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# THE ARTIFICIAL BREEDING OF THE DRONES FOR THE PUREBRED REPRODUCTION OF BEES IN THE CONDITIONS OF THE UNISOLATED APIARY

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The article is devoted to some aspects of the beekeeping such as pure breeding of bee colonies in conditions of the unisolated area. It is shown that the artificial breeding of drones is the way to provide the reproduction of the pure Carpathian bee bred. The efficiency of this method in the conditions of Bakhchisaray district is shown.

*Key words*: melliferous bee, Carpathian race, drone brood, race defining signs.

## INTRODUCTION

The research work in the field of bee selection that had been begun in 1964 at the Scientific Research Institute of beekeeping (USSR) and other scientific institutions and experimental stations was ended in 1979 with the statement of the first plan on pedigree division into districts. Due to the statement, it was recommended to dislocate the bee races according to their greatest adaptation to the conditions of a climate and honey harvest. It was shown that scientifically grounded approach in that field of beekeeping can raise the honey productivity of separate bee colony up to 30 kg [1].

Due to the statement, it was planned to reproduce the Carpathian bee race (*Apis mellifera carpathica*) in the foothill part of Crimea. However, this is complicated by some factors. It is known that during marriage flight a queen can cover the distance up to 5 km [2] and to mate with several drones. Thus, for ordinary beekeeper it is hard to control the origin of the bee colonies through fatherly line. It leads to hybridization and the valuable pedigree material is used extremely irrationally.

In order to prevent the invasion of drones of unknown origin the apiaries traditionally place at distant areas. But, for example, in the Bakhchisaray district of Crimea it is almost impossible to achieve the necessary level of isolation by this way [3]. One of the ways to increase probability of fertilization of the queen by the thoroughbred drones is to increase the quantity of this drones in the area of marriage flight (to create the «thoroughbred drone's phon»). Usually each bee colony products a few quantity of drones independently. However, we can increase it by placing into a beehive the artificial honeycomb plate, which differs from usual in the size of brood cells. This method of artificial breeding of drones has being applied for a long time. The queen is able to lay fertilized and unfertilized eggs, this process is regulated by function of the semen pump. Start of this pump is initiated by width of a bee comb. If it is narrow enough, a compression of sensitive hairs on a paunch of the queen stimulates contraction of the semen pump.

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When the queen lays eggs in the wider drone comb, the sensitive hairs are not compressed and egg remains unfertilized. In such way, it is possible to increase quantity of the drone brood considerably (according to observations of beekeepers, not less than in 10 times). However, it requires additional work and colony resources; therefore, there is a question about efficiency of this method in the conditions of unisolated apiary when unknown origin drones participate in fertilization.

The aim of this work is to reveal the contribution of the artificially bred drones in formation of local «drone phon» and, subsequently, efficiency of this measure in pure breed reproduction on unisolated apiary.

## MATERIALS AND METHODS

Researches on determination of efficiency of artificial drone breeding were conducted on three private apiaries located in Bakhchisaray district. In 2010 fertilized Carpathian race queens were brought to apiaries from the breeding nursery (Vuchkovo). The unfertilized young queens bred from them were fertilized by the local drones, so race belonging of drones defined a race belonging of the colonies as a whole. On the apiary No. 1 (Kuibyshevo) drone brood was created according to technique described above. In total, 100 artificial honeycomb plates on 7500 bee cells were put in the beehives. The apiary No. 2 (Sokolinoye) served as the control.

The apiary No. 3 is situated in Kuibyshevo 2 km far from the apiary No. 1. Drones were not bred on it; however, it is found in a flight zone of drones from the apiary No. 1, therefore it was supposed that bees from this apiary would be morphologically closer to the race standard in comparison with the control.

For the exterior analysis the technique developed by V. Alpatov was used [4]. On trial apiaries we selected 15-20 working individuals from colonies with young queens. The bees were frozen; the right forward wing and proboscis were fixed on glass and measured under binocular microscope MBC-9 by means of an eyepiece-micrometer. Measurement of length of the wing was carried out under 10-fold increase, other measurements – under 20-fold. The linear measurements got with eyepiece-micrometer, translated subsequently in millimeters. By this way the values for the length and width of the wing, length of proboscis were got. Discoidal shift was determined by the method of Goetze [5]. The characteristics of investigated colonies were compared with the standard [6].

## RESULTS AND DISCUSSION

Results of an estimation of the race determining patterns of bees from the apiary No. 1 are presented in table 1.

Value of a cubital index of thoroughbred Carpathian bees must not exceed 43%. However, it is the top limit of the standard, the most typical for the race value is 38% [6]. The majority of the colonies on this apiary corresponds to the typical value of the given pattern that is the marker of a total absence of cross-breeding.

It is possible to consider that discoidal shift as one of the most important patterns for the race determination. The following limits are established for it: not less than 85% of cases of positive value, no more than 5% of cases of the negative. 14 from 20 colonies corresponded to the standard completely; at other cases, the insignificant increase of neutral shift was found.

*Table 1*

Morphometric values of the race determining patterns of bees from the apiary No. 1 (Kuibyshevo)

| No. colony | Cub. index, % | Discoidal shift, % | | | Length of proboscis, mm | Length of wing, mm | Width of wing, mm |
|---|---|---|---|---|---|---|---|
| | | + | 0 | - | | | |
| **Standard** | **33–43** | **≥ 85** | **≈ 10** | **≤ 5** | **6,7–7,0** | **≈ 9,33** | **≈ 3,2** |
| 1 | 40,79±1,36 | 90 | 5 | 5 | 6,30±0,11 | 9,12±0,03 | 3,21±0,02 |
| 2 | 40,16±1,93 | 100 | 0 | 0 | 6,48±0,06 | 9,19±0,07 | 3,23±0,02 |
| 3 | 34,85±2,45 | 87 | 13 | 0 | 5,87±0,39 | 8,28±0,05 | 3,15±0,02 |
| 4 | 43,24±2,13 | 87 | 13 | 0 | 6,53±0,03 | 9,24±0,04 | 3,21±0,01 |
| 5 | 43,24±1,13 | 67 | 33 | 0 | 6,02±0,13 | 9,05±0,02 | 3,17±0,01 |
| 6 | 39,57±1,38 | 76 | 18 | 6 | 6,19±0,12 | 9,21±0,05 | 3,23±0,02 |
| 7 | 41,50±2,15 | 100 | 0 | 0 | 6,49±0,06 | 9,16±0,06 | 3,22±0,01 |
| 8 | 42,92±1,39 | 63 | 32 | 5 | 6,33±0,10 | 9,15±0,03 | 3,18±0,02 |
| 9 | 40,35±1,03 | 85 | 15 | 0 | 6,12±0,28 | 9,10±0,03 | 3,19±0,02 |
| 10 | 39,54±1,37 | 66 | 27 | 7 | 6,01±0,14 | 9,24±0,03 | 3,22±0,02 |
| 11 | 43,12±1,85 | 73 | 20 | 7 | 6,28±0,14 | 9,38±0,04 | 3,25±0,01 |
| 12 | 36,98±1,56 | 86 | 7 | 7 | 6,08±0,13 | 9,17±0,06 | 3,21±0,02 |
| 13 | 42,98±0,85 | 75 | 19 | 6 | 6,35±0,09 | 9,11±0,04 | 3,21±0,01 |
| 14 | 41,32±1,89 | 93 | 7 | 0 | 6,15±0,12 | 9,21±0,03 | 3,20±0,02 |
| 15 | 38,48±1,21 | 88 | 12 | 0 | 5,70±0,14 | 9,19±0,04 | 3,23±0,02 |
| 16 | 38,72±1,42 | 82 | 12 | 6 | 6,54±0,03 | 9,23±0,02 | 3,22±0,02 |
| 17 | 41,14±1,19 | 84 | 11 | 5 | 6,21±0,14 | 9,22±0,05 | 3,19±0,02 |
| 18 | 42,00±1,13 | 94 | 6 | 0 | 6,27±0,08 | 9,06±0,03 | 3,15±0,01 |
| 19 | 38,55±1,71 | 100 | 0 | 0 | 6,53±0,04 | 9,32±0,04 | 3,25±0,02 |
| 20 | 39,92±1,03 | 93 | 7 | 0 | 6,37±0,09 | 9,04±0,06 | 3,16±0,02 |

Also we investigated such quantitative patterns as length of the proboscis, width and length of the wing. They did not show interbreed differences so brightly, but matter during selection and to some extent characterize ability to honey gathering.

The length of the proboscis, length and width of the wing in investigated bees were a little below the standard. However, it is necessary to consider that the length of the proboscis substantially depends of conditions of a honey harvest. Our samples were selected at the end of the honey-gathering period, so reduction of length of the proboscis is quite expected. Length and width of the wing, unlikely to the cubital index and the discoidal shift, are more dependent of conditions of bees habitation; therefore, at the race analysis these patterns can perform only auxiliary function.

Thus, we can unequivocally determine 14 from 20 researched colonies as a purebred Carpathian bee. At the other colonies insignificant deviations from the standard are observed (in all cases positive discoidal shift prevails, values of the cubital index are near to the top border of the standard). In table 2 the similar data for bees of the apiary No. 2 is presented.

*Table 2*

Morphometric values of the race determining patterns of bees
from the apiary No. 2 (Sokolinoye)

| No. colony | Cub. index, % | Discoidal shift, % | | | Length of proboscis, mm | Length of wing, mm | Width of wing, mm |
|---|---|---|---|---|---|---|---|
| | | + | 0 | - | | | |
| **Standard** | **33–43** | **≥ 85** | **≈ 10** | **≤ 5** | **6,7–7,0** | **≈ 9,33** | **33–43** |
| 1 | 41,91±1,56 | 86 | 7 | 5 | 6,26±0,12 | 9,12±0,03 | 3,16±0,02 |
| 2 | 48,28±2,52 | 55 | 27 | 18 | 6,44±0,03 | 9,05±0,04 | 3,13±0,02 |
| 3 | 43,66±1,34 | 94 | 6 | 0 | 6,41±0,02 | 9,06±0,02 | 3,19±0,01 |
| 4 | 41,09±1,55 | 94 | 6 | 0 | 6,38±0,09 | 9,10±0,04 | 3,13±0,02 |
| 5 | 43,35±1,90 | 92 | 8 | 0 | 6,44±0,03 | 9,01±0,04 | 3,14±0,01 |
| 6 | 45,34±2,89 | 85 | 15 | 0 | 6,51±0,10 | 9,15±0,08 | 3,18±0,03 |
| 7 | 41,71±2,17 | 55 | 27 | 18 | 6,44±0,03 | 8,97±0,05 | 3,10±0,03 |
| 8 | 44,31±1,81 | 86 | 14 | 0 | 6,47±0,03 | 8,93±0,05 | 3,18±0,02 |
| 9 | 40,03±1,05 | 84 | 0 | 16 | 6,26±0,18 | 9,00±0,06 | 3,09±0,03 |
| 10 | 46,52±1,53 | 64 | 36 | 0 | 6,31±0,16 | 9,09±0,03 | 3,16±0,01 |
| 11 | 43,93±1,02 | 33 | 50 | 17 | 6,38±0,07 | 9,00±0,03 | 3,13±0,01 |
| 12 | 46,23±2,12 | 62 | 38 | 0 | 6,30±0,22 | 9,16±0,04 | 3,18±0,02 |
| 13 | 51,01±3,76 | 71 | 0 | 29 | 6,52±0,03 | 9,16±0,04 | 3,18±0,02 |
| 14 | 40,40±1,48 | 85 | 15 | 0 | 6,49±0,04 | 9,29±0,03 | 3,21±0,01 |
| 15 | 40,91±1,69 | 93 | 7 | 0 | 6,49±0,03 | 9,06±0,05 | 3,17±0,02 |
| 16 | 44,98±1,23 | 40 | 47 | 13 | 6,47±0,04 | 8,95±0,05 | 3,16±0,02 |

Only 4 from 16 colonies correspond to the standards of thr Carpathian race. There are no colonies with the value of the cubital index below 40% unlikely to the apiary No. 1. In all colonies corresponded to the Carpathian race its value approaches the upper border of the standard. Unthoroughbred colonies differ in increase in neutral discoidal shift that is more characteristical for the Ukrainian steppe race (*Apis mellifera sossimai* Engel). However, mestization apparently has not come far yet, and bees keep characteristic for the Carpathian race gray color. In the table 3 the similar data for bees of the apiary No. 3 is presented.

On this apiary 8 of 20 investigated bee colonies can be corresponded to pure Carpathian race. In comparison with bees of the apiary No. 2, their values of the race determining patterns are much more typical for the Carpathian race. Such situation can be explained by the influence of the Carpathian race drones, bred on the apiary No. 1. The relative quantity of purebred colonies is less, than on the apiary No. 1. It confirms the supposition that with increase distance to a place of drones origin, their quantity, and, therefore, percent of the queens fertilized by them, decreases.

*Table 3*

Morphometric values of the race determining patterns of bees from the apiary No. 3 (Kuibyshevo)

| No. colony | Cub. index, % | Discoidal shift, % | | | Length of proboscis, mm | Length of wing, mm | Width of wing, mm |
|---|---|---|---|---|---|---|---|
| | | + | 0 | - | | | |
| **Standard** | **33–43** | **≥ 85** | **≈ 10** | **≤ 5** | **6,7–7,0** | **≈ 9,33** | **33–43** |
| 1 | 44,59±2,48 | 80 | 15 | 5 | 6,64±0,41 | 9,31±0,05 | 3,24±0,02 |
| 2 | 46,41±1,57 | 91 | 9 | 0 | 6,44±0,10 | 9,16±0,04 | 3,15±0,03 |
| 3 | 36,18±1,21 | 61 | 31 | 8 | 6,15±0,13 | 9,21±0,05 | 3,22±0,03 |
| 4 | 41,16±1,53 | 94 | 6 | 0 | 6,27±0,11 | 9,12±0,04 | 3,15±0,01 |
| 5 | 38,33±2,82 | 71 | 29 | 0 | 6,49±0,07 | 9,17±0,02 | 3,19±0,02 |
| 6 | 36,20±1,56 | 93 | 7 | 0 | 6,36±0,09 | 9,14±0,03 | 3,27±0,02 |
| 7 | 37,25±1,51 | 100 | 0 | 0 | 6,22±0,14 | 9,09±0,04 | 3,16±0,01 |
| 8 | 39,84±2,04 | 75 | 25 | 0 | 6,47±0,03 | 9,07±0,04 | 3,16±0,01 |
| 9 | 38,14±1,52 | 94 | 6 | 0 | 6,29±0,08 | 9,31±0,02 | 3,25±0,03 |
| 10 | 38,05±1,19 | 88 | 12 | 0 | 6,59±0.03 | 9,31±0,04 | 3,22±0,02 |
| 11 | 42,93±1,70 | 63 | 25 | 12 | 6,69±0,03 | 9,26±0,03 | 3,24±0,03 |
| 12 | 44,58±2,18 | 83 | 12 | 5 | 6,43±0,05 | 9,26±0,06 | 3,19±0,02 |
| 13 | 35,43±1,53 | 88 | 12 | 0 | 6,53±0,02 | 9,27±0,04 | 3,25±0,01 |
| 14 | 48,14±3,42 | 76 | 19 | 5 | 6,52±0,03 | 9,21±0,04 | 3,18±0,02 |
| 15 | 47,56±2,74 | 19 | 62 | 19 | 6,55±0,03 | 9,14±0,03 | 3,18±0,02 |
| 16 | 44,17±1,32 | 50 | 25 | 25 | 6,55±0,08 | 9,17±0,05 | 3,20±0,03 |
| 17 | 34,85±1,21 | 94 | 6 | 0 | 6,43±0,08 | 9,20±0,04 | 3,21±0,02 |
| 18 | 40,42±1,67 | 100 | 0 | 0 | 6,62±0,02 | 9,31±0,02 | 3,24±0,03 |
| 19 | 39,01±2,12 | 95 | 0 | 5 | 6,59±0,03 | 9,31±0,03 | 3,26±0,02 |
| 20 | 46,34±1,53 | 19 | 37 | 44 | 6,62±0,03 | 9,34±0,03 | 3,22±0,02 |

*Table 4*

Comparative characteristic of the economic valuable signs of the bee colonies from the apiaries No. 1, No. 2 and No. 3

| **No. apiary** | **Length of a proboscis, mm** | **Length of a wing, mm** | **Width of a wing, mm** | **Cub. index, %** |
|---|---|---|---|---|
| | $\bar{x} \pm S_{\bar{x}}$ | $\bar{x} \pm S_{\bar{x}}$ | $\bar{x} \pm S_{\bar{x}}$ | $\bar{x} \pm S_{\bar{x}}$ |
| 1 | 6,24±0,05[1,2] | 9,13±0,05 | 3,20±0,01[1,2] | 40,47±0,50[1,2] |
| 2 | 6,41±0,02 | 9,07±0,02[3] | 3,16±0,01 | 43,98±0,76 |
| 3 | 6,47±0,03 | 9,22±0,02 | 3,21±0,01 | 40,98±0,96 |

Note: $\bar{x}$ – mean of a pattern; $S_{\bar{x}}$ – error of mean; [1] – significant difference between groups 1 and 2; [2] – significant difference between groups 1 and 3; [3] – significant difference between groups 2 and 3.

Also we have compared apiaries on the presence of the patterns which have practical value (wing parameters, length of proboscis). Results of the comparative analysis are presented in table 4.

From the data presented in the table we can see that the apiary No. 1 significantly differs from the apiaries No. 2 and No. 3 on variety of signs – such as length of the proboscis, the length and width of a wing, cubital index. At the same time on such indicator as length of wing the significant difference is observed only between colonies from the apiaries No. 2 and No. 3. The length of the proboscis on the apiary No. 1 has appeared less, than on theapiaries No. 2 and No. 3 on 3% and 4% accordingly.

The average width of the wing of bees of apiaries No. 2 and No. 3 exceeds this value at bees of the apiary No. 1 on 1% and 0,3% accordingly. Thus, the apiary with prevalence of the thoroughbred the Carpathian bees shows little, but significant differences of economically useful patterns from theapiaries with prevalence of cross bees.

**CONCLUSIONS**

1. In the conditions of absence of spatial isolation the breeding of drones from the thoroughbred Carpathian race queens has allowed to reproduce thoroughbred posterity.
2. Breeding of drones even on the one apiary increases probability of thoroughbred fertilization on the next apiaries in radius not less than 2 km.
3. In the conditions of absence of specially cultivated Carpathian race drones hybridization has led to increase of cubital index in number of colonies, a share of neutral and negative discoidal shift, also to increase in length of proboscis and to reduction of width of wing.

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**Острогляд А. М., Івашов А. В. Штучне виведення трутнів для чистопорідного розведення бджіл в умовах неізольованої пасіки** // Екосистеми, їх оптимізація та охорона. Сімферополь: ТНУ, 2011. Вип. 4. С. 28–34.

Стаття присвячена таким аспектам бджільництва, як чистопорідне розведення бджіл в умовах неізольованого території. Розглядається штучне виведення трутнів як спосіб забезпечення репродукції чистопорідної карпатської бджоли. Встановлена ефективність даного методу в умовах Бахчисарайського району АР Крим.

*Ключові слова*: медоносна бджола, карпатська порода, , трутневий розплід, породовизначальні ознаки.

**Остроgляд А. Н., Ивашов А. В. Искусственное выведение трутней для чистопородного воспроизведения пчел в условиях неизолированной пасеки** // Экосистемы, их оптимизация и охрана. Симферополь: ТНУ, 2011. Вып. 4. С. 28–34.

Статья посвящена таким аспектам пчеловодства, как чистопородное разведение пчел в условиях неизолированного пространства. Рассматривается искусственное выведение трутней как способ обеспечения чистопородного воспроизведения карпатской пчелы. Установлена эффективность данного метода в условиях Бахчисарайского района АР Крым.

*Ключевые слова*: медоносная пчела, карпатская порода, трутневой расплод, породоопределяющие признаки.

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