J. Farm Sci., 35(1): (154-156) 2022

RESEARCH NOTE

Survival fitness and cannibalism of *Spodoptera frugiperda* in the absence of food under laboratory condition

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(Received: October, 2021 ; Accepted: January, 2022)

Abstract: Studies on cannibalism of *Spodoptera frugiperda* in absence of food revealed that, there was no cannibalism in egg stage and 1st instar larval stage. When the same larval instars were allowed for interaction, there was less cannibalism compared to interaction between the different instars of larvae. A high rate of cannibalism was observed in the absence of food. Within 6 hrs of exposure, 68 per cent of cannibalism was recorded in case of 2nd instar larvae compared to 40 and 24 per cent in 3rd instar and 4th instar larvae, respectively. As high as 46 per cent cannibalism was noticed in 4th instar v/s late instar larval treatments within 6 hrs of interaction. The highest cannibalism was registered in case of 2nd instar larvae followed by 3rd instar and 4th instar larval treatments within 6 hrs of exposure. Because of no food condition, the larvae inevitably fed on other instar larvae to survive.

Key words: Cannibalism, Interaction, *Spodoptera frugiperda*

Maize (*Zea mays* L.) is an important annual cereal crop of the world belonging to family Poaceae. It is considered as a staple foodcrop in many parts of the world. It is a third leading crop of the world after rice and wheat (Sandhu *et al*., 2007). Due to its highest yield potential among the cereals it is known globally as "Queen of cereals". In India, the major maize growing states are Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, Punjab, Haryana, Maharashtra, Andhra Pradesh, Himachal Pradesh, West Bengal, Karnataka, and Jammu and Kashmir, jointly accounting for over 95 per cent of the national maize production (Milind and Isha, 2013).

The fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) is native to the Americas and it is a key pest of maize. The fall armyworm has been reported for the first time in 2016 in Africa, in Nigeria, causing significant damages to maize. This pest has been detected for the first time in the Indian subcontinent in mid-May 2018 in maize fields in Shivamogga and Davanagere districts of of Karnataka (Sharanabasappa *et al*., 2018a) and can complete its life cycle within 30 to 45 days (Sharanabasappa *et al*., 2018b). Being a polyphagous pest, FAW is known to cause major damage to economically important cultivated crops maize, sorghum and also reported on sugarcane (Chormule *et al.*, 2019).

Cannibalism is a frequent behaviour in a wide array of animal taxa, often accounting for substantial mortality that may influence population dynamics and community structure. Cannibalism has been widely documented in larval lepidoptera, although there is considerable variation in the frequency of cannibalistic behaviour in closely related species. In many cases however, the selective advantages associated with cannibalism remain to be elucidated.Cannibalism may confer direct (nutritional) fitness benefits in the form of increased survival, developmental rate and fecundity or it may provide indirect benefits by removing potential competitors and intraspecific predators. In case of *S. frugiperda* also cannibalism behaviour is very prominent and probably the reason for low population densities irrespective of number of eggs laid on individual maize plants. Further, this behaviour might also affect the population of other species appearing simultaneously on the crop. Keeping this in view, the present study was carried out in the laboratory of the Department of Agricultural Entomology, University of Agricultural Sciences, Dharwad, Karnataka during 2020-21, with an objective to assess the intraspecific interaction of *Spodoptera frugiperda* in the absence of food under laboratory condition.

Insect culture

Egg masses of fall armyworm were collected from the field and reared to get nucleus culture. The caterpillars were reared up to adult stage. Further, a pair of freshly emerged adult moths were released into wooden cage (36 × 36 × 36 cm size) for oviposition where in provision were made with 10 per cent honey solution as food and fresh tender maize leaves were provided inside the cage for oviposition. The cut end of leaves was covered with a wet cotton wad for maintaining turgidity and freshness. Freshly laid eggs were kept in rearing boxes (24 × 10 cm) provided with wet blotting paper at the bottom to protect the eggs from desiccation. After two days when eggs turn to black purple colour, they were provided with fresh maize tender leaves as food for neonate larvae. The neonate larvae were released on leaves with the help of soft hair brush and kept in a rearing box whose cap were covered with muslin cloth in order to facilitate aeration. The food was changed after every 24 hours.

Intraspecific interaction in the absence of food

The study was conducted under laboratory conditions. There were thirteen treatments and five replications for each treatment. The laboratory reared larvae were used for experimentation and were starved for one hour before the initiation of experiment. Five larvae of each instar were placed into transparent Petri plate (9 x 1 cm) containing a wet blotting paper to maintain the moisture. Each Petri plate was considered as one replicate, with 5 replicates in a completely randomized design. Counts on larval survival was performed at 1, 2, 3, 4, 5 and 6 hours after release of larvae in each treatment and the per cent cannibalism was calculated treatment wise and the percentage values were converted to arcsine values.

The data is presented in Table 1. When egg mass was exposed to early instar larvae, no cannibalism on egg mass was noticed up to 3hrs. As high as 33.33 per cent cannibalism was recorded at 4 and 5hrs after exposure and again there was no cannibalism at 6 hrs. But however, among the early instars cannibalism was recorded at every observation interval with a total of 30.65 per cent compared to 66.66 cannibalism of egg

Table 1. Rate of cannibalism of fall armyworm, *Spodoptera frugiperda* in the absence of food

Tr. no.	Treatment details	Per cent cannibalism													
		1 hr		2 hrs		3 hrs		4 hrs		5 hrs		6 hrs		Total	
		Target instar	Other instars /stage	Target instar	Other instars /stage	Target instar	Other instars /stage	Target instar	Other instars /stage	Target instar	Other instars /stage	Target instar	Other instars /stage	Target instar	Other instars /stage
T_1	Egg mass v/s Early instar larvae	0.00	2.66	0.00	5.33	0.00	8.00	33.33	4.00	33.33	5.33	0.00	5.33 (54.74)	66.66 (33.62)	30.65
T_2	Egg mass v/s Late instar larvae	0.00	5.33	33.33	9.33	66.66	6.66	0.00	4.00	0.00	10.67	0.00	9.33 (90.00)	100.00 (43.85)	45.32
T_3	1st instar larvae	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00 (0.00)	NA
T_4	1st instar v/s Early instar larvae	6.00	2.00	12.00	8.00	6.00	8.00	10.00	2.00	10.00	6.00	8.00	4.00 (46.15)	52.00 (33.21)	30.00
T_5	1st instar v/s Late instar larvae	9.33	0.00	12.00	8.00	9.33	10.67	9.33	5.33	10.67	10.67	8.00	9.33 (49.22)	58.66 (42.32)	44.00
T_6	2nd instar larvae	8.00	NA	12.00	NA	4.00	NA	12.00	NA	20.00	NA	12.00	NA	68.00 (35.62)	NA
T_7	2nd instar v/s Late instar larvae	21.33	2.67	9.33	9.33	8.00	6.67	9.33	6.67	8.00	9.33	5.33	6.67 (51.56)	61.32 (40.01)	41.34
T_8	3rd instar larvae	8.00	NA	4.00	NA	8.00	NA	8.00	NA	4.00	NA	8.00	NA	40.00 (26.50)	NA
T_9	3rd instar v/s Late instar larvae	6.67	0.00	8.00	2.67	4.00	6.67	5.33	6.67	6.67	4.00	8.00	1.33 (39.23)	38.67 (26.56)	21.34
T_{10}	4th instar larvae	4.00	NA	6.00	NA	4.00	NA	2.00	NA	4.00	NA	4.00	NA	24.00 (29.31)	NA
T_{11}	4th instar v/s Late instar	8.00	0.00	6.00	6.00	8.00	8.00	8.00	6.00	8.00	6.00	8.00	6.00	46.00 (42.71)	32.00 (34.45)
T_{12}	5th instar larvae	0.00	NA	0.00	NA	4.00	NA	4.00	NA	0.00	NA	6.00	NA	14.00 (0.00)	NA
T_{13}	6th instar larvae	0.00	NA	2.00	NA	4.00	NA	2.00	NA	0.00	NA	0.00	NA	8.00 (16.40)	NA
												S.Em. ±		0.65	0.33
												C.D. @ 5%		1.83	0.93

*NA-Not applicable Figures in paranthesis are arcsine transformed values

mass after 6 hrs of exposure. In egg mass v/s later instar larval treatment, cannibalism of egg mass was to the extent of 33.33 and 66.66 per cent at 2 and 3hrs, respectively resulting in cent per cent cannibalism within 3 hrs of interaction with later instar larvae. While, in case of late instar larvae, a total of 45.32 per cent cannibalism was noticed during the study period. When the 1st instar larvae were allowed to interact with early instar larvae, the total cannibalism was to the tune of 52 and 30 per cent, respectively after 6 hrs of interaction. While, 58.66 and 44.00 per cent of 1st instar and late instar larvae were cannibalized within 6 hrs interacting each other (Table 1). As high as 68 per cent of 2nd instar larvae were cannibalized within 6 hrs interacting among themselves. But however, when 2nd instar larvae interacted with late instar larvae, the cannibalism of 2nd instar larvae was to the tune of 60.00 per cent after 6hrs of exposure while, it was 52.00 per cent in case of late instar larvae.

A total cannibalism of 40 per cent cannibalism was observed among 3rd instar larvae within 6hrs of interaction. But when the same instar larvae were allowed to interact with late instar larvae, the rate of cannibalism was to the extent of 38.67 and 21.34 per cent in case of 3rd instar and late instar larvae, respectively. Among the 4th instar larvae, a cannibalism of 24.00 per cent was recorded within 6hrs of exposure. The cannibalism of 4th instar larvae was enhanced to 46.00 per cent when they were exposed to late instar larvae for 6 hrs as compared to 32.00 per cent in case of later instar larvae. After 6hrs of interaction, 14 per cent cannibalism was observed among 5th instar larvae. But however, when the 5th instar larvae allowed to interact with late instar larvae, the cannibalism was 16.00 per cent in each of the group. Similarly, as low as 8.00 per cent cannibalism was noticed in 6th instar larvae after 6 hrs of interaction among themselves (Table 1).

The studies indicated that the cannibalism in *S. frugiperda* was more frequent in the absence of food as reported by Chapman *et al*. (1999b). Further, Chapman *et al.* (1999a and b) also opined that no cannibalism could be observed in egg stage or in egg mass v/s 1st instar larval treatment as noticed in the present investigation. The reasons could be attributed to the fact that eggs are inactive and 1st instar larvae have no well-developed mouthparts to feed on other larvae. A very high of cannibalism of 68 per cent within 6hrs of exposure was observed in case of 2nd instar larvae is in line with the findings of Tripathy (2020) and Via (1999) who opined that whenever the larvae have no choice for the food, inevitably they should cannibalize the larvae present in the culture box. In case of 4th instar alone treatment, 24 per cent cannibalism was noticed compared to

46 per cent in 4th instar v/s late instar treatment probably due to the stage of the victim relative to the cannibal as reported by Polis (1981) and Chapman *et al*. (1999b).

The studies indicated that the cannibalism in *S. frugiperda* was more frequent in the absence of food. But however, no cannibalism was observed in egg mass v/s 1st instar larval treatments. In case of 2nd instar larvae, a very high of cannibalism of 68 per cent was recorded within 6 hrs of interaction compared to 40 and 24 per cent in 3rd instar and 4th instar larvae. As high as 46 per cent cannibalism was noticed in 4th instar v/s late instar larval treatments within 6 hrs of interaction. The late instars of *S. frugiperda* revealed a very low cannibalism of 14 and 8 per cent in case of 5th instar and 6th instar larvae respectively.

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