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Effect of infestation of maize sotted stem borer, *chilo partellus* (Swinhoe) on height of different genotypes in normal and artificially infested lines

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Abstract

A research has been conducted during *Kharif* of the year 2018 and 2019 at research farm of Dr Rajendra Prasad Central Agricultural University Pusa, Samastipur to find out the effect of infestation of *Chilo partellus* on height of different genotypes of maize. For the assessment, a total number of 25 genotypes namely hybrids *viz.*, Shaktiman-1, Shaktiman-2, Shaktiman-3, Shaktiman-4, Shaktiman-5, RHM-1, RHM-2, RHM-3, P-3535, P-3533, P-3550, P-3555, Dekalb-9188, Dekalb-9170, composite namely Devaki, Laxmi, Suwan, Deep Jwala and promising genotypes namely New Cross 76×11, New Cross 72×70, New Cross 73×11, New Cross 73×74, New Cross 52×65, New Cross 53×52 and New Cross 50×58 were assessed for the reduction in height after artificial infestation. The result revealed that genotypes, namely P-3533 with 8.38 cm followed by DeKalb 9170 with 8.25 and Shaktiman-4 with 6.63 cm of height reduction showed maximum reduction in height while minimum height reduction was recorded in P-3555; Shaktiman-3 with 0.00 cm followed by RHM-1 with 1.01 cm and P-3550; Lakshmi (Resistant, Check) with 1.25 and found at par with each other.

Keywords: Effect of infestation swinhoe artificially infested lines

1. Introduction

Maize (*Zea mays* L.) is a staple food for millions of people in different parts of the world. In India, maize is the third most important cereal crop after rice and wheat. Maize grains are used for many purposes like human consumption (35%), animal feed & fodder (25%), poultry feed (25%) and industrial products (Starch, alcohol and popcorn) (15%). The countries with large maize growing areas are Argentina, Brazil, China, Hungary, India, Indonesia, Italy, Mexico, Philippines, South Africa, Rumania, United States and Yugoslavia. It was introduced in India from Central America in the beginning of seventeenth century. Important maize growing states in India are Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Karnataka, Punjab, Rajasthan and West Bengal. In Bihar, maize occupies an area of around 0.65 million hectares with annual production about 22.26 million tonnes [8, 9, 10, 11]. Potentially, maize cultivation is gaining importance in Bihar due to increasing demand as animal feed & fodder and raw material for industries. Therefore, there is need to explore the possibility of increasing the productivity through better understanding of some key constraints of its production.

The average maize productivity in India is 2.5 t/ha which is much less as compared to U.S. (9.6 t/ha.). In spite of the increasing area under this crop, the production is still very low which may be due to several reasons, *viz.* environmental factors, poor mechanization, insect-pests and diseases etc. Among these insect-pests are one of the major limiting factors for low yield of maize. The insect-pests of maize inflict serious loss, both directly as borers, sap suckers, stem and root feeders etc. and indirectly as vectors of several diseases.

The crop is subjected to attack by a number of insect-pests. It was observed that over 250 insect species are associated with maize in field as well as in the storage conditions [1]. Among all the insect-pests attacking the maize crop, lepidopteron group of pests, particularly the stem borers are major constraint to the productivity of maize crop. These insects are of great economic importance in most maize growing areas throughout the world. Of these, spotted stem/stalk borer, *Chilo partellus* (Swinhoe) (Lepidoptera: Crambidae) is a major cause of damage in *kharif* season. Yield loss due to this pest ranges from 10 to 20 per cent and may go up to 80 per cent [3, 4, 5].

In India, the grain loss varied from 24.3 to 36.3 per cent at different places [2, 6, 7]. Application of chemical pesticides leads to environmental pollution, increasing production cost and cause negative effect on human health with development of resistance in insect-pests. Hence, utilization of environmentally safe methods is of paramount importance. Choosing resistant variety is the first and foremost step in formulating an IPM module.

genotypic factors including types of genotypes, largely responsible for imparting resistance into the maize plants against many insects including *Chilo partellus* (Swinhoe). *Chilo partellus* infestation affect plants in many ways including to dwarfing of the genotypes. Therefore, the present study was made to find out the degree of dwarfness in infested and non-infested maize genotypes against *Chilo partellus* (Swinhoe) in different genotypes of maize [12, 13, 14].

2. Materials and Method

All selected genotypes were sown during *Kharif* in the month of July, 2018 and 2019 at research farm, RPCAU Pusa. The test insect *i. e.* *Chilo partellus* was reared in laboratory and neonate larva were used for artificial infestation in the field. The artificial infestation was done at 40 DAS.

Laboratory culture of *Chilo partellus* was developed by collecting larvae and pupae during the first fortnight of July. These collected immature larvae were reared in two feet healthy maize stalk and pupae were kept in moth emergence cage. The emerged moths were transferred to egg laying cages. Female moth started laying eggs on lined white papers inside the cage after 2-3 days. These laid egg masses turned into a black headed stage after 2-3 days of oviposition. The black headed stage of egg masses with paper bits were transferred into artificial diet vials for their further growth and development. The rearing process repeated to develop stock culture of neonate larvae. All the plants in both rows were infested with five numbers of neonate larvae at evening hours. The maize germplasm under test were closely examined at regular intervals.

Table 1: The maize germplasm under test were closely examined at regular intervals

S. No.	Genotypes	SN	Genotypes
1.	Shaktiman-1	14.	P-3533
2.	Shaktiman-2	15.	P-3550
3.	Shaktiman-3	16.	P-3555
4.	Shaktiman-4	17.	DeKalb 9188
5.	Shaktiman-5	18.	DeKalb 9170
6.	Devaki	19.	New Cross (76X11)
7.	Lakshmi	20.	New Cross (72X70)
8.	Suwan	21.	New Cross (73X11)
9.	RHM-1	22.	New Cross (73X74)
10.	RHM-2	23.	New Cross (52X65)
11.	RHM-3	24.	New Cross (53X52)
12.	Deep Jwala	25.	New Cross (50X58)
13.	P-3535		

Table 1: Pool Average of Plant Height, height of Infested Plants and Reduction in Height (cm) of Different Genotypes of Maize during *Kharif* 2018 and 2019

S. No.	Name of Genotypes	Pool Average of 2018 and 2019 of Normal Plant Height	Pool Average of 2018 and 2019 of Infested Plant Height	Reduction in Height
1.	Shaktiman-1	55.38	51.62	-3.76
2.	Shaktiman-2	55.37	51.12	-4.25
3.	Shaktiman-3	53.00	57.37	0.00

1. Plant height is a major factor affecting the infestation of Maize Spotted Stem Borer, *Chilo partellus*. In many cases, it had been observed that more infestation of Maize Spotted Stem Borer, *Chilo partellus* can decrease the plant height upto a significant level. For plant height, a total number of 5 (not-infested with artificial infestation) plants from each replication of each treatment have been selected and measured by meter scale. The measuring of stem heights had been done at the stage of 40 days after sowing of crop.
2. Plant height in artificially infested plants has been recorded as the method above mentioned, by selecting 5 artificially infested plans in each replication of each genotypes. The observations have been taken with the help of meter scale.

3. Results

The result presented in Table 1 is showing pool average of stem height of different selected genotypes at different stages during the *Kharif* of year 2018 and 2019. The pool average of height in different selected genotypes after 40 days of sowing of 2018 and 2019 was ranged from 42.75 cm to 80.38 cm in which maximum height was recorded in New Cross (72X70) with 80.38 cm followed by RHM-3 with 74.25 and Deep Jwala with 74.13 cm of pool average height. Minimum height was recorded in genotype namely RHM-2 with 42.75 cm followed by P-3550 with 44.50 and Shaktiman-5 with 48.75 cm of pool average height. The pool average height in resistant check was 62.00 cm. genotypes namely, New Cross 76X11, 58.00; RHM-1, 59.50 and Dekalb-9170, 60.00 cm were found at par among each other while RHM-3, Deep Jwala, New Cross (73X11), New Cross (73X74) and New Cross (52X65) were found superior than check, Lakshmi. The Table 1, present pool average height of artificially infested plants of both the years. After 20 days after infestation, the total height in infested plants of different genotypes was ranged from 39.87 cm to 75.75 cm in which the maximum height was observed in New Cross (72X70) with 75.75 cm followed by RHM-3 with 71.75 cm and Deep Jwala with 70.62 cm and they were superior to the check while genotypes RHM-1; Devaki were fund at par with check. Minimum height was recorded in RHM-2, 39.87 cm followed by P-3550 with 43.25 cm, Shaktiman-5 with 46.50 cm of plant height. The plant height in resistant genotype, Lakshmi was 60.75 cm.

The Table 1 also present the pool average of reduction in height of artificially infested plants. After 20 days after infestation, the total height reduction in infested plants of different genotypes was ranged from 0.00 cm to 8.38 cm in which the maximum height reduction was observed in P-3533 with 8.38 cm followed by DeKalb 9170 with 8.25 and Shaktiman-4 with 6.63 cm of height reduction. Minimum height reduction was recorded in P-3555; Shaktiman-3 with 0.00 cm followed by RHM-1 with 1.01 cm and P-3550; Lakshmi (Resistant, Check) with 1.25 and found at par with each other.

4.	Shaktiman-4	59.88	53.25	-6.63
5.	Shaktiman-5	48.75	46.50	-2.25
6.	Devaki	63.88	61.50	-2.38
7.	Lakshmi (Resistant, Check)	62.00	60.75	-1.25
8.	Suwan	62.50	58.75	-3.75
9.	RHM-1	62.13	61.12	-1.01
10.	RHM-2	42.75	39.87	-2.88
11.	RHM-3	74.25	71.75	-2.50
12.	Deep Jwala	74.13	70.62	-3.51
13.	P-3535	59.50	57.25	-2.25
14.	P-3533	63.50	55.12	-8.38
15.	P-3550	44.50	43.25	-1.25
16.	P-3555	55.87	58.87	0.00
17.	DeKalb 9188	50.75	48.25	-2.50
18.	DeKalb 9170	59.25	51.00	-8.25
19.	New Cross (76X11)	61.25	59.87	-1.38
20.	New Cross (72X70)	80.38	75.75	-4.63
21.	New Cross (73X11)	66.50	63.25	-3.25
22.	New Cross (73X74)	67.00	64.50	-2.50
23.	New Cross (52X65)	72.62	67.25	-5.37
24.	New Cross (53X52)	58.88	55.75	-3.13
25.	New Cross (50X58)	55.63	50.75	-4.88
	CD \leq 5%	2.98	1.24	0.63
	SEm (\pm)	1.07	0.42	0.27

4. Discussion

Plant height is an important character of plant, in case of all the agricultural crops, it deals with the productivity of the crop, canopy temperature, feed and fodder for cattle's and been described as biological yield. In Maize, all the selected genotypes under this experiment have shown different degree of variation among the height parameter. The height was recorded maximum and minimum both in case of hybrid/promising genotypes while at the time of tasseling maximum height was achieved by promising genotypes. There was a less difference has been recorded in height at 40 days after sowing, earlier workers [15; 16; 17] have recorded the same variations among the height at the time of 40 days after sowing. The Resistant check genotype Lakshmi showed medium height when compared to whole range of heights of selected genotypes, it was among the late tasseling genotypes. Somewhat similar findings have been concluded in the studies [18, 19, 20, 21] and they have concluded that genotypes having height between 58.50 to 70.00, fall under the resistant category. They have conducted experiments on morphological parameters of plants and their association with infestation level of *Chilo partellus*. In all given workers, Afzal *et al.*, [18b] have conducted their studies on locally available twenty genotypes of maize including hybrids and composite for screening for resistance to *Chilo partellus* in the field condition. They have seen in the results that hybrid and composite genotypes showed a greater variation among the plant height. plant height in case of finding of earlier workers [22, 23, 24, 25, 26] the height showed significant variations among all the tested genotypes of different groups. In their finding, composite and local landraces showed significant higher height including to the resistant check used by them and the work has been supported by the statement that higher the height, lower the infestation. The studies have proposed the idea of a negative correlation between the plant height and the different levels of the infestations. They have concluded that smaller plants are more susceptible in compare to plants with greater height, these finding are found to be supporting our findings of intensity of height towards the resistance and established a positive correlation between the plant height and degree of resistance. The plants being infested by artificial

infestation, shown a great degree of variation in height when compared to the normal plants of same genotype [27, 28]. The total height in infested plants of different genotypes was ranged from 39.87 cm to 75.75 cm in which the maximum height was observed in New Cross (72X70) with 75.75 cm followed by RHM-3 with 71.75 cm and Deep Jwala with 70.62 cm and they were superior to the check while genotypes RHM-1; Devaki were found at par with check. It was recorded that heavy infestation of *Chilo partellus* leads in heavy reduction in plant height and dwarfing is a very common symptom of all kind of insect infestation while the maize spotted stem borer, *Chilo partellus* is mainly concern with the infestation inside the stem [29, 30]. Feeding the inner content of stem makes plants short in height and deter their proper development. In all the genotypes, artificially infested plants shown degree of variation in their height reduction. The results of height in artificially infested plant shown that plants have maximum infestation, shown greater reduction in height in compare to normal plants [31, 32, 33, 34]. The reduction in height was more prominent in the year 2019.

5. Conclusion

In the present study it was found that plants with more height were resistant against maize spotted stem borer, *Chilo partellus*. Plant height plays a very important role in infestation of maize spotted stem borer, *Chilo partellus*. Firstly, in case of natural selection of plants, these female moths of maize spotted stem borer, *Chilo partellus* of fly up to a specific height and select leaves to lay eggs. More height of plants does not allow them to be selected for egg laying by maize spotted stem borer, *Chilo partellus*. Plant height is well known character for indicating whether the plant is healthy or not. It was observed that genotypes with heavy infestation, also showed great reduction in height and showed dwarfness. There were a number of genotypes were identified on the basis of heavy reduction of height and were considered as susceptible on. There are several genotypes identified as superior over the check due to having less reduction in height.

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