Research Paper :

Efficacy of bioagents and botonical pesticides in the management of sorghum earhed caterpillar

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SUMMARY

In recent years research has been provided that substantial yield advantages can be achieved from bioagents *viz.*, *Nomuraea releyi, Bacillus thurengensis*, HaNPV and botanical pesticide(Neem seed kernal extract) were tested against sorghum earhead caterpillar. The larval population of *H.armigera* at five,ten and fifteen days after first and second application indicated that *N. rileyi* treatments fallowed by NSKE were found significantly superior in reducing maximum larval population of 33 and 58 per cent. This may be due to epizootics of fungus which was facilitated by favourable environmental condition. The grain yield levels were directly related with per cent reduction of larval population.

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Sorghum [*Sorghum bicolor* (L.) Moench.] is an important cereal food crop of the world. Sorghum is grown both during *Kharif* and *Rabi* seasons.

Grain yield in sorghum has substantially increased with the use of high yielding and management responsive F1 hybrids and varieties. However, these high yielding varieties with higher requirement of fertilizers and difference in maturity have become more susceptible and provide continuous breeding ground for insect pests. Negligence in proper management of these pests, many times, has resulted in complete loss of crop.

Among different insect pests of sorghum, the earhead caterpillars [*Helicoverpa armigera* (Hubner)] is important. This pest is most important attacking sorghum and is reported to cause as much as 37.11 per cent yield loss in sorghum (Kulkarni *et al.*, 1980).

MATERIALS AND METHODS

The experiment was laid out at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to test the efficacy of botanicals and bioagents for the control of earhead caterpillar on sorghum. Sorghum hybrid CSH-5 was sown during *Kharif* 2001 by following package of practices (Anonymous,1998).

The randomized block design (RBD) was adopted with three replications with nine treatments having individual plot size of 4.0 $\pm$ 2.25 cm. Treatments were imposed (I spray), when the crop was at flowering stage (Table 2). Every time twenty five ear heads were randomly selected in each plot for recording the number of larvae per ear head a day before and five, ten and fifteen days after imposing treatments. Second spray was given at twenty days after the first application.

Similar observations were recorded for second spray. The grain yield per plot was recorded and expressed as quintals per hectare.

The data were subjected to analysis of variance (ANOVA) for different dates of observations before and after the application. Per cent reduction in the number of larvae was also worked out. Data on grain yield were analyzed using analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Bioefficacy of botanicals, bioagents and recommended insecticides (Table 1) were tested for their effectiveness against the population of *H. armigera* larvae at 50 per cent flowering of crop and results obtained are presented hereunder (Table 1, 2 and 3).

Efficacy of bioagents and NSKE against *H. armigera*:

The mean larval population of *H. armigera* at fifteen days after first application indicated that *N. rileyi* treatments (T_2) and (T_3) were found significantly superior in reducing maximum larval population of 47 and 48 per cent did not differ from each other. The treatments T_7 (32%) were at par T_6 (30.0%) and similar T_1 (22.0%) and endosulfan (20.0%) also. Fortnight after second spray, *N. rileyi* followed by NSKE and endosulfan treatments were found significantly superior to untreated check by reducing 66.0 and 76.0 per cent population, respectively, which were at par with T_7 (64.0%), T_1 (57.0%), T_4 (56.0%) and T_2 (42.0%). Results of the first and second spray inferred that effect of *N. rileyi* treatment was maximum in reduction of laval population after fifteen days. This may be due to epizootics of fungus which was facilitated by favourable environmental conditions.

The effectiveness of endosulfan is in agreement with Patil (1987) who reported that endosulfan 35 EC was found promising in reducing the population of *H. armigera* (63.0%). Among bioagents, *N. rileyi* followed by NSKE was found significantly superior in reducing maximum of 66.0 per cent larvae per earhead. Sequential treatments of *N. rileyi* followed by NSKE recorded maximum mean larval population reduction to the extent of 33 and 58 per cent after first and second spray, respectively which was next best treatment to endosulfan 35 EC (43 and 70%). This may be due to least inhibitory action and higher per cent of antifeedant action by NSKE. These findings are in agreement with Patil (2000) who reported that botanicals were least detrimental to fungus. The effectiveness of NSKE are in agreement with Anonymous (2000) and Kongwad (2000) who reported that NSKE (5%) was superior in suppressing *H. armigera* population. The efficacy of *HaNPV* is in accordance with the findings of Vijayakumar (1980) who observed that sprays of HaNPV @ 250 LE per hectare was comparable with that of endosulfan (0.07%) in pigeonpea, Rabindra and Jayaraj (1988) noticed that application of HaNPV @ 100 LE per acre on sorghum earhead at 50 per cent flowering stage was found to be as effective as endosulfan (0.1 %) in reducing the larval population and damage to earheads.

Among three bioagents and a botanical and one insecticide evaluated, edosulfan 35 EC (0.07%) was found to be superior in recording 76.0 per cent' larval population of *H. armigera* followed by *N. rileyi* sequential spray with NSKE (66.0%), HaNPV - NSKE (64.0%), NSKE - NSKE (57.0%) and *B. thuringiensis* - NSKE (56.0%), respectively.

Among the biorationals *N. rileyi* followed by NSKE recorded highest mean larval population reduction (33 and 58%) after first and second spray, respectively.

Grain yield:

Significantly superior grain yield was recorded in endosulfan 35 EC (48.07 q/ha) which was at par with *N. rileyi* (1 g/l) - NSKE (5%) and HaNPV (1 ml/l) - NSKE (5%) recording 45.33 and 43.63 q per hectare grain yield, respectively were also statieatly similar to each other (Table 3).

The treatment T_1 (42.95 q/ha), T_2 (42.9 q/ha), T_4 (41.0 q/ha), T_5 (42.20 q/ha) and T_6 (42.00 q/ha) were found to be superior over the un treated check(38.0 q/ha). While, treatment *N. rileyi* – NSKE (45.33 q/ha) and HaNPV-NSKE (43.63 q/ha) being at par with each other

Table 1: Different treatments under biorational pesticides against *H. armigera* on sorghum

Tr. No.	Treatments	Concentration	
		I spray	I spray
T_1	Neem seed kernel extract – NSKE	5.0%	5.0%
T_2	*Nomuraea rileyi* (Farlow) Samson (1 ? 10^8 spores/ml) – *N. rileyi*	1.0 g/l	1.0 g/l
T_3	*Nomuraea rileyi* (Farlow) Samson (1 ? 10^8 spores/ml) – NSKE	1 g/l	5 g/l
T_4	*Bacillus thuringiensis* (Berliner) – *B. thuringiensis*	1.0 ml/l	1.0 ml/l
T_5	*Bacillus thuringiensis* (Berliner) – NSKE	1.0 ml/l	5.0 ml/l
T_6	HaNPV – HaNPV (250 LE/ha)	1.0 ml/l	1.0 ml/l
T_7	HaNPV – NSKE	1.0 ml/l	5.0 ml/l
T_8	Endosulfan 35 EC - Endosulfan 35 EC	0.07%	0.07%
T_9	Untreated check	-	-

Table 2 : Efficacy of NSKE and bioagents against *Helicoverpa armigera* on sorghum

Tr. No	Treatments	Number of larvae per earhead									
		I spray					II spray				
		1 DBT	5 DAT	10 DAT	15 DAT	Mean	1 DBT	5 DAT	10 DAT	15 DAT	Mean
1.	Neem seed kernel extract (5%) – NSKE	1.92a	1.12ccd (42.00)	1.30bc (32.00)	1.50bc (22.00)	1.31 (32.0)	1.60bc	0.94bc (41.00)	0.80bc (50.00)	0.68bc (57.00)	0.81 (49.0)
2.	*Nomuraea rileyi* (1 g/l) – N. Rileyi	1.95°	1.68ab (14.00)	1.20bc (38.00)	1.02c (48.00)	1.30 (33.0)	1.20c	0.96bc (20.00)	0.78bc (35.00)	0.70bc (42.00)	0.81 (32.0)
3.	*Nomuraea rileyi* (1 g/l) – NSKE (5%)	1.96°	1.66ab (15.00)	1.25bc (36.00)	1.04c (47.00)	1.32 (33.0)	1.18c	0.58c (51.00)	0.50c (58.00)	0.40c (66.00)	0.49 (58.0)
4.	*Bacillus thuringiensis* (1 ml/l) – B. thuringeinsis	1.94a	1.28bc (34.00)	1.54b (21.00)	1.70ab (12.00)	1.51 (22.0)	1.82ab	1.12b (39.00)	0.98b (46.00)	0.90b (51.00)	1.00 (45.0)
5.	*Bacillus thuringiensis* (1 ml/l) – NSKE (5%)	1.97a	1.32bc (33.00)	1.52b (23.00)	1.72ab (13.00)	1.52 (23.0)	1.80ab	1.06bc (41.00)	0.90bc (50.00)	0.80bc (56.00)	0.92 (49.0)
6.	HaNPV (1 ml/l) - HaNPV	1.93a	1.48abc (23.00)	1.40bc (27.00)	1.36bc (30.00)	1.41 (27.0)	1.44bc	1.04bc (28.00)	0.96b (33.00)	0.84b (42.00)	0.95 (34.0)
7.	HaNPV (1 ml/l) – NSKE (5%)	1.96a	1.52abc (22.00)	1.42bc (28.00)	1.34bc (32.00)	1.43 (27.0)	1.48bc	0.76bc (49.00)	0.66bc (55.00)	0.54bc (64.00)	0.65 (56.0)
8.	RPP (Endosulfan 35 EC) (0.07%)	1.96a	0.80d (59.00)	0.98c (51.00)	1.56bc (20.00)	1.11 (43.0)	1.74ab c	0.64c (63.00)	0.54c (69.00)	0.42c (76.00)	0.53 (70.0)
9.	UTC (Untreated check)	1.98a	2.04a – (3.00)	2.15a (-9.00)	2.20a - (11.00)	2.13 (8.0)	2.25a	2.15a (4.00)	2.08a (8.00)	1.96a (13.00)	2.06 (8.0c
	S.E.±	0.02	0.05	0.06	0.05	-	0.05	0.06	0.05	0.05	-
	C.D. (P=0.05)	NS	0.15	0.17	0.16	-	0.16	0.17	0.16	0.16	-
	CV (%)	2.05	5.58	6.25	5.87	-	5.85	7.04	0.55	6.86	-

DBT – Days before treatment
DAT – Days after treatment
Figures in the parentheses indicate per cent reduction in the population from initial population
Means followed by same letter do not differ significantly by DMRT (P=0.05)

Table 3: Grain yield of sorghum as influenced by NSKE and different bioagents

Tr. No.	Treatments	Grain yield (q/ha)	Increase yield over control (%)
1.	Neem seed kernel extract (5%) – NSKE	42.95b	13.03
2.	Nomuraea rileyi (1 g/l) – N. Rileyi	42.90b	12.89
3.	Nomuraea rileyi (1 g/l) – NSKE (5%)	45.33ab	19.29
4.	*Bacillus thuringiensis* (1 ml/l) – B. thuringeinsis	41.00bc	7.89
5.	*Bacillus thuringiensis* (1 ml/l) – NSKE (5%)	42.20bc	11.05
6.	HaNPV (1 ml/l) - HaNPV	42.00bc	10.53
7.	HaNPV (1 ml/l) – NSKE (5%)	43.63ab	14.82
8.	RPP (Endosulfan 35 EC) (0.07%)	48.07a	26.50
9.	UTC (Untreated check)	38.00c	-
	S.E.±	1.47	-
	C.D. (P=0.05)	4.41	-
	CV (%)	5.94	-

Figures in the parentheses indicate per cent reduction in the population from initial population

were intermediary in producing yield next to endosulfan treatment(48.07 q/ ha). However, lowest grain yield registered in untreated check (38.0 q/ha). The increase in grain yield over control (26.50%) was observed in endosulfan 35 EC followed by *N. rileyi* sequential spray with NSKE (19.29%), HaNPV – NSKE (14.82%), NSKE-NSKE (13.03%), *N. rileyi – N. rileyi* (12.89%), *B. thuringiensis* – NSKE (11.05%), HaNPV – HaNPV

Table 4 : Economics of biorational pesticides against *H. armigera* on sorghum

Tr. No.	Treatments	Yield (q/ha)	Yield advantage (q/ha)	Total cost of protection (Rs./ha)	Benefit (Rs./ha)	B:C ratio
1.	Neem seed kernel extract (5%) – NSKE	42.95b	4.95	750.00	1980	2.64
2.	Nomuraea rileyi (1 g/l) – N. Rileyi	42.90b	4.20	520.00	1680	3.23
3.	Nomuraea rileyi (1 g/l) – NSKE (5%)	45.33ab	7.33	635.00	2932	4.62
4.	Bacillus thuringiensis (1 ml/l) – B. thuringeinsis	41.00bc	3.0	1100.00	1200	1.09
5.	Bacillus thuringiensis (1 ml/l) – NSKE (5%)	42.20bc	4.90	765.00	1960	2.56
6.	HaNPV (1 ml/l) - HaNPV	42.00bc	4.00	1320.00	1600	1.21
7.	HaNPV (1 ml/l) – NSKE (5%)	43.63ab	5.63	875.00	2252	2.57
8.	RPP (Endosulfan 35 EC) (0.07%)	48.07a	10.07	720.00	4028	5.59
9.	UTC (Untreated check)	38.00c	-	-	-	-

Means followed by same letter do not differ significantly by DMRT (P=0.05)

(10.53%) and *B. thuringiensis* – *B. thuringiensis* (7.89%).

Economics of biorational pesticides against sorghum earhead caterpillar:

Economics of NSKE and bioagents were calculated and were presented in Table 4. Data revealed that maximum benefit (Rs. 4028.00/ha) was obtained in endosulfan 35 EC followed by *N. rileyi* sequential spray with NSKE (Rs. 2932.00/ha) and HaNPV sequential spray with NSKE (Rs. 2252.00/ha). Among the bioagents *N. rileyi* recorded maximum profit of Rs. 1680.00 per hectare followed by HaNPV (Rs. 1600.00/ha) and *B. thuringiensis* (Rs. 1200.00/ha). However, NSKE – NSKE produced higher profit of Rs. 1980.00 per ha than all other bioagents.

Highest benefit:cost ratio (5.59) was obtained in endosulfan 35 EC (0.07%) followed by *N. rileyi* – NSKE (4.62), *N. rileyi* – *N. rileyi* (3.23), NSKE – NSKE (2.64), HANPV – NSKE (2.57) and *B. thuringiensis* – NSKE (2.48).

Maximum profit of Rs. 4028.0, 2932.0, 2252.0, 1980.0 and 1960.0 were obtained with endosulfan 35 EC, *N. rileyi* (1 g/l) - NSKE (5%), HaNPV (1 ml/l) - NSKE (5%) and *N. rileyi* (1 g/l), respectively. The higher benefit cost ratio was obtained in endosulfan 35 EC (5.59) followed by T_3 (*N. rileyi* - NSKE), T_2 (*N. rileyi* - *N. rileyi*), T_1 (NSKE.- NSKE), T_7 (HaNPV - NSKE) and T_8 (*B. thuringiensis* - NSKE) recording 4.62, 3.23, 2.64, 2.57 and 2.48, respectively. There are no such studies on record to substantiate the present findings.

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REFERENCES

Anonymous (1998). Improved package of practices for field crops. Transitional tract of Karnataka,Zone,pp.18-24.

Anonymous (2000). First Annual Report for 2000-01, Department of Agricultural Entomology. University of Agricultural Sciences, Dharwad, Karnataka, India, pp. 14-15.

Kongwad, S.B. (2000). Bio-ecology and management of sorghum earhead caterpillar with special reference to *Cryptoblabes gnidiella* (Miller). M.Sc.(Ag.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka (India).

Kulkarni, K. A. and Thontadharya, T.S., Jotwani, M.G. and Parameshwarappa, R. (1980). Present status of earhead caterpillars on sorghum and their management. Presented at the All India Sorghum Workshop, 12-14 May, 1980, Coimbatore,

Patil, L. G. (1987). Studies on the biology and control of head caterpillar *Heliothis armigera* (Hubner) on sorghum and estimation of crop loss. M. Sc. (Ag.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka (India).

Patil, R.K. (2000). Ecofriendly approaches for the management of *Spodoptera litura* (F.) in groundnut. Ph. D. Thesis, University of Agricultural Sciences, Dharwad, Karnataka (India).

Rabindra, R.J. and Jayaraj, S. (1988). Efficacy of nuclear polyhedrosis virus with adjuvant as high volume and ultra low volume application against *Heliothis armigera* (Hubner) on chickpea. *Tropical Pest Management,* **34** : 441-444.

Vijaykumar, A. (1980). Studies on the food plant ecology of *Heliothis armigera* (Hubner) (Lepidoptera: Noctuidae) and its integrated control. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, T.N. (India).

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