.ro

Abstract

Rapeseed (Brassica napus L. ssp. oleifera D.C.) is one of the main melliferous plants due to its nectar secretion and important number of flowers per plant, but especially due to its flowering in a critical period for honey bees, when important quantities of pollen and nectar are required. Although the nectar secretion of the rapeseed flowers is very important for the good development of the honey bees families in the spring and for obtaining some commercial honey yield by the beekeeper, and is playing an important role in the attractiveness of the honey bees as pollination agent for the rapeseed crops, there is still a lack of information concerning the nectar secretion by the rapeseed flowers. Under these circumstances, researches were carried out regarding the nectar secretion and honey production of different rapeseed crops located in different places from South Romania in the years 2009 and 2010. The nectar determination was completed by rapeseed plant characteristics such as plant high, average number of plants per square metre, average number of inflorescences per plant, average number of flowers per inflorescence, and average number of flowers per plant.

Key words**:** *nectar secretion, honey, rapeseed.*

INTRODUCTION

Honey bees and rapeseed plants have a special relationship: living one life is dependent on another. Rapeseed flowers give protein (pollen) and energy (nectar) food to honey bees, and in exchange honey bees assure the cross-pollination process. Many authors have hypothesized that a good nectar secretion of the rapeseed flowers is associated with a better pollination due to the increased number of bees that are visiting the flowers [1]. Even the self-fertility of the rapeseed flowers is possible within a certain percentage, the seed yields obtained in the crops without entomophilies pollination are significantly lower compared to those obtained in crops pollinated by honey bees [2].

The nectar secretion and the conditions under which nectar is produced by the rapeseed flowers are essential for farmers (for entomophilies pollination of the crop) but especially for beekeepers. For a beekeeper who wants to obtain honey production, it is essential to know which crops produce nectar and how much they are producing that.

Although rapeseed crop is important for beekeeping, there is a lack of studies regarding the secretion of nectar of the rapeseed flowers [2]. However, it is obviously that the important number of flowers per unit of area gives great melliferous value to the rapeseed crops; this is being emphasised by the flourishing in a critical period for honey bees, when the demands for protein and energy needs are high. Moreover, the melliferous importance of the rapeseed crops in Romania is emphasised by the increasing cultivated surfaces in the last years, the rapeseed being more and more of interest for the Romanian farmers.

The present study started from the idea that there is a strong need to know more about the melliferous characteristics of the rapeseed plant. This necessity is more emphasised when we talk about pastoral beekeeping to the rapeseed crops, situation when the beekeeper has to know as much as possible about the melliferous potential of the rapeseed crop.

A better understanding of the nectar secretion processes is necessary for a future improvement of the nectar secretion of the rapeseed plants through plant breeding and agricultural techniques which give an increased attractiveness of the rapeseed flowers for the honey bees, this being a necessary condition for a better pollination, respectively for a better yielding capacity of the crops.

MATERIAL AND METHOD

Studies concerning the nectar secretion were performed in different rapeseed crops located in South Romania, in the years 2009 and 2010. In 2009, the studies were performed in seven rapeseed crops, out of which three rapeseed crops in Giurgiu County (Bălănoaia, Valea Bujorului, and Naipu), three rapeseed crops in Călăraşi County (Lehliu, Şoldanu, and Dichiseni), and one rapeseed crop in Teleorman County (Nicolae Bălcescu). In 2010, the studies were performed in two rapeseed crops, out of which one rapeseed crop in Călăraşi County (Ulmeni) and one rapeseed crop in Ilfov County (Baloteşti).

In all studied rapeseed crops there were performed the following determinations:

- Determination of the nectar secretion (quantity of nectar per rapeseed flower and its concentration in sugar;
- Calculation of the potential honey production (quantity of honey per hectare);
- Determination of the honey production (quantity of honey per hive).

Determination of the nectar secretion. The quantity of secreted nectar per flower was determined by the capillaries method. Extracting nectar from flowers was performed using glass capillary micropipettes, which were composed of three distinct parts, respectively: a capillary tube of 50 mm length which was ending with a capillary head having an inner diameter of 0.1 mm; two spherical bubbles forming an angle of 90^{o} and having an inner diameter of 4 mm; a suction head of 10 mm length having an inner diameter of 2 mm (Photo 1). On the suction head, there was placed a rubber tube of 50 cm length which was ending with a glass tube (Photo 2)

Photo 1. Glass capillary micropipette

Photo 2. Glass capillary micropipette with rubber tube and glass tube

Before using the glass capillary micropipettes, these were marked and weighted using an analytical balance, and were kept in closed boxes. For using the glass capillary micropipettes, the rubber tube was fixed on the suction head, the capillary head was placed into the rapeseed flower, and the glass tube ending the rubber tube was placed into the mouth and the nectar was aspired. The nectar was passing through the capillary tube and arrived into the first spherical bubble where it was collected.

The nectar was extracted from 10 rapeseed flowers which were mull isolated for 24 hours. After the nectar was extracted from the 10 analysed rapeseed flowers, the rubber tube was taken out from the suction head and the glass capillary micropipette was weighted using the analytical balance. The difference in weight between the glass capillary micropipette with nectar and its initial mass represents the nectar extracted from the rapeseed flowers. The quantity of nectar was expressed as mg nectar per flower.

The sugar concentration in nectar was determined by using a refract meter (portable refract meter OPTICA, 0-80 Brix). In this respect, the rubber tube was fixed again on the suction head of the glass capillary micropipettes with nectar, the glass tube ending the rubber tube was placed into the mouth and the nectar was blowing away on the refract meter blade. The two blades of the refract meter

were then closed and the nectar concentration in sugar was read on the refract meter scale (Photo 3).

Photo 3. Determination of the nectar concentration in sugar with refract meter

In 2009, for each rapeseed crop there were performed 20 nectar determinations, each determination consisting in 10 analysed rapeseed flowers. This meant that 200 rapeseed flowers were analysed for each rapeseed crop. The nectar determinations were repeated after one week.

In 2010, for each rapeseed crop there were performed 20 nectar determinations per day during 13 days, and each determination consisted of 10 analysed rapeseed flowers. This meant that a total number of 2,600 rapeseed flowers for each rapeseed crops were analysed.

In both years of determinations, the nectar was extracted between 8 a.m. and 12 a.m. when the rapeseed crop was in the full flowering stage (between 28 of April and 12 of May). Before the nectar determination, the rapeseed inflorescences were mull isolated 24 hours to avoid loses of nectar caused by insects. The quantity of nectar obtained in this manner was conventionally considered to be the quantity secreted within 24 hours.

Calculation of the potential honey production. The quantity of nectar and its sugar concentration are used for calculating the potential honey production per unit of surface. But, it is also necessary to determine the number of rapeseed flowers per plant and the number of plants per hectare. In this respect, parallel to nectar analysis, 20 plants of each rapeseed crop were analysed for determining the number of flowers per plant, as well as the average number of inflorescences per plant and the average number of flowers per inflorescence. Also, the number of plants per hectare was determined of each rapeseed crop studied to calculate the number of flowers per hectare.

The sugar production per flower was calculated from the quantity of nectar (in mg per flower) and its sugar concentration, this representing the quantity of sugar (in mg) per flower produced in 24 hours. By multiplying the quantity of sugar per flower with the average number of flowers per hectare, it was obtained the quantity of sugar produced per hectare by the rapeseed crop in 24 hours.

It was determined that a rapeseed flower was flowering for three days and knowing that the honey contains 80% sugar and 20% water, it was then calculated the potential honey production.

Determination of the honey production. In each analysed rapeseed crop there were bee hives and one hive with an average development of the bee family was put on a control balance. Each day during the flowering stage it was registered the hive weight in order to establish the quantity of honey produced by the bee family.

RESULTS AND DISCUSSIONS

Results obtained in 2009. In the analysed rapeseed crops from South Romania in 2009, the nectar secretion varied between 0.69 and 2.45 mg per flower, with an average value of 1.13 mg per flower. However, more often the nectar secretion varied between 0.7 and 1.2 mg per flower. The nectar concentration in sugar was in average 62.1%, with a variation between 38.2 and 72.8%. However, more often the nectar concentration in sugar varied between 66 and 73%. As it was expected, there was registered a negative correlation between nectar secretion and nectar concentration in sugar, respectively when the nectar secretion was high the nectar concentration in sugar was small and vice-versa (Fig. 1).

The honey production was determined by the nectar secretion and its concentration in sugar and by the biological characteristics of the rapeseed plants, which at their turn are determining the number of rapeseed flowers per surface unit and even the nectar secretion of the rapeseed flowers.

The plant high, one of the characteristics that can potentially affect the number of flowers per plant was in average of 128 cm in the analysed rapeseed crops, with variations between 89 and 148 cm (Table 1). But, the correlation of the average number of flowers per plant with plant high in the analysed rapeseed crops from South Romania in 2009 was not so good, which meant that the number of flowers per plant was less influenced by the plant high (Fig. 2).

The plant population is known to be one of the crop characteristics with a significant effect on the productive capacity of the crop, as well as on the number of flowers per plant and per surface unit (square metre). The plant population varied between 19 and 66.5 plants per square metre (Table 1). There was a significant negative correlation of the average number of flowers per plant with the average number of plants per square metre in the analysed rapeseed crops from South Romania in 2009. That meant the higher plant population the lesser number of flowers per plant is (Fig. 3). But, there is a positive correlation of the average number of flowers per square metre with the average number of plants per square metre up to 50-55 plants per square metre. After this threshold the average number of flowers per square metre starts to decrease (Fig. 4).

The average number of inflorescences per plant was of 4.7, with variations from 2.9 up to 7.9 (Table 1). There was a significant negative correlation of the average number of inflorescences per plant with the average number of plants per square metre in the analysed rapeseed crops from South Romania in 2009 (Fig. 5).

The average number of flowers per inflorescence was of 58.4, with variations between 54.1 up to 67.3 (Table 1). It is interesting to notice that there was a positive correlation of the average number of flowers per inflorescence with the average number of inflorescences per plant (Fig. 6). This means that when there are more inflorescences per plant, the number of flowers per inflorescence is higher. That can be explained by the fact that more inflorescences per plants means good growth and development conditions for the rapeseed plants which can develop more flowers per inflorescence.

The average number of flowers per plant was of 277, with variations between 157 and 532 (Table 1).

Up to 300-400 flowers per plant, the nectar secretion as mg per flower is increasing, but after this threshold the nectar secretion is decreasing (Fig. 7).

The potential honey production (the calculated honey production) varied between 195.9 and 331.7 kg per hectare, with an average value for the analysed rapeseed crops of 242.2 kg per hectare (Fig. 8).

The honey production per hive (control hive) varied from 6.3 up to 23 kg, with an average value of 17.2 kg (Fig. 8).

Table 1. Rapeseed plant characteristics in the analysed crops from South Romania in 2009

Place of analysed rapeseed crop	Plant high (cm)	Average number of plant per m^2	Average number of inflorescence per plant	Average number of flowers per inflorescence	Average number of flowers per plant
Bălănoia	121	53.5	3.6	58.3	210
Lehliu	139	29.5	5.9	56.0	330
Şoldanu	148	19.0	7.9	67.3	532
Nicolae Bălcescu	136	65.0	2.9	54.1	157
Naipu	142	45.0	4.3	56.5	243
Valea Bujorului	123	53.0	3.8	57.9	220
Coslogeni	89	52.0	4.3	55.5	239
Radomireşti	128	66.5	4.6	61.9	285
Average	*128*	*47.9*	*4,7*	*58.4*	*277*

Results obtained in 2010. In the analysed rapeseed crops from South Romania in 2010 the nectar secretion was determined every day during ten days. Each day the nectar secretion and the nectar concentration in sugar had different values, according to the climatic conditions and the progressing of the flowering process. This variation from day to day was registered in both rapeseed crops analysed in South Romania in 2010. As in 2009, there was registered a negative correlation between nectar secretion and nectar concentration in sugar, which meant that when the nectar secretion was high the nectar concentration in sugar was small and vice-versa (Fig. 9 and 10).

In the analysed rapeseed crops from South Romania in 2010 and during the ten days of analyses, the nectar secretion was in average 1.88 mg per flower, while the nectar concentration in sugar was in average 49.2%.

In the analysed crops in 2010, the average number of flowers per plant was of 265 and the potential honey production (the calculated honey production for the rapeseed crops) was in average of 324.8 kg per hectare.

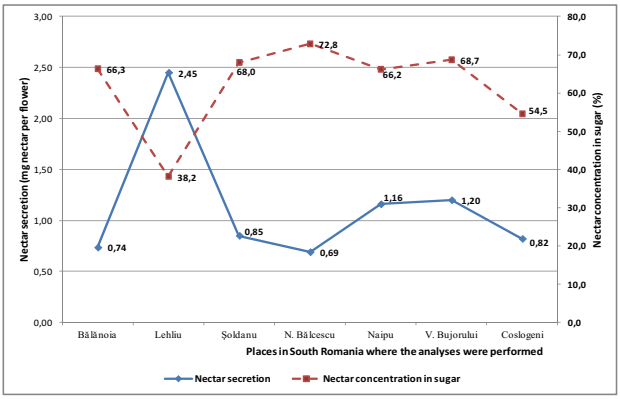

Fig. 1. Nectar secretion and its concentration in sugar in the analysed rapeseed crops from South Romania in 2009

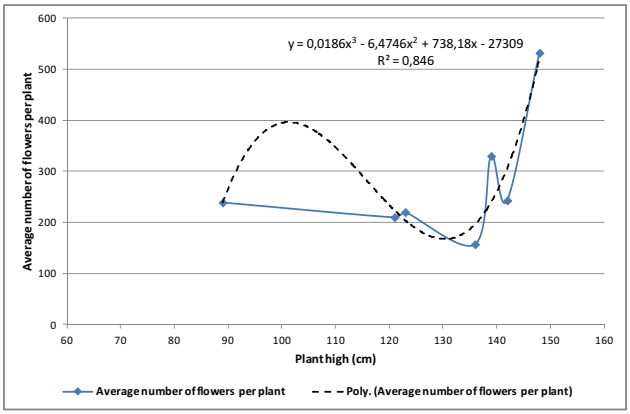

Fig. 2. Correlation of the average number of flowers per plant with the plant high in the analysed rapeseed crops from South Romania in 2009

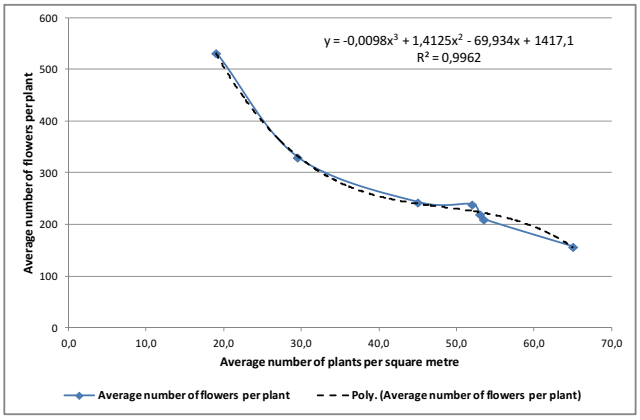

Fig. 3. Correlation of the average number of flowers per plant with the average number of plants per square metre in the analysed rapeseed crops from South Romania in 2009

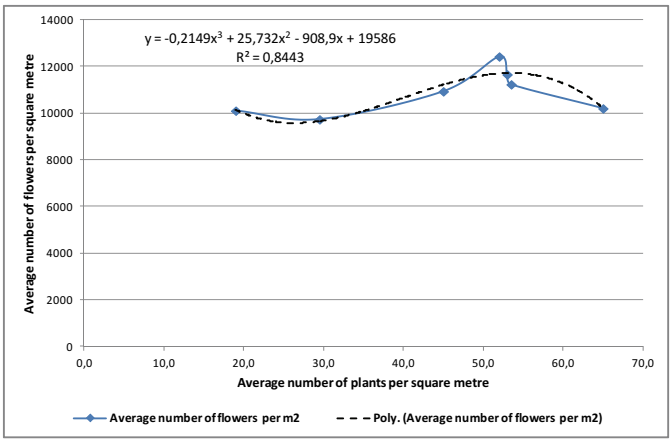

Fig. 4. Correlation of the average number of flowers per square metre with the average number of plants per square metre in the analysed rapeseed crops from South Romania in 2009

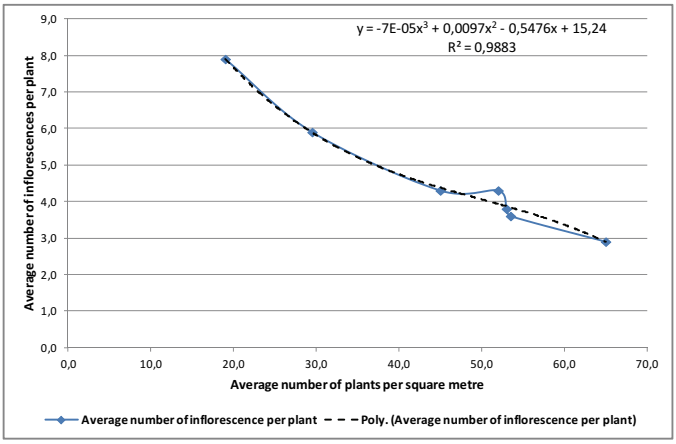

Fig. 5. Correlation of the average number of inflorescences per plant with the average number of plants per square metre in the analysed rapeseed crops from South Romania in 2009

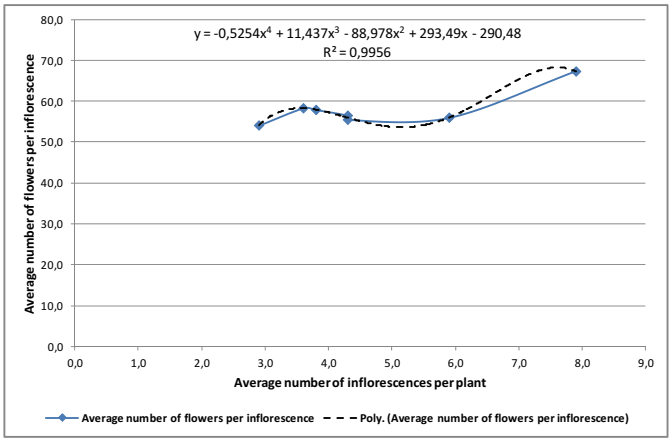

Fig. 6. Correlation of the average number of flowers per inflorescence with average number of inflorescences per plant in the analysed rapeseed crops from South Romania in 2009

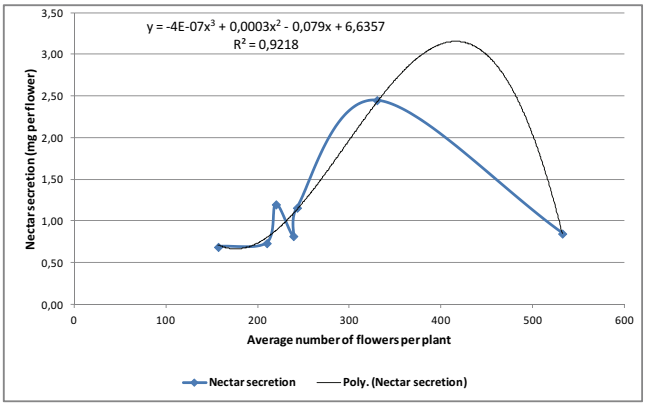

Fig. 7. Correlation of the nectar secretion with average number of flowers per plant in the analysed rapeseed crops from South Romania in 2009

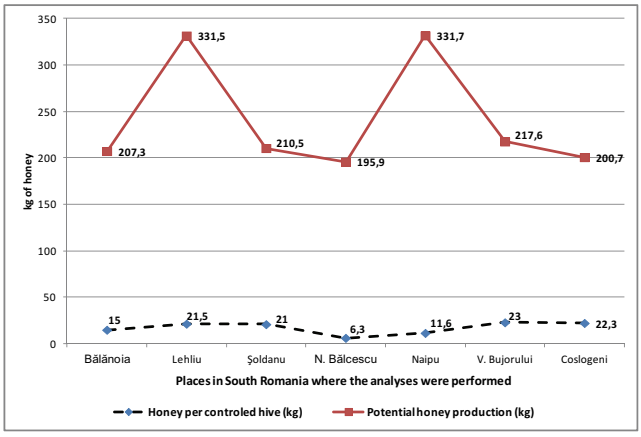

Fig. 8. The potential honey production and the honey production per hive in the analysed rapeseed crops from South Romania in 2009

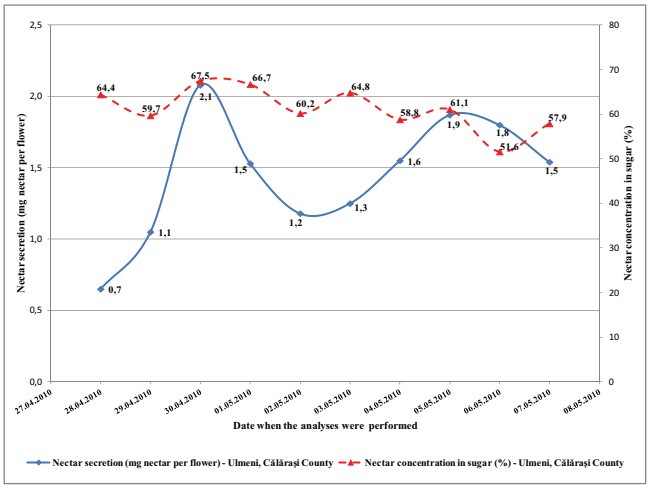

Fig. 9. The nectar secretion and the its concentration in sugar in the rapeseed crop from Ulmeni, Călăraşi County from South Romania in 2010

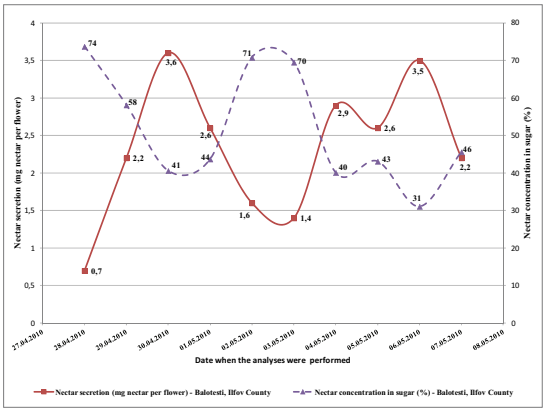

Fig. 10. The nectar secretion and its concentration in sugar in the rapeseed crop from Baloteşti, Ilfov County from South Romania in 2010

CONCLUSIONS

In the analysed rapeseed crops from South Romania in 2009, the nectar secretion was in average 1.13 mg per flower, with an average concentration in sugar of 62.1%. In 2010, the nectar secretion was in average 1.88 mg per flower, with an average concentration in sugar of 49.2%. In the analysed rapeseed crops from South Romania in 2009, there were identified the following correlations:

- the average number of flowers per plant was not so good correlated with plant high;
- the average number of flowers per plant was negatively correlated with the average number of plants per square metre;
- the average number of flowers per square metre was positively correlated with the average number of plants per square metre up to 50-55 plants per square metre; after this threshold the average number of flowers per square metre starts to decrease;
- the average number of inflorescences per plant was negatively correlated with the average number of plants per square metre;
- the average number of flowers per inflorescence was positively correlated with the average number of inflorescences per plant;
- the nectar secretion was increasing up to 300-400 flowers per plant, but after this threshold the nectar secretion was decreasing;
- the nectar secretion was negatively correlated with the sugar concentration in nectar.

The potential honey production (the calculated honey production) in the analysed rapeseed crops from South Romania in 2009 was in average 242.2 kg per hectare, while in 2010 was in average 324.8 kg per hectare.

The honey production per hive (control hive) in the analysed rapeseed crops from South Romania in 2009 was in average 17.2 kg.

The data registered in the analysed rapeseed crops from South Romania in 2010 showed that the nectar secretion and the sugar concentration in nectar are varying in time from one day to another, according to the climatic conditions and the progressing of the flowering process.

ACKNOWLEDGEMENTS

This research work was carried out with financial support provided by the Romanian PNII Program - Partnerships for Priority Domains, under the Contract no 52-119/2008 between National Centre for Programs Management and Beekeeping Research and Development Institute of Bucharest.

REFERENCES

[1] Mesquida, J., Marilleau, R., Pham-Delegue M.H., , Renard, M., 1988. *A study of rapeseed (Brassica napus L. var. oleifera Metzger) flower nectar secretions*. Apidologie, 19 (3), 307-318.

[2] Bommarco, R., Marini, L., Vaissière, B.E., 2012. *Insect pollination enhances seed yield, quality, and market value in oilseed rape*. Oecologia DOI 10.1007/s00442-012-2271-6, Springer-Verlag.