The Inheritance of Certain Quantitative Characters in the Ligustica × Fasciata Honeybee Hybrid[1]

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ABSTRACT

The F_1 (Italian × Egyptian) hybrid workers surpassed those of the pure Italian race in the measurements of most organs (except the lengths of hind basitarsus and first wax-mirror) and showed some hybrid vigour in all characters. When the F_1 queenbees were backcrossed to Egyptian drones they produced workerbees with organs mostly smaller than those of both F_1's and Italian workers unless in case of both hind-tibia and hind basitarsus, but they significantly exceeded those of the pure Egyptian workerbees.

INTRODUCTION

The Italian honeybee race *Apis mellifera ligustica* Spin. is considered as one of the best races in many countries. A few beekeepers in the Arab Republic of Egypt prefer this race to the Carniolan which is preferred by the majority. As the Egyptian drones (race *Apis mellifera fasciata* L.) which are predominant in most districts, usually take an active part in mating virgin queenbees reared from imported races, it was decided to study the effect of the hybridization of both standard races on the worker offspring. In a previous study (4) it was found that the F_1 Carnio-Egyptian hybrid workers had smaller organs than their Carniolan aunt workers, but they showed slight hybrid vigour when compared with the midparental average. When the F_1 queenbees were backcrossed to Egyptian drones, the backcross workers had approximately as small organs as the paternal (Egyptian) race except both flagellum and forewing lengths, which were larger.

In the present study it was aimed to carry out similar investigations on the Italian honeybee race reared in a semi-isolated area in Egypt.

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MATERIALS AND METHODS

Three Italian queenbees reared from a strain kept in San-el-Hagar, Sharkia governorate, for several years, were brought to the experimental apiary in the Faculty of Agriculture, Shebin-el-Kom, Egypt, and introduced into nuclei. Three virgin queenbees were reared from their brood and were allowed to be mated in a native apiary of Egyptian honey bees, to produce F_1 colonies. Three queenbees, each reared from one of these crossed queens, were also mated in the same Egyptian apiary to produce backcross colonies. Three Egyptian colonies were taken from the same paternal apiary and hived in nuclei on artificial combs, to be compared with Egyptianized Italian and hybrid colonies.

Samples of 50 workers were taken each from the Italian mother colonies, the F_1's, the backcross and the Egyptians. The length of proboscis, the length of the right antenna and its flagellum, the length and width of the right fore-wing, the number of hooks on the hind wing, the length of the different segments of the right hind leg, and the dimensions of the first wax-mirror were estimated.

The bees were slightly anaesthetized by means of calcium cyanide then dropped in boiling water to ensure the full extension of the proboscis. Dissected parts of each bee were mounted on a glass slide in a medium of glycerine jelly. A 7X ocular was used during all these investigations. A low objective No. 3 was used to allow all the organs of the bee to be measured by the same power. The factor of these lenses was found to be 0.056 mm.

The data for each organ measured were statistically analysed by F test. The data of a character showing significant difference were reanalysed by L.S.D. test to compare the average measurements of the four bee groups with each other.

RESULTS AND CONCLUSIONS

The data for all the characters (except the number of wing hooks) showed significant differences. The average measurements and their least significant differences for the different organs in the two pure Egyptian and Italian strains, and their F_1 and backcross hybrids are given in Table 1. The data show that the Italian workerbees significantly surpassed the Egyptians in the dimensions of all organs. The F_1 hybrid surpassed the best race which is the maternal (Italian) in the measurements of all the worker organs except in the lengths of the hind basitarsus and the first wax-mirror. However, the difference between the F_1 and the Italian race was significant only as regards the proboscis length (at 5% level) and the forewing length (at 1% level).

The measurements of the backcross workers decreased more than both the F_1 and the pure Italians in all organs except the lengths of both hind tibia and hind basitarsus as the former was insignificantly more than that of the Italian and the latter was insignificantly more than both of the pure Italian and the F_1. The differences between the backcross and the F_1 were significant in all the other characters. The backcross differed significantly from the pure Italian too in lengths of proboscis, antenna, flagellum and wax mirror and in the widths of both forewing and wax mirror. However, the backcross workers were still significantly superior to the pure Egyptians in all the characters. Table 2 includes the heterosis estimates and the percentages of decrease or increase in the F_1 hybrid and the backcross. The average midparental measurements, from which the heteroses were estimated, for the F_1 hybrid, have been calculated on the arithmetic scale from the means of the two pure strains.

Table 1 The average measurements (in mm) for the different organs in the two pure Italian and Egyptian strains and their F_1 and backcross hybrids, compared according to the least significant differences (L.S.D.)

Organs	Egyptian	Backcross	Italian	F_1	L.S.D. 5%	L.S.D. 1%
Proboscis L.	5.860[a]	6.203[a]	6.391[b]	6.467	0.0529	0.0748
Antenna L.	3.966[a]	4.159[a]	4.245	4.273	0.0319	0.0451
Flagellum L.	2.734[a]	2.859[a]	2.956	2.958	0.0247	0.0349
Forewing L.	8.278[a]	8.921[c]	8.970[a]	9.102	0.0572	0.0809
Forewing W.	2.860[a]	3.091[a]	3.148	3.177	0.0322	0.0456
No. of hooks	20.72	21.20	20.54	20.72	—	—
Hind femur L.	2.423[a]	2.592[d]	2.601	2.622	0.0249	0.0353
Hind tibia L.	3.028[a]	3.167	3.164	3.179	0.0269	0.0382
Basitarsus L.	2.007[a]	2.051	2.045	2.042	0.0143	0.0203
Wax mirror L.	1.344[a]	1.439[a]	1.514	1.510	0.0250	0.0354
Wax mirror W.	2.064[a]	2.252[a]	2.336	2.348	0.0333	0.0471

[a] Significantly different at 1% level from the following categories.
[b] Significantly different at 5% level from the following categories.
[c] Significantly different at 1% level from the following (not underlined) category, but insignificant from that underlined.
[d] Significantly different at 5% level from the following (not underlined) category, but insignificant from that underlined.

Table 2 Heterosis estimates and percentages of decrease or increase in the crosses between the Italian and the Egyptian honeybee races

	Measurements for the F_1		Measurements for the backcross	
Organs measured	Difference % from mother's races	Heterosis %	Difference % from F_1	Difference % from Italian
Proboscis L.	1.19	5.57	−4.08	−2.94
Flagellum L.	0.07	3.97	−3.35	−3.28
Antenna L.	0.66	4.08	−2.67	−2.03
Fore-wing L.	1.47	5.54	−1.99	−0.55
Fore-wing W.	0.92	5.76	−2.71	−1.81
No. of Hooks	0.88	0.44	+2.32	+3.70
Hind Femur L.	0.81	4.38	−1.14	−0.35
Hind tibia L.	0.05	2.68	−0.38	+0.09
Basitarsus L.	−0.15	0.79	+0.44	+0.29
Wax mirror L.	−0.26	5.67	−4.70	−4.95
Wax mirror W.	0.51	6.17	−4.09	−3.60

The Italian bee, which was used in the present investigation slightly differed from the pure bred Italian in Italy from which it has been widely distributed in large numbers to many parts of the world. This Italian strain averaged 6.391 in proboscis length, 4.245 mm in antenna length, 2.956 mm in its flagellum length, 8.97 mm in forewing length, 3.148 mm in forewing width, 20.54 in wing-hooks number, 2.601 mm in hind-femur length, 3.164 mm in hind-tibia length, 2.045 mm in hind-basitarsus length, 1.514 mm in wax mirror length and 2.336 mm in wax-mirror width. However, all the organs of the Italian workerbees were significantly larger than those of the Egyptian workerbees.

The dimensions of the same worker organs of the Egyptian honeybee race, in the apiary in which the Italian queens were mated, are in the same range as found before by the senior author and by others (1,2,3,4,5,6,7). They averaged 5.86 mm, 3.966 mm, 2.734 mm, 8.278 mm, 2.86 mm, 20.72 hooks, 2.423 mm, 3.028 mm, 2.007 mm, 1.344 mm and 2.064 mm, respectively.

The F_1 hybrid workers averaged 6.467 mm, 4.273 mm, 2.958 mm, 9.102 mm, 3.177 mm, 20.72 hooks, 2.622 mm, 3.179 mm, 2.042 mm, 1.51 mm, and 2.348 mm in the same organs, respectively. When compared with the best (maternal) race, the F_1 workers showed a percentage of increase varying from 0.05% to 1.47% in most organs except in the lengths of the hind basitarsus and the first wax mirror which showed a slight decrease of −0.15% and −0.26% respectively. When the measurements of the hybrid workers were compared with the means of both maternal and paternal races together, a slight hybrid vigour was noticed in all organs varying from 0.44% to 6.17%. These results may be interpreted to mean that the net effects of genes favouring high measurements for the organs in the Italian race are slightly dominant over the corresponding genes in the Egyptian race.

The backcross workers averaged 6.203 mm in the proboscis length, 4.159 mm in the antenna length, 2.859 mm in its flagellum length, 8.921 mm in forewing length, 3.091 mm in forewing width, 21.2 hooks on hind wing, 2.592 mm in hind femur length, 3.167 mm in hind tibia length, 2.051 mm in hind basitarsus length, 1.439 mm in wax mirror length and 2.252 mm in wax mirror width. These measurements showed some decrease in most organs from both F_1 and Italian race except in number of hooks and basitarsus length. The length of the hind tibia showed a slight increase than that of the pure Italian race only.

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توارث بعض الصفات الكمية في هجين النحل الايطالى مع المصرى

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المستخلص

استهدفت هذه الدراسة تقدير أثر تهجين سلالة النحل الايطالى مع سـلالة النحل المصرى وكذلك تأثير التهجين الرجعي بين الهجين الأول والسلالة المصرية على الأعضاء ذات الأهميـة الاقتصادية للشغالات الناتجة ، وذلك لمعرفة كفاءتها في الانتاج ، وشملت هـذه الدراسة طول كل من الخرطوم وقرن الاستشعار وشمراخه وطول وعرض الجناح الامامى وعدد خطاطيف الجناح الخلفي ومقاسات بعض قطع الرجل الخلفية وهي الفخذ والساق والرسـغ القاعدى وكذلك طول وعرض مرآة الشمع .

وقـــد تفوقت شغالات الجيل الأول عن شغالات السلالة الايطالية في مقاسات معظم الاعضاء (ما عدا أطوال الرسغ القاعدي ومرآة الشمع) وأظهرت شيئا من قوة الهجين في كل الصفات ، وعندما هجنت ملكات الجيل الأول رجعيا مع ذكور النحل المصرى، كانت أعضاء الشغالات الناتجة أصغر ممـــا في شغالات الهجين الأول وشغالات السلالة الايطالية ما عدا في أطوال الساق والرسغ القاعدي ، ولكن بصفة عامة زادت كل الأعضاء في الحجم عمـــا في شغالات النحل المصري .