WHITE GRUBS (SCARABAEOIDEA) CONTINUE TO CAUSE SPORADIC DAMAGE TO SUGARCANE IN SOUTH AFRICA AND SWAZILAND

By A. J. M. CARNEGIE

South African Sugar Association Experiment Station, Private Bag X02, Mount Edgecombe 4300

Abstract

During recent years at least 5 species of scarab beetles have been associated with damage to sugarcane in various parts of Natal, the Transvaal, and Swaziland. The history of such damage is reviewed briefly, and mention made of recent insecticide trials on ratoon crops. Chemicals tested included aldicarb (granular), carbofuran (granular), carbosulfan (controlled release), chlorpyrifos (CR), ethoprofos (granular), isazofos (emulsifiable concentrate), and oxamyl (EC and CR).

Introduction

Many species of indigenous Scarabaeoidea have been recorded from sugarcane fields in southern Africa and several have been associated with economic losses. Investigatory work has been limited, and has been confined to those few species which have occurred in sufficient numbers to cause alarm, or which have been identified as important crop spoilers. Some species, eg *Heteronychus licas* Klug, have been associated almost entirely with irrigated fields, and might well not have reached pest proportions in the absence of irrigation. Others are recorded pests of other crops eg *Schizonycha affinis* Boh and *Hypopholis sommeri* Burm feed on wattle and have been troublesome in sugarcane mainly in the vicinity of wattle plantations or on land which was formerly under wattle.

In the past few years the range of white grub damage appears to have expanded, and reports have been received of damage in areas which formerly had been free of these pests. Although damage has not been extensive, it has been locally serious and there have been reports of damage by species which were not recognised before as crop spoilers in those areas.

Life-cycles and population dynamics of various species which attack sugarcane have been considered in some detail by Sweeney[6] and Carnegie.[3] The life-cycle of scarabs follows a typical seasonal pattern and those species studied have usually completed the cycle in one year. Adults emerge and fly in spring and early summer, during which time eggs are laid. Larvae feed on plant tissue or on soil organic matter below ground through the winter months, pupating in late winter or spring. This cycle may become distorted, eg under irrigation in Swaziland adult *H. licas* have been noted in large numbers and caused serious damage to ratoon cane in July.

White grubs are not easy to control. In many cases the adult beetle, which is an active flier, does not damage the crop but serves merely to spread the infestation, by flying from its point of emergence, mating, and ovipositing at the base of a cane plant. The hatched larva remains in the soil, and as it develops feeds on the subterranean plant tissues. The damaging stages of the life-cycle therefore are protected by being underground.

For many years, in some cane-growing countries, white grubs were combated with applications to the soil of such persistent insecticides as dieldrin, aldrin, and benzene hexachloride. For example these were used against many species in Australia, *Cochliotis melolonthoides* (Gerst.) in Tanzania and *H. licas* in Swaziland. In many countries (including South Africa) such persistent insecticides are now banned because, although they may be effective against the target pest, they have apparent disadvantages.

There has been circumstantial evidence of resistance by white grubs to dieldrin in both Tanzania and Swaziland; and in those countries the application of dieldrin against white grubs has been associated with increases in populations of the stalk borer *Eldana saccharina* Walker, presumably because predatory ant populations have been suppressed.

In parts of Australia there is evidence that cane fields treated with dieldrin have subsequently suffered damage by cicadas (*Melampsalta puer* Walk.), which are extremely difficult to control. In Madagascar the experience with the cicada *Yanga guttulata* Signoret, following the use of aldrin, was similar (Williams *et al*[8]). In the past few years an indigenous cicada (awaiting identification) has been associated with damage to ratoons in parts of Swaziland. In a recent report, Williams[7] suggests that the decline in numbers of *H. licas* in Swaziland over the past 20 years may have been natural, and not the result of habitual applications of dieldrin at planting. In South Africa, use of dieldrin against white grubs although effective (Carnegie[3]), has never been widespread; but it has in Zimbabwe, where its efficacy has been demonstrated (Cackett[2]). Clearly the need for an alternative insecticide is apparent and various trials have been conducted in the search for one.

Species abundance and distribution

Heteronychus licas *Klug (Dynastidae)*

Sweeney,[6] in the 1960's, found this species to be by far the most common in Swaziland cane fields (75 to 80% of larvae sampled). All types of soil were equally heavily populated, provided the top 300 mm were moist and the cane less than about 4 months old. Williams,[7] in 1985, found this species commonly throughout Swaziland sugarcane areas, but far less abundantly than it had been 20 years earlier; and on some estates other species, eg *Adoretus* spp. and *Asthenopholis subfasciata* (Blanch.) were far more abundant. However, he visited Swaziland for only one month and could not take full account of possible seasonal fluctuations.

Since the early 1960's this species in particular has been repeatedly associated with damage to sugarcane in Swaziland and, because of it, application of dieldrin or aldrin to planting furrows became a routine procedure.

In South Africa this species has caused damage to cane particularly in the lowveld areas of eastern Transvaal, but also occasionally at Pongola. In recent years there have been severe, but very localised and transient outbreaks in the Nkwalini valley and on the Umfolozi river flats in Northern Natal.

The species is damaging also in the Zimbabwe lowveld where increases in numbers were associated with successive seasons of above-average rainfall. Cane grown on all soils was affected, but that on heavier soils tended to be more heavily infested and stony soils avoided.

The first instar larva appears to feed largely on organic matter in the soil, but both maturing larvae and adults cause severe damage to roots and lower stems.

Hypopholis sommeri *Burm and* Schizonycha affinis *Boh (Melolonthidae)*

These two melolonthids were the subject of an investigation in the Natal Midlands during the 1970's (Carnegie[3]). Both have been recorded as damaging other host plants, including wattle trees (*Acacia mearnsii* De Wild), and it has been where cane was grown alongside wattle plantations or on soil previously under wattle that damage to sugarcane has occurred. Only the larvae feed on sugarcane, crop loss resulting from damage to root tissue and occasionally to the subterranean stem. Adult beetles eat wattle foliage, and in early summer *H. sommeri* may occur in sufficient numbers to bend the branches of trees on which they are feeding.

Until recently records of damage to sugarcane in South Africa by these two species were received only from the Natal Midlands and central inland Zululand, although large numbers of adults of *S. affinis* were frequently abundant in insect light traps in coastal areas.

During 1971 a species of *Schizonycha*, possibly *S. affinis* was on occasions associated with very localised damage in Swaziland. In 1987 damage to ratoon cane by *S. affinis* was noted near the coast at Emoyeni in Natal, and the affected field has been the subject of an insecticide trial. Reports of damage by *S. affinis* were received also from upper Tongaat in Natal.

Asthenopholis minor *Brenske (Melolonthidae)*

In 1986 a heavy infestation was seen in northern Swaziland in a field of ratoon cane, which was badly damaged. (*A. subfasciata* (Blanch) is mentioned from Swaziland by both Sweeney[6] and Williams[7] who were possibly dealing with a misidentification of the same species). This species was not recorded as damaging cane in South Africa until 1987 when an outbreak occurred in one field of ratoon cane at Emoyeni in Natal, where an insecticide trial was conducted.

Adoretus fusculus *Fahr (Rutelidae)*

During 1986 this species was associated with noticeable but transient damage to ratoon cane on several farms near Gingindlovu in Natal. Neither Sweeney[6] nor Williams[7] considers this species to be a serious crop spoiler.

Other white grub species

A number of other species undoubtedly occur in South African cane fields, but have not yet been associated with crop damage. Of those other species recorded recently from Swaziland, Williams[7] considers *Anomala* sp. to be present sometimes in sufficient numbers to cause some damage.

Insecticide trials

In recent years, with the threatened or actual banning of dieldrin, most trials have been aimed at finding a suitable alternative chemical.

Insecticide is most conveniently and effectively applied at planting, and ideally should remain effective for the duration of the plant crop and for several subsequent ratoons. To be effective against white grubs in a ratoon crop the insecticide would generally have to penetrate the soil or be applied beneath the growing plant. Alternatively it might be possible to time application so that it coincided with emerging or ovipositing adults.

In the course of many trials conducted in South Africa and Swaziland, the results of some of which have been published (Carnegie[3]), no satisfactory substitute for dieldrin applied at planting, has been found.

Persistence is important, and persistent insecticides are internationally unpopular, the tendency being to encourage the use of transient insecticides of low mammalian toxicity.

In recent years the development of encapsulated formulations has provided a slow or controlled release mechanism for chemicals, so that transient insecticides (such as chlorpyrifos and ethoprophos) may acquire persistent properties. In Australia, some success with white grub control is claimed from applications of such formulations (Bull[1]; Chandler[5]); but their limited testing on sugarcane in South Africa has not so far proved rewarding.

In a 'pilot' observation trial on ratoon cane in Swaziland, marked reduction of *H. licas* larvae (98%) resulted from the application of ethylene dibromide into soil along the cane rows by means of a nematicide injector gun (Carnegie and Heathcote[4]). Such an application method is impracticable and a ban exists on the agricultural use of ethylene dibromide; but there is perhaps scope for streamlining the method of applying an acceptable non-phytotoxic, volatile chemical. A tractor-mounted applicator, although cumbersome, has shown some promise.

It is difficult to time application of insecticide to coincide with adult emergence or oviposition of white grubs, which emerge and oviposit over a seasonal but extended period. Such timing is especially difficult when persistent insecticides are not available.

The trials discussed below were aimed at larvae in ratoon cane. Chemicals were applied onto, or closely adjacent to the rows, and were covered immediately with soil. At each assessment, two samples consisting of a 300 mm cube of soil, were taken from a row of each plot. All scarab adults, pupae and larvae, alive or dead, were recorded.

Trial 1

This was conducted in August 1987 against *H. licas* on the Umfolozi river flats. It was abortive, due to flooding in late September; but it deserves mention because it demonstrated that grubs could survive in the soil for 3 days under nearly 2 m of water. Before the flood there were 35,5 live larvae per treated plot; after the flood there were 1,2. The trial continues to be monitored in case treatment effects should become apparent.

Trial 2

This was conducted on ratoon cane at Emoyeni against *A. minor*, and the treatments were the same as those in Trial 1. These were: SuSCon 140 g (Chlorpyrifos) at 4 kg and 6 kg ai ha^{-1}; CR chlorpyrifos at 4 kg and 6 kg ai ha^{-1}; CR carbosulfan at 3 kg ai ha^{-1}; isazofos (Miral) 500 ec at 1 kg ai ha^{-1}; aldicarb (Temik) granular at 3 kg ai ha^{-1}; carbofuran (Curaterr) granular at 3 kg ai ha^{-1}. There were two sets of controls. The design was randomised blocks with 6 replications.

Results to date are shown in Table 1.

Table 1

Mean numbers of live larvae (*Asthenopholis minor*) after treatment of soil in a ratoon crop at Emoyeni (Trial 2). (Pre-treatment mean 16,8)

Treatment	First post-treatment sampling (20 days)	Second post-treatment sampling (46 days)	Third post-treatment sampling (90 days)
Control	12,8	14,6	7,1
Carbofuran	4,0	8,2	3,5
Isazofos	6,8	4,8	2,8
Aldicarb	11,8	16,7	8,0
CR chlorpyrifos (4 kg ha^{-1})	13,2	12,7	5,2
(6 kg ha^{-1})	11,5	10,2	3,5
Chlorpyrifos (SuSCon) (4 kg ha^{-1})	13,5	17,3	2,8
(6 kg ha^{-1})	13,5	7,1	2,8
CR carbosulfan	20,5	15,1	9,2
*SED (control vs chemical treatment)	±3,3	±3,1	±1,8

* SED = standard error of difference

Trial 3

This was conducted on ratoon cane at Emoyeni against *S. affinis*. Treatments were: oxamyl (Vydate) ec at 3 kg ai ha^{-1}; oxamyl CR granular at 4 kg ai ha^{-1}; ethoprofos (Mocap) granular at 4 kg ai ha^{-1}. There were two sets of controls. The design was a latin square with 6 replications. Results to date are shown in Table 2.

Table 2

Numbers of live larvae (*Schizonycha affinis*) after treatment of soil in a ratoon crop at Emoyeni (Trial 3). (Pre-treatment mean 47,5)

Treatment	First post-treatment sampling (15 days)	Second post-treatment sampling (50 days)
Control	59,8	15,3
Ethoprofos	18,2	8,7
Oxamyl EC	52,9	18,7
Oxamyl granular	61,8	19,0
SED (control versus chemical treatment)	±6,8	±2,8

Discussion of insecticide trials

In current trials on ratoon cane, results to date suggest that carbofuran, isazofos (Table 1) and ethoprofos (Table 2) all suppressed numbers of white grubs in the soil. SuSCon at 6 kg ha^{-1} also appeared at the second sampling to be effective; but the poor performance of the same chemical at 4 kg ha^{-1} casts doubt on its effectiveness (Table 1).

Over the sampling period, the general drop in numbers of larvae in all treatments was the result of larvae developing into adults and migrating, ie a seasonal effect.

The trials are due for re-treatment and further monitoring.

General discussion and conclusions

In southern Africa there are several species of white grubs which attack sugarcane as larvae, and at least one (*H. licas*) causes damage as an adult. The species tend to be locally abundant and restricted to certain areas, and are not a constant and acute problem. It is not therefore generally economical to apply insecticide at planting on the assumption that a white grub population will develop.

It would be a distinct advantage if a suitable insecticide could be effectively applied to ratooning cane whenever a white grub problem is identified. In current insecticide trials it appears that 3 of the insecticides tested suppressed populations.

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