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Integrated Control of Whitegrub, *Holotrichia serrata* F. on Sugarcane

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ABSTRACT

Experiments were conducted to study the methods of controlling *Holotrichia serrata* F. in sugarcane through mechanical, chemical and biological means. While mechanical collection of the grubs proved successful the timely application of fensulfothion or quinalphos granule controlled the pest and increased the yield. *Bacillus popilliae* was also effective to control the grub.

INTRODUCTION

Whitegrubs have become important pests of sugarcane in the country during the last two decades. Three species *Holotrichia serrata* F., *H. consanguinea* Blanch and *Anomala bengalensis* Blanch, of which the former is more common, are important pests of sugarcane in South India. As the visible symptoms of damage appear late, when the damage to root is almost complete, the crop suffers heavy losses. Considerable difficulty has been experienced in controlling this pest effectively with any single method of control and so different methods of control of this pest were tried to check this pest during the epidemic period from 1971 to 1973.

MATERIALS AND METHODS

Chemical control experiments were conducted form 1972 to 1975 with a view to study the efficacy of seven insecticides, viz. BHC dust, and fensulfothion, disulfoton, phorate, dyfonate, quinalphos and chlorfenvinphos granules. These were applied through soil in two doses, one at planting as a whole and another in equally split doses of half at planting and half at 90th day after planting, coinciding with the period of grub activity in the crop. Observations on grub population, millable canes and yield at harvest in the different treatments were made.

Biological control of the grubs was tried with an exotic and local strain of *Bacillus popilliae* Dutky and *B. lentimorbus* Dutky in laboratory tests. Pathogenicity tests were first conducted by injection of the bacterial spores prepared in sterile water at a concentration of 1 million spores per grub (3rd instar) using an 'Agla' microsyringe, after adjusting the spore concentration with a haemocytometer. Control grubs were given plain sterile water injection of the same quantity. The grubs were then allowed to feed on sugarcane roots of plants grown

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in sterile soil. The progress of infection and mortality of grubs were observed. Subsequently multiplication of *B. popilliae* strains was done by the same method of injecting bacterial suspension in second and third instar grubs. With the spores thus obtained different methods of inducing infection in healthy grubs were tested in the laboratory with potted plants in sterile soil.

Another experiment was planted with 46 commercial varieties to test their resistance/susceptibility for whitegrubs. The experiment was replicated thrice and artificial inoculation of 2nd and 3rd instar grubs was done at 20 per row during June to ensure uniform infestation. Observations on extent of damage in roots, underground cane stalk, weight of roots and other associated attributes were made to assess the relative resistance/susceptibility shown by the commercial varieties for grub attack.

Visual observations on the usefulness of agronomic practices like deep ploughing, ratoon crop etc. were made on the grub incidence in the problem fields in the farm.

RESULTS AND DISCUSSION

The night observations of beetles during 1972-74 showed that the beetles were not attracted to light. These were however easily collected from feeding trees which were highly preferred like *Melia azadirachta* and *Ailanthus* sp. by shaking them down and killing them in kerosene. On an average 150 to 250 beetles were collected by two labourers in two hours between 8 and 10 p.m. during the peak period of emergence.

The critical stage for the control of the beetles is the period of mass emergence during March to June, varying in different localities according to the climate and species of the beetle. Showers of rain during this period greatly stimulate the beetle activity. Mechanical control campaigns conducted during nights when these are active, have been reported to be successful in Karnataka by Veeresh (1974), who also found that spraying the feeding trees with parathion, endrin or carbaryl is useful in killing the beetles. The removal of superfluous feeding trees from the vicinity of sugarcane fields also helps in reducing the grub menace. Use of light traps has been successful in the case of *H. consanguinea*.

Preliminary pathogenicity tests on the second and third instar grubs with three strains of bacteria established their ability to parasitise *H. serrata* (Table I). However, further work on biological control was carried on only

TABLE I. Infection of the whitegrub *H. serrata* by the milky disease bacteria.

Treatment	Number of grubs infected and surviving	Percent infection
Bacillus popilliae (exotic strain)	385	75.1
Control	35	Nil
B popilliae (local strain)	387	66.9
Control	50	Nil
B. lentimorbus (exotic strain)	96	42.7
Control	20	Nil

TABLE II. Efficacy of different methods of inoculation of two strains of *B. popilliae* in pot studies

Treatment	Strength (spore load)	Local strain		Exotic strain	
		Total grubs inoculated and surviving	Percent infection	Total grubs inoculated and surviving	Percent infection
Feeding healthy grubs in spore suspension for 15 minutes	1 million spores/ml	43	53.5	37	48.6
Soil inoculation with infected grubs after maceration	—do— (500 ml in 4 kg of soil)	43	56.3	36	47.2
Pouring suspension of bacteria	—do—	44	52.3	32	34.4
Sterilised roots dipped in spore suspension for 15 minutes	1 million spores/ml	39	61.5	42	50.0
Control	500 ml of sterile water	19	0.0	20	0.0

with the two strains of *B. popilliae* as the extent of infection by *B. lentimorbus* was low. The grubs infected by *B. popilliae* became milky white in appearance at the posterior side in 15-25 days, as the blood became turbid. The grubs continued to feed on the roots and subsequently the body colour changed completely to milky white. These infected grubs did not moult or pupate, but died in about two months. The results of the different methods of soil inoculation tried are given in Table II. This proved the ability of the pathogen to infect the grub when inoculated orally.

The observations on the performance of varieties in resisting whitegrub attack showed that varieties varied considerably in regard to damage sustained by them as a result of whitegrub attack. Among the 46 varieties tested, eight have shown promise of resistance to grub attack and these and four other susceptible varieties are compared in Table III, with regard to extent of damage to roots and canes. The varieties Co. 285, Co. 453, Co. S. 510 and Co. 6304 are relatively resistant. Visual observations on grub infestation in plant and ratoon crops showed that ratoons were more heavily attacked. Deep ploughing of the fields

TABLE III. Varietal behaviour in sugarcane to whitegrub damage

Variety	Extent of damage to	
	Roots	Canes
Co. 285	Low	Low
Co. 453	Medium	Medium
Co. 975	Medium	Medium
Co. 1158	Low	Medium
Co. 6304	Medium	Heavy
Co. 6902	Medium	Medium
Co. S 510	Low	Low
Co L. 29	Medium	Low
Co. 449	Heavy	Heavy
Co. 740	Heavy	Heavy
Co. 775	Heavy	Heavy
Co. 62175	Heavy	Heavy

TABLE IV Influence of insectidal treatments on population of grubs, millable canes and yield

Treatment		Population of Grubs Mean (squre root) per 1/500 ha	Millable canes per 1/250 ha kg	Yield of cane per 1/250 ha
BHC dust 10 kg a. i./ha	— 1 application	7.43	236.25	318.70
—do—	— 2 application	7 12	224.50	298.50
Fensulfothion 5G 5kg a. i./ha	— 1 application	5.09	243.00	323.60
—do—	— 2 application	3.22	285.25	388.97
Disulfoton 5G 5 kg a. i./ha	— 1 application	6.92	227.75	286.02
—do—	— 2 application	6.43	226.50	220.02
Phorate 10G 5 kg a. i./ha	— 1 application	7.12	228.75	316.55
—do—	— 2 application	6.86	228.25	309.30
Dyfonate 10G 5 kg a. i./ha	— 1 application	5.48	231.25	310.10
—do—	— 2 application	6.29	248.75	332.75
Quinalphos 5G 5 kg a. i./ha	— 1 application	6.86	213.50	249.14
—do—	— 2 application	4.79	250.00	340.42
Chlorfenvinphos E. C. 24 5 kg a. i./ha	— 1 application	6.60	210.50	270.47
—do—	— 2 application	6.45	220.50	289.10
		7.40	210.25	255.92
	C. D. (P=0.05)	1.18	32.24	38.00

after harvest exposed large number of grubs, pupae and beetles, wnich were immediately fed by crows and mynahs.

The grub population in the field is appreciably reduced by timely application i.e. during May-June, of fensulfothion (Dasanit) or quinalphos (Ekalux) granules 5% at 40 to 50 kg/ha (2 to 2.5 kg a.i./ha). This insecticidal treatment not only reduces the grub population, but gives higher number of millable canes and enhances the yield of the crop (Table IV), thus compensating for the high investment cost of insecticide.

The results of the laboratory studies on the infection of the grubs with bacteria show that this can be also used to advantage in problem areas. Its natural occurrence in Coimbatore area gives the added possibility of its sucessful colonization in problem areas, after multiplying the pathogen in the laboratory. Further work on this aspect is necessary, before field application of the pathogen can be recommended.

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