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SUPPRESSION OF THE POPULATION OF DIACRISIA OBLIQUA WLK. BY CHEMOSTERILIZATION

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ABSTRACT

Bisazir sterilized both the sexes of Diacrisia obliqua Wlk, but it's sterility action was more pronounced on males rather than females. Different pairing experiments exert considerable influence on the susceptibility of the experimental insect in inducing sterility. Both the treated sexes when paired together produced maximum sterility effect. The order of efficacy was treated male X treated female, treated male X normal female , normal male X treated female. Bisazir when used in final instar larval and adult food exhibited cent percent sterility, when both the sexes were intercrossed at 0.5% and 1% levels, respectively. Bisazir affected the oviposition as well as the hatchability of eggs. The rate of hatchability was lower when males were treated , whereas higher , when only females were treated. There was total control over reproduction at 1 % level, due to the combined effect of Bisazir on the sterility and fecundity. In case of larval feeding treatments, increase in pupal duration and reduction in longevities of both sexes of adults were also noted. The adults were completely tolerant to the toxic action of bisazir, but it produced maximum of 71.4% net mortality at 1% larval feeding concentration. Thus, sterilization of larvae and adults of Lepidopterous pests would be a unique tool for the suppression of it's natural population.

Key words : Chemosterilization, Bisazir, Larval and adult feeding treatment, Lepidopterous pest, Control over reproduction and Population management.

INTRODUCTION

The lepidopterous insect pest selected here for chemosterilization study was Diacrisia obliqua Wlk (Arctidae), commonly known as Bihar hairy caterpillar, is a serious pest of agriculture. It is a notorious pest of jute in Bengal, Bihar, Orissa and Assam. As it is a polyphagous pest, it feeds upon jute, pea, cotton, chrysanthemum, sun-hemp, sesame, castor, mulberry, cowpea, sweet potato, soybean, mustard, turmeric, tobacco, sunflower, groundnut, maize, linseed, lettuce, Lucerne, cabbage and cauliflower etc. The larvae defoliate the plants and move from one field to another. Several lepidopterous pests are suitable subject for eradication by the sterile male technique (Knipling, 1966) and chemosterilants (Borkovec, 1966). However, relatively few compounds have been tested on Lepidoptera and little work has been done with bisazir. The objective of the present investigational study is to find out the suitability of Bisazir (AI3 – 61585) for the population management of *Diacrisia obliqua* .

MATERIALS AND METHODS

Initially the larvae were collected from the sunflower (*Helianthus annus*) field and mass culture was raised in the laboratory. The fresh and clean castor (*Ricinus communis* Linn) leaves were provided twice daily for feeding. Last instar larvae were selected for oral administration as it feeds voraciously and treatment of earlier stages produces heavy or complete mortality of treated individuals. The leaves of host plant were dipped in various concentrations of acetone solution of chemosterilants and air dried for the final instar feeding treatments. The newly emerged virgin moths less than 12 hours of age were collected and placed in individual chimneys. Bisazir (p, p-bis, 1-aziridinyl – N – methyl phosphinothioic amide) was administered orally to adult moths of both sexes for adult feeding treatment. The treated diet (10 % honey mixed sugar solution containing the test compound) soaked in a cotton wick was placed in a small cavity block and moths were allowed to feed for 24 hours. After feeding treatment, the moths were transferred to another chimney with suitable mate. Only one pair was kept inside the chimney, which was provided with fresh succulent leaves for the purpose of egg laying and moths were allowed to feed on 10 % honey mixed sugar solution. All the test crosses were replicated three times. Control experiments were run along, in an identical manner, to know the natural sterility. Eggs laid and eggs unhatched in each experiment was recorded to reveal sterility percentage. Net sterility percentage was calculated after correcting the data with natural sterility (Abbott, 1925). Total control over reproduction (Chamberlain, 1962) was also calculated to record the combined impact of sterility & reduction in fecundity, on reproduction of test insect.

RESULTS AND DISCUSSION

Oral administration of Bisazir to the final instar larvae and adult moths of *Diacrisia obliqua* resulted in significant sterility of the treated individuals. The effect on the inhibition of oviposition was more pronounced on treated females rather than normal females mated with treated males. The net sterility was found to be directly proportional to the concentration. It exhibited a maximum of 98.1 % reduction in fecundity in treated females crossed with treated males at 1.0 % level of concentration of bisazir in case of adult feeding treatment and complete control over reproduction was achieved at 1.0 % in each pairing test. More or less similar observations were reported by the other investigators also. Similarly Young and Cox (1965) found that the oral application of tepa and apholate to male fall army worm, *Spodoptera frugiperda* did significantly reduce the number of eggs laid by untreated females. Probably reduction in fecundity was due to inadequate insemination as reported by Harwalkar *et al.* (1971).

Table 1 : Fecundity, hatching, sterility and control over reproduction in the adults emerging out of the treated larvae

Concentration (%)	Pairing treatment	Avg No. eggs laid per female± S.E.	Avg No. eggs laid per female ± S.E	Hatching (%)	Sterility (%)	Net Sterility (%)	Reduction in fecundity (%)	Control over reproduction (%)
Control	CM X CF	1295.0 ± 3.7	1293.0 ± 3.0	99.8	0.1	--	--	--
	TM X TF	1122.0 ± 2.9	842.3 ± 3.8	75.0	24.9	24.8	13.3	34.8
0.001	TM X NF	1190.3 ± 1.7	951.3 ± 2.1	79.9	20.0	19.9	08.0	26.4
	NM X TF	1156.6 ± 3.6	1007.0 ± 2.4	87.0	12.9	12.8	10.6	22.1
	TM X TF	1119.6 ± 4.1	646.3 ± 2.1	57.7	42.2	42.1	13.5	50.0
0.005	TM X NF	1139.0 ± 1.4	683.3 ± 1.8	59.9	40.0	39.9	12.0	47.1
	NM X TF	1124.0 ± 2.8	731.3 ± 2.8	65.0	34.9	34.8	13.2	43.4
	TM X TF	1014.6 ± 3.5	496.3 ± 1.7	48.9	51.0	51.0	21.6	61.6
0.01	TM X NF	1049.6 ± 2.4	544.6 ± 2.5	51.8	48.1	48.0	18.9	57.8
	NM X TF	1031.6 ± 2.7	596.3 ± 1.6	57.8	42.2	42.1	20.3	53.8
	TM X TF	943.3 ± 3.4	357.6 ± 1.4	37.9	62.0	62.0	27.1	72.3
0.05	TM X NF	1006.6 ± 3.6	434.6 ± 2.5	43.1	56.8	56.7	22.2	66.3
	NM X TF	990.0 ± 2.6	463.6 ± 2.1	46.8	53.1	53.0	23.5	64.1
	TM X TF	762.6 ± 5.4	189.0 ± 1.6	24.7	75.2	75.1	41.1	85.3
0.1	TM X NF	887.0 ± 2.9	245.3 ± 2.3	27.6	72.3	72.3	31.5	81.0
	NM X TF	810.0 ± 1.4	275.6 ± 1.8	34.0	65.9	65.9	37.4	78.6
	TM X TF	627.0 ± 2.5	0.0 ± 0.0	0.0	100.0	100.0	51.5	100.0
0.5	TM X NF	705.0 ± 2.1	104.6 ± 1.3	14.8	85.1	85.1	45.5	91.9
	NM X TF	669.0 ± 1.6	100.6 ± 1.1	15.0	84.9	84.9	48.3	92.2
	TM X TF	446.3 ± 4.9	0.0 ± 0.0	0.0	100.0	100.0	65.5	100.0
1.0	TM X NF	592.0 ± 2.9	0.0 ± 0.0	0.0	100.0	100.0	54.2	100.0
	NM XTF	514.6 ± 3.0	0.0 ± 0.0	0.0	100.0	100.0	60.2	100.0

Net sterility: Concentration treatment = Significant at 1% level; C.D. = 5.2
Pairing treatment = Significant at 1% level; C.D. = 3.4
Reduction Concentration treatment = Significant at 1% level; C. D. = 3.1
In fecundity: Pairing treatment = Significant at 1% level; C. D. = 2.0

Coates and Langley (1982) reported that chemosterilization of *Glossina morsitans morsitans* with bisazir had no apparent deleterious effect upon the ability of males to engage in normal copulatory activity with a female and within the limits of laboratory experimentation, such males compete equally with normal males to secure a mate. Sharma (1994) reported that several chemosterilants had been tested in the laboratory and chemicals as 5-flurocil, thiotepa, tepa, metepa and apholate had given excellent results in the reduction of reproductive capacity as well as in sterility of *Tetranycus urticae, Aphis fabae, Acyrthosiphon pisum, Myzus persicae* and

Macrosiphum euphorbiae .Bisazir exhibited cent percent sterility when both the sexes were intercrossed at 0.5% larval feeding concentration, whereas at 1.0% level each pairing treatment produced complete sterility. Data indicates that the increasing concentration significantly increased the sterilizing activity of the chemical and was significantly more active on male than female. The fecundity of test females was found to be inversely proportional to the feeding concentration but it did not completely inhibit the oviposition. The maximum reduction in fecundity was 65.5%, when both the treated sexes were intercrossed at 1.0% level. Reduction in fecundity was more pronounced on treated female rather than normal female mated with treated male and it was maximum, when both the treated sexes were inter crossed. Due to the combined impact of sterility and reduction in fecundity, the total control over reproduction on female and male was 92.2 and 91.9% at 0.5% level, though the net sterility obtained at this level was 84.9 and 85.1% only respectively.

Table 2 (A): Fecundity, hatching, sterility and control over reproduction in adults

Concentration (%)	Pairing treatment	Avg No. eggs laid per female± S.E.	Avg No. eggs laid per female± S.E	Hatching (%)	Sterility (%)	Net Sterility (%)	Reduction in fecundity (%)	Control over reproduction (%)
Control	CM X CF	1309.0 ± 2.1	1309.0 ± 2.1	100.0	0.0	--	--	--
	TM X TF	988.0 ± 2.1	681.3 ± 3.0	68.9	31.0	31.0	24.5	47.9
0.001	TM X NF	1017.3 ± 1.9	722.3 ± 2.4	71.0	29.0	29.0	22.2	44.8
	NM X TF	1001.6 ± 3.0	789.6 ± 2.5	78.8	21.1	21.1	23.4	39.6
	TM X TF	756.3 ± 7.0	400.3 ± 5.0	52.9	47.0	47.0	42.2	69.4
0.005	TM X NF	835.0 ± 3.0	484.0 ± 1.4	57.9	42.0	42.0	36.2	63.0
	NM X TF	789.3 ± 3.8	512.3 ± 2.8	64.9	35.1	35.1	39.6	60.8
	TM X TF	529.6 ± 3.9	211.0 ± 2.6	39.8	60.1	60.1	59.5	83.8
0.01	TM X NF	590.6 ± 4.3	247.3 ± 2.4	41.8	58.1	58.1	54.8	81.1
	NM X TF	575.6 ± 2.3	287.3 ± 2.7	49.9	50.0	50.0	56.0	78.0
	TM X TF	307.0 ± 2.4	57.0 ± 1.2	18.5	81.4	81.4	76.5	95.6
0.05	TM X NF	349.6 ± 3.1	97.3 ± 1.5	27.8	72.1	72.1	73.2	92.5
	NM X TF	323.3 ± 1.8	121.6 ± 1.3	37.6	62.3	62.3	75.2	90.7
	TM X TF	190.6 ± 2.9	0.0 ± 0.0	0.0	100.0	100.0	85.4	100.0
0.1	TM X NF	269.3 ± 3.2	40.3 ± 2.1	14.9	85.0	85.0	79.4	96.9
	NM X TF	216.3 ± 2.6	45.0 ± 1.8	20.8	79.2	79.2	83.4	96.5
	TM X TF	74.6 ± 2.2	0.0 ± 0.0	0.0	100.0	100.0	94.2	100.0
0.5	TM X NF	107.6 ± 5.0	0.0 ± 0.0	0.0	100.0	100.0	91.7	100.0
	NM X TF	85.0 ± 1.6	5.0 ± 1.8	5.8	94.1	94.1	93.5	99.6
	TM X TF	24.0 ± 1.8	0.0 ± 0.0	0.0	100.0	100.0	98.1	100.0
1.0	TM X NF	56.0 ± 2.1	0.0 ± 0.0	0.0	100.0	100.0	95.7	100.0
	NM XTF	34.3 ± 1.2	0.0 ± 0.0	0.0	100.0	100.0	97.3	100.0

Net sterility: Concentration treatment = Significant at 1% level; C. D. = 6.9
Pairing treatment= Significant at 1% level; C. D. = 4.5
Reduction Concentration treatment = Significant at 1% level; C. D. = 1.6
In fecundity: Pairing treatment = Significant at 1% level; C. D. = 1.0

Table 2 (B):Relative sterility of Bisazir against the adults of Diacrisia obliqua Wlk., when treated orally

Pairing Treatment	Heterogeneity	Regression equation	SC_{50} Fiducial	Relative	
				Limits	Sterility
TM X TF		$Y = 1.77_x + 9.31$	0.0037	0.4349 – 3.1215	2.70
TM X NF	$X^2_{(12)} = 3.90$	$Y = 1.63_x + 8.60$	0.0063	0.2614 – 3.5266	1.58
NM X TF		$Y = 1.33_x + 7.66$	0.0100	0.0100 – 2.6601	1.00

Maria (2003) reported that diflubenzuron, lufenuron and teflubenzuron efficiently controlled the caterpillars of *Anticarsia gemmatalis* (soybean pest). Alemany *et al*. (2008) reported a pest management programme using the chemosterilant lufenuron against Mediterraean fruit fly, *Ceratitis capitata* in Mallorca island (Spain). Shakeet and Bakshi (2010) reported that the sub-lethal doses of Monocrotophos produce significant sterility effect on the gonads of *Chrotogonus trachypterus* (Blanchard).

Table 3: Mortality and longevity effect in the final instar larval feeding treatment of *Diacrisia obliqua* Wlk. with Bisazir

Concentration (%)	Total No. of larvae treated	Total No. of larvae pupated	Total No. of larvae and pupal dearh	Mortality (%)	Net mortality (%)	Average of pupal period (days)	Increase in pupal period (days)	Average longevity of moths (days)		Reduction in longevity of moths (%)	
								Male	Female	Male	Female
Control	50	49	01	02	--	08.1	--	6.4	7.7	--	--
0.001	50	49	01	02	00.0	09.0	11.1	6.0	7.6	6.2	1.2
0.005	50	46	05	10	08.1	09.5.	17.2	6.1	7.4	4.6	3.8
0.01	50	43	09	18	16.3	10.4	28.3	6.0	7.0	6.2	9.0
0.05	50	36	14	28	26.5	11.7	44.4	6.2	7.0	3.1	9.0
0.1	50	25	29	58	57.1	11.5	41.9	6.3	7.1	1.5	7.7
0.5	50	23	32	64	63.2	11.0	35.8	6.1	7.1	4.6	7.7
1.0	50	19	36	72	71.4	11.7	44.4	6.0	7.1	6.2	7.7

Bisazir neither produced mortality nor deformity in case of adult feeding treatment. There was no change in the life span of treated adults when compared with control. Similarly Young and Snow (1967) reported no apparent increase in mortality when corn ear worm (*Heliothis zea* Boddie); army worm (*Pseudaletia unipuncta* Haworth) and granulate cut worm (*Feltia subterranea* F.) were treated with as much as 53 µg tepa. But increase in larval feeding concentration increased the net mortality and resulted in prolongation of pupal duration as well as reduction in adult life span. In addition some of the treated larvae could not completely moult and some adults emerging out of treated larvae showed deformity. Bisazir exhibited it's deformity action by the formation of larva-pupa and pupa-adult intermediates showing larval-pupal and pupal-adult mosaic features. Deformed adults mainly carried wing deformity. This is in accordance with the observations of Srivastava and Khan (1988) in *Pericallia ricini* Fabr, where sub-lethal doses of penfluron produced a number of larva-pupa and pupa-adult intermediates.

REFERENCES

Abbott, W.S. (1925) A method of computing the effectiveness of an insecticide. *Journal of Economic Entomology*, 18: 265-267.

Alemany, A., Gonzalez, A., Juan, A., and Tur, C. (2008) Evaluation of a chemosterilization strategy against *Ceratitis capitata* (Diptera: Tephritidae) in Mallorca island (Spain). *Journal of Applied Entomology*, 132 (9-10): 746-752.

Borkovec, A. B. (1966) Insect chemosterilants. *Advanced Pest Control Research*, 7: 143.

Chamberlain, W. F. (1962) Chemical sterilization of the screw worm. *Journal of Economic Entomology*, 55: 240-248.

Coates, T. W., and Langley, P. A. (1982) Laboratory evaluation of contact sex pheromone and Bisazir for autosterilization of *Glossina morsitans*. *Entomologia Experimentalis et Applicata*, 31 (2-3) : 276-284.

Harwalkar, M. R., Khaire, S. N., and Rahalkar, G. W. (1971) Chemosterilization of potato Tuberworm: I. Effect of metepa on the fertility of males. *Journal of Economic Entomology*, 66: 358-361.

Knipling, E. F. (1966) Further consideration of the theoretical role of predation in sterile insect Release programs. *Bulletin Entomological Society of America*, 12: 361-364.

Maria, Santa. (2003) Control of *Anticarsia gemmatalis* Hubner (Lepidoptera: Noctuidae) with insect growth regulators. *Ciencia Rural*, 33 (4): 601-605.

Sharma, M. L. (1994) Chemical sterilants, virus vectors, insect control. *ISHS Acta Horticulturae :XI International Symposium on Fruit tree virus diseases.*

Srivastava, B.B.L., and Khan, M. Maqsood (1988) Contact toxicity of penfluron on Pericallia *ricini* Larvae. *Indian Journal of Agricultural Sciences*, 58 (3): 240-241.

Young, J. R. and Cox, H.C. (1965) Evaluation of apholate and tepa as chemosterilants for the fall army worm. *Journal of Economic Entomology*, 58: 883-887.

Young, J. R. and Snow, J. W. (1967) Tepa as a chemosterilant for the corn earworm, army worm and granulate cut worm . *Journal of Economic Entomology*, 60: 1427-1430.