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Studies on host range of fall armyworm, *Spodoptera frugiperda* (J. E. Smith) under laboratory conditions

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Abstract
Studies on host range of fall armyworm, *Spodoptera frugiperda* (J. E. Smith) were undertaken at University of Agricultural Sciences, Dharwad during 2018-19 under laboratory conditions. The result revealed that all the seven tested crops served as hosts for the fall armyworm. The lowest larval duration was observed on sorghum (18.5 days) followed by maize (19.8 days) while, highest larval period was recorded on cabbage (29.40 days). More number of eggs are laid on maize (680 eggs/female) followed by sorghum (650 eggs/female). However, no eggs were laid on cabbage, cotton and groundnut. The maximum larval survivability was observed on maize (48%) followed by wheat (46%) and sorghum (40%) while, lowest survivability was observed on cabbage (20%). Overall studies revealed that maize is the most preferred host followed by wheat and sorghum. Whereas, cabbage, groundnut and cotton are less preferred for growth and development.

Keywords: Fall armyworm, *Spodoptera frugiperda*, sorghum, maize, wheat, cotton

Introduction
The fall armyworm, *S. frugiperda* is a polyphagous insect pest that can feed on plants from more than 20 families but it displays a preference for plants of the family Poaceae (Luginbill, 1928; Anonymous, 2018a) [11, 3]. This pest is found in several countries such as Brazil, Argentina, USA, Africa and Asian countries (Prowell *et al.*, 2004; Clark *et al*., 2007, Abrahams *et al*., 2017) [14, 8, 1] causing economic losses in a variety of crops. Damages are most commonly reported on maize, paddy, sorghum, sugarcane, soybean and cotton (Anonymous, 2018a; Anonymous, 2018b; Anonymous, 2018c) [3-5]. Because of its wide host range, *S. frugiperda* is one of the most harmful pests threatening annual crops in tropical regions (Andrews, 1980; Cruz *et al*., 1999) [2, 9]. This availability of different hosts might even result in the selection of insect populations with new food preferences due to different exposure of these insects to a variety of crops (Barros *et al.*,2010) [7]. Host preference studies of *S. frugiperda* is important for addressing the effects of the nutritional composition of different crops on this pest (Scriber and Slansky, 1981; Barros *et al*., 2010) [16, 7]. However, to the best of our knowledge, this is the first study in India to compare biological characteristics of this pest when fed on different host species grown in different seasons of the year. This is crucial to understand the survival, population increase and infestation of this species throughout the year.

Material and Methods
Host range of fall armyworm
To study the host range of fall army worm, seven different crops representing cereals, pulses, oilseeds and vegetables *viz.*, maize, sorghum, wheat, napier grass, cotton, groundnut and cabbage were selected. For the experiment purpose, the larvae were collected from the culture maintained in the laboratory on maize leaves.

To study the biology of *S. frugiperda* on different host plants, the experiment was conducted under controlled laboratory conditions (25 ± 2 °C, 70 ± 10% RH) using a completely randomised design with eight treatments and three replications. Each replication was performed using 25 individual larvae (a total of 75 larvae per treatment = 3 replications of 25 larvae each). For the treatments, leaves of sorghum, cotton, maize, groundnut, napier grass and wheat were used. These hosts were grown under greenhouse in pots. Each pot was sown at a density of five plants per pot. The trial was initiated when plants had 8 to 10 completely

expanded leaves. Then, on a daily basis, one leaf from the top of the plants was exerted from each plant of all hosts under study. Initially, *S. frugiperda* eggs were isolated in waxed cups with different food sources until hatching. After that, first instar larvae were released in to rearing box containing leaves of different host plants. These insects were maintained in the laboratory for daily assessment of the following biological variables: duration of larval, pre-pupal (Non-feeding stage between the larval and pupal period), pupal period (Days), adult longevity, fecundity and survival (%). Data were analysed by finding the mean and standard deviation (SD) of each biological variable and survivability was computed by using the following formula.

$$\text{Survivabilty (\%)} = \frac{\text{Number of larva entered pupation}}{\text{Total larva released}} \times 100$$

Table 1: List of crops used for host range studies

S. No	Host crops	Scientific name	Family
1	Sorghum	*Sorghum bicolor*	Graminae
2	Maize	*Zea mays* L.	Graminae
3	Cotton	*Gossypium hirsutum*	Malvaceae
4	Groundnut	*Arachis hypogaea* L.	Leguminaceae
5	Napier grass	*Panicum purpureum v panicum typhoides*	Graminae
6	Cabbage *aestivum*	*Brassica olaraceae* Brassicaceae Wheat *Triticum*	Graminae

Results and Discussion

Host range of fall armyworm

The study revealed that all the seven different crops permitted the insect growth and development when freshly emerged larvae of *S. frugiperda* were introduced. Although the pest has been reported on maize and sorghum in India by many authors, the present study was first report on the host range and preference on other crops. However, several previous workers from other countries have already reported nearly 186 host plants of fall armyworm belonging to 42 different families (Fuxa *et al.,* 1989; Augusto *et al.,* 2010; Silvia *et al.,* 2016; Widenfalk *et al.,* 2018) [10, 6, 18, 20].

The larval duration was shortest for the larva which fed on sorghum (18.51 days) followed by maize (19.8 days) and wheat (21 days), while larva fed on cabbage leaves showed maximum larval period of 29.40 days followed by cotton (28.40 days), groundnut (28.40 days) and napier grass (24.50 days). Similarly, the pre pupal duration was 2 days on maize, sorghum and napier grass. On cabbage, groundnut and cotton pre pupal duration was 3 days. Lowest pupal period was recorded on sorghum (8 days) but it did not differ on other host plants. The highest pupal period observed in larva fed on cabbage leaves. Highest longevity of adults recorded was 13 days in female and 4 days in male on sorghum, maize and wheat. The lowest longevity of adults observed in larva fed on cabbage (2.5 days in male and 8 days in female). As high as 680 eggs / female were recorded on maize in contrast to no egg laying on cabbage, cotton and groundnut. The larval survivability in most preferred host like maize and wheat were restricted to 48 per cent and 46 per cent because of prominent cannibalism in the larvae but on less preferred hosts like cabbage and groundnut, the larval survivability was decreased to 20 per cent due to higher rate of cannibalism in larvae (Table 2).

The present findings revealed that cabbage, groundnut and cotton leaves were less preferred hosts for the development of *S. frugiperda*, when compared to the other host plants under study. The larvae that fed on cabbage, groundnut and cotton showed prolonged larval period, pupal period and reduced adult longevity. Similar results were documented by several workers that the larva preferred to feed on cereals compared to other hosts (Nagoshi *et al.,* 2007; Silva *et al.,* 2017) [12, 13]. This might be due to the composition and nutritional adequacy of these plants in relation to hosts from other botanical families (Barros *et al.,* 2010) [7]. The pupal period varied from 12 to 16 days in different crops is mainly due to difference in growing degree days. However, Silva *et al.* (2017) [17] reported as 10 to 11 days pupal period on maize, cotton and wheat could be due to variation in the experimental period and varied agroclimatic conditions. The most preferred host for egg laying was grasses and less preference was observed in dicot plants. However, instead of laying eggs on leaves of cabbage, cotton and groundnut, the moths deposited their egg masses on the screen of the cages, the counts of which was not considered. This behaviour of fall armyworm has previously been reported by Luginbill (1928) [11] and later by Sparks (1979) [19], who noted that large populations of *S. frugiperda* laid their eggs on paper and other objects instead of depositing their eggs on non-preferred host plants.

Conclusion

The fall armyworm, *S. frugiperda* also have the potential to survive on all the seven host crops and the pest completed its life- cycle on all the crops from hatching till adult emergence. However, there was no oviposition on cabbage, groundnut and cotton. Duration of the different insect stages was normal on most of the cereals and grasses, but on other crops including vegetables pest showed prolonged life cycle.

Table 2: Biology of fall armyworm on different crops under laboratory condition

Host	Larval period± SD (Days)	Pre pupal period ± SD (Days)	Pupal period± SD (Days)	Adult longevity ± SD (Days)		Larval survivability (%)	Fecundity (Number / female)
				Male	Female		
Sorghum	18.51 ± 1.19	2.00± 0.00	8.00± 0.00	4.00± 0.00	13.00± 0.00	40.00	650 ± 88.53
Maize	19.80± 1.31	2.00± 0.00	9.00± 0.00	4.00± 0.00	13.00± 0.00	48.00	680 ± 91.52
Cotton	28.40± 0.51	3.00± 0.00	9.00± 0.00	3.00± 0.00	9.00± 0.00	24.00	0.00
Groundnut	28.40± 0.51	3.00± 0.00	9.00± 0.67	3.00± 0.00	9.00± 0.00	20.00	0.00
Napier grass	24.50± 0.52	2.00± 0.00	9.80± 0.42	4.00± 0.00	12.00± 0.00	28.00	250 ± 52.53
Cabbage	29.40± 0.51	3.00± 0.00	12.00± 0.00	2.50± 0.55	8.00± 0.00	20.00	0.00
Wheat	21.00± 1.05	3.00± 0.00	13.00± 0.00	4.50± 1.05	13.00± 0.00	44.00	565 ± 27.78

References

1. Abrahams P, Beale T, Cock M, Corniani N, Day R, Godwin J. Fall armyworm status, impacts and control options in Africa: Preliminary evidence note CABI, UK. http://www.invasivespecies.org. 2017.
2. Andrews KL. The whorlworm, *Spodoptera frugiperda*, in Central America and neigh boring areas. Florida Entomologist. 1980; 63:456-467.
3. Anonymous. CABI: Datasheet *Spodoptera frugiperda* (Fall armyworm), invasive species compendium. https://www.cabi.org, 2018a.
4. Anonymous. EPPO Global Database. https://gd.eppo.int/ EPPO, Paris, France, 2018b.
5. Anonymous. UKPHRR: Assessment of *Spodoptera frugiperda* – likelihood of establishment and host plants relevant in surveys7/7. UK Plant Health Risk Register. https://secure.fera.defra.gov.uk, 2018c
6. Augusto C, Laura MJ, Guillermina MS, Gabriela MM, Silvina P, Santiago M, Eduardo W Gerardo G. Review of the host plants of fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae). Rev. Soc. Entomol. Argent. 2010; 69(3, 4):209-231.
7. Barros E, Torres JB, Ruberson JR, Oliveira MD. Development of *Spodoptera frugiperda* on different hosts and damage to reproductive structures in cotton. Entomologia Experimentalis et Applicata. 2010; 137:237-245.
8. Clark PL, Molina-Ochoa J, Martinelli S, Skoda SR, Isenhour DJ, Lee DJ *et al*. Population variation of *Spodoptera frugiperda* (J. E. Smith) in the Western Hemisphere. J. Insect Sci. 2007; 7:1-10.
9. Cruz I, Figueiredo MLC, Oliveira AC, Vasconcelos CA. Damage of *Spodoptera frugiperda* (Smith) in different maize genotypes cultivated in soil under three levels of aluminium saturation. Inter J. Pest Mgt. 1999; 45:293-296.
10. Fuxa JR. Seasonal occurrence in *Spodoptera frugiperda* larvae on certain host plants in Louisiana. J. Entomol. Sci. 1989; 24:273-285.
11. Luginbill P. The fall armyworm, United States Department of Agriculture. Washington, DC. U.S. Dep. Agric. Tech. Bull. 1928; 34:91.
12. Nagoshi RN, Adamczyk JJ, Meagher J, Gore RL, Jackson R. Using stable isotope analysis to examine fall armyworm (Lepidoptera: Noctuidae) host strains in a cotton habitat. J. Econ Ent. 2007; 100:1569-1576.
13. Nagoshi RN, Meagher RL. Seasonal distribution of fall armyworm (Lepidoptera: Noctuidae) host strains in agricultural and turf grass habitats. Environl Ent. 2004; 33:889.
14. Prowell DP, Michael M, Silvain JF. Multilocus genetic analysis of host use, introgression and speciation in host strains of fall armyworm (Lepidoptera: Noctuidae). Ann. Entomol Soc. America. 2004; 97:1034-1044.
15. Quisenberry SS. Fall armyworm (Lepidoptera: Noctuidae) host strain reproductive compatibility. Florida Entomologist. 1991; 74:194-199.
16. Scriber JM, Slansky JRF. The nutritional ecology of immature insects. Annu Rev. Ent. 1981; 26:183-211.
17. Silva DM, Bueno FA, Andrade K, Stecca CS, Oliveira CS. Biology and nutrition of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) fed on different food sources. Sci. Agric. 2017; 74:18-31.
18. Silvia RC, Marucci SM, Barbosa TA. Bioecology of *Spodoptera frugiperda* in different cover crops. Biosci. J. 2016, 93-97.
19. Sparks AN. A review of the biology of the fall armyworm. Florida Entomologist. 1979; 62:83-87.
20. Widenfalk O, Jakobsson M, Hammarstrom A, Widenfalk L. Trade and production of plants and plant products in Swedan – A knowledge base for pest risk analysis. Technical Report. 2018, pp.40.