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EFFECT OF THREE LARVAL DIETS ON THE DEVELOPMENT OF THE ARMYWORM, *SPODOPTERA LATIFASCIA* WALKER, 1856 (NOCTUIDAE, LEPIDOPTERA)

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ABSTRACT

Some biological effects of feeding larvae of the armyworm Spodoptera latifascia *with leaves of three plant species (cotton, soybean and lettuce) have been studied. Some indicative measurements were utilized to determine the host suitability of these three plant species.*

Cotton leaves (Gossypium hirsutum) *were found to be better than soybean* (Glycine max) *for the development and growth of this insect. Lettuce leaves* (Lactuca sativa) *were incapable of sustaining this insect. Moreover, the stress of the latter diet was associated with a latent microbial disease, a mixed infection caused by* Vairimorpha sp. *and a nuclear polyhedrosis virus (NPV).*

Cotton leaves can be recommended as a suitable diet for mass rearing of this insect species. Due to recent outbreks of S. latifascia *observed in the States of São Paulo, Santa Catarina and Paraná and because of the frequent applications of wide spectrum chemical insecticides, it can be expected that this insect will soon become one of the important pests threatening cotton and other economic plantations in Brazil.*

INTRODUCTION

Spodoptera latifascia Walker, 1856 occurs in the New World in low densities on some economic plants such as soybeans, cotton, potato and gramineous species (Mendes, 1938; Hambleton, 1939; Lima, 1950; Bertels, 1953, 1962 and Silva *et al.*, 1968). Recently, outbreaks which caused severe economic damage were recorded by the present authors in some Brazilian farms, principally in the States of São Paulo, Paraná and Santa Catarina. It is probable that these outbreaks result from the frequent applications of wide spectrum chemical insecticides which destroy the natural enemies of *S. latifascia.* However, no mention of this insect has been found in the agricultural literature since it has not previously reached the level of economic significance.

Eggs and larvae of this insect were used, together with other hosts, in mass rearing of some coccinellid predators by Szumkowski (1955). Lara *et al.* (1976) determined the influence of height of light traps on the capture of some moths, including *S. latifascia.*

The present study was carried out due to the recent importance of *S. latifascia* as a possible pest of some plantations, such as cotton and soybean. The purpose of this investigation was to determine the effects of three natural diets on some developmental aspects of this insect. We also studied the role of deficient nutrition as an activator of latent diseases in the larvae.

MATERIAL AND METHODS

Larvae of *S. latifascia* collected during an outbreak in sweet potato *(Ipo-*

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moea batatas) plantations in Mogi Mirim, SP, were reared in the laboratory. Eggs were obtained from laboratory reared adults to initiate the culture. The experiments were carried out utilizing laboratory F2 and F3 populations under normal conditions of temperature and relative humidity, during the summer of 1979.

Tender leaves of three plant species, cotton *(Gossypium hirsutum),* soybean *(Glycine max)* or lettuce *(Lactuca sativa),* were offered daily as food to the larvae. The adults of the three treatments were fed 10% sugar solution.

Rearing and experimental techniques developed by Habib (1978) and Habib & Patel (1977) were used during the present work. Criteria, such as larval duration time, pupal weight and duration time, adult longevity, adult reproductive capacity and natural mortality during the immature stages, were used as measurements to evaluate the food suitability for the development of *S. latisfascia.*

The approximate digestibility (AD) was calculated according to Waldbauer's (1968) formula:

$$AD = \frac{\text{Weight of food utilized (WU)}}{\text{Weight of food ingested (WI)}} \times 100$$

where:
WI = Weight of offered leaves — Weight of leaves left over;
WU = Weight of food ingested — Weight of faeces.

The moisture-Air-Oven method (2 stages) N.° 44-15A, recommended by the American Association of Cereal Chemists (1975) was applied to determine the moisture content of the leaves and consequently the dry weights.

The means of minimum and maximum temperatures as well as the relative humidity were recorded during the experiments. Standard statistical tests were applied in the analysis of the results.

RESULTS AND DISCUSSION

Two natural hosts (cotton and soybean) as well as one rarely attacked in nature (lettuce) were tested to evaluate the suitability of each to sustain populations of *S. latifascia.*

Cotton as well as soybean leaves showed nutritive conditions more adequate than lettuce leaves for growth and development. Mortalities during the whole life cycle in cotton, soybean and lettuce treatments were 5, 8 and 94% respectively.

Most of the larvae which fed on cotton leaves developed through 5 instars (about 69% of the individuals). However, 4 and 6 instars were observed among some individuals of the same treatment. No relation was observed between sex and number of instars. On the other hand, the number of instars observed among larvae which fed on soybean leaves varied from 4 to 8; 6 instars were observed in 54% of the individuals. Also, no relation was observed, in this treatment, between sex and number of instars.

Table 1 shows the duration time, by sex, of the different stages, as well as of the whole life cycle in cotton and in soybean treatments.

The individuals which fed on cotton leaves showed a larval duration time (13.37 days) significantly shorter than those which fed on soybean leaves (16.94 days). This datum, in addition to the lesser natural mortality and more uniform development observed with cotton leaves indicates that a diet of these leaves is more adequate than soybean leaves for the development of this insect.

The pupal duration time observed in cotton leaves treatment (9.51 days) was also shorter than in soybean one (11.42 days) and can be considered as a confirmation of the greater suitability of cotton than soybean leaves. The pupal weights also support our conclusion. The average weight for the cotton treatment was greater than that of the soybean one (0.249 g against 0.146 g, respectively).

Table 1 : Duration time of different stages and complete life cycle, in days, of S. latifascia , in two food treatments.

	Cotton leaves				Soybean leaves			
	Females (n=48)		Males (n=48)		Females (n=44)		Males (n=44)	
	$\bar{x} \pm$ sd	Range	$\bar{x} \pm$ sd	Range	$\bar{x} \pm$ sd	Range	$\bar{x} \pm$ sd	Range
Larval	13.83 ± 0.51	10-19	12.90 ± 0.26	11-15	17.95 ± 0.71	11-24	15.93 ± 0.51	14-18
Prepupal	1.42 ± 0.10	1- 2	1.27 ± 0.09	1- 2	1.41 ± 0.10	1- 2	1.40 ± 0.13	1- 2
Pupal	9.50 ± 0.22	8-12	9.90 ± 0.14	9-11	11.40 ± 0.27	9-13	11.80 ± 0.36	8-14
Mated adults	13.17 ± 0.86	6-19	13.73 ± 0.56	9-18	12.27 ± 0.58	10-22	12.40 ± 0.71	6-16
Life cycle	39.92 ± 1.03	32-50	39.77 ± 0.55	35-45	44.45 ± 1.28	34-55	42.87 ± 0.89	35-47

mean conditions : 30.42°C (max.), 23.12°C (min.); 69.84% R.H.

sd = Standard deviation

All the parameters showed highly signigicant differences between cotton and soybean treatments.

It can be concluded that soybean leaves are not as adequate as cotton leaves for the growth and development of larval, as well as for pupal stages of *S. latifascia.*

The average approximate digestibility (AD) of cotton leaves fed upon by mature larvae was 81.33%, while the AD in the soybean treatment averaged 75.14%. This also confirms the greater suitability of cotton as a host plant for *S. latifascia* than soybean.

The larval diet also affected the adult life. An average longevity of 13.18 days was observed in adults of larvae fed on cotton leaves, while on soybean leaves the adults showed a shorter life span (an average of 12.33 days).

The last indicator used in our evaluation was reproductive capacity. Table 2 shows that the oviposition period of females reared on cotton leaves was much longer than that of females fed soybean leaves. Also, the total number of eggs deposited, as well as the number per female per day, was much higher in adults from cotton leaves than those whose larvae fed upon soybean leaves.

Table 2 : Pre-, oviposition and post-oviposition periods, in days, as well as reproductive capacity, in females of S. latifascia, in two food treatments.

	Cotton leaves (48)		Soybean leaves (44)	
	$\bar{x} \pm sd$	Range	$\bar{x} \pm sd$	Range
Pre-oviposition	4.11 ± 0.21	2- 6	4.62 ± 0.47	2- 7
Oviposition	7.83 ± 0.54	5-14	5.32 ± 0.77	1-10
Post-oviposition	2.50 ± 0.33	1- 6	3.08 ± 0.86	1-13
Eggs / female	1309 ± 96.6	176-3020	597 ± 62.1	28-1272
Eggs/Female/day	166 ± 12.9	35- 614	98 ± 9.3	12- 233

mean conditions: 29.91°C (max.), 24.23°C (min.); 70.08% R.H.

From all of these data, it is evident that the army worm *S. latifascia* developed more successfully on cotton leaves than on soybean ones. Based on this conclusion, it can be expected that, in nature, cotton plantation could be more threatened by this insect species than soybean plantations. Also, the utilization of cotton leaves as a natural diet in mass rearing of *S. latifascia* can be recommended.

When lettuce leaves were offered to *S. latifascia* larvae, the individuals did not develop adequately in any of the trials. Only 5.5% of 200 individuals reached the adult stage. Only one mated female deposited eggs (only 47 eggs). The larval stage suffered an average of 46.2% mortality, while in the prepupal and pupal stages 38.7 and 11.6% respectively of the insects died.

The high mortality observed in this treatment was a result of an activation of a mixed latent disease (viral and microsporidian) presumably provoked by nutritional deficiencies of lettuce leaves.

The older larvae showed the pathological symptoms more evidently and had a higher mortality than the younger ones. The diseased larvae showed reduction followed by total cessation of feeding. Digestive disturbances indicated by dysentery and diarrhea were observed. Sluggishness and flacidity were detected, indicating general disfunction and tissue deterioration. The hemolymph of these larvae had high densities of microsporidian spores and NPV inclusions.

Based on the morphological and cytological features of the microsporidian pathogen, as well as comparisons with Kramer (1965) and Pilley (1976) descriptions, the agent is tentatively identified as *Vairimorpha* sp. (Microsporidia, Nosematidae). Both microsporidian and NPV infections are relatively common in noctuid larvae (Tanada & Chang, 1962; Kramer, 1965; Maddox, 1968; Pilley, 1976; Andrade, 1981; Patel, 1981).

REFERENCES

American Association of Cereal Chemists, 1975. *Approved methods of the American Association of Cereal Chemists.* AACC, INC, St Paul, Minnesota.

Andrade, C. F. S., 1981. *Estudos ecológicos e patológicos da poliedrose nuclear de* Alabama argillacea *(Hbn., 1818) (Lepidoptera, Noctuidae).* Tese de Mestrado, UNICAMP, Campinas.

Bertels, A., 1953. Pragas de solanáceas cultivadas. *Agros, Pelotas 6*(4): 154-160.

Bertels, A., 1962. Insetos-hospedes de solanáceas. *Iheringia 25:* 1-11.

Habib, M. E. M., 1978. Effects of various larval and adult diets on the American cotton leafworm, *Alabama argillacea* (Hbn., 1818) (Lepidoptera, Noctuidae). *Z. angew. Ent. 85:* 218-224.

Habib, M. E. M. & P. N. Patel, 1977. Biology of *Heliothis virescens* (Fabricius, 1781) (Lepid., Noctuidae) on two host plants in the laboratory. *Indian J. agric. Sci. 47*(11): 537-539.

Hambleton, E. J., 1939. Notas sobre os lepidópteros que atacam os algodoeiros do Brasil. *Arqos Inst. biol., S Paulo 10:* 235-248.

Kramer, J. P., 1965. *Nosema necatrix* sp. n. and *Thelohania diazoma* sp. n., microsporidians from the armyworm *Pseudolatia unipunctata* (Haworth). *J. inv. Pathol. 7:* 117-121.

Lara, F. M., S. Silveira Neto & J. T. Barbosa, 1976. Coleta de alguns noctuídeos com armadilhas luminosas instaladas em diferentes alturas e fases lunares. *Científica 4*(1): 59-63.

Lima, A. M. C., 1950. *Insetos do Brasil 6*(2) (Lepidoptera). Escola Nacional de Agronomia (Série Didática n.° 8), Rio de Janeiro.

Maddox, J. V., 1968. Generation time of the microsporidian, *Nosema necatrix,* in larvae of the armyworm, *Pseudolatia unipunctata. J. inv. Pathol. 11:* 90-96.

Mendes, L. O. T., 1938. Observações sobre alguns insetos coletados sobre algodoeiro durante os anos de 1936 e 1937. *J. Agron., Piracicaba 1*(2): 149-163.

Patel, P. N., 1981. *Estudos de fatores bióticos de controle natural em populações de* Spodoptera frugiperda *(Lepid., Noctuidae).* Tese de Mestrado, UNICAMP, Campinas.

Pilley, B. M., 1976. A new genus, *Vairimorpha* (Protozoa: Microsporidia), for *Nosema necatrix* Kramer 1965: Pathogenicity and life cycle in *Spodoptera exempta* (Lepidoptera, Noctuidae). *J. inv. Pathol. 28:* 177-183.

Silva, A. G., C. R. Gonçalves, D. H. Galvão, A. J. L. Gonçalves, J. Gomes, N. N. Silva & L. Simoni, 1968. *Quarto catálogo dos insetos que vivem nas plantas do Brasil, seus parasitos e predadores,* Parte 2, 1.° tomo, 622 pp. Ministério da Agricultura, Departamento de Defesa, Rio de Janeiro.

Szumkowski, W., 1955. Observaciones sobre la biología de algunos Coccinellidae (Coleoptera). *Boln Ent. venez. 11:* 77-96.

Tanada, Y. & G. Y. Chang, 1962. An epizootic resulting from a microsporidian and two virus infections in the armyworm, *Pseudolatia unipunctata* (Haworth). *J. inv. Pathol. 4:* 129-131.

Waldbauer, G. P., 1968. The consumption and utilization of food by insects, *in* J. W. Beament, J. E. Treherne & V. B. Wigglesworth, eds., *Advances in Insect Physiology 5:* 229-282. Academic Press, New York & London.