Melliferous Characteristics of Sunflower with Importance for Pastoral Beekeeping

Viorel ION*, Nicoleta ION**, Victor □TEFAN*,
Răzvan COMAN**, Grigore FOTA**

*University of Agronomic Sciences and Veterinary Medicine of Bucharest
59 Mărăşti Blvd, 011464, Bucharest-1, Romania; Email: viorelion@agro-bucuresti.ro
**Beekeeping Research and Development Institute of Bucharest
42 Ficusului Blvd, 011464, Bucharest-1, Romania; Email: ionnicoleta2006@yahoo.com

Abstract

In the present paper, there is presented a synthesis of the experimental data obtained though different research projects in the period 2002-2009 with respect to the melliferous characteristics of the sunflower crop that should be known by the beekeepers practicing the pastoral beekeeping. Thus, there are presented the following: the period and duration of flowering process at different sunflower hybrids; the potential honey yield at different sunflower hybrids; the climatic conditions (rainfall and temperature) that affect the melliferous potential and their effect; self-fertility and its relationship with honey production; the gain in seed yield obtained through pollination by the help of melliferous bees.

Keywords: *Sunflower; Melliferous characteristics; Pastoral beekeeping.*

INTRODUCTION

The beekeepers practicing the pastoral with their beehives at sunflower crops has to know which are the melliferous characteristics of the sunflower hybrids, respectively the period and duration of the flowering process, as well as the potential honey yield, all these to be sure they will get a high honey yield.

The sunflower crop is the most important oilseed plant in Romania, ranging the third place as cultivated area, after maize and wheat. The important surfaces cultivated with sunflower and the melliferous characteristics of this plant put the sunflower among the most important melliferous crop, ensuring the last great honey production before winter [1].

The importance of sunflower as melliferous plant results both from the period and duration of flowering [3], as well as from the large number of flowers per unit of area, but also from the great nectar secretion. Unfortunately, the melliferous characteristics of sunflower are affected by the climate conditions [4], fact ascertained by beekeepers over great variations in time and space of honey productions. The beekeepers are interested in the specific melliferous characteristics of the sunflower hybrids, because the hybrids assortment admitted to be cultivated in Romania is diversifying very much in the last years by cultivating some new hybrids, which are less known or even unknown with respect to their melliferous potential [2].

MATERIAL AND METHOD

In the period 2002-2008, there were carried out researches in field experiments for studying 40 sunflower hybrids, among which 20 Romanian hybrids which were studied in the period 2002-2004 (Favorit, Festiv, Florina, Jupiter, Alcazar, Top 75, Venus, Alex, Saturn, Minunea, HS 2442, HS 2606, Milenium, Romina, Performer, Select, Justin, Splendor, Hercule, Felix) and 20 foreign hybrids which were studied in the period 2005-2008 (Huracan, Kasol, Lindor, Masai, Mateol, Podium, Saxo, Sunko, Fly, Rigasol, Rigasol OR, Fleuret OR, Arena, Melody, NK Armoni, Alexandra, NK Dolbi, NK Ferti, Opera PR, Sanay).

The experiments were located on a reddish preluvosoil located 15 km faraway Northeastern from Bucharest, within the experimental farm Moara Domnească (Royal Mill) belonging to the University of Agronomic Sciences and Veterinary Medicine of Bucharest.

To the studied sunflower hybrids, determinations were performed in view to establish the flowering period and duration of this stage, the nectar secretion and sugar nectar concentration in view to calculate the potential honey yield, as well as the number of seeds per sunflower head isolated from insects and number of seeds per sunflower head free-pollinated in view to calculate the degree of self-pollination and to establish if there is a correlation between the self-pollination and the melliferous potential. Also, there were performed yield determinations in view to calculate the seed yield obtained under pollination conditions and the gain in seed yield through pollination (compared to the yield obtained under self-pollination conditions).

For establishing the period and duration of flowering process, the flowered heads were counted every two days. Thus, it was established the moment when the first sunflower heads flowered, the starting moment of the flowering process within the crop, i.e. the moment when 10% of the heads were flowered. Also, it was established the moment when 10% of the heads were still in flower within the crop (10% of the heads still had flowers), and the moment when all the heads within the crop finished the flowering process, respectively.

In view to calculate the honey yield, the nectar secretion was determined using the capillaries method, and by means of a refractometer the nectar concentration in sugar was determined.

In the year 2009, researches were carried out in Giurgiu County in view to establish the daily gain in honeybee within the beehive by daily weighting the beehive.

In view to identify and quantify the influence of the climatic factors on the melliferous characteristics of the sunflower hybrids, data regarding the melliferous potential at the sunflower hybrids cultivated in Romania were collected, analyzed and interpreted. In this respect, there were used the database belonging to the Melliferous Resources Laboratory – Beekeeping Research and Development Institute of Bucharest and the experimental data obtained during the period 2002-2008 by the researchers from Faculty of Agriculture, University of Agronomic Sciences and Veterinary Medicine of Bucharest in collaboration with the researchers from Beekeeping Research and Development Institute of Bucharest. Also, the climatic data starting from 1960 were collected, analyzed and correlated with the melliferous data of the sunflower varieties and hybrids. Also, and for the researches carried out in the field, the climatic data were registered by the help of an automatic weather station.

In view to identify the influence of the climatic factors during the years for the same sunflower hybrids, the melliferous potential was studied for 4 sunflower hybrids (Fleoret OR, Melodi, Sunko and Arena), cultivated in 2007 and 2008 in different periods of the year (the hybrids were sown at different dates), namely: in 2007: 1st period – 27 of March; 2nd period – 6 of April; 3rd period – 18 of April; 4th Period – 12 of May; 5th Period – 2 of June; in 2008: 1st period – 30 of March; 2nd period – 11 of April; 3rd period – 21 of April; 4th Period – 07 of May; 5th Period – 27 of May.

RESULTS AND DISCUSSION

The beekeepers interested to go in pastoral with their beehives to the sunflower crops should know the period and duration of flowering process at different sunflower hybrids. Thus, in South Romania the flowering process at sunflower crop can be characterised by the following aspects (table no 1):

- The beginning of flowering process is recorded in the second part of June, respectively from 18th of June to 1st of July.
- The end of flowering process, respectively the moment when no sunflower heads are in flower in the whole crop, is recorded between 6th and 20th of July.
- A period of 1-6 days is necessary between the occurrence of the first flowered heads in the crop and the beginning of the flowering process, considered to be the moment when 10% of the sunflower heads are in flower; in this moment the beekeeper has to have his beehives at the sunflower crop, thus the bees to gather the nectar secreted by the sunflower flowers and produce a high quantity of honey.
- The period between the moment when 10% of the sunflower heads have flowered and the moment when only 10% of sunflower heads are still in flower, which is the period of actual intense nectar gathering by the melliferous bees, is from 10 to 20 days.
- The flowering period of the whole crop, respectively the period from the first flowered heads occurred in the crop to the end of the flowering process when no sunflower heads are in flower in the whole crop, ranges between 12 and 30 days.

The period and duration of flowering process is according to the sunflower hybrid but also these are influenced by the climatic conditions. In this respect, the beekeepers have to pay attention to the fact that the flowering period is earlier with 5-6 days in the drought years, while the flowering duration is longer because of the irregular development of sunflower plants.

At the forty studied sunflower hybrids in the period 2002-2008, the potential honey yield varied as average values between 6 and 83.5 kg per hectare (table no 2), but in some isolate determinations there were obtained values up to 115 kg per hectare.

The melliferous potential is according to the cultivated hybrid, but also to the climatic conditions. Under the climate conditions of 2007, the potential honey yield in sunflower hybrids, which were studied over different sowing periods, ranged between 13,6 kg/ha (in Fleuret OR hybrid) and 52,6 kg/ha (in Melody hybrid) (table no 3). Under the climate conditions of 2008, the potential honey yield in the same sunflower hybrids as in 2007, which were studied over different sowing periods, ranged between 35,2 kg/ha (in Fleuret OR hybrid) and 74,7 kg/ha (in Melody hybrid) (table no 4).

In view to benefit at maximum about the melliferous potential of the sunflower crop, the beekeepers hves to bring their beehives at the sunflower crops by the flowering of the first sunflower heads and not to overcome the moment when 10% of the heads are in flower, because otherwise there will be registered significant looses in honey yield (figure no 1).

The climatic conditions affect the melliferous potential from one year to another, but also within the same year if the sunflower hybrid is cultivated at different sowing moments.

As climatic factor, the rainfall is one of the most important. Water deficit diminishes nectar secretion and increases its sugar content, while water supply improves nectar secretion, and decreases the sugar content. Potential honey yield is firstly determined by the quantity of secreted nectar and then by the nectar sugar content, this two nectar characteristics been negative correlated (figure no 2). This means that in drought years the nectar secretion will be decreased and the honey production will be diminished.

The rainfall has a significant influence on the nectar secretion and nectar concentration in sugar at sunflower. By analyzing the melliferous data and the climatic conditions over time, it was observed that rainfall of 300-400 mm from January to the flowering moment, and rainfall of 200-300 mm along the vegetation period of sunflower up to the flowering moment, have determined an increased honey yield.

Also, the rainfall in the period of sunflower flowering has a positive influence on the honey yield. Of course, if the flowering process is overlapping a period with lots of rains, the melliferous bees will not collect the nectar because they are clogged to fly, and the high potential honey yield will not be valorized by the bees.

The soil water reserve accumulated during winter from the snowfall and rainfall can lead to a relatively good potential honey yield if the sunflower is sowing in the optimum sowing period.

Temperature represents also one of the climatic factors with a significant influence on the nectar secretion and nectar concentration in sugar at sunflower. By analyzing the melliferous data and the climatic conditions over time, it was observed that daily average temperatures less than 19^{o}C for the period 1st of May – 15th of July and less than 20.5^{o}C for the period 1st of June – 15th of July decreased the honey yield. Also, it was observed that a high temperature during the flowering process determines a decreasing of the honey yield.

The percentage of self-pollination (auto-fertility) at the studied sunflower hybrids in the period 2002-2008 registered a wide variation, ranging from 18% to 98%, but not at all been correlated with the nectar secretion, respectively the potential honey production (table no 2; figure no 3).

The gain in seed yield obtained through pollination at different sunflower hybrids ranges from 70 to 910 kg seeds per hectare. This gain of yielding should be a very serious reason for the farmers growing sunflower to collaborate with beekeepers and to be interested to have beehives at their crops for assuring the sunflower plants pollination (table no 2).

CONCLUSIONS

1. Period and duration of flowering process at sunflower is different according to the sunflower hybrid, but also according to the climatic conditions.
2. Flowering period is earlier with 5-6 days in drought years, while the flowering duration is longer because of the irregular development of sunflower plants.
3. Melliferous potential at sunflower is determined by the cultivated hybrid, been significantly influenced by the climatic conditions (rainfall and temperature).
4. Good water status of sunflower plants determined by rainfalls and water status of the soil has a positive influence on the nectar secretion and honey yield that could be potentially obtained at a sunflower hybrid.
5. Water deficit diminishes the nectar secretion and increases its sugar content, this leading to the decreasing of honey yield.
6. A period with lots of rains that overlapping the flowering process diminishes the honey yield because the melliferous bees will not collect the nectar, they been clogged to fly.
7. High temperature during the flowering process has a negative influence on the honey yield.
8. Honey yield at sunflower crops does not depend on the hybrid self-pollination percentage, these two characteristics been not correlated.
9. The presence of bees in the sunflower crops determines a gain in seed yield obtained through pollination ranging from 70 to 910 kg seeds per hectare, according to the hybrid, which should be of great interest for the farmers to collaborate with beekeepers.

ACKNOWLEDGEMENTS

The researches carried out for the elaboration of the present paper were financed through the following contacts:

- Contract nr. 102/2001 between AGRAL Program and Beekeeping Research and Development Institute of Bucharest.

- Contract no 106/2005 between Managerial Agency for Scientific Research, Innovation and Technological Transfer – POLITEHNICA Bucharest and University of Agronomic Sciences and Veterinary Medicine of Bucharest – Faculty of Agriculture, in the frame of Romanian CEEX Program.
- Contract no 52-119/2008 between National Centre for Programs Management (CNMP) and Beekeeping Research and Development Institute of Bucharest, in the frame of Romanian PNII Program - Partnerships for Priority Domains.

REFERENCES

1. Ion Nicoleta, Gh.V. Roman , V. Ion, R. Coman (2004). Outcomes related to the melliferous characteristics of sunflower hybrids cultivated in Romania. Danube Delta II – Natural Sciences Studies and Research and Muzeologie. Ed NereaMia Napocae, Tulcea (pp. 93-98).
2. Ion Nicoleta, V. Ştefan, V. Ion, G. Fota, R. Coman (2007). Results concerning the melliferous characteristics of the sunflower hybrids cultivated in Romania. Scientific Papers, vol. 40 (2), Faculty of Animal Sciences and Biotechnologies Timişoara, Editura AGROPRINT Timişoara (pp. 80-90).
3. Ion V., V. Ştefan, Nicoleta Ion (2007). Results on the flowering stage in the Romanian-grown sunflower hybrids. Scientific Papers, vol. 40 (2), Faculty of Animal Sciences and Biotechnologies Timişoara, Editura AGROPRINT Timişoara (pp. 91-100).
4. Ion V., Nicoleta Ion, V. Ştefan, G. Fota, R. Coman (2008). Influence of the climatic factors on the melliferous characteristics of the sunflower hybrids. Scientific Conference „Durable agriculture in the context of environmental changes", „Ion Ionescu de la Brad" Iaşi University of Agricultural Sciences and Veterinary Medicine – Faculty of Agriculture, Volume 51, Serie Agronomy.

Table no 1

Data regarding the flowering process at some sunflower hybrids studied at Research Farm *Royal Mill* belonging to the USAMV Bucharest
(Average values and limits of variation)

Nr. crt.	Sunflower hybrid	Years when the sunflower hybrids were studied	First heads flowering	10% of heads flowered (beginning of flowering process)	10% of heads still in flower	End of flowering process (no any flowered heads)	No of days from the stage 10% of heads flowered to the stage 10% of heads still in flower	No of days from the first calitides flowering to the end of flowering process
1.	Favorit	2002 2003 2004	30 June	01 July	13 July	15 July	13	16
2.	Performer		01 July	02 July	14 July	17 July	13	17
3.	Florina		30 June	01 July	13 July	15 July	13	16
4.	Jupiter		26 June	27 June	06 July	07 July	10	12
5.	Alcazar		29 June	30 June	10 July	11 July	11	13
6.	Top 75		28 June	29 June	10 July	11 July	12	14
7.	Venus		25 June	26 June	05 July	06 July	10	12
8.	Splendor		28 June	29 June	11 July	13 July	13	16
9.	Felix		30 June	01 July	10 July	11 July	10	12
10.	Justin		01 July	02 July	13 July	15 July	12	15
11.	Select		27 June	28 June	11 July	14 July	14	18
12.	Alex		30 June	01 July	11 July	12 July	11	13
13.	Saturn		25 June	26 June	06 July	07 July	11	13
14.	Hercule		27 June	28 June	10 July	11 July	13	15
15.	Minunea		26 June	27 June	10 July	12 July	14	17
16.	HS2442		28 June	29 June	10 July	12 July	12	15
17.	HS2606		25 June	26 June	08 July	11 July	13	17
18.	Festiv		01 July	02 July	13 July	13 July	12	13
19.	Milenium		27 June	28 June	10 July	13 July	13	17
20.	Romina		26 June	27 June	10 July	12 July	14	17

Nr. crt.	Sunflower hybrid	Years when the sunflower hybrids were studied	First heads flowering	10% of heads flowered (beginning of flowering process)	10% of heads still in flower	End of flowering process (no any flowered heads)	No of days from the stage 10% of heads flowered to the stage 10% of heads still in flower	No of days from the first calitides flowering to the end of flowering process
21.	Huracan	2006 2007 2008	28 June	29 June	13 July	18 July	15	21
22.	Kasol		22-28 June	25-29 June	08-16 July	18-19 July	13-18	22-26
23.	Lindor		20-28 June	23-29 June	07-16 July	14-19 July	14-18	22-24
24.	Masai		22-28 June	26 June-01 July	09-17 July	18-19 July	13-17	22-26
25.	Mateol		19-26 June	24-28 June	07-14 July	18 July	13-17	23-29
26.	Podium		22-28 June	25-29 June	09-16 July	18-19 July	14-18	22-26
27.	Saxo		19-27 June	25-29 June	09-14 July	15-18 July	14-16	22-26
28.	Sunko		21-27 June	23-29 June	10-16 July	18-19 July	17-18	23-27
29.	Fly		21-28 June	24 June-01 July	07-16 July	18 July	13-16	21-27
30.	Rigasol		18-28 June	21-29 June	06-16 July	15-18 July	15-18	21-27
31.	Rigasol OR		18-24 June	20-28 June	05-13 July	18 July	15-16	25-30
32.	Fleuret OR		18-24 June	20-27 June	07-12 July	18 July	16-17	25-30
33.	Arena		22-28 June	23-29 June	11-12 July	16-18 July	14-18	21-24
34.	Melody		22-28 June	24-30 June	07-15 July	18 July	13-16	21-26
35.	NK Armoni		23-28 June	25 June-01 July	11-18 July	19-20 July	16-18	23-26
36.	Alexandra		21-27 June	23-29 June	08-14 July	18 July	15-16	22-27
37.	NK Dolbi		22-28 June	24-29 June	08-14 July	18 July	14-16	21-26
38.	NK Ferti		22-27 June	23-29 June	10-14 July	18 July	16-17	22-26
39.	Opera PR		23-28 June	25-29 June	11-14 July	18 July	16	21-25
40.	Sanay		21-24 June	24-28 June	14-15 July	18-20 July	18-20	25-29
Limits of variation		*2002 – 2008*	*18 June – 01 July*	*20 June – 02 July*	*05 July – 18 July*	*06 July – 20 July*	*10-20 days*	*12-30 days*

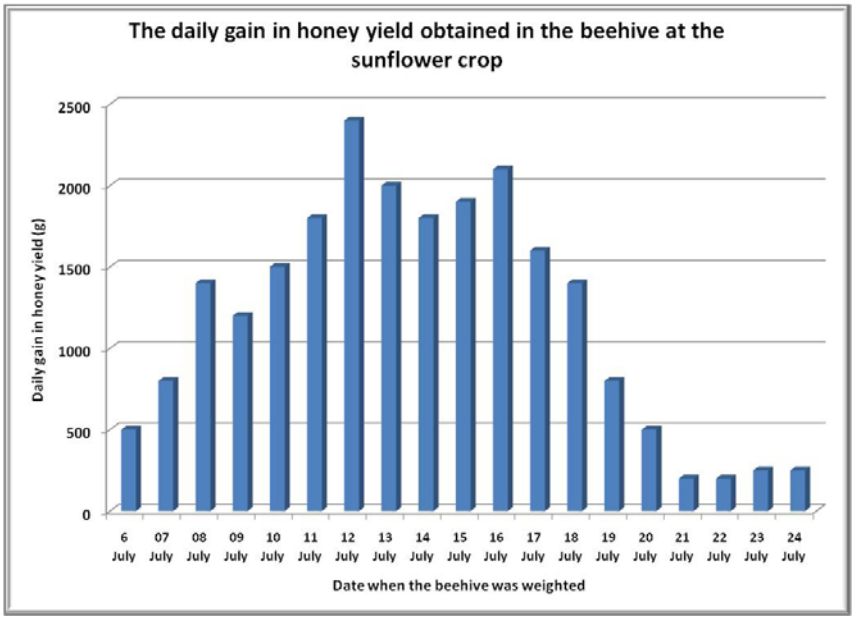

Figure no 1. The daily gain in honey yield obtained in the beehive at the sunflower crop registered by the daily weighting of the beehive

(Data obtained in 2009, in Giurgiu County – Gruiu village)

Table no 2

Data regarding the melliferous and pollination characteristics at some sunflower hybrids studied at Research Farm *Royal Mill* belonging to the USAMV Bucharest
(Average values and limits of variation)

Nr. crt.	Sunflower hybrid	Years when the sunflower hybrids were studied	Honey yield (kg/ha)	Self-pollination (%)	Gain in seed yield through pollination (compared to the yield obtained under self-pollination conditions) (q/ha)
1.	Favorit	2002 2003 2004	13.5 – 24.0	20 – 60	1.8
2.	Performer		9.3 – 16.8	61 – 98	1.1
3.	Florina		10.8 – 19.2	-	-
4.	Jupiter		8.4 – 14.9	-	-
5.	Alcazar		7.1 – 12.6	-	-
6.	Top 75		6.2 – 11.1	-	-
7.	Venus		11.8 – 19.2	-	-
8.	Splendor		13.0 – 15.3	47 – 69	1.7
9.	Felix		10.3 – 15.5	48 – 81	1.0
10.	Justin		12.1 – 13.0	46 – 97	6.3
11.	Select		11.5 – 16.0	18 – 93	6.0
12.	Alex		9.3 – 11.1	36 – 91	2.2
13.	Saturn		6.0 – 8.4	-	-
14.	Hercule		13.0 – 17.0	29 – 75	1.0
15.	Minunea		10.8 – 19.3	-	-
16.	HS2442		8.8 – 15.6	-	-
17.	HS2606		7.5 – 13.3	-	-
18.	Festiv		11.3 – 13.0	33 – 54	8.8
19.	Milenium		10.1 – 18.2	-	-
20.	Romina		7.3 – 8.5	18 – 47	9.1
21.	Huracan	2006 2007 2008	11.8 – 46.5	94	5.3
22.	Kasol		13.8 – 41.6	50 – 64	1.5 – 4.5
23.	Lindor		9.2 – 56.5	52 – 73	4.0 – 6.0
24.	Masai		6.8 – 70.8	78 – 84	1.5
25.	Mateol		10.3 – 57.4	57 – 79	0.7 – 8.3
26.	Podium		11.7 – 54.8	66 – 86	4.4
27.	Saxo		6.1 – 70.5	70 – 83	2.9 – 3.8
28.	Sunko		14.5 – 52.6	56 – 85	1.1 – 6.0
29.	Fly		8.9 – 49.0	58 – 84	3.3 – 4.8
30.	Rigasol		12.0 – 34.9	61 – 80	7.2
31.	Rigasol OR		8.9 – 10.9	78 – 83	3.6
32.	Fleuret OR		10.3 – 39.8	51 – 62	3.7 – 4.2
33.	Arena		9.0 – 52.2	59 – 73	3.0 – 5.2
34.	Melody		13.6 – 58.8	87 – 90	1.9 – 2.4
35.	NK Armoni		13.5 – 55.3	93 – 95	1.2
36.	Alexandra		8.1 – 21.7	61 – 93	4.7
37.	NK Dolbi		14.2 – 83.5	55 – 86	7.6
38.	NK Ferti		12.9 – 50.4	70 – 81	2.7 – 4.1
39.	Opera PR		10.3 – 52.6	74 – 86	1.1 – 3.1
40.	Sanay		9.5 – 37.6	84 – 89	1.8 – 2.7
Limits of variation		*2002-2008*	*6.0 – 83.5*	*18 - 98*	*0.7 – 9.1*

Table no 3

Potential honey yield at some sunflower hybrids function of sowing moment in 2007

Data obtained at Research Farm Royal Mill of USAMV Bucharest (Average values)

Nr. crt.	Sunflower hybrids	Potential honey yield function of sowing moment (kg honey per hectare)				
		I *(27 of March)*	II *(6 of April)*	III *(18 of April)*	IV *(12 of May)*	V *(2 of June)*
1.	Melody	26,0	23,3	13,6	52,6	45,5
2.	Sunko	38,0	34,3	14,5	52,4	43,4
3.	Arena	35,0	31,7	23,0	24,3	32,0
4.	Fleuret Or	29,0	28,7	13,6	43,1	35,8

Table no 4

Potential honey yield at some sunflower hybrids function of sowing moment in 2008

Data obtained at Research Farm Royal Mill of USAMV Bucharest (Average values)

Nr. crt.	Sunflower hybrids	Potential honey yield function of sowing moment (kg honey per hectare)				
		I *(30 of March)*	II *(11 of April)*	III *(21 of April)*	IV *(07 of May)*	V *(27 of May)*
1.	Melody	66.0	64.0	45.1	71.0	74.7
2.	Sunko	53.9	61.7	48.6	53.9	63.3
3.	Arena	54.0	58.2	52.7	57.2	67.1
4.	Fleuret Or	35.2	41.1	46.6	41.2	51.4

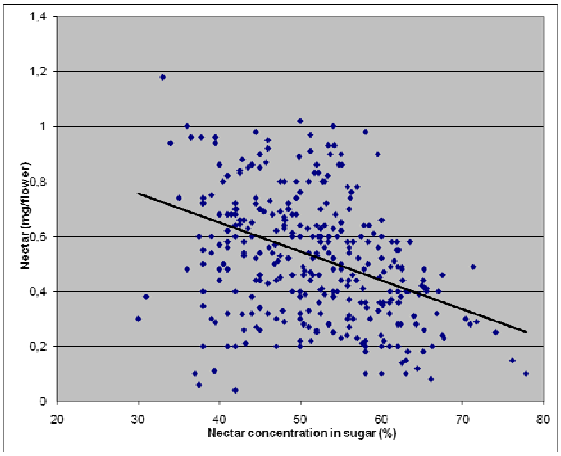

Figure no 2. Correlation between nectar secretion and nectar concentration in sugar at the sunflower hybrids studied in the period 1960-1992 within ICDA Bucharest

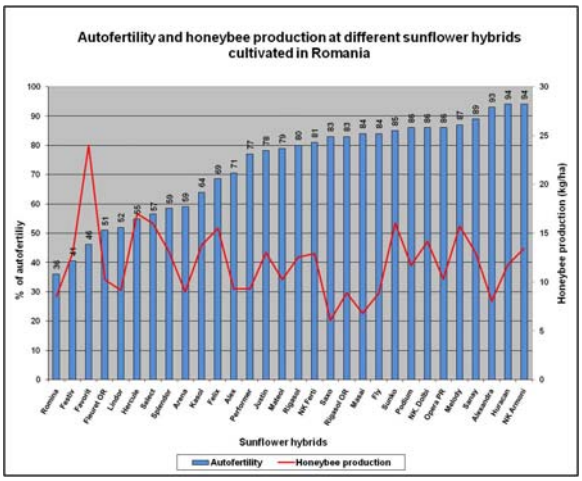

Figure no 3. Autofertility and honeybee production in some sunflower hybrids cultivated in Romania