EVALUATION OF WEEVIL CONTROL METHODS FOR SWEETPOTATO PRODUCTION IN NORTHERN NAMIBIA

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ABSTRACT

Of the three sweetpotato weevil control measures evaluated at Bagani Research Station during the 1997/98 season, chemical control using carbaryl was the only effective treatment, which reduced weevil damage by as much as 50% compared to the control. Regular irrigation to prevent soil cracks attracted more weevils from the dry surroundings causing severe damage. Applying ash to the soil was not effective in repelling weevils. Chemical control should be complemented with other cultural practices that have been shown to reduce sweetpotato weevil damage.

INTRODUCTION

The three weevil species *Cylas puncticollis, C. formicarius and C. brunneus* have been reported as major pests of sweetpotato in Africa (Smit, 1997). *C. puncticollis* which is larger than the other two species and totally black is the most common (Figure 1).

Figure 1. Adult of *Cylas puncticollis* (photograph taken from Theberge, 1985).

The life cycle of the three species is similar. Female weevils lay eggs in holes dug in the tubers or the woody sweetpotato vine bases. The larvae tunnel into the tubers or vines and the pupae develop within the larval tunnel. Weevil adults developing from the pupae emerge from the tubers during feeding. The complete lifecycle takes 32 days at ± 27 °C, while in cooler climatic conditions the lifecycle takes longer. The damage caused by tunnelling of the tubers is shown in Figure 2.

In response to the damage the tubers produce a toxin that induces a sweet smell and bitter taste. Tunnelling of the vine base causes thickening and cracking affecting overall plant and tuber growth. The rough sweetpotato weevil *Blosyrus obliquatus* (Figure 3) is also a common sweetpotato pest that has been observed in northern Namibia (Figure 4). The adults are brownish with a rugged surface which makes them look like a lump of soil (Skoglund & Smit, 1994).

Figure 2. Weevil damage caused by tunnelling of the sweetpotato tubers (photograph taken from Skoglund and Smit, 1994).

Figure 3. Adult rough sweetpotato weevil *Blosyrus obliquatus* (photograph taken from Skoglund and Smit, 1994).

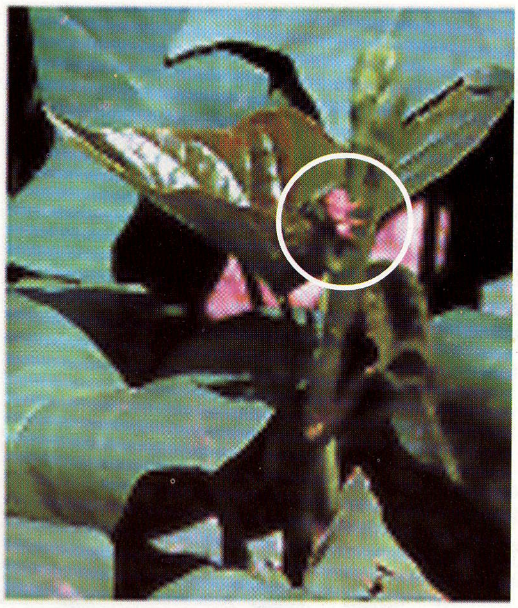

Figure 4. Rough sweetpotato weevil on sweetpotato foliage at Sibbinda ADC, Caprivi Region.

The adults feed on foliage and the females lay eggs underneath fallen leaves. The larvae develop into pupae in the soil. Larvae cause damage by gouging shallow tunnels onto the tuber surfaces (Figure 5). The flesh just underneath these grooves discolours, reducing the tubers' marketability.

Figure 5. Damage to sweetpotato tubers caused by the rough sweetpotato weevil (photograph taken from Skoglund and Smit, 1994).

All sweetpotato weevils are very mobile on foot and can fly short distances. They can however not dig down through sand (Smit, 1994; Smit, 1964). Although sweetpotato is the preferred host, weevils can also breed on related *Ipomoea* weeds. Population build up is slow at the beginning of the crop growing season because only a small number of larvae survive in the stem. After that the population growth rates increase steeply when the females lay their eggs in enlarging tubers, which are exposed at the soil surface or through soil cracks.

Control measures generally recommended are effective in reducing damage caused by both the normal and rough sweetpotato weevil (Skoglund & Smit, 1994; Daiber et al., 1994). Cultural control measures recommended for sweetpotato weevil include crop rotation, sanitation, use of weevil-free planting materials, increased distance between old and newly planted fields, removal of nearby alternate hosts, adjustment of planting date, flooding or regular irrigation, mulching, incorporation of ash into the soil before planting, earthing up or filling of soil cracks and harvesting as soon as the tubers mature (Smit, 1997; Skoglund & Smit, 1994; Martin & Leonard, 1967; Onwueme & Sinha, 1991; Daiber et al., 1994; Smit, 1964; Fielding & van Crowder, 1995). Which measures are suitable for a given production system depends on the local environmental conditions and farming practices. Use of the entomopathogenic fungus *Beauveria bassiana* as biological control measure is limited to areas with constantly moist climate.

Research has been conducted on the use of sex pheromones to reduce the male weevil population (Smit, 1997; Pillai et al., 1993). Reduction in the male population however has no clear effect on tuber infestation and damage. Weevil control using chemicals has been evaluated repeatedly and good control has been achieved when insecticides are applied regularly (Muruvanda et al., 1986; Smit, 1997; Daiber et al. 1994). Suitable insecticides include methyl parathion, carbaryl, endosulfan, acephate, permethrin, deltamethrin, tralomethrin, gamma-BHC and triazophos. Dipping of planting materials in insecticide solutions prior to planting has also been found effective in controlling weevils during the first few weeks of the growing season.

To date no completely weevil resistant sweetpotato variety has been identified (Smit, 1997). Varieties with partial resistance have been identified and less susceptible varieties have been bred (Hahn et al., 1981). Varieties with deep tuber formation have been reported to escape weevil infestation (Smit, 1994; Fielding & van Crowder, 1995).

Damage caused mostly by the rough sweetpotato weevil has been observed in northern Namibia, especially where plots are maintained throughout the year for multiplication. Investigation into suitable control measures and their economic implications is necessary before sound recommendations for weevil control can be made. Of the recommended cultural control measures regular irrigation of sweetpotato plots and incorporation of ashes into the soil were identified as suitable for trial purposes in northern Namibia. Practices such as crop rotation, sanitation, use of weevil-free planting materials, distance between old and newly planted fields and removal of nearby alternate hosts should be promoted but cannot be accommodated in a trial layout as they involve treatments over whole fields. Planting dates are predicted by rainfall and can normally not be modified due to the very short rainy season.

Mulching has been found to attract termites and is therefore not suitable for crop production in northern Namibia. Earthing up or soil crack filling may lead to unnecessary soil moisture loss and is labour intensive, soil cracking can however be prevented by regular irrigation. The use of the chemical carbaryl was chosen for testing purposes as it was found the least expensive of all the recommended insecticides. Although not conclusive, the variety SP2019 has been identified as less susceptible to weevil damage in preliminary variety evaluation trials during the 1996/97 season.

METHODS

The trial was conducted at Bagani Research Station in the Caprivi region. Three treatments namely incorporation of ashes into the soil, regular plot irrigation and carbaryl treatment were tested against an untreated control plot. Blocks for the different treatments were divided into sub-plots of two varieties SP2003 and SP2019, the latter selected for its apparent low susceptibility to weevil damage. The trial layout was a randomized complete block design with four replications. The blocks, which were 2.3m apart consisted of six 4.6m long rows, of which 3 rows were planted to SP2003 and the other three to SP2019. Cuttings were planted at 1.2 x 0.3 m. For the ash treatment 2.7kg of ash (500 kg/ha) from the leadwood (*Combretum imberbe*) was incorporated into the soil at planting. The irrigated plots were kept moist by localized spray irrigation during dry periods. A total of 140mm water was applied in eight irrigations. For the insecticide treatment sweetpotato cuttings were dipped in a 3.33g Carbosan per litre water solution before planting. Plots were then treated four times with 5.2 litres of a 1.32g Carbosan/l water solution at three-week intervals. The four middle rows (2 rows of each variety) were harvested four months after planting and data on total number of tubers and number of tubers damaged by weevils recorded. All data were analyzed with SigmaStat two-way analysis of variance and MS Office Excel.

RESULTS

The average percentage weevil damaged tubers for each treatment is shown in Table 1.

Table 1. Percentage weevil damaged tubers for four control treatments and two varieties evaluated at Bagani Research Station during the 1997/98 season

Treatment	Variety		
	SP 2019	SP 2003	Mean
Control	40.5	33.9	37.5 [b]
Ashes	37.5	18.8	28.1 [bc]
Irrigation	50.1	85.3	67.7 [a]
Carbaryl	13.2	12.2	12.7 [c]
Mean	35.3	37.5	36.5
CV	36.186		
$F_{Variety}$	0.267	$F_{treatment}$	26.648
$P_{Variety}$	0.612	$P_{treatment}$	<0.001

Table 1 shows that there was no significant difference in percentage damaged tubers between varieties as well as between the control and the ash treatment. This indicates that ash application is not effective in repelling sweetpotato weevils. The damage recorded in the irrigation treatment was significantly higher than the control. Weevils might have been attracted to the moist patches from the extremely dry surroundings caused by the low rainfall of the 1997/98 season. Weevil damage in the insecticide treated plots was significantly lower than in any other plots. This shows that chemical control was the only effective control method for weevil in this experiment.

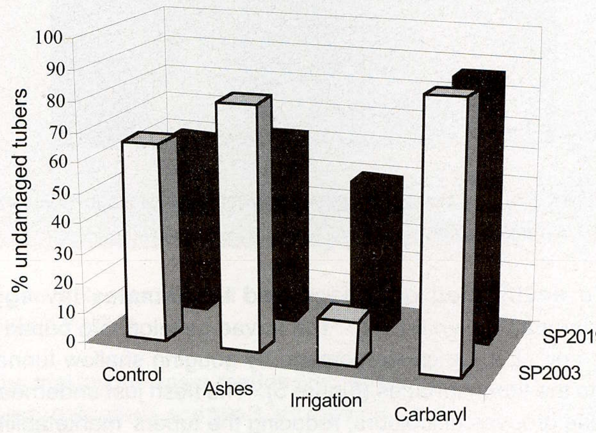

Figure 6. Percentage sweetpotato tubers undamaged using different weevil control measures.

DISCUSSION

Application of the insecticide carbaryl to sweetpotato was the only effective control method that considerably reduced weevil damage. The cost of control using carbaryl insecticide is low relative to most of the other recommended insecticides. At the cost of N$ 20.20 per kg of carbaryl, control would cost N$ 90.48 per ha when applied four times during the growing season at 1.12 kg/ha. For an area of 0.1 ha, which is more realistic in sweetpotato production in northern Namibia, the cost for this control regime would only be N$ 9.05, provided that spraying equipment is available. At an average yield of 15 t/ha of which only 12.7 % is unmarketable due to weevil damage instead of 37.5 % when left untreated, a farmer would gain the additional income from about 3.7 t/ha by applying chemical sweetpotato weevil control.

Chemical control can be complemented with cultural control methods such as earthing up or soil crack filling. The general lack of irrigation water, equipment and knowledge on irrigation practices make regular irrigation unfit for use as sweetpotato weevil control method in existing farming systems. It is recommended that the described and other methods be re-evaluated during more growing seasons to consolidate the findings and enable formulation of recommendations on sweetpotato weevil control.

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