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EFFICACY OF INSECTICIDES AGAINST PINK STEM BORER *SESAMIA INFERENS* WALKER INFESTING BARNYARD MILLET *ECHINOCHLOA FRUMENTACEA*

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ABSTRACT

Pink stem borer, *Sesamia inferens* causes deadheart and white ear symptoms by boring into stem and peduncle region causing yield losses in barnyard millet. A field trial to find out efficacy of cartap hydrochloride 4G, chlorantraniliprole 18.5SC, flubendiamide 20WG, emamectin benzoate 5SG, spinetoram 11.7SC and phorate 10G against *S. inferens* was carried out in Tamil Nadu. Spinetoram 11.7SC (92.63%) was the most effective followed by flubendiamide 20WG (90.56%). Phorate 10G (81.57%) was found to be less effective. Plots treated with spinetoram 11.7SC gave maximum yield (9.57 q/ ha) with the cost benefit ratio of 1:3.08 followed by flubendiamide 20% WG (8.91 q/ ha) with the cost benefit ratio of 1:3.42. Phorate 10 G was the least performing treatment with 29.62% increase in yield over control with the cost benefit ratio of 1:2.84. Control plot recorded 44.5% less yield when compared to treated plots.

Key words: *Sesamia inferens*, *Echinochloa frumentacea*, insecticides, deadheart, white ear, spinetoram, chlorantraniliprole, phorate, yield, cost benefit ratio

Barnyard millet (*Echinochloa frumentacea* Link*)* belongs to the family Poaceae, is a multi-purpose crop cultivated for both food and fodder (Gomashe, 2017). It is a very good source of nutrients like proteins and dietary fibers. The grains are good source of carbohydrates, fibers and minerals like zinc and iron when compared to other major cereals (Renganathan et al*.,* 2020). The nutritional contents per 100g of barnyard millet grains are 11.6 g protein, 74.3 g carbohydrates, 5.8 g fat, 14 mg calcium, 15.2 mg iron, 14.7 g crude fibers, 121 mg phosphorus, 4.4 mg minerals and 300 k.cal of energy (Changmei and Dorothy, 2014). The demand for this crop has been recently hiked because of its high nutrient content. Barnyard millet is damaged by several insect pests like defoliators, stem borers and sap feeders. Among them, pink stem borer, *Sesamia inferens* Walker (Noctuidae: Lepidoptera) is a serious pest in barnyard millet (Gahukar and Reddy, 2019). In peninsular India, it causes more damage throughout the year (Santhosh et al., 2008). Adults lay eggs inside the leaf sheath in clusters. After hatching, the larva bores into the stem and feeds inside. During panicle emergence, the infestation causes white chaffy panicles which is termed as white ear (Reddy et al*.,* 2003). Though many studies have been done for the management of pink stem borer in different crops, yet no study is done on their infestation and control in barnyard millet. Hence, the present study was undertaken to identify the suitable insecticides for the management of *S. inferens* in barnyard millet.

MATERIALS AND METHODS

The experiment was conducted in the fields of Agricultural College and Research Institute, Madurai. The efficacy of six insecticides viz., cartap hydrochloride 4G, chlorantraniliprole 18.5SC, flubendiamide 20WG, emamectin benzoate 5SG, spinetoram 11.7SC and phorate 10G were evaluated in MDU-1 variety of barnyard millet. All the recommended agronomic practices were followed except plant protection chemicals. The pretreatment count was taken one day before every spray. Two rounds of insecticidal spray were given on 30 and 50 days after germination. The granules were applied in the leaf whorls and others were given as foliar spray. The total number of tillers and deadhearts were counted in 10 randomly selected plants from each plot at 5, 10 and 15 days after spray. The % deadheart, % white ear, % reduction over control and increase in yield over control were calculated (Kumar, 2018).

The economics like cost of cultivation, net returns and cost benefit ratio in different treatments were calculated based on the yield data and market price of barnyard millet using the formula given by Sidar et al. (2017). The experiment was carried out using

Table 1. Efficacy of insecticides against *S. inferens* and effect on yield of barnyard millet

Trt. No.	Insecticides	Dosage (a.i./ha)	PTC	First spray (% incidence)			Second spray (% incidence)			Percentage incidence (pooled mean)	Cumulative % reduction over control	Yield (q/ ha)	Gross return (Rs.)	C:B Ratio
				5 DAS	10 DAS	15 DAS	5 DAS	10 DAS	15 DAS					
T_1	Cartap hydro-chloride 4% G	750 g a.i./ha	18.93 (25.78)	5.56 (13.63)^{a}	4.51 (12.26)^{b}	3.49 (10.76)^{abc}	6.12 (14.31)^{cd}	6.05 (14.23)^{cd}	5.89 (14.04)^{c}	5.27 (13.26)^{d}	86.66	7.95 (2.82)^{d}	45315	1:2.49
T_2	Chlorantraniliprole 18.5% SC	30 ml/ha	18.88 (25.74)	5.13 (13.08)^{a}	4.17 (11.78)^{ab}	3.14 (10.20)^{abc}	4.93 (12.82)^{bc}	4.95 (12.86)^{bc}	4.47 (12.20)^{b}	4.46 (12.19)^{c}	88.71	8.83 (2.97)^{c}	50331	1:3.31
T_3	Flubendiamide 20% WG	25 g a.i./ha	18.44 (25.42)	4.45 (12.18)^{ab}	3.51 (10.79)^{ab}	2.62 (9.31)^{ab}	3.98 (11.51)^{ab}	3.95 (11.46)^{ab}	3.88 (11.36)^{ab}	3.73 (11.13)^{b}	90.56	8.91 (2.98)^{b}	50787	1:3.42
T_4	Emamectin benzoate 5% SG	9.5 g a.i./ha	19.56 (26.24)	5.97 (14.14)^{b}	4.56 (12.32)^{b}	3.75 (11.16)^{bc}	6.76 (15.07)^{c}	6.71 (15.01)^{d}	6.53 (14.80)^{c}	5.71 (13.82)^{d}	85.55	7.81 (2.79)^{de}	44517	1:2.78
T_5	Spinetoram 11.7% SC	50 g a.i./ha	18.06 (25.14)	3.47 (10.73)^{a}	2.70 (9.46)^{a}	2.19 (8.50)^{a}	3.19 (10.29)^{a}	3.14 (10.21)^{a}	3.03 (10.03)^{a}	2.95 (9.89)^{a}	92.63	9.57 (2.84)^{a}	54549	1:3.08
T_6	Standard check - Phorate 10 G	1 kg a.i./ha	17.87 (25.00)	9.19 (17.64)^{c}	6.48 (14.74)^{c}	4.47 (12.20)^{c}	8.18 (16.61)^{d}	7.52 (15.91)^{d}	7.29 (15.66)^{c}	7.28 (15.65)^{e}	81.57	7.57 (2.75)^{e}	43149	1:2.84
T_7	Untreated check	-	18.85 (25.72)	26.64 (31.06)^{d}	34.31 (35.84)^{d}	42.34 (40.58)^{d}	43.48 (41.24)^{e}	44.85 (42.03)^{e}	45.47 (42.39)^{d}	39.51 (38.93)^{f}	-	5.84 (2.42)^{f}	33288	1:2.60
	SEd		NS	0.94	1.07	1.20	1.09	0.86	0.82	0.47		0.020		
	CD (p=0.05%)			2.06	2.34	2.62	2.37	1.87	2.40	1.02		0.044		

Value in the parentheses are square root transformations; In a column, means followed by same letter are not significantly different at P = 0.05 as per LSD; Selling price of barnyard millet – Rs. 5700/q; Cost of cultivation excluding cost of insecticides – Rs. 12800, PTC- Pretreatment count.

RBD with each treatment replicated thrice. The data collected from each plot were processed to arcsine and square root data transformation. The data were analyzed using AGRES software to differentiate the transformed mean values using Fisher's Least Significant Difference (LSD, p=0.05) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

One day before first spray the pretreatment count on deadheart damage ranged from 17.87 to 19.56% (Table 1). Five days after spraying spinetoram 11.7SC (3.47) recorded the lowest deadhearts followed by flubendiamide 20WG (4.45). The maximum damage was recorded in phorate 10G (9.19). On 10 days after spray, the lowest deadheart damage was in spinetoram 11.7SC (2.70) followed by flubendiamide 20WG (3.51). The maximum damage was in emamectin benzoate 5SG (4.56) and phorate 10G (6.48). On 15 days after spray spinetoram 11.7SC (2.19) recorded the least damage followed by flubendiamide 20WG (2.62) which were statistically on par. In second spray, on 5 days after spray the least white ear damage (3.19) was in spinetoram 11.7SC followed by flubendiamide 20WG (3.98) and chlorantraniliprole 18.5SC (4.93) which were significantly different. Emamectin benzoate 5SG (6.76) and phorate 10G (8.18) showed maximum white ear which were statistically on par. The data collected 10 days after spray revealed that spinetoram 11.7SC (3.14) led to the lowest white ear damage followed by flubendiamide 20WG (3.95) and chlorantraniliprole 18.5SC (4.95). The maximum white ears war with emamectin benzoate 5SG (6.71) and phorate 10G (7.52). At 15 days after spray also, spinetoram 11.7SC (3.03) showed the lowest white ear damage followed by flubendiamide 20WG (3.88). The treatment phorate 10G recorded the highest damage of 7.29%.

The cumulative white ear (damage) reduction over control was calculated with pooled mean. Spinetoram 11.7SC (92.63) gave maximum reduction followed by flubendiamide 20WG (90.56), chlorantraniliprole 18.5SC (88.71), cartap hydrochloride 4G (86.66) and emamectin benzoate 5SG (85.55). The least reduction (81.57%) was recorded in phorate 10 G. The non-effectiveness of granules might be due to profuse tillering of the crop. The cost of cultivation except plant protection chemicals was Rs.12800. More yield was obtained with spinetoram 11.7% SC (9.57 q/ ha) followed by flubendiamide 20% WG (8.91 q/ ha). Emamectin benzoate 5% SG (7.81 q/ ha) and phorate 10 G (7.57 q/ ha) led to the least yield. The % increase

in yield over control was more in spinetoram 11.7% SC (63.87) and low in phorate 10 G (29.62). The gross and net return were calculated based on the price of barnyard millet grains (One quintal = Rs. 5700). The cost benefit ratio was maximum in flubendiamide 20% WG (1:3.42) followed by chlorantraniliprole 18.5% SC (1:3.31), spinetoram 11.7% SC (1:3.08) and phorate 10 G (1:2.84). Less CBR was recorded in emamectin benzoate 5% SG (1:2.78) and cartap hydrochloride 4% G (1:2.49).

Previous studies found that cartap hydrochloride 4G was the most effective against *S. inferens* in finger millet (Sasmal, 2018), Spinosad 45SC recorded highest % yield increase (Deole et al. 2017) in maize. Sahu and Deole (2017) found emamectin benzoate as the most effective. It is concluded that spinetoram 11.7SC and flubendiamide 20WG are the superior ones and can be recommended against *S. inferens* with maximum cost benefit ratio.

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