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# Identification and standardization of maize genotype for the rearing of maize spotted stem borer, *Chilopartellus* (Swinhoe) on its natural host

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**Abstract**
A total number of five genotypes namely CML-165, CML-169, CML-373, CML-186 and HKI-586 were evaluated for their nutritional significance on the basis of feeding and survival of the immature stages of maize spotted stem borer, *Chilopartellus* (Swinhoe). The results under this study revealed that genotype CML-186 followed by HKI-586 were superior in the term of larval, Pupal survival while in the case of feeding, maximum feeding was done in CML-186 which was followed by genotypes HKI-586 and CML-165 and they were found at par in larval feeding. The results showed the significant importance of genotype CML-186 in rearing of maize spotted stem borer on natural host. In all the above tested genotypes, no any genotype was found to be having any significant adverse effect on larval population of test insect.

**Keywords:** *Chilopartellus*, maize, genotypes, rearing, test insect, natural-host

## Introduction

India is an agriculture-based economy, having an average of 140 per cent cropping intensity which includes many groups of crops like cereals, pulses, oilseeds, fodders, vegetables and many others. Maize is the most important and second most widely grown cereal after rice. The origin place of maize or corn is Mexico and firstly domesticated about 10000 years ago by indigenous people of Mexico (Benz, 1999) [3]. It is also believed to have originated in Northern Guatemala. Maize is a species of family Poaceae (tribe Maydeae), botanically known as *Zea mays* and firstly described by Carl Linnaeus (Franklin *et al.* 2013) [6]. Maize is a diploid (2n=20) and cross pollinated (monoecious) crop. The leafy stalk of the plant produces pollen inflorescences and separate ovuliferous inflorescences called ears that yield kernels or seeds, which are fruits of maize. Maize is very rich in nutrients like proteins, minerals & vitamins and termed as queen of cereals due to having highest genetic potential for yield. The plant of maize grows straight up to 2.5 meter, unbranched and having leaves on every node.

Maize is grown for many purposes including grains for food, for vegetable and for animals feed and fodders (Kakar *et al*. 2003) [10]. It is well-known for its role as food, feed and industrial crop in Indian subcontinent and other divisions of the new as well as old world. It is also being used for production of alcohol-based drinks, sweetener agents for food commodities, starch, oil and different proteins. Recently, it was recently has been came into light that sweet corn can also be used in the production of industrial-fuels. A Healthy plant of maize can constitute about 60 to 68 per cent of carbohydrate and 7 to 15 per cent of amino compounds. The edible embryo part which forms about 12 per cent share of the whole grain is the source of different nutrients like protein, fats and sugar. Yellow part of maize is known to be the richest sources of Vitamin-A. Maize has more riboflavin than wheat or rice and is rich in phosphorous and potassium. About 50 per cent of the total Indian produce is consumed as poultry feed and about 8 percent is consumed by the starch industry. The sweet corn has 1.2 to 5.7 per cent of edible type of oils. Maize oil is more commonly being used as a cooking medium and for manufacturing of different hydrogenated oils. Maize serves as a source in the manufacture of different bio-chemicals like starch, syrup, dextrose, oil, gelatin, lactic acid etc. Maize flour can be used as a thickening substance in the preparation of many edibles' items like soups, sauces and sweet custard powder. "Corn syrup is used as an agent in confectionary units. Corn sugar (dextrose) is used in pharmaceutical formulations as sweetening agent". "The gel of corn on account of its moisture retention character is used as a bonding agent for ice-cream cones, as a dry dusting agent for baking products according to Arnon, 1949". Maize in India is used as a source of poultry food (43%), human feed (23%), cattle feed (17%), starch industry (14%), brewery (2%) and seed (1%). It is extremely important for human and animal nutrition as staple food in a number of developed and developing countries. Maize consumption in India has grown up to 19 million tones (Anonymous, 2019) [1].

Maize spotted stem borer, *Chilopartellus* is a major pest of maize and sorghum and mainly infest the crops during the *Kharif* season of the year. The pest belongs to Crambidae family of Lepidoptera order and characterized by having four metamorphic stages during its life cycle *i.e., egg*, larva, pupa and adults. The pest mainly attacks the crop during *Kharif* as it requires hot and humid climate to develop into adults and in winters mostly, they hibernate inside the stems of their hosts in larval stages. The pest mostly attacks on the stem portion of the crops as the name reveals, neonate larvae use to make pinholes on the whorl leaves that later becomes windows while larvae use to transport themselves inside the stem. The larvae feeds on the inner content of stem and develop inside the stem. After approx. five moults, the larvae turn into the pupae inside the stem. Before take the pupation, larvae use to make an exit holes to make surety of a passage for their exit after turning into the adult (Weatherwax, 1955) [16]. Rearing of insects is a prime work of testing resistance in different crops including maize, jawar, rice etc. for the rearing of these insects mostly artificial or natural host have been used. In most of artificial diets, the larval mortality is an important problem therefore the study has been undertaken to minimize the loss of larvae at the time of shifting them from natural host to artificial host and from artificial host to natural hosts before transferring them to the field.

**Materials and Methods**

The present study has been undertaken RBD with a total number of five promising genotypes namely CML-165, CML-169, CML-373, CML-186 and HKI-586 in three replications. A total number of 30 plants of each genotype have been grown at Apiary of Dr. Rajendra Prasad Central Agricultural University, Bihar during the Kharif of 2017 and 2019. All replications were randomized as per RBD and with the help of Random Table.

The total numbers of 10 plants were grown in each genotype. In another plot, a total number of 20 plants of each genotype were grown approx. 30 days earlier from main trial of standardization, for this plot no randomization and replication has been followed.

The larvae were collected from Research farm of Tirhut College of Agriculture, Dholi and place in 2 feet sets of stems and placed in rearing cage on daily observation. The humidity was maintained with the help of wet cloths. For this healthy set of 2 feet has been collected from plot two and used for rearing of field collected larvae. A total number of three larvae have been released per sets and the sets were changed at every two to three days upto the pupation. After pupation, pupae were placed in moth emerging cage for emergence of moths. All the newly emerged moths were placed in another cage designed for mating and egg laying.

A total number of 20 plants have been selected and eggs were placed in whorl of plants for hatching and emerging of neonates. After emergence, these larvae were used to invest a total number of 10 randomly selected plants from each replication of each genotypes at the rate of 15 larvae per plant and the following data have been taken at different crop stages:

Leaf injury score has been taken after 20 days of artificial infestation with help of standard formula given by Guthrie *et al*. 1960 [7] and the standard procedure of rankings is given in Table.1 below.

Larval, Pupal and Pupal Cases intensity has been recorded at 20 days after infestation by cutting and splitting 10 previously selected and infested plants from each replication of each genotypes and the population has been counted visually and expressed as intensity of larvae/pupae/pupal cases per plant.

**Table 1:** Leaf Injury Score and Symptoms

| Sl. No. | Injury Symptoms | Score |
|---|---|---|
| 1 | Plants showing no. infestation symptoms. | 1 |
| 2 | 1-2 leaves with pinholes. | 2 |
| 3 | 3-4 leaves with holes. | 3 |
| 4 | 1/3 of the leaves showing infestation symptoms. | 4 |
| 5 | 1/2 of the leaves with infestation symptoms. | 5 |
| 6 | 2/3 leaves with infestation symptoms and the holes becoming window. | 6 |
| 7 | Leaves with long window and plant growth are stunted. | 7 |
| 8 | Almost all leaves displaying heavy infestation and plant growth is stunted. | 8 |
| 9 | Dead-heart formation observed. | 9 |

Exit holes were counted in all the selected and splitted plants by visual observation and expressed asexit holes per plant.

The excreta in all the splitted plants were collected and the sample was weighed and expressed as excreta in mg per plant. For stem tunneling, all the previously selected and splitted plants were used, the tunnel length was measured with the help of scale and expressed in tunneling in cm per plant.

**Results and Discussion**

The results presented in Table 2. Showed different parameters of significance of hosts.

The Table 2 contain larval intensity per plant which was ranged from 3.00 to 4.50 larvae per plant in which maximum larvae were recorded in CML-186 with 4.50 larvae per plant followed by HKI-586 with 4.00 and CML-165; CML-373 with 3.50 larvae per plant while the minimum intensity of larvae were recorded in CML-169 with 3.00 larvae per plant. Hosts having maximum number of larval survivors were the best performers among all the tested hosts and gave better results in supporting the larval population (Kumar, 1992; Bhoi *et al*. 2019; Rao and Panwar, 2002) [11, 4, 13]. Similarly, maximum pupae were recorded in CML-186; CML-165 with 4.00 pupae per plant followed by HKI-586; CML-373 with 3.50 pupae per plant while the minimum intensity of pupae were recorded in CML-169 with 3.00 pupae per plant. In case of pupal cases, maximum pupal cases were found in CML-373 with 2.50 pupal cases per plant followed by CML-165; CML-186 with 2.00 pupal cases per plant while lowest count of pupal case was observed in case of CML-169 with 1.00 pupal case per plant. The feeding significance or preference was estimated through the estimation of excreta found inside the stem of plants.

The Table 2 containing excreta of maize spotted stem borer which was ranged from 520 mg to 1140 mg, showing different levels of feeding. The maximum excreta were recorded in case of CML-186 with 1140 mg per plant followed by CML-165; HKI-586 with 740 mg and CML-169 with 620 mg of excreta per plant while minimum excreta were recorded in CML-373 with 520 mg of excreta per plant. Immature stages and indices were well known fact of defining a better host and nutritional value of plant (Kabre and Ghorpade, 1999 and Samal *et al*. 2018; Sahoo *et al*. 2021) [9, 15, 14, 5].

**Table 2:** Significance of Different Genotypes in Rearing of Maize Spotted Stem Borer, *Chilopartellus*

| S. No. | Name of Genotypes (Hosts) | Larval Intensity | Pupal Intensity | Intensity of Pupal Cases | Intensity of Excreta (mg) | Leaf Injury Score | Stem Tunneling Intensity | Intensity of Exit Holes |
|---|---|---|---|---|---|---|---|---|
| 1. | CML-165 | 3.50 | 4.00 | 2.00 | 740 | 5.50 | 6.35 | 4.00 |
| 2. | CML-169 | 3.00 | 3.00 | 1.00 | 620 | 4.00 | 5.59 | 3.00 |
| 3. | CML-373 | 3.50 | 3.50 | 2.50 | 520 | 5.00 | 7.00 | 4.00 |
| 4. | CML-186 | 4.50 | 4.00 | 2.00 | 1140 | 6.50 | 9.25 | 5.00 |
| 5. | HKI-586 | 4.00 | 3.50 | 1.50 | 740 | 5.00 | 6.50 | 4.00 |
| SE(m)± | | 0.37 | 0.33 | 0.36 | 1.49 | 0.41 | 0.43 | 0.31 |
| CD (0.05) | | 1.05 | 0.95 | 0.97 | 4.37 | 1.17 | 1.20 | 0.87 |

The Table 2. Also contains different infestation symptoms to validate different levels of susceptibility of different hosts, it contains leaf injury scores, stem tunneling and intensity of exit holes. The leaf injury score in different hosts ranged from 4.00 to 6.50 in which maximum leaf injury score was recorded in CML-186 with 6.50 followed by CML-165 with 5.50 and CML-373 with 5.00 leaf injury score. Minimum leaf injury score was noted in CML-169 with 4.00 leaf injury score.

In the case of stem tunneling, maximum tunnel length was recorded in CML-186 with 9.25 cm followed by CML-373 with 7.00 and HKI-586 with 6.50 cm of tunnel length while minimum tunneling was found in case of CML-169 with 5.59 cm of tunnel length. The Table 2 also contain Exit holes per plant which was ranged from 4.00 to 6.00 in which maximum exit holes were observed in case of CML-186; CML-165 with 6.00 followed by CML-373 and HKI-586 with 5.00 exit holes per plant while host CML-169 showed minimum number of exit holes. Hosts with higher levels of susceptibility leads in development of more intensity of different parameters of host suitability and support more larval population. It was observed that hosts having maximum intensity of infestation, showed maximum support to the population with better performance in rearing (Ram *et al.*2018; Jalali and Singh, 2002; Dash *et al.* 2021) [12, 18, 5].

## Conclusion

The present experiment has been laid with the aim of finding suitable host for rearing of test insect, maize spotted stem borer, *Chilopartellus* for testing and use in artificial infestation.

It was required to rear insects in artificial diets in order to maintain a greater population while the requirement of transferring them into natural hosts before the artificial infestation directly in the field is due to instability in fields after many generations in lab. In order to make them stable on natural hosts, it was required to transfer them on natural hosts in laboratory before transferring them into the field. For the present experiment, a total number of five promising genotypes were selected to know the best suitable host for maize spotted stem borer, *Chilopartellus*. All the tested genotypes were passed through many parameter tests and evaluation. Among all the tested hosts CML-186 was found best performer and used for further rearing in different experiments of HPR.

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