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ECONOMIC STUDY ON SUGAR CANE INJUREDBY RODENTS IN UPPER EGYPT

Abazaid, A.A.
Sugar Crops Research Institute, Giza, Egypt

ABSTRACT

Two field experiments were conducted during 1998/99 and 1999/2000 seasons in the Experimental Station of Mattana (Qena Governorate). In the studied crop cycle of sugarcane (the plant cane, 1st, 2nd and 3rd ratoon crops), damage caused by rodents to the top of cane stalks was comparatively higher than that of base part of stalks. Top damage was higher in plant cane crop and the 1st ratoon than that in the 2nd and 3rd ones. Damaged stalks showed lower density, purity, brix (total soluble solids) values and sucrose content than non-damaged stalks. The average loss in cane yield for the four sugarcane crops (plant cane, 1st, 2nd and 3rd ratoon) was LE. 915.04, while the loss in sugar production averaged LE. 1353.5 for the same crops.

INTRODUCTION

Rodents damage a variety of agricultural crops throughout most regions of the world. At least 50 species of rats are involved. Damage is reported in rice, corn, sorghum, wheat, peanut, oil palm, vegetables, fruits, and sugar cane. (Fall, 1988).

In Egypt, vertebrate pests attack sugar crops (sugar cane and sugar beet). The annual loss caused by rodents was estimated by 5 to 8 % in sugar cane yield and it may reach 20 % in severe infestation (Ibrahim, 1972). Also, Abdel-Gawad *et al.* (1982) found that sugar cane fields were highly infested with rodents in EL-Minia governorate and that rat damage caused 41.3% reduction in sugar cane yield and 31.6% in total sucrose. Ali (1991) found that the average percentage of damaged cane stalks was higher (20.9 %) at the 5 meters beside the borders of the field and decreased gradually towards the field center.

Bates (1960) estimated that the loss of sugar caused by the epidemic rodents in 1958 and 1959 in Guyana was least (12,750 tons) i.e., 1.8 % of a total of 703,443 tons produced in those years. A similar level of damage (1.7 %) was sustained in Puerto Rico in 1961. Collado and Ruano (1963) found that the most heavily infested plantations suffered between 8 and 11 percent loss of cane in the early 1950 in Mexico. Mungomery (1965) estimated that in recent years annual losses in Queens land varied between 20,000 and 30,000 tons of cane or 0.2-0.3 percent of the total crop. Metcalf and Thomas (1966) reported that damage caused by rats in 1965 amounted to 5.4 % of the potential yield of ten fields at one estate in Jamaica. Martorell *et al.* (1967) calculated that 17,527 tones of sugar were lost but 1.000,559 tons, raw value, were produced.

Rodent damage can affect both harvested weight and sugar content of cane. Losses of 10-30 % of the potential yield are common and total loss has been reported. Sugar content is reduced by the general debilitating effect of rodent damage on the plant by fermentation of sugar in damaged stem and by an increased susceptibility to a variety of diseases of which red rot

(*Physalospora tucumanensis*) is the most important one (Collado and Ruano, 1963; Bates, 1960). Such secondary losses may be more serious than the direct losses due to consumption of cane (Doty, 1945).

A greater loss in sugar yield may occur if damaged stems were broken down. In Australia, Hitchcock and Kerkwyk (1975) observed a little loss of sugar if stalks were bitten but not broken, meanwhile, losses were significant if canes were broken down. Higher losses from a lodge crop have also been reported from India (Khan, 1977) and Hawaii (Doty, 1945).

This study was carried out to study the economic losses of sugar cane caused by rodents in Upper Egypt in sugar cane plantations. Hence, a study was undertaken at Mattana Research Station, Qena governorate, Upper Egypt to determine the effect of rodent damage at various crop growth stages and its effects on growth and yield parameters of sugar cane.

MATERIALS AND METHODS

Two field experiments were conducted during 1998/99 and 1999/2000 seasons in the Experimental Station of Mattana (Qena Governorate).

This study took place on sugarcane variety G.T.54-9 at Mattana Agricultural Research Station, Qena Governorate. An average of four replicates (each replicate had 25 of sugar cane stalks in 1 m^2) for the plant cane, the first, second, and third ratoon crops during the period from January to June in 1999-2000 season. Cane stalks were carefully examined to determine the percentage of rodent infestation to its top and base parts. The effects of infestation on some chemical properties, i.e., brix (the total soluble solids in the juice), juice density, purity %, and pol. % was studied. Cane yield and sucrose reduction were determined from four replicates (25 kg of cane stalks/replicate) for the four sugarcane crops. The losses in (L.E.) cane stalks **production and/or sugar yield were estimated as follows:**

1. Loss percentage = weight (kg) of (healthy stalks - infested stalks)/healthy stalks x 100.
2. Loss in tons/fed = cane stalks production (tons/fed) x Loss percentage
3. The losses in L.E. = Loss in tons/fed (cane or sugar productions) x price

* Price of one tone of cane stalks = LE 95.0 and the price of one tone of sugar = LE 1200 (for 1999/2000 season).

RESULTS AND DISCUSSION

Rodent infestations in various sugar cane plantations:

The percentage of sugarcane stalks injured by rodents in the plant cane, 1st, 2nd, 3rd ratoon crops during the period from June to January was determined (Fig.1). The results indicated that, the infestation by rodents in the four crops of sugar cane was concentrated on the base of the stalks during the period from June to September. During this period, the activity and population density of *Arvicanthus niloticus* were high. Thus, the field rat may be responsible for the base infestation in sugar cane plantations (Abdel-Gawad *et al.* 1982). Despite the type of sugarcane plantation, the highest base infestation was recorded during June and July, whereas no or low

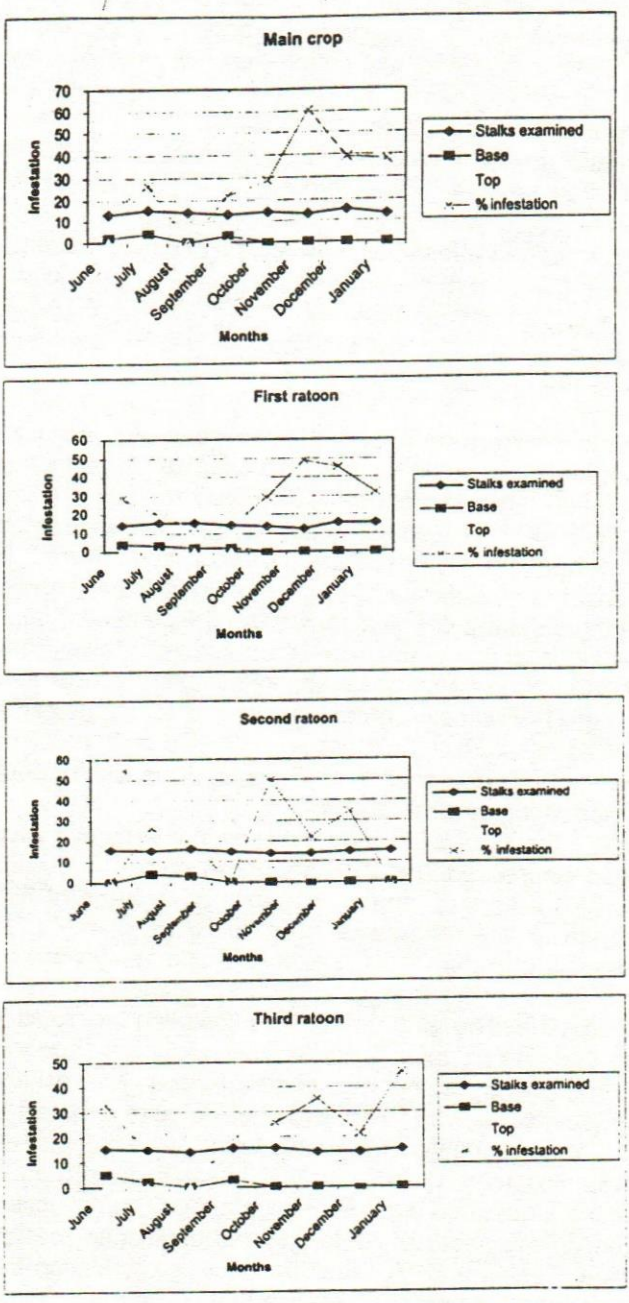

Fig (1): Percentage of rodent infestation on sugar cane plantations through the period from June to January.

infestation was recorded in August. This may be attributed to the migration of rodents at that time from sugarcane fields to other more preferable crops such as maize, tomato, and/or watermelon. The top infestation was recorded during the period from October to January. This infestation was caused by *R.attus rattus. frugivorus* which build its nests in the middle of the field where plants are dense and lodge. For all types of sugarcane plantations, top infestation was comparatively higher than base infestation. This may be due to the nature of plant growth, rodent species attacking plants and its behavior of eating and building nests.

The maximum top infestation was recorded during November for the plant cane crop (60.6%) and the first ratoon (48.4%), in October for the second ratoon (50%), and in January for the third ratoon (46.1%). In general, the top infestation was higher in stalks of the plant cane and first ratoon than that in the second and third ratoons.

Effect of rodent infestation on chemical properties of sugar cane juice:

Juice analysis for some chemical properties of non-infested, base and top infested stalks of the plant cane, the first, second and third ratoons were studied (Fig.2). For all studied sugarcane plantations, juice of infested stalks showed lower brix values than those of non-infested ones. The reduction in brix value was apparent in juice of top infested stalks. Damage caused by rodents to the top of stalks may affect the content of sugar and this explains the low value of brix in the juice of top infested stalks. The density of the juice was found to be related to the brix values and had the same trend of brix readings (Fig.2). Sucrose percentage was also influenced by rodent infestations. Values of sucrose % were less in juice of infested stalks than that of non-infested stalks for the four cane crops. The reduction was remarkable in juice of top infested stalks.

Since the infestation by rodents decreased sucrose content, purity % of juice was also decreased (Fig.2). Regardless crop cycle, juice purity in sound stalks ranged from 81.3 and 84.4 % with an average of 82.99 %. For the top-infested stalks, the range was 72.91 to 78.16 % with an average of 75.95 %. The effects of rodent's infestation on juice purity were obtained by Ibrahim (1972) who revealed that juice purity of sound cane was 85.5 and 77.6 % for injured cane. The effect of rodent infestation on reducing sugar % (Fig.2) revealed that, the glucose % was relatively higher in sound cane juice than that of injured cane for the four crops of sugarcane except the third ratoon in which glucose % was relatively higher in base infested stalks. The pol.% (indication of sugar content) was also found to be influenced by the rat injury. The pol.% was lower in the juice of infested cane than that of the sound cane for the studied crop cycle of sugarcane. The reduction in pol. % was much higher in the juice of the top injured cane than that of the base injured cane juice. Teshima (1970) found a positive correlation between the percent loss of pol. and the percent rat damage in Hawaii.

Effect of rodent infestation on the cane yield and sucrose:

Sugar cane yield and sucrose produced from non infested, base and top infested stalks, of various types of sugar cane plantations were determined (Fig.3). The weight of infested stalks was lower than that of sound

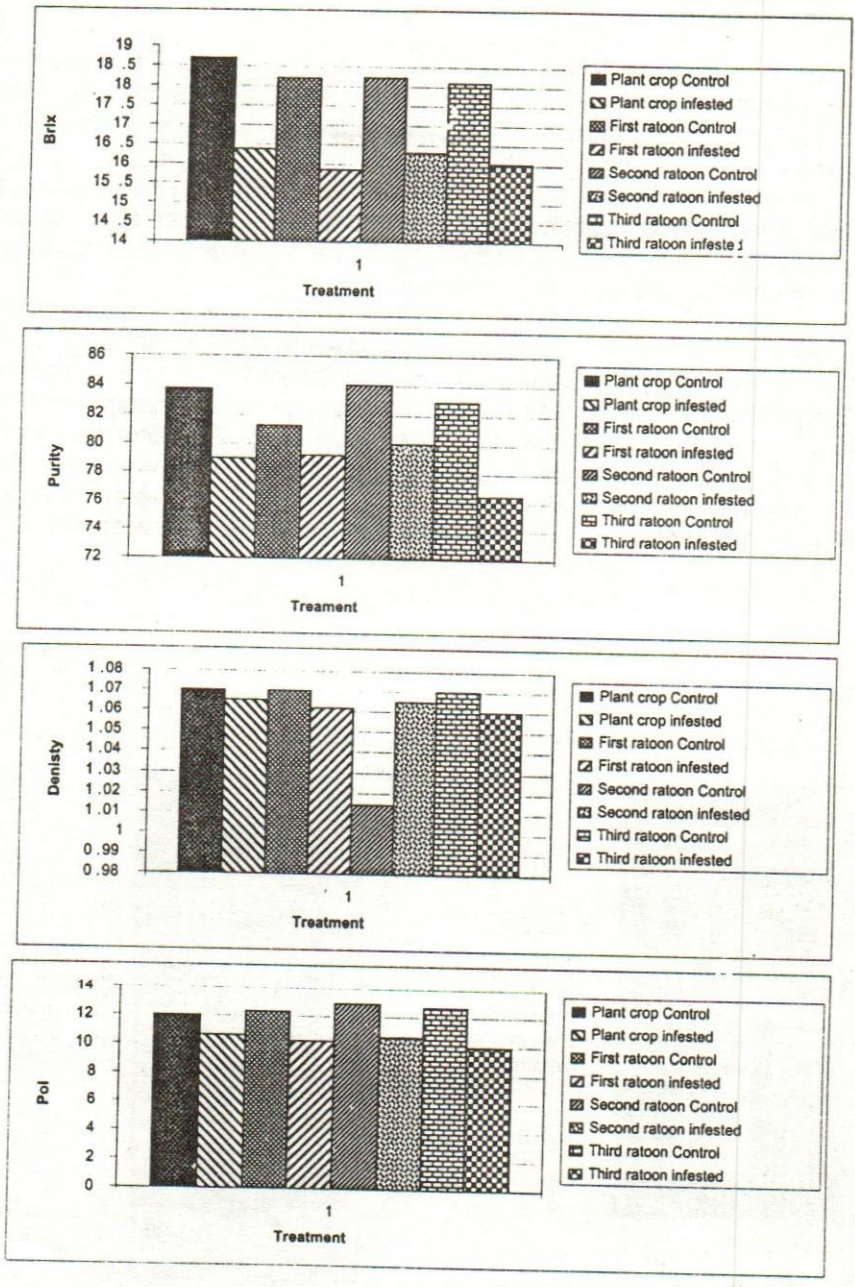

Fig. (2): Effect of rodent infestation on chemical properties, i.e. brix, density, purity, and pol. % of sugar cane plantation

stalks for the plant cane. The reduction in sugar cane weight of the top infested plants reached 8.5% of plant cane crop yield and 29 % of the third ratoon. As for the base infested plants, yield reduction reached 13.9 % of the plant crop and 41.7 % of the third ratoon.

In general, the reduction in cane yield was higher in base infested than that of top infested stalks. Top infested plants may produce tillers, which compensate infested stalks if the damage happened early. Whereas, base infestation damaged stalks may broke down.

The comparatively high percentage of reduction in sugar cane weight of the third ratoon than that of the other three cane crops (plant crop, first, and second ratoons) may be due to the variation of the degree of rodent infestation. The third ratoon was severely attacked by rodents compared with the other three sugar cane crops. In addition, sucrose content was negatively influenced by rodent infestation (Fig.3). Base and top infestations reduced the final sucrose weight of the four sugar cane crops. The effect was apparent in top infestation, where more than 25% reduction in sucrose was recorded.

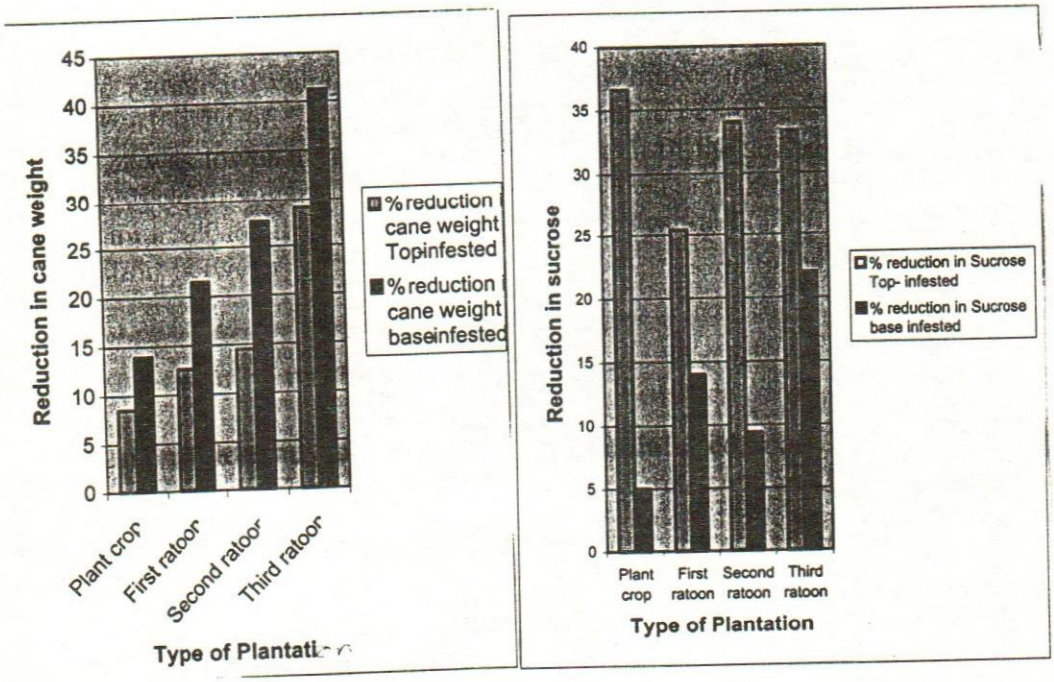

Fig. (3): Effect of rodent infestation on cane yield and sucrose reduction % on cane Plantation.

Table (1): Farmer and national income losses as result of rodent's injury for the four studied sugarcane crops.

	Unit	The Plant cane	First ratoon	Second ratoon	Third ratoon	Average
# Farmer losses						
25Healthy stalks	Kg	34.13	33.75	33.50	27.00	32.09
25Infested stalks	Kg	30.30	28.00	26.40	17.50	25.55
Loss	Kg	3.83	5.75	7.10	9.50	6.54
Loss	%	11.21	17.04	21.19	35.19	20.39
Production	T/fed	46.88	48.03	48.03	48.03	47.74
Loss	T/fed	5.25	8.18	10.18	16.90	9.73
Loss (LE *)	LE.	493.94	769.19	956.87	1588.55	915.04
#National income						
Sucrose% Healthy	%	10.69	10.14	10.82	10.50	10.54
Sucrose% Infested	%	8.50	8.10	8.50	7.60	8.18
Loss	%	2.19	2.04	2.32	2.90	2.36
Loss	%	20.49	20.12	21.44	27.62	22.42
Sugar yield t/fed	T/f	5.01	4.87	5.20	5.04	5.03
Loss in sugar		1.03	0.98	1.11	1.39	1.13
Losses L.E.**	LE	1232.01	1175.77	1337.16	1671.44	1353.50

***Loss money (L.E.) / Cane yield / ton = LE. 95**

****Loss money (L.E.) /Sugar local price in 99/ 2000: LE. 1200.**

Economic losses caused by rodents to sugar cane:

Since the infestation by rodent decreased cane and sugar yields in all sugar cane plantations in the field. data in Table (1) showed that the loss in cane yield/feddan was L.E 393.94, 769.19, 956.87, and 1588.55 for the plant cane crop, first, second, and third ratoon, respectively. Also, losses in sugar production in the plant cane crop, first, second, and third ratoon was L.E. 1232.01, 1175.77, 1337.16, and 1671, respectively, based on the price in 1999/2000 (one ton of sugar is amounted to L.E. 1200).

In Florida, USA, Samol (1972) estimated the losses in stalks due to rat's infestations in sugar cane plantations by 4.87 %, which amounted $ 13.7 per acre. The total loss was more than $ 2,000,000.

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اقتصاديات ضرر إصابة القوارض لقصب السكر في مصر العليا

عبد اللطيف عبد الله أبازيد

معهد بحوث المحاصيل السكرية – مركز البحوث الزراعية – الجيزة – مصر

أجريت تجربتان حقليتان فى محطة بحوث المطاعنة (محافظة قنا) خلال موسمى ١٩٩٨/٩٩ و ١٩٩٩/٢٠٠٠ لدراسة اقتصاديات الضرر الناتج من اصابة القوارض (الفئران) لمحصول قصب السكر فى مصر العليا.

أوضحت النتائج أن الإصابة القمية لعيدان قصب السكر كانت أعلى من الإصابة القاعدية فى القصب الغرس والخلفة الأولي و الثانية و الثالثة. كذلك فإن الإصابة ألقميه للعيدان كانت أعلى في محصول الغرس والخلفة الأولي عنها في الخلفة الثانية والثالثة. انخفضت جودة العصير من حيث الكثافة والنقاوة والسكروز في حاله العيدان المصابة عن السليمة في زراعات القصب الغرس والخلف الأولي والثانية والثالثة.

تمثل الضرر المادي المتسبب عن اصابة القصب بالفئران في حدوث فقد في الوزن بنسبة مئوية بما يعادل ٩١٥و٠٤ جنيه مصري كمتوسط عام خلال زراعات الغرس وحتى الخلفة الثالثة. أما الفقد في السكر الناتج فكان بنسبة مئوية بما يعادل ٥و١٣٥٣ جنيه مصري كمتوسط عام ولنفس الزراعات.