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DIFFERENTIAL RESPONSE OF SELECTED WILD *NICOTIANA* SPECIES TO BEET ARMYWORM, *SPODOPTERA EXIGUA* (HUB.)

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The response of nine wild *Nicotiana* species to the beet armyworm, *Spodoptera exigua* (Hub.) was studied through construction of age-specific life tables, age-specific fertility table of female and computing the life parameters. It was observed that *S. exigua* could complete its life cycle only on *N. eastii.* The survivorship of the insect on the other species ranged from 6-26 days. Lowest survival (6 days) and life expectancy (3.44) were recorded when the insect was reared on *N. acaulis.* On *N. eastii,* the species that supported complete life cycle, age-specific life table took 30 days and the expectancy of life at the beginning of life table was 9.91. Immature stages and pre-oviposition period of female lasted 25.5 days on this species and the female survivorship was 0.02 at the beginning of fertility table of female . Potential fecundity to an extent of 78.96% was contributed during the first three days of the fertility table. The net reproductive rate (R0) was 13.32 and the potential fecundity (Pf) was 707.0 on this species. Mean generation time (Tc) was 27.24 days and an intrinsic rate of increase (rc) of 0.10 females / female / day was recorded. The weekly multiplication rate was 1.95 and the population of the insect could double itself in 7.29 days on this species. The species, *N. gossei, N. acaulis* and *N. alata* which differed the development of *S. exigua* with lowest life expectancy could be utilised as sources of resistance to this pest in future breeding programmes after the inheritance of resistance of this trait is established.

INTRODUCTION

The beet armyworm, *Spodoptera exigua* (Lepidoptera: Noctuidae), is an economically important pest of crops worldwide, attacking plants from over 20 families (Bin Zhang *et al.,* 2011). The wide host range of the insect includes asparagus, beans and peas, sugar and table beets, celery, cole crops, lettuce, potato, tomato, cotton, cereals, oilseeds, tobacco, many flowers, and a multitude of weed species (Robinson *et al.,* 2010). Host plants play an important role in increase in population and outbreak of cosmopolitan polyphagous insect pest, such as *S. exigua.* Host preference, suitability and availability are very important factors that govern the population dynamics and status of an insect as a pest. The beet armyworm has been reported as a pest on tobacco in early nursery stage both on burley and FCV tobaccos and causes considerable loss of seedlings when unchecked (Prasad, 2004). It also appears sporadically on the planted crop too. The response of wild *Nicotiana* species to *S. exigua* has not yet been studied. Hence the present study aims to understand the extent to which nine wild species of genus *Nicotiana* defend themselves constitutively from the infestation by *S. exigua* through construction of laboratory life tables of the insect.

MATERIALS AND METHODS

A laboratory culture of *S. exigua* was maintained on fresh leaves of Bengalgram at 25±5ºC and 75±5% relative humidity. The host plants are nine different wild *Nicotiana* species *viz.*, *N. gossei, N. eastii, N. megalosiphon, N. sylvestris, N. repanda, N. alata, N. acaulis, N. undulata* and *N. rustica.* These were grown at the premises of Central Tobacco Research Institute, Rajahmundry using standard agronomic practices and no plant protection measures were taken up on these plants.

The hatchability of eggs of a cohort laid on a single day was initially determined by counting the number of eggs hatched in three replicates. 100 larvae that hatched from one cohort of eggs were transferred to freshly plucked leaves of the host plants and maintained in ventilated plastic containers with wet cotton and filter paper to retain the turgidity of leaves. The larvae were maintained in groups of 20 for the initial five days to cater to their gregarious nature. Later the larvae

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were maintained individually till death or pupation. Data on mortality were recorded everyday till all the adults died.

The methods suggested by Deevey (1947), Birch (1948), Morris and Miller (1954), Atwal and Bains (1974) and Chaudhary and Bhattacharya (1986) were used for constructing the life tables and for computing various life parameters. A computer programme developed using MS-Excel was used for processing the data (Lalitha Bharathi *et al.*, 2008).

RESULTS AND DISCUSSION

Age-specific life table of *S. exigua* on wild *Nicotiana* sp.

Age-specific life tables of *S. exigua* were constructed on nine wild *Nicotiana* species starting with a cohort of 100 eggs laid on a single day. Except on *N. eastii*, the insect could not complete its life cycle on any other species. The insect survived for 6 days on *N. acaulis*, *N. gossei* and *N. alata* with the lowest life expectancy of 3.44 on *N. acaulis* at the beginning of the life table followed by 4.54 and 4.62 on *N. gossei* and *N. alata* respectively (Fig 1 to 3). First instar mortality accounted for steep drop in survivorship in all these three species. *N. undulate* and *N. rustica* sustained the survival of *S. exigua* for 8 days whereas *N. megalosiphon*, *N. repanda* and *N. sylvestris* supported survival for 11, 14 and 26 days, respectively (Fig 4 to 8). The life expectancy (ex) at the beginning of life table was 9.91 on *N. eastii*, the species that could support complete life cycle of the insect. The entire life table on this

Figure 1 : Age specific survivorship (lx), death(dx) and expectation of life (ex) of *Spodoptera exigua* on *N.gossei*

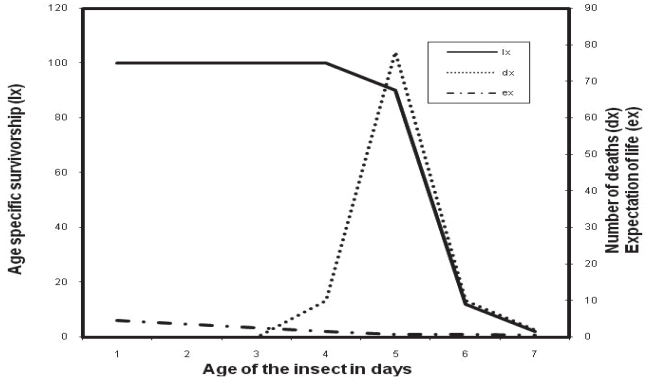


Figure 2 : Age specific survivorship (lx), death (dx) and expectation of life (ex) of *Spodoptera exigua* on *N.repanda*

Figure 3 : Age specific survivorship (lx), death(dx) and expectation of life (ex) of *Spodoptera exigua* on *N.alata*

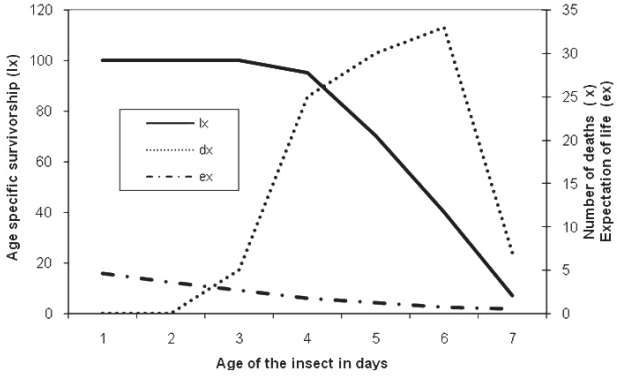


Figure 4 : Age specific survivorship (lx), death (dx) and expectation of life (ex) of *Spodoptera exigua* on *N.sylvestris*

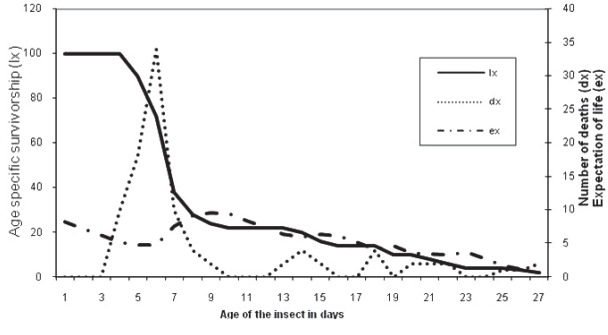


Figure 5 : Age specific survivorship (lx), death (dx) and expectation of life (ex) of *Spodoptera exigua* on *N.rustica*

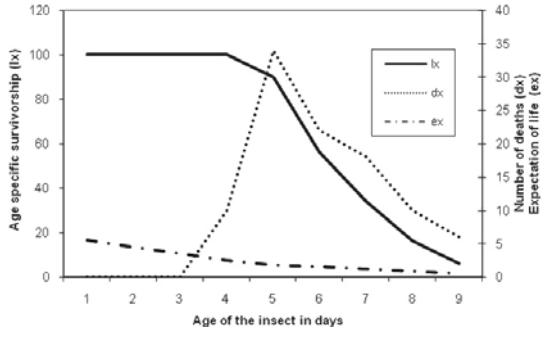


Figure 6: .Age specific survivorship (lx), death (dx) and expectation of life (ex) of *Spodoptera exigua* on N.*eastii*

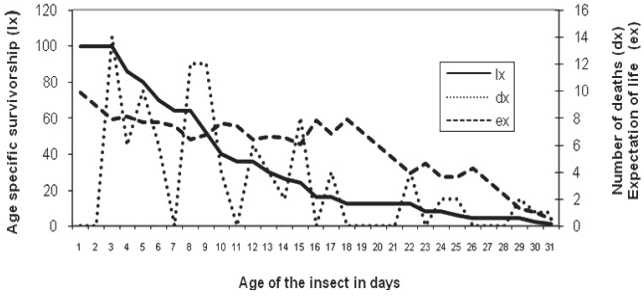


Figure 7 : Age specific survivorship (lx), death (dx) and expectation of life (ex) of *Spodoptera exigua* on *N.megalisiphon*

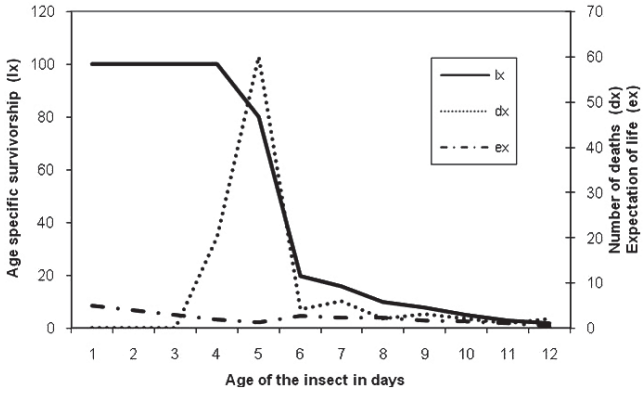


Figure 8 : Age specific survivorship (lx), death (dx) and expectation of life (ex) of *Spodoptera exigua* on N.acaulis

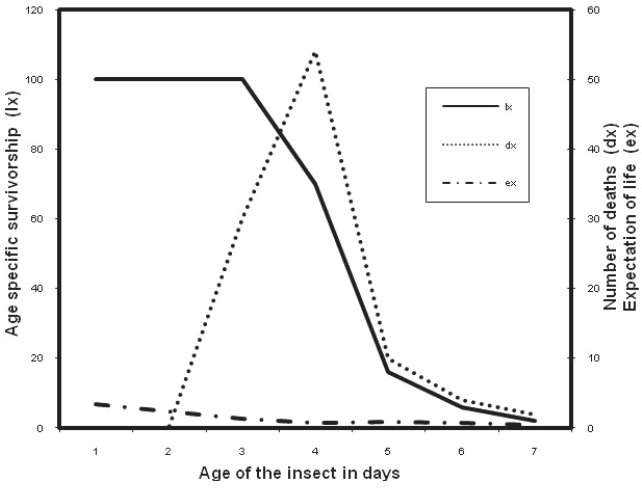
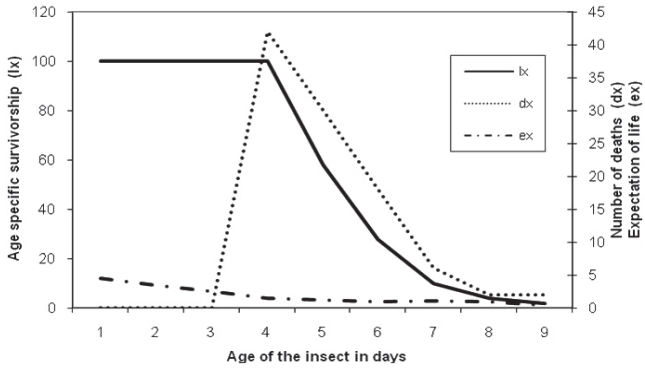


Figure 9 .: Age specific survivorship (lx), death (dx) and expectation of life (ex) of *Spodoptera litura* on *N.undulata*



species lasted 30 days with 60% mortality being recorded between the 3rd and 8th day of the life table (Fig.6).

Life and fertility table of female of *S. exigua* on *N. eastii* is given in Table 1. The immature stages and pre-oviposition period lasted for 24.5 days. Oviposition reached a peak on the third day of the fertility table followed by a decline. The entire ovipostion was spread over 5 days. The female survivorship was only 0.02 when *S. exigua* was reared on this species. 78.96 % of the potential fecundity was contributed during the first three days of the fertility table.

The life parameters of *S. exigua* when reared on *N. eastii* are given in Table 2. The net reproductive rate (R_0) was 13.32 and the potential fecundity (Pf) was 707.0 on this species. Mean generation time (Tc) was 27.24 days and an intrinsic rate of increase (rc) of 0.10 females / female/day was recorded. The weekly multiplication rate was 1.95 and the population of the insect could double itself in 7.29 days at the recorded rate of increase.

Chari and Patel (1972) determined the relative susceptibility of different species of *Nicotiana* to *S.litura* in laboratory tests in India and found that *N. repanda* was the most resistant species. When the survival of *S. litura* on 32 different wild accessions of wild *Nicotiana* species was studied by Lalilatha Bharathi *et al.*(2008), it was observed that the larvae could survive only for 6 days on *N.gossei* and *N. sylvestris* and for 7 days on *N. rustica*, *N. trigonophylla* and *N. repanda*. The tobacco caterpillar could complete its life cycle only

Table 1: Life and fertility table of *S. exigua* on *N. eastii*

Pivotal days X	Age specific female survivorship lx	Natality rate mx	Net reproductive rate lxmx	lxmx.X	Value of $e^{-r}x$ lxmx when r =0.10	Percent contribution of each age group to r
0.5 to 24.5	**immature stages and pre-oviposition period**					
25.5	0.02	110	2.2	56.10	0.1949	19.49
26.5	0.02	160	3.2	84.80	0.2578	25.78
27.5	0.02	230	4.6	126.50	0.3369	33.69
28.5	0.02	125	2.5	71.25	0.1665	16.65
29.5	0.01	82	0.82	24.19	0.0497	4.97
		707	**13.32**	**362.84**	**1.0057**	**100**

on *N. glauca* and *N. debneyii* in this study. Higher levels of leaf surface waxes were thought to be a probable reason for poor growth of the test insect on the species *N. gossei* and *N. trigonophylla.* These species also recorded high density of glandular trichomes too. The results from the above two studies are in confirmation with the results obtained in the present study where the species *N. gossei* and *N. repanda* supported poor survival of *S. exigua.* Tobacco with high levels of duvanes and sucrose esters incurred little feeding damage which may be due to non-preference and antibiosis factors (Johnson and Chaplin, 1982). Prabhu *et al.* (1981) observed that cytoplasmic polar lipid fraction of leaf was the most toxic to early instars of *S. litura.* In another study by Eckel *et al.* (1998), it was observed that trichome exudates from *Nicotiana* species affect the survival, development and behaviour of pestiferous and beneficial insects. Based on the present study it was observed that high concentration of leaf surface waxes and high density of glandular trichomes on the leaves could probably be the reason for poor growth and development of *S. exigua* on the wild *Nicotiana* species under the study. The species, *N. gossei*, *N. acaulis* and *N. alata* could also be utilised as sources of resistance to this pest in future breeding programmes after the inheritance of resistance of this trait is established.

ACKNOWLEDGEMENTS

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Table 2: Life parameters of *S. exigua* on *N. eastii*

S. No	Life parameter	Value
1	Net Reproductive Rate (R_0)	13.32
2	Potential fecundity (Pf)	707.00
3	Intrinsic rate of increase (approximate)- r_c female/female/day	0.10
4	Mean generation time (T_c) in days	27.24
5	Finite rate of increase (ë) female/female/day	1.10
6	Doubling time (DT)	7.29
7	Annual rate of increase	1.17×10^{15}
8	Weekly multiplication	1.95

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