Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(2): 762-771

Received: 26-01-2019
Accepted: 27-02-2019

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Identification of resistant maize genotypes and their antibiotic effect on larvae of stem borer (*Chilo partellus*) under laboratory conditions

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Abstract
Spotted stem borer, *Chilo partellus* (Swinhoe) is the most important pest of maize in Kashmir and host plant resistance is an important component for controlling this pest under subsistence farming conditions. Therefore, a study was carried out to identify sources of resistance in various locally used genotypes maize for resistance and to determine antibiotic influence (mortality percentage) of identified resistant genotypes on larvae of stem borer in maize under laboratory conditions. Twenty four maize genotypes were screened against maize stem borer (*C. partellus)* and entire screening was based on Leaf Damage Score (LDS), dead heart formation and tunnel length. Among all the genotypes screened CM- 133 and CM-123 were highly resistant, KDM-895A, KDM-381A, KDM-362B and KDM-402 were found resistant. KDM-340A, KDM-361 and KDM-935A were highly susceptible and Basi-local was observed extremely susceptible. Larval mortality was observed highest in genotypes CM-133 and CM-123 as compared to KDM-895A, KDM-381, KDM-362B and KDM-402. However, least larval per cent mortality was observed in highly susceptible check Basi-local. Field screening and Per cent larval mortality in laboratory indicated that there is considerable diversity in maize genotypes for antibiosis component of resistance to *C. partellus*. Genotypes placed in different groups, and showing antibiosis to *C. partellus* can be used in resistance breeding programs to diversify the basis of resistance to this pest.

Keywords: *Chilo partellus*, Maize, field screening, percent larval, mortality

Introduction
Maize (*Zea mays* L) is the world's most widely adapted top ranking food crop followed by wheat and rice. Globally maize is cultivated on an area of 159 million hectare with a production of 819 million tonnes and productivity of 5.2 tonnes per hectare [11]. In India, maize is the third most important cereal crop after rice and wheat cultivated on an area of 8.3 million hectare with a production of 21 million tonnes and average yield of 2.5 tonnes per hectare [3]. In Jammu and Kashmir state maize occupies an area of 0.32 million hectare with a production of 0.55 million tonnes and productivity of 1.75 tonnes per hectare [4]. Productivity of maize in valley under rainfed conditions is 11.5 quintals per hectare against 23 quintals per hectare in Jammu [5]. In J and K 85 per cent of crop is grown in rainfed areas and ranks second most important crop after paddy. Maize being the highest yielding cereal crop in the world is of significant importance for countries like India, where rapidly increasing population already out stripped the available food supplies. The plant is attacked by 140 species of insect pests causing varying degrees of damage however, only about a dozen of them are quite serious causing damage from sowing till storage [25]. The damage may be caused by certain insects attacking roots (rootworms, wireworms, white grub and seed corn maggots), leaves (aphids, armyworm, stem borers, thrips, spider mites and grasshoppers), stalks (stem borers and termites), ear and tassel (stem borers, earworms, adult rootworms and armyworm) and grain during storage (grain weevils, grain borers, Indian meal moth and angoumois grain moth). Insect damage can occur at any stage of maize production and storage. Its severity depends on germplasm used, cultivation practices, level of pest infestation, control strategies used and climate [6]. Maize crop is most vulnerable to maize stem borer *Chilo partellus* (Swinhoe) and cause severe losses [26]. A yield loss of 24-74 per cent has been reported alone by this pest [18, 19, 17]. Lella and Srivastav (2013) reported that larvae of *C. partellus* after hatching feed on soft surface of the leaves and then enter the stem through whorl for feeding on the pith of the stem.

The growth of the plants becomes stunted and resulting in dead hearts when attacked by *C. partellus* at their initial stages. The larvae migrate from other plants and enter the stem through lower nodes by making the holes. Stem borers pupate inside the stem and make exit holes before pupation for the emergence of adults. Sometimes, the larvae inside the stem enter the ears through the shank and damage the ears. The larvae of next generation of stem borer feed on tassels. There are five overlapping generations of *C. partellus* that can be found throughout the year in India. The fifth generation undergoes hibernation during winter from mid-October/November to mid-February/March. The first two or three generations damage the spring maize crop and third to fifth generation damages the summer maize crop, thereby reducing the quality and yield of such an important crop. The nature of damage and behaviour of the pest makes it very difficult to control by conventional insecticides and biological control agents. Once the pest enters the plant tissue, it becomes almost impossible for biological control agents and pesticides to reach the target. Moreover, the indiscriminate use of the pesticides has caused many problems like eradication of natural enemies and polluting the environment along with the development of resistance in the pest. In view of above mentioned constraints there is a need to develop alternative management strategies. Host plant resistance against various pests including insects has remained a reliable source for pest management since the advent of modern agriculture. The use of insect resistant cultivar is an essential component of IPM which offers an economic, stable and ecologically sound approach to minimize the damage caused by the borers. There are many plant characters which are responsible for host plant resistance. The plant structures may influence positively as well as negatively on herbivores and their natural enemies [14, 1]. These characters may be divided into morphological and biochemical basis of resistance of the host plant which significantly exhibit resistance to *C. partellus* in maize and show variable degree of preference against the pest. Morphological characters are most important in host plant resistance to *C. partellus* [22] and are known to contribute a lot towards the host plant resistance [28, 23, 15, 16]. In maize these characters are responsible for suitability of a cultivar for feeding, oviposition and development. Trichome densities and surface waxes are considered to have negative effect on the oviposition and development of *C. partellus* [16]. Similarly, tunnel length, stem thickness, plant height and length of 3rd internode at crop maturity have negative impact on the infestation of pest [2]. Biochemical factors such as phenols and sugars also play an important role in plant defense mechanism to *C. partellus* [10]. In view the above mentioned constraint there is a need to develop alternative management strategies. Therefore, developing resistant maize to stem borer is a viable option to reduce the costs of production and storage. The objectives of this study were to: (1) Identify sources of resistance in various locally used genotypes maize for resistance to and (2) Determine antibioitic influence of plant biochemicals on resistance to stem borer in maize under laboratory conditions.

Materials and Methods

Field experimentation

The experiment was carried out in the experimental field of Dryland (*Karewa*) Agricultural Research Station (DARS), Budgam a constituent of SKUAST-Kashmir, Shalimar situated at an altitude of 1560 meters above mean sea level during 2014. A total of twenty four maize genotypes were screened against maize stem borer (*C. partellus*) under natural infestation condition. The experimental site during maize growing season recorded maximum temperature of 34ºC to minimum of 14ºC with a relative humidity of 40- 45%. The sowing of the experimental material was carried in plots of 3×2 m on 20th May 2014 in Randomized Block Design with three replications of each genotype maintaining row to row and plant to plant distance of 60 and 20 cm, respectively. Other agronomical practices were carried out as per the package of practices recommended by Division of Agronomy, SKUAST-Kashmir, Shalimar. However, no insecticidal treatment was given to the experimental material. Laboratory experiment was conducted during 2015 in the Division of Entomology SKUAST-K, Shalimar.

Field screening

Data on leaf damage was taken on visual ratings score at an interval of 20, 30 and 40 Days After Sowing (DAS) on five infested plants per plot as per scale of 0-9 (Table-1) as recommended by CIMMYT (2011). On the basis of rating score, the accessions were grouped as extremely resistant, highly resistant, resistant, moderately resistant, susceptible, highly susceptible and extremely susceptible.

Table 1: Visual rating scale given by CIMMYT (2011)

S. No.	Visual rating of damage	Numerical score	Resistance reaction
1.	No damage	0	Extremely resistant
2.	Few pin hole or fine hole of injury on 1-2 leaves	1	Highly resistant
3.	Few small holes on few leaves	2	Resistant
4.	Few leaves with several small holes	3	Resistant
5.	Several leaves with holes	4	Moderately resistant
6.	Few leaves with elongated lesions	5	Moderately resistant
7.	Several leaves with elongated lesions	6	Susceptible
8.	About half of leaves with long lesions/tattering	7	Susceptible
9.	Most of leaves with long lesions or severe tattering	8	Highly susceptible
10.	Most leaves with long lesions or lodged or plant dying due to severe damage	9	Extremely susceptible

Laboratory screening

In this experiment chopped leaves of seven identified least susceptible genotypes and a highly susceptible check were placed in glass jar covered with muslin cloth. There were five Replications for each genotype. Ten larvae collected from field of DARS were released in each jar. Data related to per cent mortality were collected three, six and nine days after release of larvae.

Results and Discussion

The results presented in Table-2 and Fig.1 revealed that borer infestation amongst different genotypes varied significantly on the basis of leaf damage score at 20 Days After Sowing (DAS) and ranged from 0.33 to 3.26. None of the genotypes was extremely resistant or immune to the borer damage. Genotypes CM-133 and CM-123 were significantly at par, each recorded minimum leaf damage score of 0.33. Similarly genotypes *viz.,* KDM-381A, KDM-362B, KDM-895A and KDM-402 suffered leaf damage score of 0.60, 0.66, 0.73 and 1.60, respectively. However, KDM-381A, KDM-362B, KDM-895A were statistically at par but KDM-402 significantly differed from other genotypes on the basis of leaf damage score at 20 DAS. Genotypes *viz*., KDM-72, C-6, CM-128, SMC-3, SMH-2 and KDM-914A exhibited the leaf damage score of 2.46, 2.53, 2.53, 2.60, 2.60 and 2.66, respectively, and were significantly at par with each other at 20 DAS. Moreover, Genotypes *viz*., KDM-463, KDM-912A, KDM-322, KDM-916A, C-15, KDM-962A and KDM-340A supported leaf damage score of 2.73, 2.73, 2.80, 2.86, 2.86, 2.93, and 2.93, respectively and were statistically at par with each other. Similarly, genotypes KDM-935A, KDM-1263, KDM-361A and KDM-347 were significantly at par with a leaf damage score of 3.00, 3.00, 3.06 and 3.06, respectively. However Basi-local showed maximum leaf damage score of 3.26 and differed significantly from all other genotypes screened under natural infestation conditions at 20 DAS.

Table 2: Relative susceptibility of different maize genotypes to stem borer *Chilo partellus* (Swinhoe) on the basis of leaf damage score at Dryland (*Karewa*) Agricultural Research Station, Budgam during 2014

S. No.	Genotype	Leaf damage score		
		20 DAS	30 DAS	40 DAS
1.	KDM-914A	2.66^{d}	5.33^{f}	5.80^{f}
2.	CM-133	0.33^{a}	0.60^{a}	0.93^{a}
3.	CM-123	0.33^{a}	0.66^{a}	0.86^{a}
4.	CM-128	2.53^{d}	3.66^{d}	3.93^{d}
5.	C-15	2.86^{e}	5.66^{g}	7.06^{h}
6.	SMC-3	2.60^{d}	4.66^{e}	5.13e
7.	KDM-962A	2.93^{e}	5.26^{f}	6.00^{f}
8.	Basi-local	3.26^{g}	7.26^{i}	8.86^{j}
9.	KDM-72	2.46^{d}	4.73^{e}	5.13^{e}
10.	KDM-340A	2.93^{e}	6.46^{h}	8.06^{i}
11.	C-6	2.53^{d}	4.66^{e}	5.13^{e}
12.	KDM-895A	0.73^{b}	1.26^{b}	1.86^{b}
13.	KDM-347	3.06^{f}	6.66^{h}	8.13^{i}
14.	KDM-381A	0.60^{b}	1.26^{b}	1.86^{b}
15.	KDM-322	2.80^{e}	5.66^{g}	7.06^{h}
16.	KDM-1263	3.00^{f}	5.66^{g}	7.13^{h}
17.	KDM-912A	2.73^{e}	5.46^{f}	5.93^{f}
18.	KDM-361A	3.06^{f}	6.53^{h}	7.93^{i}
19.	KDM-916A	2.86^{e}	5.73^{g}	7.06^{h}
20.	KDM-362B	0.66^{b}	1.33^{b}	1.73^{b}
21.	KDM-402	1.60^{c}	2.33^{c}	2.93^{c}
22.	KDM-463	2.73^{e}	5.26^{f}	6.06^{g}
23.	KDM-935A	3.00^{f}	6.60^{h}	8.06^{i}
24.	SMH-2	2.60^{d}	3.53^{d}	3.93^{d}
	$CD_{(P=0.05)}$	0.20	0.24	0.22

Each figure is a mean of three replications

The value in individual columns superscripted by similar letter(s) do not differ significantly

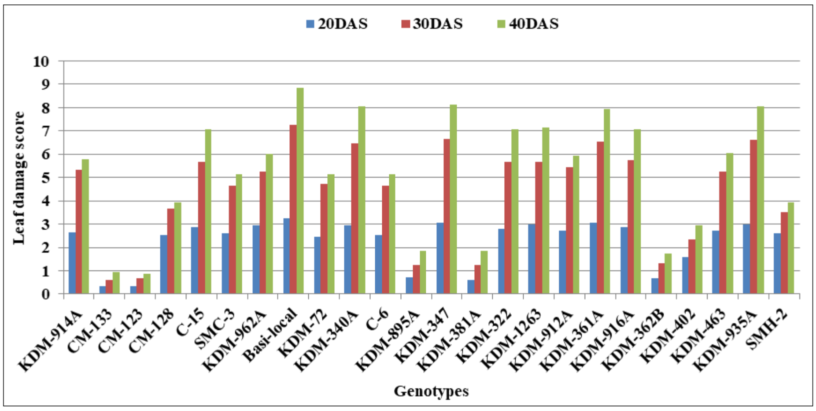

Fig 1: Leaf damage score of different maize genotypes against *Chilopartellus* (Swinhoe)

Almost similar trend was noticed when leaf damage score was recorded at 30 DAS (Table-2 and Fig. 1). Lowest leaf damage score of 0.60 was recorded in CM-133 followed by 0.66 in CM-123 which were significantly at par with each other. Genotypes *viz.,* KDM-895A, KDM-381A and KDM-362B exhibited leaf damage score of 1.26, 1.26 and 1.33, respectively and were significantly at par however, KDM-402 differed significantly from all other genotypes with leaf damage score of 2.33 at 30 DAS. The genotypes *viz.*, SMH-2 and CM-128 different significantly from other genotypes but were at par with each other in recording the leaf damage score of 3.53 and 3.66, respectively. Similarly, genotypes SMC-3, C-6 and KDM-72 were at par with each other by recording the leaf damage score of 4.66, 4.66 and 4.73, respectively but significantly different with other genotypes. Genotypes KDM-962A, KDM-463, KDM-914A, KDM-912A, C-15, KDM-322, KDM-1263 and KDM-916A exhibited the leaf damage score of 5.26, 5.26, 5.33, 5.46, 5.66, 5.66, 5.66 and 5.73, respectively however, KDM-962A, KDM-463 and KDM-914A were statistically at par with each other, whereas, C-15, KDM-322, KDM-1263 and KDM-916A differed significantly with other genotypes but were also at par with each other in leaf damage score at 30 DAS. Genotypes *viz.*, KDM-340A, KDM-361A, KDM-935A and KDM-347 resulted in leaf damage score of 6.46, 6.53, 6.60 and 6.66, respectively, besides being significantly at par with each other. Basi-local differed significantly from all other genotypes which exhibited maximum leaf damage of 7.26 under natural infestation conditions at 30 DAS.

The leaf damage score at 40 DAS ranged from minimum of 0.86 to maximum of 8.86 and all the genotypes suffered more damage as compared to damage at 20 and 30 DAS (Table-2 and Fig.1). The genotypes CM-123 and CM-133 recorded minimum leaf damage score of 0.86 and 0.93, respectively and were statistically at par with each other. Genotypes *viz.*, KDM-362B, KDM-895A and KDM-381A resulted in leaf damage with a score of 1.73, 1.86 and 1.86, respectively and were statistically at par but KDM-402 recorded 2.93 leaf damage score and was significantly different from all genotypes. Genotypes CM-128 and SMH-2 recorded 3.93 each leaf damage score. Genotypes SMC-3, C-6 and KDM-72 exhibited a leaf damage score of 5.13 each and were at par however, and differed statistically from all other genotypes. Genotypes *viz.*, KDM-914A, KDM-912A and KDM-962A suffered leaf damage score of 5.80, 5.93 and 6.00, respectively and were significantly at par but KDM-463 with leaf damage score of 6.06 significantly differed from all other genotypes. Similarly, genotypes *viz.*, C-15, KDM-322, KDM-916A and KDM-1263 were also at par with leaf damage score of 7.06, 7.06, 7.06 and 7.13, respectively. KDM-361A, KDM-340A, KDM-935A and KDM-347 were at par with each other and recorded the leaf damage score 7.93, 8.06, 8.06 and 8.13, respectively. Basi-local suffered the maximum leaf damage with the score of 8.86 and differed significantly from all other genotypes screened under natural infestation conditions at 40 DAS (Table-2 and Fig.1).

On the basis of leaf damage score (Table- 3) all the twenty four genotypes screened fall into nine categories *viz.*, highly resistant with score 1 which included CM-133 and CM-123, whereas KDM-895A, KDM-381A and KDM-362B fall into resistant category with score 2. Similarly, KDM-402 was in resistant category with score 3. Moderately resistant category with score 4 included the genotypes *viz.*, CM-128 and SMH-2. Similarly, SMC-3, KDM-72 and C-6 were registered in moderately resistant category with score 5. However, KDM-914A, KDM-962A, KDM-912A and KDM-463 were grouped in susceptible category with score 6. Similarly, C-15, KDM-322, KDM-1263 and KDM-916A were placed in susceptible category with score 7. Genotypes *viz.*, KDM-340A, KDM-347, KDM-361A and KDM-935A were categorized into highly susceptible category with score 8. However, Basi-local was registered in extremely susceptible category with score of 9 under natural infestation conditions (Plate-1 to 6).

Table 3: Different Levels of resistance of maize genotypes to stem borer *Chilo partellus* (Swinhoe) on the basis of leaf damage score at DARS (Budgam) during 2014

S. No.	Genotypes	Numerical score	Reaction
1.	CM-133/CM-123	1	Highly resistant
2.	KDM-895A/KDM-381A/KDM-362B	2	Resistant
3.	KDM-402	3	Resistant
4.	CM-128/ SMH-2	4	Moderately resistant
5.	SMC-3/ KDM-72/ C-6	5	Moderately resistant
6.	KDM-914A/KDM-962A/ KDM-912A/KDM-463	6	Susceptible
7.	C-15/KDM-322/KDM-1263/KDM-916A	7	Susceptible
8.	KDM-340A/KDM-347/KDM-361A/KDM-935A	8	Highly susceptible
9.	Basi-local	9	Extremely susceptible

Few pin holes of injury on 1-2 leaves (highly resistant with score 1)

Few small holes on few leaves (resistant with score 2)

Plate 1: Maize genotypes highly resistant and resistant to *C. partellus* (Swinhoe)

Few small holes on few leaves (Resistant with score 2)

Few leaves with several small holes (Resistant with score 3)

Several leaves with holes (Moderately resistant with score 4)

Plate 2: Maize genotypes resistant and moderately resistant to *C. partellus* (Swinhoe)

Few leaves with elongated lesions (Moderately resistant with score 5)

Few leaves with elongated lesions (Moderately resistant with score 5)

Several leaves with elongated lesions (Susceptible with score 6)

Plate 3: Maize genotypes moderately resistant and susceptible to *C. partellus* (Swinhoe)

Several leaves with elongated lesions (Susceptible with score 6)

Several leaves with elongated lesions (Susceptible with score 6)

About half of leaves with elongated lesions/tattering (Susceptible with score 7)

Plate 4: Maize genotypes susceptible to *C. partellus*(Swinhoe)

About half of leaves with elongated lesions/ tattering (Susceptible with score 7)

About half of leaves with elongated lesions/ tattering (Susceptible with score 7)

Most of the leaves with long lesions or severe tattering (Highly susceptible with score 8)

Plate 5: Maize genotypes susceptible and highly susceptible to *C. partellus*(Swinhoe)

Most of the leaves with long lesions or severe tattering (Highly susceptible with score 8)

Most of the leaves with long lesions or severe tattering (Highly susceptible with score 8)

Most leaves with long lesions orplant dying due to severe damage (Extremely susceptible with score 9)

Plate 6: Maize genotypes highly susceptible and extremely susceptible to *C. partellus* (Swinhoe)

During the present studies, 24 genotypes screened were categorized as highly resistant, resistant, moderately resistant, susceptible, highly susceptible and extremely susceptible corresponding to leaf damage score of 1, 2-3, 4-5, 6-7, 8 and 9. Earlier same scale had been used to by Ampofo and Saxena (1989) to categorize different maize genotypes into various resistant groups. Similarly, Dass *et al*. (2006) categorise maize genotypes on the basis of leaf injury score but based on 1-9 scale. The present studies (Table-2 and Fig-1) revealed a wide range of variation in susceptibility among 24 genotypes of maize against *C. partellus* however, leaf damage score ranged between 0.33 to 3.26, 0.60 to 7.26 and 0.86 to 8.86 at 20, 30 and 40 DAS, respectively. All the genotypes lacked immunity, but CM-133 and CM-123 was categorized as highly resistant, whereas, Basi-local extremely susceptible to the pest. Initially at 20 DAS undamaged to pin holes on 1 or 2 leaves were found on resistant genotypes which later at 30 DAS changed to small rounded holes followed by small and large rounded holes at 40 DAS. On the other hand, on susceptible genotypes, initial small to large rounded holes increased first to large round and large lesions and then to large elongated lesions at 20, 30 and 40 DAS, respectively. The present results are almost in consonance with the studies of Lella and Srivastav (2013) who recorded leaf damage score of 1 to 2.2, 1.4 to 4.2, 2. 6 to 6.6 at 20, 30 and 60 DAS in different maize genotypes. Similarly Chavan *et al.*, 2007 also identified various resistant maize genotypes on the basis of leaf injury rating on 1- 9 rating scale in different maturity groups and observed a range from 2.4 to 6.4 which also support our findings (Table-2 and Fig-1).

Antibiosis component of resistance to *C. partellus* seven field tested genotypes was studied in terms of larval mortality at 3, 6 and 9 DAR (Table-4 and Fig-2). Data on per cent larval mortality was undertaken as a measure of antibiotic component of resistance to *C. partellus.* Larval mortality of *C. partellus* reared on chopped leaves showed significant differences between genotypes tested. The findings on per cent larval mortality varied from 2 to 50 per cent at 3 DAR. Lowest larval mortality of 2 percent was recorded on highly Susceptible Basi-local whereas 40, 42, 44 and 48 per cent in KDM-402, KDM-362B, KDM-381A, KDM-895 and CM-123, respectively and were statistically at par with each other. Maximum larval motality was observed on genotype CM-133 under laboratory conditions at 3 DAR (Table-4 and Fig-2).

Table 4: Per cent mortality of maize stem borer (*Chilo partellus*) larvae on six least susceptible and one highly susceptible (check) genotypes of maize under laboratory conditions during 2015

S. No.	Genotype	Mortality percentage		
		3 DAR	6 DAR	9 DAR
1.	CM-133	50^{c} (44.98)	80^{c} (63.40)	92^{d} (75.22)
2.	CM-123	48^{b} (43.82)	80^{c} (63.40)	84^{c} (66.66)
3.	KDM-895	44^{b} (41.52)	78^{c} (62.08)	82^{b} (65.03)
4.	KDM-381A	42^{b} (40.36)	76^{c} (60.75)	80^{b} (63.40)
5.	KDM-362B	40^{b} (39.21)	74^{c} (59.42)	80^{b} (63.40)
6.	KDM-402	40^{b} (30.21)	64^{b} (53.15)	76^{b} (60.75)
7.	Basi-local	2^{a} (3.68)	6^{a} (8.99)	14^{a} (19.32)
	$CD_{(P=0.05)}$	4.66	6.78	7.46

Each figure is a mean of five replications
The value in individual columns superscripted by similar letter(s) do not differ significantly

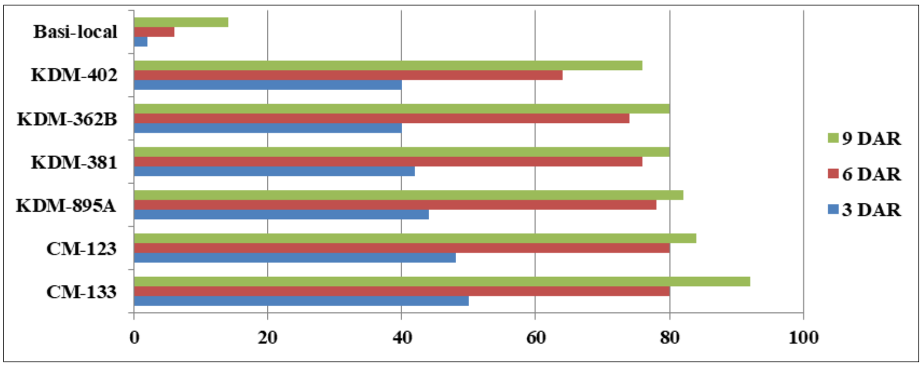

Fig 2: Mortality percentage of maize stem borer (*Chilo partellus*) larvae on least susceptible genotypes of maize

Larval mortality percentage ranged between 6 to 80 at 6 DAR under laboratory conditions (Table-4 and Fig-2).On Basi-local 6 per cent larval mortality was observed whereas 64 per cent larval mortality was recorded on genotype KDM-402. Highest larval mortality of 80 per cent was observed on genotype CM-133 and CM-123 followed by 78, 76 and 74 per cent which was observed on genotypes KDM-895, KDM-381A and KDM-362B, respectively.

At 9 DAR per cent larval mortality ranged from 14- 92 per cent under laboratory conditions (Table-4 and Fig-2). Highest larval mortality of 92 percent was recorded on genotype CM-133 followed by 84 percent on genotype CM-123. Genotypes KDM-895, KDM-381A, KDM-362B and KDM-402 exhibited larval mortality of 82, 80, 80 and 76 per cent, respectively and were statistically at par with each other. Lowest larval mortality of 14 per cent were observed on highly susceptible check Basi-local.

Thus, larval mortality percentage varied from 2 to 50, 6 to 80 and 14 to 92 at 3, 6 and 9 DAR, respectively. Larval mortality was observed highest on genotypes CM-133 and CM-123 as compared to KDM-895A, KDM-381, KDM-362B and KDM-402. However, least larval per cent mortality was observed on highly susceptible check Basi-local at 3, 6, 9 DAR. The antibiotic effects of the resistant genotypes on the development of *C. Partellus* may be because of secondary plant substances in the leaves and/or poor nutritional quality of the food. The antibiotic effects of the resistant genotypes on the development of *C. Partellus* may be because of secondary plant substances in the leaves and/or poor nutritional quality of the food. Low sugar content and high phenol content (Dhillon and Chaudhar, 2015), and greater amounts of amino acids, tannins, neutral detergent fiber (NDF), acid detergent fiber (ADF), and lignins (Khurana and Verma, 1982, 1983), and silica content (Narwal, 1973) are associated with resistance to *C. partellus* in sorghum. War *et al.* (2012) reported that among the secondary metabolites, plant phenols constitute one of the most common and widespread group of defensive compounds, which play a major role in Host Plant Resistance against herbivores, including insects. Phenols act as a defensive mechanism not only against herbivores, but also against microorganisms and competing plants. Qualitative and quantitative alterations in phenols and elevation in activities of oxidative enzyme in response to insect attack is a general phenomenon. Lignin, a phenolic heteropolymer plays a central role in plant defense against insects and pathogens. It increases the leaf toughness that reduces the feeding by herbivores and also decreases the nutritional content of the leaf. Oxidation of phenols catalyzed by polyphenol oxidase (PPO) and peroxidase (POD) is a potential defense mechanism in plants against herbivorous insects. Quinones formed by oxidation of phenols bind covalently to leaf proteins and inhibit the protein digestion in herbivores. In addition, quinones also exhibit direct toxicity to insects. Dhillon and Chaudhary (2015) reported that phenolic acids *viz.*, ferulic acid and p-coumaric acid showed significant negative correlations and further suggested that maize plant defense against *C. partellus* could be due to concentration of particular biochemical constituent and/or interaction with different biochemical compound.

Conclusion

Field screening and Per cent mortality in laborarory indicated that there is considerable diversity in maize genotypes for antibiosis component of resistance to *C. partellus*. Genotypes placed in different groups and showing antibiosis to *C. partellus*, can be used in resistance breeding programs to diversify the basis of resistance to this pest.

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