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Short Communication

Varroa destructor resistance to fluvalinate in Algeria

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ABSTRACT

Varroa destructor Anderson & Trueman, is considered as a major problem for the beekeeping sector, not only for *Apis mellifera* L. in Algeria but also worldwide. In cases of no control it can cause severe problems that may end in the death of honeybee colonies. Fluvalinate is the predominant compound used in Algeria to control *V. destructor*, its constant application has caused the appearance of resistant mite populations to this product in several parts of the world. This study was conducted to detect the possible existence of populations of resistant mites to fluvalinate in the area north-center of Algeria. To determine the mites mortality percentage to the fluvalinate, they were exposed to strips of 2.5 x 1.0 cm. Varroa mortality in apiaries treated with fluvalinate was 41.23%, lower than the 81.51% mortality obtained in apiaries that only received an alternative treatment. A significant difference ($P > 0.05$) was found between two mortality of Varroa. These results show for the first time the existence of *Varroa destructor* populations resistant to fluvalinate in Algeria. These results are essential for beekeeping sector not only in Algeria but also in Africa since very little data is available on this issue in the northern parts of Africa.

KEYWORDS: *Apis mellifera*, *Varroa destructor*, fluvalinate, resistance, Algeria

1. INTRODUCTION

Varroa destructor is a parasitic mite that infests its natural host, the honey bee *Apis mellifera* L. (Hymenoptera: Apidae) worldwide. It causes varroasis which is considered as the main economic challenge that faces the industry. It causes significant economic losses for the beekeeper as well as for the farmer who needs pollinators [1]. *Varroa jacobsoni* damages bee brood and adult honey bees (*Apis mellifera* L.) by feeding on bee hemolymph, thus greatly weakening or killing the bee. In the year 1981 *Varroa destructor* was registered for the first time through the Algerian-Tunisian border [2]. Since that time several chemical treatments have been used to control this ectoparasite, including fluvalinate, flumethrin, and amitraz with specific formulation for apicultural usage [3]. The pyrethroid tau-fluvalinate (Apistan®), an acaricide that is tolerated by honey bees, has been used for its control since 1988. Fluvalinate is applied as a contact treatment using pesticide-impregnated plastic strips. Application of fluvalinate has been the major method for controlling this pest [4].

Fluvalinate, a synthetic pyrethroid, has emerged as the most widely used varroa miticide. Its efficacy against varroa was discovered in studies in France [5]. From the late 1980s to the early 1990s, the efficacy of pyrethroid fluvalinate application was close to 100% [6]. Its widespread use, and often its misuse throughout those years, has placed a strong selective pressure on mite populations, and therefore, resistant populations have emerged in several countries worldwide. Several studies described resistance by *V. destructor* to fluvalinate in Italy [7], Poland [8], Israel [9], France [10], and Spain [11]. In 1998 the detection of fluvalinate resistant mites in the United States was reported, associated with lack of control of

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the mites with Apistan [12]. Trouiller in 1998 [13] monitored the spread of resistance to pyrethroids throughout Europe and his data supported the theory that the resistant strain originated in Italy in the early 1990s and spread to Slovenia, Switzerland, France, Belgium and Austria. To our knowledge, there is a good amount of information on the resistance of Varroa mites to fluvalinate in African bee populations.

Resistance is defined as "a genetic change in response to selection by toxicants that may impair control in the field" [14]. The development of resistance depends on the interaction of many factors, e.g. the degree of dominance and fitness of the genes conferring resistance [15], the breeding habits of the pest, extent of exposure to the toxicant and other ecological factors [9]. The biochemical mechanism of resistance has been investigated; monooxygenases of the P450 system are involved, at least in the strain of *V. destructor* that originated in Italy and later spread through the Old World, while esterases do not play a significant role [16].

The aim of the present work is to evaluate the resistance of Varroa to fluvalinate in two regions of the mid-north of Algeria.

2. MATERIALS AND METHODS

A field experiment was initiated in July 2011 in 3 apiaries where the fluvalinate was applied in a continuous way for a period of 3 years for the control of *V. destructor* (Blida), and 3 apiaries where some alternative method was applied (Oxalic acid, amitraz, thymol) for a period of similar time (Tizi Ouzou), taking 10 samples for each apiary (Figure 1).

The method of Elzen *et al*. (1998) [16] was used to assess resistance levels in the six apiaries. The assay was conducted as follows. Cut a 9 mm by 25 mm strip from an Apistan strip and staple it to the centre of an index card. Place the card in a 500 ml jar with the strip facing inwards. Prepare a 2-3 mm light metal mesh cover for the jar. Collect samples of 150 bees from each hive, place them in the jar, place a sugar cube in the jar and cover it with the mesh lid. Store upturned in the dark, at room temperature. After 24 hours, hit the upturned jar with your palm three times over white paper. Count the dislodged mites and place the upturned jar in a freezer until the bees are dead (4 hrs). Count the remaining mites. Percent mortality was calculated as (number of mites killed in 24 h/total mites in the jar) × 100.

The data obtained was analyzed with Statistica software version 5.0 using analysis of variance (ANOVA).

3. RESULTS AND DISCUSSION

The results of the treatments carried out on the six apiaries are indicated in Table 1. The average efficacy of the treatment with fluvalinate in Blida was 41.23%. In the region of Tizi Ouzou, the

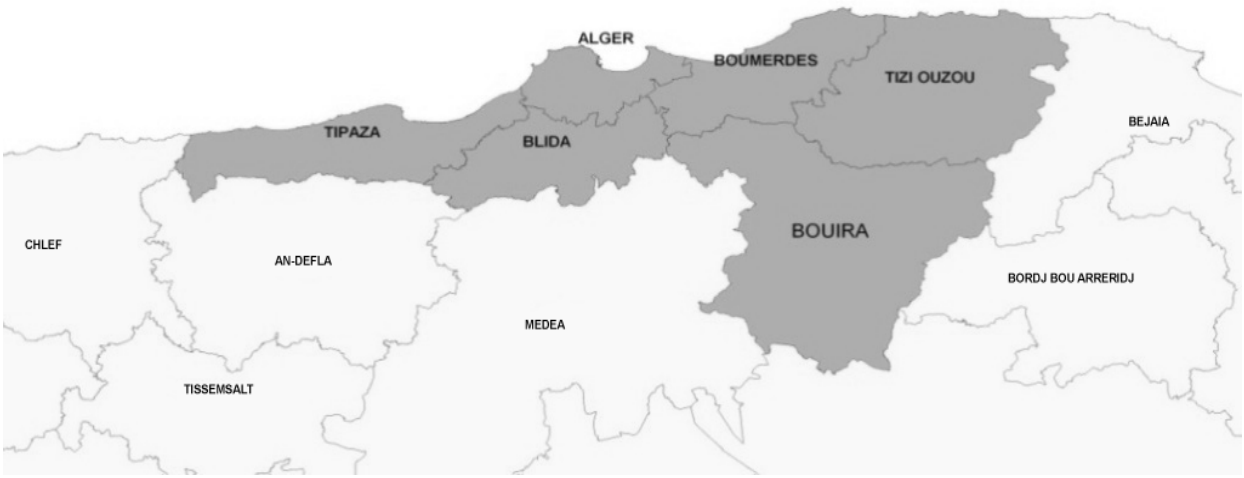

Figure 1. Area of north-central Algeria. Apiary 1, 2 and 3 (Area of Blida), Apiary 4, 5 and 6 (Area of Tizi Ouzou).

Table 1. Percentage of varroa mortality obtained with the fluvalinate application.

Location		Colony sampled	Mean (% mortality) ± SE
Blida			
	Apiary 1	10	46.45+5.34 a
	Apiary 2	10	36.23+3.65 a
	Apiary 3	10	41.20+6.87 a
Tizi Ouzou			
	Apiary 4	10	89.54+3.90 b
	Apiary 5	10	91+55+5.76 b
	Apiary 6	10	87.45+67 b

Letters indicate significant differences between treatments ($P < 0.01$).

efficacy of the treatments was 81.51%. Significantly lower mite mortality was observed in Blida compared to the other apiaries in Tizi Ouzou. The analyses of variance showed no difference in effectiveness ($P > 0.01$) among the three apiaries of Blida and Tizi Ouzou.

The reduced efficacy of fluvalinate suggested by our studies in Blida may be due to the following reasons:

- Fluvalinate is used in some unapproved methods (home-made strips) and at uncontrolled doses.
- Fluvalinate has been used in Algeria since 1988. Mites tend to quickly develop resistance to acaricides [17].
- Algerian beekeepers use other traditional product-based fluvalinate (strips of cardboard or wood impregnated with the molecule) [18]. It is the chemical product that promotes the development of mite resistance to fluvalinate.
- Many cases of resistance in Europe were associated with the use of agricultural formulations of the pyrethroids [19].

The percentage of mortality in the apiaries of Tizi Ouzou that received alternative treatment was higher than the mortality observed in the apiaries that received regular treatment based on fluvalinate (Blida). These results are similar to those reported by Milani and Della Vedova [20], Mozes-Koch *et al.* [9] who observed a higher percentage of mortality in apiaries that are not treated with fluvalinate. The percentage of resistant mites decreased by approximately ten times in three years, during which the mite underwent over 30 generations. A slow decline indicates a small disadvantage associated with resistance to fluvalinate in *V. destructor* [15]. Resistance is usually associated with decreased fitness leading to a decrease in the frequency of the resistance allele (reversion). Reversion of fluvalinate resistance of approximately 50% per year has been reported in Italy following withdrawal of the active ingredient [13].

CONCLUSION

This is the first reported incidence of *V. destructor* resistance to pyrethroids in Algeria. This study further indicates the urgent need to expand and to implement more rational strategies in the fight against *V. destructor*. An integrated pest management approach needs to be developed to deal with the increasing problem of acaricide resistance in *V. destructor* populations in Algeria. The effects of residues and their by-products in honey and wax present environmental concerns and is another reason for reducing the use of conventional chemical mite-control methods in beekeeping.

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