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Data on annual population density of *Eurygaster integriceps* on Sardari and Gaskogen wheat cultivars and Sahand barley cultivar in Korayim, Ardabil, Iran

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Abstract. Sun pest, *Eurygaster integriceps* Puton (Heteroptera: Scutelleridae), is the major pest of wheat and barley in all regions except the Northern and Southern shores of Iran. This pest causes high damage to all vegetative hosts (stems, spikes and leaves) by feeding sap in nymph and adult stages (mother and new generation). Information on its biology and population density was evaluated in order to gain a better understanding of the best way to its control. In this study, we studied the effects of Sardari (dry land) and Gaskogen (aqua culture) wheat cultivars and Sahand barely cultivar (dry land) on population density of nymphs and adults of this pest. Present study was done by sweeping with hand-net and counting square meter quadrate methods in Korayim region of Ardabil, Iran. Results showed that population density of nymphs and adults of *E. integriceps* on aqua culture cultivar of wheat (Gaskogen) were more than other wheat and barley cultivars. Nymph and adult population in the barley cultivar (Sahand) were less than in the wheat cultivars (Gaskogen and Sardari).

Keywords: *Eurygaster integriceps*; Gaskogen wheat cultivar; Sardari wheat cultivar; Sahand barely cultivar; Population density.

Introduction

Wheat, *Triticum aestivum* L., and barley, *Hordeum vulgare* L., are very important food crops in the near East, Middle East, and South-Western Asian countries. The Sunn pest, *Eurygaster integriceps* Puton (Heteroptera: Scutelleridae), is the most important insect pest of cereals (wheat and barley) in Iran. It has a single generation a year and an obligatory diapause in the adult stage. Nymphs and adults cause damage by feeding on leaves, stems and grains (Cardona et al. 1983, Radjabi 2000, Gul et al. 2006). It damages the host in two ways: 1- quantitative damage (yield reduction) causing central bud death, hollow and thin spikes as the result of mother adults feeding and also blotch all or some parts of spikes with nymphs and new adults feeding. 2-qualitative damage (perish or reduction of Gluten and consequently reduction of bakery properties) because of new generation feeding (Javahery 1995, Kinaci et al. 1998). *E. integriceps* has one generation a year and during the life cycle is active only two and a half months to three months on the family of grasses and some of other plants (Radjabi & Termeh 1992). When the new generation reaches the adult stage in the wheat field in early summer, the young adults pass through a stage of intensive feeding of wheat grains, lasting for about 10-12 days. This period is of the greatest importance because quantities of fat and other food reserves are accumulated preparatory to migration to the mountains and subsequent diapauses through late summer and winter. Successful feeding at this time related on large extent of the survival insects in good condition until the following spring (Brown 1962).

Sunn pest population is generally low in most areas of Ardabil province of Iran, but the population of this pest has strongly increased in the fields of Korayim region of this province in recent years and has caused heavy damage to wheat. In order to effectively control this pest, information in biology, ecology and management solutions are needed. Despite a long history of the pest in Iran, there are few studies, if any, on the effects of environmental factors on its population. Some works have addressed the effect of different cultivars on biological parameters like fecundity (Zomorrodi 1961, Abdollahy 1989) and reproductive diapause (Martin et al. 1969, Radjabi & Termeh 1992, Radjabi 2000) but there isn't any study related to comparison of Sunn pest population on wheat cultivars or on wheat and barley cultivars. In 1982, a sudden increase in the *E. integriceps* population occurred in the Thrace region of Turkey, after the introduction of new wheat varieties. A serious outbreak occurred during 1987-89 and as a result, thousands of hectares of wheat were damaged (Kinaci et al. 1998). Thus, evaluation of Sunn pest population on new cultivars might be applicable in the integrated management of this pest. In the present study, the population densities of *E. integriceps* were studied on Sardari (dry land) and Gaskogen (aqua culture) wheat cultivars and Sahand (dry land) barely cultivar.

Materials and Methods

The study was done in the Korayim region of Ardabil province in Iran. This area is one of the cold regions and has a mild summer and a long period of frigid. Decreasing in air-temperature usually begins in November with downfall of snow on heights and it often prolongs until end of April. The average annual rainfall in this region is about 350 mm that often is as snow. In order to study the effects of cultivars on population density of *E. integriceps*, for each cultivar was selected one experimental field with approximately 1 hectare area at 1500 meter altitude.

Evaluation of nymph and adult population densities were done with two methods including sweeping with hand-net and counting square meter quadrate (Banks & Brown 1962). Sweeping was done with hand-net (38 cm mouth diameter, 52 cm deep cone-shaped net and 110 cm knob) by the same person. We counted the number of nymphs and adults found in the net. This work was repeated 10 times in each field. For quadrate method, a wooden box with dimensions of 1×1 m was used. Thus, the wooden box randomly was thrown 10 times in different parts of the farm except 5 m far from edge of the field. The number of nymphs and adults present in each quadrate was counted and recorded. Sampling was done after complete migration of insects from the winter refuges toward wheat and barley fields from early May to August for each three days.

Obtained data were analyzed in the Split Plot design. In the

main plot there were plants and repeat for plants and sampling times were subplots. To equalize variances, mortality percentages of insects were transformed using the square root method. Data were subjected to analysis of variance (ANOVA) by SAS software (SAS Institute 1999). The means were separated using the Duncan's test at the 5% level.

Results

Analysis of Variance of nymph and adult population densities of Sunn pest on two wheat cultivars (Sardari and Gaskogen) and a barley cultivar (Sahand) for quadrate method is presented in Table 1. Significant difference was observed for three host plants in terms of population density of females, males and nymphs of Sunn pest. Among the different sampling times and population densities of nymphs, males and females obtained significant differences, too. A comparison mean data of population density of Sunn pest on three studied plants in quadrate method is given in Table 2. In all cases, population density of males and females in Gaskogen wheat cultivar (aqua culture) was more than Sardari wheat cultivar (dry land) and in the Sardari wheat cultivar was significantly more than Sahand barley cultivar (dry land). Population density of nymphs on Sardari wheat cultivar was more than Gaskogen wheat cultivar and on Gaskogen wheat cultivar was more than Sahand barely cultivar (Table 2). On the other hand, population density of nymph and adults of *E. integriceps* on Sahand barley cultivar was less than wheat cultivars.

The analysis of variance of the population densities of nymph, male and female of Sunn pest on the three host plants with the method of Sweeping are presented in Table 3. A significant difference was observed among studied plants in terms of population density of females, males and nymphs. A significant difference was revealed for sampling times in the population density of females, males and nymphs. Comparison of population density data for adults and nymphs in three host plants with sweeping method is presented in Table 4. The density of males and females on the Sardari and Gaskogen wheat cultivars were higher than Sahand barley cultivar. Nymph density on the Sardari wheat was higher than others. Density of nymph and adult population of *E. integriceps* on Sahand barley cultivar in this method alike quadrate method was less than wheat cultivars.

Discussion

Study of insect's density can be useful to calculate damage, concept of biological traits and delicacy of controlling methods of them. Accordingly, many studies were conducted to evaluate population densities to achieve these purposes (Critchley 1998, Kinaci et al. 1998, Maafi & Parker 2001, Iranipour et al. 2003, Afsarian et al. 2006). Losses due to the

Table 1. Analysis variance of population density data for nymphs and adults of *E. integriceps* in quadrate method.

Source	Df	Mean square		
		Nymph	Female	Male
Plant	2	2.88**	0.782**	0.798*
Repeat for Plant	27	0.043**	0.160^{ns}	0.016 ^{ns}
Sampling Time	15	2.65**	0.460**	0.591**
Sampling Time × Plant	30	0.394**	0.240**	0.252**
Error	405	0.042	0.016	0.016

* indicate significant difference at $P \leq 0.05$
** indicate significant difference at $P \leq 0.01$
^{ns} no significant difference

Table 2. Comparison mean of population density data for nymphs and adults of *E. integriceps* in quadrate method.

Plant	Nymph	Female	Male
Sardari wheat cultivar (dry land)	5.65 a	1.43 b	1.62 b
Gaskogen wheat cultivar (aqua culture)	4.44 b	1.97 a	2.08 a
Sahand barley cultivar (dry land)	1.41 c	0.54 c	0.64 c
LSD	0.75	0.27	0.33

Different letters (a, d, and c) are significantly different at 5% level.

Table 3. Analysis variance of population density data for nymphs and adults of *E. integriceps* in sweeping method.

Source	Df	Mean square		
		Nymph	Female	Male
Plant	2	0.675**	0.093**	0.103**
Repeat for Plant	27	0.008 ^{ns}	0.010^{ns}	0.014*
Sampling Time	15	0.171**	0.085**	0.113**
Sampling Time × Plant	30	0.037**	0.019**	0.024**
Error	405	0.0015	0.008	0.009

* indicate significant difference at $P \leq 0.05$
** indicate significant difference at $P \leq 0.01$
^{ns} no significant difference

Table 4. Comparison mean of population density data for nymphs and adults of *E. integriceps* in sweeping method.

Plant	Nymph	Female	Male
Sardari wheat cultivar (dry land)	1.24 a	0.46 a	0.49 a
Gaskogen wheat cultivar (aqua culture)	0.72 b	0.41 a	0.50 a
Sahand barley cultivar (dry land)	0.28 c	0.17 b	0.19 b
LSD	0.17	0.15	0.18

Different letters (a, d, and c) are significantly different at 5% level.

Sunn pest are highly variable, depending on the population density of the insect, weather conditions, water availability and wheat cultivar characteristics (Yuksel 1969). As importance of Sunn pest, we studied population density of this pest with two methods for first time in region of Korayim, Ardabil, Iran: sweeping with hand-net and counting square meter quadrate. Although sweeping caught only 10-20 percent of the bugs above ground and sampled only those bugs at the top of the plants, the estimation obtained from sweep count reflected the difference in population between plants (Banks & Brown 1962). Counting quadrate has the advantage of estimating the Sunn pest population above ground. It can be obtained to any increased degree of accuracy by increasing the number of quadrates (Banks & Brown 1962). Therefore, in this study we used both methods for the estimation of the Sunn pest population.

Radjabi (2000, 2007) observed that rainy conditions in spring could delay development of *E. integriceps* in relation to wheat. Moreover, oviposition begins later and is extended over a longer period. This has an indirect effect on the next generation by shortening of pest feeding. Salavatiyan (1991) also stated when such conditions occur in successive years, they can lead to a considerable decline in the population. Other workers reemphasized on the indirect effect of drought on pest abundance via its indirect effect on wheat growth and nutrition (Safavi 1972, Salavatiyan 1991). Afsarian et al. (2006) found that drought might also cause direct mortality in the pest population. However, when fields were irrigated for longer periods, densities of nymphs and adults in the next generation were lower even when initial adult densities were the same. These results uphold our observations that population density of *E. integriceps* in Gaskogen wheat cultivar (aqua culture) was higher than other cultivars (dry land).

Karaca et al. (2004) investigated the effect of different cereal (wheat and barley) on the population density of Sunn Pest in the south east Anatolia region of Turkey during 1993-1995. In cereal fields which had the same or similar over wintered adult populations, different nymphal densities may have occurred. More nymphs were counted in wheat fields than in barley fields in the different years that dependent on climatic and environmental conditions. In our study, nymphal density of Sunn pest in wheat cultivars (Sardari and Gaskogen) was more than in the barley cultivar (Sahand) for each two methods, too. Furthermore, adult population on wheat cultivars was less than that on barely cultivar. On the other hand, Sahand barley cultivar was unsuitable for nymphs and adults of *E. integriceps*. According to Rezabeigi (2001) in barley field, Sunn pest's life cycle was completed 7-10 days earlier than that in the wheat fields and Sunn pest synchronized its life cycle with phonological stage of hosts. In barley fields 75% of the pest population were able to complete their life cycle on harvesting time, but at the same time wheat plants were at the waxy stage and only 27% of the individuals were in adult stage. At harvest the weight of males and females was found to be significantly higher in wheat than that in barley and a significant correlation of the weight of newly emerged adults with plant growth span. This finding can be reason for low population of Sunn pest in barley cultivars.

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