Results concerning the melliferous characteristics of the sunflower hybrids cultivated in Romania

Nicoleta ION*, Victor ŞTEFAN, Viorel ION**, Grigore FOTA*, Răzvan COMAN***

* Apiculture Research and Development Institute of Bucharest, Romania
** University of Agronomical Sciences and Veterinary Medicine of Bucharest, Romania

In Romania, the sunflower is the most important melliferous plant among the field crops. The sunflower cultivated area in Romania had an increasing trend in the last decade, this being one of the crops which attracted a great interest from farmers. In the same time with a great interest from the farmer, the beekeepers became also very interested about sunflower, and that is because the sunflower represents the most important melliferous crops even by the period and duration of flowering or by the large number of flowers and nectar secretion. The nectar produced by the sunflower flowers are gathered with great interest by bees insuring important honey productions.

The beekeepers are mainly interested in the specific melliferous characteristics of sunflower hybrids. This is very much due to the fact that the hybrids assortment admitted to be cultivated in Romania increased very much in the last years by breeding new sunflower hybrids, and also by cultivating some new hybrids from abroad.

The present paper presents the melliferous characteristics of thirty three sunflower hybrids studied in the period 2002-2006 in South Romania. In order to evaluate the quantity of sugar per hectare and further the potential yield of honey per hectare, the nectar secretion (capillaries method), the sugar concentration of the nectar (refractometer method), the number of flowers per head and the number of plants per hectare were determined during field studies.

Material and method

The studies on the melliferous potential in sunflower hybrids were made during the experiments on sunflower carried out in 2004 and 2006, on a brown reddish soil, located 15 km North-East from Bucharest, within the field trial belonging to the Agriculture Faculty, Bucharest University of Agronomic Sciences and Veterinary Medicine.

A number of 33 sunflower hybrids were studied, 13 of them being Romanian hybrids (Festiv, Florom 350, Alex, Romina, Performer, Turbo, Favorit, Justin, Splendor, Trajano, Hercule, Felix, Select) and 20 being foreign hybrids (Melody, Sunko, Sanay, Kasol, NK Dolbi, NK Ferti, NK Armoni, Opera PR, Rigasol, Huracan, Podium, Fleuret OR, Rigasol, OR, Mateol, Lindor, Fly, Arena, Alexandra, Masai, Saxo).

The nectar secretion was determined using the capillaries method, which is one of the direct methods. This method is often used in researches, being an operative and adequately accurate one, compared to other direct methods. At the same time it enabled us to analyze the nectar both quantitatively (mg/flower), and qualitatively (sugar %), without tearing off the flowers from the plant.

The nectar was extracted by means of a capillary (figure 2), initially weighted on an analytical balance (fig. 1). After extracting the nectar from a certain number of flowers (in sunflower the nectar is extracted from 50 flowers), the capillary was again weighted, and by deduction we obtained the quantity of nectar (in mg/flower), which was then divided by the number of flowers used for the extraction. The result revealed the quantity, in mg, of nectar produced by a single flower. Then, by means of a refractometer we were able to determine the concentration of nectar in sugar (figure 3).

In order to find the nectar secretion in flowers to be analyzed we placed gauze covered over the head flowers 24 hours before the analysis.

The quantity of nectar obtained in this manner was conventionally considered to be the quantity secreted within 24 hours. To find out the nectar secretion in a sunflower flower, the quantity of nectar produced per flower, in one determination, multiplies by 3 (3 representing the number of flowering days of a fertile flower).

Figure 1. Weighting the capillaries used for nectar extraction

Figure 2. Nectar extraction in sunflower by means of a capillary

Figure 3. Determination of sugar concentration using a refrectometer

The quantity of nectar and its sugar concentration helped us calculate the honey production per surface unit. Thus, while carrying out the nectar analysis, we calculated the number of flower/head for each hybrid. Then, knowing the number of plants per surface unit, we managed to determine the number of flowers per ha.

The sugar production per ha was estimated according to the following formula:

$$Z = z \times n \times d / 1000000$$

where: Z = sugar production per ha;
z = sugar production in mg per flower;
n = number of flowers per ha;
d = flowering duration, in days, of a single flower.

The sugar production per flower was estimated by multiplying the quantity of nectar (in mg/flower) with its sugar concentration. Hence, the glucidic index was calculated, this representing the quantity of sugar (in mg) per flower in 24 hours. The glucidic index is a parameter specific to each plant species, and to each variety/hybrid within the species. For this reason, it is a useful element in comparing various species and cultivars for their value as melliferous sources.

The estimated honey production/ha represents the potential quantity of honey theoretically obtained per ha of crops during a season, in an analyzed species. The following formula was used for the estimation of honey production in sunflower hybrids:

$$M = Z \times 1.25$$

where: M = honey production per ha, in kg;
Z = sugar production per ha;
1.25 = coefficient of sugar transformation in honey

The field determinations and observations aimed also at determining the frequency of pollinators' visits per sunflower head, as well as the duration of these visits, thus determining the attractiveness index for each hybrid (the result of multiplication between the frequency of visits and the average duration of a visit). The frequency of visits was estimated by counting the honeybees and other spontaneous pollinating insects that visited the flower heads in a given period, namely 5 minutes. For each insect visiting the head flowers we estimated the average duration of the visit in seconds. Each observation was carried out, four times, on groups of 4 neighboring head flowers.

We have also calculated the percentage of self-pollination in the studied sunflower hybrids. Therefore, 5 head flowers in each experimental plot were isolated with a gauze cover before opening, deterring any possibility of fertilization with pollen carried by insects. At maturity, the isolated head flowers in each plot were harvested separately, thus, determining the average number of fertile achenes (with seeds) per head flower. From each experimental plot we harvested 5 head flowers freely pollinated and calculated the average number of fertile pops per head flower.

The percentage of self pollination was estimated according to the following formula:

$$\text{Self-pollination} = \frac{\text{average no of fertile achenes per isolated head flower}}{\text{average no of fertile achenes per freely pollinated head flower}} x100 \quad (\%)$$

We have also estimated the length and diameter of the corolla tube for each hybrid.

Results and discussions

The nectar secretion estimated for the 33 sunflower hybrids averaged 0.22 mg/flower, with margins of variation ranging from 0.11 mg/flower (Saxo hybrid) to 0.37 mg/flower (Favorit hybrid). The best values of nectar secretion, exceeding 0,3 mg/flower, were recorded in Favorit, Hercule and Sunko hybrids (figure 4).

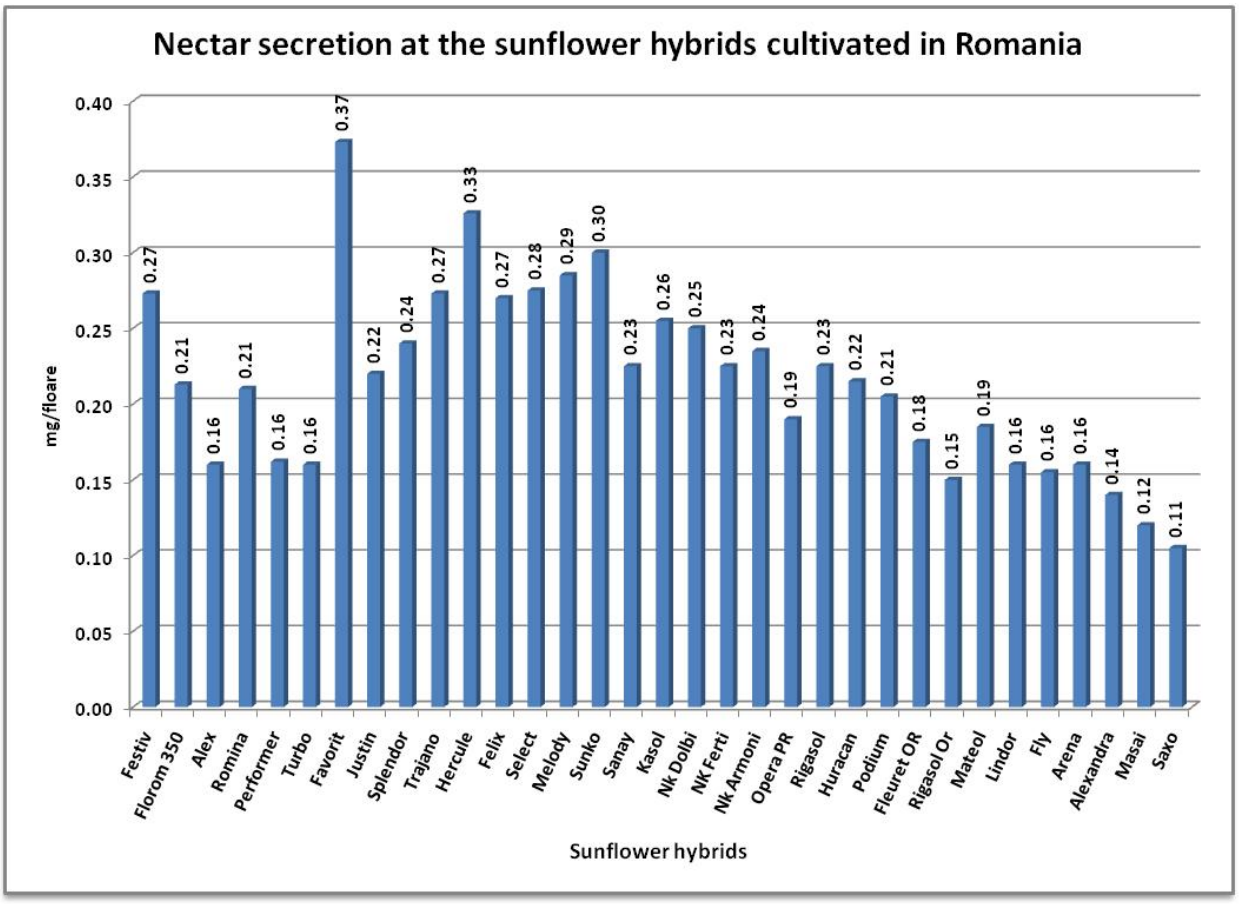

Figure 4. Nectar secretion in sunflower hybrids cultivated in Romania

Honeybees efficiently collect the nectar with a sugar content varying from 50 to 55%. When in need, they also collect the nectar with a sugar content bellow 15%, and never collect the nectar with a sugar content bellow 5%, because, the more the nectar is diluted the more energy the honeybees consume to evaporate the water surplus. Honeybees are inefficient in collecting the too concentrated nectar (with a sugar content exceeding 85%), as they must dilute it with their saliva, a process requiring a high exhaustion of their body.

In the studied sunflower hybrids, sugar content ranged from 55.5% (Festiv hybrid) to 69.3% (Alex hybrid), with an average value of 65.5% (figure 5).

The glucidic index in sunflower hybrids ranged from 0.07 mg/flower (Saxo hybrid) to 0.25 mg/flower (Favorit hybrid). Values exceeding 0.2 mg/flower were recorded only in two hybrids, namely Favorit and Hercule, and values bellow 0.1 mg/flower were recorded in three hybrids: Alexandra, Nasai and Saxo. For the most sunflower hybrids, the glucidic index varied from 0.1 to 0.2 mg/flower (figure 6).

In figure 7 we see that the glucidic index is correlated to the honey production. The glucidic index is the determining factor for honey yield, meaning that the hybrid with the lowest glucidic index has the lowest honey production (Saxo hybrid), and the hybrid with the highest glucidic index results in the greatest honey production (Favorit).

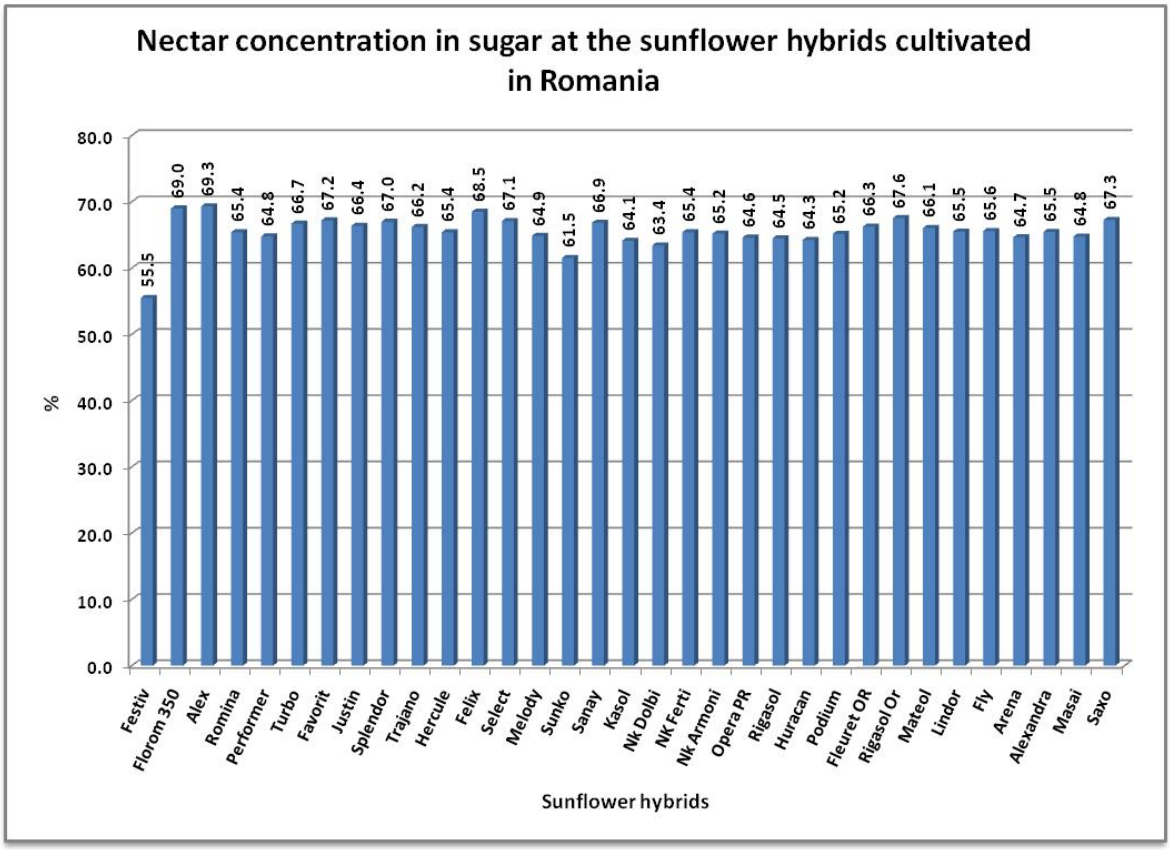

Figure 5. Nectar concentration in sugar in sunflower hybrids cultivated in Romania

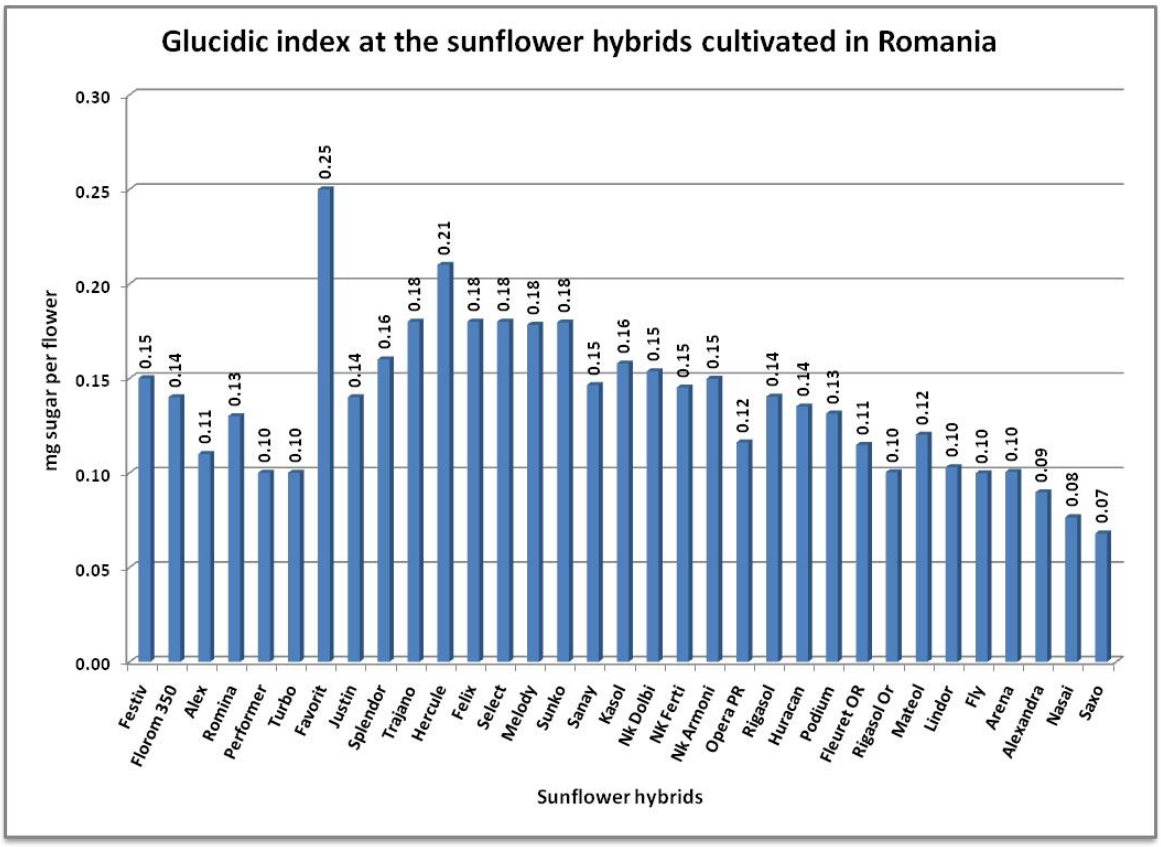

Figure 6. Glucidic index in sunflower hybrids cultivated in Romania

In figure 7 we also notice that there are other factors influencing the estimation of honey production. Thus, in the hybrids Romina, Performer and Turbo honey production is not directly related the glucidic index, meaning that, although the Romina hybrid had a glucidic index greater than Performer and Turbo, the honey production in Romina was lower than that of the other two hybrids, yet honey production calculated in Performer was much lower than the honey production in Turbo.

Honey production ranged from 6.1 kg/ha (Saxo) to 24 kg/ha (Favorit), with an average value 12.1 kg/ha for all the 33 studied hybrids. In most hybrids, honey production ranged from 9 to 17 kg/ha.

As the figure 8 presents, in the studied hybrids honey production does not depend on the self pollination percentage. This aspect comes to support the idea according to which the pressure of selection over a high self fertility does not lead to a decrease in nectar secretion, which would become useless in attracting the insects in *Helianthus annuus* crops.

The percentage of self fertility ranged from 36% (Romina) to 94% (Huracan and NK Armoni), with an average of 73% for all the 33 studied hybrids. This leads to the conclusion that the presence of honeybees is not necessarily in the pollination of some sunflower hybrids (e.g. Alexandra, Huracan and NK Armoni), while for other hybrids honeybees must be present in order to perform pollination and to insure increased seed production. Thus, sunflower breeders must take into account the necessity to bring the haves with honeybees for the pollination of sunflower hybrids as: Alex, Felix, Kasol, Arena, Splendor, Select, Hercule, Lindor and Fleuret OR, and the presence of honeybees is compulsory in the case of Favorit, Festiv and Romina hybrids.

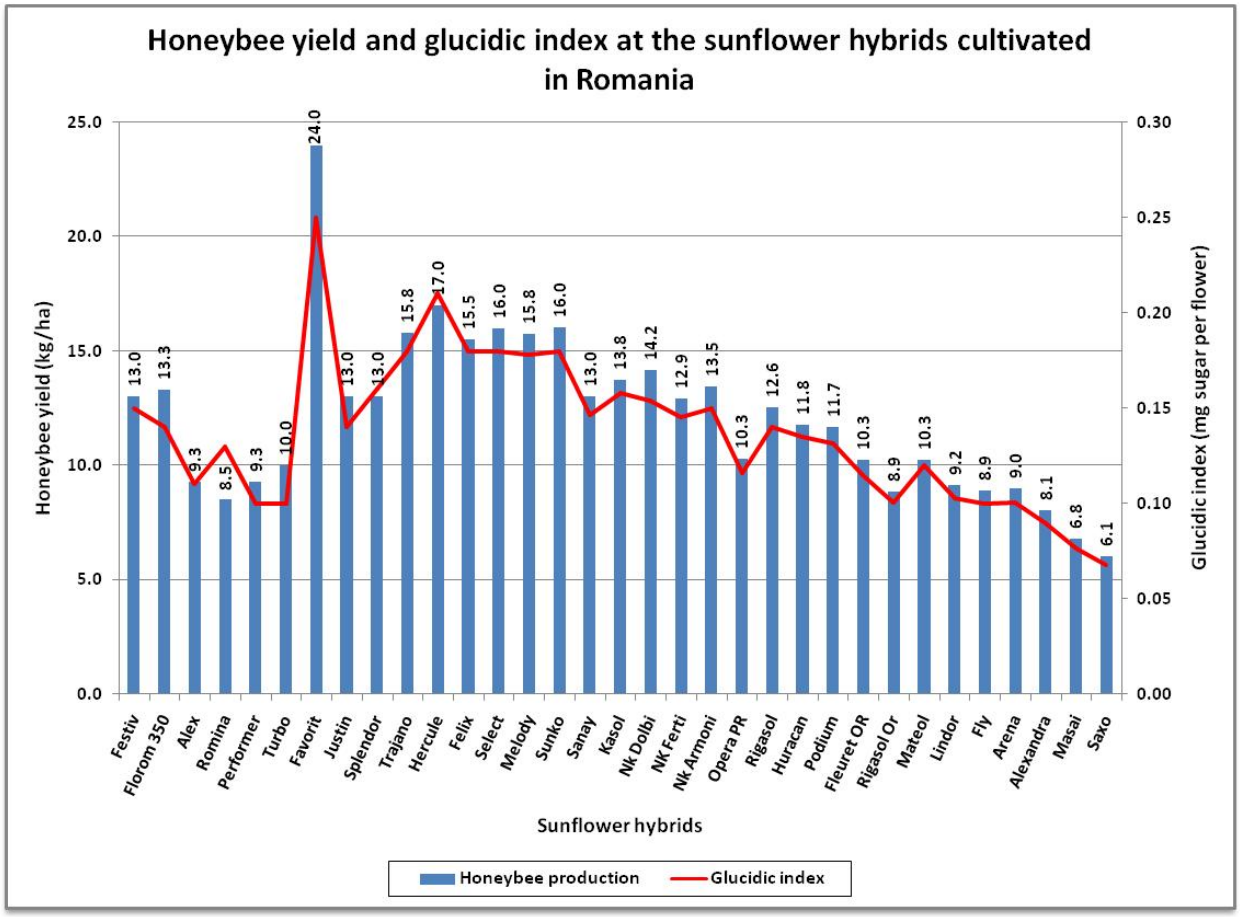

Figure 7. Honey yield and glucidic index in sunflower hybrids cultivated in Romania

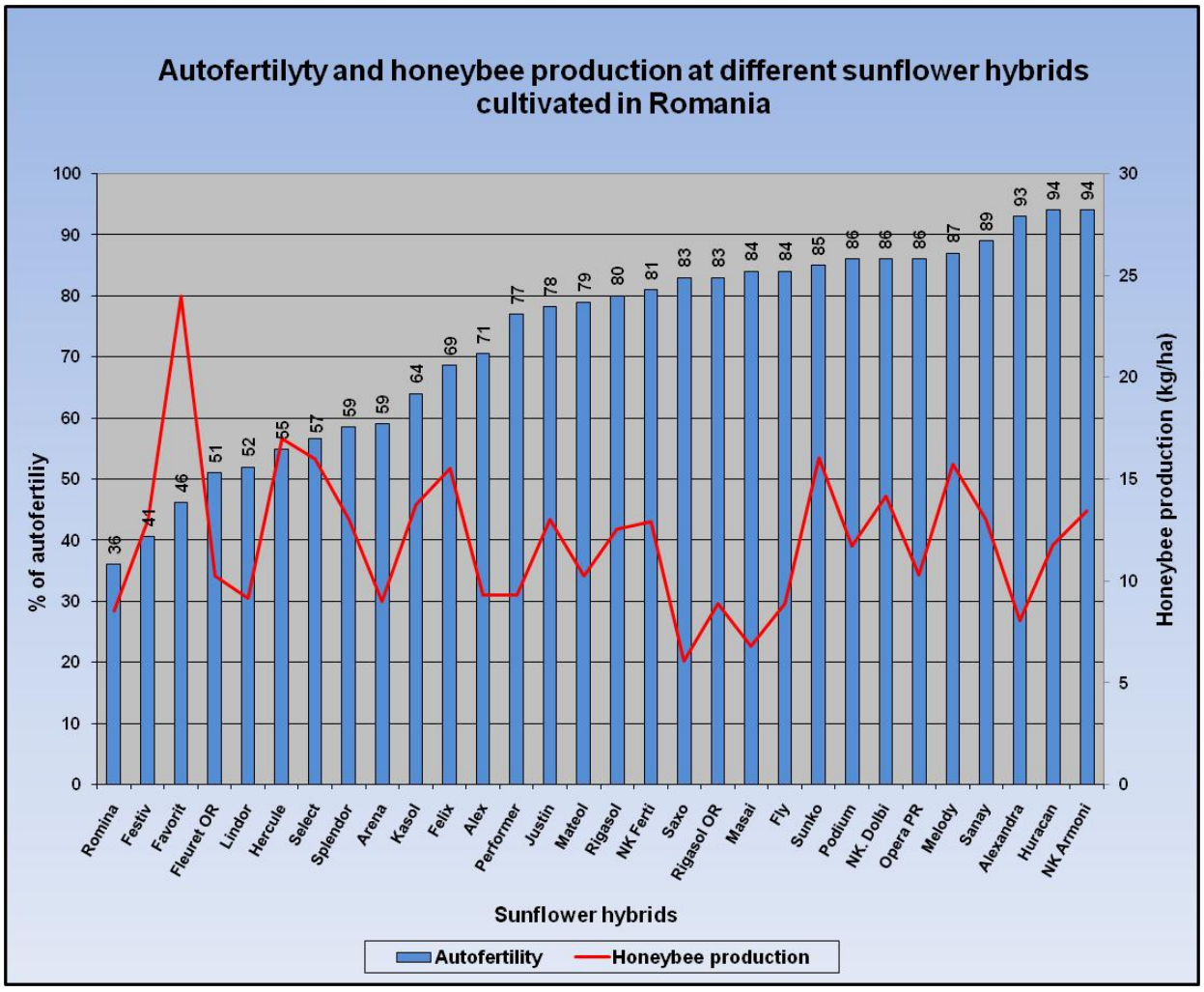

Figure 8. Self fertility and honey production in some sunflower hybrids cultivated in Romania

The insects visiting the head flowers of sunflower plants were mainly honeybees and insects from the spontaneous entomofauna represented by Lepidoptera (butterflies), diptera (flies), hymenoptera (hornets, feral bees), heteroptera (flats). The honeybees participation in the pollination process reached 78.6%, while the insects from the spontaneous entomofauna participated in a proportion of 18.2%. Among these insects, the presence of bumble bees in the pollination process was the greatest (3%), followed by butterflies of various species (3.4%). We should mention that, generally, during these observations there was no record of banishment or competition between honeybees and spontaneous pollinating insects.

The melliferous potential is also influenced by the accessibility of honeybee to nectaries, and this accessibility depends in turn on the length of the corolla tube, meaning the depth to which the nectaries are placed in comparison to the honeybee tongue. As it regards the studied sunflower hybrids, the length of the corolla tube ranged from 5.1 to 6.3 mm, not exceeding the length of the honeybee tongue, which ranges from 6.02 to 6.61 mm (figure 9).

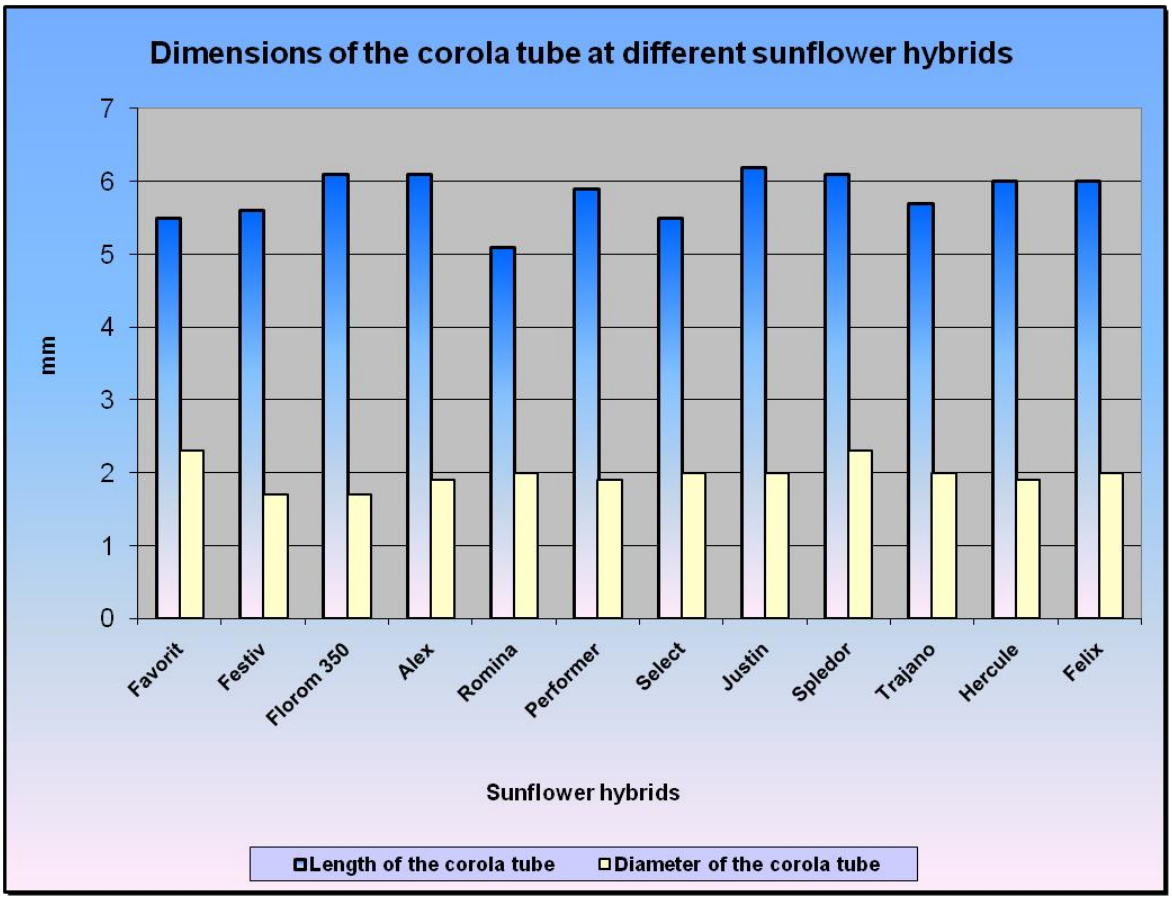

Figure 9. Dimensions of the corolla tube in sunflower hybrids cultivated in Romania

Conclusions

1. Nectar secretion in the 33 studied sunflower hybrids averaged 0.22 mg/flower, with margins of variation from 0.11 mg/flower (Saxo) to 0.37 mg/flower (Favorit).
2. Sugar content ranged between 55.5% in Festiv hybrid and 69.3% in Alex, with an average value of 65.5%;
3. The glucidic index in the studied sunflower hybrids varied between 0.07 mg/flower (Saxo) up to 0.25 mg/flower (Favorit). For most of the sunflower hybrids, the glucidic index ranged from 0.1 to 0.2 mg/flower.
4. The glucidic index is the determinant factor of honey yield.
5. Honey production varied between 6.1 kg/ha (Saxo) and 24 kg/ha (Favorit), with an average value for all 33 studied hybrids of 12.1 kg/ha.
6. In most studied hybrids, honey production ranged from 9 to 17 kg/ha.
7. Honey production does not depend on the self fertility.
8. The self fertility percentage ranged from 36% (Romina) to 94% (Huracan and NK Armoni), with an average value for the 33 studied hybrids of 73%.
9. Sunflower breeders must insure the presence of honeybees to perform the pollination of sunflower hybrids Alex, Felix, Kasol, Arena, Splendor, Select,Hercule, Lindor and Fleuret OR, their presence being compulsory when it comes to Favorit, Festiv and Romina.
10. The length of the corolla tube for the studied hybrids varied between 5.1 and 6.3 mm, not exceeding the length of honeybee tongue, which ranges from 6.02 to 6.61 mm.

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