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Evaluation of Ovicidal Effect of Extracts from Hop, Oregano, Lemon Balm and Clove on the Sunn Pest, *Eurygaster maura* L. (Hemiptera: Scutelleridae)**

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ABSTRACT

Botanical insecticides may be an alternative to minimize or replace the use of synthetic chemical insecticides against pests of agricultural importance. In this search, the ovicidal effects of four plant extracts Lemon Balm *Melissa officinalis* L, Hop *Humulus lupulus* L, Oregano *Origanum vulgare* L. and clove *Syzygium aromaticum* (L.) were tested against *Eurygaster maura* L. (Hemiptera:Scutelleridae) under laboratory conditions. One to three-day-old eggs were dipped in plant extracts. The effects of three concentrations of plant extracts 2.5, 5 and 10% were studied. It was observed that as the concentration increased, the inhibition of egg hatchability increased. Lemon Balm extract didn't show significant ovicidal effect. On the other hand, Oregano and clove extracts moderately showed ovicidal effect. Hop extract revealed the best result in inhibiting egg hatchability (57.49%) at 10% concentration. It can beconcluded that hop extract may be used as supportive in an integrated pest management programme aimed at controlling *E.maura*.

1. Introduction

The Sunn pest, *E. maura* is a very damaging insect pest of wheat and barley which are important crops in Turkey (Lodos, 1982). It has occurred a trouble in Middle Anatolia, particularly in Aksaray, Konya, Ankara and Kırşehir since 1995 (Şimşek et al, 1996). The Sunn pest feeds on ripenning wheat grains, damaged grains largely fall the quality of the cooking of the leaven. The stages of late nymphal development and the intensive feeding of newly emerged adults are important phases in the biological cycles for *Eurygaster* spp. In the early instars nymphs don't feed intensely. Feeding densities and the damage to crops increases rapidly after the third instar. The newly emerged adult insects begin to feed on wheat grains intensively (Paulian and Popov, 1980; Popov et al, 1996). The Sunn pest, during feeding with its piercing-sucking mouthparts, injects protein-degrading enzymes from salivary glands into the cereals to soften the food. As a result of feeding, the enzymes induce quick relaxation of dough, which concludes in the production of bread with a low volume and coarse texture (Boyd et al, 2002).

Many plants have been demonstrated to have insecticidal, ovicidal, anti-ovipositional effect, antifeeding and other features, which are helpful in pest management (Ertürk et al, 2006; Yanar and Düzdemir, 2012; Elma and Alaoğlu, 2014a; Taş et al, 2015). Plants consist of a plentiful source of bioactive chemicals (Kim et al, 2005). Monoterpenes, triterpenes and sesquiterpene lactones are samples of such metabolites that may have the commercial application (Heywood et al, 1977; Barney et al, 2005).

Turkey has an extraordinarily rich flora (Şimşek et al, 1996). In this study, the ovicidal effect of extracts of four plants, which exist in Turkish flora were determined under laboratory conditions against the sunn pest *Eurygaster maura* L. (Heteroptera: Scutellaridae).

2. Materials and Methods

2.1. Insect rearing and egg production

Eurygaster maura adults were collected from overwintering sites in Karadağ - Karaman Province, Turkey, and proceed with plucked fresh wheat plants in the laboratory at 26±1° C under long day photoperiod

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(16:8 h light and dark). After the eggs were laid by the adults, on the wheat leaves and white paper napkins, these eggs were collected daily and used in this study (Kıvan, 2005).

2.2. Plants and sample preparation

The different parts (from leaves, flower buds or aerial parts) of lemon balm, hop, oregano and clove are used in this study (Table 1).

Table 1
List of the plant materials used against *Eurygaster maura* eggs.

Family	Plant name	Tissue Used
Lamiaceae	Lemon Balm	Leaves
Cannabaceae	Hop	Flower buds
Lamiaceae	Oregano	Aerial parts
Myrtaceae	Clove	Flower buds

They were dried at room temperature and were shredded to small size with a grinder (Retsch SM100). Five hundred grams of methanol (Merck % 99.5) is added to 50 grams of dried plant and allowed to stand for six days in the dark. Then the plant suspension was sieved through Whatman No.1 filter paper before methanol was vaporized in a rotary evaporator (Heidolp-VAP Precision) at 35 ± 2°C. The resulting residue was dissolved in the pure water including 10% acetone (v/v) to yield doses containing 2.5%, 5%, and 10% (w/w) plant extract. The control solution consisted of 10% acetone in distilled water (v/v).

2.3. Ovicidal activity of plant extracts on eggs

The ovicidal activity of plant extracts was assessed against *E.maura* egg mass, aged one to three days old three egg masses (41-42 eggs) were dipped into different concentrations of plant extracts for three-five minutes. Eggs were then directly taken to a filter paper to soak in the surplus solution and dried for half an hour at the room temperature. After that, these eggs were placed in a petri dish. The eggs were incubated conditions at 26±1°C, 16 h light: 8 h dark for 7-8 days. The numbers opened and unopened eggs were counted. The experiment was repeated three times. Each assay was consisted of three concentrations of plant extracts and one control. Unopened eggs were counted as dead. The ovicidal activity evaluating experiment data were calculated by emergence inhibition index (EII) (Ma, 2001) and calculated by the formula: EII= [(C – T)/C] 100%, Where T is emergence in the treatment and C is emergence in the untreated control (Mulla and Darwazeh, 1979).

3. Results and Discussion

The ovicidal effect on *E. maura* eggs of plant extracts, lemon Balm, hop, oregano and clove, is presented in table 2. Plant extracts showed variable toxicity to eggs of *E. maura* (ranged from 2.49 to 57.49%). The inhibition of egg hatchability decreased significantly with plant extract concentration. Hop extract revealed the best result in inhibiting egg hatchability (57.49%) at 10% concentration. Ovicidal effect for oregano and clove extracts was moderate and EII was 35%, 32.5% at 10% concentration, respectively. The inhibition of hatchability of the Lemon Balm extract was low and ranged from 2.49 to 15%.

Table 2
Ovicidal effects of different concentrations of plant extracts against the eggs of *E. maura* (expressed by emergence inhibition index % (EII))

Materials	EII (Mean ± SE) Concentrations (%)		
	%2.5	%5	%10
Lemon balm extract	2.49±0.57	10±0.57	15.01±0.33
Hop extract	12.49±0.66	30±0.88	57.49±1.20
Oregano extract	4.99±0.33	17.49±0.57	35±0.33
Clove extract	7.49±0.66	22.50±0.33	32.50±0.57

The results showed that the percent kill of egg masses of extracts were constantly increased by depending on the extract concentration. Similar results were reported by other studies in which different extracts had a dose-dependent effect on insect (Ouda et al, 1998; Phasomkusolsil and Soonwera, 2012; Zambare, 2012).

Secondary organic compounds contained in plants have a significant potential in pest management. It has been reported that these compounds exhibit toxins, ovicidal, repellent, oviposition deterrents and feeding deterrents on pests (Isman, 2006). There have been many studies on the ovicidal effect of the plant extracts to several species in different insect orders. (Javaregowda and Krishna Naik, 2007; Zambare et al, 2012; Yorulmaz Salman et al, 2014; Yorulmaz Salman et al, 2015; Alkan and Gökçe, 2017). But few studies reported on ovicidal effect of plant extracts against Sunn pest. Kıvan (2005) reported that the toxic effect of azadirachtin (NeemAzal T/S) were investigated on egg, nymph and adult stages of the Sunn pest *Eurygaster integriceps* Put, and also reported that the mortality of eggs was recorded 36%. In another study for ovicidal properties against *E. maura* reported that *Foeniculum vulgare* extract was found effective in causing 76.22% egg mortality among the methanol extracts of eight plants. (Elma and Alaoğlu, 2014b).

Hops includes alpha acids, prenylflavanoids, beta acids and proanthocyanidins (Hoek et al, 2001; Taylor et al, 2003). The beta acid derivative of hop avoids plants from chewing and piercing-sucking insect pests (Hampton et al, 2002) and the two-spotted spider mite, *Tetranychus urticae* Koch (Jones et al, 1996; Jones et al, 2003). Future studies will need to be performed to detect whether the activity of Hop against egg of sunn pest is interceded by the acid compound. Moreover, recognition of the bioactive compounds of hop may enable to development of botanical insecticides.

4. Conclusion

In this study, ovicidal activity of some plant extracts against sunn pest, E. maura were investigated. Data showed that hop extract has potential to be used as part of an integrated pest management against sunn pest because they had the highest effect among the four plant extracts tested. In addition, these results could support the search for new natural products providing an alternative to synthetic ovicidal from other Turkish indigenous plants. However future studies are needed to study the chemical structure and action mechanism of the active principle. Moreover, it is necessary to investigate the extract's efficacy, usefulness and chemical stability in field conditions.

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