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SUSTAINABLE MANAGEMENT OF SUGARCANE PYRILLA, *PYRILLA PERPUSILLA* WLK. (HOMOPTERA : LOPHOPIDAE) BY USING CULTURAL, CHEMICAL AND BIOLOGICAL PRACTICES IN PUNJAB, PAKISTAN

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ABSTRACT

Management of sugarcane pyrilla, was carried out on sugarcane variety HSF-240 with different control measures, in the research area, Directorate of Sugarcane, Ayub Agricultural Research Institute, Faisalabad, Punjab, Pakistan during 2008.Various control methods, like, cultural (fortnightly hoeing and destruction of weeds to remove alternate host plants, and detrashing of older leaves twice during the season and trash-mulching), biological (4-times release of cocoons of *Epiricania melanoleuca* @ 2500/ha from June 15 to September 15) , chemical (carbofuran @ 35 kg/ha from one month after sowing and coupled with earthing up), were applied singly and in their possible combinations, such as, biological + cultural, biological + chemical, cultural + chemical and cultural + biological + chemical control with the objective to keep the pest population below the economic threshold level and to find the most economical and effective method of control, for communication to the farmers. Application of cultural + biological + chemical controls in combination, resulted in a minimum population of *P. perpusilla* i.e., 0.32/leaf with maximum yield 3415.67 monds/ha, whereas cultural methods showed a maximum pest population of 3.65/leaf, with minimum yield of 2214.33 monds/ha. The application of cultural + chemical + biological control methods resulted in maximum net gain i.e., Rs. 149167/- per hectare with a cost-benefit ratio of 9.44 and was found to be the best treatment.

Keywords: Biological, Cultural, *Pyrilla perpusilla,* Sugarcane, Sustainable management

INTRODUCTION

Sugarcane is an important cash crop and shares 3.6 and 0.8% in value added of agriculture and GDP respectively. During the year 2010-11, total cultivated area under sugarcane crop was 0.988 million hectares which yielded 55.3 million tons of canes. (GOP, 2010-11).

Sugarcane leaf-hopper, *Pyrilla perpusilla* Wlk. (Lophopidae: Homoptera), is the most destructive pest of the sugarcane. The nymphs and adults feed by sucking the cell-sap from the leaves of sugarcane and other secondary host plants, that extensively affects the yield (Kumar and Yadav, 2006). *Pyrilla perpusilla* causes direct and indirect losses and the attacked leaves become pale and wither later on. The feeding by pest causes poor growth of sets which also creates difficulty in milling of effected canes (Kumarasinghe and Wratten, 1996).The infestation during the early growth period of cane, affects the yield adversely, whereas the late-infestation from September onwards, mostly affects the sucrose contents (Puri and Siddharth, 2001).These losses, in sugarcane, can only be minimized with a proper protection of the cane-crop from insect pests, with a scientifically designed IPM Program, throughout the year. Pesticides are applied as and when needed, in combination with cultural practices, resistant varieties as well as with an introduction and conservation of the natural enemies. Pesticides will continue to play an important role in the IPM Program.

The Integrated Pest Management (IPM), is the most, desirable approach, which intends to integrate more than one possible control measures to keep the insect pests below an economic threshold level. Hence, the problem necessitates the establishment of an IPM strategy in which ideal factors are to be considered. Eco-friendly pest-control in sugarcane by using IPM techniques like cultural, mechanical, resistant

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varieties and bio-control agents for the management of sugarcane pyrilla were recommended by various authors (Singh *et al*., 2001; Verma *et al*., 2002). Varieties with a hard mid-rib, erect and narrow leaves, are less preferred by the top-borer and pyrilla. Biological control of Pyrilla, has been reported as major achievement in Haryana, India (Madan, 2001). *Epiricania melanoleuca* (Fletcher) is a potential ectoparasitoid, which successfully controls the sugarcane leaf hopper, *P. perpusilla* through field colonization. (Rajak, 2007; Gangwar *et al*., 2008). During the study regarding the efficacy of different control measures, against pyrilla in a ratoon crop, minimum pest population (0.45 and 0.28 individuals/leaf) was found where cocoons of *Epiricania melanoleuca* were placed followed by the treatment with Furadan 3G @12 kg/acre (0.85 and 0.67 individuals/leaf) as against check (3.75 and 4.05 individuals/leaf), Rana *et al.* (2002). Chemical control was found to be more effective method as compared to the biological control for the management of *P. perpusilla in* sugarcane (Wasim, 2007).As for as cultural practices are concerned the trash-burning or mulching, has no effect on the pest populations, because the development from nymphs to the adults, takes place on the living plant parts (Brar *et al.,*1983). However, trash mulching, alone, gave 100% eggs parasitization, by the ecto-parasite. (Mohyuddin and Qureshi, 1999; 2000). The de-trashing not only reduces the pest menace like pyrilla, white flies, mealybugs, inter node-borer but also improves the aeration and yield in sugarcane (Kathiresan, 2004).The present study was designed to focus on the integration of various control methods, like cultural, biological & chemical, to find out the most effective & economical combination for an IPM strategy of *P. perpusilla* and for recommendation to the farmers.

MATERIALS AND METHODS

The study was conducted, in the research area, Directorate of Sugarcane, Ayub Agriculture Research Institute, Faisalabad, Punjab, Pakistan. The sugarcane variety HSF-240 was sown on February 20, 2008. Experiment was laid out in Randomized Complete Block design with three replications on a plot size of 13m × 4.5 m, with a row to row distance of 0.76 m. The sets consisting of two buds, were placed side by side longitudinally. Management of sugarcane pyrilla, was carried out by using various control methods, such as, cultural control (fortnightly hoeing, detrashing of older leaves twicely and trash mulching at the time of sowing), biological control (4-times releasing of cocoons of *Epiricania melanoleuca* @ 2500 cocoons per ha, in the season from June 15 to September 15), chemical control (carbofuron @ 35 kg/ha starting from one month after sowing and coupled with earthing up), were applied, singly, and in their possible integrations, viz., biological + cultural control, biological + chemical control, cultural + chemical control and cultural + biological + chemical control and check with the objective to minimize the pest attack and find the most economic and effective control method, by determining the cost benefit ratio.

Data collection and analysis

The data, regarding the Pyrilla-population, per leaf, were recorded, through ten randomly selected leaves from each plot on fortnightly basis (15±2 days). Treatment means, were compared by a DMR test, at P=0.05. The whole analysis, was performed, using IBM compatible computer, with an Mstat package.

RESULTS

Treatment effects on the population of *P. perpusilla*

The data regarding the analysis of variance for the population of *P. perpusilla,* on resistant genotype of sugarcane, in various control methods, at different dates of observations, is presented in Table 1. The data showed significant differences ($P < 0.01$), among the dates of observation, various control methods and in their various interactional combinations. The means were compared by a DMR Test, at P=0.05 and the results are presented in Table 2. The application of biological + cultural + chemical control, in integration, resulted in a minimum population of *P. perpusilla,* and it did not differ, significantly, from other treatments, where cultural + chemical and biological + chemical control, were applied in combination each, and showing 0.42/leaf population of *P. perpusilla*. The maximum population of the pest, was recorded to be 3.65/leaf, in those treatments, where cultural methods were practiced and it differed significantly from those observed in all other treatments. The biological and chemical control methods, when applied, singly, resulted in 0.99 and 0.64/leaf population of the *P. perpusilla,* which differed significantly with each other. The later mentioned figures, showed a non-significant variation with those where biological and cultural control methods were integrated, together and resulted in 0.53/leaf population of the pest. From these results, it was observed that the plots, where cultural+ chemical + biological methods, were integrated, together, proved to be the best treatment, for the control of the pest.

Treatment effect at various dates of observation

The effect of treatment was significant, at various dates of observation. There was no need to describe these results, because the effect of control treatments was computed with the effect of other treatments.

Interactional effect among the dates of observation & various control methods

The results regarding the interactional response, among various treatments, and dates of observations, are presented in Table 3.Significant differences were found to exist, among various treatments and dates of observation.

The population of *P. perpusilla,* was significantly reduced, in all the treatments, as against the control. Maximum control of the pest was recorded at all the dates of observation, in those treatments, where combination of cultural + chemical + biological control methods, was applied, followed by the biological + chemical, cultural + chemical and biological + cultural control measures. All the treatments had a significant control of the population, against the control treatment, at all the dates of observation.

Table 1
An analysis of variance for the data, regarding the effect of various methods, for the control of *Pyrilla perpusilla,* in the resistant variety of sugarcane, at various dates of observation.

SOV	D.F.	M.S.	F. Ratio
Replications	2	0.003	0.06
Dates of observation (D)	9	31.159	628.45 **
Methods (M)	7	199.647	4026.62 **
D X M	63	10.680	215.40 **
Error	158	0.050	

CV = 12.23
** = Significant at P < 0.01.

Table 2
A comparison of means for the data, regarding the population of *Pyrilla perpusilla,* on resistant variety of the sugarcane, in various control methods.

Control Measures	Average
T1 = Cultural Control	3.65 b
T2 = Biological Control	0.99 c
T3 = Chemical Control	0.64 d
T4 = Biological control + Cultural Control	0.53 de
T5 = Biological Control + Chemical Control	0.42 ef
T6 = Cultural + Chemical Control	0.42 ef
T7 = Cultural + Chemical Control + Biological Control	0.32 f
T8 = Control	7.59 a

Average LSD = 0.13
Means sharing similar letters are not significantly different by DMR Test at P = 0.05

Table 3
A comparison of means for the data, regarding the population of *pyrilla perpusilla,* on resistant variety of sugarcane, in various methods of control, at various dates of observation

Methods	Interaction among Dates of Observation and Vari ous Control Methods (LSD = 0.36)										
	15.05.08	31.05.08	16.06.08	01.07.08	16.07.08	31.07.8	15.08.08	30.08.08	15.09.08	30.09.08	Av.
T1	0.60 stuvwxyz[\	0.83 qrstuvw	1.30 nop	2.90 k	1.90 m	4.07 i	5.27 h	7.20 f	6.23 g	6.20 g	3.65 b
T2	0.47 vwxyz[\]^	0.67 qrstuvwxy z	0.93 qrstu	1.63 mn	1.10 opq	1.03pqrs	1.07 pqr	0.97 pqrst	0.97 pqrst	1.07opqr	0.99 c
T3	0.23 [\]^	0.27 yz[\]^	0.57 tuvwxyz[\]^	0.70qrstuvwxy	0.43 wxyz[\]^	0.63 rstuvwxyz[	0.70 qrstuvwxy	0.93 pqestu	0.83 qrstuvw	1.07opqr	0.64 d
T4	0.23 [\]^	0.13] ^	0.33 xyz[\]^	0.60 stuvwxyz[\	0.37 [\]^	0.50 uvwxyz[\]^	0.70 qrstuvwxy	0.77 qrstuvwx	0.77qrstuvwx	0.90 pqrstuv	0.53 de
T5	0.10 ^	0.10 ^	0.17 \]^	0.47vwxyz[\]^	0.20 [\]^	0.47 vwxyz[\]^	0.57 tuvwxyz[\]	0.70qrstuvwxy	0.67 qrstuvwxyz	0.77 qrstuvwx	0.42 ef
T6	0.23 [\]^	0.20 [\]^	0.20 [\]^	0.40 wxyz[\]^	0.27yz[\]^	0.37xyz[\]^	0.53 tuvwxyz[\] ^	0.67 qrstuvwxyz	0.60 qrstuvwxyz[\	0.77 qrstuvwx	0.42 ef
T7	0.10 ^	0.10 ^	0.07	0.27 yz[\]^	0.10 ^	0.33xyz[\]^	0.43 wxyz[\]^	0.57 tuvwxyz[\]^	0.53 tuvwxyz[\]	0.73 qrstuvwx	0.32 f
T8	0.93 Pqrstu	1.47 No	2.50 l	6.50 g	3.70 j	8.33 e	10.67 d	13.80 b	12.60 c	15.43 a	7.59 a
Av. LSD = 0.13	0.35 I	0.47 I	0.76 h	1.68 f	1.01 g	1.97 e	1.49 d	3.20 b	2.90 c	3.67 a	

IPM impact on the sugarcane yield

The data, regarding the analysis of variance for cane-yield (monds per ha), in different treatments, given in Table 4 showed a highly significant difference, among the treatments. The means, were compared by a DMR Test, at P=0.05 (Table 5). It is evident from the results, that the maximum yield (3415.67 monds/ha), was obtained in those plots, where cultural + chemical and biological control methods, were integrated and it differed significantly from those recorded in all other treatments. The application of cultural method, yielded the minimum output, i.e., 2214.33 monds/ha of the cane-yield and, also, differed significantly from those obtained in all other treatments. The descending order of other

treatments was that cultural + chemical control> biological + chemical control> chemical control> biological + cultural control and biological control with 3284.33, 3198.33, 2804.00, 2719.00 and 2571.33 monds/ha, respectively. In general it was observed, from these results, that the application of chemical insecticide (carbofuran), alone, or in combination with other control methods proved to be the best and resulted in a maximum cane-yield, as compared to those methods, where chemical control was not applied.

Cost benefit ratio

The results, pertaining to the cost benefit ratio, in term of the total income, net gain over check and cost benefit ratio (CBR), are shown in Table 6. The results revealed that a maximum cost benefit ratio (1:16.81) was observed in those treatments, where biological control was applied singly. The net gain over check, was calculated to be Rs. 64733/- and was not, so encouraging, as those treatments where cultural+ chemical + biological control methods, were integrated and the net-gain was calculated as Rs. 149167/-. But, in this treatment the cost benefit ratio was obtained to be 1: 9.44 and this was due to a high treatment cost, i.e., Rs.15800/-. The minimum cost benefit ratio was observed to be 1:6.45 in those treatments, where cultural methods were applied. The cost benefit ratios of 11.53, 11.28, 9.35 and 13.96 were obtained in those plots, where cultural + chemical, biological + chemical, biological + cultural and chemical control were applied, respectively. From these results, it was observed that although the cost benefit ratio, was maximum in the biological control application, yet the net gain over check, was not so encouraging as compared to those treatments, where cultural + chemical + biological control, were integrated. Thus, this treatment proved to be good for recommendation to the farmers.

Table 4
An analysis of variance and comparison of means for the data, regarding cane-yield (monds/ha), in different treatments.

SOV	D.F.	M.S.	F. Ratio
Replications	2	387.375	1.00
Treatments	7	828212.327	2132.77 **
Error	14	388.327	

CV = 0.71
** = Significant at P < 0.01

Table 5
A comparison of means for the data, regarding the cane-yield (monds/ha), in different treatments.

Name of Treatment	Means
T1 = Cultural Control	2214.33 g
T2 = Biological Control	2571.33 f
T3 = Chemical Control	2804.00 d
T4 = Biological control + Cultural Control	2719.00 e
T5 = Biological Control + Chemical Control	3198.33 c
T6 = Cultural + Chemical Control	3284.33 b
T7 = Cultural + Chemical Control + Biological Control	3415.67 a
T8 = Control	1924.00 h
LSD at 5%	34.50

Means sharing similar letters are not significantly different by DMR Test.

Table 6
The cost benefit ratio.

Name of Treatment	Total Income (Rs.)	Net Gain Over Check	Treatment Cost (Rs)	CBR
T1 = Cultural Control	221433	29033	4500	1:6.45
T2 = Biological Control	257133	64733	4000	1:16.81
T3 = Chemical Control	280400	88000	7300	1:13.96
T4 = Biological + Cultural Control	271900	79500	8500	1:9.35
T5 = Biological + Chemical Control	319833	127433	11300	1:11.28
T6 = Cultural + Chemical Control	328433	136033	11800	1:11.53
T7 = Cultural + Chemical + Biological Control	341567	149167	15800	1:9.44
T8 = Control	192400			

DISCUSSION

The present findings are in conformity with the findings of Madan (2001), who reported that the biological control of Pyrilla is the major achievement. Similarly, Rajak (2007) and Gangwar *et al*. (2008), controlled *P. perpusilla* population with the ecto-parasitoid. In the present study, the application of cultural methods, viz., fortnightly hoeing + detrashing of older leaves + trash mulching, showed a significant control of the pest and resulted in a population of 3.65 *P. perpusilla* per leaf as against 7.59 in control. The present findings cannot be compared with those of Mohyuddin and Qureshi (1999, 2000), who reported that trash mulching, alone, gave 100% eggs parasitization, by the ecto-parasite.

Similarly the present findings, cannot be compared with Brar *et al*. (1983), who studied different cultural control methods, as those included in the present project. The results are also in close agreement with Kathiresan (2004) who reported that de-trashing not only improve the cane yield and quality through aeration and sanitation but also reduce the pest menace like pyrilla. The present findings are in conformity with those of Madan (2001), who reported that the biological control of pyrilla is the major achievement, in Haryana. These results can also be compared with those of Singh *et al*. (2001), because he adopted integrated approaches, like cultural, mechanical and biological,with need based insecticides and reported that natural control of pyrilla saved the farmers a total of Rs. 50000/- to Rs. 100000/-. The present findings can be compared with those of Verma *et al*. (2002), Rana *et al*. (2002), Wasim (2007), who controlled the population of *P. perpusilla* with the introduction of ecto-parasite, integrated with the chemical application and found a significant control of the pest.

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REFERENCES

Brar, R.S., P.N. Avasthy and S. Kishan, 1983. Sugarcane trash in relation to multiplication of Pyrilla and its parasitoid, *Epipyrops melanoleuca* Fletcher. Maharashtra Sugar., 8: 35-37.

Gangwar, S.K., D.C. Srivastava, R.K. Tewari, M.R. Singh, M.R. and Rajak, D.C., 2008. Management of *Pyrilla perpusilla* Walker in sugarcane with ecto-parasitoid *Epiricania melanoleuca* Fletcher, during epidemics in sub-tropical India. Sugar Tech., 10(2): 162-165.

Government of Pakistan (GOP), 2010-11. Economic Survey of Pakistan. Ministry of Food, Agriculture and Livestock, State Bank of Pakistan, pp. 18-19.

Kathiresan, G., 2004. Karumpuk kathi - a new sugarcane de-trasher. Cooperative-Sugar, 35(12): 939-940.

Kumar, A. and P.R. Yadav, 2006. Studies on biomass of sugarcane pest, *Pyrilla perpusilla* walker under Western conditions. J. Exp. Zool., 9 (1): 173-180.

Kumarasinghe, N.C. and S.D. Wratten, 1996. The Sugarcane Lophopid plant hopper *Pyrilla perpusilla* (Homoptera: Lophopidae): a review of its biology, pest status and control. Bull. Entomol. Res., 86: 485-498.

Madan, Y.P., 2001. Integrated pest management in sugarcane. Indian-sugar., 50(12): 867-871.

Mohyuddin, A.I. and M.A. Qureshi, 1999. Successful experience in Integrated Pest Management Pakistan. Proc. workshop on Integrated Pest Management of Agricultural Pests of OIC Member Countries in Asia, 8-11March, 1999, Islamabad. pp. 24-36.

Mohyuddin, A.I. and M.A. Qureshi, 2000. History of sugarcane *Pyrilla perpusilla* (Walk.) and its biological control based Integrated Pest Management, in Pakistan. Proc. Ann. Convention Sugar Tech. Rawalpindi, 28-29 August, 2000, pp.186-192

Puri, K.D. and K. Sidharth, 2001. Effect of *Pyrilla epidemic* (1999-2000) on Sugarcane yield and sucrose. Proc. 63rd Ann. Conv. Sugar Tech. Assoc., Ind., 25th to 27th August, 2001. A60-A68.

Rajak, D.C., 2007. Colonization & redistribution of *Epiricania melanoleuca* Fletcher against *P. perpusilla* Walker. Ann. Pl. Protec. Sci., 15: 83-86.

Rana, Z.A., I. Haq and A. Tufail, 2002. Efficacy of different control measures against sugarcane borers and pyrilla in ratoon crop. Pak. J. Agric. Res., 40(2): 99-103.

Singh, S.P., S. Jagmohan, K.S. Brar, S. Maninder and S. Darshan, 2001. Demonstration of biological control based integrated pest management on sugarcane in Morinda mill area in Punjab. Ind. J. Sugarcane Tech., 16(1): 58-64.

Verma, A., J. Chandra and R.K. Tanwar, 2002. Eco-friendly pest control in sugarcane. Indian Farming (India). (Feb 2002), 51(11): 40-43.

Wasim, M.A., 2007. Comparison of chemical control and biological control of sucking insect pest complex of sugarcane. M.Sc. Thesis, U.A.F.,Pakistan, PP. 80-83.