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Crop loss estimation of yellow stem borer *Scirpophaga incertulas* (walker) damage on paddy

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Abstract
The present experiment on effect of different treatments on crop loss due to yellow stem borer was conducted at ZAHRS, College of Agriculture, Shivamogga 2015. The results suggest that the plots which was sprayed thrice at 15 days after sowing in nursery followed by 15 and 30 days after transplanting (DAT) was considered as best treatment. The lowest yield loss compared to the best treatment was realised with 11.07 per cent in the treatment which was sprayed at 15 and 30 days after transplanting. Finally if there were no spray against stem borer, yield loss may expect up to 87.66 per cent.

Keywords: crop loss estimation, yellow stem borer, *Scirpophaga incertulas*

1. Introduction
Estimation of the extent of damage and crop losses by the stem borer is essential for determining the potential crop production, isolating resistant strains of the plant, classification of the pests, which warrant control measures, and finding out the effectiveness of the control measures [2]. The varietal resistance is considered as the most effective method of controlling rice stem borers and a great economic potential, since it helps cumulative reduction of pest populations and lessens the need for chemical control [6]. Although earlier workers lamented that the stem borers inflicted significant and severe yield losses of the crop annually, and stem borers regularly infested crops from seedling stage to maturity. However, neither actual loss nor careful statistics maintained or any regular survey was made [4]. Plant type, crop vigour, and the pest complex can play a large role in determining eventual yield loss by stem borers. Low tillering varieties have less opportunity to compensate for 'dead hearts'. Rice plants may compensate for damage during early growth stages but the extent to which plants are able to overcome this damage is unknown [1]. Information on yield losses attributable to rice stem borer infestation [1]. Such factors as intensity of attack, species of borers, time of attack and rice varieties, play a major role in crop assessment. Furthermore, the nature of damage caused is an important factor in estimation of yield loss [1]. Therefore, this study was aimed to assess the yield loss on rice due to stem borer infestation, which may help to develop a fruitful management strategy of the very important pests of rice

2. Material and Methods
A field experiment was carried out during *Kharif* 2015 at ZAHRS, Shivamogga in order to find out crop loss caused due to yellow stem borer on paddy. The paddy crop was raised during *Kharif* 2015 using variety, IET-sanna in a randomized block design (RBD) with four replications and 7 treatments with plot size of 4 m x 3 m and a spacing of 20 cm x 10 cm between rows and plants, respectively. In each plot five spots were selected and tagged for taking observations on per cent dead heart and white ear incidence.
All agronomic practices were followed as per the recommendations except for the yellow stem borer control. For the management of yellow stem borer at different days after transplanting Chlorpyriphos 20 EC (@ 2 ml/lit) recommended insecticides was sprayed and blanket application of Malathion 50EC (2ml/lit) sprayed against Gundhi bug during milking stage of the crop. The treatment details of the experiment are presented in Table 1.

Table 1: Crop loss estimation caused due to yellow stem borer on paddy

S. No	Treatments	Crop stages
T_1	Spraying at 15 days after sowing in nursery followed by 15 and 30 Days after transplanting(DAT) (3 sprays)	Seedling
T_2	Spraying at 15 and 30 DAT (2 sprays)	Tillering
T_3	Spraying at 30 DAT (1 spray)	Tillering
T_4	Spraying at 60 DAT (1 spray)	Flowering
T_5	Spraying at 90 DAT (1 spray)	Ripening
T_6	Spraying at 90 and 120 DAT (2 spray)	Ripening
T_7	Untreated check (No spray)	

Observations were recorded on number of dead heart at 30th and 60th days after transplanting and at pre harvest, number of white ears were recorded by counting the damaged ear heads from 5 randumly selected spots each with five hills and the per cent dead heart and percent white ears in different treatments was worked out. The net plot grain and fodder yield on weight basis per plot was recorded and converted to per hectare.

The crop loss estimation was calculated based on the per cent loss in yield over best treatment using the formula,

$$\text{Per cent loss in yield} = \frac{100 \text{ X (Yield of best treatment} - \text{Yield of the treatment in question)}}{\text{Yield in best treatment over best treatment}}$$

For the comparision, statistical analysis DMRT was done

3. Results

Sixty days after planting the per cent dead heart among the different treatments was varied from 6.05 to 38.23 per cent. The treatment which was sprayed at 15 days after sowing in nursery followed by 15 and 30 days after transplanting recorded minimum per cent dead heart (6.05 per cent) which was significantly superior over other treatments and this was followed by the treatment which sprayed at 15 and 30 days after transplanting, (12.53 per cent) and the treatment which was sprayed at 30 days after transplanting (22.05 per cent) (Table 1).Further, this was followed by the treatment which received spray at 60 days after transplanting and the treatment which was sprayed at 90 and 120 days after transplanting (26.55 and 27.01 per cent respectively) and were on par with each other. The treatment which was sprayed at 90 days after transplanting recorded relatively maximum per cent dead heart (31.22 per cent). However, the highest dead heart per cent was recorded in untreated check (38.23 per cent).

During pre-harvest period the white ear per cent among the treatments was varied from 6.84 to 35.20 per cent white ear. The treatment which was sprayed at 15 days after sowing in nursery followed by 15 and 30 days after transplanting recorded minimum per cent white ear (6.84 per cent white ear) and this treatment was followed by the treatment which was sprayed at 15 and 30 days after transplanting (19.60 per cent white ear) and the treatment which was sprayed at 30 days after transplanting, (26.85 per cent white ear). The next best treatments were when the crop was sprayed at 60 days after transplanting and the treatment which was sprayed at 90 and 120 days after transplanting recorded 29.10 per cent and 30.60 per cent white ear respectively and were on par with each other. The treatment which received spray at 90 days after transplanting recorded maximum of 33.10 per cent white ear which was on par with untreated check. However, the highest per cent dead heart was recorded in untreated check (35.20 per cent)

The grain yield was recorded highest in the treatment, which was sprayed at 15 days after sowing in nursery followed by 15 and 30 days after transplanting (55.98 q ha^{-1}) having 87.68 per cent yield increase over control which was significantly superior over all the treatments. (Table 2).With respect to fodder yield, the plots sprayed at 15 days after sowing in nursery followed by 15 and 30 days after transplanting obtained 57.12 q ha^{-1} (88.30 per cent increase over control) which was significantly superior over all the treatments.

From the investigation, the treatment which was sprayed at 15 days after sowing in nursery followed by 15 and 30 days after transplanting was the best treatment having highest grain yield with the minimum infestation with respect to both per cent dead heart and per cent white ear. Per cent loss in grain yield over best treatment was calculated the results are as follows (Table 2). The treatment which was sprayed at 15 and 30 days after transplanting showed 11.07 per cent loss over best treatment and the treatments sprayed at 30 days after transplanting, the treatment which was sprayed at 60 days after transplanting showed 19.03, 31.62 per cent loss over best treatment, respectively. Further the treatment which was sprayed at 90 and 120 days after transplanting showed 38.42 per cent loss over best treatment. Later the treatment which was sprayed at 90 days after transplanting showed relatively maximum yield loss of 64.93 per cent loss over best treatment. However, the highest per cent grain yield loss over best treatment showed in untreated check with 87.66 per cent loss over best treatment.

With respect to fodder yield, the treatment which was sprayed at 15 days after sowing in nursery followed by 15 and 30 days after transplanting was the best treatment having highest fodder yield with the minimum infestation with respect to both per cent dead heart and per cent white ear. Per cent loss in fodder yield over best treatment was calculated the results are as follows.

The treatment which received spray at 15 and 30 days after transplanting showed 5.19 per cent loss in fodder yield over best treatment and the treatments sprayed at 30 days after transplanting, the treatment which was sprayed at 60 days after transplanting showed 15.76, 19.69 per cent loss over best treatment respectively. Further the treatment which was sprayed at 90 days after transplanting showed 38.97 per cent loss over best treatment. Later the treatment which was sprayed at 90 and 120 days after transplanting showed maximum yield loss of 40.61 per cent loss over best treatment. However, the highest per cent grain yield loss over best treatment showed in untreated check was 88.39 per cent loss over best treatment.

Spraying at 15 days after sowing in nursery followed by 15 and 30 days after transplanting fetched higher net returns of Rs. 79280.34 per ha. This was followed by the treatment which was sprayed at 15 and 30 days after transplanting, the treatment sprayed at 30 days after transplanting and the treatment sprayed at 60 days after transplanting of Rs.

70138.21, Rs. 64576.71, 56175.84 respectively. Treatment which was sprayed at 90 and 120 days after transplanting and Treatment which was sprayed at 90 days after transplanting yield lesser net returns of Rs 49680.46 and Rs. 39483.25.

However, the B: C ratio was recorded highest to be 2.48 in the treatment sprayed at 15 days after sowing in nursery followed by 15 and 30 days after transplanting, it was followed by the treatment which was sprayed at 15 and 30 days after transplanting, the treatment sprayed at 30 days after transplanting and the treatment sprayed at 60 days after transplanting with 2.29, 2.21, 1.92 respectively. Relatively Lowest B: C ratio was observed in the treatment which was sprayed at 90 and 120 days after transplanting and the treatment which was sprayed at 90 days after transplanting of 1.62, 1.35 respectively compared to untreated control with 1.13(Table 3)

Table 1: Effect of different treatments on yield loss caused due to yellow stem borer during *Kharif 2015*

Tr. No.	Treatment	Crop Stages	Dead Heart (%)	White Ear (%)	Plot Basis Kg/12m^2	
					Grain Yield	Fodder Yield
T1	Spraying At 15 Days After Sowing In Nursery Seedling Followed By 15 And 30 DAT (3 Sprays)		6.05(14.03) A	6.84 (14.38) A	6.65	6.92
T2	Spraying At 15 And 30 DAT (2 Sprays)	Tillering	12.53(20.10) B	19.60 (26.25) B	6.01	6.66
T3	Spraying At 30 DAT (1 Spray)	Tillering	22.05(27.99) C	26.85 (30.81) C	5.59	5.99
T4	Spraying At 60 DAT (1 Spray)	Flowering	26.55(31.00) Dc	29.10 (32.63) Dc	5.01	5.82
T5	Spraying At 90 DAT (1 Spray)	Ripening	31.22(33.01) D	33.10 (33.39) Ed	4.01	4.99
T6	Spraying At 90 And 120 DAT (2 Spray)	Ripening	27.01(30.75) Dc	30.60 (33.19) Dc	4.79	5.01
T7	Untreated Check (No Spray)	-	38.23(41.34) E	35.20 (41.32) E	3.9	4.03
	S Em ±		2.29	2.72	-	-
	CD @ 0.05		4.82	5.72	-	-
	CV (%)		11.18	12.41	-	-

Observations: 5 hills per treatment; Figures in parenthese are Arcsine transformed values;
Means followed by sameletters do not differ significantly by DMRT (P=0.05); DAT- Days after transplanting

Table 2: Effect of different treatments on Grain and fodder yield during *Kharif* 2015

		Grain yield		Straw yield	
Tr. No	Treatments	Hectare basis (q/ha)	Per cent loss in yield over best treatment	Hectare basis (q/ha)	Per cent loss in yield over best treatment
T1	Spraying at 15 days after sowing in nursery followed by 15 and 30 DAT (3 sprays)	55.98e	-	57.12e	-
T2	Spraying at 15 and 30 DAT (2 sprays)	50.40d	11.07	54.30d	5.19
T3	Spraying at 30 DAT (1 spray)	47.03d	19.03	49.40d	15.76
T4	Spraying at 60 DAT (1 spray)	42.53dc	31.62	47.72dc	19.69
T5	Spraying at 90 DAT (1 spray)	33.94b	64.93	41.10b	38.97
T6	Spraying at 90 and 120 DAT (2 spray)	40.44dc	38.42	40.65dc	40.61
T7	Untreated check (No spray)	29.83a	87.66	30.32a	88.39
	S Em ±	3.40	-	3.47	-
	CD @ 0.05	7.15	-	7.31	-
	CV (%)	11.73	-	11.50	-

Observations: 5 hills per treatment; Means followed by same letters do not differ significantly by DMRT (P=0.05);
DAT- Days after transplanting; Chlorpyriphos 20 EC@2ml/lit was used; Cost of insecticide – Rs 250/1 l

Table 3: Cost economics of different treatments on yield loss caused by yellow stem borer during *Kharif*2015

Tr. No	Treatments	Cost of plant protection (Rs/ha)	Total cost of crop production (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	C:B ratio
T_1	Spraying at 15 days after sowing in nursery followed by 15 and 30 DAT (3 sprays)	4260	32061.25	111341.6	79280.34	2.48
T_2	Spraying at 15 and 30 DAT (2 sprays)	2840	30641.25	100779.5	70138.21	2.29
T_3	Spraying at 30 DAT (1 spray)	1420	29221.25	93797.96	64576.71	2.21
T_4	Spraying at 60 DAT (1 spray)	1420	29221.25	85397.09	56175.84	1.92
T_5	Spraying at 90 DAT (1 spray)	1420	29221.25	68704.5	39483.25	1.35
T_6	Spraying at 90 and 120 DAT (2 spray)	2840	30641.25	80321.71	49680.46	1.62
T_7	Untreated check (No spray)	0.00	27801.25	59303.2	31501.95	1.13

DAT – Days after transplanting;Cost of paddy = 1800/q; Cost of labour : Rs 250; Number of labour required per spray /ha = 2;
Chlorpyriphos 20 EC @2ml/li was used; Cost of insecticide – Rs 250/1l

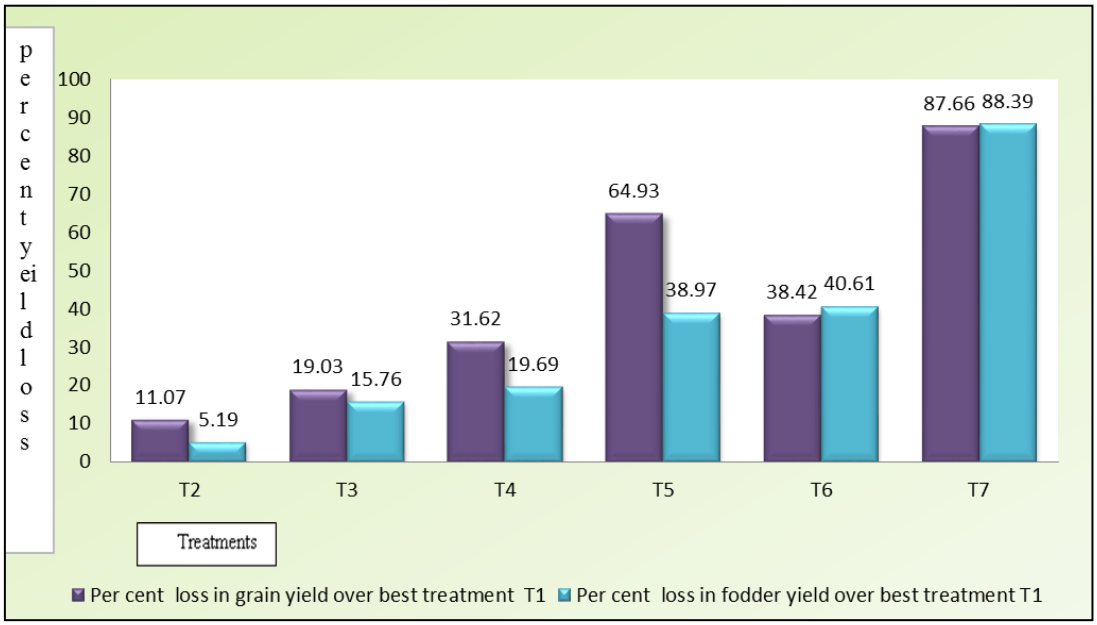

Fig 1: Effect of different treatments on yield loss caused due to yellow stem borer during *Kharif* 2015

4. Discussion

The present investigation is close agreement with [2] reported that chlorpyriphos 20 EC applied as root or leaf dip treatment before transplanting *i.e.*, as nursery spray followed by spraying at 5 DAT and 20 DAT gives the less per cent dead heart and white ear. Further [7] who reported that spraying of chlorpyriphos 20 EC in early stages recorded the lowest infestation of stem borer with 2.17 per cent dead heart and 10.31 per cent white ear and [3] also reported that nursery application of chlorpyriphos 20 EC was most effective against yellow stem borer.

The similar results are in line with the [2, 3, 6, 7]. The grain yield was recorded highest in the treatments, which was sprayed at 15 days after sowing in nursery where [5] also got the highest yield when they take up nursery spraying followed by 15 and 30 days after transplanting (55.98 q ha^{-1}) and the treatment which was sprayed at 15 and 30 days after transplanting (50.40 q ha^{-1}) with 87.68 and 68.95 per cent yield increase over control respectively. The present investigation is close agreement with findings of [7] who reported that spraying of chlorpyriphos 20 EC in early stages recorded higher yields of 4.65t/ha. Further [2] also reported that highest yield was recorded in the field which was sprayed in nursery and 5 and 10 days after transplanting

The results on per cent loss in yield due to yellow stem borer showed that in the control with the infestation of 38.23 per cent dead heart and 35.20 per cent white ear recorded the lowest grain yield of 29.83 q/ha and fodder yield of 30.32 q/ha with 87.66Per cent loss in yield over best treatment. The present investigation is close agreement with [5] who reported that infestation was high in the untreated plots (33.3 per cent white ear) with the per cent loss of 40.10 compare to treated plots.

5. Conclusion

Spraying of insecticide at the right time is very important. From this study we can conclude that early application of chlorpyriphos that is before the emergence of yellow stem borer in the nursery itself and later need based application based on the ETL level in the field can relatively control the yellow stem borer incidence and relatively received high yield.

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