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POSSIBILITIES OF USING NATURAL METHODS IN FIGHTING DISEASES AND PESTS IN ORGANIC BEE-KEEPING

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ABSTRACT

Like other organisms, honey bees are under the threat of various parasites and microorganisms surrounding them. These parasites and microorganism cause bees to be infected with many diseases, weaken their colonies and accordingly lead to decrease in their productivity. While in conventional bee-keeping chemicals are generally used to fight diseases and pests, in organic bee-keeping required precautions are taken to protect bees from diseases before they get infected or substances and methods not harmful to organic production are preferred.

In spite of all the precautions taken, when colonies get infected with any disease, they should be treated and if necessary, colonies need to be isolated. In organic bee-keeping, instead of chemical mixtures, phytoterapic and homeopathic treatment methods should be used. In order to protect the equipments such as frames, hives and combs from pests, they should be treated with sodium hypochlorite, caustic soda together with some physical administrations such as vapor and direct fire. However, in organic bee-keeping the use of chemical drugs is forbidden. During the periods, when veterinary drugs are administration method used, duration of the treatment and the time when the treatment was terminated should be clearly recorded and the certification institute should be informed.

One of the biggest challenges encountered in bee-keeping is varroa destructor parasite and it should be treated with formic acid, lactic acid, ascetic acid, oxalic acid, menthol, timol, eucalyptol and kafir etc. As formic acid is an organic acid naturally existing in honey, the dose administered does not leave any residues in honey and after a short while following the treatment, the ratio of formic acid decreases to its normal level, it does not have negative effects on human health, it is very suitable to be used to fight against varroa and lime diseases. Moreover, it has also been determined that eucalyptus peels and leaves and orange peels are effective in fighting against varroa.

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In the current study, the use of natural methods in fighting against diseases in bee-keeping, reduction of the formation of pesticide residues in honey and the use of natural products in fighting against parasites were investigated.

Keywords: Honeybee, disease, pest, organic bee-keeping and fight.

1. INTRODUCTION

Organic bee-keeping is defined as bee-keeping activities conducted without using any artificial feeding and chemical drugs from the production of the product to its consumption in organic fields whose natural structure has not been deteriorated (Gökce and Konak, 2003). The extent to which bee products can be defined as organic depends on features of hives, quality of environmental conditions, how products are obtained, processed, stored and how organic the conditions of storage. Thus, when there are agricultural activities conducted in the same region where organic bees are kept, these activities should also conform with the standards of organic agriculture (Anonymous, 2002) because the effects coming from external sources such as harmful matters pollute air, water and soil and thus deteriorate the bee products. In addition, both agricultural products and bee colonies in the same environment are negatively affected. In other words, organic bee-keeping activities should be performed in agricultural fields where organic production is carried out. Though animal and plant health and consciousness of protecting the environment may vary from society to society, a great advancement has been observed in these fields. Producers and consumers' tendencies towards production methods not destroying the environment and agricultural products not having toxic effects on humans are continuously gaining strength (Anonymous, 2002).

The existing suitable geographic structure and vegetation well integrating with this structure offer good opportunities for the production of organic bee products (Konak, 2003). Especially in wide meadows and areas where locust trees, chestnuts and lime trees blossom and pine forests, it is quite possible to produce organic honey and pollen (Gökçe, 2002). Yet, these conditions are not enough for organic production on their own, bee-keeping conditions are also important. One of the pre-requisites of conversion from conventional bee-keeping to organic bee-keeping is to control infrastructure wastes released and honeycombs in the colony and to meet the needs of bee-keepers converting to organic bee-keeping. Particularly meeting the great demand for beeswax that is difficult to find is of great importance for organic bee-keeping (Imdorf et al., 2003; Lodesani at al., 2003; Livia et al.; 2003).

Organic production is an alternative production system protecting the ecologic balance in nature, considering the optimum use of natural resources and energy and attaching greater importance to

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the quality rather than the quantity and aiming to yield healthy and safe products. As a result of excessive and unconscious use of synthetic chemicals, the amount of evidence indicating the harmful effects of foods treated with these synthetic chemicals on human health is increasing. Therefore, the problem of undesired residuals in honey products to be exported is increasing in severity. If our bee-keepers use natural methods to fight against diseases and pests and do not leave any chemical residuals in honey products, the negative influences on human healthy can be reduced (Gül,2005).

Honey bees not only produce highly valuable products such as honey, beeswax, royal jelly, bee venom and propolis for human diet and health but also contribute to the pollination of many plant species; thus, they are of great importance for agricultural production and maintenance of natural balance (Genç, 1996). Therefore, honey bees are raised to produce above-mentioned valuable products and to increase the quality and quantity of products in agricultural production all over the world and great benefits are obtained. However, as in all the other agricultural activities, problems such as diseases and pests also negatively affect bee-keeping. Drugs used in order to overcome these problems leave residues in honey and wax and thus pose a threat to human health (Kaftanoğlu, 2000).

Varroa destructor is a dangerous parasite surviving by sucking the blood of larva, pupa and imago of honey bees (*Apis Mellifera L.*). Its main host is *Apis Cerena* known as Indian bee. As a result of nomadic unconscious bee-keeping activities to produce more honey, this parasite was transmitted to *Apis Mellifer* (Kaftanoğlu, 2000). Travelling first to Russia and then to East European countries, *Varroa destructor* then spread across all the continents and wiped out hundreds of thousands of colonies. It was introduced to Turkey for the first time in 1977 and spread across the country in a short time. Though many precautions were taken, it still poses a great threat to colonies (Kaftanoğlu et al., 1992).

A mature varroa is brown or dark brown and its body is horizontally covered with chitin. Adult females are 1.1-1.2 mm. long and 1.5-1.6 mm. wide (Kaftanoğlu and Yeninar, 2000). A female varroa has the capacity of reproduction. For larvas to acquire the ability to reproduce, they need to be fed with Juvenile hormone in their hemolenf. For this purpose, varroa, before attaching itself on the larva, enters into comb cell where there is a larva and it starts lying eggs 60 hours after getting enough Juvenile hormones. In a male bee cell, 5 female and in a worker bee cell, 3 female varroas can come out as mature. After coming out of the cell, varroa clings to any bee in the hive and feeds on its blood (Kaftanoğlu and Yeninar, 2000; Tutkun and İnci, 1992).

As Varroa destructor feeds by sucking blood, the bee loses protein and becomes susceptible to bacteria, fungi and other photogenes. Microbic infections and protein loss shorten the life of a

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bee and increases the losses in winter. The flying activity in the survivors becomes very weak. In their pupa period, bees are more negatively affected from varroa and complete their growth with many deformations.

Kaftanoğlu et al. (1992) investigated the effects of formic acid on the lime disease caused by *Varroa destructor* and in in vitro conditions and its bio-efficiency against *Ascosphera Apis* was proved. Formic acid administration to colonies was performed in the spring months of the same year four times with four-day intervals each. Its effectiveness against *Varroa destructor* was found to be 93.3% on average and 45.28% against lime disease. The doses of formic acid administered to the colonies were found to have no negative effects on the development of queens, worker bees and colonies.

Çetin (2010) conducted a study to investigate the use of eucalyptus peels and leaves and orange peels in the fight against varroa and infection rate was reduced by 94% in the eucalyptus peel and leaf treatment and by 99% in orange peel treatment.

Kumova (2001) conducted a study to determine the effectiveness of some drugs in varroa control and found the effectiveness level of coumaphos as 83.4%.

Giray et al. (2007) stated that as the use of perizin is not very widespread in our country, honey bees cannot develop enough resistance to varroa and it is still very harmful.

Charriere et al. (2004) argued that the most effective fight against varroa can be given in the winter period when there are no babies and found that depending on its different applications, coumaphos is highly effective in fighting against varroa at ratios ranging between 89% and 98%.

Maver and Poklukar (2004) emphasize that the drugs used against varroa leave residues on the honey and thus pose a threat for human health; therefore, time of drug administration should be considered carefully.

Akyol and Korkmaz (2005) conducted a study on a 20 honey-bee (*Apis mellifera*) colony and reported the efficiency of formic acid, lactic acid and oxalic acid as 93.57%, 91.16% and 90.75%, respectively. All of these three organic acids have quite strong influences on *varroa* and the difference between them is statistically insignificant.

2. PROTECTION OF HEALTH ACCORDING TO THE STANDARDS OF ORGANIC BEE-KEEPING

As in all living entities, honey bees are under the threat of various parasites and microorganisms surrounding them. These parasites and microorganism cause bees to be infected with many

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diseases, weaken their colonies and accordingly lead to decrease in their productivity. While in conventional bee-keeping chemicals are generally used to fight diseases and pests, in organic bee-keeping required precautions are taken to protect bees from diseases before they get infected or substances and methods not harmful to organic production are preferred. For this purpose, first thing to be done is to take preventive measures to protect honey bees against diseases. These measures can be;

1. Robust races and lines of bees should be selected, and queens should be regularly replaced with the new ones,

- 2. Hives should be systematically checked and male babies should be controlled,
- 3. Equipments used in bee yards should be regularly disinfected with organic methods,
- 4. Contaminated matters or resources should be disposed carefully,
- 5. Be combs should be regularly renewed,
- 6. Adequate amount of pollen and honey should be left in hives (Gökçe, 2002).

Disinfection of hives should be carried out by burning with blowtorch. Other bee-keeping equipments should be disinfected in boiling water. For disinfecting hives and equipments, potassium and sodium soap, water and vapor, lime paste, lime, quicklime, sodium hypochlorite (e.g. household bleach), caustic soda, caustic potash, hydrogen peroxide, natural plant extracts, citric, parasitic acid, formic acid, lactic acid, oxalic acid, alcohol, formal and sodium carbonate can be used (Losedani et al, 2003).

Despite all the precautions taken, when colonies are infected, they should immediately be subjected to treatment and within the criteria of organic production, the treatment should be conducted. The colonies undergoing treatment are taken into frames with organic honeycombs. If it is inevitable to use chemical drugs, then they should be administered under the supervision of a vet. Following the completion of the treatment, all the honeycombs should be replaced with the new ones (Anonymous, 2002; Gökçe, 2002; Imdorf et al., 2003; Livia et al.; 2003).

Moreover, in order to reduce the use of chemicals, attempts have been made in recent years to develop disease and pest resistant bee species in many countries such as America, Europe and Australia (Milani et al., 1995).

While attempts to develop resistant species are continuing, works are being conducted to make the drugs to be used against diseases and pests harmless to human and bee health. To this end, greater importance is attached to organic drugs and their applications have been initiated (Konopacka et al., 1995).

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3. ORGANIC DRUGS USED AGAINST DISEASES

Fast growth of agriculture and stock-raising in recent years has resulted in an increase in the use of chemical drugs. Intense use of chemicals has polluted the environment so much that organic agriculture and use of organic drugs have become an obligation. This also holds true for beekeeping (Kumova et al., 2007).

As the use of natural drugs in fighting against diseases does not lead to any toxic effect on health, it can be an effective way of fighting (Wilkinson et al., 2002). These drugs are explained below:

Eucalyptus Peel and Leaf: There is volatile oil, polyphenolic acids and flavonoids in the leaf of eucalyptus (Anonymous, 1999).

As eucalyptus is an aromatic plant and used in pharmaceutical industry, it can also be used for the control of varroa. Eucalyptus peel and leaf are burnt in a windbag and is given to each colony in the form of smoke five times. The application must be performed after bees have returned to the hive towards evening and the entry of the hive should be kept closed for 15 minutes. With this application, 60% success rate was obtained in fighting against varroa (Dwijendra, 2014).

Formic Acid: It is an organic drug used in fighting against varroa (Varroa destructor). It is a colorless, volatile and weak organic acid. Its quality of being vaporized is drawn on and it must be administered when the temperature is between 10 and 25 0C. In colonies, the success rate of this application is 84%. During the application, the entry to the hive and ventilation holes should be kept open. As in the natural honey there is formic acid by 0.1-0.5%, no residual problem is encountered (Eguaras, 2002).

In order not to experience quality problems in the honey, the application should not be finished at least 6-8 weeks before the honey harvest (Anonymous, 2003). With the formic acid application, 95% success rate was obtained. When used properly, formic acid demonstrates an efficiency ranging from 90% to 95%. It must be used when the temperature is between 10 and 20C°. If the temperature of the environment exceeds 30 C° then it can be harmful for bees. In the first week of the application, if the temperature reaches 28 C°, formic acid plates should be collected. Otherwise, as a result of the loss of the queen and baby bees, the colony might be wiped out (Akyol et al., 2005). Formic acid was also found to be effective against lime disease by 50% (Kaftanoğlu et al., 1992).

As formic acid is an organic acid naturally existing in honey, the dose administered does not leave any residues in honey and after a short while following the treatment, the ratio of formic

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acid decreases to its normal level, it does not have negative effects on human health, it is very suitable to be used to fight against varroa and lime diseases (Kaftanoğlu et al, 1992).

Oil of Thyme (Thymovar®): It is a drug effective on varroa (Varroa destructor), which is an external parasite on bees. They are used in the form of sponges each of which includes 15 g oil of thyme. By means of vaporization from the sponges, the vapor of the oil of thyme diffuses throughout the hive. It creates a deadly effect on varroa mites after vaporization and this vapor does not cause any harm to bees (Anonymous, 2001). The accumulation of this drug in the honey is at the level of >0,8mg/kg. As it is not classified as carcinogenic according to the norms of the European Union, it can be used to fight against varroa (Imdorf et al., 1999).

Oxalic acid: It is a drug used in fighting against varroa (Varroa destructor). Its active substance is oxalic acid. With its administration, 94% success rate was obtained in colonies. Oxalic acid was reported to be killing varroas on adult bees but not be killing varroas within the closed baby cells (Nanetti et al., 2003). In its application, 30 gr oxalic acid is mixed with pure water until the mixture becomes 1000 ml and then is implemented to each honeycomb covered by bees 4 times with a 7 day-interval between two administrations in the form of 3-4 ml spray (Çetin, 2010).

Lactic acid: Lactic acid crystals can easily be dissolved in water. This acid is an organic drug used in the control of varroa. In the natural content of the honey, there is 200 ppm lactic acid. The threshold level for it to give harm to the taste of the honey was reported to be 800-1600 ppm (Schulz ve ark., 1995). Administered in late autumn and early spring, the drug was found to be effective on varroas by 99.4%.

It should be administered to the surface of the honeycomb in the form of 5-6 ml doses. Lactic acid is applied by spraying 4 times with a 7-day interval between two administrations (Liorente et al., 1995).

Orange peel: Orange peel consists of volatile oil components (terpens, alcohols, esters, aldehydes and ketones) (Shaw, 1979). As it is rich in volatile oil acids, it can be used in fighting varroa (Kumova et al., 2007). After orange peel is dried, it is applied in the form of vapor with the help of a windbag through the entry hole and the cover of the hive. The application should be conducted after bees have returned to their hive towards evening and the entry hole should be kept closed for 15 minutes. With this application, 99% success rate was obtained in fighting against varroa (Çetin, 2010).

Obeson gel: This is a white colored viscous gel and its per-gram includes 250 mg timol. It is used in fighting against varroa. Obeson gel is placed in an aluminum bowl inside the hive for each colony when the average day temperature is 15 0C in early spring and late autumn. For the

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curative effect to be continued, the application must be reiterated two weeks later (Anonymous, 2010a).

Ecostop: It is an organic drug used against varroa. It is commercially available as tablets and in the content of it there is timol and mint. During its application, environmental temperature should be at least 8 0C and at most 40 0C. It must be used in early spring and late autumn. Depending on the intensity of varroa and the power of the colony, it can be given to colonies as 1-2 tablets. The period during which tablets are effective is 45 days (Anonymous, 2010b).

Use of salt instead of naphthalene to fight against wax moth can be given as an example for the use of drug in organic honey production. Besides this, frames with male bee cells can used as a biological method. Another method of fighting is heating method. In this method, the hive is heated at 45 0C for 5 minutes. The varroas falling off under the hive are collected and annihilated (Gökçe, 2002).

4. CONCLUSION AND RESULT

One of the most important factors hindering the development of our bee-keeping sector is diseases and pests. Therefore, bee-keepers should be informed about the characteristics and symptoms of most widely seen parasites and diseases and means of fighting them. Unconscious and wrong applications may lead to economic loss and spread of the disease across healthy colonies.

It must be kept in mind that while fighting diseases, the main purpose is to protect the health of the bee. If we want to have a productive bee-keeping industry and to produce healthy bee products, we have to perform treatments in certain periods. During these treatments, the drug used should not leave any residues on bee products and wax. In developed countries, consumers have started to prefer products without residues. This urges people in developing countries to opt for products without residues.

With the use of organic drugs in fighting against diseases and pests, they can be more easily controlled and the problem of residues is eliminated. At the same time, organic drugs do not lead to toxic effects on bee products.

Moreover, great care should be taken for the timely application of the correct drugs at appropriate doses. It should be remembered that overuse and unnecessary use of drugs might result in some residues left on honey and wax and thus, might pose a threat to human health. Beekeepers should be careful about diseases and pests and they should be offered with assistance by the experts working in provincial directorates of agriculture.

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