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EFFECT OF CRUDE SEED EXTRACT OF SOME INDIGENOUS PLANTS FOR THE CONTROL OF LEGUME POD BORER *(Maruca vitrata* F.) ON COUNTRY BEAN

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Abstract

The crude seed extract of neem, black pepper, mahogani, and garlic bulb with three doses were evaluated against legume pod borer in the country bean field in two seasons *kharif* 2006 and *rabi* 2006-2007. The neem seed extract applied @150 and 100 g/l and mahogani seed extract @ 100 g/l of water 7 days intervals on the country bean showed better performance in the reduction of flower and pod damage with significantly higher yield of bean in both the seasons. The seed extracts lost the efficacy against legume pod borer after 7 days of application.

Keywords: Indigenous plant materials, crude extract, country bean, legume pod borer.

Introduction

The legume pod borer, *Maruca vitrata* F. *(=Maruca testulalis* Geyer) is a serious pest of leguminous crops in the tropics and subtropics of Asia, Africa, and Latin America. The adults of legume pod borer do not feed on the flower buds, flowers and pods but they mate and oviposit on them. The larvae feed on flower buds, flowers aad young pods of different bean plants (Chi *et al.,* 2003; Rekha and Mallapur, 2007). Female moths lay eggs throughout the crop growing season, but damage occurs mainly during flowering and podding stages. Young larvae feed mainly on flowers, whereas mature larvae attack fruits and pods (Liao and Lin, 2000). The legume pod borer larvae boring round hole in the corolla of the flowers which are converted to a mass of brownish frass.

Maruca vitrata F. is the major yield reducer of bean. Losses due to *Maruca vitrata* have been estimated at $30 million annually (Anon., 1992). In Sri Lanka, Dharamasena *et al.* (1992) reported 84 % yield loss, while Joseph and Saxena (1996) observed 90 to 100 % pod damage in the pigeon pea cultivar ICPL 87 under non strayed conditions. Most of the country bean growers in Jessore region of Bangladesh use large quantities of chemical insecticides indiscriminately to control this pest and most of the farmers have been using “cocktail” (Mixture of 3-5 insecticides) and spray at every or every alternate day (Kabir *et al.,* 1996; Rashid *et al.,* 2003). This practice not only increases cost of production but also causes environmental pollution and human health hazard (Kabir *et al.,* 1996;

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Rashid *at al.,* 2003), develop the pest resistance (Forrester, 1990; Ekesi, 1999) and also destroy natural enemies (Ulrichs *et al.,* 2001). Sometimes persistent pesticides accumulate in the higher food chain of both wildlife and human and become concentrated by biomagnifications (Metcalf, 1975; Senapati *et al.,* 1992). For all these reasons, it is essential to search the alternative control measures for the management of legume pod borer. Many researchers studied the insecticidal action of plant materials (Akhauri and Yadav, 2002; Prajapati *et al.,* 2003; Oparaeke *et al.,* 2005). Indigenous plant materials are cheaper, easily available and hazard free in comparison with chemical insecticides. The present study was conducted to evaluate the efficacy of crude seed extracts of different plants against legume pod borer in the country bean field.

Materials and Method

The trial was carried out for two consecutive seasons viz. *kharif* 2006 and *rabi* 2006 - 07 at Regional Agricultural Research Station, Jessore to evaluate the effectiveness of four plant extracts with three doses along with a control against legume pod borer. The country bean seeds (Barinagar local) were sown on 21 June, 2006 in 54 plots each measuring 3.0 m x 1.5 m. Treatments were assigned in randomized complete blook (Factorial) design with three replications and spacing of 1.5 m and 2.0 m between plots and blocks, respectively. Intercultural operations were done as and when necessary. Fertilizers were applied as per recommendation. Four botanicals viz., seeds of neem *(Azadirachta indica),* black pepper *(Piper guineense),* mahogani *(Swietinia mahogani*), and garlic bulb *(Allium sativum)* were collected from different locations of Bangladesh.

Freshly collected 600 g seeds of neem, black pepper, mahogani, and garlic bulb were crushed by electric grinder separately one day before the schedule spray. The crusher machine was washed and cleaned properly after crushing each material. The crushed materials were transferred to the plastic bucket separately. Three litres of water was added to the crushed plant material in a separate plastic bucket and left for 12 hours. After 12 hours, plant extract was separated from crushed plant materials by decanting through a muslin cloth. This extract was considered as a stock extract. The extract contained active components from 200 g test material per liter of water. It was diluted to contain active components from 50 g, 100 g, and 150 g per litre of water. The process was repeated for all the cases and the cloth was washed at each time. Treatments were as follows:

T_1 = Spray of neem seed extract @ 50g, 100g, and I 50g per litre of water at an interval of 7 days commencing from first incidence of legume pod borer.

T_2 = Spray of neem seed extract @ 50g. 100g, and 150g per litre of water at an interval of 14 days commencing from first incidence of legume pod borer.

T_3 = Spray of black pepper seed extract @ 50g, 100g and 150g per litre of water at an interval of 14 days commencing from first incidence of legume pod borer.

T_4= Spray of garlic bulb extract @ 50g, 100g, and 150g per litre of water at an interval of 14 days commencing from first incidence of legume pod borer.

T_5 = Spray of mahogani seed extract @ 50g, 100g, and 1 50g per litre of water at an interval of 7 days commencing from first incidence of legume pod borer.

T_6 = Untreated control.

The above mentioned doses of different crude seed extracts were sprayed on the bean plants using knapsack sprayer. Knapsack sprayer was washed and cleaned after each plant extract spraying. Only water was sprayed in untreated control plot. Number of healthy and infested flowers were counted and recorded at 14 days interval from 25 inflorescences randomly selected per plot before spray and to calculate percentage of flower infestation at each observation. The pods were harvested from each treatments before each spray. At each harvest, number of healthy and infested pods were recorded and weighed to calculate percentage of pod infestation. The number of legume pod borer larvae were counted and recorded from randomly selected 10 infested pods before spray and after 24 hours of spray to calculate percentage of surviving larvae. All the data were analyzed statistically after appropriate transformations and the means were compared using DMRT by MSTAT computer software.

Results and Discussion

Effect of seed extracts on flower infestation

The crude seed extracts sprayed on bean plants caused from 11.30 to 23.71 % flower damage which differed significantly ($P < 0.01$) from 30.45 % of flower infestation in untreated control in *kharif* 2006 (Table 1). The neem seed extract applied @ 100 g/l at 7 days intervals during the *kharif* season resulted the lowest damage (11.30 *%).* The second highest flower damage of 23.71 % was recorded in the plots with neem seed extract applied @ 50 g/l at 14 days intervals, which was statistically identical to other treatments of neem seed extract and the lowest dose of black pepper. The effect of garlic extract on flower damage was almost similar to black pepper. Mahogani seed extract at 150 g/l at 7 days interval caused 16.29 % flower infestation followed b its lower dose, and its lowest dose showed similar effect to that of garlic bulb. In *rabi* season, the flower infestation at all treatments decreased on the country bean (Table 1). However, the flower damage ranged from 10.52 to 23.49 % and recorded significantly different damages among the tested plant materials. The highest flower infestation was 23.49 % in untreated control and the lowest flower infestation of 10.52 % in

treatment of mahogani seed extract sprayed 150g/l at 7 days intervals, which was statistically identical to its 100 g/l applied at 7 days intervals and neem seed extract @150 g/l at 7 days intervals. The plants treated with seed extract of black pepper and garlic bulb at all doses did not differ significantly with respect to flower damage in *rabi* season except black pepper seeds extract applied @ 100 g/l (Table 1). The reduction of flower infestation over control incurred from 22.13 to 62.89 % in the *kharif* and 19.58 to 55.21 % in *rabi* season among the treatments (Table 1).

Table 1. Percentage of infested flowers by legume pod borer and after spraying with different doses of crude seed extracts in two cropping seasons.

Plant materials	Spray interval	Dose (g/L)	Kharif 2006		Rabi 2006-07	
			Infested flower (%)	Reduction of damage over control (%)	Infested flower (%)	Reduction of damage over control (%)
Neem seed	7	150	18.38(25.38)e-g	39.64	11.30 (3.43)1	51.89
		100	1l.30(19.63)h	62.89	12.70 (3.64) I	45.93
		50	20.59(26.98)c-e	32.38	13.44 (3.73) gh	42.78
Neem seed	14	150	22.20(28.10)b-d	27.09	14.82 (3.92) fg	36.91
		100	22.59(28.37)b-d	25.81	16.22 (4.09) c-f	30.95
		50	23.71(29.14)b	22.13	15.36(3.98)ef	34.61
Black pepper	14	150	20.22(26.72)d-f	33.60	18.13 (4.32) b	22.82
		100	23.07(28.70)bc	24.24	15.96 (4.06) d-f	32.06
		50	21.74(27.76)b-d	28.60	18.89 (4.32) b	19.58
Garlic bulb	14	150	21.02(27.29)cd	30.97	17.32 (4.22) b-d	26.27
		100	20.4 1(26.85)d-f	32.97	16.99 (4.18) b-e	27.67
		50	20.90(27.20)cd	31.36	17.90 (4.29) be	23.80
Mahogani seed	7	150	16.29(23.80)g	46.50	10.52 (3.33) i	55.21
		100	18.14(25.21)fg	40.53	11.12(3.41)1	52.66
		50	21.17(27.39)cd	30.48 •	13.30 (3.72)gh	43.38
Untreated		0	30.45(33.49)a		23.49 (4.91) a	

Figures in parentheses are arc sine transformations for infested flowers (*kharif* 2006) and square root transformations for infested flowers (*rabi* 2006-07).

Means with same letter(s) in a column were not significantly different.

The highest reduction of flower infestation over control was 62.89 % obtained from the plots of neem seed extract applied @ 100 g/l at 7 days intervals during *kharif* season. In the *rabi* season, it was 55.21 % in mahogani seed extract treated plots applied @ 150 g/l at 7 days intervals, which was close to mahogani seed extract treated plots applied 100 g/l (52.66 %) at 7 days intervals and neem seed extract @ 150 g/l (51.89 %) and 100 g/l (45.93 %) at 7 days intervals, respectively. The tested crude seed extracts on the infestation of flowers over untreated control indicated that these plant materials had some effect on *Maruca vitrata*, although none of the tested plant materials could completely stop *Maruca vitrata* infestation in both seasons. The percentage of flower damage was about 1.63 times less in treated plots in *kharif* season compared to untreated plots, whereas in *rabi* season, it was 1.67 times less. Neem and mahogani seed extracts applied @ 100 and 150 g/l at 7 days intervals provided maximum protection of flower infestation as 11.30 % and 16.29 % in *kharif* season, respectively. On the other hand, neem, black pepper, and garlic bulb extracts applied at 14 days intervals offered the minimum both in 4he seasons execpt neem seeds extract in *rabi* season. The present results on the flower infestation was in agreement with Ramasubramanian and Babu (1991) who tested neem seed kernel extract against *Maruca vitrata* on lablab bean. Similar results were also supported by Tanzubil (2000), Akhauri and Yadav (2002) and Prajapati *et al.* (2003) who used neem seed extract, neem oil, neem cake and black pepper and garlic bulb extract with varied doses against the *Maruca vitrata* attacking cowpea and pigeonpea.

Effect of seed extracts on pod infestation

The pod infestation of bean plants was high compared to flower. *Maruca vitrata* damaged from 19.36 to 51.90 % bean pods which differed signifltantly ($p < 0.01$) among the treatments during the *kharif* season (Table 2). The highest pod infestation was obtained in the untreated control plots (51.90 %). Garlic bulb extract sprayed @ 100 g/l at 14 days intervals showed 46.26 % pod damage next to control followed by its other treatments. All treatments of neem seed, black pepper, and garlic bulb at this interval, but the later extract at higher doses caused lower damage. The lowest pod infestation of 19.36 % was obtained in the plots treated with mahogani seed extract applied @150 g/l at 7 days intervals. In the *rabi* season the pod infestation of *M vitrata* also differed significantly ($P < 0.01$) among, the treatments with the highest infestation was 33.83% in the untreated control plots and the lowest was 18.15% in the plots treated with neem seed extract @ 100g /1 at 7 days intervals (Table 2). The other treatments showed similar trend as in *kharif* season.

The reduction of pod damage due to spraying plant seeds extracts ranged from 10.87 to 62.70 % over control in the *kharif* and 9.67 to 46.35 % in the *rabi* season. Considering intensity of pod damage, it was evident that the higher doses of neem and mahogani (150g and 100 g/l, respectively, at 7 days intervals) always offered the maximum protection against *Maruca vitrata* on country bean

in both the seasons. The overall pod infestation resulting from application of crude seed extracts was 1.43 and 1.53 times less than untreated control in *kharif* and *rabi* season, respectively. The plant materials including *Azadirachta indica* seeds reduced significantly the pod damage by *Maruca vitrata* on cowpea as much as 75.3 - 81.5 % (Ameh and Ogunwolu, 2000). In the present study, seed extracts of neem and mahogani reduced 46.33 and 62.90 % reduction of pod damage. These two plant materials were effective protectant against *Mauca vitrata.* The summer season favoured the multiplication of this pest increasing infestation due to warm and high humid weather as compared to winter season, and effects of seed extracts also showed increase and decrease of flower and pod damage. Alghali (1993), Reddy *et al.* (2001), Sahoo and Behera (2001), Akhilesh and Paras (2005) reported that the high temperature, high relative humidity, and rainfail provided the maximum incidence arid infestation of flower and pod as found in cowpea and pigeon pea caused by *Maruca vitrata.*

Table 2. Percentage of damaged pods by legume pod borer after spraying with different doses of crude seed extracts during *kharif* 2006 and *rabi* 2006 - 07.

Plant materials	Spray interval (Days)	Dose (g/L)	Kharif 2006		Rabi 2006-07	
			Infested pod (%)	Reduction of pod damage over control (%)	Infested pod (%)	Reduction of pod damage over control (%)
Neem seed	7	150	37.89(37.99)ef	26.99	19.88(26.49) ef	41.24
		100	37.00(37.74)f	28.71	18.15(25.21) f	46.35
		50	42.61(40.74)b-d	17.90	20.58(26.96) ef	39.17
Neem seed	14	150	42.78(40.85)b-d	17.57	22.34(28.20)d	33.96
		100	41.04(39.84)de	20.92	22.46(28.27) de	33.61
		50	42.88(40.90)b-d	17.38	24.26(29.51) d	28.29
Black pepper	14	150	41.68(40.21)c-e	19.69	29.67(33.00) b	12.30
		100	42.23(40.53)b-d	18.63	30.38(33.46) ab	10.20
		50	42.42(40.64)b-d	18.27	29.62(32.98) b	12.44
Garlic bulb	14	150	43.49(41.25)b-d	16.20	30.43(33.49) ab	10.05
		100	46.26(42.86)b	10.87	30.56(33.53) ab	9.67
		50	45.69(42.53)bc	11.97	28.38(32.20) bc	16.11
Mahogani seed	7	150	19.36(26.09)i	62.70	20.06(26.61) ef	40.70
		100	27.42(31.57)h	47.17	19.36(26.12)cf	42.77
		50	32.06(34.48)g	38.23	25.59(30.39) cd	24.36
Untreated		0	51.90(46.09)a		33.83(35.56) a	

Figures in parentheses are arc sine transformations for infested pods. Means with same letter(s) in a column were not significantly different.

Surviving larvae *of Maruca vitrata* after spray

After 24 hours of application of plant materials on the bean plants, the larvae of *M. vitrata* survived 78.49 to 96.34 % during the *kharif* and 81.17 to 98.85 % in *rabi* season and showed no significant differences among the treatments. (Table 3). However, the maximum of 96.34 % larvae survived during the *kharif* and 98.85 % during *rabi* season in untreated control plots, while lowest was 78.49 % from black pepper treated plots sprayed @ 100 g/l and 81.17 % from mahogani seed extract plots applied @150 g/l in both the seasons. The remarkable percentage of larvae of *M vitrata* survived after treatment with crude seed extracts (Table 3) was evideni. This might indicate that these plant materials did not have much toxic action on the larvae. The crude seed extracts protected the flower and pod damage mostly by the antifeedant and repellent effect. Singh *et al.* (1985), Cobbinah and Osei (1988) reported that the neem seed extract applied @ 5%, neem emulsion, aqueous-methanol extract of defatted neem cake was most effective in reducing the incidence of *Maruca vitrata* on cowpea, green gram, and pigeon pea.

Table 3. Percentage of surviving larvae of legume pod borer inside the pods sprayed with different doses of crude seed extract on country bean during *kharif* 2006 and *rabi* 2006 - 07.

Plant materials	Spray interval (Days)	Dose (g/L)	Kharif 2006	Rabi 2006-07
			Surviving larva (%)	Surviving larva (%)
Neem seed	7	150	82.61(9.12)	85.21(9.26)
		100	85.93(9.29)	86.50(9.33)
		50	87.58(9.38)	89.53(9.49)
Neem seed	14	150	80.65(9.01)	88.45(9.43)
		100	88.04(9.41)	88.12(9.41)
		50	86.82(9.34)	90.18(9.52)
Black pepper	14	150	82.30(9.11)	88.48(9.40)
		100	78.49(8.89)	86.82(9.34)
		50	85.73(9.29)	91.44(9.59)
Garlic bulb	14	150	84.06(9.19)	83.88(9.18)
		100	84.30(9.20)	82.44(9.10)
		50	86.60(9.33)	91.55(9.60)
Mahogani seed	7	150	79.10(8.92)	81.17(9.04)
		100	82.72(9.12)	83.81(9.18)
		50	85.42(9.25)	86.53(9.33)
Untreated		0	96.34(9.84)	98.85(9.96)

Figures in parentheses are square root transformations for surviving larvae.

Effect of seed extracts on bean yield

The weight of healthy pods, infested pods and total pods differed significantly ($P < 0.01$) among the treatments of plant materials in two seasons except weight of infested pods in *rabi* season (Table 4). The weight of healthy pods recorded from 1.99 to 8.82 tons per hectare during *kharif* season, while in *rabi* season, it was 10.53 to 20.24 tons per hectare. The treatments of 150 and 100 g/l neem seed extract resulted identical and highest quantity of bean pods resulted 8.32 and 8.82 t/ha and yield was significantly less in mahogani with similar effect of two doses applied at 7 days intervals. The yield was also less at 50 g/l of mahogani than neem seed extract. The weight of healthy pods was not found significantly different among plots treated with all doses of black pepper and garlic bulb in *kharif* season except black pepper seed extract treated plots ones at 150 g/l at 14 days intervals (Table 4). The dose 50 WI of garlic bulb extract recorded lowest weight of healthy pods of 1.99 t/ha identical to garlic bulb and black pepper extract plots @ 100 g/l and 150 g/l at 14 days intervals and untreated control. The weight of healthy pods of all treatments increased during *rabi* season at least by 3-5 folds in comparison with *kharif* season and differed significantly among treatments like that of the *kharif* season at both 7 and 14 days intervals (Table 4). The highest weight of infested pods of 3.75 t/ha was found in neem seed extract plots applied @ 150 g/l at 7 days intervals followed by @ 100 g/1. The lowest was 0.98 t/ha harvested from garlic bulb extract plots sprayed @ 50 g/l at 14 days Intervals followed by @150 g/l, and 100g/l, neem seed extract @ 50g/l at 14 days intervals and untreated control (Table 4). During *rabi* season, weight of infested pods was less than that of *kharif* season and did not differ significantly among the treatments. The weight of total pods ranged from 2.97 to 12.09 t/ha during the *kharif* season and 11.17 to 22.07 t/ha during the *rabi* season and was in the same order as that of healthy and infested pods.

The pod yield increased in the.treated plots ranging from 1.30 to 68.49% and 6.05 to 38.74 % over untreated control in *kharif* and *rabi* season, respectively. The maximum increase of pod yield was 68.49 % from neem seed extract applied 150 g/l at 7 days intervals, which was close to @ 100 g/l in *kharif* season, whereas in the *rabi* season, it was 38.63 % and 38.74 % (Table 4). The pod yield decreased in the plots applied with garlic bulb extract for all doses in *kharif* season but in the *rabi* season this occurred only in lower dose of garlic bulb and mahogani seed extract (50g/l). Neem and mahogani seed extracts resulted better protection of pod damage to *Maruca vitrata* and these plant materials caused increase of pod yield in all doses with more than 2.49 times higher pod yield compared to untreated control in the first year. In the second year, the pod yield also increased in tested plots with lower rate. Similar observations were made by Ramasubramanian and Babu (1991) who reported neem seed kernel extract to be effective in increasing pod yield of lablab bean against *Maruca vitrata.* Cobbinah and Osei (1988), Kareem *et al.* (1988) and Prajapati *et al.* (2003) observed the neem seed extract @ 3-10 % to be effective against *Maruca vitrata* on the yield of cowpea and green gram.

Among the plant materials, the neem seed extract applied @150 g and 100g/l and mahogani seed extract @ 100 g/l of water at 7 days intervals on the country bean showed better performance in the reduction of flower and pod damage with significantly yield increase of bean.

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