THE PLUM TREE CONDUCTED POLLINATION WITH THE BEES HELP

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Abstract

The research purpose was to identify an efficient mecanism (modality) of pollination, with the help of bees, of the plum trees culture in intensive orchards. It was done an experiment, in order to test comparative the three methods (ways) of hives placement on the ground at the plum trees pollination, in 3 analogous intensive sectors, with five sorts of plums, that are compatible to the pollination, of 10 hectares each, which were located at a distance of 600 m from each other. In all sectors of the orchard, bee colonies have been assigned with the charge of 3 families/ha. In the first sector (I batch - control) of orchard, hives with bee colonies were located at the edge of the orchard (sector) in the front side of rows. In the second sector (II batch), the hives were located on the technologic road which separated in the centre the sector of orchard, perpendicular to fruit trees rows. The distance between hives was 5 m from each other. In the third sector of the orchard (III batch), the hives were located, inside of the orchard, between the tree rows, in line, at a distance of 100 m from each other and over every 7th row of trees. In each experimental batch were rated the free entomophily pollination results (crossed) and isolated (self pollination). It was found that, in the I batch, frequency of bees visit at tree blossom, has been weaker in the first days of hives placement, but was quite good in batches II and III, even from the first day. With the increase of air temperature from 14 up 18ºC, in all batches was registered a growth tendency of bees visits frequency at blossom. The results of the experiment, have shown that free pollination (cross) entomophily (with predominant participation in proportion of 90 - 95% of honey bees) of plum trees in the orchard ensures the flowers fertilization, depending of beehives location on the field, at the level of 19.0 – 41.5%, that is 17.3 – 33.6 times higher, compared with the isolated pollination - self pollination (1.1 – 1.2%). Therefore, it has been confirmed, once again, the conclusion of many researchers, that, the participation of honey bees at pollination of apple's culture is an indisputable necessary measure. Uniform and proportional placement of bee hives inside the orchard, between the rows, in line, at a distance of 100 m from each other, and over every 7th row of trees, ensures a significant increase, compared to the witness batch (located at the orchards edge), of bees visit frequency to the flowers is 2,3 times more (td = 14.3; P < 0.001), of the bees flight intensity (with and without balls) with 23,1 – 40.9 % (td = 5.8 – 6,9; P < 0.001), of collected pollen quantity - with 57.4 % (td = 10.9; P < 0.001), of flowers fertilizing degree - with 2.1 times (td = 14.4; P < 0.001) and, compared to traditional methods of hives placement (on the technological roads of the orchard), ensured the growth of bees visits frequency on blossom - with 74.4 % (td = 12.9; P < 0.001), of collected pollen quantity from apple - with 17.5 % (td = 2.4; P < 0.05), and of the flowers fertilization degree - with 2.2 times (td = 12.8; P < 0.001).

Key words: pollination, plum, honey bees, placement, bee hives

INTRODUCTION

Multiple researches in the area of the tree culture pollination [1, 2, 3, 4, 5, 6, 7, 10, 12, 13, 15, 17] demonstrates that the free (crossed) process of pollination of blossom with the help of the insects, brings a total production increase of over 20-150 %. In addition to the quantitative effect, the entomophily pollination is remarkable in, that the quality of the fruit and seeds resulted from insects pollination is, at least 10 % higher to those pollinated without insects [15]. The trees with flowers poorly pollinated by insects, where a small number of ovules enter in contact with the male gametes from the pollen grains, produce fruit, which have the shape more affected, are less sweet and have less seeds [16].

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The reasearch results conducted in the U.S. shows that 33 % of foods consumed in this country come from plants pollinated by insects, including 75-90 % bees, and the total value of crops and goods, derived from bees pollination, constitutes about 19 billion dollars (Şt. Lazăr, 2002, quoted by Maria Magdici, 2005) [11]. The bees contribution to the growth of agricultural and fruit trees production are an important value increase of any country's economy, estimated at 10-30 times higher than the income obtained from exploitation of bee products: honey, pollen, wax, propolis, etc. [16].

The well-known american specialist Rom C. Roi, 1972 [13] noted that ordinary "if 5-10% of one tree's flower would produce fruit harvest, then the commercial harvest would be fully realized." The problem is that only a quarter (1/4) of the bounded flowers reach the maturation phase good to be picked. Therefore, in order to ensure a commercial fruit crop is required a fertilization degree of the tree blossom of not less than 20 %. But, also ensuring that minimum of fertilization of tree blossom is in danger, either because of the insects insufficient activity, or (and) because of unfavorable weather conditions.

Because of the use of chemical pesticides and insecticides, in order to wrest against weeds, pests, and to prevent diseases, there has been a drastic reduction in the number of species and populations of pollinating insects. The quantity and biodiversity of entomophily pollinators, nowadays, are under of the risc of extinction directly proportional to the agriculture intensification [15]

Taking into consideration the fact of early blossoming (15 - 22 April) of rosacea fruit trees, such as Prunus domestica, while the wild pollinators, such as Bombus hortorum, Bombus lapidarius, Bombus terrestris and others, are in limited number and solitary, because only the young mated queens survive over winter, and the colonies are at the early stages of metamorphose development, thus not possessing of real pollination potential, then this situation brought to entomophily pollination of fruit trees orchards, including plums, to be accomplished almost exclusively by Apis mellifera bees, the only insects, that can be conducted by humans according to pollination requirements [16]. In these conditions, according to some scientific information [8, 10, 14], the bees pollination of fruit trees represents a share of over 90-95% of the total entomophile pollination.

The knowledge of the need of fruit trees entomophyle pollination was realized first by growers and beekeepers from countries with a developed agriculture, since the late nineteenth century. After the Second World War, in some countries with advanced agriculture, such as USA, Canada, Germany, New Zealand, Australia, China, Argentina and others, the renting of bee colonies for entomophile pollination of crops became an industrial practice for growers, which caused an increasing demand of bee colonies and according of conducted entomophile pollination services with the bees help, has become a business for beekeepers . According to some information [9], in the U.S. in the last 10 years, annually are rented over 2 million bee colonies for pollination of over 90 crops species and the value of the crops pollination service by bees is estimated at 14.6 $ billion USA. The value gain of agricultural production from these crops is estimated at about 438 billion $. Since the service of crops pollination with the help of bees, is always requested, it is appreciated, more or less convenient for the beekeepers, with a value of about $ 100 per bee family. The economic income obtained by beekeepers in the pollination services of at least two crops per year, is 2.5 times higher than that obtained from the sale of hive products. However, the payment terms depend also on the achieved harvest. In this context, beekeepers are interested in achieving a more efficient pollination with a less number of beehives, covering, thereby, large areas of orchard, and obtaining good harvests.

Unfortunately, the plum growers in our country (Republic of Moldova), not all realized the need for orchards pollination, with the bees help, that is why the payment for the services of orchards pollination is ridiculous (130 lei MD/ha or 40-43 lei MD (3.0-3.2 $) per bee family. In addition, the traditional pollination mecanism of plum orchards, as well as the proposed one in official editions [14] is not the most efficient, and therefore the need for trees pollination by honey bees is not convincing enough for all orchards cultivators.

In this context, in the present work, we propose the purpose of comparative testing of some mecanisms of beehives placement on the field, and the development of some effective proposals for plum orchards pollination with the help of the bees.

MATERIAL AND METHOD

The work was carried out under the institutional application project: code - 11.817.08.17A "Development of advanced growing technology and diversified exploitation of *Apis mellifera Carpatica* bee families".

An experiment was carried out in order to test various bee colonies exploiting mechanisms, at the plum culture pollination in intensive orchards. To do this, during the April 18-23, 2013, was organized the transport of 90 bee families of SRL "Casa Albinei",com. Hulboaca, mun. Chisinau, to the blossomed plum pollination, from orchards of SRL "Codru- ST", Straseni. Beeing known the fact that, at multiple fruit trees, especially at the plum, there are a number of unfruitful (steril) trees, which need another's pollination with the pollen of other tree sorts with biological affinity, and the reciprocal pollination degree of the tree sorts varies a lot depending on their compatibility [8]. The growers of the orchard, examined in our experiment, were quite cautious, ensuring the orchard sectors, with alternated planting of tree rows of five plum sorts compatible to pollination: Within the orchard sectors, were planted alternated, rows of trees, of four varieties that are compatible to the pollination: *Stanley, Prezident, Naiboleco, Udlinennaia şi Cabardinca*. The distance between rows was 3.5 m.The distance between the trees in the row was 1.2 m.

In this experiment, were tested comparatively, three techniques (methods) of hives location, on the field, at the plum pollination, in 3 similar orchard sectors, of 10 ha each, which were over 600 m away from each other.In all orchard sectors, the bee families were distributed calculated of each 3 families per 1 ha.

The first orchard sector (Ist batch), has served as witness, where the hives with bee families were located according to the old schema (method) - at the edge of the orchard (sector) in front of the rows.

In the second orchard sector (IInd batch), the hives with bee families were located according to the traditional technology, on a technological road, that separated, in the middle, the orchard sector, perpendicularly to the fruit trees rows. The distance between hives, located along the way, was *5 m* from each other.The hearth of the hives placement, on the technological road, was toward the hearth of bee hives, located at the edge of the orchard, at a distance of over 600 m, according to the recommendations of the Institute of Zoology of the Science Academy from Moldova [14].

In the third orchard sector (IIIrd batch), the hives with bee families, were placed in series, between the rows, at a distance of 100 m from each other. Each following number of hives was placed over each 7th row of fruit trees. The third sector of orchard is located at a distance of approximately 600 m from the IInd sector hearth.

In all sectors of the orchards, the beehives with bee families were located at the beginning of the trees full swing blossoming period and kept for 6 days, after that being removed.

To speed up the process of bees getting used to the scent of flowers and increasing the flying intensity, in all sectors of hives location, they were fed, daily, throughout all the period, with sugar syrup of 50%, mixed with flowers infusion, freshly collected from those trees, in amount of 50 g flowers to 1 litre of syrup. The mixture was administered 50 ml to each frame interval with bee.

In each experimental sector (batch) have been studied:

- the frequency intensity of the bee at 9 representative trees of each experimental orchard batch, where was registered,while 5 minutes, the bees number, visiting the flowers of the tree branch sector with 1000 flowers;
- the quantity and types of pollen, collected by a bee family, during one day of experiment, registering the data of pollen collector, at 30 bee families from each experimental batch of the orchard;
- the flight intensity of the bee family was assessed by the bees number (with, or without pollen balls) arrived to the beehive while 10 minutes;
- the share of entomophily pollination of the trees inflorescence, in the total pollination, for which, in every experimental batch of orchard, was isolated a crown of a the representative tree with an impenetrable net (gauze) for insects;

- the degree of flowers fertilization (fruits binding)-through appreciation, after 18-20 days after flowering, of pollination results and recording the number of fertile and sterile flowers at 1000 inflorescences.

The data obtained, in all experiences, were processed statistically using computer software „STATISTICS – 6" and appreciated their certainty, according to the biometric variation statistics, by the methods of Плохинский Н.А., 1969 [19].

RESULTS AND DISCUSSIONS

Analysis of the data, obtained in the experiment of plum trees pollination in orchards, demonstrates that, honey bees *Apis mellifera* are attending the flowers quite intensive, starting even from first days of placing the beehives on the orchard's lands (tab. 1).

Table 1 The frequency of bees visits at plum tree flowers, on a compact sector of branches with 1000 flowers, *bees/5 minutes*

Nr. of the day	Air temperature, t°C	Batch I	Batch II			Batch III		
		M ± m	M ± m	d	td	M ± m	d	td
1	14°	7.4 ± 0.5	9.9 ± 0.6	+2.5**	3.2	18.8 ± 1.2	+11.4***	8.8
2	16°	9.6 ± 0.3	12.6 ± 1.0	+3.0**	2.9	21.6 ± 0.9	+12.0***	12.8
3	18°	12.2 ± 0.8	14.2 ± 1.3	+2.0	1.3	29.4 ± 2.3	+17.2***	7.1
4	17°	12.3 ± 0.9	14.0 ± 0.9	+1.7	1.3	26.4 ± 1.7	+14.1***	7.3
5	17°	12.2 ± 1.0	15.2 ± 0.9	+3.0*	2.3	28.3 ± 1.7	+16.1***	8.2
6	15°	9.6 ± 0.6	13.0 ± 1.1	+3.4*	2.7	23.2 ± 2.4	+13.6***	5.5
Ave rage	16,2°	10.6 ± 0.4	13.1 ± 0.4	+2.5***	4.5	24.6 ± 0.9	+14.0***	14.3

*Notice: * P < 0.05; ** P < 0.01; *** P < 0.001;*

We have found that, the bees frequency intensity to the flowers, depends on the day of the pollination period, air temperature, as well of the way or technique of the hives placement, at the orchard pollination.

The bees visits frequency of the tree flowers in first two days, in all batches, was lower, compared to next 3-5 days, decreasing in the 6th day of pollination.

Thus, the bees visits frequency of the tree flowers, by the first batch is weaker in first days of bees placement on the field, increasing with 19.7 % on the 2nd day, and with 64.9% on the 3rd day, so that then dropps with 21.3% in the last (6th) day of pollination. In the experimental batches II and III, in which the bee families were located closer to the trees of respective orchard sector, the bees visits frequency of the trees flowers, was high enough, even on the first day of placement of the beehives, with 33.8% and 2.5 times ($P < 0.01$ şi $P < 0.001$). On next 2-5 days of pollination, the bees visits frequency of tree flowers in batche II and III increased with 27,3 – 53.5% and 14.9 – 50.5%, what is, also higher,compared with the witnes batch, respectively, with 24.5% and 2.3 times.

We have found, also, that with the increase of air temperature in all experimental batches, has been registered a concomitant rising tendency, in the frequency of bees visits to the plum flowers.

Thus, with increasing of air temperature from 14°, up to 17- 18°C, the frequency of bees visits to plum flowers increases, in the Ist batch, from 7.4 to 12.3 bees/5 minutes; or 66.2% ($P < 0.001$), in the IInd batch - from 9.9 to 15.2 bees/5 minutes or 53.5% ($P < 0.001$) and in the IIIrd batch from 18.8 to 29.4 bees/5 minutes, or 56.4% ($P < 0.001$).

This rise tendency of the flowers bees visits frequency, depending on the air temperature, can be reflected more clearly in the chart from Figure 1.

The results obtained by us, on the bees frequency of visiting apple flowers, are in accordance with the data of Langridge D.F., Australia [10], who mentioned, that, there is clearly a connection between environmental temperature and flight activity of the bees.

From the chart, mentioned-above, we notice that, under 14°C the bees flying activity is weak, between 14° and 15°C – the curve of bees visits frequency rises suddenly, and between 15° and 28°C - the curve of bees visits frequency rises and maintains at a high level.

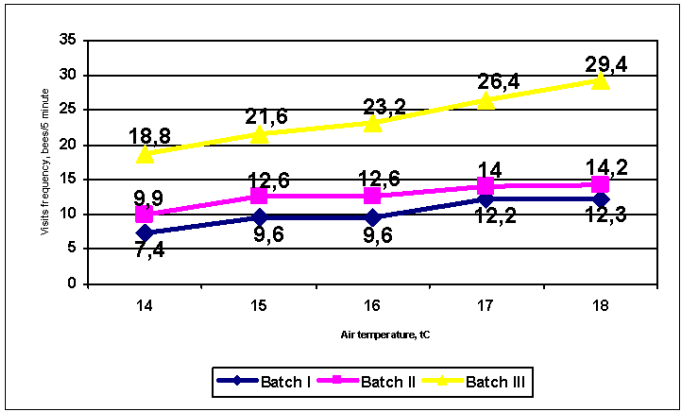

Fig. 1 Bees visits frequency of the plum flowers

At the same time, in our experiment, the highest influence on the frequency of bees visits to flowers, is the mechanism (method) to place hives with bee families on the land of fruit trees orchards.

The data in table 1 shows that, the traditional way of bee hives placement on the edge of the orchard (Ist batch) is overcome, because the bees frequency to the fruit trees from orchard is the lowest. The placement of the bees families on the technological roads (IInd batch) of orchard (according to the recommendations of the Institute of Zoology of the ASM, 1990), the frequency of bee visits to apple flowers is growing significantly, on average, from 10.6 ± 0.4 până la 13.1 ± 0.4 bees/ 5 min, sau cu 23.6 % (td = 4.4; P < 0.001).

The highest frequency of bee visits to tree flowers, was recorded in the IIIrd experimental batch, in which bee families were placed uniformly between the tree rows, at a distance of 100 m of each other, and over every 7 rows.

This mechanism (method) of the bee hives placement for pollination, ensure a substantial increase of the bees visit frequency to the plum flowers, compared to the witness batch, with 14.0 bees/ 5 minute, sau 232.1 % (2.32 times; td = 14.3; P < 0.001) and, compared to batch II – with 11.5 bees/ 5 min, or 87.8 % (td = 11.7; P < 0.001).

Based on the analysis of the data obtained in the experiment, we can conclude that, the more uniform and proportional the placement of bee hives between the tree rows is, ashigheris the bees visit frequency to the flowers. This is due to the fact that the bees are at a smaller distance of the picking source, making less effort in search of food and making more flights in a period of time.

The increase of the bees visits frequency to the flowers, contributes to the quality improvement of the plum culture pollination. It can be found in the analysis of the pollen amount, collected by the bees and their flight intensity (tab. 2).

Table 2 The collected pollen amount and the bees flight intensity during the full swingflowering of the plum culture in the orchards

Indicators	Batch I (N=10)	Batch II (N = 10)			Batch III (N = 10)		
	M ± m	M ± m	d	td	M ± m	d	td
The total collected pollen, g/day/family	77 ± 3	91 ± 7	+14	1.8	103 ± 2	+26***	7.2
inclusive: plum	54 ± 2	70 ± 7	+16*	2.2	85 ± 2	+31***	10.9
The plum pollen share in the total amount, %	70.9 ± 6.2	77.5 ± 5.2	+15,3	0.8	83.2 ± 3.9	+12.3	1.7
Flight intensity, bees total/10 min /family:	152.1±4.2	161.8±3.6	+9,7	1.7	197.5±6.0	+45.4***	6.2
without pollen balls	91 ± 2	97 ± 7	+6	0.8	112 ± 3	+21***	5.8
with pollen balls	61 ± 2	65 ± 7	+4	0.5	86 ±3	+25***	6.9
The ratio of the bees with pollen balls towards to those without pollen balls, %	67.0 ± 5.6	67.8 ± 6.6	+0,8	0.1	77.1 ± 4.6	+10.1	1.4

*Notice: * P < 0.05; ** P < 0.01; *** P < 0.001;*

It was found that, during one day, the bees of one colony bring to collector 77 – 103 g of pollen. Most of the pollen collected by the bees (70.9 – 83.2 %) is of the plum (main culture). At the same time, the bee families from the Ist batch, which were placed at the orchards edge, have collected a noticeable amount (23 g, or 29.9%) of polifloral pollen.

The experimental data have shown that the mode how the bee hives are located at the plum pollination, influences all the characters related to the quantity and quality of the pollen collected by the bees, and to their flight intensity.

Thus, the smallest pollen amount, gained by a bee family, on average per day, placed at the plum pollination, was recorded in the Ist batch, where the bee hives were located at one side (edge) of the orchard. With a more uniform and proportional placement of bee hives inside the orchard, the pollen amount collected, on average, per day, from a bee family grows from 77 ± 3 g/day in batch I, up to 91 ± 7 g/day in the Iind batch, with 14 g/day, or 18.2 % (td = 1.8; P < 0.1).

The highest pollen amount, gathered by bees in the nest was found in the IIIrd batch, where the hives with bee families were placed in series between the tree rows. Thus, the amount of the daily accumulated pollen, in the nest at plum pollination, the bee families from IIIrd batch exceeded compared to their fellows from Ist batch(witness)- with 26 g, or 33.8% (td = 7.2; P <0.001), and had overcome the tendencies toward bee families from IInd batch.

It is important to note that, bees from IInd and IIIrd batches ensured the total increase of pollen quantity, collected from the amount of basic culture pollen (plum) submitted to a controlled pollination with the help of the bees.

Thus, by the plum pollen share in the total quantity of collected pollen, the bee families from IInd batch had a weak increase tendency, compared to the witness batch, and bee families from IIIrd batch exceeded significantly their fellows from the witness batch with 12.3 percentage points, or 17.3% (td = 1.7; P < 0.1). This explains the higher quality pollination in IInd and IIIrd batches, of the basic culture (plum) taken in experiment.

The research results have shown that the bees pollination volume of the plum culture, and its quality is determined also by the flight intensity of the bees, as of the bees without pollen balls, which bring nectar, as well as of those with balls, which specifically visited the flowers in order to collect pollen.

The data obtained in the experiments demonstrates the fact that, at the plum pollination in orchards, IInd batch bee families had a weaker flight intensity tendency compared to the witness batch, and IIIrd batch bee families, had a significantly higher flight intensity, compared to those from the witness batch. At the same time, in all experimental groups, the flight intensity of the bees without pollen balls was higher compared to that of bees with balls.

At the plum pollination, the flight intensity of the bees without balls in IIIrd batch, was higher compared to the witness batch - 21bees/10 minutes, or 23.1% (td = 5.8; P<0.001) and, the flight intensity of the bees with balls of the IIIrd batch was higher compared to the witness batch, with 25 bees/10 minutes, or 41.0% (td = 6.9; P< 0.001).

At the same time, has also been found that IInd and IIIrd batches, where the hives with bee families were located more uniformly,on the land of pollinated culture, manifested an increase tendency of flight intensity raport of the bees with pollen balls, compared to the bees without pollen balls, which flew only to pick nectar. This shows that the mechanisms of placement the hives with bee families, tested in batches II and III, contributes to improve the quantity and quality of pollination and collecting a bigger quantity of trading pollen.

Appreciating, at the end, the result of plum trees pollination with the help of the bees and the pollination efficiency depending on the mechanism of hives placement on the land of pollinated culture, we identified the size of the impact of entomophily pollination and its dependency on how are located the hives on the ground (tab. 3).

Table 3 Results of apple flowers pollination, calculated per 1000 inflorescences (05.05.2013)

Nr. of sec-tor	Indicators	Batch I			Batch II			Batch III		
		Pollination type		Free % isolated	Pollination type		Free % isolated	Pollination type		Free % isolated
		isolated	free		isolated	free		isolated	free	
1	Number of fertile flowers	10	200	2000	13	315	2423	12	470	3917
	Number of sterile flowers	990	800	80.8	987	685	69.4	988	530	53.6
	Fertlisation degree (GF), M±m, %	1.0±0.3	20.0±1.3	2000	1.3±0.3	31.5±1.5	2423	1.2±0.3	47.0±1.6	3917
	Difference (d) GF toward witnes	-	-	-	+0.3	+11.5***	-	+0.1	27***	-
	Degree of difference certainty (td)	-	-	-	0.7	5.8	-	0.2	13.1	-
2	Number of fertile flowers	12	190	1583	14	300	2143	13	400	3077
	Number of sterile flowers	988	810	82.0	986	700	71.0	987	600	60.8
	Fertlisation degree (GF), M±m, %	1.2±0.3	19.0±1.3	1523	1.4±0.4	30.0±1.5	2143	1.3±0.4	40.0±1.6	3077
	Difference (d) GF toward witnes	-	-	-	+0.2	+12.5***	-	+0.1	+21***	-
	Degree of difference certainty (td)	-	-	-	0.4	6.3	-	0.3	10.2	-
3	Number of fertile flowers	11	180	1636	10	220	2200	12	375	3125
	Number of sterile flowers	989	820	82.9	990	780	78.8	988	625	63.2
	Fertlisation degree (GF), M±m, %	1.1±0.3	18.0±1.2	1636	1.0±0.3	22.0±1.4	2200	1.2±0.3	37.5±1.5	2529
	Difference (d) GF toward witnes	-	-	-	-0.1	+4.0*	-	+0.1	+19.5***	-
	Degree of difference certainty (td)	-	-	-	0.2	2.2	-	0.2	10.2	-
Total plum	Number of fertile flowers	33	570	1727	37	835	2257	37	1245	3365
	Number of sterile flowers	2967	2430	81.9	2963	2165	73.1	2963	1755	59.2
	Fertlisation degree (GF), M±m, %	1.1±0.2	19.0±0.7	1727	1.2±0.2	27.8±0.8	2257	1.2±0.2	41.5±1.6	3365
	Difference (d) GF toward witnes	-	-	-	+0.1	+8.8***	-	+0.1	+22.5***	-
	Degree of difference certainty (td)	-	-	-	0.4	11.0	-	0.3	12.8	-

*Notice: * P < 0.05; ** P < 0.01; *** P < 0.001;*

Thus, comparing the number of fertile and sterile flowers, as a final result of pollination, as in case of isolated pollination (on branches covered with impenetrable mesh for insect), as well as in case of entomophily free pollination (with access of honey bees and other insects), we found that the fertilization degree of the flowers is determined predominantly by the insects activity and influenced by the system of bee hives placement in orchard.

The isolated pollination (auto pollination), in all sectors and experimental groups, at a examination of a sector tree with 1000 flowers, were found just 10-14 fertile flowers, the rest being sterile flowers. This means that the flower fertilization degree (GF) at isolated pollination was very low, and represented only 1.0±0.3 – 1.4±0.4 %.

In the case of free entomophily pollination (cross), on a surface of 1000 flowers, have been registered, depending on the batch and sector, from 180 up to 470 of fertile flowers,

the fertilization degree representing 18.0±1.2 – 47.0±1.6 %. Therefore, the impact of entomophily pollination consists in an increase, compared to the isolated pollination, with 16.4 – 39.2 times of the fertilization degree of the plum trees flowers.

The lowest degree of flowers fertilization at entomophily pollination, was recorded in Ist batch, where the hives with bee families were located at the edge of the orchard, according to the traditional plan.

This pollination system ensures only the under minimal degree (18 – 19 %) or the minimal limit (20 %) of fruit connection, compared to normative calculations of Rom C. Roy, 1973 [13].

With the more uniform and proportional location of bee hives on the field of pollinated culture, the flowers fertilization degree increases substantially.

Thus, the flowers fertilization degree in IInd batch, in all researched sectors, was higher compared to the witness batch, on average with 8,8 percentage points, or 46.3% (td = 11.0; P< 0.001).

The highest degree of flowers fertilization at entomophily pollination was found in the IIIrd batch, where the hives with the bee families were located, according to the system elaborated by us – placement in series uniformly, between rows, at the distance of 100 m from each other and over each 7 rows of the orchard sectors. Thus, the fertilization degree of flowers in this batch was higher, so compared to the witness batch –with 22.5 percentage points, or 218.4 % (2.2 times; td = 12.8; P < 0.001), and compared to batch II – with 13.7 percentage points, or 49.3 % (td = 2.1; P < 0.05).

Generalizing in the end the results of testing various mechanisms of placement the hives at the plum pollination in the orchards, we can conclude in full accordance with communications of researchers Cârnu I. and Cociu V., 1971 [2], Rom C. Roy, 1970 [13], who mentioned that dispersed placement of bee hives inside the orchard ensures not only a complete and uniform pollination, but also a larger productionof the bee family, due to the fact that bees moving on small distances do not waste, realizing higher efficiency.

CONCLUSIONS

1. The free (cross) entomophilies (with major participation in approximately 90-95% of honeybees) pollination at plum trees in the orchards ensures the flowers fertilization, depending on the beehives location on the ground, at a level of 19.0 – 41.5 %, that is 17.2 – 33.6 times higher, compared to the isolated pollination -auto pollination (1.1-1.2%). Therefore, the participation of honey bees at pollination of plum culture is an indisputable necessary measure.

2. The uniform and proportional placement of the hives with bee families, inside the orchard between the rows, in series, at a distance of 100 m from each other, and across each 7th tree row, ensures a significant increase, compared to the witness batch (located on the edge of the orchard), of the bees visits frequency of flowers -2.3 times (td = 14.3; P<0.001), of the bees flight intensity (with and without pollen balls) with 23.1 – 40.9 % (td = 5.8 – 6.9; P<0.001), of the collected pollen quantity - with 57.4 % (td = 10.9; P<0.001), of the flowers fertilizing degree - with 2.2 times (td = 12.8; P < 0.001) and, compared to the traditional methods of placement the hives (on technological roads of orchard), ensures the increase of the flower visits frequency by the bees - with 74.4 % (td = 11.7; P<0.001), the quantity of collected plum pollen – with 13.2% (td = 1.6; P<0.1) and of the flowers fertilization degree – with 49.3 % (td = 7.7; P < 0.001).

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