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Field screening of maize hybrids (*Zea mays* L.) against the maize stem borer and aphid

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Abstract
Maize is a versatile, miracle crop and thus termed as "Queen of Cereals" (Hanegave *et al*., 2011). It is a crop with wide adaptability which occupies important place as food (25%), animal feed (12%) poultry feed (49%), industrial products mainly starch (12%) and one per cent each in brewery and seed (Dass *et al*., 2008). It belongs to tribe Maydeae of the family Poaceae. Like other crops, it also faces several abiotic and biotic stresses. Biotic stresses may include insect's pests, parasites and pathogens, which are known since ancient times. It is attacked by the 140 different species of insect pest which reduce the yield; out of these 10 species cause the major damage (Arabjafari and Jalali, 2007). Foliar damage occurs when the whorl stage plants are attacked. This type of damage is expressed characteristically as lesions, formed by the scraping the epidermis and parenchyma on one side of the leaf, often leaving the other epidermis intact and transparent. In maize, heavy infestation by aphid caused leaves to turn yellow or red following the feeding and may shrivel and die, particularly if the weather is dry. This experiment was carried out in order to identify the reaction of developed maize hybrids to maize stem borer and aphid under field conditions in randomized block design with three replications. Scoring of aphid infested leaves were based on 0-5 scale, but for stem borer scale was 0-9 rating. After leaf scoring PDI was arcsin transformed and analysis was done.

Keywords: Maize stem borer, mean leaf injury score, stem tunneling %, PDI

Introduction
Maize is a versatile, miracle crop and thus termed as "Queen of Cereals" (Hanegave *et al*., 2011) [7]. It is a crop with wide adaptability which occupies important place as food (25%), animal feed (12%) poultry feed (49%), industrial products mainly starch (12%) and one per cent each in brewery and seed (Dass *et al*., 2008) [5]. Like other crops, it also faces several abiotic and biotic stresses. Biotic stresses may include insect's pests, parasites and pathogens, which are known since ancient times. It is attacked by the 140 different species of insect pest which reduce the yield; out of these 10 species cause the major damage. In maize, heavy infestation by aphid caused leaves to turn yellow or red following the feeding and may shrivel and die, particularly if the weather is dry. According to Forbes (1905), there is some evidence that the insect may at times prevent fertilization of the kernel by sucking the sap from the silk or pistillate flower and killing it before it has performed its function. McColloch, (1921) [2], reported that pollen production may be non-functional if aphids feed on tassel. Honeydew produced may result into gummed tassel, which prevent the pollen shedding occasionally. This crop is susceptible to *Chilo partellus* which causes severe damage to maize (Songa *et al*, 2001) [3]. *C. partellus* damage maize plants in two primary ways.

Foliar damage occurs when the whorl stage plants are attacked. This type of damage is expressed characteristically as lesions, formed by the scraping the epidermis and parenchyma on one side of the leaf, often leaving the other epidermis intact and transparent. Upon unfolding of leaves lesion are seen as small holes or windows on the leaves. The MSB can cause 20 to 80% plant damage. Sharma and Gautam (2010) found that stem borer controlled field yielded 28% more harvest of grain yield as compared to uncontrolled one. The use of resistant varieties is environmentally safe, economically feasible and socially acceptable approach of pest management. Resistant materials can be used in breeding programs in host plant resistance studies or directly in variety testing prior to recommendation or release. So, keeping in mind the above points this study was carried out in order to identify resistance genotypes against MSB and maize aphids under field conditions.

Materials and Methods

The material for study was developed by crossing the productive lines with three different testers. The experiment was conducted during kharif 2019 at the Research farm of Birsa Agricultural University, Ranchi. The experiment was laid out in randomised block design with three replications. The crop was grown by following recommended agronomic practices as per the package of practices. The hybrids thus obtained were evaluated for maize stem borer and maize aphids under field conditions.

The leaf injury rating scale (1-9) was used for evaluating different treatments against damage of maize stem borer.

There are one to nine descriptive visual rating scales which are as follows.

1 = Apparently healthy plant.
2 = Plant showing slightest damage on leaf or few pinholes on 1-2 leaves.
3 = Plant showing more pin holes or shot holes on 3-4 leaves.
4 = Plants showing injury (pin holes, shot holes, slits) in about one-third of total number of leaves and mid-rib tunneling on 1-2 leaves, if any.
5 = Plants showing 50% of leaf damage (pin-holes, shot-holes, slits, streaks) and mid-rib damage, if any.
6 = Plants showing varied types of leaf injury in about two-third of the total number of leaves.
7 = Plants with every type of leaf injury and almost all the leaves damaged.
8 = The entire plant showing maximum leaf injury and likely to form dead-heart (such plants usually show stunted growth).
9 = Dead-heart.

The extent and intensity of pest infestation for each genotype were determined by using following formulae.

Per cent infestation = {(No. of infested plants/plot$^{-1)}$/Total number of plants/plot $^{-1}$} x100

Per cent stem tunneling = (Average length of tunnel/Average plant height) x100

For screening of aphids population 0-5 scale rating was used where 0 to 2 was scored as resistant (R), 2.1- 3.0 was rated as moderately resistant (MR), 3.1-5.0 as moderately susceptible (MS) and >5 as susceptible (S).

Results

Incidence of pest's infestation was assessed as the proportion of plants showing symptoms in the field.

Table 1: Stem borer mean plant infestation, stem tunneling and leaf injury

Genotypes	Mean plant infestation (%)	Stem tunneling (%)	Mean leaf injury score
BAU-15-255 XHKI1532	24.5 (29.7)	6.2 (14.4)	1.7
BAU-15-71 XHKI1532	34.9 (36.2)	8.4 (16.9)	2.7
52216 XHKI1532	28.4 (32.2)	5.6 (13.7)	2.0
BAU-15-145 XHKI1532	45.2 (42.2)	8.3 (16.7)	2.5
BAU-15-102 XHKI1532	34.3 (35.9)	9.5 (18.0)	2.5
BAU-15-255 XSUWAN	25.0 (30.0)	7.9 (16.1)	3.5
BAU-15-71 XSUWAN	60.7 (51.2)	8.2 (16.6)	2.0
52216 XSUWAN	37.3 (37.7)	6.9 (15.2)	3.0
BAU-15-145 XSUWAN	44.0 (41.6)	8.0 (16.4)	2.5
BAU-15-102 XSUWAN	53.5 (47.0)	8.1 (16.6)	2.5
BAU-15-255 XHKI 577	51.70 (46.0)	6.1 (14.3)	2.5
BAU-15-71-XHKI 577	43.2(41.1)	5.4 (13.4)	2.0
52216 XHKI 577	27.9 (31.9)	8.5 (16.9)	3.5
BAU-15-145 XHKI 577	41.80 (40.3)	6.6 (14.9)	3.0
BAU-15-102 XHKI 577	53.9 (47.3)	6.3 (14.5)	2.5
SEM(±)	2.78	0.51	-
SED	3.94	0.72	-
CV%	12.27	5.72	-

Figures in the parentheses are arcsine transformations

The hybrids were grouped into four categories based on 0-5 leaf score rating resistant, moderately resistant, moderately susceptible and susceptible presented in table 2.

Table 2: Aphid infested leaf score

Genotypes	Aphid Infested leaf score	Reaction
BAU-15-255 XHKI1532	3.4 (10.6)	Moderately Susceptible
BAU-15-71 XHKI1532	3.4 (10.7)	Moderately Susceptible
52216 XHKI1532	3.0 (10.1)	Moderately Resistant
BAU-15-145 XHKI1532	2.8 (9.8)	Moderately Resistant
BAU-15-102 XHKI1532	2.9 (9.9)	Moderately Resistant
BAU-15-255 XSUWAN	3.6 (11.0)	Moderately Susceptible
BAU-15-71 XSUWAN	3.2 (10.3)	Moderately Susceptible
52216 XSUWAN	3.2 (10.4)	Moderately Susceptible
BAU-15-145 XSUWAN	2.8 (9.7)	Moderately Resistant
BAU-15-102 XSUWAN	3.1 (10.2)	Moderately Susceptible
BAU-15-255 XHKI 577	3.3 (10.5)	Moderately Susceptible
BAU-15-71 XHKI 577	4 (11.5)	Moderately Susceptible
52216 XHKI 577	3.4 (10.6)	Moderately Susceptible
BAU-15-145 XHKI 577	2.9 (9.9)	Moderately Resistant
BAU-15-102 XHKI 577	3.6 (11.1)	Moderately Susceptible

Figures in the parentheses are arcsine transformations

The highest mean plant infestation percentage was recorded in BAU-15-71 XSUWAN (60.7%) and lowest by BAU-15-255 XHKI1532 (24.5%). In case of stem tunneling highest value was observed for BAU-15-102 XHKI1532 (9.5%) and lowest in BAU-15-255 XHKI 577(6.1%). Highest mean leaf injury score (3.5) by stem borer was in 52216 XHKI 577and BAU-15-255 XSUWAN but lowest was observed in BAU-15-255 XHKI1532 (1.7) In case of aphid infestation, five hybrids

were classified as moderately resistant and ten as moderately Susceptible.

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