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Natural enemies of *Ostrinia nubilalis* (Hubner) and papulation density of pest and its dominant natural enemy on four corn hybrids in Moghan region

Javad Salmani Moghanlou[1], Seyed Ali Asghar Fathi[1], Gadir Nuri Ganbalani[1], Jebraeil Razmjou[1], Masoud Taghizadeh[1], Abasalt Rostami Ajirlou[2] and Morad Shaban[3*]

[1-] *Department of Entomology, school of agriculture science, Mohaghegh Ardabili University, Ardabil, Iran*
[2-] *Ph.D Student in Agro-ecology, Department of Crop Production and Plant breeding, School of Agriculture, Zabol University, Zabol, Iran*
[3-] *Young Researchers Club, Boroujed branch, Islamic Azad University, Boroujerd, Iran*

Abstract

The European corn borer, *Ostrinia nubilalis* (Hübner), is an important insect pest of corn, *Zea mays* L., crop in Moghan region. In field experiments, the density of eggs and larvae of *O.nubilalis* and percentage of eggs and larvae parasitisms were studied on four corn hybrids NS704 (commercial cultivar), NS770, NS640 and MV524 (cultivars with high yield). Furthermore, in this study, the predators and parasitoids of the European corn borer were collected and identified on four corn hybrids in an experimental field. The seeds of corn hybrids were planted in an experimental field, approximately 700 m^2. This experiment was conducted in a completely randomized block design with four replications. Samplings were conducted from the V6 (six leaf collar) until the R3 (milk) growth stages of corn. On each sample date, five plants/hybrid from each of the four replication were selected randomly and number of eggs (parasitized and non- parasitized) of *O. nubilalis* per plant was recorded using a 20X hand lens, then the stalk of these plants were dissected and number of larvae, larval mines and parasitized larvae per plant were recorded. The results showed that, the lowest density of eggs, larvae and larval mines were observed on NS704. While, the percentage of eggs and larvae of this month on NS704 were higher than on the other three tested hybrids . Therefore, it was concluded that the NS704 hybrid was less suitable to the European corn borer among the tested corn hybrids and has the potential to be used in the integrated management of *O. nubilalis*. Furthermore, in this study 12 predators' species and 2 parasitoid species were collected and identified from experimental field. The predator bug, *Orius niger* Wolff, and parasitoid wasps, *Trichogramma brassicae* Bezd and *Habrobracon hebetor* (Say), had higher abundance rate on four tested hybrids.

Key words : Corn hybrids, natural enemies and *Ostrinia nubilalis*

Introduction

Maize (Zea mays) or corn is the most important cereal crop in Iran and with rice and wheat, maize is one of the three most important cereal crops in the world. Maize is high yielding, easy to process, readily digested and cheaper than other cereal crops. It is also a versatile crop, growing across a range of agro

Corresponding Author E-mail: Shaban.morad@yahoo.com

ecological zones. Every part of the maize plant has economic value which the grain, leaves, stalk, tassel and cob can all be used to produce a large variety of food and non food production. Corn is a very versatile grain that benefits mankind in many ways. Each year, 6 billion bushels of corn are used as feed for cattle, hogs and poultry in the United State. Another 2 billion bushels were exported, which is an integral part of this country's balance are converted to sweeteners, starch, flower cereal, liquor, animal feed, vegetable oil, alcohol for fuel and hundreds of other products (Beyranvand et al, 2013). Forgive to highest seed yield in agriculture addition to both fertilizer and pest management is very important (Shaban, 2013a,b in chickpea; Azimi et al, 2013in wheat and Beyranvand et al, 2013). pests (*Lepidoptera: Pyralidae*) in maize (*Zea mays* L.) production in Moghan region, Iran. European corn borer larvae cause yield losses of up to 30% in regions with a high natural occurrence of ECB due to feeding and tunneling in plants (Jarvis et al. 1974, Bohn et al. 1998). Furthermore it is assumed that ECB damage favors secondary mold infections such as *Fusarium* spp. or *Ustilago maydis*, which may led to additional yield losses and adversely affect the quality of grains (Lew et al. 1991, Munkvold et al. 1997, 1999). The ECB originated in Europe and expanded to the Middle East, northern Africa, North America, and Central America (Hoffmann und Schmutterer 1999). The Z-race of ECB primarily depends on maize as the host plant and, therefore, developed into an important maize pest since maize production rapidly increased in Central Europe (Langenbruch and Szewczyk 1995). In contrast, the polyphagous E-race attacks a wide range of herbaceous wild and cultivated plant species with stems large enough for larvae to enter, *e.g.*, *Polygonum* spp., *Utrica* spp., and *Solanum tuberosum* L. (Hudon and LeRoux 1986). In Central Europe the ECB completes normally one generation (univoltine) per year. In warmer regions, ECB occurs with two or more generations (multivoltine), depending on the geographic latitude and regional climatic conditions. Moths of ECB occur mid of June until the second half of July and oviposit egg masses onto maize plants in the late whorl stage before anthesis. After 10 to 14 days larvae begin to hatch. First- and second-instar larvae feed initially on leaf tissue within the whorls and then attack the enclosed tassels, feeding on the developing anthers. Later instars prefer pollen that accumulate in the leaf axils, attack the ears and shanks before boring into the stem of the plant. The adult larvae feed extensively in the stalks moving downwards to the bottom of the stalk or inside the ear to diapause (Hoffmann and Schmutterer 1999). In many maize growing areas, ECB populations exceed the economic threshold and, therefore, farmers are forced to take control measures (Rost 1996). The traditional ECB management method is to destroy shelter for overwintering by crushing maize residues and plowing. Furthermore, various insecticides (pyrethroid or organophosphate insecticides) as well as bacterial (Bacillus thuringiensis, Bt) and biological (Trichogramma parasites) control methods for ECB are available. However, ECB larvae on maize plants are difficult to combat, because they are exposed to sprays or antagonists for only a short period of time before they bore into the plant. Improving natural host plant resistance is an economically and ecologically promising mean to control ECB infestation.

Therefore, this experiment was laid out in order to determine of the density of eggs and larvae of *O.nubilalis* and percentage of eggs, larvae parasitisms, predators and parasitoids on four corn hybrid.

MATHERIAL AND METHODS

A field experiments, the density of eggs and larvae of *O.nubilalis* and percentage of eggs and larvae parasitisms were laid out on four corn hybrids NS704 (commercial cultivar), NS770, NS640 and MV524 (cultivars with high yield) under temperate condition in station of agricultural farm in Ardabil provience (Moghan station), Iran during 2011 and 2012. The experiment was conducted in a completely randomized block design with four replications. The predators and parasitoids of the European corn borer were collected and identified on four corn hybrids in an experimental field. The seeds of corn hybrids were planted in an experimental field, approximately 700 m^2. Samplings were conducted from the V6 (six leaf collar) until the R3 (milk) growth stages of corn. On each sample date, five plants/hybrid from each of the four replication were selected randomly and number of eggs (parasitized and non- parasitized) of *O. nubilalis* per plant was recorded using a 20X hand lens, then the stalk of these plants were dissected and number of larvae, larval mines and parasitized larvae per plant were recorded.

RESULTS AND DISCUTION

The results showed that, The effect of corn hybrid and growth stages on egg density, larvae and larval mines were significant in two years of 211 (table1) and 2012 (table2).

Table 1. Analysis of variance (mean squares) for egg density, larvae and larval mines in 2012

SOV	egg density	larvae	larval mines
hybrid(h)	49.56**	4.1**	7.4**
growth stage(g)	280**	13.4**	36**
h*g	1.53	0.11	0.27
Error	9.44	0.69	1.12

* and **:Significant at 5 and 1% probability levels, respectively.

Table 2. Analysis of variance (mean squares) for egg density, larvae and larval mines in 2012

sov	egg density	larvae	larval mines
hybrid(h)	74.1*	3.99**	10.8**
growth stage(g)	203**	10.8**	32.6**
h*g	5.45	0.24	0.32
Error	26.05	0.52	0.82

* and **:Significant at 5 and 1% probability levels, respectively.

In plants with 6 leaves the lowest density of eggs, larvae and larval mines were observed on NS704 in 2011, while, the percentage of eggs and larvae on NS704 were higher than on the other three tested hybrids . Density of egg on plants not significant different between NS704 and MV524 hybrids in 2011. data suggest that *O. nubilalis* does not have a vertical preference for oviposition in the canopy in these two hybrids. These data are similar to those collected in swecorn that showed a uniform vertical distribution of *O. nubilalis* egg masses on plants (Spangler and Calvin 2001). Possibly the uniform egg mass deposition within the plant canopy is a strategy to minimize intraspecific competition by *O. nubilalis* for food resources (Harmon et al. 2003). The mean of eggs on NS704 hybrid was significant less than NS770 and NS640 hybrids but density of eggs on NS704 and MV524 was deference significant in this year. Ovipositional preference for the lower leaf surface by *O. nubilalis* is consistent with that observed on other plants (Capinera 2001). This may be a strategy to reduce egg mortality from fluctuating environmental conditions as well as predation by natural enemies. In 2012, in plants with 6 leaves he lowest density of eggs, larvae and larval mines were same increased in both hybrids. In this year density of eggs in silking stage was more than other stages in maize phonology. The NS704 hybrid was less suitable to the European corn borer among the tested corn hybrids and has the potential to be used in the integrated management of *O. nubilalis*.

Furthermore, in this study 12 predators' species and 2 parasitoid species were collected and identified from experimental field. The predator bug, *Orius niger* Wolff, and parasitoid wasps, *Trichogramma brassicae* Bezd and *Habrobracon hebetor* (Say), had higher abundance rate on four tested hybrids. Smith (1996) suggested that *Trichogramma* find host eggs by random searching, and it is hypothesized that parasitization by the parasitoid is inversely proportional to the size (Wang et al. 1997) and complexity (Gingras and Boivin 2002) of the host plant. n general, the greater the plant surface area to search, the lower the parasitization rate. Smith (1996) suggested that *Trichogramma* species, in general, are much more habitat-specific than host-specific. This has been demonstrated in *T. pretiosum* and *T. minutum* (Thorpe 1985). Some host plants provide volatile cues (kairomones) that arrest and stimulate searching and parasitization in *Trichogramma* (Noldus 1989). More research into the environmental cues (visual and chemical) used by *T. ostriniae* for host finding may help to explain these differences. Control of *O. nubilalis* and other lepidopteran pests in bell pepper has traditionally only been effective with routine insecticide applications (Barlow et al. 2004). *Trichogramma* parasitoids occur worldwide and play an important role anatural enemies of a wide range of lepidopteran pests in agricultural crops (Smith 1996). The use of biological control is the preferred tactic to control pests in systems when timing and frequency of chemical sprays is difficult. Integration opesticide applications with biological control releases may be beneficial when control of a pest needs to be increased. Any pesticide used during the growing season has the potential to disrupt biological control efforts. Development of integrated control programs that are based on ecologically compatible use of chemical and biological methods is essential for effective use of beneficial organisms in cropping systems (Franz et al. 1980). Tolerance for crop injury plays an important role in the level of *O. nubilalis* control required. Potato can withstand reasonable levels of *O. nubilalis* tunnel injury without significant yield loss (Nault and Kennedy 1996), but tolerance for *O. nubilalis* in pepper is much lower because the marketable portion of the crop is directly injured (Hazzard and Ghidiu 2001). Therefore, combined *O. nubilalis* mortality rates from parasitization and other factors would need to be higher in pepper than potato for economic control. European corn borer eggs and early instars are attacked by naturally-occurring predators, parasitoids, and pathogens (Mason et al. 1996). These natural enemies along with abiotic factors contribute to a relatively high natural mortality (60–90%) of *O. nubilalis* eggs and early instars in corn (Frye 1972, Showers et al. 1976, Ross and Ostlie 1990). In sweet corn, Kuhar et al. (2002) showed that 60 to 80% of *O. nubilalis* eggs and early larvae perished from natural causes, and that increasing egg parasitization to 37% with augmentative releases of *T. ostriniae* increased the total mortality to more than 90%. This resulted in a concomitant 50% reduction in ear damage. Thus, depending on the degree of pest pressure, the tolerance for injury in the host plant and the market, and the level of natural control, *T. ostriniae* may provide an effective management option for *O. nubilalis* in solanaceous crops. More work is needed to optimize release rates and strategies, as well as compatibility with other management tactics such as insecticides.

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