Indian Journal of Applied Entomology **26**(1) : 79–80 (2012)

IDENTIFICATION OF VULNERABLE STAGE OF MAIZE TO *CHILO PARTELLUS* (SWINHOE)

Maize stem borer, *C. partellus* is an important pest of maize across the world. It also attacks sorghum, millets, rice, sugarcane, pearlmillet and other graminicious grasses. It is an internal stem borer and once larvae enter inside the stem then become difficult to manage with insecticide therefore, efforts are regularly being made to develop the resistance varieties. The developed germplasms are screened against the artificial infestation of maize stem borer after data recorded on LIR. The LIR is totally dependent upon the selection of plant stage for release of either eggs or larvae of *C. partellus*. The release of *C. partellus* in the early stage of plant may transform the plants to dead hearts while delayed releases do not cause significant damage.

So for no systematic work has been done on identification of vulnerable stage of maize plant for release of *C. partellus* and their impact on damage parameters *viz*., LIR, plant height and yield. Therefore, present investigation was planned to find out the most susceptible stage for artificial release of *C. partellus*.

The proposed investigation was conducted at Instructional Farm of Rajasthan College of Agriculture, Udaipur, during 2011. The test germplasm Pratap Maize–5 were sown on 29th June, 2011 at 60 × 60 and 25 × 25 cm row to row and plant to plant spacing. There were 12 plants in each row and only 10 plants were selected for recording the data. The fifteen neonate larvae were released at 7, 9, 11, 13, 15, 17, 19 and 21 days after germination to achieve all categories of leaf injury rating (1–9). One row with three replications were sown for every infestation dose. Thus thirty plants were taken in consideration for observation of each infestation level. One row was kept control after every infestation row. After one month of release of neonate larvae of maize stem borer leaf injury rating (1–9) was recorded. Further, plant height (cm) up to tassel base and yield were recorded at 14 per cent moisture.

The data on Leaf injury rating (LIR) showed that highest LIR, 9.00, was recorded up to 11 days after germination in T_1, T_2 and T_3 and were statistically at par followed by 8.33, 7.67, 6.67, 4.67 and 3.67 in T_4, T_5, T_6, T_7 and T_8 (13, 15, 17, 19 and 21 DAG) respectively. It is also clear from the table that LIR, 8.33 recorded in T_4 (13 DAG) was at par with T_1, T_2, T_3 and T_5 (7, 9, 11 and 15 DAG) respectively but significantly different from T_6, T_7 and T_8 (17, 19 and 21 DAG). LIR recorded in T_5, T_6, T_7 and T_8 also differ statistically to each other.

It is evident from the data that minimum plant height, 18.53 cm was recorded in T_1 (7 DAG) followed by 19.92, 22.75 and 26.48 cm in T_2, T_3 and T_4 (9, 11 and 13 DAG) but were statistically at par. The plant height recorded in other treatments T_5, T_6, T_7 and T_8 (15, 17, 19 and 21 DAG) were 49.13, 98.82, 139.70 and 160.58 cm respectively and were statistically differ to each other.

The data on yield (g /plant) showed that maximum plant yield, 102.22 g /plant was recorded at 21 days after germination (T_8) followed by 88.39, 54.82 and 26.87 g / plant in T_7, T_6 and T_5 (19, 17 and 15 DAG) respectively and was statistically different to each other. No yield was recorded in the remaining treatments, T_1 to T_5.

Table 1. Effect of plant age on damage parameters caused by *C. partellus* and yield in maize

S.No.	Treatments (DAG)	LIR	Plant height (cm)	Plant yield (g/plant)	Total yield (q/ha)
T_1	7	9.00	18.53	0.00 (0.71)	0.00 (0.71)
T_2	9	9.00	19.92	0.00 (0.71)	0.00 (0.71)
T_3	11	9.00	22.75	0.00 (0.71)	0.00 (0.71)
T_4	13	8.33	26.48	0.00 (0.71)	0.00 (0.71)
T_5	15	7.67	49.13	26.87 (5.21)	17.91 (4.29)
T_6	17	6.67	98.82	54.82 (7.41)	36.54 (6.07)
T_7	19	4.67	139.70	88.39 (9.42)	58.92 (7.71)
T_8	21	3.67	160.58	102.22 (10.13)	68.14 (8.28)
SEm±		0.271	5.642	0.221	0.153
CD (P = 0.05)		0.822	17.113	0.670	0.465
CV (%)		6.473	14.587	8.749	7.291

Figures in parentheses are square root transformed values; DAG = Days after germination

The data computed for total yield showed similar trends wherein maximum yield, 68.14 q/ ha was achieved in T_8 (21 DAG) followed by 58.92, 36.54 and 17.91 q /ha in T_7, T_6 and T_5 (19, 17 and 15 DAG) respectively and was significantly different to each other. No yield was recorded in remaining test treatments. The data clearly indicates that though release of larvae up to 11 DAG, completely transform the plants to dead hearts but plants are very susceptible to *C. partellus* up to 15 days where no yield could be recorded.

The present findings are in agreement with the work of Sarup *et al*. (1977) who reported that the most critical stage of maize crop is 10 day old plants. Similarly, Maredia and Mihm (1990) also reported that damage caused by southwestern corn borer varies as per the plant stage. They observed that infestation was highest at 4–5 leaf stage and declined with the age of plants at infestation, the decline was less between the 4–5 and 6–8 leaf stage than between the 6–8 and 9–11 leaf stages. They also reported that 6–8 fully extended leaf stage would be the best stage for artificial infestation of southwestern corn borer. Davis *et al*. (1991) observed that degree of resistance or susceptibility in maize against southwestern corn shift with plant growth stage and found low level of resistance when infested in the reproductive stage of growth.

Kumar (1994) of the opinion that artificial infestation by 1st generation of *C. partellus* on maize during the early whorl stage resulted in significantly greater population and more damage than released on anthesis.

Lourencao and Santos (2005) supported the present investigation that maize plants at 8 and 10 leaf stages were more susceptible to *S. frugiperda* with losses of 11.1 to 15.4 per cent respectively. Similarly, Farid *et al*. (2007) also reported that early vegetative stage is most susceptible to the stem borer *C. partellus* and no increase in damage at tasseling. Jindal and Hari (2010) was also of the opinion that artificial release of *C. partellus* in maize up to at 2.5 week after germination resulted in better explanation of resistance because different components of resistance expressed at this stage.

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Indian Journal of Applied Entomology **26**(1) : 81–82 (2012)

SOME MORPHOLOGICAL PLANT CHARACTERS IN RELATION TO APHID RESISTANCE IN SORGHUM

Sorghum aphid, *Melanaphis sacchari* distributed in Asia, Africa, and the America is an occasional pest worldwide. It prefers to feed on the undersurface of older leaves and the damage proceeds from the lower to upper leaves. The nymphs and adults suck sap from the lower surface of leaves leading to stunted plant growth. The aphids secrete honeydew on which sooty molds grow thereby fodder quality gets spoilt. An attempt was made to establish the correlation between morphological plant characters and incidence of this pest.

The experiment was laid out in a randomized block design and replicated thrice at Agricultural Research Station, N.A.U., Tanchha during *rabi* 2006–07 and 2007–08 under rain fed condition. Twelve genotypes of sorghum *viz.*, SR 655–1, SR 713–1, SR 833–22, SR 1030, SR 11151–1, SR 1638, SR 1657, SR 1665, BP 53, Nizer goti, GJ 36, GJ 38 were sown in October (*Rabi*) in plots of 4.0 meter length comprising with 60 cm × 10 cm spacing. The treatments were replicated thrice. All recommended agronomical practices were followed. Experimental area was kept free from insecticidal spray throughout the season in order to record the incidence of insect pests. Observations on aphids, *Melanaphis sacchari* were recorded at weekly interval. For this purpose, three leaves were observed selecting one each from top, middle and bottom canopy of randomly selected five plants from plot. Mean population of aphids per leaf was worked out and the data were statistically analyzed.

The leaf length and breadth were recorded for the purpose of evaluating resistance to aphids: Leaf size at maturity stage: The length of leaf from the base to the tip along the midrib was measured and the mean length was calculated. The mean breadth of leaf at the middle of leaf was measured for the fourth leaf from base was selected. Simple correlations between leaf size and aphid population in sorghum was worked out.

The data on population of the aphids recorded during *rabi* (2006–07 and 2007–08) as well as pooled data are presented in Table 1. Among the different genotypes evaluated for their susceptibility to aphids, SR 1665 harboured the lowest population (2.89/leaf) during 2006–07 and SR 1030 had the lowest population (2.58/leaf) during 2007–08. The genotype BP 53 recorded significantly highest aphid population the other than genotypes being 30.57/leaf and 25.16/leaf during 2006–07 and 2007–08, respectively.

Table 1. Mean population of aphids, *M. sacchari* in different sorghum genotypes during *rabi*

S. No.	Name of genotype	Mean population of aphids/ leaf		
		2006–07	2007–08	Pooled
1.	SR 655–1	3.38 (11.44)	3.28 (4.77)	3.33 (8.11)
2.	SR 713–1	2.54 (6.47)	2.07 (4.35)	2.30 (5.41)
3.	SR 833–22	2.03 (4.19)	2.20 (4.92)	2.11 (4.56)
4.	SR 1030	2.15 (4.83)	1.59 (2.58)	1.87 (3.70)
5.	SR 1115–1	3.77 (15.11)	2.60 (6.82)	3.19 (10.97)
6.	SR 1638	1.90 (3.72)	2.17 (4.75)	2.03 (4.23)
7.	SR 1657	2.77 (7.81)	3.17 (10.78)	2.97 (9.04)
8.	SR 1665	1.68 (2.89)	2.25 (5.15)	1.97 (4.02)
9.	BP 53	5.46 (30.59)	5.00 (25.16)	5.23 (27.28)
10.	Nizer goti	2.80 (7.86)	3.49 (13.00)	3.15 (10.43)
11.	GJ 36	4.45 (20.43)	3.56 (12.97)	4.01 (16.70)
12.	GJ 38	2.59 (7.62)	2.73 (7.57)	2.66 (7.59)
	Mean	10.25	8.53	9.39
	S.Em ±	0.38	0.23	0.24
	CD @ 5%	1.13	0.67	0.68
	CV %	22.58	14.00	18.96

* Figure in parenthesis is retransformed values while those outside are square root ($\sqrt{x+0.5}$) transformation values.

The results on pooled data (Table 1) revealed that the lowest population was recorded on SR 1030 (3.70/ leaf) and was at par with SR 1665 (4.02/leaf), SR 1638 (4.23/leaf), SR 833–22 (4.56/leaf) and SR 713–1 (5.41/leaf). The genotype BP 53 recorded significantly the highest aphid population (27.88/ leaf). The SR genotypes SR 1030, SR 1665, SR 1638, SR 833–22 and SR 713–1 were less susceptible to aphids. The genotype BP 53 was highly susceptible to aphids as compared to other genotypes followed by GJ 36 (16.70/ leaf), SR 1115–1 (10.97/ leaf) and Nizer goti (10.43/ leaf).

Table 2. Grain yield in different sorghum genotypes during *rabi*

S. No.	Name of genotype	Grain yield (kg/ha)		
		2006–07	2007–08	Pooled
1.	SR 655–1	1403	979	1191
2.	SR 713–1	1878	1498	1688
3.	SR 833–22	979	994	987
4.	SR 1030	1871	1557	1714
5.	SR 1115–1	2653	1432	2043
6.	SR 1638	2010	1308	1659
7.	SR 1657	2024	1505	1765
8.	SR 1665	2002	1198	1600
9.	BP 53	1425	1842	1633
10.	Nizer goti	1929	1586	1758
11.	GJ 36	2112	1578	1845
12.	GJ 38	1915	1827	1871
	Mean	1850	1442	1646
	S.Em ±	200.82	128.73	208.18
	CD @ 5%	589.03	377.57	NS
	CV %	18.80	15.46	17.74

The yield statistical analysis of pooled data showed that the yield difference among different genotypes. The genotype SR 1115–1 gave numerically higher grain yield (2043 kg ha^{-1}) than all genotypes. The genotypes SR 1115–1 though showed medium incidence of aphid (10.97/ leaf) yielded more than the variety SR 1030, which showed minimum incidence of aphids (3.70/ leaf). The yield of different genotypes varied according to the varieties characters like differential yielding ability coupled with ability to recover the damage caused by the pest.

Influence of physical characters of sorghum plants on incidence of sorghum aphids: The different plant characters (physical) of 12 sorghum genotypes were correlated with incidence of aphids during *rabi* season. Data pertaining to simple correlation between different plant characters of sorghum genotypes with the incidence of aphid have been presented in Tables 3 and 4. Among the morphological characters, breadth of leaf showed significant and positive correlation with aphid population (r = 0.371); while, peduncle length and number of internodes showed significant negative correlation with aphid population (r = – 0.337, – 0.264).

Table 3. Simple correlations between different physical parameters of sorghum genotypes and incidence of sorghum aphids

S. No.	Plant characters	Aphids		
		2006–07	2007–08	Pooled
1.	Length of leaf	0.111	– 0.311	– 0.055
2.	Breadth of leaf	0.601**	0.070	0.371*
3.	Number of leaves	– 0.370*	– 0.176	– 0.112

* Significant at 5% level; ** Significant at 1% level

The genotype, SR 1030 registered lowest aphid population (3.70 aphids/ leaf) and its leaf breadth was also least (4.89 cm) as compared to other genotypes. Contrarily, aphid population was the highest (27.88 aphids/ leaf) in genotype BP 53 which had the smallest peduncle length (13.37 cm) and lesser number of internodes (7.03). The plant height, length of leaf and number of leaf showed non significant negative correlation with aphid population, while length of internodes showed non significant positive correlation with aphid population. Results of these studies are in line with the findings of Balikai and Lingappa (2002). Who reported that with the increase in the plant height and number of leaves, there was a reduction in aphid population. The negative correlation of peduncle length and number of internodes with aphid population showed that genotypes, less preferred by aphids, had faster growth and might escape pest attack, while positive correlation of breadth of leaf with aphid population indicates that narrow leaf sorghum germplasm are less preferred by aphids.

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