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Determiming the Performances of Honeybees, Pure Bred Caucasian, Anatolian and Their Reciprocal Crosses under Nomad Beekeeping Conditions

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Abstract: This study was carried out to determine the brood production, development of adult worker bee population and honey yield of pure bred Caucasian (*Apis mellifera Caucasica*) (C (♀♂)), Anatolian (A (♀♂) (*Apis mellifera anatoliaca*) honeybees and their reciprocal crosses (C (♂) × A (♀) and A (♀) × C (♂)) under nomad beekeeping conditions in Central and South-East Anatolia with coastal side of East Mediterranean region of Turkey. All Queens were reared in same apiary, with same methods and at the same time. All of them were instrumentally inseminated. Average number of frames, covered with bees, of 10 measuring times between 25th April and 31st October, in C (♀♂), A (♀♂), C (♀) × A (♂) and A (♀) × C (♂) genotypes were found to be 11.6±0.4, 17.2±0.9, 11.5±0.5 and 17.8±1.0 number/colony and the brood areas 3754.2±340.8, 5425.1±416.9, 3742.6±323.8 and 5194.8±428.7 cm^2 $colony^{-1}$ were found, respectively. The total average honey yields for 4 groups were found as 36.3±3.5; 43.9±4.1; 33.1±3.5 and 55.3±4.5 kg $colony^{-1}$, respectively in 3 different ecological regions. There were found significant differences ($p<0.01$) among the groups with respect to on frames covered with bees, brood area and the honey yields. There were calculated high and significant ($p<0.01$) correlations ($r = 0.85$, $r = 0.82$) between frames covered with bees, brood areas and honey yield.

Key words: Honeybee, genotype, brood area, adult bee, pure bred Caucasian

INTRODUCTION

Several honeybee (*A. mellifera* L.) races and native ecotypes have been adapted to different ecological regions of Turkey. Turkey's diverse regions have different climates because of irregular topography. Existence in particular of the mountains that run parallel to the coasts, results in significant differences in climatic conditions from one region to the other. Rain clouds can not penetrate to the interior part of the country and drop most of their water on the coastal area. While, the coastal areas have milder climates, the inland Anatolian plateau experiences extremes of hot summers and cold winters with limited rainfall. Because of these reasons, nothing can be said about general overall climate of Turkey and it can be said that all of the four seasons exist at the same time in Turkey. Its fauna and flora are much diversified and it is also, a gene pool for many species, due to climatic, topographical and geomorphology variations.

The Anatolian honey bees have many ecotypes that are differs from each other with morphologically, physiologically and behaviorally (Guler and Kaftanoglu, 1999). The Aegean (Mugla), Thrace, Gokce-ada and Central Anatolian are the popular ecotypes and the Caucasian is the most popular honey bee race in Turkey. All these races and ecotypes are the products of the natural selection and well raw materials for selective breeding (Akyol and Kaftanoglu, 2001). Some races, (Caucasian and Anatolian) have been taken from Turkey to USA and used for breeding experiment (Adam, 1983).

Caucasian and Anatolian bees are very good nectar and honeydew collectors in their original regions (Genc *et al*., 1999). The Caucasian (*Apis mellifera caucasica*) bees, native bees of the North Eastern Anatolia, are the most gentle and productive, especially in higher elevations and temperate climates of central and eastern Anatolia. Their survival rates, colony development in early spring and honey production are low in the subtropical Mediterranean climates. On the

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other hand, Aegean (Mugla) ecotype honey bees are well adapted to subtropical Mediterranean climate in Aegean region for pine honeydew honey production (Guler and Kaftanoglu, 1999). Survival rates and colony development are faster in early spring and the survival rate of mugla ecotype is well during the long honeydew secretion period in the autumn and honey yield is high. They are also, excellent nectar collectors but their performance in the higher elevations is not as good as the Caucasian bees. Both bees have some desirable characters and they are widely used by the beekeepers all over the country. This study was carried out to determine the performances of pure bred Caucasian (C (♀♂)) and Anatolian (A (♀♂)) *Apis mellifera anatolica*, Aegean (Mugla) ecotype) honey bees with their reciprocal crosses (C (♀) × A (♂)) and A (♀) × C (♂)) under migratory beekeeping conditions in Central and South-East Anatolia with coastal side of East Mediterranean region of Turkey.

MATERIALS AND METHODS

The original (native) research colonies were obtained from immobile-settled local beekeepers at Aegean (Mugla, (28°15'07E longitude, 36°50'26N latitude)) and North-East Anatolia (Ardahan-Posof (42°42'02E longitude, 41°01'39N latitude)) regions. The colonies were settled in the same apiary and observed for a year for some economically important characteristics. Queen rearing facilities were done as described by Laidlaw (1979). The mature queen pupae were settled in small mating nuclei for emergence and development. In order to prevent natural mating, queen excluders were installed at the entrance of nuclei. When, the virgin queens are 10 days old, they were instrumentally inseminated with 10 μL semen obtained from pure bred colony males. Instrumentally inseminated queens were stuck with identification tags and one wing was clipped to prevent natural mating. The inseminated queens were housed again in original nuclei till egg laying. After laid the eggs, the experimental colonies were equalized with regard to adult bee, brood and food stocks in full-size Langstroth wooden hives. Each group consists of seven colonies and total 28 honey bee colonies were used to test the performance of pure bred Caucasian, Anatolian and their reciprocal crosses in 4 groups. The colonies were checked regularly, the amount of adult bees and the brood area were recorded at 21 day intervals between 25th April and 31st October. The colonies were transferred to central Anatolia (Nigde (34°59'01E longitude, 37°49'31N latitude)) on 20th May for production of wild flower honey and Southeastern Anatolia (Urfa (38°55'27E longitude, 36°57'29N latitude) at 10th August for production cotton (*Gossypium* sp.) 3honey and East Mediterranean (Samandag (36°50'22E longitude, 36°13'07N latitude) on 20th September for production western heath-garrigues (*Erica manipuliflora*) honey with wintering as practiced by migratory beekeepers. Puchta method was used for calculating the brood area (Fresnaye and Lensky, 1961). Honey harvests were done as described by Dogaroglu and Pekel (1982) to determine the honey yield. Statistical analysis of colony characteristics (number of frames covered with adult bees and brood area sizes) were performed by Repeated Measure (GLM), randomized plot design (ANOVA) was used for honey yield. Duncan's multiple range tests were used to compare the means between the genotypes (Little and Hills, 1975).

RESULTS AND DISCUSSION

Number of frames covered with bees: The overall average numbers of frames covered with bees through the experiment are summarized in Fig. 1. There is significant ($p<0.01$) difference among genotypes in terms of number of frame covered with bees. The average numbers of frames for C (♀♂), A (♀♂), C (♀) × A (♂) and A (♀) × C (♂) genotypes were found to be 11.6±0.4, 17.2±0.9, 11.5±0.5 and 17.8±1.0 number colony^{-1}, respectively for 3 locations in one production season.

Figure 1 shows that the colonies headed by Anatolian queen produced approximately 35% higher adult bee population than those produced by colonies headed by Caucasian queen. These results, obtained in the current experiment, were in agreement with findings of Dogaroglu and Pekel (1982), Dogaroglu *et al.* (1992), Guler and Kaftanoglu (1999) and Akyol and Kaftanoglu (2001), but were higher than those reported by Kaftanoglu *et al.* (1993), Firatli and Budak (1994), Guler and Kaftanoglu (1999), Sahinler and Gul (2004) and Arslan *et al.* (2004) about for Anatolian bees (A (♀♂), A (♀) × C (♂)).

The adult bee population of colonies headed by Caucasian queens was found consistent with findings of Dogaroglu and Pekel (1982), Dogaroglu *et al.* (1992), Guler and Kaftanoglu (1999), Akyol and Kaftanoglu (2001) and Arslan *et al.* (2004), on the other hand, the adult bee population of colonies headed by Caucasian queens was higher than those reported by Kaftanoglu *et al.* (1993), Guler and Kaftanoglu (1999), Firatli and Budak (1994), Gurel (1995) and Gencer (1996), but lower than those reported by Genc *et al.* (1999).

Sealed brood area: The average brood sizes in C (♀♂), A (♀♂), C (♀) × A (♂) and A (♀) × C (♂) genotype colonies were found to be 3754.2±340.8, 5425.1±416.9, 3742.6±323.8

and 5194.8±428.7 cm^2 colony^{-1}, respectively. There were found significant ($p<0.01$) differences in sealed brood areas among genotypes.

Figure 2 shows that the colonies headed by Anatolian Queen (A (♀♂) and A (♀) × C (♂)) produced approximately 45% more brood than colonies headed by Caucasian Queen (C (♀♂) and C (♀) × A (♂)). The brood areas of Anatolian genotypes, obtained in the current experiment, were in agreement with findings of Dogaroglu and Pekel (1982), Firatli and Budak (1994), Akyol and Kaftanoglu (2001), Sahinler and Gul (2004) and Arslan *et al.* (2004), whereas the brood areas of Anatolian genotypes, obtained in the current experiment, were higher than those obtained by Dogaroglu and Pekel (1982), Dogaroglu *et al.* (1992), Firatli and Budak (1994), Gurel (1995), Guler and Kaftanoglu (1999) and Akyol and Kaftanoglu (2001).

The brood areas of Caucasian colonies were considerably higher than those obtained by Dogaroglu *et al.* (1992) and Guler and Kaftanoglu (1999), but lower than that obtained by Genc *et al.* (1999).

Honey production The average honey production of C (♀♂), A (♀♂), C (♀) × A (♂) and A (♀) × C (♂) genotypes in migratory beekeeping conditions are given in Table 1.

There are significant ($p<0.01$) differences in honey production among genotypes (Table 1). It is reported that average annual honey yield for Anatolian and Caucasian genotypes in East Mediterranean region were 34.86±3.58 and 20.54±1.39 kg colony^{-1} (Dogaroglu and Pekel, 1982), in Southeastern Anatolia were 23.9±5.2 and 17.6±5.3 kg colony^{-1} (Kaftanoglu *et al.*, 1993), in Aegean region were 23.0 and 21.8 kg colony^{-1}, respectively (Gencer and Karacaoglu, 2003). Guler (1999) and Guler and Kaftanoglu (1999) determined that the annual honey yield for *Aegean ecotype* of Anatolian, 57.2±3.4, 50.16±4.3 kg colony^{-1} and for Caucasian 26.6±5.5, 26.5±5.5 kg colony^{-1} under migratory beekeeping conditions, respectively. Genc *et al.* (1999) determined the average honey yield for Caucasian was 30.6±3.2 kg colony^{-1}, Dodologlu and Genc (2002) reported that for Caucasian (C (♀♂)), Anatolian (A (♀♂)) and their reciprocal crosses (C (♀) × A (♂) - A (♀) × C (♂)) were 8.05±2.2, 11.2±1.5, 8.4±1.5 and 11.8±1.7 kg colony^{-1}, respectively under immobile beekeeping conditions in Eastern Anatolia. Gencer (1996) compared native Central Anatolia (Beypazari (CA (♀♂))) ecotype with Caucasian (C) and reciprocal crosses in immobile Central Anatolia region condition and determined that annual honey production for CA (♀♂), C (♀♂), CA (♀) × C (♂) and C (♀) × CA (♂) genotypes were 9.6, 10.0, 8.9 and 15.7 kg/colony/year, respectively. Akyol and Kaftanoglu, (2001) reported that annual honey yield for Caucasian (C (♀♂), Mugla Ecotype of Anatolian (A (♀♂), C (♀) × A (♂) and A (♀) × C (♂) genotypes were 33.0±0.8 kg, 53.9±3.1, 32.3±1.5 and 65.0±3.4 kg colony^{-1}, respectively.

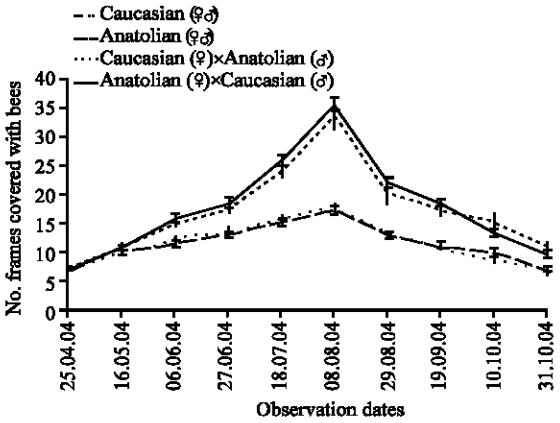

Fig. 1: Average number of frames covered with bees of the experimental groups

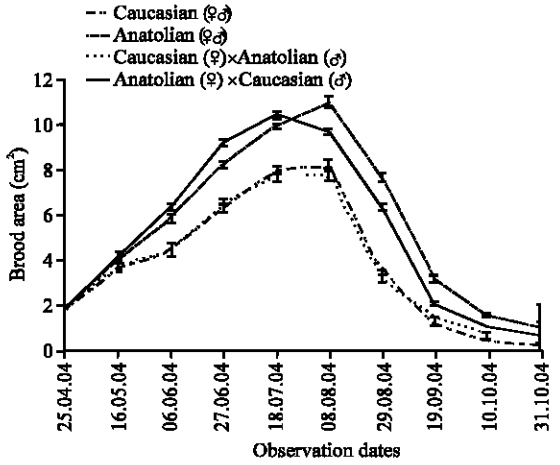

Fig. 2: Average brood area of the genotypes thought the experiment (cm^2 colony^{-1})

Table 1: Average honey yields of the experimental groups (kg $^{-1}$colony)

		Harvest ($\bar{x}$ ± SE)			
Genotypes	n	1	2	3	Total ($\bar{x}$ ± SE)
C (♀♂)	7	16.00±1.15b	14.00±1.34b	6.00±0.95b	36.00±1.15b*
A (♀♂)	7	20.00±1.30a	15.00±1.45b	9.00±1.15ab	43.00±1.30ab
C (♀) × A (♂)	7	15.00±1.23b	12.00±1.18b	6.14±1.14b	33.14±1.18b
A (♀) × C (♂)	7	23.00±1.45a	21.71±1.38a	10.00±1.52a	54.71±1.45a

*Different letter indicate significant differences among the group means ($p<0.01$)

There were found similarities and differences between the current study and other studies on honey production. Main reasons of these differences in the number of frames covered with bees, brood production and honey yield among the different studies could be altitude, climatic conditions, geographic region, flora of experiment areas, years, source of genotypes and different management conditions (Pankiw and Page, 2001; Bacandritsos *et al*., 2004).

CONCLUSION

This study showed that pure bred Anatolian (♀♂) and Anatolian hybrid colonies have similar brood production and adult bee population pattern; however Anatolian (♀) hybrid colonies produced average 21.4% more honey. The Anatolian genotype was superior to the Caucasian in terms of development of colony population, brood rearing activity and honey yield under migratory beekeeping conditions. Results showed that productivity of colonies could be increased with controlled mating and hybridizing. This result is consistent with findings of Cale and Goven (1956), who reported that colony development rates, pollination activities and bee products can be increased by proper hybridization.

The selections of maternal and paternal lines are very important for the success of bee breeding programs. Prolific lines or genotypes, such as native Anatolian (*Aegean ecotype*) or Italian, Carniolan and commercial hybrids as a maternal line and Caucasian as a paternal line for migratory beekeeping facilities can be suggested. On the other hand, due to migratory beekeeping and commercial queen rearing facilities; the pure stocks are being hybridized. The pure native races or the ecotypes like Caucasian and Anatolian (*Aegean ecotype*) bees in Turkey must be preserved in their homeland for the breeding studies and for the biodiversity.

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