

COMPARATIVE DEMOGRAPHIC PARAMETERS OF FALL ARMYWORM (*SPODOPTERA FRUGIPERDA*) ON FIVE HOST PLANTS

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ABSTRACT

The fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae) is an invasive insect pest that threatens a wide range of host plants throughout the world. In Pakistan, it was reported, for the first time in maize crop during 2019-20 from samples received from Sindh province. This study explores the biology and fecundity of *S. frugiperda* across five different host plants i.e. maize (*Zea mays*), sorghum (*Sorghum bicolor*), cotton (*Gossypium hirsutum*), spinach (*Spinacia oleracea*) and cauliflower (*Brassica oleracea*). Results revealed that maize was the most suitable host of *S. frugiperda*, with shortest larval developmental time (21 days), maximum survival rate (95%) and highest fecundity (1573 eggs/female). Sorghum ranked second, followed by cotton, spinach, and cauliflower as the least preferred host. The maximum larval developmental time was observed on cotton (28 days), whereas female fecundity was lowest on cauliflower (1396 eggs/female). All life table parameters were found highest on maize plant. It was concluded that *S. frugiperda* demonstrated maximum preference for maize compared to the other tested host plants. However, order of preference of host plants by *S. frugiperda* was as maize > sorghum > cotton > spinach > cauliflower. These findings underscore the role of maize in supporting population growth of *S. frugiperda*, and also suggest alternative host crops where targeted pest management strategies can be focused.

Keywords: host preference, life table, survival rate, reproductive rate, life expectancy

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INTRODUCTION

Fall armyworm (FAW), *Spodoptera frugiperda* (Lepidoptera: Noctuidae) is the most important insect pest of economically important crops across tropical and sub-tropical regions (Lestari *et al.*, 2020). Originating from the Americas, FAW has rapidly spread across Africa, Asia and more recently into Europe (Tay *et al.*, 2023; Cean *et al.*, 2024; Lytra *et al.*, 2024). In Pakistan, it was reported on maize in 2019 (Naeem-Ullah *et al.*, 2019; Gilal, *et al.*, 2020). FAW larvae is the most destructive stage, feeding on all developmental stages of maize, but especially the whorls of young plants of 45 days old (Cruz *et al.*, 1999). Young larvae feed on surface of the leaves of young maize plants, leaving only white papery areas referred to as 'window panes' (Pogue, 2002). FAW can feed plant tissues at various stages of growth i.e. seedlings, foliage, tassels, cobs, husks, and developing kernels (Goergen *et al.*, 2016). In case of severe infestation by FAW, up to 30–40% of yield losses have been documented in maize (Storer *et al.*, 2010; García-Gutiérrez *et al.*, 2012). Adaptability of FAW to a variety of environmental conditions and its ability to

quickly develop resistance against insecticides make this pest difficult to manage, further underscoring the need for sustainable management strategies.

Host plant selection plays a key role in the developmental biology and population dynamics of FAW. Several studies have revealed that maize is the preferred host plant of FAW, supporting faster larval development and higher female fecundity compared to other crops (Meagher *et al.*, 2004; Guo *et al.*, 2021). The adaptability of FAW to a wide range of host plants not only raise concerns about its potential to infest new host plants but also necessitate the comprehensive research into biology of FAW across various hosts (de Sá *et al.*, 2009; Navasero and Navasero, 2020; Wang *et al.*, 2020). Although, extensive studies have been conducted on FAW in maize and sorghum systems, but the biological effects of other important crops like cotton, spinach and cauliflower still needs to be explored (Kenis *et al.*, 2022).

To develop effective pest management strategies, it is critical to have better understanding of FAW demographic parameters on various host plants. Although, FAW is highly invasive and destructive insect pest, still significant knowledge gaps exist regarding its

development, reproduction, and survival on non-traditional host crops such as spinach and cauliflower, which are increasingly being reported as part of its expanding host range (Nurkomar *et al.*, 2023). Current studies have primarily focused on major staple crops like maize, leaving the impact of FAW on other economically important crops underexplored. Life table studies provide important information about insect pest development, reproduction and survival under different conditions, which are vital in forecasting population growth and applying control measures at the appropriate time. The purpose of this study is to fill these knowledge gaps by studying the life cycle and fecundity of *S. frugiperda* on five economically important crops—maize, sorghum, cotton, spinach, and cauliflower—using age-stage, two-sex life table analysis (Nurkomar *et al.*, 2023). The findings of this research will assist in developing integrated pest management (IPM) strategies, with the aim of curtailing crop losses and improving pest control in affected regions.

MATERIALS AND METHODS

Insect Collection: To establish lab culture, late-instar larvae of *S. frugiperda* were randomly collected from infested maize fields of Agricultural Farm of MNS University of Agriculture, Multan, Pakistan during 2020-2021, placed in collection vials along with fresh leaves of maize and brought to the lab. The larvae were kept in individual plastic cups (20 mL) to avoid cannibalism.

Mass Rearing of Fall Armyworm: The larvae were reared on fresh leaves of maize plant under controlled laboratory conditions, maintained at 25-28°C, 65-75% relative humidity and 14:10 Light: Dark photoperiod. Twenty to twenty-five days old leaves of maize plant grown in pots under laboratory conditions were provided to larvae as a food. Newly emerged adults of *S. frugiperda* were transferred to glass jars (30 cm height and 16 cm diameter) in pairs. Five pairs of adults were kept in one glass jar so that they can mate and start egg-laying. A 10% of honey solution was provided to adult individuals in glass jars for feeding. Fresh leaves of maize plants were also provided to adults for oviposition (egg laying). Maize leaves having eggs were collected from glass jars and replaced with fresh leaves on daily basis (Agboyi *et al.*, 2020).

Growing Host Plants under Laboratory Conditions: Five host plant species like cotton (*Gossypium hirsutum*), maize (*Zea mays*), sorghum (*Sorghum bicolor*), spinach (*Spinacia oleracea*) and cauliflower (*Brassica oleracea*) were used in this study. The selection of these host plants was based on their economic significance, known association with *S. frugiperda* and widespread cultivation in Pakistan. Seeds of these crops were sown in 30 cm tall pots. The pots were then kept under laboratory conditions

with a temperature 26-28°C, relative humidity 70-80% and 12:12 Light: Dark photoperiod. To avoid contamination, no pesticide was applied on growing plants. All host plants were fertilized with the farmyard manure as commonly practiced by farmers in the field. Farmyard manure was provided at the time of sowing. Water was also provided to plants in pots according to plant requirements (Hammad *et al.*, 2017).

No Choice Feeding Test of *S. frugiperda*: For the feeding experiment, larvae from the first progeny (F₁ Generation) of *S. frugiperda* were used. To maintain the turgidity or freshness of cotton plant leaves, soaked cotton was wrapped around the petiole of cotton leaves (Barros *et al.*, 2010). Individual larva was placed in a petri dish (9 cm diameter) and fed with fresh leaves of single host plant throughout the trial. Each of the five treatments consisted of 50 petri dishes arranged in a completely randomized design (CRD). So in total, 250 larvae were used where, each petri dish was considered an experimental unit. During the experiment following parameters were assessed; larval growth rate, pupation period, adult emergence and fecundity.

Statistical Analysis: The data were subjected to Age-Stage, Two-Sex Life Table Analysis (Hsin Chi Version: 2017.09.01) (Hussain *et al.*, 2023).

RESULTS

Life Parameters of FAW on Different Host Plants:

Developmental time of all stages (Egg, Larvae, Pupae, Adult Male & Female) of FAW: The results demonstrated (Table-1) that incubation time of *S. frugiperda* did not differ significantly among the host plants studied. The egg hatching period observed similar on all tested host plants (3.00 ± 0.00 days). For first instar larvae, developmental time on maize was shorter (3.12 ± 0.06 days) followed by sorghum (3.32 ± 0.06 days) and longer on cotton (4.96 ± 0.07 days) followed by spinach (3.98 ± 0.07 days) and cauliflower (3.92 ± 0.08 days). Second instar larval developmental time on maize was shorter (3.28 ± 0.08 days) followed by sorghum (3.44 ± 0.10 days) and longer on cotton (4.44 ± 0.08 days) followed by spinach (4.00 ± 0.1 days) and cauliflower (3.90 ± 0.11 days). Third instar larval developmental time on maize was shorter (3.27 ± 0.08 days) followed by sorghum (3.54 ± 0.13 days) and longer on cotton (4.36 ± 0.1 days) followed by spinach (4.00 ± 0.09 days) and cauliflower (3.86 ± 0.10 days). The fourth instar larval developmental time on maize was shorter (3.42 ± 0.11 days) followed by sorghum (3.58 ± 0.10 days) and longer on cotton (4.33 ± 0.08 days) followed by spinach (3.94 ± 0.08 days) and cauliflower (3.91 ± 0.11 days). The fifth instar larval developmental time on maize was shorter (3.48 ± 0.07 days) followed by sorghum (3.78 ± 0.13

days) and longer on cotton (4.63 ± 0.1 days) followed by spinach (4.12 ± 0.08 days) and cauliflower (3.94 ± 0.11 days). The sixth instar larval developmental time on maize was shorter (4.46 ± 0.11 days) followed by sorghum (4.64 ± 0.15 days) and longer on cotton (5.71 ± 0.9 days) followed by spinach (5.46 ± 0.17 days) and cauliflower (5.18 ± 0.14 days). The overall larval duration on maize was shorter (21.00 ± 0.51 days) followed by sorghum (22.5 ± 0.67 days) and longer on cotton (28.42 ± 0.52 days) followed by spinach (25.5 ± 0.59 days) and cauliflower (24.75 ± 0.65 days). The pupal developmental time on maize was shorter (6.69 ± 0.13 days) followed by sorghum (7.30 ± 0.13 days) and longer on cotton (11.15 ± 0.2 days) followed by spinach (10.02 ± 0.13 days) and cauliflower (8.48 ± 0.18 days). The whole pre-adult developmental period on cotton was substantially longer (42.37 ± 0.49 days) followed by spinach (38.52 ± 0.488 days) and cauliflower (36.2 ± 0.57 days) whereas the pre-adult developmental period on maize was shorter (31.15 ± 0.41 days) followed by sorghum host (32.18 ± 0.59 days). The larval surviving rate was observed highest on maize ($95.0 \pm 2.00\%$) followed by sorghum ($92.0 \pm 1.99\%$) and cotton ($91.0 \pm 1.98\%$), whereas lowest on spinach ($85.0 \pm 2.05\%$) followed by cauliflower ($89.0 \pm 1.95\%$). Longevity of adult female was highest on maize (11.64 ± 0.36 days) followed by sorghum (11.41 ± 0.48 days) and cotton (11.39 ± 0.39 days) whereas lowest on spinach (11.19 ± 0.44 days) followed by cauliflower (11.26 ± 0.36 days). However, Longevity of adult male was highest on maize (6.76 ± 0.17 days) followed by sorghum (6.74 ± 0.16 days) and cotton (6.62 ± 0.16 days) whereas lowest on spinach (6.43 ± 0.14 days) followed by cauliflower (6.54 ± 0.14 days) (Table-1). The results revealed that the female adults lived longer as compared to the male adults. Total longevity was determined to be substantially higher on maize host (8.98 ± 0.39 days) followed by sorghum (8.87 ± 0.43 d) and cotton (8.72 ± 0.42 d) whereas lowest on spinach (8.46 ± 0.36 days) followed by cauliflower (8.54 ± 0.36 days). The compatibility and incompatibility of *S. frugiperda* on diverse tested host plants are expressed in these data (Table 1).

Fecundity (APOP & TPOP): Total pre-ovipositional period (TPOP) on maize was shorter (34.57 ± 0.62 days) followed by sorghum (35.71 ± 0.81 days) and longer on cotton (45.68 ± 0.74 days) followed by spinach (41.84 ± 0.86 days) and cauliflower (38.52 ± 0.89 days) (Table-2). While adult pre-ovipositional period (APOP) on maize was longer (3.00 ± 0.00 days) followed by sorghum (2.95 ± 0.05 days) and cotton (2.87 ± 0.07 days) whereas shorter on spinach (2.43 ± 0.1 days) followed by cauliflower (2.71 ± 0.09 days). The longest oviposition period was reflected in the feeding of *S. frugiperda* on maize (5.95 ± 0.08 days) followed by sorghum (5.89 ± 0.08 days) and cotton (5.84 ± 0.1 days) whereas shorter

on cauliflower (5.76 ± 0.05 days) followed by spinach (5.79 ± 0.1 days). The higher fecundity (eggs/female) was observed on maize (1573.74 ± 20.08) followed by sorghum (1505.73 ± 13.98) and cotton (1493.1 ± 16.09) whereas lower fecundity was observed on cauliflower (1396.27 ± 20.53) followed by spinach (1462.16 ± 15.07). For daily maximum fecundity, the same pattern was seen. The daily-maximum fecundity was observed higher on maize (401 ± 4.09) followed by sorghum (398 ± 4.08) and cotton (396 ± 4.07) whereas lower fecundity was observed on cauliflower (390 ± 4.01) followed by spinach (395.0 ± 4.06). The long-life maximum fecundity was observed higher on maize (1800 ± 19.23) followed by sorghum (1750 ± 18.93) and cotton (1700 ± 18.05) whereas lower fecundity was observed on cauliflower (1650 ± 18.38) followed by spinach (1680.0 ± 18.04) (Table 2). For daily-maximum fecundity, the same pattern was seen. The daily-maximum fecundity was observed higher on maize (401 ± 4.09) followed by sorghum (398 ± 4.08) and cotton (396 ± 4.07) whereas lower fecundity was observed on cauliflower (390 ± 4.01) followed by spinach (395.0 ± 4.06). The long-life maximum fecundity was observed higher on maize (1800 ± 19.23) followed by sorghum (1750 ± 18.93) and cotton (1700 ± 18.05) whereas lower fecundity was observed on cauliflower (1650 ± 18.38) followed by spinach (1680.0 ± 18.04) (Table 2). According to the results of the mean comparison, maize was more susceptible to *S. frugiperda*, whereas spinach was less susceptible (Table 2).

Age-stage specific life expectancy (exj) of *S. frugiperda*: Age stage specified life expectancy (exj) indicated the expected life duration of *S. frugiperda* on five tested host plants (Fig. 1). Freshly laid eggs had a life expectancy of about 48.52, 43.74, 38.96, 39.95 and 42.14 days on cotton, cauliflower, maize, sorghum and spinach host plant, respectively. First, second, third, fourth, fifth and sixth instar larvae on cotton host plant had a life expectancy of about 44.52, 40.52, 37.48, 34.76, 33.2 and 29.23 days, respectively. It was 41.74, 38.74, 34.73, 191 31.73, 28.72 and 26.69 days, followed by 34.96, 32.96, 29.59, 28.59, 27.13 and 23.15 days for first, second, third, fourth, fifth and sixth instar larvae when fed on cauliflower and maize, respectively. Similarly, it was 36.90, 34.89, 32.87, 30.77, 27.56 and 25.36 days followed by 39.14, 36.14, 32.84, 34.34, 30.88 and 27.88 days on, sorghum and spinach, respectively. Pupae on cotton, cauliflower, maize, sorghum and spinach host plant had a life expectancy of about 24.23, 23.62, 20.19, 22.07, 23.90 days. Female and male adult on cotton, cauliflower, maize, sorghum and spinach had a life expectancy of about 17.07 and 10.70 days followed by 18.73 and 13.01, 17.18 and 12.20, 19.35 and 11.11, 16.76 and 10.76 days, respectively (Fig. 1).

Age specific survival rate (lx), age-stage specific fecundity (fxj), age-specific fecundity (mx) and age-

specific maternity (l_{mx}) of *S. frugiperda*: Figure 2 showed the resulted values of l_x, m_x, and l_{mx} for *S. frugiperda* reared on five selected host plants. The value of age specific surviving rate (l_x) was noted 0.98, 0.97, 1.00, 0.99, 0.98 on cotton, cauliflower, maize, sorghum and spinach respectively. The value of age specific fecundity (m_x) was noted 71.28, 50.78, 121.60, 72.76, 48.78 on cotton, cauliflower, maize, sorghum and spinach alternate host respectively. The value of age specific maternity (l_{mx}) was noted 640.76, 623.01, 724.05, 659.54 and 513.27 on cotton, cauliflower, maize, sorghum and spinach host plant, respectively (Fig. 2).

Age-stage specific survival rate (s_{xj}) of *S. frugiperda*: The age stage specific survival rate (s_{xj}) demonstrated the possibility of *S. frugiperda* eggs surviving on five different host plants (Fig. 3). Survival curve for freshly

laid eggs on cotton host plant was about 1.00. Survival curve for First, second, third, fourth, fifth and sixth instar larvae on cotton host plant was about 0.99, 0.97, 0.94, 0.86, 0.76 and 0.78, respectively. Instar wise larval survival of FAW on cauliflower 1.00, 0.99, 0.74, 0.66, 0.56 and 0.64 on maize 1.00, 0.99, 0.82, 0.76, 0.69 and 0.75 on sorghum 1.00, 0.98, 0.88, 0.65, 0.60 and 0.56 and on spinach it was 0.97, 0.94, 0.78, 0.70, 0.66 and 0.69 respectively. Survival curve for pupae on cotton, cauliflower, maize, sorghum and spinach host plant was 0.86, 0.76, 0.80, 0.66, 0.74 respectively. Survival curve for female adult on cotton, cauliflower, maize, sorghum and spinach host plant was 0.42, 0.32, 0.43, 0.40, 0.36 respectively. Survival curve for male adult on cotton, cauliflower, maize, sorghum and spinach host plant was 0.32, 0.28, 0.33, 0.26, 0.24 respectively (Fig. 3).

Table 1: Developmental duration (days) of *Spodoptera frugiperda* on different host plants.

Life stages	Developmental Duration (d)				
	Maize	Sorghum	Cauliflower	Spinach	Cotton
Egg	3.00±0.00 ^a	3.00±0.00 ^a	3.00±0.00 ^a	3.00±0.00 ^a	3.00 ± 0.00 ^a
L1	3.12±0.06 ^a	3.32±0.06 ^a	3.92± 0.08 ^{ab}	3.98±0.07 ^{ab}	4.96 ± 0.07 ^b
L2	3.28 ±0.08 ^a	3.44 ±0.10 ^a	3.90±0.11 ^{ab}	4.00±0.1 ^{bc}	4.44 ± 0.08 ^c
L3	3.27±0.08 ^a	3.54±0.13 ^{ab}	3.86±0.10 ^b	4.00±0.09 ^{bc}	4.36 ± 0.1 ^c
L4	3.42±0.11 ^a	3.58±0.10 ^a	3.91 ±0.11 ^b	3.94±0.08 ^b	4.33 ± 0.08 ^c
L5	3.48±0.07 ^a	3.78±0.13 ^{ab}	3.94±0.11 ^{ab}	4.12±0.08 ^b	4.63 ± 0.1 ^c
L6	4.46±0.11 ^a	4.64±0.15 ^a	5.18±0.14 ^b	5.46±0.17 ^{bc}	5.70 ± 0.9 ^c
Pupa	6.69±0.13 ^a	7.30±0.13 ^b	8.48±0.18 ^c	10.02±0.13 ^d	11.15 ± 0.2 ^c
Total pre-adult	31.15±0.41 ^a	32.18±0.59 ^{ab}	36.2±0.57 ^b	38.52±0.48 ^c	42.37 ± 0.49 ^d
Pre-adult survival rate (%)	95.0±2.00 ^d	92.0±1.99 ^c	89.0±1.95 ^b	85.0±2.05 ^a	91.0 ± 1.98 ^c
Female adult longevity	11.64 ± 0.36 ^c	11.41 ± 0.48 ^b	11.26 ± 0.36 ^a	11.19 ± 0.44 ^a	11.39 ± 0.39 ^{ab}
Male adult longevity	6.76 ± 0.17 ^c	6.74 ± 0.16 ^c	6.54 ± 0.14 ^b	6.43 ± 0.14 ^a	6.62 ± 0.16 ^{bc}
Total longevity	8.98 ± 0.39 ^c	8.87 ± 0.43 ^c	8.54 ± 0.36 ^a	8.46 ± 0.36 ^a	8.72 ± 0.42 ^b

Note: Standard errors (SE) were estimated by bootstrapping (10,000 resamplings). L1–L6 indicate first to six instars of FAW. Means sharing the same superscript letter(s) in a row are not significantly different (P > 0.05), according to the LSD test.

Table 2: Life parameters of *Spodoptera frugiperda* on different host plants.

Parameters	Maize	Sorghum	Cauliflower	Spinach	Cotton
APOP	3.00 ± 0.00 ^d	2.95 ± 0.05 ^{cd}	2.71 ± 0.09 ^b	2.43 ± 0.11 ^a	2.87 ± 0.07 ^c
TPOP	34.57 ± 0.62 ^a	35.71 ± 0.81 ^{ab}	38.52 ± 0.89 ^b	41.84 ± 0.86 ^c	45.68 ± 0.74 ^d
Oviposition days	5.95 ± 0.08 ^c	5.89 ± 0.08 ^{bc}	5.76 ± 0.05 ^a	5.79 ± 0.1 ^a	5.84 ± 0.1 ^b
Fecundity (Eggs/female)	1573.74 ± 20.08 ^c	1505.73 ± 13.98 ^c	1396.27 ± 20.53 ^a	1462.16 ± 15.07 ^b	1493.1 ± 16.09 ^b
Daily maximum	401 ± 4.09 ^c	398 ± 4.08 ^{ab}	390 ± 4.01 ^a	395.0 ± 4.06 ^b	396 ± 4.07 ^b
Life-long maximum	1800 ± 19.23	1750 ± 18.93	1650 ± 18.38	1680.0 ± 18.04	1700 ± 18.05
Intrinsic rate of natural increase (r _m , per day)	0.33 ^c	0.27 ^b	0.21 ^{ab}	0.16 ^a	0.19 ^{ab}
Net reproductive rate (R ₀ per generation)	89.13 ^c	77.25 ^{bc}	69.54 ^b	73.76 ^{bc}	33.54 ^a
Mean generation time (T)	50.2 ^c	44.8 ^b	41.3 ^b	38.6 ^b	25.8 ^a
Finite rate of increase (λ)	1.18 ^b	1.15 ^b	1.12 ^b	1.10 ^a	1.09 ^a

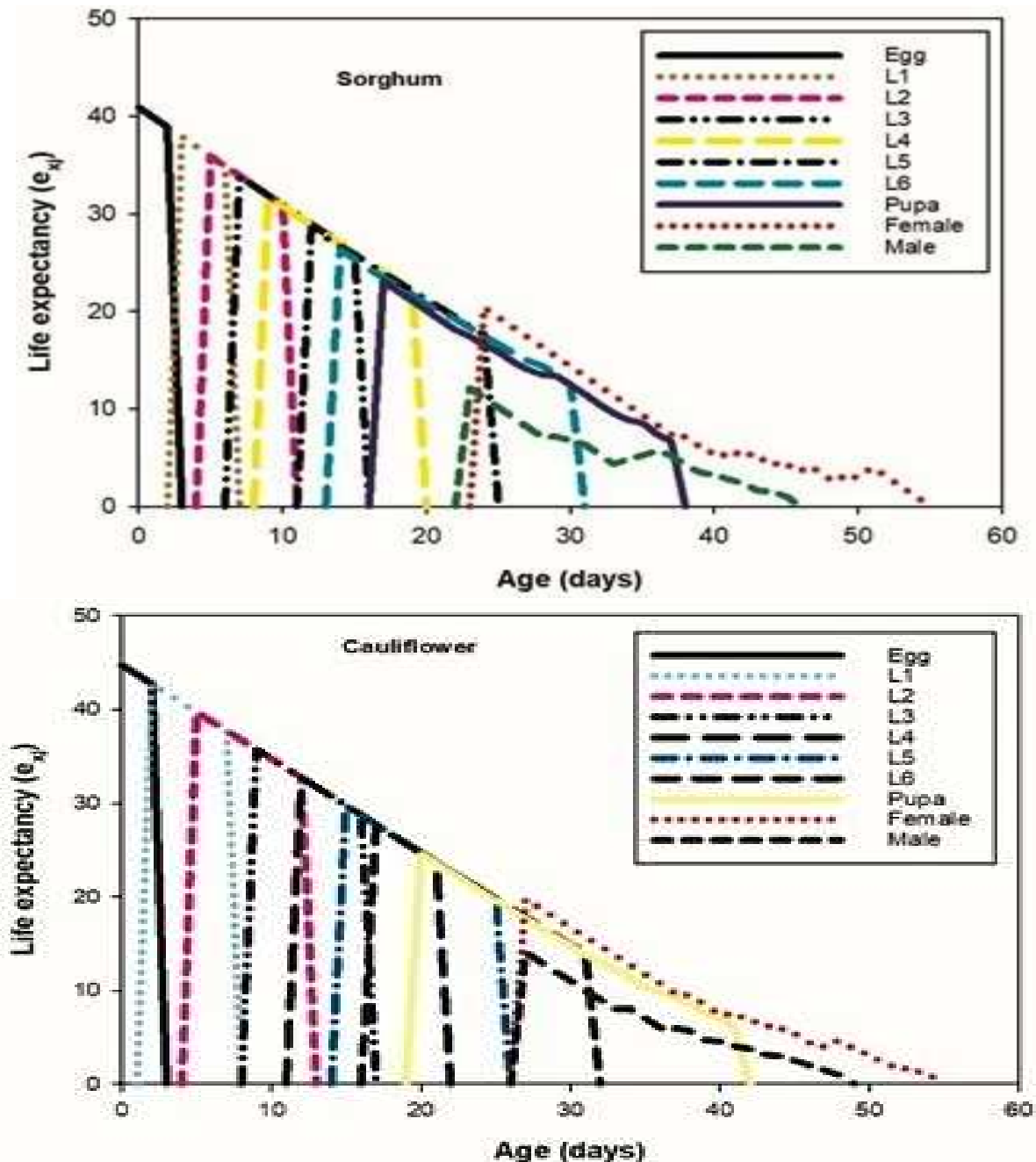
Note: Standard errors (SE) were estimated by bootstrapping (10,000 resampling). APOP: adult pre-ovipositional period; TPOP: total pre-ovipositional period (from eclosion of larva to oviposition by the adult); R₀: net reproductive rate; r: intrinsic rate of natural increase; T: mean generation time; λ: finite rate of increase.

Means sharing the same superscript letter(s) in a row are not significantly different (P > 0.05), according to the LSD test.

Age-stage specific reproductive rate (v_{xj}) of *S. frugiperda*: The age stage specified reproductive rate (v_{xj}) of *S. frugiperda* reared on cotton demonstrated the contribution of insects of particular age (x) and stage (j) to future population (Fig. 4). The reproductive rate increased when female adult of *S. frugiperda* started to lay eggs. Increase in reproductive rate occurred at 36-54, 26-48, 22-42, 22-46 and 30-52 days on cotton, cauliflower, maize, sorghum and spinach, respectively. Reproductive rate peaks occurred at 42, 30, 28, 34 and 40 days of age which reached at the peak of 882.77, 910.21, 923.21, 785.76 and 719.01 eggs on cotton,

cauliflower, maize, sorghum and spinach, respectively (Fig. 4).

Intrinsic rate of natural increase (r_m , per day) of FAW was 0.33, 0.27, 0.21, 0.16 and 0.19 on maize, sorghum, cauliflower, spinach and cotton respectively. Similarly, Net reproductive rate (R_0 per generation) was 89.13, 77.25, 69.54, 73.76 and 33.54 whereas, mean generation time (T) were 50.2, 44.8, 41.3, 38.6, 25.8 on maize, sorghum, cauliflower, spinach and cotton respectively. Finite rate of increase (λ) on maize, sorghum, cauliflower, spinach and cotton was 1.18, 1.15, 1.12, 1.10 and 1.09 respectively (Table 2).



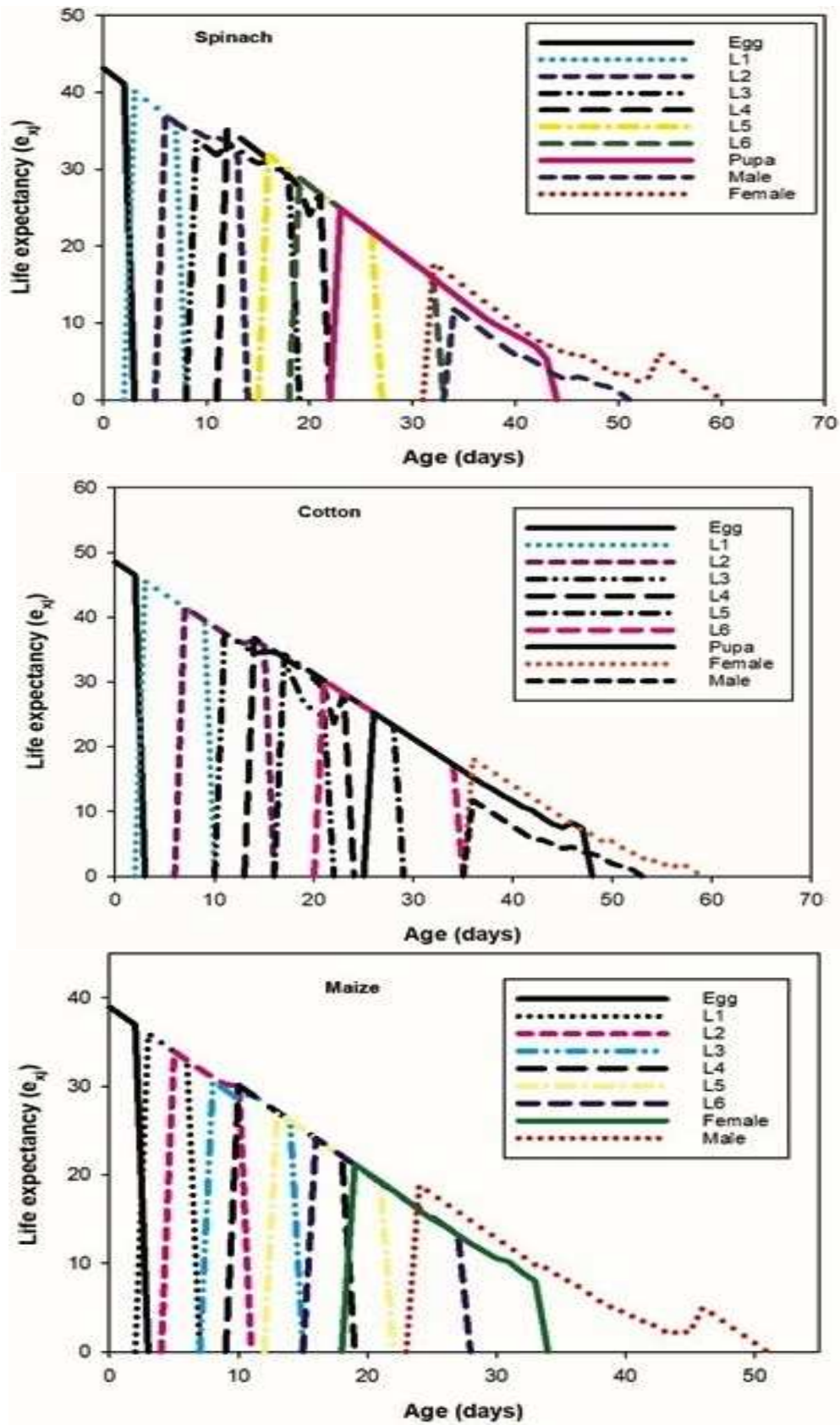


Fig. 1: Age-stage specific life expectancy (e_{xj}) of *Spodoptera frugiperda* reared on different host plants.

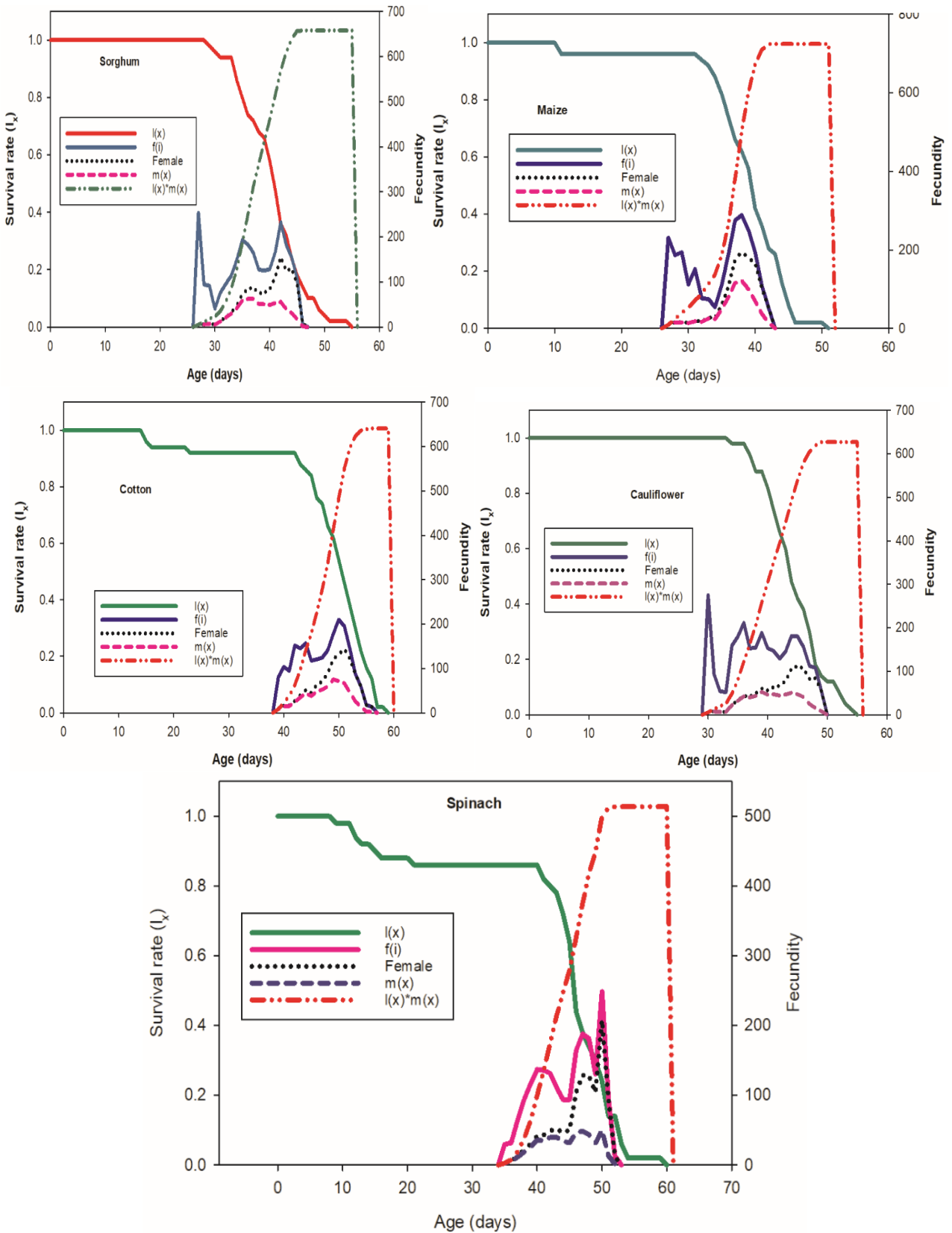


Fig. 2: Age specific survival rate (l_x), age-stage specific fecundity (f_x), age-specific fecundity (m_x) and age-specific maternity ($l_x m_x$) of *Spodoptera frugiperda* reared on different host plants.

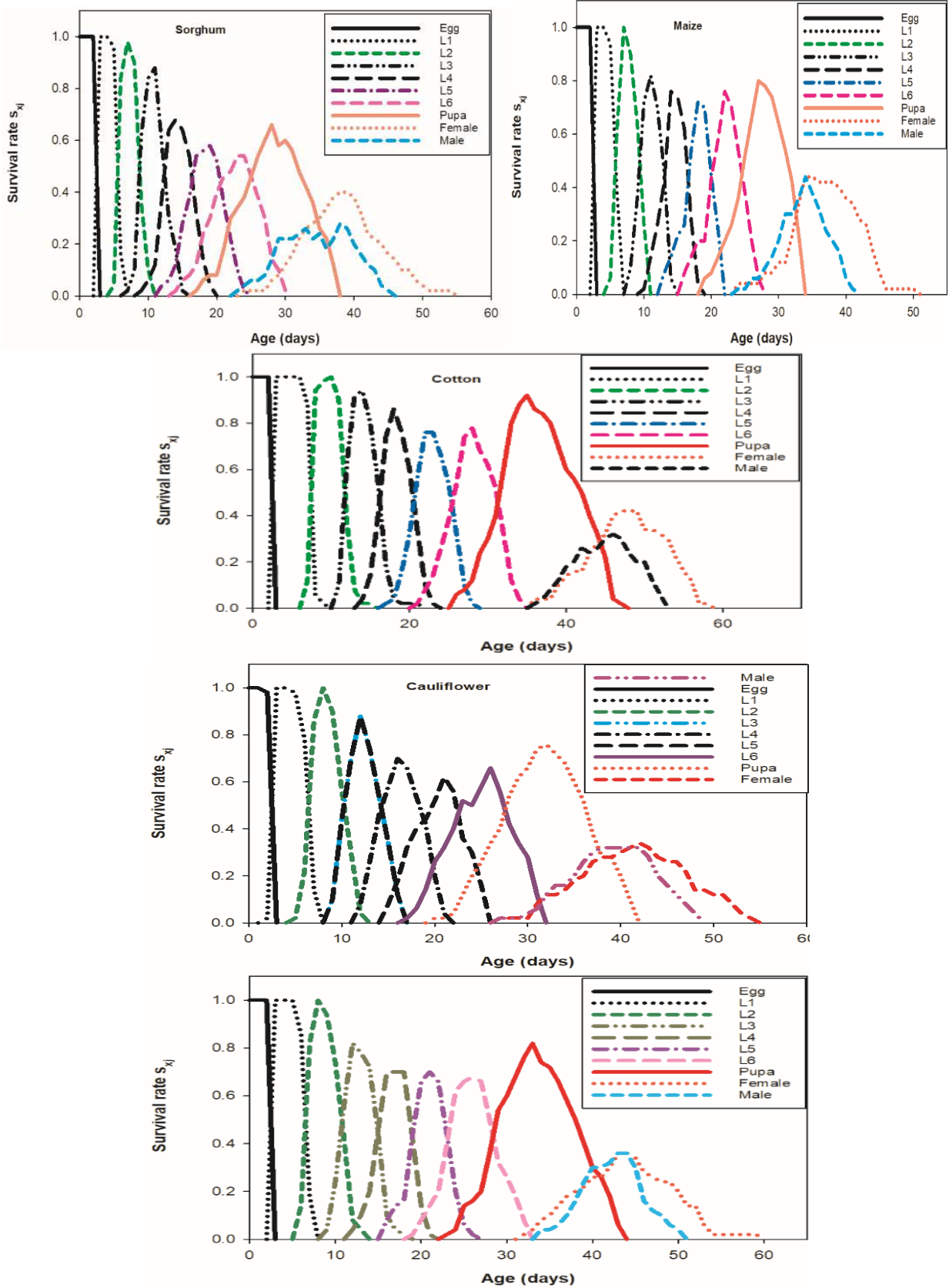


Fig. 3: Age-stage specific survival rate (s_{xj}) of *Spodoptera frugiperda* reared on different host plants.

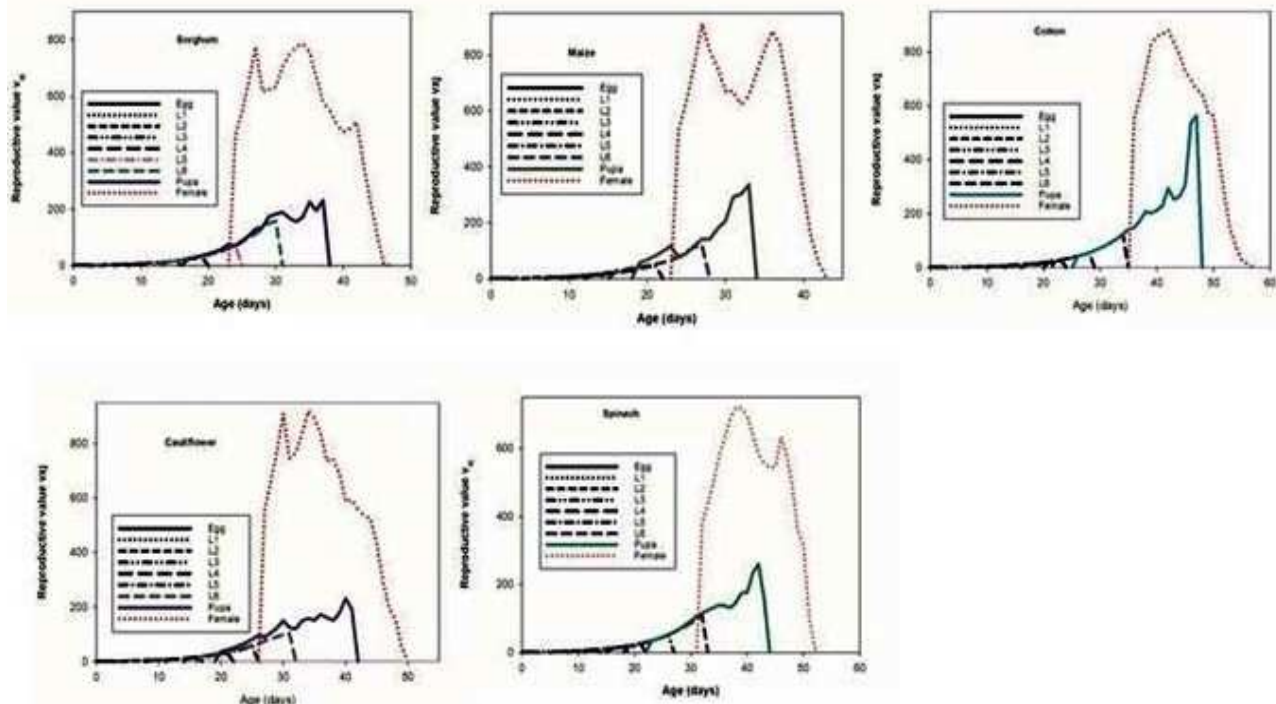


Fig. 4: Age-stage specific reproductive rate (v_{xj}) of *Spodoptera frugiperda* reared on different host plants.

DISCUSSION

Selection of host plants in insect pests, especially in phytophagous insects like *S. frugiperda*, plays a critical role in their biology and population dynamics. The results from this study clearly shows the substantial effect of different host plants on the development, survival, and fecundity of *S. frugiperda*. Our findings highlight the preferential suitability of maize for *S. frugiperda* compared to other tested host plants, as evidenced by faster larval development, higher survival rates, and greater fecundity on maize.

Developmental and survival experiments revealed that fall armyworm completed its life duration quickly on maize crop. Total larval duration was about 21-22 days. Pupal period was 6-7 days. Adult longevity was about of 6-7 and 10-11 days for male and female respectively. Our result findings were confirmatory to the research findings of Kandel *et al.*, (2020) where they also found faster development of *S. frugiperda* on maize crop compared to other host plants. The average development cycle of *S. frugiperda* was about 22 days (Tendeng *et al.*, 2019). Our findings were confirmatory to the research findings of Navasero and Navasero (2020) where they found shorter life cycle of *S. frugiperda* on maize crop even under different lab conditions compared to the conditions used in our experiment. In comparison to wheat, soybean, tomato, cotton, and Chinese cabbage, *S. frugiperda* fed on maize showed a shorter pre-adult developmental period (Wang *et al.*, 2020). Life span of

various developmental stages of *S. frugiperda* was shorter on sorghum crop. Egg duration was 3 days. Larval duration was about 22-23 days. Pupal period was 7-8 days. Adult longevity was about of 6-7 and 10-12 days for male and female respectively. Our findings of current study are confirmatory to the research findings of da Rosa *et al.*, (2012) where they studied the life cycle of *S. frugiperda* on sorghum crop. Life span of *S. frugiperda* was shorter on sorghum crop (Chen *et al.*, 2020). Larvae of *S. frugiperda* grew faster on sorghum (de Sá *et al.*, 2009). The larval durations of *S. frugiperda* raised on maize were much shorter than sorghum, wheat, soybean and cotton (Chen *et al.*, 2020). Life span of various developmental stages of *S. frugiperda* was longer on cotton crop. Egg duration was 3 days. Larval duration was about 28-30 days. Pupal period was 12-13 days. Adult longevity was about of 6-7 and 10-12 days for male and female respectively. Our findings of current study are confirmatory to the research findings of Silva *et al.*, (2017) where they studied that larval feeding of *S. frugiperda* on cotton crop had longer developmental cycles were observed than soybean. Larval developmental period was longer on cotton than soybean and millet (Barros *et al.*, 2010). Life span of various developmental stages of *S. frugiperda* was intermediate on cauliflower and spinach crop as compared to other tested host plants. Egg duration was 3 days. Larval duration was about 24-25 for cauliflower and 25-26 days for spinach. Pupal period was 8-10 for cauliflower and 10-12 days for spinach. Male adult longevity was about

of 6-8 for cauliflower and 6-7 days for spinach. Female adult longevity was about of 10-11 for cauliflower and 10-12 days for spinach. The effect of spinach and cauliflower host plants on FAW had not been reported previously and present studies were first time reported in Pakistan.

Fecundity is an important indicator of reproductive success of insect pests. In this study, fecundity of *S. frugiperda* was higher on maize (1573 mean number of eggs/female) and lower on cauliflower (1396 mean number of eggs/female) than that of sorghum, cotton and spinach host plant. According to Wang *et al.*, (2020), comparative studies on cotton, tomato, wheat, soybean and cabbage revealed *S. frugiperda* had highest fecundity on maize. In another study, maize plant had a considerable impact on the fecundity of *S. frugiperda* than other reported host plants (Deng *et al.*, 2024). The fecundity of *S. frugiperda* female raised on maize was higher than sorghum, wheat, soybean and cotton (Chen *et al.*, 2020). On maize, FAW females had the maximum fecundity than sorghum and artificial diet (He *et al.*, 2021).

High fecundity of *S. frugiperda* on maize plant is of particular concern for pest management, as it explains a higher reproductive rate and faster population growth. As the age-stage two-sex life table analysis revealed, *S. frugiperda* reared on maize had the highest intrinsic rate of increase (r) as well as highest net reproductive rate (R_0). Both of these key parameters are used for predicting population growth. On contrary, the lower reproductive rates on spinach and cauliflower suggest that these crops are less favorable for *S. frugiperda* and could potentially serve as components of an integrated pest management (IPM) strategy.

The findings of this study have strong implications for managing *S. frugiperda*, specifically in maize-dominated agroecosystems. As fall armyworm demonstrate higher preference for maize, it is evident that this crop plays a key role in population growth of *S. frugiperda*. Therefore, monitoring and early intervention approaches should prioritize maize crop to avoid area-wide infestations. The high fecundity observed on sorghum (1505 eggs per female) and cotton (1493 eggs per female) highlights the potential challenges in managing *S. frugiperda* on these crops, particularly in areas where they are extensively cultivated. For these crops, adopting integrated pest management (IPM) strategies, such as targeted pheromone trapping, application of selective biopesticides, and the use of resistant crop varieties, could be effective in minimizing pest pressure. Moreover, incorporating less preferred hosts of *S. frugiperda* in crop rotation or intercropping programs could potentially reduce pest pressure on maize and other key crops. While this study offers valuable insights into the life history traits of *S. frugiperda* on different host plants, future research should focus on

additional crops and environmental conditions to further improve the pest management strategies. Exploring the impact of abiotic factors, like temperature and humidity, on the insect pest's performance across different host plants could reveal more context-specific recommendations for pest control. Furthermore, research into resistant crop varieties, plant secondary metabolites' role in deterring *S. frugiperda* and their associated microbes will be crucial for developing sustainable long-term solutions.

Conclusion: This study identifies maize as a preferred host plant of fall armyworm (*S. frugiperda*), which enabling faster larval growth, higher survival rates and higher fecundity compared to other tested plants. However, order of preference was as maize > sorghum > cotton > spinach > cauliflower. These findings emphasize the need for targeted monitoring and management strategies for fall armyworm in maize-dominated farming systems along with other host plants. Integrating less favorable host plants like spinach and cauliflower, into crop rotation or intercropping systems could help in reducing pest pressure. This research plays a key role in basic understanding to develop more effective integrated pest management strategies.

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