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Oviposition preference of Fall armyworm *Spodoptera frugiperda* (Lepidoptera:Noctuidae) (J.E.Smith) among monocot and dicot plants

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ABSTRACT

Oviposition preference of *Spodoptera frugiperda* was studied on both monocot (rice, maize, sorghum, cumbu, cumbu napier, ragi and sugarcane) and dicot plants (cotton, castor, groundnut, sunflower, red gram, black gram and cowpea) under the laboratory condition. *S. frugiperda* moths highly preferred bottom and middle canopy of maize and cumbu napier for oviposition than other plants in both the free choice and no choice tests. In no choice test, *S. frugiperda* laid eggs on all the monocot and dicot plants except black gram, red gram and cowpea, in free choice test it completely prefered monocot plants. In monocots, pre oviposition period was shortest on cumbu napier (2.52 ± 0.22) and longest on ragi (3.79 ± 0.21), oviposition period was shortest on ragi (5.20 ± 0.19) and longest on maize (6.20 ± 0.36), egg mass per plant was maximum on maize (5.2 ± 0.57) and eggs per egg mass were maximum on sorghum (105 ± 19.89), egg mass per plant and eggs per egg mass were minimum on ragi (2.6 ± 0.54 and 45.8 ± 8.25). In dicots, pre oviposition period was shortest on cotton (4.20 ± 0.20) and longest on groundnut (5.62 ± 0.23), oviposition period was shortest on groundnut (3.33 ± 0.28) and longest on castor (5.04 ± 0.16), minimum egg mass per plant and eggs per egg mass were recorded on groundnut (2.9 ± 0.54 and 4.2 ± 3.56) and egg mass per plant was maximum on cotton (4 ± 0.79), eggs per egg mass were maximum on castor (47.8 ± 3.34).

Key words : *Oviposition preference, Spodoptera frugiperda, Maize, Host plant and Trichome*

Introduction

The fall armyworm *Spodoptera frugiperda* (J.E.Smith) is a crucial pest of maize (*Zea mays* L.) in tropical and subtropical regions and in India it reported in 2018 (Ganiger*et al*., 2018). The effect of this invasive pest on economically important crops is unpredictable. It feeds on various crops such as maize, soybean, sunflower, cotton, chillies, beans, groundnut, tobacco, pulses *etc*., (Patil*et al*., 2015). Fall armyworm reduces productivity of maize by affecting it in all developmental stages (Andrews, 1988), its infestations at mid to late whorl stage of maize prompted yield losses of 15-73 % (Hruska and Gould, 1997). The fall armyworm adults are nocturnal, emerging at dusk to feed, mate and oviposit. The female moths lay egg masses on upper or under side of the leaf and covered with scales. Each egg mass contains 50-150 eggs. Incubation period varies from 4-5 days (Sparks, 1979). The most advantageous temperature for larval development is 28° C, but it decreases for every oviposition and pupation (Ramirez-Garcia *et al*., 1987). Oviposition of insects is a chain of behavioural activities includes searching, landing and contact. Studies on ovipositional behavior need to determine the function of plant kairomones in the

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host finding and orientation behavior of gravid moths. Optimal ovipositional theory (Mother knows best) is the primary ovipositional preference study. Insects use visual and semiochemical stimuli to discover a host plant. Variations in oviposition orientation on different host plants initiated by volatiles or chemical cues.To qualify as a host plant, female moths need to find and accept the plant for oviposition and the larvae should accept the plant as a food source (Saeed *et al.*, 2010; Henniges - Janssen *et al.*, 2014). Because of the polyphagous nature of fall armyworm, in this study we aimed to recognize oviposition choice of fall armyworm moths on various monocot and dicot plants. The most preferred host plant can be utilized as trap crop in IPM programmes.

Materials and Methods

Oviposition preference experiments on different hosts were conducted at Entomology laboratory, Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirapalli. Free choice and No choice tests were conducted with Monocot plants (rice, maize, sorghum, cumbu, cumbu napier, ragi and sugarcane) and Dicot plants (cotton, castor, groundnut, sunflower, red gram, black gram and cowpea) to determine the preferred host for oviposition. Plants selected for experiment were grown in greenhouse condition at 25 ± 2 ºC, 65 ± 5 % RH. Thirty days old potted plants were used for each experiment. The various host plants had been sown on different dates for getting the identical growth level of plants. Commonly used hybrid or varieties without seed treatment was sown in plastic pots (capacity, 20 liters). Egg masses of fall armyworm were collected from maize field and after hatching they were reared until adult emergence under laboratory conditions at 26 ± 1ºC, 60-70% RH with photoperiod of 14:10 h (L:D). Newly emerged adults were provided with ten per cent honey mixture. In no choice test, thirty days old host plants were individually covered with mylar film cages with net covering on top for proper aeration (60 × 60 cm) and one pair of adult was released (Fig 1). Number of egg masses per plants, number of eggs per egg mass and position of eggs on plants was observed. Canopy preference also noted. Similar procedure was followed for all other host plants In the free choice test, all the monocots and dicot plants were kept inside the screened cage (1.5 × 1.5 m) without individual plant covering and ten pairs of fall armyworm adults were released (Fig 2). Completely randomized design was adopted with three replications and ten plants per replication. Highly preferred monocots and dicots were selected from the above two experiments were pooled and oviposition preference was assayed on those most preferred plants. After completion of oviposition period of adults, egg mass count, scales over the egg mass, position and size of egg mass were evaluated with three days interval until the longevity of adults. Abaxial surface of selected monocot and dicot plants leaf was exposed under stereo microscope and density of trichomes were observed for correlate the impact of plant trichome density on oviposition preference of *S. frugiperda*.

Results and Discussion

Both in no choice and free choice tests, oviposition of *S.frugiperda* was maximium on bottom and middle canopy of plants. No eggs were noticed on upper canopy of plants. In all the host plants fall armyworm eggswere laid on lower surface of the leaves but in cumbu napier eggs are laid on upper surface of leaves. Comparable variations were observed on egg masses per plant, number of eggs per egg mass, position of eggs on plants and layer of scales over the egg masses. The variations between mean numbers of egg masses among various plants was significant (Table 1 and 2).

Under free choice condition female moths of fall armyworm preferred the monocot plants (rice, maize, sorghum, cumbu, cumbu napier, ragi and sugarcane) over dicot plants (cotton, castor, groundnut, sunflower, red gram, black gram and cowpea) for egg laying. Fall armyworm fed on grasses such as rice, wheat, maize, sorghum, sugarcane and millets (Ali *et al.*, 1989). Even though fall armyworm is a polyphagous pest, it primarily affects crops of Poaceae family (Montezano *et al.*, 2018). According to Murua *et al.*, (2008) maximum number of egg masses/female was reported on maize (8.80 ± 1.13) in line with this study, in our experiment maximum number of egg masses recorded on maize (5.2 ± 0.25) in both no choice and free choice test. Number of eggs per egg mass was higher of Sorghum (105 ± 8.89) lower on ragi (45.8 ± 8.25). Variation in number of eggs per egg mass laid on different maize

germplasm by *S.inferens* was earlier reported by Pratap divekar *et al*., (2019) as 29.67 to 191.00. Pre oviposition and oviposition period on maize was ranged from (3.01 ± 0.23) and (6.20 ± 0.36 days) which was in line with the findings of Murua *et al*., (2008) who reported the pre oviposition period as 3.50 ± 0.40 and oviposition period as 7.44 ± 0.96 days. Among the monocot plants, cumbu napier recorded the shortest pre oviposition period (2.52 ± 0.22) and ragi recorded longest (3.79 ± 0.21 days). The oviposition period ranged from 5.20 ± 0.19 (Ragi) to 6.20 ± 0.36 (Maize) (Table 1)

Among the dicot plants more number of egg mass and more number of eggs per egg mass were recorded on castor (4 ± 0.35) and (47.8 ± 1.49). According to Miranda, (2006) *S.frugiperda* preferred the lower side of the top leaves of cotton for oviposition and egg masses covered with more layers of abdominal hairs.Up to 6.20 ± 1.01 egg masses/cotton plant was recorded by Arlindo *et al*., (2013) which was agree with our study. We recorded 3.5 ± 0.22 egg masses/cotton plant and eggs also covered with multi layer of abdominal hairs. Pre-oviposition period ranged between 4.20 ± 0.20 on cotton to 5.62 ± 0.23 on groundnut and oviopsition period ranged between 3.33 ± 0.28 on groundnut to 5.04 ± 0.16 on castor (Table 2). In soybean varieties pre oviposition period and oviposition period of *S. exigua* was (3.13 ± 0.24 to 4.42 ± 0.27 days) and (7.05 ± 0.59 to 11.14 ± 0.82 days) (Farahani *et al*., 2011) and that of *S. frugiperda* was (4.23 ± 1.59) and (6.62 ± 1.95) (Murua *et al*., 2008).

For some insects, dense pubescence on plant leaves act as an alluring substrate for oviposition (Renwick and Chew, 1994) likewise in our study, among the dicot plants taken for experiment cotton had dense, multiangulate types of trichomes even though number of eggs per egg mass was maximum on cotton (41.8 ± 4.02) adjacent with castor (47.8 ± 3.34). Multi layer of scale covering was observed on egg mass laid on rice, ragi, cotton and single layer scale noticed on maize, sugarcane and sunflower. In sorghum, cumbu napier and castor egg masses were not covered with abdominal scales and eggs were laid sparsely on cumbu napier. Variations in oviposition behavior of *S.frugiperda* can be associated with the chemical and physical characteristics of different plants. In all the monocot plants (rice, maize, sorghum, cumbu, cumbunapier, ragi and sugarcane) unicellular and conical type of trichomes were observed. In dicots, pluricellular and filiform type was observed on sunflower, unicellular and muliangulate type was observed on cotton, unicellular and papillary type was observed on red gram. Dicotyledons were normally harier than monocots (Jeffree, 1986). Compared with rough surface of leaves, visual stimuli, tactile stimuli and chemical stimuli, trichomes had not that much influence on determined the oviposition site of fall armyworm adults (Bernays *et al*, 1994).

Conclusion

Though all the monocot plants were equally preferred by *S. frugiperda* for oviposition, maize was the most favoured one and ragi was less favoured one. Among the dicot plants cow pea, black gram and red gram were less preferred for oviposition and castor was the most prefered plant for oviposition. The ovipositional choice of fall armyworm can be

Table 1. Oviposition behavior of *Spodoptera frugiperda* on monocot plants

Treatments	Pre oviposition period (days)	Oviposition period (days)	Egg masses/ plant	Eggs/egg mass
Rice	3.43 ± 0.30(1.85)^{b}	5.71 ± 0.31(2.39)^{cd}	3.4 ± 0.54(1.83)^{e}	52.4 ± 5.59(7.23)^{d}
Maize	3.01 ± 0.23(1.72)^{d}	6.20 ± 0.36(2.48)^{a}	5.2 ± 0.57(2.28)^{a}	97.2 ± 9.54(9.85)^{b}
Sorghum	3.15 ± 0.32(1.77)^{c}	5.85 ± 0.20(2.41)^{bc}	4 ± 0.70(1.99)^{c}	105 ± 19.89(10.24)^{a}
Cumbu	3.49 ± 0.23(1.86)^{b}	5.54 ± 0.34(2.35)^{e}	3 ± 0.79(1.73)^{f}	50.2 ± 4.41(7.07)^{e}
Cumbunapier	2.52 ± 0.22(1.58)^{e}	5.90 ± 0.31(2.42)^{b}	4.2 ± 0.44(2.04)^{b}	98.8 ± 5.21(9.93)^{b}
Ragi	3.79 ± 0.21(1.94)^{a}	5.20 ± 0.19(2.27)^{f}	2.6 ± 0.54(1.61)^{g}	45.8 ± 8.25(6.76)^{f}
Sugarcane	3.44 ± 0.28(1.85)^{b}	5.68 ± 0.21(2.38)^{de}	3.8 ± 0.44(1.94)^{d}	82.4 ± 5.77(9.07)^{c}
SEd	0.0115**	0.0151**	0.0145**	0.057**
CD(P=0.01)	0.032	0.042	0.041	0.161

Each value is a mean of four replication with standard deviation
Figures within parentheses are square root transformed values

Table 2. Oviposition behavior of *Spodoptera frugiperda* on dicot plants

Treatments	Preoviposition period (days)	Oviposition period (days)	Egg masses/ plant	Eggs/egg mass
Cotton	4.20 ± 0.20(2.04)[d]	4.90 ± 0.19(2.21)[a]	4 ± 0.79(1.99)[a]	41.8 ± 4.02(6.46)[b]
Castor	4.50 ± 0.25(2.12)[c]	5.04 ± 0.16(2.24)[a]	3.5 ± 0.5(1.86)[b]	47.8 ± 3.34(6.90)[a]
Groundnut	5.62 ± 0.23(2.37)[a]	3.33 ± 0.28(1.79)[c]	0.6 ± 0.54 (0.77)d	4.2 ± 3.56(2.04)[d]
Sunflower	4.64 ± 0.23(2.15)[b]	4.63 ± 0.41(2.15)[b]	2.9 ± 0.54 (1.69)c	32 ± 6.67(5.65)[c]
SEd	0.0132**	0.0165**	0.009**	0.055**
CD (P=0.01)	0.04	0.05	0.03	0.16

Each value is a mean of four replication with standard deviation
Figures within parentheses are square root transformed values

Fig 1. No choice study

Fg 2. Free choice study

used to decide its preference level and that plant can be utilized as a trap crop in IPM.

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Conflict of interest

The authors declare there is no conflict of interest.

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