*Biological Forum – An International Journal* 14(3): 383-389(2022)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

# Screening of Maize Inbred lines for Resistance to Fall armyworm, *Spodoptera frugiperda* (J.E. Smith)

*Sneha A.[1*], Srinivasan T.[2], Murugan M.[3], Ravikesavan R.[4] and Amirtham D.[5]*
*[1]P.G. Scholar, Department of Agricultural Entomology,*
*Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu), India.*
*[2]Assistant Professor, Department of Millets,*
*Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu), India.*
*[3]Professor, Department of Agricultural Entomology,*
*Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu), India.*
*[4]Director, Centre for Plant Breeding and Genetics,*
*Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu), India.*
*[5]Assistant Professor, Department of Biochemistry,*
*Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu), India.*

*(Corresponding author: Sneha A.*)*
*(Received 14 May 2022, Accepted 06 July, 2022)*
*(Published by Research Trend, Website: www.researchtrend.net)*

**ABSTRACT: Field screening of fifty maize inbreds against the fall armyworm was carried out during *rabi*, 2021-2022. On the basis of leaf damage rating and kernel damage rating of maize BOX.NO 72173-2-1-1 recorded the minimum leaf damage (2.1), while BOX.NO 426-3 recorded the maximum leaf damage (6.6). With regard to kernel damage BOX.NO.1076-5-2-2 recorded the minimum kernel damage (1.5), while BOX.NO 1076-5-4-1, 9119-1-2-1 and BOX.NO 426-3 recorded maximum kernel damage (5.8). Among 13 maize inbreds that were found to be less susceptible with a leaf injury rating less than 4.0 the leaf damage rating showed a non-significant correlation with total number of leaves/plant (r = -0.441), while significant correlation was recorded with respect to leaf area (r = +0.644). A highly significant negative correlation was obtained with leaf trichome density (r = -0.831) at 45 DAS. The kernel damage rating showed positive correlation with the cob length (r= +0.571) and the height of the cob (r= +0.895).**

**Keywords:** Host plant resistance, Maize, Fall armyworm,*Spodoptera frugiperda*, Leaf damage, Kernel damage.

## INTRODUCTION

Maize (*Zea mays* L.) is referred to as the "Queen of cereals" and in many parts of the world maize is being used as a staple food. In India, maize is the third most important food crop after rice and wheat. It is cultivated in 90.27 lakh ha with the productivity of 3070 kg/ha (INDIASTAT, 2019). Maize is cultivated throughout the year in all states of the country for various purposes including grain, fodder, green cobs, sweet corn, baby corn, pop corn, etc. Of the total maize produced in India, approximately 47 per cent is used as poultry feed, followed by 13 per cent as livestock feed and food purpose each, 12 per cent for industrial purposes, 14 per cent in starch industry, 7 per cent as processed food and 6 per cent for export and other purposes (IIMR, 2016-19). In Tamil Nadu, it is cultivated in an area of 3.24 lakh hectare with 25.91 lakh tonnes of production during 2017-18 (INDIASTAT, 2020). About 250 insect species are associated with maize in field and storage conditions (Mathur, 1992) and with the recent introduction of the invasive fall armyworm *Spodoptera frugiperda* (Lepidoptera: Noctuidae) there is a growing concern among maize growers of the country (Navin *et al*., 2021).

The fall armyworm is an insect native to tropical and subtropical regions of the Americas (Sparks, 1986; FAO, 2018). The incidence of this pest was first observed in Shivamogga, Karnataka during May, 2018 (Tippannavar *et al*., 2019).Among Indian states, Madhya Pradesh and Karnataka has the highest area under maize (15% each) followed by Maharashtra (10%), Rajasthan (9%), Uttar Pradesh (8%) among others. After Karnataka and Madhya Pradesh, Bihar is the highest maize producer, while Andhra Pradesh is having the highest state productivity. Some districts like Krishna, West Godavari etc. records as high as 12 t/ha productivity (IIMR, 2020). The fall armyworm larvae is a cosmopolitan (Luginbill, 1928), polyphagous pest which can feed on about 80 different plant species including crops such as corn, rice, small millets, sugarcane, alfalfa, soybean, sorghum, cotton and vegetable crops (Wiseman *et al*., 1966; Sparks, 1979; Pitre and Hogg 1983; Pogue, 2002; Capinera, 2008). Though this pest feeds on several crops, maize is the most preferred host. It feeds mostly on all the stages of maize, the fall armyworm larva enters into maize field as early as 13 days old crop and starts scrapping on the leaf surface initially. Within a week the 3rd instar stage start to reside inside the whorl causing extensive damage to meristamatic region of the plant (Harrison, 1986; Melo and Silva 1987).

Presently, fall armyworm is kept under check through a predominantly pesticide based approach which may not be feasible in the long run. Host plant resistance seems to be an alternate option which will provide ecologically and environmentally feasible solution for managing fall armyworm. Morphological, nutritional and secondary metabolite variations among the maize hybrids influence the feeding preference of fall armyworm. The morphological plant characters *viz.,* number of leaves/plant, leaf area, leaf trichome density, cob length and cob height above ground and nutritional properties *viz.,* total protein content, amino acids, glucose, total non-structural carbohydrates (TNC), protein to TNC (P/C) ratio and biochemical properties *viz*., peroxidase and lipoxygenase activities are said to confer resistance to fall armyworm by several researchers all over the world (Paul and Deole 2020; Chen *et al*., 2009). Hence the present study was aimed at identifying biophysical and biochemical bases of resistance in maize inbred lines being maintained at TNAU, Coimbatore.

## MATERIALS AND METHODS

**Rearing of *S. frugiperda.*** The life stages of fall armyworm *viz.,* egg masses and larva were collected from the infested maize field at Department of Millets, New area, TNAU, Coimbatore (11.024˚ N latitude and 76.924˚E longitude). The different life stages were reared at fall armyworm laboratory, Department of Agricultural Entomology, TNAU, Coimbatore.

Egg masses collected from corn fields were surface sterilised with a 0.02 percent sodium hypochlorite solution, dried, and stored individually in plastic jars until hatching. The neonates were moved to a larger plastic container with artificial diet after hatching. Larvae were grown in plastic jars on artificial diet from the third instar onwards until they reached the pre-pupal stage. Pupae were collected from the jar after pupation, put on sterilised petridish with cotton and kept on the cage for moth emergence. For egg-laying, these adult moths were released into an oviposition cage with 10 day old potted maize plants. The male to female moth ratio in the oviposition cage was 1:1. Adult moths were fed with a cotton swab soaked in a ten percent honey solution. Using a camel hair brush, the eggs placed on the potted maize plants were retrieved and utilised for culture multiplication.

**Screening of maize inbred lines.** The different maize inbreds were sown in the New area of Department of Millets, TNAU, Coimbatore during *Rabi* 2021-2022 in a Randomized Block Design (RBD) with a row length of 2.5 cm under two replications (Table 3b). The recommended agronomic practices *viz.,* fertilizer application, irrigation and weeding were followed scrupulously as per the crop production guide recommendation of TNAU. Artificial infestation was done manually, using a camel hair brush, with 5-10 neonates into the whorl of each plant at 21 days after emergence (Prasanna *et al*., 2022). Fall armyworm infestation was recorded at weekly intervals on ten randomly selected plants from each inbred starting from 7 days after emergence up to 52 days after emergence, by which time tassels would have started emerging. The fall armyworm infestation was recorded following a 1-9 scale with different levels of whorl injury (Table 1) (Davis *et al.,* 1996) besides following a 1-9 scale for kernel damage (Table 2) (Williams *et al*., 2006). After categorizing the maize inbreds as resistant/ susceptible (Table 1 & 2), a total of 13 inbreds which registered lesser score (≤ 4.0) were further selected for observation of various morphological plant characteristics. The details of maize inbreds are furnished in Table 3a.

**Morphological basis of resistance against *Spodoptera frugiperda* in maize.** Different morphological plant parameters *viz.,* number of leaves per plant, plant height (cm), leaf length (cm), leaf width (cm), leaf trichome density (no/cm$^2$), cob height (cm) and length (cm) were recorded from the maize inbreds. Leaf length and leaf width were measured from the 3$^{rd}$ leaf from the top with the help of a measuring tape. Leaf trichome density was counted under a Leica microscope from 6$^{th}$ leaf on an area of one cm$^2$ dia at three different points of a leaf, selected randomly and the mean trichome density was arrived and expressed as no/cm$^2$. Cob height above the soil level and cob length was measured with the help of measuring tape up to the node position of cob. All the parameters were recorded from three plants that were randomly selected in a row. The data were subjected to ANOVA and statistically analyzed with IBM SPSS Statistics v22.0.

## RESULT AND DISCUSSION

The data regarding fall armyworm damage recorded from 50 inbreds is furnished in Table 3. On the basis of leaf damage rating and kernel damage rating of maize BOX.NO 72173-2-1-1 recorded the minimum leaf damage (2.1), while BOX.NO 426-3 recorded the maximum leaf damage (6.6). With regard to kernel damage BOX.NO.1076-5-2-2 recorded the minimum kernel damage (1.5) while, BOX.NO 1076-5-4-1, 9119-1-2-1 and BOX.NO 426-3 recorded maximum kernel damage (5.8).

**Morphological characters Vs leaf damage& cob damage by *S. frugiperda.*** Various morphological characters such as number of leaves per plant, leaf trichome density, leaf area (leaflet length and leaflet width) were correlated with leaf damage of maize by fall armyworm on 13 selected inbreds. Similarly the cob length and cob height above ground were also correlated with that of kernel damage of maize by fall armyworm (Table 5).

**Number of leaves/ plant.** The number of leaves in 13 different inbreds varied from 7.4 to 10.4 leaves/ plant (Table 4). The maximum number of leaves was recorded in the UMI 406 (10.4) and BOX.NO. 1048-7 (10.0) which were at par with each other followed by BOX.NO.1253-8 (9.6), while minimum number of leaves was recorded in UMI 1003-2-3 (7.4). Leaf number in relation to fall armyworm can be interpreted in two ways. Higher the number of leaves, higher the surface area for fall armyworm oviposition and hence can have a direct bearing on the fall armyworm infestation (Yadav *et al*., 2021). On the other hand, plants being tolerant to fall armyworm tend to produce more number of leaves as a means of compensation (Ali *et al*., 2018). In the present investigations, number of leaves had a negative but non-significant correlation (r = -0.44) with that of leaf damage rating.

**Leaf area ($cm^2$).** The leaf area is one of the factor that corresponds to higher levels of infestation by fall armyworm. The leaf area in different inbreds varied from 108.2 $cm^2$ to 398.9 $cm^2$. The maximum leaf area (398.9 $cm^2$) was observed in the BOX.NO.1048-7 followed by BOX.NO.1131-5 (335.4 $cm^2$), BOX.NO.1131-1 (315.2$cm^2$) which were at par with each other. Whereas, the minimum leaf area was observed in BOX.NO.72173-2-1-1 (108.2 $cm^2$) (Table 4). The fall armyworm, *Spodoptera frugiperda* had a significant positive correlation between leaf area ($cm^2$) and leaf damage rating. However, it was positive indicating that with increase in leaf area ($cm^2$) there will be increase in infestation level (r = 0.64). This is in accordance with Yadav *et al*. (2021) where more number of broader leaves play a role in increasing the temperature of canopy as well as help in the movement of larva from plant to plant for natural egg laying besides providing more surface area. But according to Afzal *et al*. (2009) the leaf length and width was found to be negatively correlated with infestation by *C. partellus,* which is a stem borer, though.

**Leaf trichomedensity (No/ $cm^2$.** The leaf trichome density of 13 maize genotypes differed significantly. The trichome density in different inbreds ranged between 18.7 to 64.3 no/$cm^2$. The maximum trichome density was observed in BOX.NO.72173-2-1-1 (64.3/$cm^2$) followed by BOX.NO.1076-5-2-2 (46.0/ $cm^2$) and UMI 406 (35.7/$cm^2$), whereas, the minimum trichome density was observed in BOX.NO.1048-7 (14.45/$cm^2$) (Table 4).

The fall armyworm, *Spodoptera frugiperda* incidence had a highly significant negative correlation between trichome density (no/ $cm^2$) at 45 DAS and leaf damage rating (r= -0.83). Density of trichomes plays a crucial role in plant resistance and had an influence against the chewing damage by *S. frugiperda* (Gustavo Moya-Raygoza *et al*., 2016). The trichomes also actas a barrier for feeding by fall armyworm, which could explain why resistant hybrids have lesser leaf damage (Wellso and Hoxie 1982). According to the investigations of Afzal *et al*. (2009) the leaf trichomes may have impeded the ingestion of plant material and may have influenced the digestion and usage of the food by the fall armyworm.

**Cob length (cm).** The length of cob of maize showed significant difference in different genotypes. The cob length in different inbreds varied from 14.9 to 39.8. Higher cob length is one of the factor corresponds to higher level of infestation by fall armyworm. The length of cob (39.8 cm) was observed as maximum in UMI 1153, while the minimum length of cob was observed in UMI 1003-2-3 (14.9 cm), followed by UMI 406 (16.7 cm) and BOX.NO.72173-2-1-1 (17.6 cm) which were at par with each other (Table 4).

There was a significant positive correlation between cob length (cm) and kernel damage rating. Thus, with increase in cob length (cm) there was increase in infestation level (r = 0.57). This is in contradiction to Ali *et al.* (2015) where the cob length showed a significant but negative correlation with that of pest infestation.

**Cob height (cm) above ground level.** The height of cob above ground showed significant difference in different inbreds. The cob height above ground in different inbreds ranged from 58.7 to 120 cm. Cobs formed at a greater height is one of the factor that corresponds to higher level of infestation by fall armyworm. It was found to be maximum in BOX.NO.1048-7 (120 cm), while minimum in BOX.NO.72173-2-1-1 (61.7 cm) followed by UMI 406 (72.7 cm) and UMI 504 (73.0 cm) which were at par with each other (Table 4).

The fall armyworm, *Spodoptera frugiperda* had a significant positive correlation between cob height above ground level (cm) and kernel damage rating. But it was positive indicating that with increase in cob height above (cm) there was increase in infestation level (r= 0.89).Cobs positioned at greater heights from ground level implies that, adult moths will find it easy to oviposit on the cobs. On the other hand, cob positioned at relatively lesser heights will not be clearly visible from above and this could be the reason for the positive correlation. But according to Kulkarni *et al*. (2015) the cob height was negatively correlated with *Chilo partellus* and *Sesamia inferens* infestation and the differences are found to be non- significant.

**Table 1: Leaf damage rating based rating scale (Davis *et al*., 1992).**

| Rating | Explanation/definition of damage | Resistance reaction |
|---|---|---|
| 1 | No visible leaf feeding damage | Highly resistant (HR) |
| 2 | Few pinholes on 1-2 older leaves | Resistant (R) |
| 3 | Several shot-hole injuries on a few leaves (<5 leaves) and small circular hole damage on leaves | |
| 4 | Several shot-hole injuries on a several leaves (6-8 leaves) or small lesions/pin holes, small circular lesions and a few small elongated (rectangular- shaped lesions of up to 1.3 cm in length present on whorl and furl leaves | Partially resistant (PR) |
| 5 | Elongated lesions (>2.5 cm long) on 8-10 leaves, plus a few small- to mid-sized uniform to irregular- shaped holes (basement membrane consumed eaten from the whorl and/or furl leaves | |
| 6 | Several large elongated lesions present on several whorl and furl leaves and /or several large uniform to irregular-shaped holes eaten from the whorl and furl leaves | Susceptible (S) |
| 7 | Many elongated lesions of all sizes present on several whorl and furl leaves plus several large uniform to irregular- shaped holes eaten from the whorl and furl leaves | |
| 8 | Many elongated lesions of all sizes present on most whorl and furl leaves plus many mid-to large sized uniform to irregular- shaped holes eaten from the whorl and furl leaves | Highly Susceptible (HS) |
| 9 | Whorl and furl leaves almost totally destroyed and plant dying as a result of extensive foliar damage | |

*HR= Highly resistant, R = Resistant, PR= Partially resistant, S= Susceptible, HS= Highly susceptible

**Table 2: Ear and kernel damage based rating scale (Williams *et al*., 2006).**

| Rating | Explanation/definition | Resistance reaction |
|---|---|---|
| 1 | No damage to any ears | Highly resistant (HR) |
| 2 | Damage to a few kernels (< 5) or less than 5% damage to an ear | Resistant (R) |
| 3 | Damage to a few kernels (6-15) or less than 10% damage to an ear | |
| 4 | Damage to 16-30 kernels or less than 15% damage to an ear | Partially resistant (PR) |
| 5 | Damage to 31-50 kernels or less than 25% damage to an ear | |
| 6 | Damage to 51-75 kernels or more than 35% but less than 50% damage to an ear | Susceptible (S) |
| 7 | Damage to 76-100 kernels or more than 50% but less than 60% damage to an ear | |
| 8 | Damage to >100 kernels or more than 60% but less than 100% damage to an ear | Highly Susceptible (HS) |
| 9 | Almost 100% damage to an ear | |

*HR= Highly resistant, R = Resistant, PR= Partially resistant, S= Susceptible, HS= Highly susceptible

**Table 3 a: Details of maize inbred lines.**

| Inbred lines | Source |
|---|---|
| UMI 164 , UMI 1098-4 , UMI 96 , UMI 504 , UMI 178, UMI 346-1, UMI 1009-2-2 , UMI 406, UMI 29-2, UMI 142, UMI 692-2, UMI 1131-1, UMI 298-2-2, UMI 1153, UMI 1003-2-3, UMI 1051, UMI 1151-2 and 9119-1-2-1 | TNAU, India |
| BOX.NO 1048-7, BOX.NO 9119-1-1, BOX.NO 1076-5-4-2, BOX.NO 72173-2-1-1, BOX. NO 71810, BOX. NO 1024-5, BOX.NO 1131-5, BOX.NO 1043-7, BOX.NO 1076-5-2-2, BOX.NO 1258-7, BOX.NO 1075-2, BOX.NO 1076-5-4-1, BOX.NO 71806, BOX.NO 9233-1, BOX.NO 1917-2-1-1, BOX.NO 2243-1, BOX.NO 1118.3, BOX.NO 1053.6, BOX.NO 1265-6-2, BOX.NO 1110.8, BOX.NO 1046-7, BOX.NO 1266-7, BOX.NO 1060-5, BOX.NO 426-3 and BOX.NO 1253-8 and BOX.NO 1064-5 | CIMMYT, India |
| HYD.NO 1075-2, HYD.NO 1075-4-1-1, HYD.NO 2007-2-2-15, HYD.NO 1082-2, HYD.NO 1101 and HYD.NO 1075-4-2 | Winter nursey, IIMR, India |

**Table 3b: Damage caused by fall armyworm observed on different maize genotypes and Resistance responses, 2022.**

| Sr. No. | Genotype | Leaf damage rating (1-9 scale) | Resistance reaction | Kernel damage rating (1-9 scale) | Resistance reaction |
|---|---|---|---|---|---|
| 1 | UMI 164 | 4.6 | PR | 3.3 | R |
| 2 | UMI 1098-4 | 4.8 | PR | 3.2 | R |
| 3 | UMI 96 | 5.2 | PR | 4.6 | PR |
| 4 | UMI 504 | 3.6 | R | 2.2 | R |
| 5 | UMI 178 | 4.9 | PR | 3.5 | R |
| 6 | UMI 346-1 | 5.3 | PR | 4.6 | PR |
| 7 | UMI 1009-2-2 | 4.2 | PR | 3.4 | R |
| 8 | UMI 406 | 2.8 | R | 2.0 | R |
| 9 | UMI 29-2 | 3.0 | R | 2.8 | R |
| 10 | UMI 142 | 4.4 | PR | 3.6 | R |
| 11 | UMI 692-2 | 3.7 | R | 2.9 | R |
| 12 | UMI 1131-1 | 3.8 | R | 2.6 | R |
| 13 | UMI 298-2-2 | 3.5 | R | 2.3 | R |
| 14 | UMI 1153 | 3.5 | R | 2.7 | R |
| 15 | UMI 1003-2-3 | 3.8 | R | 2.5 | R |
| 16 | BOX.NO 1048-7 | 3.0 | R | 2.8 | R |
| 17 | UMI 1151-2 | 4.8 | PR | 3.0 | PR |
| 18 | BOX.NO 9119-1-1 | 4.6 | PR | 3.3 | PR |
| 19 | BOX.NO 1076-5-4-2 | 4.9 | PR | 3.9 | PR |
| 20 | BOX.NO 72173-2-1-1 | 2.1 | R | 1.5 | HR |
| 21 | BOX. NO 71810 | 5.3 | PR | 4.7 | PR |
| 22 | BOX. NO 1024-5 | 5.2 | PR | 4.3 | PR |
| 23 | BOX.NO 1131-5 | 4.0 | PR | 3.6 | PR |
| 24 | BOX.NO 1043-7 | 4.2 | PR | 3.8 | PR |
| 25 | BOX.NO 1076-5-2-2 | 2.2 | R | 1.5 | HR |
| 26 | BOX.NO 1258-7 | 5.1 | PR | 4.9 | PR |
| 27 | BOX.NO 1075-2 | 4.2 | PR | 3.8 | PR |
| 28 | BOX.NO 1076-5-4-1 | 7.1 | S | 5.8 | PR |
| 29 | BOX.NO 71806 | 4.4 | PR | 3.5 | R |
| 30 | BOX.NO 9233-1 | 4.1 | PR | 2.9 | R |
| 31 | BOX.NO 1917-2-1-1 | 5.2 | PR | 4.7 | PR |
| 32 | BOX.NO 2243-1 | 6.0 | S | 5.5 | PR |
| 33 | BOX.NO 1118.3 | 4.9 | PR | 3.8 | R |
| 34 | BOX.NO 1053.6 | 5.1 | PR | 4.9 | PR |
| 35 | BOX.NO 1265-6-2 | 5.1 | PR | 4.7 | PR |
| 36 | BOX.NO 1110.8 | 6.1 | S | 5.7 | PR |
| 37 | BOX.NO 1046-7 | 6.5 | S | 5.5 | PR |
| 38 | BOX.NO 1266-7 | 5.0 | PR | 4.6 | PR |

| | | | | | |
|---|---|---|---|---|---|
| 39 | BOX.NO 1060-5 | 4.5 | PR | 3.9 | R |
| 40 | BOX.NO 426-3 | 6.6 | S | 5.8 | PR |
| 41 | BOX.NO 1253-8 | 3.6 | R | 2.4 | R |
| 42 | HYD.NO 1075-2 | 4.6 | PR | 3.8 | R |
| 43 | HYD.NO 1075-4-1-1 | 5.9 | PR | 4.0 | PR |
| 44 | HYD.NO 2007-2-2-15 | 5.6 | PR | 4.4 | PR |
| 45 | HYD.NO 1082-2 | 5.3 | PR | 4.7 | PR |
| 46 | HYD.NO 1101 | 5.3 | PR | 4.4 | PR |
| 47 | HYD.NO 1075-4-2 | 4.1 | PR | 3.6 | R |
| 48 | 9119-1-2-1 | 6.1 | S | 5.8 | PR |
| 49 | UMI 1051 | 4.3 | PR | 4.3 | PR |
| 50 | BOX.NO 1064-5 | 4.3 | PR | 3.6 | R |
| | C.D. at 5% | 0.25 | | 0.16 | |
| | C.V. | 2.74 | | 2.18 | |

Values are mean of two replication
HR= Highly resistant, R = Resistant, PR= Partially resistant, S= Susceptible, HS= Highly susceptible

**Table 4: Leaf and kernel damage rating and various morphological characteristics in selected maize inbreds.**

| | Leaf damage | | | | Kernel damage | | |
|---|---|---|---|---|---|---|---|
| **Inbreds** | **Leaf damage rating** | **No. of leaves/plant** | **Leaf area ($cm^2$)** | **Leaftrichome(No/ $cm^2$)** | **Kernel damage rating** | **Cob length (cm)** | **Cob height (cm)** |
| B. NO. 1253-8 | 3.6 $^{abc}$ | 9.6 $^{c}$ | 225.8 $^{f}$ | 27.3 $^{f}$ | 2.4 $^{c}$ | 28.6 $^{c}$ | 77.7 $^{e}$ |
| UMI 1131-1 | 4.0 $^{a}$ | 9.2 $^{d}$ | 315.2 $^{c}$ | 18.7 $^{i}$ | 2.6 $^{bc}$ | 26.1 $^{de}$ | 84.7 $^{d}$ |
| B.NO.1048-7 | 3.0 $^{a}$ | 10.0 $^{b}$ | 398.9 $^{a}$ | 14.45 $^{j}$ | 5.5 $^{bc}$ | 38.5 $^{a}$ | 120 $^{a}$ |
| UMI 504 | 3.6 $^{bc}$ | 8.8 $^{e}$ | 220.5 $^{fg}$ | 25.0 $^{g}$ | 2.2 $^{a}$ | 24.9 $^{e}$ | 73 $^{f}$ |
| UMI 298-2-2 | 3.5 $^{abc}$ | 8.4 $^{f}$ | 221.6 $^{fg}$ | 30.0 $^{e}$ | 2.3 $^{b}$ | 26.4 $^{d}$ | 77 $^{e}$ |
| UMI 1003-2-3 | 3.8 $^{abc}$ | 7.4 $^{g}$ | 287.1 $^{d}$ | 19.0 $^{hi}$ | 2.5 $^{c}$ | 14.9 $^{g}$ | 84.3 $^{d}$ |
| B.NO.1076-5-2-2 | 2.2 $^{abc}$ | 9.4 $^{cd}$ | 150.6 $^{g}$ | 46.0 $^{h}$ | 1.5 $^{c}$ | 29.8 $^{c}$ | 58.7 $^{g}$ |
| UMI 692-2 | 3.7 $^{ab}$ | 9.4 $^{cd}$ | 256.8 $^{e}$ | 20.3 $^{d}$ | 2.9 $^{c}$ | 28.9 $^{c}$ | 110 $^{b}$ |
| UMI 29-2 | 3.0 $^{a}$ | 9.4 $^{cd}$ | 210.8 $^{g}$ | 32.3 $^{c}$ | 2.8 $^{bc}$ | 31.9 $^{b}$ | 94.3 $^{c}$ |
| UMI 406 | 2.8 $^{d}$ | 10.4 $^{a}$ | 180.5 $^{h}$ | 35.7 $^{d}$ | 2.0 $^{bc}$ | 16.7 $^{f}$ | 72.7 $^{f}$ |
| UMI 1153 | 3.5 $^{cd}$ | 8.6 $^{ef}$ | 221.7 $^{fg}$ | 31.0 $^{c}$ | 2.7 $^{c}$ | 39.8 $^{a}$ | 87.3 $^{d}$ |
| B.NO.72173-2-1-1 | 2.1 $^{a}$ | 9.2 $^{h}$ | 108.2 $^{j}$ | 64.3 $^{a}$ | 1.5 $^{bc}$ | 17.6 $^{f}$ | 61.7 $^{g}$ |
| B.NO.1131-5 | 4 $^{bc}$ | 8.8 $^{h}$ | 335.4 $^{b}$ | 18.45 $^{de}$ | 3.6 $^{bc}$ | 28.5 $^{c}$ | 111 $^{b}$ |
| C.D. at 5% | 0.69 | 0.35 | 45.45 | 1.40 | 0.13 | 1.37 | 3.74 |
| C.V. | 9.41 | 2.27 | 13.13 | 2.80 | 2.93 | 2.97 | 2.57 |

*All values are mean of three replication
Within the column mean sharing similar alphabets are statistically not significant by Least significant difference (LSD) at P = 0.05 level

**Table 5: Correlation coefficient and regression models between infestation (%) of *Spodoptera frugiperda* (J.E. Smith) and various morphological plant characters in maize crop during 2022.**

| Damage rating | Plant characters | r- value | $R^2$ | Regression equation |
|---|---|---|---|---|
| Leaf damage | No.ofleaves/plant | -0.44 $^{ns}$ | 0.1943 | y = +10.869-0.5303x |
| | Leaf area ($cm^2$) | 0.64 * | 0.4149 | y = +88.72-18.011x |
| | leaf trichome density (No/$cm^2$) | -0.83 ** | 0.6919 | y = - 23.347 + 80.3x |
| Kernel damage | Cob length (cm) | 0.57 * | 0.3261 | y = +15.965+ 4.2045x |
| | Cob height above ground (cm) | 0.89 ** | 0.8013 | y = +41.868+ 16.467x |

ns- non significant, *significant at 5%, **significant at 1%

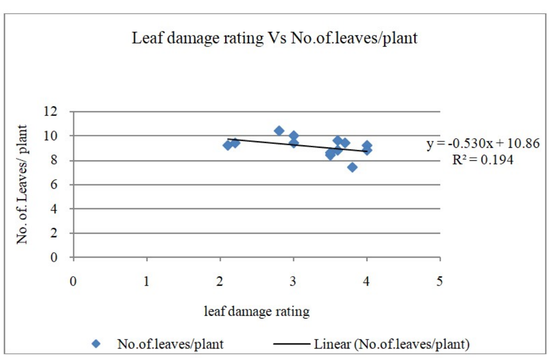


**Fig. 1.** Leaf damage rating Vs No. of. Leaves per plant.

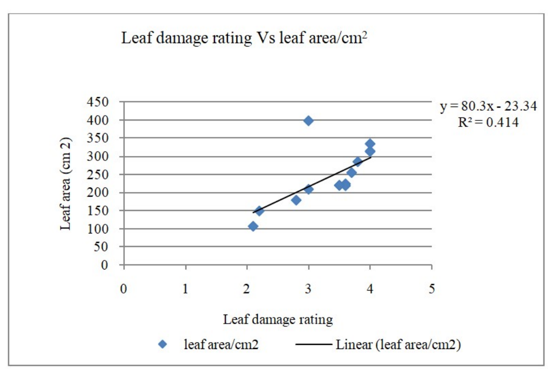


**Fig. 2.** Leaf damage rating Vs Leaf area.

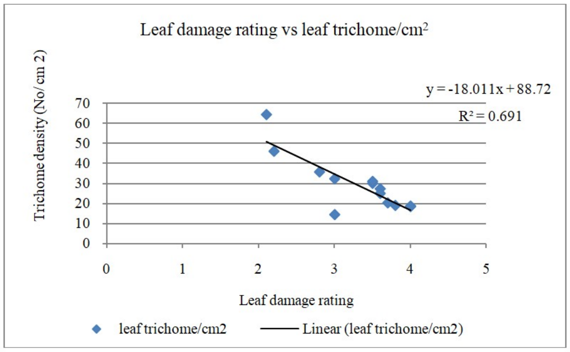


**Fig. 3.** Leaf damage rating Vs Trichome density.

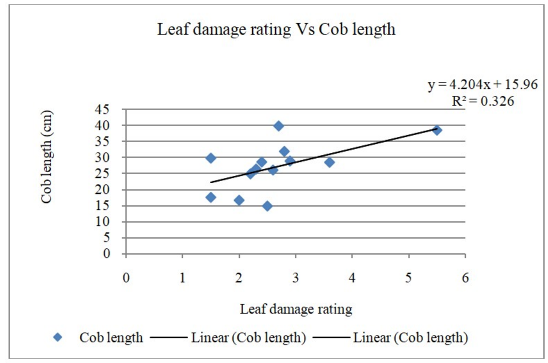


**Fig. 4.** Leaf damage rating Vs Cob length.

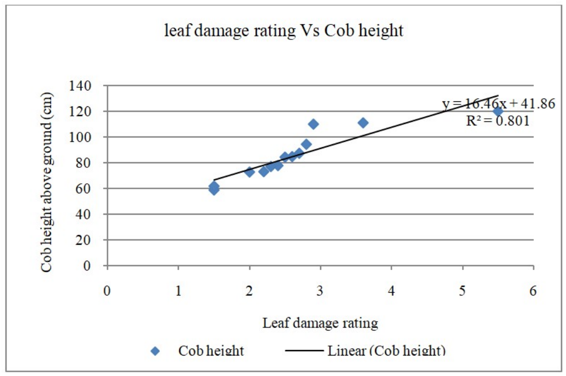


**Fig. 5.** Leaf damage rating Vs Cob height above ground.

## CONCLUSION

Screening of fifty maize inbreds against maize fall armyworm was done under artificial infestation by releasing neonate larvae into the whorl of each plant. On the basis of leaf damage and kernel damage rating BOX.NO 72173-2-1-1 recorded minimum leaf damage (2.1) while, the BOX.NO 426-3 recorded maximum leaf damage (6.6). With regard to kernel damage BOX.NO.1076-5-2-2 recorded minimum kernel damage (1.5) while, BOX.NO 1076-5-4-1, 9119-1-2-1 and BOX.NO 426-3 recorded maximum kernel damage (5.8).

Among 13 maize inbreds that were found to be less susceptible with a leaf injury rating less than 4.0, the leaf damage rating showed non-significant negative correlation with total number of leaves/plant (r = -0.441), while, significant positive correlation (r = +0.644) was recorded with the leaf area ($cm^2$) A highly significant but negative correlation was obtained with trichome density (r =-0.831). The kernel damage rating showed significant positive correlation with that of cob length (cm) (r=0.571) and the cob height above ground (cm) (r=0.895). Thus, it is concluded that the plant morphological characteristics plays an important role in feeding and oviposition preference for fall armyworm and the inbreds with higher trichome density can be used as donors in breeding programmes.

**Acknowledgements.** The authors express sincere gratitude to the Department of Agricultural Entomology, TNAU for providing laboratory facilities to carry out research activities. The authors are also thankful to the Department of Millets, TNAU for providing maize inbreds for research purposes.

**Conflicts of interest**. None.

## REFERENCES

Afzal, M., Nazir, Z., Bashir, M. H., & Khan, B. S. (2009). Analysis of host plant resistance in some genotypes of maize against *Chilo partellus* (Swinhoe) (Pyralidae: Lepidoptera). *Pakistan Journal of Botany*, *41*(1), 421-428.

Ali, S., Masroor, Z., & Masroor, M. D. (2018). First record of the fall armyworm, *Spodoptera frugiperda* (JE Smith, 1797)(Lepidoptera: Noctuidae), an evil attack on paddy in Magadh, Bihar (India). *Journal of Emerging Technologies and Innovative Research*, *5*(2), 546-549.

Capinera, J. L. (Ed.). (2008). *Encyclopedia of entomology*. Springer Science & Business Media.

Chen, Y., Ruberson, J. R., & Olson, D. M. (2008). Nitrogen fertilization rate affects feeding, larval performance, and oviposition preference of the beet armyworm, *Spodoptera exigua*, on *cotton. Entomol. Exp. Appl.* 126:244–255

Davis, F. M., Wiseman, B. R.,Williams,W.P. and Widstrom, N. W. (1996). Insect colony, planting date, and plant growth stage effects on screening maize for leaf-feeding resistance to fall armyworm (Lepidoptera: Noctuidae). *Florida Entomologist*. 79, 317–328.

Harrison, F. P. (1986). Oviposition and subsequent infestations of corn by fall armyworm. *Fla. Entomol.* , *69*, 588-592.

Hartley, R. D., Jones E. C. (1978). Phenolic components and degradability of the cell walls of the brown midrib mutant, bm3, of *Zea mays*. *Journal of the Science of Food and Agriculture*, *29*(9): 777-782.

Kulkarni, S., Mallapur, C. P., & Balikai, R. A. (2015). Influence of plant morphological traits on the incidence of stem borers in different maize hybrids. *Journal of Eco-friendly Agriculture*, *10*(2), 157-162.

Mathur, L. M. L. (1992). Insect pest management and its future in Indian maize programme. In *XIX International Congress of Entomology*.

Melo, M. and Silva, R. F. P. (1987). Influência de trêscultivares de milho no desenvolvimento de *Spodoptera frugiperda* (J. E. Smith, 1797) (Lepidoptera: Noctuidae). *An Soc Entomol Bras*. *16*: 37-49.

Moya-Raygoza, G. (2016). Early development of leaf trichomes is associated with decreased damage in teosinte, compared with maize, by *Spodoptera frugiperda* (Lepidoptera: Noctuidae). *Annals of the Entomological Society of America*, *109*(5): 737-743.

Paul, N., & Deole, S. (2020). Screening of maize genotypes against fall army worm, *Spodoptera frugiperda* (Smith) with reference to plant morphological characters at Raipur (Chhattisgarh). *Journal of Entomology and Zoology Studies*, *8*(4): 580-587

Pitre, H. N., & Hogg, D. B. (1983). Development of the fall armyworm on cotton, soybean and corn (*Spodoptera frugiperda)*. *Journal of the Georgia Entomological Society*, *18*(2): 182-187

Pogue, M. G. (2002). *A world revision of the genus Spodoptera Guenée:*(*Lepidoptera: Noctuidae). Philadelphia: American Entomological Society, 43*: 1-202

Prasanna, B. M., Bruce, A., Beyene, Y., Makumbi, D., Gowda, M., Asim, M., & Parimi, S. (2022). Host plant resistance for fall armyworm management in maize: relevance, status and prospects in Africa and Asia. *Theoretical and Applied Genetics*, 1-20.

Sparks, A. N. (1986). Fall armyworm (Lepidoptera: Noctuidae): potential for area-wide management. *Florida Entomologist*, 603-614.

Sparks, A. N. (1979). A review of the biology of the fall armyworm. *Florida entomologist*, 82-87.

Tippannavar, P. S., Talekar, S. C., Mallapur, C. P., Kachapur, R. M., Salakinkop, S. R., & Harlapur, S. I. (2019). An outbreak of fall armyworm in Indian subcontinent: A new invasive pest on maize. *Maydica*, *64*(1), 10.

Wellso, S. G., Hoxie, R. P. (1982). The Influence of Environment on the Expression of Trichomes in Wheat 1.*Crop Science, 22*(4): 879-86.

Williams, W. P., Buckley, P. M., & Daves, C. A. (2006). Identifying resistance in corn to southwestern corn borer (Lepidoptera: Crambidae), fall armyworm (Lepidoptera: Noctuidae), and corn earworm (Lepidoptera: Noctuidae). *Journal of Agricultural and Urban Entomology*, *23*(2), 87-95.

Wiseman, B. R., Painter, R. H., & Wassom, C. E. (1966). Detecting corn seedling differences in the greenhouse by visual classification of damage by the fall armyworm. *Journal of Economic Entomology*, *59*(5), 1211-1214.

Yadav, M. K., Lipsa, D., &Sandeep, R. (2021). Evaluation of Host Plant Resistance Traits in Certain Genotypes of Maize (*Zea mays* L.) against Maize Spotted Stem Borer (*Chilo Partellus* Swinhoe, Crambidae). *Int. J. Entomol. Res*., *6*, 64-69.

**How to cite this article:** Sneha A., Srinivasan T., Murugan M., Ravikesavan R. and Amirtham D. (2022). Screening of Maize Inbred lines for Resistance to Fall armyworm, *Spodoptera frugiperda* (J.E. Smith). *Biological Forum – An International Journal*, *14*(3): 383-389.