Induction of Sexual Sterility in the
Egyptian Cotton Leafworm, *Spodoptera*
littoralis BOISDUVAL, by Feeding of
Certain Compounds to Adults
(Lepidoptera : Noctuidae)¹

The success of alkylating agents; apholate, metepa and tepa, in inducing complete sterility in the Egyptian cotton leafworm *Prodenia litura* F. (= *Spodoptera littoralis* BOISDUVAL) when fed to adults (TOPPOZADA *et al.*, 1966) has encouraged the search for innocuous chemosterilants of rather more potency. TOPPOZADA *et al.* (1966) concluded that tepa was the most effective compound studied; it was almost 15 times as effective as either apholate or metepa.

Therefore, tepa was re-evaluated in the present study to admit a reliable comparison with some other compounds of less hazards (cf. PENCE, 1963; CHANG *et al.*, 1964) when offered in honey water to adults of *S. littoralis*. These compounds were the non-alkylating analogue of tepa (hempa; hexamethyl phosphoramidate), the anti-metabolite for histamine (imidazole; glyoxaline or 1,3-diazole) and the pyrimidine analogue (5-fluorouracil).

MATERIAL AND METHODS

Test moths were derived from the homogeneous and insecticide-susceptible laboratory culture maintained at $27 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ R.H. as described by EL-IBRASHY and CHENOUDA (1970). The experiments were carried out under a constant temperature of $30 \pm 0.1^\circ\text{C}$ and uncontrolled relative humidity.

Freshly emerged moths (14–20 out of each sex) were used for each concentration of every chemical tested. Sexes were held isolated for 24 hrs in jars provided with a cotton-tuft saturated with a 10% honey water incorporated with the desired concentration of the chemical. Each treated moth was subsequently allowed to mate with an untreated opposite sex in a glass cup furnished with a cotton-tuft saturated with plain honey solution. Another group with the same number of moths was kept in couples at 24 hrs after emergence that has been continually fed since eclosion on untreated honey solution to be used as a check for treated insects. Maintenance

of pairings for egg laying was quite similar to that described by EL-IBRASHY (1971). The extent to which the compound affected the fertility of the moths was determined on the basis of the egg hatchability according to CHAMBERLAIN's formula (1962).

RESULTS AND DISCUSSION

Using the sterilizing concentration level as the index of sterility in adults of *S. littoralis* (Table 1), hempa appeared the most effective sterilant tested against both sexes (the least amount required for complete sterility; 0.005% in females and 0.010% in males). 5-fluorouracil seemed unpromising due to its limited solubility in water. However, imidazole was the most promising of the 4 compounds studied when both adult longevity and sterility were considered altogether.

Our adult sterilizing concentration of tepa for either sex of *S. littoralis* (0.080%) was similar to that reported by TOPPOZADA *et al.* (1966) for the same insect. However, adult females were generally more sensitive than adult males to the sterilant activity of imidazole or hempa (sterilizing concentrations were lower in females). The sterilizing concentrations of all the compounds tested appeared to decrease the number of eggs laid in treated females as well as in untreated females mated to sterilized males. Nevertheless, the number of eggs laid at the substerilizing concentrations had in some cases no apparent relationship with the concentration used. The insignificant increase or decrease in the number of eggs laid was perhaps due largely to the fact that the compounds offered to insects were formulated in 10% honey water and hence no information on the exact amount of treated honey solution the insects have sipped, so it was not known how much of a candidate compound the insects might have received.

TOPPOZADA *et al.* (1966) found that males of *S. littoralis* were sterilized as 24-hour-old adults when they ingested apholate, metepa, or tepa. Tepa was nearly 15 times as effective as apholate or metepa. In other tests, the sterilizing concentrations for both sexes were about the same. It is conceivable then to conclude generally that alkylating agents (tepa, metepa, and apholate) are less effective as chemosterilants for either sex of *S. littoralis* than either hempa; a non-alkylating

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Table 1. EFFECT OF CERTAIN CHEMOSTERILANTS OFFERED FOR 24 HOURS TO NEWLY ECLOSED ADULTS OF *Spodoptera littoralis* AT DIFFERENT CONCENTRATIONS IN 10% HONEY WATER UPON LONGEVITY AND EGGS VIABILITY

Compound	Concen- tration	Treated ♀ ♀				Treated ♂ ♂			
		Mean adult longevity (days)	Mean eggs laid per ♀ ± S.E.	Mean eggs hatched per ♀ ± S.E.	Eggs viability % decrease (corrected)	Mean adult longevity (days)	Mean eggs laid per ♀ ± S.E.	Mean eggs hatched per ♀ ± S.E.	Eggs viability % decrease (corrected)
Tepa (n=18)	0.100%	6.3	637.6 ± 152.1	0.0	100.0	5.2	636.9 ± 175.0	0.0	100.0
	0.080	6.7	566.5 ± 109.2	0.0	100.0	7.9	754.6 ± 157.4	0.0	100.0
	0.050	6.4	555.8 ± 157.9	121.3 ± 33.4	92.0	6.6	663.0 ± 181.0	191.9 ± 68.4	87.3
	0.030	6.6	863.5 ± 163.1	170.7 ± 66.2	88.7	6.4	523.1 ± 135.8	211.1 ± 89.9	86.1
	0.010	6.6	1020.4 ± 181.4	371.4 ± 104.0	75.5	7.1	841.0 ± 155.5	328.6 ± 114.2	78.3
	0.008	6.8	1404.0 ± 201.1	1026.8 ± 213.4	32.8	7.2	1208.8 ± 212.2	908.7 ± 120.0	40.0
Check (n=18)		9.3	1781.7 ± 311.2	1514.5 ± 206.0		9.4	1781.7 ± 311.2	1514.5 ± 206.0	
Hempa (n=15)	0.010	6.8	269.4 ± 94.4	0.0	100.0	5.6	483.9 ± 100.2	0.0	100.0
	0.008	6.7	311.5 ± 100.0	0.0	100.0	6.5	413.7 ± 112.2	78.1 ± 23.0	94.0
	0.005	6.7	285.6 ± 80.5	0.0	100.0	7.0	1585.7 ± 289.6	99.2 ± 22.8	92.4
	0.002	6.4	300.1 ± 81.8	45.3 ± 13.3	96.5	6.9	1710.3 ± 255.6	312.4 ± 99.6	75.9
	0.001	6.2	786.2 ± 104.4	171.3 ± 82.3	86.3	7.0	1618.4 ± 255.3	690.3 ± 96.4	46.8
		9.3	1553.0 ± 164.2	1297.6 ± 196.6		9.5	1553.0 ± 164.2	1297.6 ± 196.6	
Check (n=15)									
	0.100	9.4	526.8 ± 189.4	0.0	100.0	10.1	985.3 ± 181.0	0.0	100.0
	0.010	8.5	738.2 ± 108.7	0.0	100.0	9.6	1342.0 ± 240.3	346.2 ± 172.2	72.2
	0.008	8.8	625.1 ± 119.2	81.2 ± 21.4	93.4	9.8	1261.7 ± 202.0	937.8 ± 197.7	27.7
	0.005	10.1	887.3 ± 126.0	106.6 ± 24.1	91.8	9.4	1754.5 ± 271.7	977.8 ± 211.1	24.6
	0.002	9.4	1161.2 ± 180.7	387.3 ± 101.2	70.2	10.2	1185.5 ± 161.8	1084.9 ± 198.5	16.4
Check (n=15)	0.001	9.8	1442.0 ± 222.2	1007.8 ± 204.0	22.3	10.3	1703.2 ± 226.3	1578.3 ± 213.5	-21.6
		9.3	1553.0 ± 164.2	1297.6 ± 196.6		9.5	1553.0 ± 164.2	1297.6 ± 196.6	
5-fluorouracil (n=20)	0.100	9.1	572.2 ± 110.1	0.0	100.0	10.4	1080.0 ± 214.4	489.5 ± 121.0	34.5
	0.080	8.9	1093.5 ± 181.6	182.3 ± 71.0	75.5	10.1	1120.1 ± 131.2	571.7 ± 140.0	23.5
	0.050	10.1	1082.2 ± 203.3	654.6 ± 66.6	12.4	11.2	1138.0 ± 124.4	748.7 ± 167.8	-0.2
	0.030	9.0	1386.3 ± 336.7	1101.0 ± 200.3	-47.3	9.9	1170.3 ± 202.0	816.5 ± 198.1	-9.3
		9.6	1062.7 ± 142.8	747.3 ± 130.2		9.5	1062.7 ± 142.8	747.3 ± 130.2	
	Check (n=20)								

n=Number of individuals of each sex used for each chemical concentration, while in check groups it denotes number of couples.

analogue of tepa, or imidazole; an antihistaminic compound. This might aid the chemists in synthesizing new compounds (by correlating structure with biological, i.e. sterilizing, activity or help entomologists to select better compounds to sterilize such an economically important insect.

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Preliminary Assay of Antifeeding Chemicals for the Brown Planthopper, *Nilaparvata lugens* (STÅL)¹ (Hemiptera: Delphacidae)

The chemicals which inhibit the insect from feeding represent a different approach to plant protection. The induced plant resistance by such chemicals is of value to substitute or augment varietal resistance, and can play the role of a desirable partner in integrated control programs for crop pests. A number of chemicals displaying antifeeding properties against various chewing insects have been reported by many workers, for examples triazenes, triphenyltins, phenylcarbamates, etc. (WRIGHT, 1967). However informations on antifeeding chemicals for plant-sucking insects have been very meager. MITTLER (1967) observed that histidine, glutamic acid and arginine have a slightly deterrent effect on the feeding of *Myzus persicae* (SULZER). Also DAHLMAN and HIBBS (1967) have studied the feeding responses of the potato leafhopper, *Empoasca fabae* (HARRIS) to solanaceous alkaloids, and found that tomatine, solanine, solanidine, demissidine and leptine I reduce the rate of initial imbibition of the leafhopper.

It is the purpose of this paper to present the results obtained from preliminary screening tests on the antifeeding activities of various amino acid

derivatives against the brown planthopper, *Nilaparvata lugens* (STÅL), an insect pest of economic significance, which causes serious damage to rice crops by sucking the plant sap.

More than 50 commercially available amino acid derivatives, including D-isomers of amino acids, were screened against the female adult of the laboratory-reared brown planthopper. Each chemical to be tested was dissolved in 5% sucrose solution at a concentration of 1000 ppm, and applied to the insects through a stretched parafilm membrane. Saturated solutions were used when the solubility of the chemicals was less than 1000 ppm. The several effective chemicals were further tested at lowered concentrations of 100 and 10 ppm. The method used for evaluation of antifeeding activities of the chemicals is the same as that described by SŌGAWA (1971) for testing the phagostimulative effect of amino acids and sugars, where, the value of the ratio of honeydew droplets excreted to probings attempted during the test period (24 hrs) was used as an index of the feeding response of insects to the dietary solutions containing each of the chemicals to be tested.

The results are shown in Table 1. Among the chemicals tested, decarboxylated derivatives of aromatic amino acids, such as hordenine, methoxytryptamine, noradrenaline, phenethylamine, serotonin, tryptamine and tyramine

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