EFFECT OF DIFFERENT WHEAT VARIETIES ON SOME OF DEVELOPMENTAL PARAMETERS OF *ANAGASTA KUEHNIELLA* (LEPIDOPTERA: PYRALIDAE)

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ABSTRACT: Wheat (*Triticum aestivum L.*) varietal susceptibility to the Mediterranean flour moth, *Anagasta kuehniella) Zeller*, 1879) was evaluated in ten dry land and irrigated wheat that was produced at Azarbayejan, Iran. In this study some biological parameters of pest were affected by evaluated wheat varieties. Investigated parameters were included weight of larvae, emergence rate of pupae, emergence rate of adults, sex ratio and fecundity. Weight of larvae, emergence rate of pupae and sex ratio in the different cultivars at probability levels of 5% were not significant. The varieties on the emergence rate of adults and fecundity at probability levels of 5% had significant difference. As the highest and lowest rates were obtained at varieties of 'Sardari' and 'Shirudi', respectively. Also the highest and lowest fecundity were observed at varieties of 'Azar 2' and 'Rasad' respectively. Emergence rate of adults in wheat with high protein levels were decreased and fecundity in this varieties increased. According to these experiments different wheat varieties have high resistance to infestion by mediterranean flour moth, *Anagasta Kuehniella* (Lep.: Pyralidae) and results of this study is disreble for use in agriculture.

KEY WORDS: *Anagasta kuehniella*, wheat varieties, resistance, flour moth.

The Mediterranean flour moth, *Anagasta kuehniella* Zeller, is one of the major pests in industrial flourmills in temperate climates (Jacob & Cox, 1977). Moth larvae produce webbing, which blocks machinery and pipes; presence of larvae and webbing in the end product is unacceptable to consumers (Hansen & Jensen, 2002). Its control generally requires the use of chemical insecticides that are toxic to humans, domestic animals and the environment. Given increasing problems with resistance and impact on non-target organisms related to the use of synthetic insecticides, there is an urgent need for the development of safer alternatives, such as insecticide proteins that interfere with the digestive process (Carlini & Grossi-de-Sá, 2002; Montesdeoca et al., 2005).

Trichogramma species are used worldwide in biological control against insect pests with over 32 million ha of agriculture and forest being treated annually (Li, 1994). Commercial facilities produce large numbers of *Trichogramma* from parasitized eggs of stored product moths (Bernardi et al., 2000). It would be beneficial to store large numbers of host adults to obtain the desired number of host eggs when planning parasitoid releases. Host diet is of importance to the nutritional quality of host eggs and the subsequent survival of Trichogramma and other egg parasitoids released into the environment as biological control agents (Hunter, 2003). Understanding the role of host diet on host acceptance by *Trichogramma* could improve the success of biological control programs by increasing the predictability of parasitoid performance in an inundative release (Song et al., 1997).

Wheat cultivars are developed for a wide variety of locations and applications in crop production. Improved cultivars are bred to increase resistance to diseases and insects, adapt to new environments, increase quantities of certain nutrients, change growth habits, and to increase productivity (Martin et al., 1976). Although increased yield is often the target of crop improvement, it is important that the commodity not be highly susceptible to pathogens or grain degrading components capable of negating any increases to net returns. Wheat cultivars have different levels of resistance to stored product insects (Singh & Mathew, 1973, Phadke & Bhatia, 1975, Amos et al., 1986; Sinha et al., 1988; McGaughey et al., 1990; Cortez-Rocha et al., 1993). This study was conducted to determine relative levels of host resistance to infestation by the mediterranean flour moth among ten cultivars. The specific objectives were to compare yield of adult mediterranean flour moth fecundity in ten wheat cultivars, compare the effects of varieties on emergence rate of pupae, emergence rate of adults and sex ratio, correlate levels of mentioned parameters by mediterranean flour moth with physical and chemical characteristics of wheat cultivars, and assess the effect of wheat cultivar on dry weights of larva moths.

MATERIALS AND METHODS

Wheat Varieties

Ten Wheat varieties were developed at Azarbayejan, Iran. These varieties consist of 'Sardari', 'Gohardasht', 'Tajan', 'Niknejad', 'Shiroodi', 'Arta', 'N-80-19', 'Zagros', 'Azar 2' and 'Rasad'. All Wheat varieties were milled and before starting experiments, subsamples of each variety were analyzed using the Kjeldahl method according standard methods (Velp scientifica, UDK 142, Italy) for determination of Protein content (AACC., 1983).

Insects

The *A. kuehniella* stock culture was obtained from laboratory colonies at the Department of Plant Protection, Faculty of Agriculture, University of Tabriz. *A. kuehniella* larvae were reared on ten wheat varieties, and the normal rearing conditions were 27 ± 1°C, 70 ± 5% R.H., and a photoperiod of 16:8 (L:D) h. This culture was maintained under these rearing conditions for 4 generations.

Evaluation of developmental parameters

Investigated parameters were included weight of larvae, emergence rate of pupae, emergence rate of adults, sex ratio and fecundity. For measurement of larval weight in both sexes, 20 fifth instar larvae were used which completed their nutrition. For estimation of emergence rate of pupae; we used last stage larvae which had completed their nutrition and were in pupate threshold. Assessment of emergence rate of adults was done by monitoring egg stage to adults stage.

Data analysis

Data was submitted to analysis of variance (ANOVA) and mean comparison was made using Duncan test in a completely randomized design. A significance level of 0.05 was used for all statistical tests.

RESULTS

Effect of different wheat varieties on larval weight
When male and female larva were fed on various wheat varieties, any significant difference observed between the weight of larva in both sexes exception in 'Arta' and 'Shiroodi' varieties ($F= 10.43$, $P< 0.05$ male and $F= 9.93$, $P< 0.05$ female).

Effect of different wheat varieties on emergence rate of pupae
There were not any significant difference between the emergence rate of pupae in both sexes, when they were fed on different wheat varieties ($F= 0.489$, $P< 0.05$ male and $F= 0.574$, $P< 0.05$ female).

Effect of different wheat varieties on emergence rate of adults
Statistical analysis showed that there was a significant difference between the emergence rate of adults fed on different wheat varieties. The highest emergence rate of adults was recorded in larvae fed on 'Sardari' variety (96%). the lowest emergence rate was observed in larvae fed on 'shirudi' variety (58%). However, emergence rate of adults fed on 'Gohardasht', 'Tajan', 'Niknejad', 'Arta', 'Zagros', and 'Rasad' remained low at under 80% ($F= 6.254$, $P< 0.05$) (Table 1).

Effect of different wheat varieties on sex ratio
When larvae were fed on different wheat varieties any significant difference observed between the sex ratio of adult ($F= 1.64$, $P< 0.05$).

Effect of different wheat varieties on fecundity
Fecundity was affected by the biochemical composition of different wheat varieties. Statistical analysis showed that there was a significant difference between the Fecundity of female adults fed on different wheat varieties. The highest mean of egg number were recorded in female adults fed on 'Azar 2' and 'Niknejad' variety (respectively, 231.2 and 223). The lowest mean of egg number were observed in female adults fed on 'Rasad', 'Sardari' and 'Shirudi' variety (respectively, 168, 171.3 and 177.2) ($F= 17.708$, $P< 0.05$) (Table 2).

DISCUSSION

Weights of male and female larva were not affected by different wheat varieties. Toews et al. (2000) similar to results of this experiments found that there were no significant difference at probability levels of 5% between weight of adult *Rhyzopertha dominica* (F.) that were grown on different wheat varieties with different protein levels. Also Pyria et al. (2010) indicated that insect weight fed on wheat did not very significantly by modification in wheat chemical characteristics. Weight of larvae grown on 'Arta' and 'Shiroodi' varieties reduced due to inadequate amount of flour available to larvae during the breeding. The seeds of these two cultivars after flour mills had relatively high humidity and were more hardness. Therefore flours were not milled completely and this caused that the larvae could not feed properly especially in lower ages.

Emergence rate of pupae in both sexes were not affected by different wheat varieties. For estimate emergence rate of pupae; we used last stage larvae in pupate threshold. In this stage, larvae were passed nutrition effects and survived, therefore different wheat varieties can not effect on emergence rate of pupae. However emergence rate of adults on different wheat varieties have significant difference. Fields (2006) used various ratios of protein-rich pea flour mixed with

wheat flour Protein-rich pea flour and showed that with increasing amounts of protein-rich pea flour, mortality of adults increased. Also resistances of different maize genotypes with various protein on *Sitophilus oryzae* were assessed. Results showed that genotypes with high percentage of protein caused increase in mortality of adults (Hossain et al., 2007).

Fecundity was affected by the biochemical composition of different wheat varieties. fecundity of lesser grain borers, *Rhyzopertha dominica* (F.), were assessed on eight U.S. Wheat Cultivars. While eaten protein increased by feed on different wheat varieties; subsequent production of insect were increased (Toews et al., 2000). Also different ratios of protein-rich pea flour mixed with wheat flour and its effect on development of stored beetles were evaluated. Results showed that progeny production with increasing amounts of protein-rich pea flour was increased (Fields, 2006). Hossain et al. (2007) reported that the progeny production of *Sitophilus oryzae* (L.) with feeding of different genotypes of maize with high protein was increased. It is according to this fact that reproduction especially act of vitellogensis in insect is depends on the amount of protein in their diets (Chapman, 2009).

In our study, there was a positive correlation between fecundity rate and Protein levels of different wheat varieties (r=0.461) (Fig. 1). Sex ratio of adult fed on different wheat varieties was not affected by different wheat varieties. Effect of diets containing four grains (soybeans, barley, wheat and corn) and two types of vitamin nutrient (wheat germ and brewer's yeast) on A. kuehniella were studied. Sex ratio was not affected by diet, but it caued increasing longevity of female adults (Rodrigez et al., 1988). Rodrigez Philho et al. (1989) investigated the Sex ratio in the diets of dry and wet wheat flour and reported that this ratio was 50: 50. Therefore results of other studies confirm the results of our study.

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LITERATURE CITED

[AACC] American Association of Cereal Chemists. 1983. Approved methods of the AACC. Procedure 46–12. Approved 10 August 1976, revised 3 November 1983 and 8 October 1986. AACC, St. Paul, MN.

Amos, T. G., Semple, R. L. & Williams, P. 1986. Multiplication of some stored grain insects on varieties of wheat. Gen. Appl. Entomol., 18: 48-52.

Bernardi, E. B., Haddad, M. L. & Parra, J. R. P. 2000. Comparison of artificial diets for rearing *Corcyra cephalonica* (Stainton, 1865) (Lep.: Pyralidae) for *Trichogramma* mass production. Rev. Bras. Biol. 60: 45-52.

Carlini, C. R. & Grossi-de-Sá, M. F. 2002. Plant toxic proteins with insecticidal properties. A review on their potentialities as bioinsecticides. Toxicon, 40: 1515-1539.

Cortez-Rocha, M. O., Wong-Corral, F. J., Borboa-Flores, J., Sanchez-Marinez, R. I. & Cinco-Moroyoqui, F. J. 1993. A study on the susceptibility of wheat varieties to *Rhyzopertha dominica* F. Southwest. Entomol., 18: 287-291.

Chapman, R. F. 1985. Structure of the digestive system. In: G.A. Kerkut and L.I.Gilbert (editors). Comprehensive Insect Physiology, Biochemistry and Pharmacology.Vol. 4.Pergamon Press, Oxford, 165-211.

Fields, P. G. 2006. Effect of Pisum sativum Fractions on the Mortality and Progeny Production of Nine Stored-Grain Beetles. Journal of Stored Products Research, Vol. 42: 86-96.

Hansen, L. S. & Jensen, K. M. V. 2002. Effect of temperature on parasitism and host-feeding of *Trichogramma turkestanica* (Hymenoptera: Trichogrammatidae) on *Ephestia kuehniella* (Lepidoptera: Pyralidae). J. Econ. Entomol., 95 (1): 50-56.

Hossain, F., Boddupalli, P. M., Sharma, R. K., Kumar, P. & Singh, B. B. 2007. Evaluation of Quality Protein Maize Genotypes for Resistance to Stored Grain Weevil *Sitophilus oryzae* (Coleoptera: Curculionidae). International Journal of Tropical Insect Science, 27 (2): 114-121.

Hunter, M. D. 2003. Effects of plant quality on the population ecology of parasitoids. Agric. For. Entomol., 5: 1-8.

Jacob, T. A. & Cox, P. D. 1977. The influence of temperature and humidity on the lifecycle of *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae). Journal of Stored Products Research, 13: 107-118.

Li, L.Y. 1994. Worldwide use of Trichogramma for biological control on different crops: a survey. In: Wajnberg E, Hassan SA (eds) Biological control with egg parasitoids. CABI, Wallingford, pp. 37-44.

Martin, J. H., Leonard, W. H. & Stamp, D. L. 1976. Principles of field crop production, 3rd ed. Macmillan, New York.

McGaughey, W. H., Speirs, R. D. & Martin, C. R. 1990. Susceptibility of classes of wheat grown in the United States to stored-grain insects. J. Econ. Entomol., 83: 1122-1127.

Montesdeoca, M., Lobo, M. G., Casanas, N., Carnero, A., Castanera, P. & Ortego, F. 2005. Partial characterization of the proteolytic enzymes in the gut of the banana weevil, Cosmopolites sordidus, and effects of soybean Kunitz trypsin inhibitor on larval performance.Entomologia Experimentalis et Applicata, 116: 227-236.

Phadke, K. G. & Bhatia, S. K. 1975. Rate of increase of Sitophilus oryzae (L.) and Rhyzopertha dominica (F.) in different varieties of wheat. Indian J. Entomol., 37: 292-302.

Priya, S., Kaur, N. & Gupta, A. K. 2010. Purification, Characterization and Inhibition Studies of α-Amylase of *Rhyzopertha dominica*. Pesticide Biochemistry and Physiology, 98: 231-237.

Rodriguez Filho, I. L., Haddad, M. L., Parra, J. R. P. & Stein, C. P. 1991. Comparison of wet and dry diets for creating *Anagasta kueniella* (Zeller, 1879) (in portuguese). Annals of the Entomological Society of Brazil, 20 (2): 417-425.

Rodriguez, M. H., Cabello, G. T. & Vargas, P. 1988. Influence of diet and lighting on longevity, fecundity and fertility of *Anagasta kuehniella* Zeller (Lep.: Phycitidae) (in Spanish). Biorational Control of Arthropod Pests, 14 (4): 561-566.

Singh, H. N. & Mathew, G. 1973. Comparative resistance of different wheat varieties (to rice weevil *Sitophilus oryzae* Linn.) during storage. Mys. J. Agric. Sci., 7: 86-89.

Sinha, R. N., Demianyk, C. J. & McKenzie, R. I. H. 1988. Vulnerability of common wheat cultivars to major stored product beetles. Can. J. Plant Sci., 68: 337-343.

Song, S. J., Bourchier, R. S. & Smith, S. M. 1997. Effect of host diet on acceptance of eastern spruce budworm eggs by *Trichogramma minutu*m. Entomol. Exp. Appl., 84: 41-47.

Toews, M. D., Cuperus, G. W. & Phillips, T. W. 2000. Susceptibility of Eight U.S. Wheat Cultivars to Infestation by *Rhyzopertha dominica* (Coleoptera: Bostrichidae). Environmental of Entomology, 29 (2): 250-255.

Table 1. Effect of different wheat varieties on emergence rate of adult.

Different wheat varieties	Protein (%) (Mean ± SE)	Emergence rate of adults (%) (Mean ± SE)
Sardari	9.97±0.18g	48±3.64a
Gohardasht	17.82±0.36bc	35.33±1.52bcd
Tajan	18.87±0.35a	42.33±2.51bcd
Nikneja	17.15±0.29d	38±1bc
Shiroodi	10.64±0.35ef	29±6.24d
Arta	18.04±0.31b	37.67±5.5bc
N-80-29	17.31±0.67cd	33.67±5.77cd
Zagros	19.35±0.33a	38.67±5.13bc
Azar 2	10.44±0.21fg	41abc
Rasad	11.25±0.22 e	30.33±2.08d

Means followed by the same letter in a column are not significantly different at P < 0.05 (ANOVA, Duncan's test)

Table 2. Effect of different wheat varieties on Fecundity of female adults.

Different wheat varieties	Protein (%) (Mean ± SE)	Number of egg (Mean ± SE)
Sardari	9.97±0.18g	271.33±15.05f
Gohardasht	17.82±0.36bc	283.20±22.21ef
Tajan	18.87±0.35a	302.03±19.97cd
Nikneja	17.15±0.29d	323.07±17.64ab
Shiroodi	10.64±0.35ef	277.27±26.64f
Arta	18.04±0.31b	293±16.62de
N-80-29	17.31±0.67cd	306.73±16.72cd
Zagros	19.35±0.33a	312.07±23.05bc
Azar 2	10.44±0.21fg	331.27±17.33a
Rasad	11.25±0.22 e	296.81±28.50f

Means followed by the same letter in a column are not significantly different at P < 0.05 (ANOVA, Duncan's test)

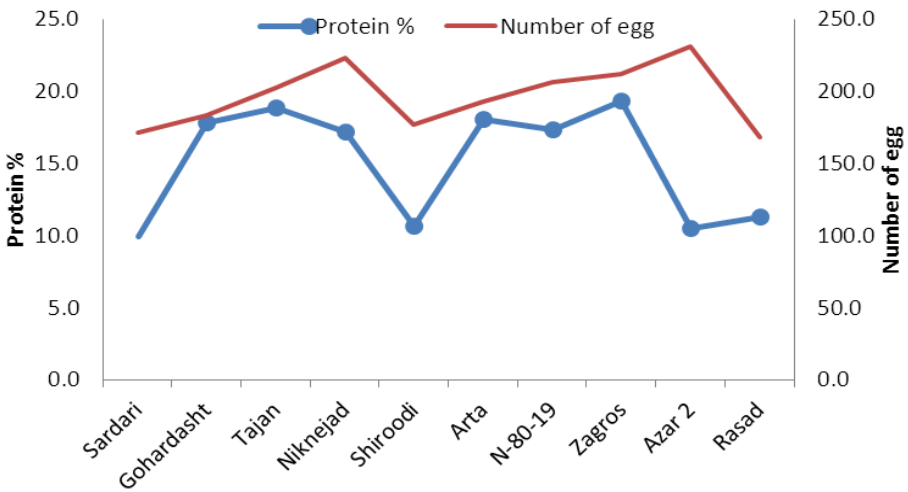

Figure 1. Correlation between protein rate and fecundity of Mediterranean flour moth on different wheat varieties.