*Indian Journal of Applied Entomology* **29**(1) : 24–29 (2015)

# BIO-EFFICACY OF FLUBENDIAMIDE 90 + DELTAMETHRIN 60 – 150 SC AGAINST POD BORER IN CHICKPEA (*CICER ARIETINUM* L.)

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## ABSTRACT

The bio efficacy of Flubendiamide 90 + Deltamethrin 60 – 150 SC against the pod borer in chick pea was evaluated using four dosages of Flubendiamide 90 + Deltamethrin 60 – 150 SC at the rate of 167, 200 and 250 ml/ha, along with conventional insecticides such as Deltamethrin 100 EC at 150 ml, Flubendiamide 480 SC at 47 and 100 ml, Quinalphos 25 EC at 1000 ml and Novaluron 10 EC at 750 ml/ha. The treatment Flubendiamide 90 + Deltamethrin 60 – 150 SC @ 250 ml/ha was found significantly superior to all treatments and caused highest reduction in the larval population of pod borer followed by Flubendiamide 480 SC at 100 ml and Flubendiamide 90 + Deltamethrin 60 and 150 SC at 200 ml/ha. Both these treatments were at par to each other and were next in order of effectiveness. Flubendiamide 90 + Deltamethrin 60 - 150 SC @ 250 ml/ha exhibited the lowest pod damage with a mean of 5.30 and 4.72 per cent as against 36.10 and 38.64 per cent in control that was followed by Flubendiamide 480 SC @ 100 ml/ha and Flubendiamide 90 + Deltamethrin 60 – 150 SC @ 200 ml/ha which exhibited 6.94 and 7.50; 9.49 and 10.86 percent pod damage during *rabi* 2011-12 and 2012-13, respectively. Flubendiamide 90 + Deltamethrin 60 – 150 SC @ 250 ml/ha recorded significantly highest seed yield of 18.06 and 17.90 q/ha followed by Flubendiamide 480 SC @ 100 ml/ha and Flubendiamide 90 + Deltamethrin 60 – 150 SC @ 200 ml/ha, which yield 16.85 and 17.20 q/ha; 15.50 and 15.96 q/ha as against 10.53 and 11.40 q/ha in untreated control during *rabi* 2011-12 and 2012-13, respectively.

**Key Words :** Pod borer, Chick pea, Flubendiamide 90 + Deltamethrin 60 - 150 SC

## INTRODUCTION

Chickpea, *Cicer arietinum* L., is a very important pulse crop extensively grown throughout the country. It is an excellent source of vegetable protein (Khan, 1980). The crop is attacked by a number of insect-pests. The gram pod borer, *Helicoverpa armigera* Hübner is considered as a serious pest of the crop causing substantial losses in its yield (Patel *et al*., 1971; Reed *et al*., 1980; Lal *et al*., 1985; Naresh & Malik, 1986 and Lal, 1996). The pod borer inflicts heavy crop losses from seedling to maturity, but the losses reach its peak when the pods appear (Mehto & Singh, 1983; Deka *et al*., 1989). Lal (1996) reported that the seed yield losses due to *H. armigera* were 75-90 per cent and in some places the losses were up to 100 per cent. These losses can be reduced by the application of insecticides (Sinha *et al*., 1983; Singh *et al*., 1987; Rakesh *et al*., 1996 and Balasubramanian *et al*., 2001). Several insecticides are recommended for the management of pod borer in India, which mainly belong to organophosphate, organochlorine, and carbamate groups but reduction in use of harmful insecticide and popularization of use of newer broad spectrum chemicals with minimum hazardous effects should be the primary objective in pest management programme. Conventional pesticides are gradually being replaced by newer chemicals of which Flubendiamide is one such new compound. It is one of the important insecticides that have excellent action on insects with abnormal symptoms such as body contractions and feeding cessation. It cause a gradual contraction of the insect body thickening and shortening without convulsions and activates the ryanodine receptor, a calcium release channel, which is involved in muscle contraction. Flubendiamide is a broad spectrum foliar contact insecticide used in wide range of crops against several economically important insect pests of order Lepidoptera. It has activity on all developmental stages of target insect, the death of pest usually occurs in 24-48 hours.

The use of synthetic pyrethroid insecticides in agriculture has increased many folds because of their low mammalian toxicity, bio-degradability and excellent insecticidal activity. Many workers have tested the efficacy of synthetic pyrethroids alone against this pest. Among the new insecticides the combination of Synthetic pyrethroid, Deltamethrin and Flubendiamide is one of the most effective insecticides which remained most effective up to 14 days after application against the pod borer in chick pea. Two of these are more biologically active than the others and have been isolated and concentrated to create a new novel combination. It acts as a contact and stomach poison having a rapid knock-down effect with long lasting efficacy. It is important to compare the efficacy of this insecticide

against pests for effective pest management and to reduce the indiscriminate use of insecticides. Thus, the present study was conducted to evaluate a novel insecticide Flubendiamide 90 + Deltamethrin 60 – 150 SC against pod borer in chickpea.

## MATERIALS AND METHODS

The experiment on the bio-efficacy of Flubendiamide 90 + Deltamethrin 60 – 150 SC at the rate of 167, 200 and 250 ml/ha, along with Deltamethrin 100 EC at 150 ml, Flubendiamide 480 SC at 47 and 100 ml, Quinalphos 25 EC at 1000 ml and Novaluron 10 EC at 750 ml/ha in chick pea was conducted at Rajasthan College Agriculture Udaipur during *Rabi* 2011-12 and 2012-13. The experiment was conducted in RBD with nine treatments replicated three times. Chickpea variety GNG - 469 was sown on 29 October and 5 November during 2011 and 2012, respectively. Sowing was done in plots each measuring 4.8 x 4.8 sq meter at row to row spacing of 30 cm. Each treatment was applied three times at an interval of 10 days initiating first spray at the appearance of the pest. A volume of 375 liter of water/ha was used in each spray. Spraying was done with Knapsack sprayer pump using hollow cone /triple action nozzle. The observations on the population of pod borer larvae *were* recorded 1 day before and 3, 5 and 7 days after each spray on five plants/plot selected randomly. The data were subjected to statistical analysis after calculating the mean reduction in the population of larvae of pod borer at 3, 5 and 7 days after each spray. The mean damage to pods for each treatment was also calculated by counting total number of pods and number of damaged pods on five plants selected randomly, at harvest. The seed yield of chickpea was recorded at the time of harvesting for each treatment separately and yield per hectare was calculated.

The effect of Flubendiamide 90 + Deltamethrin 60 - 150 SC @ 167, 200 and 250 ml /ha along with other treatments on natural enemies was studied by counting the population of common predatory fauna *viz.;* population of grubs and adults of *Coccinella* spp. and *Chrysoperla carnea* at regular intervals in each replication on five plants selected randomly.

## RESULTS AND DISCUSSION

All the treatments were significantly superior over untreated control in reducing infestation of pod borer in chickpea. However, among all the treatments Flubendiamide 90 + Deltamethrin 60 – 150 SC @ 250 ml/ha was significantly superior to all treatments and caused highest reduction in the larval population of pod borer with a mean of 74.50, 81.36, 68.36; 78.40, 85.32, 77.45 and 81.65, 93.42 and 88.72 percent reduction during rabi 2011-12 and 76.18, 83.30, 69.75; 75.98, 87.36, 79.61; 85.60, 96.40 and 90.27 percent mean reduction during 2012-13 at 3, 5 and 7 days after first, second and third spray, respectively. It was followed by Flubendiamide 480 SC at 100 ml and Flubendiamide 90 + Deltamethrin 60 and 150 SC at 200 ml/ha. Both these treatments were found at par to each other and were next in order of effectiveness. These treatments caused 64.72, 70.83, 79.65; 65.58, 71.63 and 81.63 percent; 62.45, 69.80, 76.14; 63.36, 72.81 and 78.94 percent at 7 days after first, second and third spray during Rabi 2011-12 and 2012-13, respectively (Table 1 and 2).Deltamethrin 100 EC at 150 ml/ha followed the above treatments with a mean reduction of 56.86, 69.82 and 69.27; 57.70, 65.12 and 68.14 percent reduction at 7 days after first, second and third spray during 2011-12 and 2012-13, respectively (Table 1-2).

The efficacy of Flubendiamide 90 + Deltamethrin 60 - 150 SC @ 250 ml/ha against pod borer was manifested in terms of lowest pod damage due to pod borer. The data presented in Table 3 clearly shows that Flubendiamide 90 + Deltamethrin 60 - 150 SC @ 250 ml/ha was the most effective treatment in checking infestation of pod borer as it exhibited the lowest pod damage with a mean of 5.30 and 4.72 per cent as against 36.10 and 38.64 per cent in control during *rab*i 2011-12 and 2012-13, respectively. It was followed by Flubendiamide 480 SC @ 100 ml/ha and Flubendiamide 90 + Deltamethrin 60 – 150 SC @ 200 ml/ha which exhibited 6.94 and 7.50; 9.49 and 10.86 percent pod damage during *rabi* 2011-12 and 2012-13, respectively.

The data presented in Table-3 reveals that all the treatments yielded significantly higher over control. Flubendiamide 90 + Deltamethrin 60 – 150 SC @ 250 ml/ha recorded the significantly highest seed yielded of 18.06 and 17.90 q/ha during *rabi* 2011-12 and 2012-13, respectively. It was followed by Flubendiamide 480 SC @ 100 ml/ha and Flubendiamide 90 + Deltamethrin 60 – 150 SC @ 200 ml/ha which yield 16.85 and 17.20 q/ha; 15.50 and 15.96 q/ha as against 10.53 and 11.40 q/ha in untreated control during *rabi* 2011-12 and 2012-13, respectively. The data presented in Table-3 reveals that no significant difference was recorded in the population of grubs and adults of *Coccinella* spp. and *Chrysoperla carnea* in different treatments of Flubendiamide 90 + Deltamethrin 60 – 150 SC at 167, 200 and 250 ml/ha. Thus, the data indicates that Flubendiamide 90 + Deltamethrin 60 – 150 SC at 167, 200 and 250 ml/ha did not cause adverse effects on the common predators.

The results of present investigation are in confirmation with the findings of Bhoyar *et al.* (2004), Meena *et al.* (2006) and Muthukrishna *et al.* (2002) who also reported the higher efficacy of these molecules. Superior performance of flubenadamide against H. armigera have been reported by Dey *et al.* (2012) whereas Chandrakar and Shrivastava (2002), Srivastava, R. M. Sehgal, V. K. reported that application of mixtures of insecticides resulted in the lowest pod damage (10%)

**Table 1. Efficacy of Flubendiamide 90 + Deltamethrin 60-150 SC against pod borer, *H. armigera* in chickpea (rabi 2011-12)**

| S.No. | Treatments (g a.i./ha) | Formulation dose (ml/ha) | Mean reduction over control, days after spray | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | First spray | | | Second spray | | | Third spray | | |
| | | | 3 days | 5days | 7days | 3 days | 5days | 7days | 3 days | 5days | 7days |
| 1. | Flubendiamide 90 + Deltamethrin 60-150 SC at 15+10 | 167 | 45.24 (50.42)* | 49.79 (58.32) | 44.12 (48.46) | 48.65 (56.36) | 51.63 (61.47) | 47.67 (54.65) | 49.27 (57.42) | 56.08 (68.86) | 51.57 (61.36) |
| 2. | Flubendiamide 90 + Deltamethrin 60-150 SC at 18+12 | 200 | 53.96 (65.32) | 57.90 (71.65) | 52.24 (62.45) | 47.45 (70.94) | 62.52 (78.48) | 56.73 (69.80) | 59.00 (73.34) | 64.56 (81.26) | 60.88 (76.14) |
| 3. | Flubendiamide 90 + Deltamethrin 60-150 SC at 22.50+15 | 250 | 59.42 (74.50) | 64.60 (81.36) | 55.81 (68.36) | 62.43 (78.40) | 67.78 (85.32) | 61.76 (77.45) | 64.82 (81.65) | 75.99 (93.42) | 70.93 (88.72) |
| 4. | Deltamethrin 100 EC at 15 | 150 | 51.87 (61.87) | 56.95 (70.26) | 48.94 (56.86) | 56.52 (69.56) | 61.10 (76.45) | 56.68 (69.82) | 57.62 (71.32) | 62.50 (78.62) | 56.34 (69.27) |
| 5. | Flubendiamide 480 SC at 22.50 | 47 | 45.98 (51.70) | 44.68 (49.44) | 43.57 (47.50) | 48.23 (55.62) | 51.56 (61.32) | 49.75 (58.24) | 52.77 (63.36) | 55.80 (68.36) | 50.05 (58.75) |
| 6. | Flubendiamide 480 SC at 48 | 100 | 55.84 (68.42) | 60.27 (75.30) | 53.58 (64.72) | 58.49 (72.60) | 61.79 (77.52) | 57.36 (70.83) | 62.41 (78.40) | 67.58 (85.15) | 63.30 (79.65) |
| 7. | Quinalphos 25 EC at 250 | 1000 | 49.22 (57.34) | 54.76 (66.70) | 51.54 (61.32) | 54.01 (65.47) | 58.88 (73.28) | 55.25 (67.50) | 57.06 (70.43) | 62.21 (78.26) | 57.85 (71.68) |
| 8. | Novaluron 10 EC at 75 | 750 | 47.00 (53.46) | 52.74 (63.27) | 50.67 (59.82) | 52.34 (62.64) | 56.98 (70.24) | 53.68 (64.88) | 56.03 (68.72) | 59.55 (74.24) | 56.72 (69.83) |
| 9. | Untreated Control (Water spray) | - | - | - | - | - | - | - | - | - | - |
| | S. Em. $\pm$ | - | 1.35 | 1.43 | 1.03 | 1.26 | 1.75 | 1.24 | 1.43 | 1.89 | 1.69 |
| | C.D. at 5% | - | 4.04 | 4.29 | 3.10 | 3.80 | 5.26 | 3.73 | 4.28 | 5.69 | 5.07 |

* Values in parenthesis are retransformed per cent value.

**Table 2. Efficacy of Flubendiamide 90 + Deltamethrin 60-150 SC against pod borer, *H. armigera* in chickpea (rabi 2012-13)**

| S.No. | Treatments (g a.i./ha) | Formulation dose (ml/ha) | Mean reduction over control, days after spray | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | First spray | | | Second spray | | | Third spray | | |
| | | | 3 days | 5days | 7days | 3 days | 5days | 7days | 3 days | 5days | 7days |
| 1. | Flubendiamide 90 + Deltamethrin 60-150 SC at 15+10 | 167 | 44.63 (49.36)* | 48.53 (56.14) | 42.52 (45.67) | 48.35 (55.84) | 52.38 (62.74) | 47.06 (53.60) | 50.42 (59.40) | 54.44 (66.18) | 50.45 (59.46) |
| 2. | Flubendiamide 90 + Deltamethrin 60-150 SC at 18+12 | 200 | 55.01 (67.05) | 58.42 (72.45) | 52.78 (63.36) | 58.71 (72.89) | 62.98 (79.12) | 58.66 (72.81) | 60.99 (76.30) | 66.06 (83.18) | 62.85 (78.94) |
| 3. | Flubendiamide 90 + Deltamethrin 60-150 SC at 22.50+15 | 250 | 60.88 (76.18) | 66.11 (83.30) | 56.68 (69.75) | 60.75 (75.98) | 69.61 (87.36) | 63.30 (79.61) | 68.02 (85.60) | 80.22 (96.40) | 72.62 (90. 27) |
| 4. | Deltamethrin 100 EC at 15 | 150 | 50.93 (60.27) | 57.74 (71.50) | 49.43 (57.70) | 54.01 (65.46) | 58.31 (72.40) | 53.80 (65.12) | 57.02 (70.36) | 61.79 (77.65) | 55.64 (68.14) |
| 5. | Flubendiamide 480 SC at 22.50 | 47 | 46.57 (52.74) | 44.98 (49.96) | 43.59 (47.54) | 47.22 (53.87) | 50.50 (59.52) | 48.67 (56.37) | 51.48 (61.25) | 54.21 (65.76) | 50.76 (59.96) |
| 6. | Flubendiamide 480 SC at 48 | 100 | 56.88 (70.08) | 61.67 (77.34) | 54.10 (65.58) | 59.72 (74.47) | 63.37 (79.74) | 57.95 (71.63) | 63.58 (79.74) | 69.61 (86.75) | 65.04 (81.63) |
| 7. | Quinalphos 25 EC at 250 | 1000 | 50.68 (59.84) | 56.39 (69.35) | 51.31 (60.93) | 53.43 (64.46) | 59.94 (74.90) | 55.29 (67.52) | 57.70 (71.36) | 62.09 (77.94) | 56.93 (70.15) |
| 8. | Novaluron 10 EC at 75 | 750 | 46.52 (52.64) | 53.63 (64.81) | 49.47 (57.75) | 51.07 (60.49) | 56.98 (70.24) | 54.20 (65.74) | 56.33 (69.20) | 60.50 (75.66) | 55.89 (68.50) |
| 9. | Untreated Control | - | - | - | - | - | - | - | | - | - |
| | S. Em. $\pm$ | - | 1.17 | 1.41 | 1.05 | 1.36 | 1.65 | 1.60 | 1.94 | 2.41 | 2.19 |
| | C.D. at 5% | - | 3.49 | 4.23 | 3.15 | 4.08 | 4.95 | 4.81 | 5.83 | 7.23 | 6.57 |

* Values in parenthesis are retransformed per cent value.

**Table 3: Effect of Flubendiamide 90 + Deltamethrin 60-150 SC on pod damage, natural enemies and yield of chickpea (rabi 2011-12 and 2012-13)**

| S.No. | Treatments (g a.i./ha) | Formulation dose (ml/ha) | Pod damage (%) | | Natural enemies (population/5plants) | | | | Yield (q/ha) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2011-12 | 2012-13 | *Chrysoperla* | | *Coccinella* spp. | | 2011-12 | 2012-13 |
| | | | | | Grub | Adult | Grub | Adult | | |
| 1. | Flubendiamide 90 + Deltamethrin 60-150 SC at 15+10 | 167 | 26.13 (19.40)* | 25.48 (18.51) | 1.67 (1.47) | 1.00 (1.22) | 1.33 (1.35) | 1.67 (1.47) | 12.70 | 12.10 |
| 2. | Flubendiamide 90 + Deltamethrin 60-150 SC at 18+12 | 200 | 17.94 (9.49) | 19.24 (10.86) | 1.66 (1.47) | 0.67 (1.08) | 1.33 (1.35) | 1.67 (1.47) | 15.50 | 15.96 |
| 3. | Flubendiamide 90 + Deltamethrin 60-150 SC at 22.50+15 | 250 | 13.30 (5.30) | 12.54 (4.72) | 1.33 (1.35) | 2.00 (1.52) | 1.33 (1.35) | 1.33 (1.35) | 18.06 | 17.90 |
| 4. | Deltamethrin 100 EC at 15 | 150 | 20.94 (12.78) | 19.52 (11.18) | 1.33 (1.35) | 1.67 (1.47) | 1.67 (1.47) | 2.00 (1.58) | 15.65 | 16.14 |
| 5. | Flubendiamide 480 SC at 22.50 | 47 | 22.38 (14.50) | 22.48 (14.63) | 1.00 (1.22) | 1.00 (1.22) | 1.67 (1.47) | 1.67 (1.47) | 12.50 | 12.64 |
| 6. | Flubendiamide 480 SC at 48 | 100 | 15.26 (6.94) | 15.88 (7.50) | 1.33 (1.35) | 1.67 (1.46) | 2.33 (1.66) | 2.00 (1.58) | 16.85 | 17.20 |
| 7. | Quinalphos 25 EC at 250 | 1000 | 18.83 (10.42) | 19.73 (11.40) | 1.00 (1.22) | 1.33 (1.34) | 1.67 (1.47) | 2.33 (1.68) | 15.65 | 15.36 |
| 8. | Novaluron 10 EC at 75 | 750 | 36.92 (36.10) | 38.43 (38.64) | 1.67 (1.47) | 1.67 (1.46) | 2.00 (1.58) | 2.67 (1.71) | 12.98 | 13.54 |
| 9. | Untreated Control (Water spray) | - | - | - | 1.67 (1.45) | 1.33 (1.35) | 2.00 (1.58) | 2.33 (1.68) | 10.53 | 11.40 |
| | S. Em. $\pm$ | - | 0.37 | 0.38 | 0.06 | 0.12 | 0.07 | 0.11 | 0.79 | 0.71 |
| | C.D. at 5% | - | 1.13 | 1.15 | 0.19 | 0.37 | 0.21 | 0.35 | 2.37 | 2.13 |

* Values in parenthesis are retransformed per cent value.

and grain damage (0.73%) by pod borer with highest yield (1618.3 kg/ha) in pigeonpea. Tohinshi *et al.* (2010) concluded that flubendiamide was the first example of 1, 2-benzenedicarboxamide insecticides but also the first practical synthetic insecticide with a mode of action as an activator of ryanodine receptors. It shows high selective activity against lepidopteran insect pests, which leads to excellent efficacy in the field, and excellent safety against non-target organisms, including various beneficial arthropods and natural enemies. These properties suggested the suitability of flubendiamide for integrated pest management (IPM) programs. Thilagam *et al.* (2010) reported that flubendiamide 60 g a.i. per ha showed marked reduction in the *Helicoverpa* larval population and recorded up to 96.00 per cent reduction in damage in cotton. The present findings clearly indicated that the new generation insecticides like flubendiamide in combination with synthetic pyrethroids were found effective against gram pod borer, *Helicoverpa armigera* along with an increased level of yield. Hence, it is suggested that the effective insecticides may be alternated in order to avoid the development of resistance.

## ACKNOWLEDGEMENT

The senior author is thankful to Bayer Crop Science Ltd. for providing financial assistance and Director Research, MPUAT, Udaipur, Dean, RCA, Udaipur and Head, Department of Entomology for providing necessary facilities to carry out the present research work.

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