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Studies on Resistance/Susceptibility of different maize germplasm against maize stem borer, *Chilo partellus* (Swinhoe) in rabi season

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ABSTRACT

The study was conducted on hundred germplasm of maize against stem borer (Chilo partellus) during rabi season 2014-15 at oil seed research farm of C.S.A university of agriculture and technology, Kanpur. Among them 14 germplasm of maize found resistance against stem borer having 0.0 percentage damage they are-PC-6, CIM-180, TSK-9, CMS-5, CIM-78, TR4-19, DMR-706, DMR-605, DMR-606, DMR-607, DMR,110, DMR-615, DMR-703,DMR-618, three germplasm were found moderately susceptible having 6 to15 per cent of damage, i.e., TR-7-8-9, TSK-90, DMR-70 and 12 germplasm were found susceptible having 16-30 per cent of damage, i.e., DMR-701, DMR-608, TSK-44, R9-303, CIMMYT14/K/13, TR4-19, DMR-705, TSK-99, TSK-98, TSK-10, TR3-13, DMR-707. Whereas 71 germplasm observed highly susceptible to maize stem borer having more than 30 per cent of damage were i.e., TR-1-10, TSK-48, DMR-604, DMR-608, DMR-627, TSK-27/CMMYT-4, DMR-118, DMR-708, DMR-106, DMR-120, DMR-603, DMR-610, DMR-130, DMR-107, CIM141-1, CIM-18-, HKI-180, DMR-103, DMR-131, TSK-99-1, TR2/17, DMR-709, DMR-614, DMR-804, DMR-501, DMR-505, DMR-105, DMR-108, DMR-109, DMR-122, DMR-502, DMR-128, DMR-505, DMR-124, PCDMR, DMR-121, DMR-119, DMR-122, DMR-613, DMR-619, DMR-116, TSK-101, DMR-609, CMMYT K/12/10, DMR-802, DMR-115, DMR-112, DMR-781, DMR-611, DMR-104, DMR-114, DMR-126, DMR-129. NEW LOCAL, TSK79-1, DMR-601, DMR-101, DMR-503, DMR-123, MH-5, DMR-612, DMR-803, DMR-504, DMR-102, DMR-110, DMR-111, DMR-113, DMR-117, DMR-131, DMR-608.

Keywords: *Varietal, screening, maize hybrid, stem borer.*

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INTRODUCTION

Maize (*Zea mays)* is a plant belonging to the family *Gramineae*. It is cultivated globally being one of the most important cereal crops worldwide. Maize is not only an important human nutrient, but also a basic element of animal feed and raw material for manufacture of many industrial products. Over 85 per cent of maize produced in the country is consumed as human food. Green cobs are roasted and consumed by people with great interest. The grains special variety called 'popcorn'. The grains are part from food as bread, pops and gruel are used for many industrial products like manufacture of starch, alcohol, acetic and lactic acids, glucose, paper, rayon, plastic, textile, adhesive, dyes, synthetic rubber, resins artificial leather and boot polish. It is also a feed for cattle. Maize is the third most important food grain in India after wheat and rice. In India, about 28 per cent of maize produced is used for food purpose, about 11 per cent as livestock feed, 48 per cent as poultry feed, 12 per cent in wet industry (for example starch and oil production) and 1 per cent as seed [1]. Maize is the most versatile crop with wider adoptability in varied ecologies. It has highest genetic potential among the food grain crops. In India, maize crop is grown in an area of 8.49 million hectare with a production of 21.28 million tons and the productivity 2.507 ton/ha in 2010-11 [2]. In Uttar Pradesh, it is grown in an area 7.45 lac hectare with a production of 12.32 lac tons and the productivity was 1.653 ton/ha in 2010-11 [2]. Maize is attacked over 250 species of insect-pest. Of these, four borers viz. Maize stem borer, *Chilo partellus*, *Sesamia inferens* (Walker), Shoot fly,

Antherigona Soccata (Rondani) and Asiatic Corn borer, *Ostrinia furnacalis* (Guenes) are regular and Serious pest for maize [9]. Maize stem borer, *C. partellus* is a serious pest of maize in India and distributed throughout the country. The *C. partellus* is also widely distributed in Asia *viz.,* India, Pakistan, Bangladesh, Afghanistan, Nepal, Cambodia, Indonesia, Sri Lanka, Thailand, Vietnam, Iraq, Japan, Nyasaland and Taiwan [10]. Percentage of avoidable losses primarily due to *C. Partellus* during *kharif* (rainy) season varied from 24.3 to 36.0 per cent in different agro-climatic regions of India [4]. Thus keeping in view the importance of insect pest and crop the present studies on resistance/susceptibility of different maize germplasm against maize stem borer, *C. partellus* in *rabi* season.

MATERIAL AND METHODS

The present study on resistance/susceptibility of different germplasm of maize against stem borer in *rabi* season. The germplasm of maize were grown during *rabi* season on 2014-15, at oil seed research farm of C.S.A university of agriculture and technology, Kanpur, which is situated in subtropical zone at altitude of 26.3 north, longitude 80.15^{o} east and 1270 meter above to sea level in gangatic alluvial soil of central U.P.

Selection of genotypes

In order to screen the relative resistant/susceptibility of different maize germplasm against maize stem borer the following genotypes were screened under field conditions. They have been used to represent the following cultivars of maize in table 1.

Table 1. List of maize germplasm

Sl. No	Germplasm	Sl. No	Germplasm	Sl. No	Germplasm	Sl. No	Germplasm	Sl. No	Germplasm
01	DMR-781	21	TSK-98	41	CIM-78	61	DMR-612	81	DMR-103
02	TSK-101	22	R9-303	42	TR-4-19	62	DMR-613	82	DMR-104
03	PC-6	23	DMR-703	43	TR-3-13	63	DMR-614	83	DMR-105
04	NEW LOCAL	24	DMR-704	44	DMR-701	64	DMR-615	84	DMR-106
05	PC DMR-92	25	DMR-707	45	DMR-702	65	DMR-616	85	DMR-107
06	MH-5	26	DMR-708	46	DMR-705	66	DMR-617	86	DMR-108
07	CIMMYT K12/10	27	DMR-601	47	DMR-706	67	DMR-618	87	DMR-109
08	TSK 79-1	28	DMR-602	48	DMR-803	68	DMR-619	88	DMR-110
09	TSK-7-8	29	DMR-603	49	DMR-804	69	DMR-801	89	DMR-111
10	TR 2/17	30	DMR-604	50	DMR-805	70	DMR-802	90	DMR-112
11	CIM-180	31	DMR-605	51	DMR-501	71	DMR-116	91	DMR-113
12	HKI-193	32	DMR-606	52	DMR-502	72	DMR-117	92	DMR-114
13	CIM 141-1	33	DMR-607	53	DMR-503	73	DMR-118	93	DMR-115
14	TSK-9	34	TR4/17	54	DMR-504	74	DMR-119	94	DMR-125
15	CIMMYT 14/K-13	35	TR-7-8-9	55	DMR-505	75	DMR-120	95	DMR-126
16	TSK-99	36	TSK-10	56	DMR-101	76	DMR-121	96	DMR-127
17	TSK-99-1	37	TSK-90	57	DMR-608	77	DMR-122	97	DMR-128
18	TSK79/9	38	TR-1-10	58	DMR-609	78	DMR-123	98	DMR-129
19	TSK27/CIMMYT-4	39	TSK-48	59	DMR-610	79	DMR-124	99	DMR-130
20	TSK-44	40	CM-55	60	DMR-611	**80**	DMR-125	100	DMR-131

Grading for stem borer *C. partellus* damage was categorized in the five grades, on the basis of percentage stem damage. The data related to leaf injury rating were grouped under following categories as given in table 2.

Table 2: Leaf injury rating scale by Lella *et al.* [8]

Sl.No	Grading	Symbol	% stem damage
1	Resistance	R	0.00
2	Moderately resistant	M.D	1-5
3	Moderately susceptible	M.S	6-15
4	Susceptible	S	16-30
5	Highly susceptible	H.S	Above-30

Observations: The observation was recorded in the morning hours. To record the per cent damaged, for which the total number of healthy stem and total number of damaged stem in each germplasm were observed. Three observation were recorded at vegetative stage, cob formation and as well as maturity stage. The percentage of dead heart damage was calculated by,

Per cent of dead heart= $\frac{\text{No. of dead heart plants}}{\text{Total no.of plants}} \times 100$

RESULTS

Based on observations recorded for stem borer infestation, the nature of damage of maize stem borer at different larval instars was found to vary, as the first instar larvae feed on tender part, particularly in the central whorl, second and third instar larvae attack all parts of the plant except the roots and fourth and fifth instar larvae damage stem near the soil. The screening of maize germplasm had a great significance to find out a resistance line against maize and Jowar stem borer *C. partellus.* All the 100 maize germplasm were categorized under five different grades.

Resistance germplasm: Out of 100 germplasm, 14 germplasm were found resistant having 0.0 per cent damage are given table-3,

Table 3: Showing relative plant resistance of 14 selected germplasm against *C. partellus* attack.

Sl.No	Germplasm	Infestation
1	PC-6	0.0
2	CIM-180	0.0
3	TSK-9	0.0
4	CM-55	0.0
5	CIM-78	0.0
6	TR-4	0.0
7	DMR-706	0.0
8	DMR-605	0.0
9	DMR-606	0.0
10	DMR-607	0.0
11	DMR-610	0.0
12	DMR-615	0.0
13	DMR-703	0.0
14	DMR-618	0.0

Moderately susceptible germplasm: Out of 100 germplasm 3 germplasm were found moderately susceptible having 6-15 per cent damage are given table-4,

Table 4: showing moderate susceptibility of 3 selected germplasm against *C. partellus* attack.

Sl.No	Germplasm	Infestation (%)
01	TR-7-8-9	11
02	TSK-90	14
03	DMR-702	15

Susceptible germplasm: Out of 100 germplsm 12 germplasm were found susceptible having 16-30 percent damage is given table-5

Table 5: showing susceptibility of 12 selected germplasm against *C. partellus* attack.

Sl.No	Germplasm	Infestation (%)
01	Tr-10	16
02	TSK-44	16
03	R9-303	18
04	TSK-99	20
05	DMR-608	25
06	CIMMYT-14/K/13	25
07	TR-4-19	25
08	DMR-705	25
09	TSK-98	25
10	DMR-707	25
11	DMR-701	30
12	TR3-13	30

Highly susceptible germplasm: There are 71 germplasm have been grouped as a highly susceptible germplasm against stem borer having more than 30 per cent damage is given in table-6,

Table 6: Showing highly susceptibility of 71 selected germplasm against *C. partellus* attack.

Sl. No.	Germplasm	Infestation (%)
01	TR-1-10	33
02	TSK-48	33
03	DMR-604	33
04	DMR-608	33
05	DMR-127	33
06	TSK-27/CMMYT-4	34
07	DMR-118	36
08	DMR-708	35
09	DMR-706	35
10	DMR-120	35
11	DMR-603	36
12	DMR-610	37
13	DMR-130	38
14	DMR-107	38
15	DMR-141-1	39
16	CIM-180	39
17	HKI-180	40
18	DMR-103	41
19	DMR-131	41
20	TSK-99-1	44
21	TR2/17	44
22	DMR-704	44
23	DMR-614	45
24	DMR-804	46
25	DMR-501	46
26	DMR-505	46
27	DMR-105	46
28	DMR-108	46
29	DMR-109	47
30	DMR-122	47
31	DMR-502	47
32	DMR-128	47
33	DMR-505	47
34	DMR-124	48
35	PCDMR	48
36	DMR-121	49
37	DMR-119	49
38	DMR-122	49
39	DMR-613	49
40	DMR-619	49
41	DMR-116	50
42	TSK-101	50
43	DMR-609	50
44	CMMYT K/12/10	50
45	DMR-122	50
46	DMR-802	50
47	DMR-115	50
48	DMR-112	50
49	DMR-781	51
50	DMR-104	51
51	DMR-114	51
52	DMR-126	51
53	DMR-611	52
54	DMR-129	52
55	NEW LOCAL	54
56	TSK-79-1	54
57	DMR-601	55
58	DMR-101	55
59	DMR-503	55
60	DMR-123	56
61	MH-5	56
62	DMR-612	57
63	DMR-803	57
64	DMR-504	58
65	DMR-102	58
66	DMR-110	58
67	DMR-111	58
68	DMR-113	58
69	DMR-117	59
70	DMR-131	60
71	DMR-608	60

DISCUSSION

Resistance/susceptibility of maize germplasm against stem borer, *C. partellus*:

In present studies regarding the resistance and susceptibility of 100 germplasm against *C. partellus*, 14 germplasm of maize found resistance against stem borer having 0.0 per cent infestation they are PC-6, CIM-180, TSK-9, CMS-5, CIM-78, TR4-19, DMR-706, DMR-605, DMR-606, DMR-607, DMR,110, DMR-615, DMR-703 and DMR-618. While the none of germplasm was found moderately resistance having 1-5 per cent of damage. Three germplasm were found moderately susceptible having 6-15 per cent of damage *i.e.*, TR-7,8&9, TSK-90, DMR-70 and 12 germplasm were found susceptible having 16-30 per cent of damage *i.e.,* DMR-701, DMR-608, TSK-44, R9-303, CIMMYT14/K/13, TR4-19, DMR-705, TSK-99, TSK-98, TSK-10, TR3-13, DMR-707. Whereas germplasm observed highly susceptible to maize stem borer having more than 30 per cent of damage were *viz.,* TR-1-10, TSK-48, DMR-604, DMR-608, DMR-627, TSK-27/CMMYT-4, DMR-118, DMR-708, DMR-106, DMR-120, DMR-603, DMR-610, DMR-130, DMR-107, CIM141-1, CIM-18-, HKI-180, DMR-103, DMR-131, TSK-99-1, TR2/17, DMR-709, DMR-614, DMR-804, DMR-501, DMR-505, DMR-105, DMR-108, DMR-109, DMR-122, DMR-502, DMR-128, DMR-505, DMR-124, PCDMR, DMR-121, DMR-119, DMR-122, DMR-613, DMR-619, DMR-116, TSK-101, DMR-609, CMMYT K/12/10, DMR-802, DMR-115, DMR-112, DMR-781, DMR-611, DMR-104, DMR-114, DMR-126, DMR-129. NEW LOCAL, TSK79-1, DMR-601, DMR-101, DMR-503, DMR-123, MH-5, DMR-612, DMR-803, DMR-504, DMR-102, DMR-110, DMR-111, DMR-113, DMR-117, DMR-131, DMR-608. According to Saxena [12] reported that the genotype IS-18368 to be the highly susceptible, IS-1846 and IS-2146 to be moderately susceptible IS 4660 and IS-2205 to be moderately resistant, IS-1044 to be highly resistant. Of the 23 genotypes screened and found that SSV-7073 appeared as a promising resistant genotype, while nandyal, SSV

53,SSV6928,HES-4 and IS-2312 showed reduced levels of peduncle and stem tunneling damage. The control genotypes DI-6514 and CSH-14 showed the highest level of panicle and harvest stage damaged genotypes SSV-7073 showed very significantly less dead heart, leaf scrapping, pinholes, peduncle or stem tunneling damage compared to all other. It may therefore hold promise as a genotype in sorghum improvement research. Nandyal, SSV-53, SSV69528, HFS-4 and IS-2312 were promising in terms of peduncle and stem tunneling damage. Kumar [7]reported that ovipositional non preference by *C.partellus* on maize genotype was due to presence of trichomes and surface waxes. One genotypes, ICZ-T, with trichomes on both sides of the leaf surface. In some studies on foliar injury due to attack by*C.partellus* on two genotypes (ICZ-1-CM) and (ICZ-2-CM) both antibiosis and tolerance were reported to be the components of resistance. Rao *et al.* [11] were reported seven maize genotypes compromising resistant, moderately resistant and highly susceptible to *Chilopartellus* to observe the role of biochemical plant factors at various stages of crop growth *i.e.,* 10, 20 and 30 days after emergence. Distinctly low leaf chlorophyll, carotenoids nitrogen, crude protein and moisture content were observed in resistant cultivars compared to susceptible ones. The correlation between leaf injury due to *Chilopartellus* with these biochemical factors individually were positively correlated the significantly difference being in a carotenoids content in early stage of crop growth contribute towards resistance against the borer in maize. Anuradha [3] screening of 45 maize inbreed lines comprising of 20 sweet corn,13 popcorns and 49 normal maize against *C. partellus,* artificial infestation was done at 12 days after germination and leaf injury rating was recorded on 1-9 scale at 30 days after infestation in both the replications. Hussain *et al.* [6] reported that in IVHT grain, entries SPH 1654 and SPV 462 recorded minimum shoot fly damage, whereas SPV 1616 and SPV 1907 recorded minimum stem borer dead hearts (2.46 and 2.92%) and minimum leaf injury by entry SPH 1648 (5.14%). In IAVT dual purpose trial, CSV 15 and SPV 2013 recorded significantly minimum shoot fly, CSV 15, CSV 17, SPV 1870 and SPV 12016 recorded minimum stem borer damage, SPV 1870 (5.33%) recorded minimum leaf injured plants. Whereas SPV 2016 and SPV 2018 recorded significantly maximum grain yield in terms of g/plant (80 g each, respectively). In case of AHT grain, test entry, SPH 1615 and local check recorded minimum shoot fly, SPH 1615 and SPH 1596 recorded lesser stem borer dead hearts, SPH 1615 recorded minimum leaf injury and SPH 1634 recorded maximum grain yield/plant (108 g/plant) as compared to rest of the entries tested. In case of local check resistance trial entries SPV 1616, PKV 809 and CSV 17 recorded minimum shoot fly, stem borer and leaf injury. Dhillon *et al*. [5] evaluated for resistance to *C. partellus*, maize genotypes *viz.,* CPM 1, CPM 2, CPM 4, CPM 8, CPM 15, and CPM 18 were found resistant to *C. partellus* with diverse mechanisms of insect resistance and also possessed desired morphological and agronomic traits. These genotypes could be used in breeding programme for the development of stem borer-resistant maize varieties and hybrids.

CONCLUSION

On the base of current studies, it is concluded that among 100 germplasm , 14 found to be resistance, 3 moderately susceptible, 12 susceptible and 71 germplasm found to be the highly susceptible to maize stem borer.

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