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A SAMPLE STUDY OF STEM BORER INFESTATION OF RICE CROP AND ITS EXPECTED EFFECTS ON YIELD OF RICE AT GUJJO (SIND) 1981

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A sample study of stem borer infestation of rice crop of 1981 and its expected relationship with loss in yield was studied in 18 representative 16 sq. ft. field plots at Gujjo (Sind). The means of data showed that there were 100188 hills per acre, 11.68 tillers per hill, on which the mean infestation was 21.35%. Of the infested tillers 18.46% were 'Dead Hearts', 4.18% 'White Heads,' and 5.46% were late tillers. The mean number of grains per panicle on uninfested and infested stems were 100.74, and 75.61 respectively, with corresponding weights of 2.40 and .32g.The total calculated actual and potential yields turned out to be 2016.62 and 2779.83 Kgs. respectively, showing a loss of 763.21 Kgs. per acre (= 27.45%). The hibernating larvae were present in 4.38% of tillers in stubble, showing a total of 35528.62 larvae per acre. These results on 'Ganjja' variety of rice in lower Sind are in many ways in contrast with those of Rahman and Ghouri (1981) obtained with 'Basmati' variety of rice in Punjab.

INTRODUCTION

Moiz[1] estimated that the loss in yield of rice in lower Sind varied from 2 to 10% normally, but could become as high as 70% in years of serious infestation. Similarly Choudhry[2] assessed the loss of rice due to stem borers in 1970 in Lahore division (Punjab-Pakistan), and stated it to be nearly 30%. Chaudhry[3] studied the loss to yield of rice by stem borers in Hafizabad Tehsil (Punjab-Pakistan) in 1956-57 and ascertained the intensity of borer attack as high as 77%, resulting into a loss of Rs.4.0 crores in one tehsil alone. Javed and Ahmed[4] and Afzal *et al.* [5] made field assessment of rice stem borer infestation and its impact on losses in yield in lower Sind. Khan and Khan[6] made similar studies in Azad Kashmir area of Pakistan.

MATERIAL AND METHODS

The studies on losses to rice, due to stem borers in Pakistan have been too inadequate, due to being only occasional, limited, and based on incomplete data. The present attempt was aimed at collecting a complete data of stem borer infestation and yield loss at Gujjo, a large field area about 10 miles south west of Thatta (Sind). The present studies were made at the preharvest time, when the rice crop was nearing ripening stage. For collecting data shown in Table 1, eighteen sampling areas were marked out in eighteen different acres of rice crop. Each sampling area measured 16. sq.ft. (4x4) along the cross-line from one corner to the opposite corner of the field. Of the 18 sampling areas, 9 were in the middle of the cross-line and 9 were near the corners. In each sampling area, counts were made of total number of hills, total number of tillers, number of healthy tillers, number of 'dead hearts,' number of 'white heads' and number of late tillers. The data shown in Table 2 was collected by removing 10 uninfested and 10 infested panicles from each sample area, counting total number of grains, and weighing them in each case. The stem borer infestation % of tillers as shown in Table 3 was calculated by actually dissecting each tiller which appeared infested, and confirming whether the appearance of 'white-head' was due to stem borer or due to some other reasons. Only those tillers have been shown as infested in Table 3, which were damaged due to stem borers.

RESULTS AND DISCUSSION

The detailed data of stem borer infestation of rice has been given in Tables 1 to 4. As is shown in Table 1, the mean number of hills per 16 sq.ft. area was 36.8 meaning 100188 hills per acre. Further, the overall percentage of uninfested tillers was 71.83. Of the remaining tillers, 18.46% were 'dead hearts', 4.18% 'White heads', and 5.46% late tillers. The mean numbers of grains (Table 2) in an uninfested and infested tiller were 100.74, and 75.61 respectively, whereas the mean weight of grains in an uninfested panicle was 2.40 g, and in an infested panile 0.32 g. The overall mean infestation by stem borers turned out to be 21.35%. The yields of rice per acre, both potential (A), actual (B),

Table 1. No. of healthy and damaged tillers in 16 Sq. Ft. areas
Infestation of Rice plants at harvest time at Gujjo (Sind-Pakistan) 1981
(Area of each observation = 16 sq. ft.)

Sample No.	No. of hills	Total No. of tillers	No. of healthy tillers	No. of dead hearts	No. of white heads	No. of late tillers
1	43	460	307	67	48	38
2	39	413	296	45	19	53
3	38	508	356	71	28	53
4	40	416	329	58	21	08
5	43	530	260	203	64	03
6	30	252	178	53	02	19
7	31	378	294	76	02	06
8	36	340	247	68	01	24
9	38	634	425	195	05	09
10	37	579	397	100	22	60
11	30	418	283	99	19	17
12	44	462	318	123	15	06
13	28	314	257	37	07	13
14	30	346	248	37	03	58
15	44	336	281	25	16	14
16	34	555	391	106	22	36
17	38	349	297	32	16	04
18	40	450	397	35	15	03
Total	663	7740	5561	1430	325	424
Mean	36.8	430	308.9	79.4	18.0	23.5

Table 2. Yields in uninfested and infested panicles of rice at Gujjo (Sind) 1981

Sample No.	10-uninfested panicles		10-infested panicles (W. heads)	
	No. of grains	Weight in (G)	No. of grains	Weight in (G)
1	925	25.05	572	2.02
2	914	23.37	892	6.75
3	1009	23.55	870	2.07
4	1259	21.53	496	1.35
5	869	14.3	725	4.3
6	1279	30.71	642	4.5
7	1062	22.07	929	4.22
8	1211	28.70	837	3.22
9	1011	24.42	915	3.2
10	1038	24.80	615	2.2
11	1019	26.86	769	2.8
12	1139	28.22	522	1.8

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13	1047	25.3	648	3.6
14	934	26.2	976	2.15
15	992	24.78	929	4.22
16	959	27.48	1009	5.5
17	677	17.9	615	1.9
18	800	18.5	650	2.1
Total	18134	433.74	13611	57.88
Mean/10-tillers	1007.4	24.09	756.16	3.2
Mean per tiller	100.74	2.40	75.61	.32

and loss (A-B = C) were calculated as below:

Calculation of yield of rice per acre
(In Kilograms)

Mean potential yield (= A)	=	Mean number of tillers x mean weight of grains in an uninfested panicle
Mean actual yield (= B)	=	(Mean number of uninfested tillers x mean weight of grains in an uninfested panicle) + (Mean number of infested tillers x mean weight of grains in an infested panicle) + (yield in dead hearts = zero) + (Yied in late tillers = zero).
Loss	=	A – B = C
Loss percentage	=	$\frac{C \times 100}{A}$

The exact calculation of stem borer infestation and consequent appearance of extra tillers have complicated the assessment of true loss in yield of rice. Kawada[7] was of the view that excessive tillering is caused by premature death of tillers in a hill during tillering stage, but no new tillers appeared at post-tillering stage in response to the death of tillers by borer attack. This phenomenon of excessive tillering is also affected by whether; the borer has affected the principal tiller, as a result of which the chances of appearance of new tillers are very meagre, or the side tillers, in which 0.35 replacement tillers appear for every one tiller lost[8]. We have based our estimates of losses to yield of rice in the present study on a number of assumptions. The first is that the mean number of grains and their weight in a panicle of an uninfested tiller is the normal potential yielding capacity of a stem. The second is that the white heads are affected in two ways i.e., either the healthy grains in them are too few, or the grain size is restricted, and both the situations are reflected in the weight of a panicle designated as 'white head.' The third is that not only 'dead hearts' give zero yield, but the late tillers, which appear as replacement tillers in the last period of pretillering stage fail to reach maturity or only a few grains appear in them at the harvest time, so that their yield for practical purposes is zero. Whereas those replacement tillers, appearing in response to death of tillers (due to borer attack), and which develope to uninfested tillers are automatically counted amongst their category, it is quite difficult to account for the yield in such tillers, as those 'dead hearts' in response to which replacement tillers would have appeared have already been counted in total of tillers lost. But actually as some of the 'dead hearts' are replaced, only those replaced are counted twice, once in the uninfested stems, and again in the 'dead hearts.' Therefore the total number of tillers on which the potential yield has been calcualted should be reduced by 35% of number of dead hearts. So the loss and loss percentage, shown here appear to be somewhat on the higher side. Till such time that we can resolve this complication satisfactorily, we should regard these estimates of yield and loss nearest to the factual, as the late tillers shown in Table 1 out-number the possible replacement tillers.

Recently Rahman and Ghouri[9] tried to determine the economic threshold of rice stem borer infestation in the Punjab-Pakistan, and concluded that control of rice borers becomes economical at 20% infestation and above. This finding is in contrast with those of Chaudhry[2] and Pathak and Dyck[10], who considered that at 3% and 10 per cent infestation levels respectively, control measures against stem borers should be adopted. Whereas the mean infestation level in the present studies was 21.35% (Table 3), the amount of calculated loss was much more proportionate than estimated by Rahman and Ghouri[9] for Basmati

Table 3. Theoretical and actual yields of rice at Gujjo (Sind) 1981

Sample/ observation No.	Infestation %	Theoretical yield (in Kgs) calculated per acre (A)	Actual yields (in Kgs) per acre (B)	Loss in yield (in Kgs) (C)	Loss %
1.	25.0	3130.80	2115.6	1015.2	32.42
2.	16.49	2627.70	1918.19	709.51	27.00
3.	19.48	3250.12	2292.88	957.24	29.45
4.	17.59	2438.4	1936.13	502.27	20.5
5.	50.37	2063.38	1087.14	976.24	47.36
6.	21.07	2106.23	1489.29	616.94	29.29
7.	20.6	2264.03	1763.09	500.94	22.12
8.	20.17	2656.61	1930.82	725.79	27.32
9.	32.10	4211.59	2827.58	1384.01	32.86
10.	21.4	3783.18	2607.29	1175.89	31.08
11.	28.2	2958.81	2017.69	941.12	31.80
12.	30.0	3546.98	2448.77	1098.21	30.96
13.	12.1	2137.16	1756.06	381.1	17.53
14.	11.5	2468.0	1770.7	697.3	28.25
15.	11.8	2259.45	1907.91	351.54	15.55
16.	23.74	4152.21	2960.31	1191.9	28.7
17.	13.9	1700.77	1455.63	245.14	14.41
18.	8.8	2281.59	2008.1	273.49	11.98
Total	384.31	50037.01	36299.18	13737.83	27.45
Mean	21.35	2779.83	2016.62	763.21	27.45

Table 4. Hibernating larvae in rice stubble at Gujjo (Sind-Pakistan) 1981
(Sample counts for 16 sq.ft.)

Obser- vation No.	No. of hills	No. of tillers	No. of T.I.	Tiller with larvae		Total	%
				C.S.	Misc.		
1	43	481	3	2	–	5	1.03
2	43	442	8	–	–	8	1.81
3	34	353	8	2	–	10	2.83
4	38	292	15	3	–	18	6.16
5	42	373	15	5	–	20	5.36
6	27	190	19	–	–	19	10.0
7	34	291	6	3	–	09	3.09
8	35	305	6	–	–	6	1.96
9	31	330	8	6	–	14	4.24
10	38	381	8	2	–	10	2.62

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11	30	284	9	2	–	11	3.87
12	32	311	23	1	–	24	7.71
13	41	439	12	2	–	14	3.18
14	36	253	8	1	–	9	3.55
15	32	402	16	2	–	18	4.47
16	34	235	21	1	–	22	9.36
17	30	205	7	3	–	10	4.87
18	30	341	4	3	–	7	2.05
19	26	275	14	–	–	14	5.09
Total	656	6183	210	38	–	248	83.25
Mean	34.5	325.42	11.05	2.0	–	13.05	4.38
Per acre	93926.25	885955.95	30083.62	5445	–	35528.62	4.38

T.I. = *Tryporyza incertulas*

C.S = Chilo supressalis

rice in Punjab. One significant reason that emerges by comparison of present studies with those of Rahman and Ghouri[9] for Punjab is that in their area of study, there were on the average 5.5 tillers per plant, nearly 50% of those in our area of study where the mean number of tillers per hills was 11.68%. As the yield of rice per acre in Sind is much higher than the same in Punjab (Year Book of Agriculture, Pakistan), the estimates of potential yield and actual yields are correspondingly much higher in areas under present study.

Hibernation of stem borers (Table 4)

Chaudhry[3] had stated that when the level of stem borer infestation was nearly 77% in rice crop in Hafizabad Tehsil (Punjab), the number of hibernating larvae were nearly one lac per acre, whereas in the present study at Gujjo-Sind, the hibernating larvae were approximately 35000 per acre, where mean infestation of rice crop by stem borers was 21.35%. This also indicates, that of the number of infesting larvae at the harvest time, nearly 20.5 succeed in hibernating. It would be just logical to expect that the higher the number of hibernating larvae, the higher would be the infestation of rice next summer.

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