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Oviposition preference of pink stem borer, *Sesamia inferens* (Walker) in maize germplasm

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Abstract
Oviposition preference of pink stem borer *Sesamia inferens* was studied on twenty maize germplasm. Results of present investigations revealed all the maize germplasm were more or less preferred for egg laying and no germplasm showed a complete antixenosis. The site selected by adult female moths of *S. inferens* for oviposition on all the maize germplasm was inner side of leaf sheath. Significant variations were revealed regarding the total number of eggs laid by *S. inferens* female on different maize germplasm. The total number of eggs laid were ranged from 29.67 to 191.00. The total number of eggs were laid maximum on the germplasm DC-2 (191.00), E-62 (149.67) and HKI-193-2 (145.00) whereas it was observed minimum on WP-21 (29.67), HKI-193-1 (37.67) and E-63 (40.67). Significantly higher number of eggs were deposited on first leaf sheath followed by second leaf sheath, basal leaf sheath and then third leaf sheath. Least number of eggs were deposited on third leaf sheath. Only four germplasm were preferred for egg laying on third leaf sheath viz., DC-2, JCY-2-7, E-62 and HKI-193-2. Maize germplasm DC-2, HKI-193-2 and E-62 received higher number of eggs on different leaf sheaths in comparison to WP-21, E-63 and HKI-193-1. Thus, the maize germplasm DC-2, HKI-193-2 and E-62 were preferred for egg laying indicating their susceptibility in comparison to least susceptible germplasm WP-21, E-63 and HKI-193-1, as these germplasm were less preferred for oviposition.

Keywords: Maize germplasm, oviposition preference, *Sesamia inferens*

1. Introduction
The pink stem borer *Sesamia inferens* is a major insect pest of maize in India and its damage is severe in maize crop during winter in peninsular India [13]. The yield losses due to pink stem borer rabi maize reported from 25.7 to 78.9% [6]. Management of pink stem borer can be effectively done by using exploring host plant resistance. Thus, resistant maize germplasm expressing high levels of resistance to insect pests need to be developed [5]. Before the larvae could ravage the host plant, the gravid female has to judge the host plant for its suitability for egg laying. Egg laying by female moth is greatly influenced by the presence or absence of physical, biochemical and physiological attributes of the genotype. All these aspects may vary with the host plant age and aid to a female moth in selecting the most appropriate host plant for egg laying [2].
Ovipositional responses of *C. partellus* were observed to give a cue for determining the germplasm susceptibility level in maize [11]. Non-preference for oviposition was reported to be one of the component of host plant resistance in sorghum [3, 16, 17]. Maize germplasm screening by using antibiosis mechanism of host plant resistance is costly and time consuming. Therefore, the present investigation was carried out to screen the different maize germplasm for resistance against pink stem borer *S. inferens* on the basis of oviposition preference.

2. Materials and methods
2.1 Rearing and Mass Multiplication of *Sesamia inferens*
The nucleus culture of pink stem borer, *S. inferens* was collected from the infested field of Indian Institute of Maize Research (IIMR), New Delhi. The field collected nucleus culture of *S. inferens* was maintained in the Entomology Laboratory, IIMR under the controlled environment at a temperature of 27 ± 2ºC and relative humidity, 65 ± 5 %. The field collected larvae reared on fresh-cut stalks of hybrid HQPM1, in 2 L glass jars. The culture was multiplied on an artificial diet [14] for subsequent generations. The moths obtained from the third generation were utilized for studying antixenosis mechanism in terms of oviposition preference of *S. inferens*.

2.2. Experimental procedure

The experiment was conducted in the glasshouse of Indian Institute of Maize Research (IIMR), New Delhi. The oviposition preference of *S. inferens* was studied on the following twenty maize germplasm: BML-6, BML-7, CM-122, CM-500, DC-2, HKI PC-5, HKI-161, HKI-163, HKI-193-1, HKI-193-2, HKI-323, HKI-1011, HKI-1105, HKI-1128, JCY-2-7, V-341, WP-8, WP-21, E-62 and E-63. Four plants were enough to support the full potential of female although at times the female used up to six plants for oviposition [9]. Thus, five plants of each germplasm were grown in the pot of diameter 14 inches. Five days after germination pots containing plants of the selected germplasm were enclosed in screening cage of size 180 cm x 180 cm x 120 cm. With the increase in plant age, egg laying was observed to be increased until 12-16 days and decreased thereafter [8]. Hence, oviposition preference of pink stem borer was studied on 12-day old maize plants. Twenty pairs of moths were released on 12- day old plants inside the screening cage containing 20 pots (five plants of each germplasm in a single pot). Observations were recorded for eggs deposited on different plant parts by a pink stem borer.

2.3 Statistical analysis

Data on oviposition preference parameters were subjected to ANOVA followed by Duncan's Multiple Range Tests (DMRT) using the statistical package SPSS.

3. Results and Discussion

The results of the investigation carried out on the oviposition preference parameters of twenty maize germplasm are presented in Table 1. Results on ovipositional responses of pink stem borer *S. inferens* revealed all the maize germplasm were more or less preferred for egg laying and complete antixenosis was not observed in any germplasm. No germplasm showed complete antixenosis in field conditions while screening maize germplasm for resistance against shoot fly **[10]**. Significant variations were revealed regarding the total number of eggs laid by *S. inferens* female on different maize germplasm. The total number of eggs laid ranged from 29.67 to 191.00. The total number of eggs were laid maximum on the germplasm DC-2 (191.00), E-62 (149.67) and HKI-193-2 (145.00) whereas it was observed minimum on WP-21 (29.67), HKI-193-1 (37.67) and E-63 (40.67). It was reported that 2-3 rows of 15 to 91 eggs per mass with a mean of 58.84±3.60 eggs [1]. A single adult female lays about 92-185 eggs in several egg masses to the upper surface of leaf sheath [7]. Significant differences were observed for eggs laid on basal leaf sheath. Eggs received on basal leaf sheath varied from 8.00 to 29.33. Lowest numbers of eggs were found on HKI-193-1 (8.00), WP-21 (8.00) and E-63 (9.33) while highest numbers of eggs were recorded on DC-2 (29.33), HKI-193-2 (28.00) and E-62 (25.33). Significant differences were revealed for eggs laid on first leaf sheath among the different maize germplasm. Eggs deposited on first leaf sheath ranged in between 17.00-106.67. Least number of eggs were obtained on WP-21 (17.00), HKI-193-1 (17.67) and E-63 (18.67). On the contrary, the highest number of eggs were recorded on DC-2 (106.67), HKI-193-2 (80.33) and E-62 (78.00) in the first leaf sheath. The number of eggs laid on second leaf sheath varied in between 4.67-42.33. Maximum numbers of eggs were laid on DC-2 (42.33), E-62 (37.33) and HKI-193-2 (31.33) whereas minimum numbers of eggs were laid on second leaf sheath in WP-21 (4.67), E-63 (12.67) and HKI-193-1 (12.00).

Very few germplasm were preferred for egg laying on third leaf sheath. The number of eggs laid on third leaf sheath were found very less in comparison to other leaf sheaths. Germplasm preferred for egg laying on third leaf sheath were DC-2, JCY-2-7, E-62 and HKI-193-2. However, the rest of the germplasm were not preferred for oviposition on third leaf sheath. A maximum number of eggs were laid on third leaf sheath in DC-2(12.67) whereas a minimum number of eggs were laid in HKI-193-2(5.33). Adult female moths of *S. inferens* preferred the inner side of leaf sheaths for oviposition among the different plant parts and distributed all the eggs on different leaf sheath randomly in multi-choice test. *Sesamia nonagrioides* preferred the inner side of the leaf sheath in maize plants as a site of oviposition to ensure the safety and survival of the eggs [4]. Adult female moths of *S. inferens* preferred to lay eggs within the leaf sheaths of lower leaves [15].

S. inferens female moths laid eggs on basal, first, second and third leaf sheath. The first leaf was found most preferable for egg laying by *S. inferens* adult female followed by second leaf sheath and then first leaf sheath. However, a third leaf sheath was observed as least preferable. *S. nonagriodes* female moth preferred laying eggs on the middle portion of the maize plant than the upper and the lower portions [4]. Adult female moths of *S. inferens* deposited eggs on the inner side of the first three leaf sheaths, maximum egg were laid in first leaf sheath. Few eggs were observed on upper side of the leaves, near the base of the seedlings and on the soil surface [18]. The maximum egg laying was observed on first leaf sheath followed by second leaf sheath, basal leaf sheath and then third leaf sheath [9, 12]. Maize germplasm DC-2, HKI-193-2 and E-62 received higher number of eggs on different leaf sheaths in comparison to WP-21, E-63 and HKI-193-1(Figure 1).

The highest percentage of eggs were deposited on first leaf sheath followed by a second, basal and then third leaf sheath (Table 2). Although there were no significant differences were observed among the maize germplasm for the percentage of eggs deposited on basal and first leaf sheath, the percentage of eggs deposited on basal and first leaf sheath ranged in between 15.28-27.72 and 45.61-58.33, respectively. The highest percentage of eggs were deposited on V-341(58.33) and lowest percentage of eggs were laid on HKI-1011(45.61) on first leaf sheath. Significant differences were observed among the germplasm for percentage of eggs deposited on second leaf sheath. The percentage of eggs deposited on second leaf sheath was ranged in between 15.22-32.69. The highest percentage of eggs were deposited on HKI-1011(32.69) whereas the lowest percentage of eggs were laid on WP-21(15.22). The first leaf sheath received maximum egg laying followed second leaf sheath and then third leaf sheath [7]. Significantly higher number of eggs (58.57%) were observed in the first leaf sheath followed by second leaf sheath (27.18%). Significantly less number of eggs were observed on basal leaf sheath (14.24%) in HQPM 1 [9]. Results of the present investigation showed that *S. inferens* female moths revealed a differential pattern for oviposition on leaf sheath in maize. A discriminatory approach for selection of an oviposition site is used by the adult female to take advantage of enemy-free space [19].

Table 1: Oviposition preference of *S. inferens* on different maize germplasm

Germplasm	Basal	First	Second	Third	Total eggs/plant
BML6	16.33±3.93$_{abcd}$	42.00±7.81$_{cd}$	19.00±4.58$_{bc}$	0.00±00	77.33±11.78$_{bcde}$
BML7	13.67±3.76$_{abc}$	40.00±8.39$_{bcd}$	17.67±3.76$_{abc}$	0.00±00	71.34±15.90$_{abcd}$
CM122	15.00±3.21$_{abc}$	43.67±9.02$_{cd}$	18.00±2.08$_{abc}$	0.00±00	76.67±13.74$_{bcde}$
CM500	12.33±0.88$_{ab}$	31.33±8.09$_{abc}$	14.00±1.73$_{ab}$	0.00±00	57.67±8.67$_{abc}$
DC2	29.33±3.18$_{e}$	106.67±6.96$_{g}$	42.33±2.03$_{e}$	12.67±2.91$_{c}$	191.00±14.22$_{h}$
HKI PC-5	18.33±4.91$_{abcde}$	46.67±6.36$_{cd}$	22.33±4.91$_{bc}$	0.00±00	87.33±16.18$_{cde}$
HKI-161	18.00±1.53$_{abcde}$	44.33±4.10$_{cd}$	19.33±3.28$_{bc}$	0.00±00	81.67±7.88$_{bcde}$
HKI-163	15.67±2.73$_{abc}$	44.00±8.14$_{cd}$	18.67±6.33$_{abc}$	0.00±00	78.33±17.14$_{bcde}$
HKI-193-1	8.00±2.08$_{a}$	17.67±3.53$_{ab}$	12.00±3.46$_{ab}$	0.00±00	37.67±8.95$_{ab}$
HKI-193-2	28.00±2.31$_{de}$	80.33±3.48$_{f}$	31.33±3.33$_{cde}$	5.33±1.33$_{b}$	145.00±7.77$_{fg}$
HKI-323	13.67±1.76$_{abc}$	38.33±4.10$_{abcd}$	17.00±2.31$_{abc}$	0.00±00	69.00±8.14$_{abcd}$
HKI-1011	18.00±6.08$_{abcde}$	34.00±4.62$_{abc}$	25.67±6.39$_{bcd}$	0.00±00	77.67±15.51$_{bcde}$
HKI-1105	19.00±5.29$_{abcde}$	35.00±6.67$_{abc}$	21.67±5.78$_{bc}$	0.00±00	75.67±17.70$_{1}$
HKI-1128	19.00±5.86$_{abcde}$	46.67±3.18$_{cd}$	23.33±2.60$_{bc}$	0.00±00	89.00±10.69$_{cde}$
JCY-2-7	20.33±2.33$_{abcde}$	58.00±4.16$_{de}$	29.33±4.67$_{cde}$	11.67±2.60$_{bc}$	119.33±5.24$_{efg}$
V-341	21.00±5.13$_{bcde}$	60.67±11.57$_{def}$	24.00±6.43$_{bcd}$	0.00±00	105.67±23.07$_{def}$
WP-8	12.33±4.91$_{ab}$	34.33±11.46$_{abc}$	18.00±4.16$_{abc}$	0.00±00	64.67±20.34$_{abcd}$
WP-21	8.00±2.31$_{a}$	17.00±6.11$_{a}$	4.67±1.76$_{a}$	0.00±00	29.67±10.09$_{a}$
E-62	25.33±1.45$_{cde}$	78.00±5.20$_{ef}$	37.33±5.81$_{de}$	9.00±4.04$_{bc}$	149.67±14.17$_{g}$
E-63	9.33±2.40$_{ab}$	18.67±4.06$_{ab}$	12.67±2.91$_{ab}$	0.00±00	40.67±9.33$_{ab}$
C.D.	10.46	19.57	12.12	3.70	39.09
S.E.(m)	3.65	6.82	4.22	1.29	13.63

Table 2: Percentage of eggs deposited on different leaf sheath in maize germplasm

Germplasm	Leaf sheath			
	Basal	First	Second	Third
BML6	20.78±2.40	54.42±6.54	24.81±4.48	0.00±0.00
BML7	18.62±1.22	56.47±0.89	24.91±0.34	0.00±0.00
CM122	19.44±1.20	56.30±1.82	24.25±2.47	0.00±0.00
CM500	22.51±3.85	52.44±6.65	25.05±3.93	0.00±0.00
DC2	15.28±0.54	55.93±0.89	22.31±1.35	6.48±1.02
HKI PC-5	20.29±1.93	54.50±2.93	25.21±1.00	0.00±0.00
HKI-161	22.15±1.06	54.41±1.66	23.44±2.70	0.00±0.00
HKI-163	20.43±1.13	56.93±1.90	22.64±2.72	0.00±0.00
HKI-193-1	21.26±1.42	47.80±2.20	30.94±1.96	0.00±0.00
HKI-193-2	19.26±0.67	55.47±1.07	21.50±1.16	3.77±1.10
HKI-323	19.76±0.25	55.71±0.73	24.53±0.67	0.00±0.00
HKI-1011	21.70±4.04	45.61±5.07	32.69±3.92	0.00±0.00
HKI-1105	24.56±1.51	47.20±2.12	28.24±0.88	0.00±0.00
HKI-1128	20.27±4.52	53.25±3.55	26.48±2.10	0.00±0.00
JCY-2-7	17.26±2.69	48.68±3.21	24.43±3.28	9.63±1.81
V-341	19.55±0.76	58.33±2.11	22.11±1.43	0.00±0.00
WP-8	17.84±3.42	52.84±2.35	29.32±2.41	0.00±0.00
WP-21	27.72±2.23	57.06±2.54	15.22±0.95	0.00±0.00
E-62	17.30±2.10	52.39±1.47	24.66±1.51	5.65±2.05
E-63	22.76±0.91	46.12±0.73	31.13±0.24	0.00±0.00
C.D.	N/A	N/A	6.646	2.003
S.E.(m)	2.249	3.046	2.317	0.698

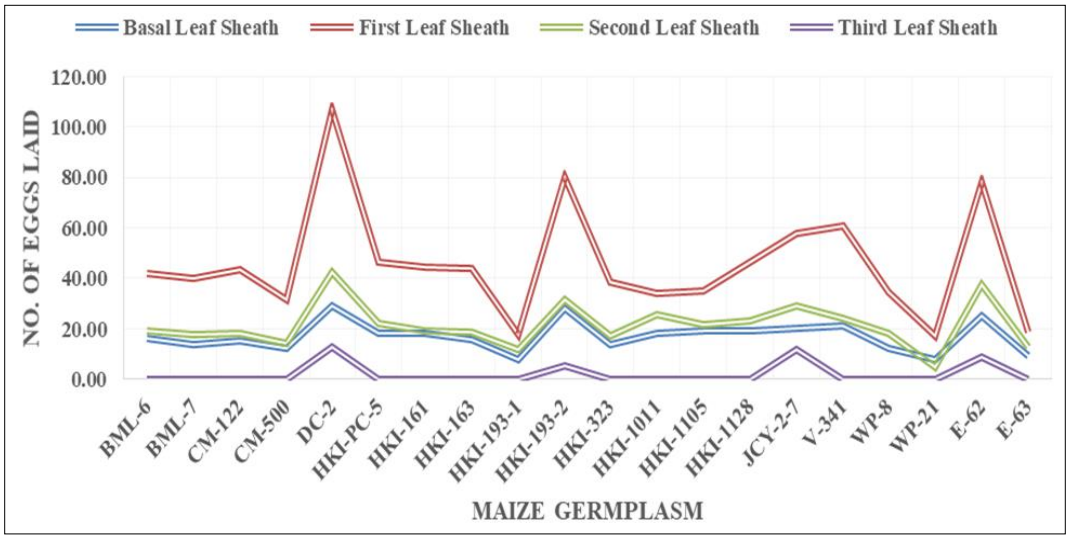

Fig 1: Oviposition preference of *S. inferens* on different leaf sheath in maize

4. Conclusion

All the maize germplasm were more or less preferred for oviposition indicating that complete antixenosis mechanism may be not fully expressed/present in any of selected the maize germplasm. Adult female moths of pink stem borer *S. inferens* preferred the susceptible maize germplasm over the resistant ones to ensure safety and survival of the newly hatched larvae. The ovipositional responses of pink stem borer can be utilized as a criterion to determine the germplasm susceptibility level which can be further utilized in screening the maize germplasm for resistance against pink stem borer *S. inferens*.

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6. References

1. Aggarwal R, Singh J, Shukla KK. Biology of pink stem borer, *Sesamia inferens* Walker on rice crop. Indian Journal of Ecology. 2004; 31:66-67.
2. Agrawal AA, Fishbein M. Phylogenetic escalation and decline of plant defense strategies. Proceedings of the National Academy of Sciences of the United States of America. 2008; 105:10057-10060.
3. Alghali AM. Insect-host plant relationships-The spotted stalk-borer, *Chilo partellus* (Swinhoe) (Lepidoptera: Pyralidae) and its principal host, sorghum. Insect Science Application. 1985; 6:315-22.
4. Ateyim STS, Obeng-Ofori1 D, Botchey MA, Owusu EO. Some Aspects of the biology and behaviour of *Sesamia nonagrioides botanephaga* Tams and Bowden (Lepidoptera: Noctuidae), a major stem borer pest of maize in Southern Ghana. West African Journal of Applied Ecology. 2009; 8:116-26.
5. Bergvinson DJ, Vassal SK, Singh NN, Panwar VPS, Sekhar JC. Advances in conventional breeding for insect resistance in tropical maize. In Proceedings of the 8th Asian Regional Maize workshop, Bangkok, Thailand, August 5-8, 2002, 325-332.
6. Chatterji SM, Young WR, Sharma GC, Sayi IV, Chahai BS, Khare BP *et al*., Estimation of loss in yield of maize due to insect pests with special reference to borers. Indian Journal of Entomology. 1969; 31(2):109-115.
7. Deole S, Dubey VK, Rana DK. Some aspects of the biology of *Sesamia inferens*: A major stem borer pest of maize in Raipur, Chhattisgarh. International Journal of Plant Protection, 2017; 10(2):386-388.
8. Kaur J, Kumar P, Singh J, Suby SB. Plant-age preference for oviposition by *Sesamia inferens* (walker) on maize, *Zea mays* L. Indian Journal of Entomology, 2014; 76(3):245-249.
9. Kaur J, Kumar P, Singh J, Suby SB, Bajya DR. Egg laying pattern of *Sesamia inferens* on maize (*Zea mays*). Indian Journal of Agricultural Sciences. 2015; 85(1):109-13.
10. Pratap AD, Kumar P, Suby SB, Sharma RK, Soumia PS, Guru Pirasanna Pandi G. Screening of maize germplasm for resistance against shoot fly. Indian Journal of Entomology, 80 Online published, IJE 17103/ August, 2018, 2018. Article DOI Number: 10.5958/0974-8172.2018.00260.2.
11. Pratap D. Ovipositional preference as a cue of germplasm susceptibility of maize against *Chilo partellus*. Indian Agricultural Research Institute. M.Sc. thesis, 2012, 58p.
12. Sekhar JC, Kumar P, Rakshit S, Singh KP, Dass S. Differential preference for oviposition by *Sesamia inferens* Walker on maize genotypes. Annals of Plant Protection Sciences. 2009; 17:46-9.
13. Sekhar JC, Bergvinson D, Venkatesh S, Sharma S, Reddy RK MLK, Singh NN. Reaction of exotic maize germplasm to pink borer *Sesamia inferens* Walker. Indian Journal of Entomology. 2004; 66(3):261-263.
14. Siddiqui KH, Sarup P, Panwar VPS, Marwaha KK. Evolution of base-ingredients to formulate artificial diets for the mass rearing of *Chilo partellus* (Swinhoe). Journal of Entomological Research. 1977; 1(2):117-31.
15. Siddiqui KH, Marwaha KK. The vistas of maize Entomology in India. Kalyani Publishers, Ludhiana, Punjab, India, 1993, 184.
16. Singh BU, Rana BS. Influence of varietal resistance on oviposition and larval development of stalk-borer *Chilo partellus* Swinhoe and its relationship to field resistance in sorghum. Insect Science Application. 1984; 5:287-96.

17. Van den Berg J, Van der Westhuizen MC. *Chilo partellus* (Lepidoptera: Pyralidae) moth and larval response to levels of antixenosis and antibiosis in sorghum inbred lines under laboratory conditions. Bulletin Entomological Research. 1997; 87:541-5.
18. Viswajyothi K. Biology of *Sesamia inferens* Walker on maize vis-à-vis impact of selected environmental variables. M.Sc. thesis. Punjab Agricultural University, Ludhiana-141 004, 2016, 29.
19. Williams ILH, Zhu Y, Snodgrass GL, Manrique V. Plant-mediated decisions by an herbivore affect oviposition pattern and subsequent egg parasitism. Arthropod-Plant Interactions. 2012; 6:159-69.