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Integrated Control of Pod Borer, *Helicoverpa armigera* (Hub.) (Lepidoptera, Noctuidae), Releasing *Chrysoperla lucasina* (Neuroptera, Chrysopidae) and Treatment of Insecticides

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Abstract: Chickpea was planted in a complete randomized block design (CRBD) in an experimental field of Agricultural Faculty of Razi University, in Kermanshah, Iran, for a two years period. Bivenich, a local Desi type variety mostly sown, by the farmers in the Kermanshah province in west Iran was used. Six treatments applied, release of green lacewing *Chrysoperla lucasina* larvae, 4 different insecticide treatments and control. The statistical softwares of SAS and MSTAT-C were used for analysis of data and comparison between means, respectively. The green lacewing 2nd instar larvae were released, one month after insecticide sprayings. The perforation of the seed coat and the weight of attacked seeds by chickpea pod borers, have been chosen as signs and impact of damage caused by the pest and inefficiency of insecticide treatments used, in both years of experiment, 2005 and 2007.

Key words: Chickpea (*Cicer arietinum*), integrated pest control, chickpea pod borer, *Helicoverpa armigera*, Kermanshah, Iran

INTRODUCTION

Chickpea (*Cicer arietinum*) a pulse of papillionaceae family, is planted widely in different countries of the world. It is also planted in Asia and composing 20% of the world's total legume production. During 2005, Iran was the fourth largest chickpea producing country in the world, ranking after India, Turkey and Pakistan (Faostat, 2006). Between the pests of chickpea, the armyworm, *Helicoverpa armigera*, is the most important in Iran (Khanjani, 2004), as well as in India (Sharma *et al*., 2005), Pakistan (Ahmed *et al*., 2004; Ahmad, 2007). During the past decade, many authors, in their research, reported, the existence of resistance to different insecticides, between populations of pod borer, for example, Scholz *et al*. (1998), Ahmad *et al*. (2001), Keshav Raj *et al*. (2001), Thibaud *et al*. (2003), Ramasubramanian and Regupathy (2004), Yang *et al*. (2005), Ahmad *et al*. (2006) and Wu *et al*. (2006). For overcoming resistance, different mechanisms were used by various researchers, for example some of researchers, have used leaf disc bioassay of different insecticides against larvae of pod borer and selected one of them, with better efficiency, for use, in the field (Duffield and Jordan, 2000), some others proposed, the rotational use of different insecticides, belonging to different groups (Razaq *et al*., 2007) and others used integrated control of pod borer, by use of nematodes, *Steinernema feltiae* together with *Ha*NPV (Narayanan and Gopalakrishnan, 2003), or release of *Trichogramma*, together, with use of Bt. and or NPV (Scholz *et al*., 1998). Another way of coping with the damage, caused by pod borer, is, the use of Bt. transgenic plants, mostly cotton. In year 2006, about 3.8 million ha of cotton grown in India, was Bt. transgenic (Gujar *et al*., 2008). Transgenic chickpea, is another alternative of control of chickpea pod borer

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(Romeis *et al*., 2004). Mirmoayedi (1997, 1998, 2001) released eggs and larvae of green lacewing *Chrysoperla carnea* as a biological control method for control of Safflower aphids and flies, cotton's leafhopper and spiny bollworm, but the results of those biological control, by release of green lacewing, was not satisfactory, therefore the method of integrated control used in this research.

MATERIALS AND METHODS

In a two years study period between 2005 and 2007, chickpea variety Bivenich, a local Desi type, generally sown by local farmers were used for our experiments. Before planting, the seeds in small holes in soil by hand, they were desinfeced by fungicide Vitavax®. The Plots were a 6×4 RCBD (Randomised Complete Block Design), each plot 4×2.5 m and irrigated biweekly. Planting ground was an experimental field of Agriculture Faculty, of Razi University. The Six treatments were as follows. First-Control, second-Deltamethrin 2.5% EC, work solution of 1/1000, third-Sevin WP 85%, work solution of 1.5/1000, fourth-Endosulfan 35% EC, work solution of 1/1000, fifth-Release of green lacewing, sixth-Spraying of BT-H (*Bacillus thuringiensis*, subsp. *aizawai*), made in Iran, 1 kg h^{-1}. For every treatment, there were four replications. Treatment one (Control) without any insecticide spraying, treatments two, three, four and six, was accompanied together with release of 20, 2nd instar larva of green lacewing in treatment five, before flowering and then, one month later, second instar green lacewing larvae were released in all plots, except control, following Mirmoayedi (1997, 2001). A female gravid adult of green lacewing *Chrysoperla lucasina* was collected and reared in laboratory condition, according to Mirmoayedi and Kharazi Pakdel (1993). After yellowing of leaves and ripening of pods, ten plants in every plot were chosen randomly and the healthy and perforated seed coat, separated in each plot and were counted. The weight of attacked and healthy pods were measured. Two statistical softwares, SAS and MSTAT-C, DMRT were used, for analysis of variance and comparison between means respectively.

RESULTS AND DISCUSSION

The data for perforated seed coat of chickpea, caused by the attack of chickpea pod borer was obtained and the weight of damaged pods measured (Table 1). The effect of year, is the only parameter with significant difference ($p<0.05$ was considered as level of significance), which signifies that, we can say with 0.05 of probability of error, that there was a statistically significant difference between two years, concerning the quantity of chickpea seed coat perforated by chickpea pod borer (Table 2). Other parameters such as (Block)×(year), treatments, (treatments)×(year) show no significant difference. Table 3 shows the analysis of variance for the weight of attacked chickpea pods, by chickpea pod borer, the data also indicates that, the only parameter with significant difference ($p<0.05$ was considered as level of significance) is the effect of the year, that means between two years of 2005 and 2007, there was a statistically significant difference concerning the weight of damaged chickpea pods. No other parameters show a significant difference, between the two years 2005 and 2007. The spraying of deltamethrin insecticide had the lowest protection effect in the year 2005 (with maximum mean number of pod coat perforated) and spraying of Endosulfan, the most effective method (with minimum of pod coat perforated). In year 2007, the maximum mean number of pod coat perforated was seen in control treatment and the minimum mean number of pod coat perforated was seen in treatment of spraying of Endosulfan (Table 4).

Comparison between means of weight of damaged pods, due to the attacks by chickpea pod borer (Table 5), showed that in 2005, the maximum of mean weight of damaged pods belonged to treatment of Sevin spraying and the minimum mean weight of damaged pods belonged to treatment of release of

Table 1: Data of Blocks and treatments and quantity of seed coat with at least one hole and weight of damaged pods

Blocks and Replications	Quantity of seed coat with holes year 2005	Quantity of seed coat with holes year 2007	Weight (g) of pods damaged in 2005	Weight (g)of pods damaged in 2007
1-1	75	31	1.8	4.4
1-2	93	6	4.6	0.2
1-3	266	2	1.7	0.2
1-4	27	3	2.2	0.3
1-5	36	27	3.4	2.5
1-6	62	23	4.1	1.5
2-1	50	4	4.5	0.4
2-2	82	22	5.5	2.1
2-3	46	17	3.5	2.1
2-4	55	7	2.0	0.2
2-5	48	16	4.0	1.7
2-6	64	15	2.1	1.0
3-1	42	6	0.6	0.4
3-2	60	26	4.1	2.0
3-3	70	25	3.4	2.0
3-4	59	17	1.6	1.8
3-5	42	9	0.8	0.8
3-6	63	21	0.7	2.1
4-1	64	36	6.4	3.3
4-2	78	64	2.4	4.1
4-3	57	32	2.4	2.5
4-4	56	31	4.0	2.2
4-5	27	36	2.4	2.5
4-6	61	34	4.0	2.5

Table 2: Data of analysis of variance of number of perforated chickpea seed coat, by SAS

Source	df	Sum of squares	Mean square	F-value	Pr>F
Year	1	23986.02	23986.02	23.41**	0.0001
(Block)×(Year)	6	8447.29	1407.88	1.37ns	0.2570
Treatments	5	7062.10	1412.42	1.38ns	0.2602
(Treatments)×(Year)	5	6227.10	1245.42	1.22ns	0.3260

*p<0.05, **p<0.01, ***p<0.001 significantly difference, ns: Non significantly difference

Table 3: Analysis of variance by SAS, concerning the weight of damaged pods (g)

Source	df	Sum of squares	Mean square	F-value	Pr>F
Year	1	18.00	18.00	10.11**	0.0034
(Block)×(Year)	6	21.41	3.56	2.00ns	0.0963
Treatments	5	8.62	1.72	0.97ns	0.4525
(Treatments)×(Year)	5	2.00	0.40	0.22ns	0.9490

*p<0.05, **p<0.01, ***p<0.001 significantly difference, ns: Non significantly difference

Table 4: DMRT analysis, comparison between means number of perforated pod coat

Name of treatment	Year 2005	Year 2007
Control	3.22AB	2.12AB
Deltamethrin	4.15A	2.10AB
Sevin	2.75AB	1.70B
Endosulfan	2.45AB	1.12B
Release of lacewing	2.65AB	1.87B
Bt-H	2.72AB	1.77B

Same alphabet denotes no significantly difference. p<0.05 was considered as level of significance

Table 5: DMRT analysis, comparison between mean weight of damaged pods (g), attacked by chickpea pod borer

Name of treatment	Year 2005	Year 2007
Control	57.75BC	19.25C
Deltamethrin	78.25AB	29.50BC
Sevin	109.80A	19.00C
Endosulfan	49.25BC	14.50C
Release of lacewing	38.25BC	22.00C
Bt-H	62.50ABC	23.25C

Same alphabet denotes no significantly difference. p<0.05 was considered as level of significance green lacewing's larvae. In 2007, the maximum weight of damaged pods belonged to deltamethrin spraying treatment and the minimum weight to treatment of endosulfan spraying. Although statistically speaking, in both years, no control method had a significantly difference to other one. ($p<0.05$ was considered as level of significance) (Table 5).

As in Table 4, in year 2005, the maximum mean number of pod coat of chickpea perforated was seen in treatment, in which deltamethrin was sprayed, so for this year, deltamethrin was the less effective and endosulfan, was, the most effective insecticide. In 2007, deltamethrin spraying was like control treatment, the less effective and the use of endosulfan, appeared to be, the best method of control. For comparing the impact of different method of control, in protection of pods against attacks by larvae of chickpea pod borer, the comparison between mean weight of pods attacked by the pest, was done by DMRT. As could be seen in Table 5, in year 2005, the maximum mean weight of pods, attacked by the pest was that of the treatment, in which, Sevin was used and the minimum was that of the treatment, in which green lacewing's larvae were released. So, the best choice of control, for the year 2005, was release of green lacewing and the worst, spraying of sevin. In year 2007, the maximum mean weight (g) of pods attacked was observed in treatment in which deltamethrin was used and the minimum mean weight of the pods attacked, belonged to treatment, in which endosulfan was sprayed. So we make a comparison between four insecticides, in an integrated control of chickpea pod borer together with the release of 2nd instar larvae of green lacewing *Chrysoperla lucasina*, in two years 2005 and 2007, endosulfan, appeared to be the most effective insecticide and deltamethrin, the less effective one. During the past twenty years, Sevin, was used preferentially by the farmers of Kermanshah province, as the choice insecticide against the chickpea podborer, today due to natural selection, there exist a very intense resistance between different populations of *Helicoverpa armigera*, against this insecticide, in this chickpea growing area. Therefore sevin could not be proposed to be used for control of chickpea pod borer, neither for chemical control, nor as component of an integrated pest control. As could be found in Table 2 and 3, the effect of year, is the only significant difference, concerning the quantity of chickpea pod coat perforated, or the weight of pods damaged, this should be due, to climatic changes existed between two years; year 2007, was more dry and hot, than, year 2005, so it is probable, that the rate of mortality of pod borer increased, in 2007, resulting in, less pod coat perforated. For the use of Bt, in a biopesticide control of pests, although Marzban *et al*. (1998) used Iranian made *Bacillus thuringiensis* (Bt-H, subsp. aizawai) for control of Indian meal moth in stored pistachio in laboratory condition, but recently he observed some drawbacks use of it, due to release of β-endotoxin (Marzban and Tajbakhsh, 2004). Cherry *et al*. (2000) found a better control of pod borer, by use of *Ha*NPV, than either, endosulfan, or *Bacillus thuringiensis*. Santham *et al*. (2005), in Tamil Nadu, India found in their experiments with rainfed and/or irrigated pigeonpea, that Bt. k (var. kurstaki) (Delfin®), it's combination with *He*NPV and *Chrysoperla carnea* release were as effective as spraying of endosulfan, in decreasing the damage caused by *Heliothis armigera* and *Exelastis atmosa*. Resistance to pyrethroids, amongst the pod borer in chickpea growing regions of India and Pakistan, were recorded to be very intense, for example as high as 1000 folds, to three pyrethroids, cypermethrin, fenvalerate, cyhalothrin, in 4 strains, collected from central and south India (Keshav Raj *et al*., 2001). Ramasubramanian and Regupathy (2004) found that, in laboratory reared larvae of pod borer, which were selected to be resistant to one pyrethroid insecticide, at the end of 14th generation, they showed a 4 or 5 folds cross resistant to all other pyrethroids, but no cross resistant to Endosulfan, or Thiodicarb. Resistance to deltamethrin, as high as 330 and 670 folds, was seen, between Chinese and Pakistani, strains of pod borer (Ahmad *et al*., 2006). Thibaud *et al*. (2003) have used a combination of two insecticides, an organophosphorous and a pyrethroid insecticides, to overcome the resistance to pyrethroids in pod borers.

REFERENCES

Ahmad, M., M.I. Arif and Z. Ahmad, 2001. Resistance to carbamate insecticides in *Helicoverpa armigera* (Lepidoptera, Noctuidae) in Pakistan. Crop. Prot., 20 (5): 427-432.

Ahmad, M., I. Denholm and R.H. Bromilow, 2006. Delayed cuticular penetration and enhanced metabolism of deltamethrin in pyrethroid resistant strains of *Helicoverpa armigera* from China and Pakistan. Pes. Man. Sci., 62 (9): 805-810.

Ahmad, M., 2007. Insecticide resistance mechanisms and their management in *Helicoverpa armigera* (Hübner). A review. J. Agric. Res., 45 (4): 319-335.

Ahmed, S., K. Zia and N. Rehmanshah, 2004. Validity of chemical control of gram podborer, *Helicoverpa armigera* (Hübner) with new insecticides. Int. J. Agric. Biol., 6 (6): 978-980.

Cherry, A.J., R.J. Rabindra, M.A. Parnell, N. Geetha, N.S. Kennedy and D. Grzywacz, 2000. Field evaluation of *Helicoverpa armigera* nucleopolyhedrovirus formulations for control of chickpea pod borer, *H. armigera* (Hubn.), on chickpea (*Cicer arietinum* var. Shoba) in Southern India. Crop. Prot., 19 (1): 51-60.

Faostat, 2006. http://faostat.fao.org/site/567/default.aspx.

Duffield, S.J. and S.L. Jordan, 2000. Evaluation of insecticides for control of *Helicoverpa armigera* (Hübner) and *Helicoverpa punctigera* (Wallengren) (Lepidoptera, Noctuidae) on soybean and the implications for field adoption. Aust. J. Entomol., 39 (4): 322-327.

Gujar, G.T., R. Nair, B.P. Singh, A. Kumari and V. Kalia, 2008. Toxicity to the cotton bollworm, *Helicoverpa armigera*, of some Cry1Ac toxins, expressed in cotton in India. Crop. Prot., 27 (3-5): 537-544.

Keshav Raj, K., J. Deepak, W. Ravindra, K. Sandhya and R. Derek, 2001. Pyrethroid resistance and mechanisms of resistance in field strains of *Helicoverpa armigera* (Lepidoptera, Noctuidae). J. Econ. Entomol., 94 (1): 253.

Khanjani, M., 2004. Field Crop Pests in Iran (Insects and Mites). Bu Ali Sina University Press. (In Farsi).

Marzban, R., H. Bayat Assadi and A. Mirmoayedi, 1998. *Bacillus thuringiensis* used as a control agent for Indian meal moth in stored pistachio in Kermanshah province. In: Proceedings of the 13th Plant Protection Congress of Iran. 23-27Aug. Vol. 1. Pests, Junior Agricultural College of Karadj, Karadj, Iran.

Marzban, R. and M. Tajbakhsh, 2004. Detection of β-endotoxin, in a bioinsecticide based on *Bacillus thuringiensis* subsp. *aizawai*. In: Proceedings of the 16th Iranian Plant Protection Congress. 28 Aug-1. Sep, Tabriz, Iran.

Mirmoayedi, A. and A. Kharazi Pakdel, 1993. Laboratory rearing of *Chrysoperla carnea* and *Chrysopa septempunctata* (Neuroptera, Chrysopidae). In: Proceedings of the 11th Plant Protection Congress of Iran. 28 Aug-2 Sep. University of Guilan, Rasht, Iran.

Mirmoayedi, A., 1997. *Chrysoperla carnea* release for the biological control of safflower aphid (*Euroleucon compositae*) and safflower fly (*Acanthiophilus helianthi*). In: Proceedings of the 16th Iranian Biology Conference, 25-27 August, Kerman University, Kerman, Iran.

Mirmoayedi, A., 1998. Release of eggs and larvae of *Chrysoperla carnea* Stephens (Neuroptera, Chrysopidae) for control of nymphs of cotton's leafhopper *Empoasca decipiens* (Homoptera, Cicadellidae). In: Proceedings of the 11th Russian Entomological Congress, 6-15 September, St. Petersburg, Russia.

Mirmoayedi, A., 2001. Release of eggs and larvae of *Chrysoperla carnea* for control of eggs and nymphs of cotton's spiny bollworm (*Earias insulana*). In: Proceedings of the 2nd Irano-Russia Agricultural and Natural Resources Conference, Moscow Timiryazev Agricultural Academy (MTTA) 1-2 Feb. Moscow, Russia.

Narayanan, K. and C. Gopalakrishnan, 2003. Integration of entomopathogenic nematode, *Steinernema feltiae* with *Helicoverpa armigera* nuclear polyhedrosis virus for the control of insect pests on vegetable pigeonpea. Ind. J. Nematol., 33 (1): 33-36.

Ramasubramanian, T. and A. Regupathy, 2004. Pattern of cross resistance in pyrethroid selected populations of *Helicoverpa armigera* Hübner (Lepidoptera, Noctuidae) from India. J. Applied Entomol., 128 (9-10): 583-587.

Razaq, M., A. Suhail, M.J. Arif, M. Aslam and A. Sayyed, 2007. Effect of rotational use of insecticides on pyrethroids resistance in *Helicoverpa armigera* (Lepidoptera: Noctuidae). J. Applied Entomol., 131 (7): 460-465.

Romeis, J., H.C. Sharma, S. Das and B.K. Sarmah, 2004. The potential of transgenic chickpea for pest control and possible effect on not target arthropods. Crop. Prot., 23 (10): 923-938.

Santham, G.D., D.V. Victoria, R.J. Rabindra and S. Jayaraj, 2005. Studies on biological control of pigeonpea and borers in India. J. Pest Sci., 67: 103-106.

Scholz, B.C.G., C.J. Monsour and M.P. Zalucki, 1998. An evaluation of selective *Helicoverpa armigera* control options in sweet corn. Aust. J. Exp. Agric., 38 (6): 601-607.

Sharma, H.C., G. Pampapathy, K. Dhilon Makesh and J.T. Ridsill-Smith, 2005. Detached leaf assay for host plant assistance to *Helicoverpa armigera*. J. Econ. Entomol., 98 (2): 568-576.

Thibaud, M., O.G. Ochou, M. Vaissayre and D. Fournier, 2003. Organophosphorous insecticides synergize pyrethroids in the resistant strain of cotton bollworm, *Helicoverpa armigera* (Hübner) (Lepidoptera, Noctuidae) from west Africa. J. Econ. Entomol., 96 (2): 458-474.

Wu, K., Y. Guo and G. Head, 2006. Resistance monitoring of *Helicoverpa armigera* (Lepidoptera, Noctuidae) to Bt insecticidal protein during 2001-2004, in China. J. Econ. Entomol., 99 (3): 893-898.

Yang, E., Y. Yang, S. Wu and Y. Wu, 2005. Relative contribution of detoxifying enzymes to pyrethroid resistance in a resistant strain of *Helicoverpa armigera*. J. Applied Ent., 129 (5, 9-10): 521-525.