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Bioefficacy Of Deltamethrin Against Gram Pod Borer (*H. Armigera)* On Pigeon Peas-A Review

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Abstract
Pigeon pea is one of the important cash crops playing a key role in the economy of Indian farmers. The productivity of pigeon pea has not increased considerably during last decade in India. Among the many factors responsible for low yields of pigeon pea in India, insect pests are the major ones. Though the pest spectrum of pigeon pea crop includes 200 insects and mites, the major insect causing heavy loss is the pod borer, *H.armigera.* Deltamethrin, a broad-spectrum synthetic pyrethroid insecticide has been applied widely around the world for more than 30 years on various crops. It is non persistent, nonvolatile, hydrophobic compound and is not likely to present a hazard under recommended rates of application to human beings and environment. Therefore, keeping in view of the above discussions the available literature related to the efficacy of this insecticide against pod borer *H. armigera* on pigeonpea and other vegetable crops has been reviewed.
Key words: Deltamethrin, Pigeonpea, *H. armigera.*

1. Introduction

In India agriculture sector is the mainstay as about half of India's population is wholly or significantly dependent on agriculture and allied activities for their livelihood. Pigeonpea is one of the important cash crops playing a key role in the economy of Indian farmers. It contributes about 90 per cent of the world's pigeonpea production. In India, the area of pigeonpea is 3.53 million hectare and Production of pigeonpea in the year 2014-15 was2810.00 Thousand Tonnes. As per IIPR Vision 2030 India needs around 32 million tons of pulses by 2030, to feed the estimated population of about 1.68 billion. Global supply of pulses is limited, as India happens to be the largest producer and consumer of pulses. The productivity of pigeonpea has not increased considerably during last decade in India. The damage caused by insect pests is one of the major reasons of low productivity. Indian agriculture is currently suffering a huge loss due to insect pests. Among the insect species infesting pigeonpea, the pod borer complex is reported to reduce the yield upto 27.77% and among the borers, gram pod borer *H.armigera* is considered as most destructive. Insecticides, herbicides and fungicide application play a vital role in modern crop production technology [1]. In countries like India and China, 50% of all insecticides used are directed to control this pest. Considerable numbers of insecticides have been tested and few of them found effective against the pod borers in pigeonpea [2] .Pesticides should be selected on the basis of minimum mammalian toxicity to minimize the residual toxicity level in agricultural commodities [1].Deltamethrin has become of choice in most countries owing to its rapid metabolism and low toxicity to humans and other non-target animals as well as its high potency on a large number of pests [3]. Therefore, keeping in view of the above discussions the available literature is related to the efficacy of deltamethrin against pod borer *H.armigera* in pigeonpea has been reviewed.

2. Pod borer*Helicoverpa armigera: A major* constraint in pulse production.

About 250 insect species belonging to 8 orders and 61 families have been found to infest pigeon pea from seedling to harvesting stages and virtually no plant parts are free from insect infestation. The constraint for the low yield is the heavy infestation of an array of pest complex. The major insect causing heavy loss is the pod borer,*H.armigera* and thus determining the yields of pigeonpea crop [4]. There is higher incidence of pod borers during flowering and pod formation stage the economic threshold level is 8- 10 eggs or 3-5 small larvae per plant at flowering stage of crop at this stage chemical control measures become necessary as an average infestation of one larva per plant may cause a yield loss of 10-15 kg haG[1].Studies have shown that the four chief characteristics polyphagy, high mobility, high fecundity, and facultative diapauses of *H. armigera* help attaining the status of a major pest.

3. Synthetic Pyrethroid deltamethrin for Crop Protection

The invention of synthetic pyrethroids was a timely development.Synthetic pesticides were introduced following the Second World War, and their uses has increased substantially and have gained worldwide attention because of their effectiveness at low doses, short-term environmental persistence, and relatively low

mammalian toxicity. One pyrethroid which is used more commonly than other synthetic pyrethroids and has found wide acceptability for agricultural purposes is Deltamethrin *(S)-Cyano-3-phenoxybenzyl, (lR,3R)-3-(2,2-dibromovinyl)- 2,2 dimethylcyclopropanecarboxylate.* The insecticide deltamethrin is a versatile active ingredient belonging to the family of pyrethroids discovered by M. Elliott et al. in 1974 and marketed by Roussel Uclaf in 1977. Deltamethrin is recommended for crop use at 10-15 g/ha. Deltamethrin is extensively used as an ectoparasiticide in animals and as insecticide in crop production and in public health programme. Deltamethrin as hydrophobic compound has a low mobility in soils. This property causes strong sorption to soil organic matter, and limited its leaching into groundwater. The insecticidal effects of deltamethrin is believed to result from its binding to a distinct receptor site on voltage-gated sodium channels and prolonging the open state by inhibiting channel deactivation and inactivation [5] . Deltamethrin,has been evaluated by the International Agency for Research on Cancer (IARC, 1991), it is classified in Group 3 (not classifiable as to carcinogenicity to humans).As per thesource from CIB & RC following Formulation are registered 2.5% Flow, 2.5% WP, 2.8% EC, 0.5% Chalk, 1.25% ULV, 25% Tab., 11% EC, 0.5% Tablet bait. Samples of EC (2.8) formulations of deltamethrin were tested forPhysico-chemical Properties as per guidelines given in the BIS specification all samples were found to be up to the mark[6].

4. Bioefficacy of deltamethrin against gram pod borer *Helicoverpa armigera*.

The available literature related to bioefficacy of deltamethrin against podborer *H.armigera* on pigeonpea and other vegetable crops have been reviewed and presented.

Faqiri and Kumar [7] in theirstudies on management of tomato fruit borer *Helicoverpa armigera* by chemical insecticides and neem products concluded that after first spray, the lowest infestation of fruit borer were recorded in treatments of Profenophos 50% EC (Cucracron 2ml/lit) (4.350), Spinosad 45%SC (5.370), Deltamethrin 2.8% EC (Decis 1ml/lit.) (5.90), NSKE (5.90), Chlorantraniliprole 18.5%SC (6.550), Neem oil (6.650). However, all these treatments were superior over control (13.24). The maximum yield was reported in Neem oil (15 q/ha), followed by NSKE (13.00 q/ha), Deltamethrin 2.8%EC (14.00 q/ha), Profenophos 50 %EC (16.00 q/ha), Chlorantraniliprole 18.5% SC (12.00 q/ha), Spinosad 45 %SC (13.00 q/ha).

Shafiq *et al* .[8] evaluated the effect of insecticides (methyl parathion @ 250 ml/ha, carbary @ 1kg/ha, cypermethrin @ 36 ml/ha,deltamethrin @ 36 ml/ha, imidacloprid @ 40 ml/ha) and biopesticides (neemarin @ 625 ml/ha,neemazal@ 625 ml/ha, neemix@ 625 ml/ ha, neem oil@ 625 ml/ ha, HaNPV@ 0.4 ml/l) for the management of *H. armigera* for three years.Results showed that cypermethrin and neemarin were most effective in reducing the larval count 3 days after treatment (DAT) after first round spray and deltamathrin was superior at 7 DAT where no larva was recorded. In second round spray, imidacloprid and cypermethrin proved to be most effective in reducing the larval count. Among all insecticides and biopesticides, cypermethrin and imidacloprid were more effective in reducing the density than other treatments and control.

Singh *et.al.* [9] tested the effect of neem based bio-pesticides on germination, infestation, field emergence, mortality and seed vigour index in pigeon pea (*Cajanus cajan*) seed cv. Azad during storage. Seed with 9.8% initial moisture and 85% germination were treated with ten Neem based bio insecticides *viz.* Neem seed kernel powder, Neem cake, Neem dry leaf powder@ 5 g/kg seed, Neem oil, Nimbicidine, Achook @ 5 ml/kg seed Neem India and Econeem@ 2.5 and 5 ml/kg seed along with Deltamethrin @ 40 mg/kg seed and one sample was kept untreated as control. Seed treated with Deltamethrin showed higher germination (82.93%), mortality (100%), field emergence (80%), infestation (0.0%) and seed vigour index (24.21) in relation to neem based bio-insecticides.

Anonymous[10] suggested the effective control of gram pod borer on *H. armigera* chickpea with Deltamethrin 2.8 EC @ 750 ml /ha.

Hussain and Sheikh [11] evaluated the efficacy of six insecticides against *H.armigera*infesting tomato. Among the treatments imidacloprid at 0.03 % proved more effective followed by deltamethrin 2.8 EC at 0.01 % and fluvalinate. The spraying of these insecticides on tomato resulted in significantly higher reduction of larval population. The field data showed that imidacloprid gave a significantly higher increase in yield (>78%) over control followed by deltamethrin.

Sood and Mondal [12] in a field experiment evaluated five insecticides against gram pod borer, *H. armigera* .The results of the study revealed that lamda cyhalothion 0.004%, deltamethrin 0.0028% and cypermethrin 0.0075% were the effective Insecticides with 9.26, 10.61 and 11.26 per cent pod Infestation,

respectively as compared to 30.79 per cent in case of untreated control.

Kumar and Nath [13] assessed the effect of insecticides for management of *H.armigera* and pod fly on grain yield and seed weight of pigeonpea. The insecticides used were (0.04% monocrotophos, 0.02 % fenvelerate, 0.006% cypermethrin, carbaryl 5D (5%), 0.004% deltamethrin, 0.07% endosulfan and 5% malathion).the minimum loss in seed weight (2.89 %)and higher grain yield (24.85 in Bahar and 18.28 q/ha in UPAS 120) was observed in plots treated with endosulfan, cypermethrin, fenvelerate, deltamethrin, carbaryl and malathion.The lowest grain yield was recorded in control plots, which had a grain yield of 9.79 and 13.16 q/ha in UPAS 120 and Bahar respectively.

Kumar and Nath [14] conducted an experiment to investigate the effect of insecticides on the extent of pod and seed damage by pod borer and pod fly in pigeonpea.Seven insecticides (0.04% monocrotophos, 0.02 % fenvelerate, 0.006% cypermethrin, carbaryl 5D (5%), 0.004% deltamethrin, 0.07% endosulfan and 5% malathion) were found significantly superior over the control in reducing the pod and seed damage.Endosulfan was the best insecticide,Which recorded the minimum pod damage of 4.08% and seed damage of 2.32% whereas the maximum pod and seed damage was recorded in the control plot (19.00 and 10.57 % respectively)

Yadav *et al.* [15] determined the relative toxicity of four synthetic pyrethroids, viz cypermethrin, deltamethrin, fenvalerate, fluvalinate along with endosulfan by bioassay method against 1 to 2 days and 8-9 days old larvae of, *H.armigera* .The order of toxicity to 1 -2 day old larvae with LC50 values, deltamethrin (0.0000244) cypermethrin (0.0000334) fluvalinate (0.00002437) fenvalerate (0.00002583) endosulfan (0.0007334). The former four insecticides were respectively. 30.06, 21.96, 3.01 and 2.84 times more toxic than endosulfan. The order of toxicity against 8-9 days old larvae was deltamethrin cypermethrin fenvalerate fluvalinate endosulfan. The synthetic pyrethroids were 23.04, 21.50, 3.54 and 2.68 times more toxic than endosulfan respectively. The LC50 values of deltamethrin, cypermethrin, fenvalerate, fluvalinate and endosulfan against 8-9 days old larvae were 0.00001162, 0.00001245, 0.00007571, 0.00009987 and 0.00026768 per cent, respectively. Among synthetic pyrethroids, deltamethrin and cypermethrin were found superior to others regarding protection against larvae of *H. armigera*.

Chand *et al.* [16]reported the residual toxicity and persistence of acephate (0.05%), deltamethrin (0.0028%), endosulfan (0.05%) and malathion (0.05%) to*H. armigera* in tomato fruits. They found that the larval mortality was 100 per cent on the day of application of endosulfan and deltamethrin which were the most toxic against*H. armigera*. Based on persistence of toxicity endosulfan and acephate were the most effective. Endosulfan residues persisted for more than 15 days.

Baruah *et al.* [17] studied the efficacy of cypermethrin (0.006 %), fenvalerate (0.008%), deltamethrin (0.002 %) and endosulfan (0.07 %) in Assam. On the basis of effect of insecticides on pod damage, it was found that on an average, synthetic pyrethroids were better than endosulfan against H. armigera infesting pigeonpea.

Singh and Singh [18] observed the efficacy of endosulfan 35 EC (0.07%), fenvalerate 20 EC (0.01 and 0.02%), methomyl 24 L (0.06 and 0.1%), quinalphos 25 EC (0.05%), cartaphydrochloride 50 SP (0.04 and 0.08%), etofenprox 10 EC (0.02 and 0.04%), monocrotophos 36 SL (0.04%), chlorpyrifos 20 EC (0.05%) and deltamethrin 2.8 EC (0.004%) against *Helicoverpa armigera, Exelastis atomosa, Maruca vitrata* and *Melanagromyza obtusa* on pigeon pea cv. P 855. Pod damage was significantly reduced in all insecticide treatments compared with the untreated control. Deltamethrin 2.8 EC, methomyl 24 L (0.1%) and fenvalerate 20 EC (0.02%) were the most effective, recording the lowest percentage of pod damage (42.3, 42.23 and 46.16%, respectively), compared with the untreated control (70.3%). Deltamethrin 2.8 EC recorded the highest yield (1559 kg) and net profit (Rs. 4544/ha). The highest cost benefit ratio (1: 17.94) was obtained with fenvalerate 20 EC (0.01%).

Yadav *et al.* [19] studied the bioefficacy of 12 insecticides namely,monocrotophos 0.04%, endosulfan,0.07%, quinalphos 0.05%, malathion 0.05%,carbaryl 0.15%, chlorpyrifos 0.05%, cypermethrin 0.006%, deltamethrin 0.007%, fluvalinate 0.06%, fenvalarate 0.008%, trizophos 0.06% and neem 0.05% against larvae of *H.armigera* in field pea and observed that cypermethrin and deltamethrin were more effective than other treatments except fenvelarate after 7 days of spraying but after 14 days of spraying all the conventional insecticides were found superior to all the synthetic pyrethroids, malathion and neem.

Conclusion

It is important to compare the efficacy of insecticides against pests for effective pest management and to reduce the indiscriminate use of insecticides.The review study showed that the use of deltamethrin is beneficial for the management of *H.armigera* on pigeon peas as it significantly reduce the infestation of gram pod borer *H. armigera* as compared to control plots. Sprays of 0.002 to 0.009% can be used by the cultivators for minimizing the losses in yield due to prominent damage caused to pods by *H. armigera.*

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