

## Pest Status of Rodents in Wonji Sugarcane Plantation, Ethiopia

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### ABSTRACT

An ecological study on pest status of rodents was carried out in Wonji Sugarcane Plantation during August 2005 - March 2006. To determine the damages made by rodents during different growth stages, three trapping grids were selected from immature sugarcane plantations (ISP), young sugarcane plantations (YSP) and old sugarcane plantations (OSP) randomly. A total of 285 captures was made in 2205 trap nights. These constituted eight species of rodents and two species of insectivores. The overall trap success was 12.9%. Variations in trap success at different growth stages of the sugarcane plantations and seasons were significant. The pest status of rodents in the sugarcane plantation was assessed at different seasons. The highest damage was recorded in YSP during wet season. The average damage caused by rodents in the plantation was 4.0%. Analysis of the stomach contents of snap trapped rodents showed presence of sugarcane fibers confirming the pest status of rodents in the sugarcane plantation.

Key Words: Rodent pest, Trap success, Stomach contents, Sugarcane plantation, Ethiopia.

### INTRODUCTION

Rodents are major agricultural pests, globally. They damage and destroy over 30% of the crops in both pre-harvest and post-harvest conditions (Singleton 2001). Fitzgibbon (1997) reported that high immigration rates from adjacent habitats and increased recruitment owing to food resources lead them to rapid population growth in agricultural fields. Such large populations cause considerable damage to a wide variety of crops, worldwide.

The most common rodent pests in sub-Saharan African countries are *Mastomys* spp. that occur all over the continent in natural grasslands, cultivated areas and in human habitats. Rodent outbreaks over large areas have been reported from many localities in Africa. Population explosion of rodents occurs at regular intervals. Leirs et al. (1996) have revealed 50% of crop losses during such outbreaks in Kenya. In Ethiopia, although comprehensive studies on the effect of rodent damage to agricultural crops are lacking, Goodyear (1976) and Afeework et al. (2003) have estimated that rodents destroy 20-26% of cereal crops.

Rodents are major pests of sugarcane. They usually gnaw lower internodes of sugarcane and cause direct

damage at the sugar formation stage of the crop. Besides their direct damage, they also expose the cane, increasing the risk of infection by bacteria and fungi (Meyer 1994). Rao (2003) reported that rodents in Australian cane fields destroyed approximately 825,000 tonnes of sugarcane valued at US\$ 50 million during 1999-2000 harvest seasons. In Hawaiian sugarcane plantations, they caused severe losses estimated at 4.5 million dollars annually (Leung 1998). In Ethiopia, although the occurrence of rodent damage on sugarcane is known, there is no scientific data to provide quantitative information on the extent of damage.

Rodents colonize cane fields as it forms suitable habitat for burrowing, feeding and breeding. Sugarcane fields also provide protective cover from avian predators for most part of the year (Parshad 1999). However, rodents cannot subsist on sugarcane alone. As rodents need additional protein, they supplement it from sources such as earthworms, spiders and insects in such habitats. Most rodents living in cane fields migrate to surrounding areas during harvest, and therefore, their populations do not rebuild until the second half of the crop cycle (Gratz 1996). In addition, during much of the first year, the sugarcane stalks stand erect, the crop canopy is open, and most fields have little ground

cover. Therefore, most rodents prefer to forage in adjacent areas of the young sugarcane fields. However, all stages of sugarcane are victims of rodent pests, although the extent of damage varies. For instance, in ratoon cane, they gnaw the stems and apical meristems of young plants. But as the cane grows, they attack the mature stalks, resulting in reduced sugar content and harvestable tonnage (Wilson and Whisson 1993). The present investigation was aimed to identify the rodent pests in Wonji Sugarcane Plantation, Ethiopia, with special reference to seasonality and the age group of the plantation.

## THE STUDY AREA

Wonji sugarcane plantation, is located about 100 km southeast of Addis Ababa. It is geographically situated between 8°31' N and 39°12' E at an average elevation of 1540 m asl (Figure 1). The plantation has a total area of 7022.24 ha and has a flat topography, where sugarcane is cultivated as perennial monocrop. The climate of the area is tropical with seasonal wet and dry periods. Short rains (March to May) merge into the main rainy season from mid-June to mid-September. The annual relative humidity ranges between 34.5-63%. The mean annual rainfall is 825 mm. The mean monthly temperature minima range between 6.9°C and 14.7°C, and that of maxima between 23.1°C and 30.0°C. The minimum temperature is 6.9°C, in November and the maximum 30.0°C in May.

## METHODS

Three grids, each of 70x70 m (4900 m<sup>2</sup>) were established in the sugarcane plantation to gather information on live-trapped rodent specimens during the wet and dry seasons using Sherman live-traps set at 10 m apart. Snap traps placed at 20 m apart, 200 m away from Sherman live traps were also used following the standard trapping techniques of Afework (1996a, b). The grids were randomly identified based on the age of the cane. The first grid contained immature (very young) plant cane (ISP) of B52-298 variety. The second grid contained old aged plantation (OSP) of NCO-334 cane variety. The third grid contained a second ratoon young plantation (YSP) of B52-298 variety. Each trap was baited with peanut butter and was checked twice a day (07:00-08:00 h and 17:00-18:00 h). For each individual trapped, the grid and the trap-station

number, the toe-clipping code, the body mass and the sexual conditions were recorded. In addition to the above, body measurements were taken from the snap trapped animals. Sexual conditions in males were detected by the colour and position of testicles (scrotal or abdominal) following Ghobrial and Hodieb (1982). Pregnant females were identified by their enlarged nipples, large swollen abdomen and body weight. Age structure (adult, sub-adult and young) was also recorded based on their weight and pelage colour (Afework 1996a). Trap success in all growth stages of the cane was computed. The extent of damage by rodents and insectivores at different growth stages of the cane was recorded.

Each grid was further subdivided into 49 cells each of 100 m<sup>2</sup> area. Out of these, 12 cells (24.5% of the total) were randomly selected and individual stalks that were damaged by rodents were counted in both seasons to calculate the extent of damage. The total stalk count per hectare was known from the records of the factory. Dissection of all snap-trapped animals was carried out for stomach content analysis. Stomach contents from the dissected animals were removed and preserved in 70% alcohol. The stomach contents were weighed after drying the moisture content at 50°C for 24 hours. The samples were washed with distilled water to remove fine particles for proper identification. Then, the contents were put on a glass slide and observed under a light microscope to identify the type as well as proportion of the diet following the techniques of Leirs (1994) and Workneh et al. (2004). SPSS software version 14.0 and Chi-square test were used to analyze the data.

## RESULTS

A total of 285 captures were made in 2205 trap nights, and the overall trap success was 12.9%. The trapped rodent species were *Mastomys natalensis*, *Arvicanthis dembeensis*, *Arvicanthis niloticus*, *Stenocephalemys albipes*, *Pelomys harringtoni*, *Mus mahomet*, *M. musculus* and *Rattus rattus*. There were also two species of insectivores trapped, *Crocidura flavescens* and *C. fumosa*. The trap success was highest in YSP and lowest in ISP (Figure 2). The variation in trap success between ISP, YSP, and OSP was significant ( $\chi^2 = 4.2$ ,  $df = 2$ ,  $p < 0.05$ ). Trap success was 19.9% during the wet season and 9.7% during the dry season across all growth stages. During the wet season, high trap success was from YSP and OSP (26.8% and 15.6%, respectively). During this season, trap success among the different growth stages

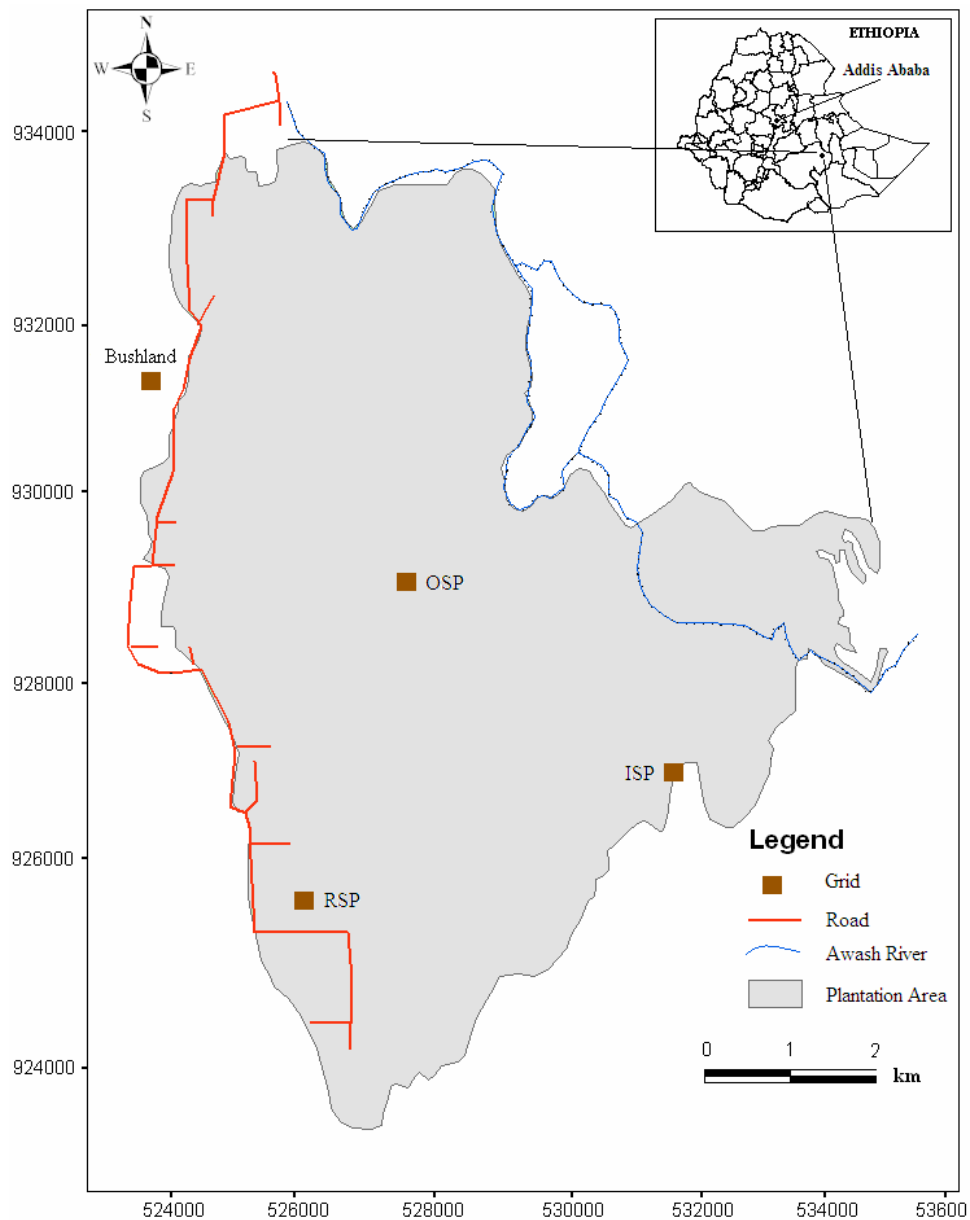


Figure 1. Map of the Wonji Sugarcane Plantation showing the location of grids

of the cane was significant ( $\chi^2 = 12.3$ ,  $df = 2$ ,  $p < 0.01$ ). Similarly, during the dry season, the highest trap success was recorded in YSP (13.1%). However, trap success from ISP, YSP and OSP during this season was not significantly different ( $p > 0.05$ ). Trap success in plantation of different growth stages during the two seasons is given in Table 1. There was significant variation during different seasons in YSP ( $\chi^2 = 4.7$ ,  $df = 1$ ,  $p < 0.05$ ), whereas it was not significantly different in grids of other growth stages ( $p > 0.05$ ).

A total of 27 stomachs of three species of rodents and one species of insectivore were available for analysis of food contents from snap trapped animals during wet and dry seasons. Stomachs of *M. natalensis* and *C. flavescens* were taken from YSP, whereas of *S. albipes* and *M. mahomet* were from OSP and ISP, respectively. Sugarcane fibers were predominant in the diet. Some of the food items which were unable to be identified were grouped under unrecognized materials (Table 2).

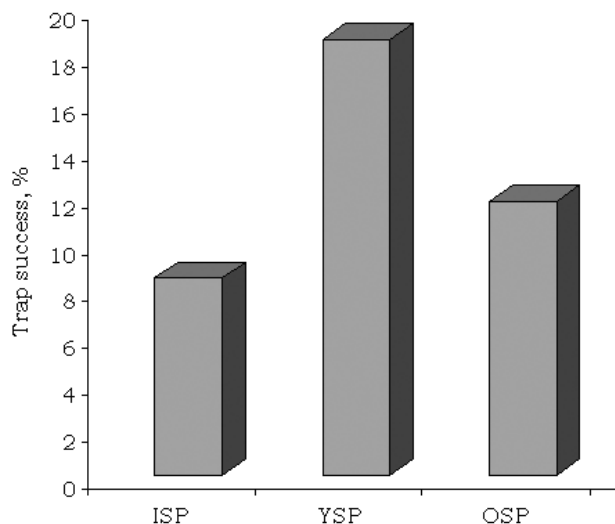


Figure 2. Overall trap success in the three growth stages of the sugarcane (ISP= Immature sugarcane plant, YSP= Young sugarcane plant, OSP= Old sugarcane plant).

Table 1. Trap success of rodents and insectivores during wet and dry seasons in different growth stages of sugarcane.

Growth stage	Season	Trap nights	No. of capture	Trap success %
ISP	Wet	294	20	6.8
	Dry	441	42	9.5
YSP	Wet	294	79	26.8
	Dry	441	58	13.1
OSP	Wet	294	46	15.6
	Dry	441	40	9.1

ISP = Immature Sugarcane plant, YSP = Young Sugarcane plant, OSP = Old Sugarcane plant

Table 2. Percentage of the diet of snap trapped rodents and insectivores

Species	Season	Number of Observations	Identified food item, %			
			A	B	C	D
<i>M. Natalensis</i>	Wet	5	67.4	163.	6.6	9.7
	Dry	4	62.7	20.1	5.2	12.0
<i>S. albipes</i>	Wet	3	58.8	17.4	6.9	16.9
	Dry	2	52.3	20.8	5.5	21.4
<i>M. mahomet</i>	Wet	5	54.2	22.7	10.1	13
	Dry	3	48.3	18.3	12.4	21
<i>C. flavescens</i>	Wet	4	13.3	16.4	22.6	47.7
	Dry	3	8.2	13.8	24.8	53.2

A = Sugarcane fibers, B = Grass, C = Animal matter, D = Unrecognized material

Table 3. Damaged sugarcane stalks of different growth stages during the wet and dry seasons.

Growth stage	Grid area	Stalks/grid		Stalks/100 m <sup>2</sup>		Damaged stalks/grid		Damaged stalks/100 m <sup>2</sup>	
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
ISP	4900	64549	56045	1317	1144	0	1127	0	23
YSP	4900	70560	60860	1440	1242	3332	1911	68	39
OSP	4900	47029	38102	960	778	1813	1176	37	24

ISP = Immature Sugarcane plant, YSP = Young Sugarcane plant, OSP = Old Sugarcane plant, \* Not observed

Damaged stalks in all growth stages of the cane were recorded in both seasons. During the wet season, no damaged stalks were observed in ISP, whereas 3332 and 1813 damaged stalks were recorded in YSP and OSP, respectively. This accounts for 4.7% of the total stalk for YSP and 3.8% for OSP in the grid. During the dry season, damaged stalks were observed in all growth stages at varying extent. During this season, the highest damaged stalk count was recorded for YSP followed by OSP and ISP. The extent of damage during this season was 2.0% for ISP, 3.14% for YSP and 3.08% for OSP of the total stalk count in the respective grids (Table 3).

## DISCUSSION

The trap success varied among the different growth stages of the sugarcane plant. It was higher during the wet season. During this season, the trap success was highest in YSP, whereas it was the least in ISP. The effect of ageing of the cane might have an effect in this respect. The ground cover in ISP during this season was devoid of vegetation. The trap success in OSP was less than in YSP, probably due to two reasons. YSP had better ground cover that invites more rodents and insectivores even from the adjacent plantations. During the fourth trapping period, OSP was mostly covered with water and was unfavourable for rodents. Therefore, during such periods, only few rodents were trapped. Jacob et al. (2003) have reported that during the breeding period, female rats may have stayed close to their offspring in the burrows, lowering the probability to encounter and enter a trap. Contrary to this, during the present investigation, breeding females were trapped at a higher frequency. The overall 12.9% was a high trap success rate compared to Siddique and Arshad (2003), who have had a trap success of only 4.1% in the sugarcane plantations in Pakistan. In comparison with other agricultural crops also, the present trap success rate is high. For instance, Odhiambo and Oguge (2003) obtained 6.2% trap success in 20,100 trap nights from maize crop in the Kenyan Rift Valley, Jacob et al. (2003) obtained 5.1% trap success in 3060 trap nights from rice field in West Java and Afework et al. (2003) obtained 11.5% trap success in 2400 trap nights from maize farm at Zeway, Ethiopia. During the present trapping, two individuals per trap were frequently captured. This was usually observed in *Mus* spp. In one occasion, one live *C. fumosa* and one dead *P. harringtoni* were obtained in a single trap. Except for frogs, captures of non-target animals were rare.

In agricultural areas, rodent damage is rarely uniform in time, but follows crop phenology. Leirs (2003) and Workneh et al. (2004) have revealed that rodents cause more damage during the reproductive stage of crops than during other growth stages. In sugarcane plantations, rodents were major pests. The extent of their damage varied with season. Maximum damage of the cane per grid was recorded in YSP during the wet season followed by OSP. This may be due to the fact that it was the breeding season for most rodent species in the area. This is in agreement with the findings of Leirs (2003), who reported that high rodent damage in agricultural fields is attained during the breeding season. No damage was observed in ISP during this season. Greaves (1982) had reported that the levels of rodent damage in agricultural fields were more intense when the crop was approaching the harvest stage. However, during the dry season, rodent damage was observed in ISP. This was because the cane during this season was grown up and contributed to a suitable habitat for rodents.

Among the rodent species in the plantation, *M. natalensis* and *Arvicantis* spp. were the major pests. Their abundance in the plantation was very high. This was in line with the findings in many agricultural fields of East Africa. For instance, Makundi and Massawe (2003), Odhiambo and Oguge (2003) and Afework et al. (2003) have reported that these species are the most serious rodent pests in agricultural fields of Tanzania, Kenya, and Ethiopia, respectively. Other rodent pests such as *S. albipes*, *P. harringtoni*, *Mus* spp. and *R. rattus* are also known to damage sugarcane.

Porcupine (*Hystrix cristata*) was observed on few occasions in the plantations near villages. It usually feeds upon vegetables in the villages and probably they may use the plantation for hiding. Larger mammals such as hippopotamus, warthogs and vervet monkeys were also seen in the plantation. Warthogs live in the plantation. Besides their damage by direct feeding, they destroy large number of cane stalks when they move through the plantation. Hippopotamus usually attack plantation along the border of the Awash River. Plantation areas where the border was surrounded by trees were also frequent victims of vervet monkeys.

Sugarcane stalks damaged by rodents can be easily distinguished from those damaged by other mammals. Usually, rodent damage is identified by open holes at lower internodes and small chips on the ground, after they have fed (Figure 3). When the damage is severe, such stalks fall down. This provides an additional advantage for rodents as a shelter. Warthogs chew the

whole part of the lower internodes and also feed on young leaves of the cane. Vervet monkeys cut the standing cane, carry and climb on trees to eat. However, they usually cut only the younger canes.

In general, the damage of rodents in the plantation was 4.0%. This was comparable with 2-5% damage reported by Stenseth et al. (2003) from Australian sugarcane plantations. However, it was less compared to the sugarcane plantations in Hawaii (40%), South America (12-20%) and India (20.7%) (Tobin et al. 1990, Stenseth et al. 2003). Major rodent pests in these regions were *Holochilus* spp., *Bandicota bengalensis*, and *Rattus* spp. Especially, *Rattus* spp. is a well known pest, which is found in large numbers in many sugarcane plantations. However, at Wonji Sugarcane fields, it was the least trapped species.



Figure 3. Damaged stem of a young standing sugarcane plant

The stomach content analysis confirmed the predominance of sugarcane fibers in the diet of rodents. The plantation is a relatively undisturbed and suitable habitat, which supplies continuous food for rodents until harvest. Therefore, rodents can minimize their energy expenditure for food in sugarcane areas. Similarly, Leirs (2003) explained that rodents cause damage because they select the food source that at a certain place and time give them the net benefit when balancing energy intake *versus* the cost of searching for food. In the stomach contents of *C. flavescens*, sugarcane fibers and grass were obtained. The majority of the stomach contents of *C. flavescens* were difficult to identify (Table 2). In all analyzed stomachs, there was a considerable amount of animal matter. This may fulfill

their protein requirements. The feeding habits of rodents observed and the present data of the stomach content analysis indicate that sugarcane plantation is the major food source in the present study area regardless of seasons.

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