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Research Article

DETERMINATION OF ECONOMIC THRESHOLD LEVEL FOR THE CHEMICAL CONTROL OF PEARL MILLET STEM BORER, *Chilo partellus* (Swinhoe)

PARMAR G.M.*, JUNEJA R.P., MUNGRA K.D., CHAUDHARI R.J. AND DETROJA A.C.
Pearl Millet Research Station, Jamnagar, 361006, Junagadh Agriculture University, Junagadh, 362001, Gujarat, India
*Corresponding Author: Email - gmparmar@jau.in

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Abstract: Investigation on determination of economic threshold level of pearl millet stem borer, *Chilo partellus* (Swinhoe) carried out at Millet Research Station, Jamnagar during *kharif* 2017 and 2021. All the treatments recorded significant reduction of stem borer infestation than untreated control. The lowest infestation of stem borer was recorded where fully plant protection was given. 5 % plant damage recorded highest net return (Rs. 14257/-) and ICBR (1:9.15) among all the treatments. So, this treatment was found economical and should be considered as economic threshold level for the pearl millet stem borer.

Keywords: *Pearl millet, Stem borer, Chilo partellus, ETL*

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Introduction

Pearl millet is the most widely grown staple food of majority of poor and small land holders in Asia and Africa. It is also consumed as feed and fodder for livestock. It accounts for almost half of global millet production. It is the sixth most important cereal crop in the world next to maize, rice, wheat, barley and sorghum. In India, pearl millet is the fourth most widely cultivated food crop after rice, wheat and maize. It occupies an area of 6.93 million ha with an average production of 8.61 million tones and productivity of 1243 kg/ha [1]. The major pearl millet growing states are Rajasthan, Maharashtra, Uttar Pradesh, Gujarat and Haryana contributing 90% of total national production.

Twenty-six insects and two non-insect pests were found feeding on pearl millet [2]. Out of these, shoot fly, *Atherigona varia* socata, stem borer, *Chilo partellus* Swinhoe and ear head worm, *Helicoverpa armigera* are comparatively more serious pests attacking the crop. Among these insect pests, the pearl millet stem borer, *C. partellus* is major threat and attack the crop from seedling to harvesting stage, causing complete loss of affected tillers. Stem borer infestation starts at vegetative stage and remains up to ear head stage. Stem borer incidence is 4.47% at 15 days after germination that gradually increases to its peak, 15.1% at 77 days after germination of the crop [3].

At vegetative stage, parallel holes on central leaves are observed which indicates the presence of larvae in central shoot. Stem borer causes between 20-60 % losses [4]. The larva penetrates inside the whorls and feeds the central shoot and making the galleries up to stems. This damage inside the bajra is reflected as empty/chaffy ear heads at ear head stage which is the direct loss in yield. Chemical spray at this stage has no meaning and thus, such strategy is needed so that the application of the insecticide can be done much before i.e., at vegetative stage and that too after deciding the damage percentage. The assessment of insect damage and the initiation of control measures became one incentive for the development of a concept of economic injury level [5]. ETL is the pest density at which control measures should be applied to prevent an increasing pest population reaching the economic injury level (EIL). Control measures are taken at this stage so that this pest does not exceed the economic injury level. So, EIL is the lowest pest population density that will cause economic damage. It is the level at which damage can no longer be tolerated and, therefore, at that point or before reaching that level, it is desirable to initiate deliberate control operation [6]. Hence, the objective is to determine economic threshold level for the chemical control of pearl millet stem borers.

Materials and Methods

The experiment was conducted in Randomized Block Design with seven treatments including control with four replications at Pearl Millet Research Station, Junagadh Agricultural University, Jamnagar during *Kharif* 2011 to 2021. The pearl millet variety GHB-558 was sown at 60 × 10 cm spacing for this purpose. The gross plot size was 5.0 × 3.6 m and net plot size was 4.0 × 2.4 m. In fully protected plots, foliar spays of recommended insecticide were done at weekly interval starting from 15 days after germination till boot leaf stage. However, no spray was done in untreated-control. Damaged plants were counted at weekly interval starting from 15 days after germination from the total plants of net plot area and thus per cent plant damage was worked out. Thus, in rest of the treatments, spray was done when the damage percentage crosses in the corresponding treatments. At vegetative stage, plants showing parallel holes due to stem borer larvae in the leaves were considered as damaged plants and per cent damaged plants were calculated. At ear head stage, numbers of ear heads showing stem borer damage were recorded separately from randomly selected 20 ear heads in each treatment from net plot and thus per cent ear head damage was worked out. Grain and fodder yield were recorded from net plot area at harvest and data thus obtained was analyzed statistically and economics of the treatments worked out. The ETL was determined on the basis of ICBR value calculated in the different treatments.

Result and Discussion

Year wise and pooled results of stem borer infestation at ear head stage [Table-1] indicated that during both the years and in pooled, differences in incidence of stem borer was found significant. All the treatments recorded significant reduction of stem borer infestation than untreated control.

Table-1 Effect of varying levels of stem borer infestations in pearl millet

No	Incidence level	Percent stem borer incidence at ear head stage		pooled
		Kharif-2017	*Kharif*-2021	
1	Fully protected	3.35*^{c} (0.34)	3.83*^{c}(0.50)	3.59*^{c}(0.42)
2	5% plant damage	8.66^{d}(2.29)	8.59^{d}(2.37)	8.74^{bc}(2.33)
3	10% plant damage	11.38^{cd}(4.03)	13.35^{c}(5.00)	12.14^{abc}(4.51)
4	15% plant damage	14.02^{c}(5.97)	15.11^{bc}(6.69)	14.49^{abc}(6.33)
5	20% plant damage	17.65^{b}(9.24)	16.86^{b}(8.31)	17.20^{ab}(8.78)
6	25% plant damage	22.91^{a}(15.48)	21.02^{a}(12.95)	21.98^{a}(14.21)
7	Untreated	24.24^{a}(17.02)	22.46^{a}(14.82)	23.43^{a}(15.92)
T	S.Em. ±	1.17	0.83	3.82
	C.D. at 5%	3.47	2.48	10.98
Y	S.Em. ±			2.04
	C.D. at 5%			NS
YxT	S.Em. ±			5.4
	C.D. at 5%			NS
	C.V.%	15.99	11.79	13

Table-2 Effect of varying levels of stem borer infestations on pearl millet yield

No	Incidence level	Grain yield (kg/ha)			Fodder yield (kg/ha)		
		2017-18	2021-22	pooled	2017-18	2021-22	pooled
1	Fully protected	2956^{a}	2590^{a}	2773^{a}	4842^{a}	5106^{a}	4974^{a}
2	5% plant damage	2798^{ab}	2576^{a}	2687^{ab}	4683^{ab}	5083^{a}	4883^{a}
3	10% plant damage	2716^{abc}	2383^{a}	2550^{ab}	4405^{abc}	5059^{a}	4732^{ab}
4	15% plant damage	2563^{abcd}	2178^{ab}	2371^{ab}	4341^{abc}	4780^{ab}	4560^{abc}
5	20% plant damage	2449^{bcd}	1823^{bc}	2136^{bc}	4154^{bc}	4693^{ab}	4424^{bc}
6	25% plant damage	2278^{cd}	1710^{bc}	1994^{cd}	4021^{c}	4312^{b}	4166^{cd}
7	Untreated control	2183^{d}	1604^{c}	1894^{d}	4000^{c}	3490^{c}	3745^{d}
T	S.Em. ±	142.18	150.56	103.54	173.7	220.71	140.43
	C.D. at 5%	422.46	447.35	297.22	516.1	655.8	403.12
Y	S.Em. ±			55.34			75.06
	C.D. at 5%			158.87			215.47
YxT	S.Em. ±			146			198.6
	C.D. at 5%			NS			NS
	C.V.%	11.09	14.18	12.5	7.99	9.5	8.83

Table-3 Economic analysis of mean values of grain yield

No	Treatment details	Yield increase over control (kg/ha)		Additional income (Rs.)	Total Expenditure (Rs.)	Net return (Rs.)	ICBR
		Grain	fodder				
1	Fully protected	879	1229	17710	5250	12460	01:03.4
2	5% plant damage	793	1138	16007	1750	14257	01:09.1
3	10% plant damage	656	987	13287	1750	11537	01:07.6
4	15% plant damage	477	815	9759	1750	8009	01:05.6
5	20% plant damage	242	679	5217	875	4342	01:06.0
6	25% plant damage	100	421	2296	875	1421	01:02.6
7	Untreated control	-	-	-	-	-	-

Lowest infestation of stem borer was recorded where fully plant protection was given. Differences in grain and fodder yield were found significant in pooled results [Table-2]. In fully protected plot, there was a maximum grain yield which was 2773 kg/ha. At 5%, 10%, 15%, 20% and 25% plant damage, the average grain yield was 2687, 2550, 2371, 2136 and 1994 kg/ha, respectively. Minimum grain yield 1894 kg/ha was obtained in untreated control. The maximum fodder yield 4974 kg/ha was obtained in fully protected plot. At 5%, 10%, 15%, 20% and 25% plant damage, the average fodder yield was 4883, 4732, 4560, 4424 and 4166 kg/ha, respectively. The minimum fodder yield 3745 kg/ha was obtained in untreated control.

Economics of each treatment was worked out on the basis of current market price of insecticide and prevailing price of bajra grain and fodder yield and finally ICBR values for each treatment was calculated. Data presented in [Table-3] indicates that 5 % plant damage recorded highest net return (Rs. 14257/-) and ICBR (1:9.15). Hence, this treatment can be considered as ETL of the stem borer in pearl millet. So, economic analysis showed that control measures should be adopted at 5% damage level of infestation to save the loss. The study on economic threshold for yellow stem borer was carried out and it was 5-9% dead-hearts in rice crop [7]. It was also determined 4% whiteheads as threshold level for *S. ncertulas*, which is slightly similar to present findings [8]. It was also noticed 5% dead hearts as threshold level at which insecticide should be applied to control yellow stem borer in rice which is slightly similar to present findings [9]. Whereas, economic threshold level for *S. incertulas* equal to 10% whiteheads which does not justify the present findings [10]. It can be safely concluded that the ETL for the control of *C. partellus* 5% plant damage. It is the best time for the application of insecticide as it fits best according to existing economic and environmental conditions.

Conclusion

The results of the present study showed that the control measures should be initiated at 5% plant damage in pearl millet crop to save the loss. It is the best time for application of chemical insecticides as it fits the best according to existing economic and environmental conditions.

Application of research

Study of application of chemical insecticides

Research Category: Agriculture Economics

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****Principal Investigator or Chairperson of research: Dr G. M. Parmar**
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Study area / Sample Collection: Pearl Millet Research Station, Jamnagar, 361006

Cultivar / Variety / Breed name: Pearl Millet

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