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The Effects of Some Drugs Used to Treat Honeybee (*Apis mellifera* L.) Diseases and Pests on Lifespan of Honeybees

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A B S T R A C T

This study was conducted to determine the effects of Bayvarol®, Fumidil-B®, Neo-Terramycin® on adult honeybee lifespan. Total twenty honeybee colonies were used and randomly divided into four groups (each group consisted of five colonies). Experimental groups: Bayvarol ®, Fumidil-B® and Neo-Terramycin® were treated to first, second and third groups, respectively. No treatment was done to forth group taken as control group. A hundred one day old worker bees were taken from each group and marked with different colors and numbered on the thorax. After the marked, all worker bees were given into the observation hive. Marked worker bees were controlled and counted daily. Statistical analysis of data was done by variance analysis method and between groups comparisons were done with Duncan's multiple range tests. Average lifespans of the first, second, third and control groups were 44.97±4.90, 46.86±6.56, 45.38±6.12 and 47.72±6.06 days, respectively. There were found statistically significant differences among average lifespan of first, second, third and control groups (P<0.01). This study showed that some drugs used to treat diseases and pests reasoned a negative effect on the lifespan of honeybees.

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Balarısı (*Apis mellifera* L.) Hastalık ve Zararlılarının Tedavisinde Kullanılan Bazı İlaçların Balarılarının Ömür Uzunluğu Üzerine Etkileri

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Ö Z E T

Bu çalışma, Bayvarol®, Fumidil-B® ve Neo-Terramycin®'in ergin balarılarının ömür uzunluğu üzerine etkilerini belirlemek amacıyla yürütülmüştür. Toplam 20 koloni tesadüfü olarak her grupta 5 koloni olacak şekilde 4 gruba ayrıldı. Bayvarol®, Fumidil-B® ve Neo-Terramycin® sırasıyla birinci, ikinci ve üçüncü grupları oluşturdu, dördüncü grup olan kontrol grubuna uygulama yapılmadı. Herbir gruptan yüzer adet bir günlük yaşlı işçi arılar alındı, farklı renklerde ve toraks üzerine numaralandırıldı. İşaretlemeden sonra tüm işçi arılar kovan içerisinde gözlenildi. İşaretlenmiş işçi arılar günlük olarak kontrol edildi ve sayıldı. Elde edilen verilere varyans analizi uygulandı ve ortalamalara Duncan çoklu karşılaştırma testi uygulandı. Gruplarının ortalama ömür uzunlukları sırasıyla; 44,97±4,90, 46,86±6,56, 45,38±6,12 ve 47,72±6,06 gün olarak belirlendi. Grupların ömür uzunlukları arasındaki farklılıklar istatistiki olarak önemli bulundu (P<0,01). Bu çalışma hastalık ve zararlıların tedavisinde kullanılan bazı ilaçların balarılarının ömür uzunlukları üzerinde negatif bir etkiye neden olduğunu göstermiştir.

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Introduction

Turkey has a great potential for apiculture because of its suitable ecology providing by own geographic location, rich flora and over 7 million honeybee colonies. However, despite all these good conditions total honey production was realized 103.000 tons/year and about 14 kg of honey yield per colony, which is substantially below from the average global yield of honey (21 kg/colony) (Anonymous, 2016). The main reasons of lower honey yield in our country can be summarized as improper use of breed, queen bee problems, insufficient vocational training, management problems, failures in the struggle of diseases and parasites (Akyol et al., 2007).

This subject is evaluated in terms of bee diseases and parasites, as in all living organisms there are also many diseases and parasites in honeybee colonies that affect the health and productivity (Tutkun and Boşgelmez, 2003). In Turkey, main disease and parasites affecting the yield efficiency of colonies can be listed as American foulbrood (*Paenibacillus larvae*), European foulbrood (*Melissococcus Plutonius*), nosema (*Nosema ceranae/apis*), chalkbrood disease (*Ascosphaera apis*), septicemia (*Pseudomonas apiseptica* ACE), Bee Paralysis (Acute and Cronic Bee paralysis Viruses), varroa (*Varroa destructor*) and wax moth (*Galleria mellonella*) (Tutkun and Boşgelmez, 2003; Akyol and Korkmaz, 2008; Giray et al., 2009). Some of honeybee parasites and pests affect colony performance negatively; the others of them can cause extinction of colonies (Le Conte et al., 2010; VanEngelsdoph et al., 2010). Today, there is no alternative method for the treatment of bee diseases and pests instead of chemical struggles. However, according to many researchers (Ginevan et al., 1982; Charriere and Imdorf, 1999; Walner, 1999; Cyborovsky, 2000; Genersch et al., 2010) the chemicals drugs used in the honeybee colonies which left residue on bee products, as a result of consuming of these products, both bees and people's health were affected adversely. In addition, the effects of drugs used for treatment of diseases and parasites are not fully known on lifespan of the bees.

In recent years, both in our country and in the world, deaths of bees and losing of bees were increased dramatically, many factors such as wrong colony management, improper genotypes using, old, inefficient and low-quality queen bees, unconscious disease and pest management, climatic changes, chemical loads on comb, environmental pollution, radioactivity etc. to these deaths and losing which were reported by researchers (Anonymous, 2007; Giray et al., 2009; Le Conte et al., 2010; VanEngelsdoph et al., 2010).

Consequently, this study was conducted to determine possible effects of some commercial registered drugs (Fumidil-B®, Neo-Terramycin® and Bayvarol ®) which were commonly used for the treatment of honeybee pests and diseases in Turkey on honeybee lifespan.

Material and Methods

In this study, standart Langstrooth type hives, glass observation hives, five framed small hives, basic beekeeping equipments, plastic numbers and plant-based natural adhesives for marking of worker bees were used. In the study, Bayvarol® (for Varroa-Flumethrin), Fumidil-B® (for Nosema-Fumagillin bisiklohekzilamin) and Neo-Terramycin® (for American foulbrood-neomycin /oxytetracycline) commercial drugs known as extensively used by the beekeepers in Turkey that were used.

The observation hive both sides made of glass was designed to visualize all bees indoor and to overlapping four combs. The hive was placed in a building and continuity of normal field activities of bees was provided from a hole inserted in the wall of building.

The queens of experimental groups with a comb were captured in a grid cage, so provided that they ovulated in the comb. After caged the queens, the drugs were applied according to the prospectuses. In the application of Bayvarol, flumethrin impregnated plastic strips were used and these strips were kept in the hive for 28 days. Fumidil-B® and Neo-Terramycin were applied four times within syrup in 7th, 14th, 21th and 28th days. After 21 day caged the queen, one day old new adult worker bees were taken into wired cages in case of them did not mix the other bees. First, second and third drug applications were made in larvae and pupae stage. Fourth application was done in adult stage. Hundred worker bees from each group on the bee's thorax in different colors according to the groups bonded numbers were transferred to the observation hive. The numbers of marked bees were controlled with 24-hour interval by checking the observation hives. The study was carried out between June and August months in Niğde province in Turkey. Analysis of variance (Anova) was performed to data obtained from the study and group differences were determined by Duncan's Multiple Range Test. Therefore, the effects of tested drugs on worker bees' lifespan were determined.

Results and Discussion

In order to determine the effects of some certain drugs in treatment of some diseases and parasites observed in honeybee colonies on lifespan of worker bees, the average lifespan of worker bees (in hives and field) were given in Table 1. From the values in Table 1, it was shown that drug untreated control group had the longest lifespan with 47.72±6.06 days, then followed group-II treated by Fumidil-B® with 46.86±6.56 days, and then followed group-III treated by Neo-Terramycin® with 45.38 ±6.12 days and then finally group-I treated by Bayvarol ® with the lowest lifespan of 44.97±4.90 days. Analysis of variance showed that differences among lifespans of groups were statistically significant ($P<0.01$). Group means were compared by Duncan test, the maximum lifespan of the drug untreated control group and group-II treated by Fumidil B® were located in the same statistical group; but this group was separated statistically from group-III treated by Neo-Terramycin® and group-I treated by Bayvarol ®. These results showed that some drugs such as Bayvarol ®, Fumidil-B® and Neo-Terramycin® against bee diseases and pests which reasoned to decreasing about 2-3 days of lifespan of worker bees.

The results of this study support the similar results as seen the possible reasons of bee deaths of some drugs used for colony treatment informed by many researchers (Drescher and Schneider, 1987; Colin and Belzunces, 1992; Wallner, 1999; Morse and Calderone, 2000; Floris et al., 2004; Bogdanov, 2006, Chauzat et al., 2006; Martel et al., 2007; Alaux et al., 2010; Johnson et al., 2009; Johnson et al., 2010; Le Conte et al., 2010; VanEngelsdorp and Meixner, 2010). In natural life cycle, lifespan of worker bees show significant changes depending on genetic structure, season and environmental factors (Ritter, 1988; Morse and Flottum, 1997). Consequently, having the same genetic origin of the bees, reared in the same colony and exposed to similar environmental conditions which increase the probability to be effective of drug treatments on different lifespans of groups.

Table 1 The effects of drug applications on the lifespan (days) of worker bees

Drug treatment	Mean±S.E.
Bayvarol ®	44.97±4.90^{c*}
Fumidil-B®	46.86±6.56^{ab}
Neo-Terramycin®	45.38±6.12^{bc}
Control	47.72±6.06^{a}
General	46.23±6.03

*: Different letters (a, b and c) represent statistically significant differences (P<0.01).

Apiculture intensively made in Turkey where a large portion of the beekeepers engaged the basic beekeeping information and lacks of sufficient information on combat of bees' pests and diseases (Akyol and Özkök, 2005). Beekeepers prefer chemical methods especially in the treatment of puppies' diseases and combating varroa because of its easy application. This choice, in particular, the dose of drug used, time of administration and number of applications in the absence of careful while dealing with bees, honeybee pests and diseases also can cause serious damage. The findings from this study showed that the use of some drugs reasoned to adverse effects on the lifespans of bees.

In conclusion, this is a pilot study conducted to determine possible effects of some drugs (coincidentally selected three of them) widely used in Turkey against honeybee diseases and pests on the lifespan of bees. The results of this study show that more comprehensive researches are necessary to determine the possible effects of therapeutic drugs and pesticides used in beekeeping and agricultural production on lifespan of bees.

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