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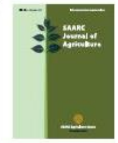

Management of Pod Borer, *Maruca vitrata* (Lepidoptera: Crambidae) in Country Bean by Newer Insecticides

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Abstract

Bean pod borer, *Maruca vitrata* F. (Lepidoptera: Crambidae) is a destructive pest of country bean causing severe yield loss. Potency of novel formulated four insecticides were tested against M. *vitrata* on BARI Shim-5 following RCBD from November 2021 to February 2022. Four treatments with 3 doses viz., T_1 = Cyproflanilide 10% DC (ACC-Cy), T_2 = Profenofos 50%, T_3 = Pyriproxyfen (Pyrifen 10.8 EC) and T_4 = Noclaim 5 SG (Emamectin benzoate), and an untreated control were evaluated. All the treatments were found significantly effective against the pod borer over untreated control. The lowest number of pod borers were counted as 5.00, 3.33, 1.33 and 3.67 from Cyproflanilide 10% DC @ 0.60 mlL^{-1} of water while the highest as 14.00, 13.33, 15.00 and 14.67 from the untrated control at 1st, 5th, 10th and 15th days after treatments, respectively. The lowest (20.42g) infested pods $plant^{-1}$ were harvested from Cyproflanilide 10% DC treated plants but the highest (86.26g) in the untreated control. The ranked of the treatments based on pod protection over control by number followed as Cyproflanilide 10% DC @ 0.60 ml L^{-1} of water > Pyriproxyfen @ 1.50 ml L^{-1} of water > Emamectin benzoate @ 1.25 g L^{-1} of water > Prophenophs 50% @ 0.75 ml L^{-1} of water. So, based on efficacy, Cyproflanilide 10% DC was found superior than Profenofos, Pyriproxyfen and Emamectin benzoate against *M. vitrata*.

Keywords: Country bean, Efficacy, Novel insecticides, Pod borer

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Introduction

Among the legumes, globally the country bean (*Lablab purpureus* L.) plays a pivotal role in diet of humans as the excellent source of inexpensive dietary protein (Seetharamu et al. 2019). It is also rich for carbohydrates, vitamins, minerals and unsaturated fatty acids such as linoleic and oleic acids (Celmeli et al., 2018; Martinez et al., 2016; Seetharamu et al., 2019). They are also active source of fodder for livestock (Chandra & Kushwaha, 2012), green manure (Ewansiha et al., 2016) and atmospheric nitrogen fixer (Singh et al., 2023). This crop is cultivated in large scale in Bangladesh as a delicious winter vegetable (Salim et al., 2013; Khan et al., 2020; Rahman et al., 2022). But production of legumes is vulnerable by several constraints, amongst the insect pests are the critical (Soundaranjan et al. 2013; Rashedin et al., 2023). Among them, the legume pod borer *Maruca vitrata* F. (Lepidoptera: Crambidae) is the most destructive polypagous insect of legume and may cause up to 98% yield losses (Ba et al., 2019).

Circumstancial evident that the farmers mostly rely on the use of insecticides to control the bean pests for quick results (Lengai et al., 2019; Konlan et al., 2016). But indiscriminate use of pesticides has serious drawbacks in the environment, disrupt the the ecosystem, hazardous to a wide range of non-target organism (Chowanski et al., 2014), creates pesticide resistance (Shehzad et al., 2023) and pest resurgence (Patil et al., 2017). Nowadays, researchers are looking to adopt alternatives of broad-spectrum synthetic insecticides. The new generation insecticides molecules offered numerous advantages over conventional pesticides like high selectivity, incredible efficacy at low dosage, safe to beneficial insects and environment as well (Kodandaram et al., 2010). So far, reports on the new molecule's bio-insecticide against the the legume pod borer are scanty in Bangladesh (Ahmed et al., 2020). To encounter the existing challenges, a field trial was undertaken to find out the efficacy of the new generation's insecticides, such as Cyproflanilide 10% DC, Profenophos 50%, Emamectin benzoate and Pyriproxyfen against the pod borer on the country bean.

Materials and Methods

The experiment was conducted in the Rabi season in On Farm Research Center of Bangladesh Agricultural Research Institute (BARI), Rajbari, Dinajpur from November 2021 to February 2022.

Plant cultivation: BARI Shim-5, *Lablab perpureus* was collected from BADC of Sadar Upazila (sub-district), Dinajpur town. Pits were prepared and sown 3 seeds in each pit followed by a light irrigation for germination. The treatments of experimental field were laid out in a Randomized Complete Block Design (RCBD) with 3 replications with untreated control. A single plant was kept in each pit by thinning at 15 days of sowing. Each plant was stacking with bamboo stick to prevent lodging at optimum growth. Cow-dung and other chemical fertilizers were applied according to the fertilizer recommendation guide (FRG, 2012). Intercultural operations including irrigation and weeding were done when needed.

Treatments: Five treatments were applied as T_1= Cyproflanilide 10% DC (ACC-Cy) @ 0.30, 0.45, 0.60 ml L^{-1} of water, T_2 = Profenofos 50%, @ 0.25, 0.50, 0.75 ml L^{-1}, T_3 = Pyrifen 10.8 EC as (Pyriproxyfen) @ 0.5, 1.00, 1.50 ml L^{-1} water while T_4= Emamectin benzoate (Noclaim 5 SG) @ 0.75, 1.00 and 1.25 gm L^{-1} of water with hand sprayers. Besides, an untreated control was maintained with sprayed water only. The insecticides were applied and evaluated against the pod borer. The experimental field was monitored keenly to observe the infestation by the borer. Then numbers and weight of infested pods were counted and recorded at 1, 5, 10 and 15 days of intervals after spraying of insecticides with 3 replications.

Statistical analysis: The data were analyzed by using Statistics 10 software to test the significance of variance among the treatments and means are separated by using Tukey's HSD test.

Results and Discussion

Effects of newer insecticides against *M. vitrata* on infested pods: Treatments of novel formulated insecticides had profound effects on pod borer infestation as compared to untreated control (Table 1). Among the treatments, significantly (P< 0.01, df = 12, F =12.18; P< 0.01, df = 12, F =23.95; P< 0.01, df =12, F =49.38; P< 0.01, df = 12, F =71.65) the lowest number of pod borers plant^{-1} were counted as 5.00, 3.33, 1.33 and 3.67 from Cyproflanilide 10% DC @ 0.60 mlL^{-1} of water at 1st, 5th, 10th and 15th days after treatments (DATs), respectively. While the highest number of pod borer plant^{-1} were found as 14.00, 13.33, 15.00 and 14.67 from the untrated control at 1st, 5th, 10th and 15th DATs, respectively. The lowest number (3.33) of pod borers plant^{-1} was recorded from Cyproflanilide 10% DC treated plants but the highest (14.23) in the untreated control. The pooled mean number pod borers plant^{-1} was followed as Cyproflanilide 10% DC @ 0.60 ml L^{-1} of water > Pyriproxyfen @ 1.50 ml L^{-1} of water > Emamectin benzoate @ 1.25 g L^{-1} of water > Profenofos 50% @ 0.75 ml L^{-1} of water.

Results revealed that selected insecticides were found very potent against pod borer as compared to untreated control. The outcomes indicated that such newer insecticides prevent the plant from the damage of pod bores. The present results are comparable with Shelke *et al*. (2021). They concluded the efficacy of 0.002% emamecten benzoate and Profenofos 50 EC @ 0.075% found good results at 3 DAS proved to be best in reducing pod damage caused by *M. vitrata*. Present results are also in agreement with Gawade *et al.* (2024) who concluded that spinosad 45 EC @ 0.003 per cent was found more effective in reducing the pod damage (2.89%) and followed by indoxacarb 14.5 SC @ 0.014 per cent (3.96%). Bharti et al. (2015) evaluated the efficacy of Indoxacarb 14.5 SC @ 60 g a.i. ha-1, Profenofos 50 EC @ 500 g a.i. ha-1, Spinosad 45 SC @ 75 g a.i. ha-1, Imidacloprid 17.8 SL @ 25 g a.i. ha-1, Endosulfan 35 EC @ 700 g a.i. ha-1, Emamectin benzoate 5% WSG @ 5 g a.i. ha-1, Flubendiamide 20 WG @ g a.i. ha-1, against *Helicoverpa armigera* Hub. in chickpea (*Cicer arietinum* L.) and found good result. Gebretsadkan et al. (2019) and Sonune *et al*. (2010) stated that profenofos 50%, abamectin, imidachloprid + lambda-cyhalothri can suppress the legume pod borer.

Table 1. Effect of newer insecticides against *M. vitrata* on number of infested pods

Treatments	Doses (g/ml) L^{-1} water	Mean number of infested pods $plant^{-1}$				Pooled mean
		1 DATs	5 DATs	10 DATs	15 DATs	
Cyproflanilide 10% DC	0.30	9.67 bcd	6.67 c-f	8.33 bc	10.00 cde	8.67
	0.45	6.00 def	5.67 d-g	4.33 de	6.33 gh	5.58
	0.60	5.00 f	3.33 g	1.33 f	3.67 h	3.33
Profenofos 50%	0.25	10.67 ab	9.33 bc	8.67 bc	10.67 bc	9.83
	0.50	8.67 b-f	7.67 cde	6.33 cd	8.33 ef	7.75
	0.75	6.00 def	6.00 d-g	4.00 de	6.00 gh	5.50
Pyriproxyfen	0.50	9.33 b-e	8.33 bcd	8.00 bc	10.33 bcd	9.00
	1.00	7.00 c-f	6.00 d-g	5.00 de	7.67 fg	6.41
	1.50	5.33 ef	4.67 fg	3.67 ef	5.00 hi	4.67
Emamectin benzoate	0.75	11.67 ab	10.67 ab	9.33 b	12.00 b	10.92
	1.00	9.00 b-f	7.33 c-f	5.33 de	8.67 def	7.58
	1.25	6.67 c-f	5.00 efg	4.00 de	5.67 h	5.33
T_0 (Control)	-	14.00 a	13.33 a	15.00 a	14.67 a	14.23
CV (%)	-	15.99	13.21	13.41	7.58	-

Effect of newer insecticides against *M. vitrata* on weight of infested pods: The insecticidal efficacy against the legume borer on the weight of pods is reflected in Table 2. Significantly ($P< 0.01$, $df = 12$, $F = 11.69$; $P< 0.01$, $df = 12$, $F = 23.74$; $P< 0.01$, $df = 12$, $F = 46.03$; $P< 0.01$, $df = 12$, $F = 69.82$) the highest weight of infested pods was estimated as 82.60, 80.0, 91.50 and 90.93g from the untreated control at 1^{st}, 5^{th}, 10^{th} and 15^{th} DATs, respectively. Conversely, the lowest infested pods were observed as 30.0, 20.33, 8.27 and 23.10g from Cyproflanilide 10% DC @ 0.60 ml L^{-1} of water at both 1^{st}, 5^{th}, 10^{th} and 15^{th} DATs, respectively. The lowest (20.42g) infested pods $plant^{-1}$ were harvested from Cyproflanilide 10% DC treated plants but the highest (86.26g) in the untreated control. The potency ranked of the treatments based on mean weight of infested pods $plant^{-1}$ followed as Cyproflanilide 10% DC @ 0.60 ml L^{-1} of water > Pyriproxyfen @ 1.50 ml L^{-1} of water > Emamectin benzoate @ 1.25 g L^{-1} of water > Profenofos 50% @ 0.75 ml L^{-1} of water.

Novel innovative research illustrated that diverse plant synthetic insecticides have been tried by several researchers with a good degree of success against legume pod borer, *M. vitrata* (Rekha 2006; Akkabathula and Rana, 2019). Tested insecticides significantly decreased the population of pod borer, pod damage and increased the grain yield as compared to untreated control. But Cyproflanilide 10% DC @ 0.60 ml/L water was found the most effective against tested insect and it was closely followed by Pyriproxyfen 1.50 ml/L water. The present findings are comparable with that of Rashedin et al. (2023). They cited that Cyproflanilide 10% DC @ 0.60 ml L-1 of water was found to be effective against the leaf folders (2.75, 2.92 and 3.34) on country ben. Randhawa and Saini (2015) reported the lowest pod damage and highest grain yield in spinosad, Cypermethrin 25 EC, Profenophos 50 EC and Indoxacarb 15 EC @ 150, 250, 1250 and 500 ml/ha treated plots against pigeonpea pod borer (Randhawa and Saini, 2015). In other study also recorded similar results who concluded that spinosad treated plants showed the lowest pod damage, lowest seed damage and highest grain yield (Gawade et al., 2024). Akkabathula and Rana (2019) also revealed that spinosad applied against insect pests of pigeon pea including pod borer resulted lowest pod damage, lowest seed damage, lowest seed loss and higher seed yield.

Table 2. Effect of newer insecticides against *M. vitrata* on weight of infested pods

Treatments	Doses (g/ml) L^{-1} water	Mean weight (g) of infested pods $plant^{-1}$				Pooled mean weight (g)
		1 DATs	5 DATs	10 DATs	15 DATs	
Cyproflanilide 10% DC	0.30	58.00 bcd	40.67 c-f	51.67 bc	63.00 cd	53.33
	0.45	36.00 def	34.57 efg	26.87 de	39.90 fg	34.33
	0.60	30.00 f	20.33 g	8.27 f	23.10 h	20.42
Profenofos 50%	0.25	65.07 abc	57.87 bc	54.60 bc	68.27 bc	61.45
	0.50	52.87 b-f	47.53 cde	39.90 cd	53.33 de	48.41
	0.75	36.60 def	37.20 d-g	25.20 de	38.40 fg	34.35
Pyriproxyfen	0.50	57.87 bcd	52.50 bcd	51.20 bc	67.17 bc	57.18
	1.00	43.40 c-f	37.80 d-g	32.00 de	49.83 ef	40.75
	1.50	33.07 ef	29.40 fg	23.47 ef	32.50 gh	29.61
Emamectin benzoate	0.75	73.50 ab	68.27 ab	60.67 b	79.20 ab	70.41
	1.00	56.70 b-e	46.93 cde	34.67 de	57.20 cde	48.88
	1.25	42.00 c-f	32.00 efg	26.00 de	37.40 g	34.35
T_0 (Control)	-	82.60 a	80.00 a	91.50 a	90.93 a	86.26
CV (%)	-	16.02	13.01	13.52	7.55	-

Effect of insecticides against *M. vitrata* on protection over control: The applied insecticides had promising effects against the borer infestation on the pod protection over control on country bean (Table 3). Statistically ($P< 0.01$, $df = 11$, $F=7.59$; $P< 0.01$, $df = 11$, $F =21.27$; $P< 0.01$, $df = 11$, $F = 24.12$; $P< 0.01$, $df = 11$, $F = 45.57$) the highest pod protection over control was observed as 64.29, 75.00, 91.11 and 73.81% from Cyproflanilide 10% DC @ 0.6 ml L^{-1} of water at 1st, 5th , 10th and 15th days, respectively after 3rd spray. Conversely, the lowest protection over control were observed as 16.67, 19.98, 37.78 and 14.29% from Emamectin benzoate @ 0.75 ml L^{-1} of water treated plant at 1st, 5th, 10th and 15th days, respectively. The highest protection over control (76.05%) by number $plant^{-1}$ was recorded from Cyproflanilide 10% DC @ 0.6 ml L^{-1} of water treated plants while the lowest (22.18%) from the Emamectin benzoate @ 0.75 ml L^{-1} of water. The potency ranked of the treatments based on protection over control by number $plant^{-1}$ followed as Cyproflanilide 10% DC @ 0.60 ml L^{-1} of water > Pyriproxyfen @ 1.50 ml L^{-1} of water > Emamectin benzoate @ 1.25 g L^{-1} of water > Profenofos 50% @ 0.75 ml L^{-1} of water.

Tested insecticides showed their significant effect in reducing the infested pods as compared to the control. These findings are parallel with Prasanna et al. (2020). They found that the highest yield was obtained in chickpea against pod borer from Cyclaniliprole 10% DC @ 40 g a.i /ha treated plots (13.25 q/ha). Present results are also comparable with Kolarath et al. (2015), Aktar et al. (2020) and Patel et al. (2012) where they found that the lowest number of infested pods were found from Emamectin benzoate treated plots Similarly, Haripriya *et al.* (2019) reported that the sequential application of Emamectin benzoate only 8.87% pod was infested by *M. vitrata* on lablab bean. Likewise, Anil and Sharma (2011) reported minimum (18.79%) fruit infestation in Emamectin benzoate. Gawade et al. (2024) also stated that the highest increased of healthy green pods was found in Spinosad and Emamectin benzoate treated plots against the *M. vitrata* hosted on cowpea but the lowest in the untreated control.

The present study demonstrates that chemical control proves to be an effective strategy against pests like pod borer. All the tested chemicals e.g., Cyproflanilide, Profenofos, Pyriproxyfen and Emamectin benzoate yielded significant results in comparison with untreated control. However, among the treatments, Cyproflanilide 10% DC @ 0.60 ml L^{-1} of water was observed more effective against *M. vitrata.*

Table 3. Effect of newer insecticides against *M. vitrata* on pod protection over control by number

Treatments	Doses (g/ml) L^{-1} water	Protection (%) over control by number $plant^{-1}$				Pooled mean (%)
		1 DATs	5 DATs	10 DATs	15 DATs	
Cyproflanilide 10% DC	0.30	30.95 cde	49.99 bcd	44.44 de	28.57 efg	38.49
	0.45	57.14 abc	57.49 bc	71.11 bc	54.76 bc	60.12
	0.60	64.29 a	75.00 a	91.11 a	73.81 a	76.05
Propfenofos 50%	0.25	23.81 de	29.98 ef	42.22 de	23.81 gh	29.95
	0.50	38.09 abcde	42.49 cde	57.78 cd	40.48 de	44.71
	0.75	57.14 abc	54.99 bc	73.33 bc	57.14 bc	60.65
Pyriproxyfen	0.50	33.33 bcde	37.48 de	46.67 de	26.19 fgh	35.91
	1.00	50.00 abcd	54.99 bc	66.67 bc	45.23 cd	54.22
	1.50	61.90 ab	64.99 ab	75.56 ab	64.29 ab	66.68
Emamectin benzoate	0.75	16.67 e	19.98 f	37.78 e	14.29 h	22.18
	1.00	35.71 abcde	44.97 cde	64.44 bc	38.09 def	45.80
	1.25	52.38 abcd	62.49 ab	73.33 bc	59.52 b	61.93
T_0 (Control)	-	-	-	-	-	-
CV (%)	-	22.76	11.76	9.29	10.77	-

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