

Role of the cultural practices for suppression the rodent infestations in sugarcane fields at Minia Governorate

Tohamy H. T.¹, Y.M.A. Abd El Galil¹, A.A Abd El-Raheem¹ and A.M.Elwan²

¹Plant Protection Research Institute, ARC, Dokki, Giza, Egypt.

²Sugar Crops Research Institute, ARC, Giza, Egypt.

Abstract:

Field experiments were conducted, to evaluate the role of cultural practices for suppressing damage of the rodents and increasing the stalks and sugar yield in sugarcane field at Malawi district, Minia Governorate, Middle Egypt, during the two successive seasons from July 2009 to February 2010 and July 2010 to February 2011. The results proved that the low susceptible cultivars to Nile grass rat, *Arvicanthis niloticu* infestation were Giza 47/88 (4.25, 5.90%); PH8013 (4.75, 5.20%) and Giza 88/68 (5.48, 6.43%), followed by the cultivars, Giza 75/368 (7.40, 9.0%) and G.T. 54/9 (7.0, 9.33%) while the cultivar Giza 74/96 (10.39, 12.45%) received the highest susceptible infestation based on number of percent infested internodes / stalk in plant and 1st ratoon, respectively. The maximum reduction percentage of sucrose cane be caused by rodent infestation was noticed in Giza 74/96 variety (24.29 and 22.82), followed by Giza 75/368 (20.23 and 13.79) and Giza 54/9 (19.31 and 15.92), while minimum reduction was recorded in

Giza 88/68 (15.72 and 9.65); Ph8013 (14.71 and 7.02) and Giza 47/88 (12.11 and 7.72) in the main plant and 1st ratoon cane, respectively. Also, percent of infested internodes caused by rodents were significantly decreased by increasing space between sugarcane rows Furthermore. The rodent damage was lightest on the spring plantation crop and was greatest on the fourth-ratoon cane crops than in any the other years. As well as, using combined of burning of trash and flood irrigation after harvesting sugarcane stubble, significantly reduced the percentage of infested rate internodes by 76, 92 and 77, 23% in both seasons, respectively compared with the control. The results indicated that the highest mean percent infested internodes by rodents was greater in sugarcane fields near drainages (11.0, 15.35%) and channels (8.05, 10.80 %) than these far from its ones (3.75, 5.15 %) in main plant and 1st ratoon cane, respectively. On the other hand, number of rat damage internodes was higher in sugarcane lodging than these in

Received on: 9/8/2012

Accepted for publication on: 23/9/2012

Referees: Prof. Khalifa.H. Abd-Elgawad, Prof. Hassan.M.Hassan.

no lodged ones (10.95;13.45%) in the main plants and 1st ratoon cane, respectively. The losses in cane and sugar yield in the main plants due to rat infestation were much lower than in the ratoons. The costs of losses in cane weight ranged from 301.14(L.E) in the main plant cane to 902.16 (L.E) in the 4th ratoon cane, while the costs of losses in sucrose content varied from 226.8 (L.E) in spring plantation to 729.0 (L.E) in 4th ratoon cane. Generally, the mean percent infested internodes caused to rodents were much greater in lower part of whole cane than in the upper part of one.

It was suggested that improved technique of cultural practices especially good yield and tolerant cultivars for rodents can be used as major components of IPM strategy for to reduce the rodents population and increase cane and sugar yield in sugarcane fields.

Key words: The Nile grass rat, *Arvicanthis niloticus*, the rodent damage sugarcane fields, ratoon, susceptibility of sugarcane varieties to rodent infestations.

Introduction:

Sugarcane is the main source for refined sugar and the sole source for molasses and black honey industry; in addition, it produces fresh juice and several chemical sub-products in Egypt. Although, the total sugar production in Egypt had increased to 45.6 %, from 797,834 tons in 1982 to 1,502,221 tons in 2010,

this production cover 70 % only from the annual need of local consumption because of the extreme increasing in human population. The studies should be continue to increase sugar production per unit area to (overcome) bridge the gap between the local production and consumption through growing high yielding and resistant or tolerant cultivars for pests and improving the agricultural practices and controlling the pests of sugarcane

Production of sugarcane is affected by three insect pests beside the rodents, the purple-lined borer, *Chilo agammenon* Bles., the pink sugarcane mealybug, *Saccharicoccus sacchari* (Cockerell), the soft scale insect, *Pulvinaria tenuivalvata* (Newstead); these pests reduce quantity and quality of sugarcane plants (Tohamy, 1999). Recently, rodents are chronic pests of sugar cane in middle and upper Egypt (Abazaid, 1990). Two rodent species, the Nile grass rat, *Arvicanthis niloticus* and Roof rat, (white belled rat) *Rattus rattus frugivorus* (Abd El Gawad et al., 1982 and Hilal et al., 1989). Rat damage is negligible until the crop is 4 to 5 months old, after which it increases substantially and progressively until harvest. Damage by Nile grass rat and Roof rat is very similar. This pest causes serious damage as it borers into the stalks and fed on the stalks and internodes making numbers rind of chips (Lindsey, 19w89). All three species chew on the internodes of the growing stalks

making (or leaving) nicks in the outer rind to healthy chiseled canoe-shaped cavities. Small chips usually are evident on the ground where rodents have fed. Also other pathogenic plant fungi which may cause serious deterioration of the quality and quantity of juice extracted (Adsuar, 1962). These symptoms affect the yield in sugarcane where size and weight of the stalks are decreased, as well as the amount of juice in the cane. It is also causes an increase in the amount of reducing sugars in the juice. Many authors, in different parts of the world showed the population density and loss of the sap and sugar due to heavy infestation by rodents can be reduced by using certain agricultural practices i.e. varieties, row spacing, age of plants (aging), density plants, flood irrigation with trashes burning and fertilizer.

(Hoque and Sanchez, 2001 and Sta-Craz *et al.*, 2007) The loss in cane and sugar yield differ from variety to another according to rind hardness, stalk diameter, degree and time of lodging, resistance to souring and potential for compensatory growth. (Ali and Farghal, 1995). Abd El Gawad *et al.*, (1982) found that reduction in the crop yield and sucrose caused by rodents in the main crop plants was increased gradually by the first, second, third and the fourth ratoon where losses become heavy. Parshad (1998) showed that chronic damage ranging from 2.0 % to 15.0 % and severe damage, sometimes

up to 100 % loss of the field crops caused by rodents in sugarcane.

Sugarcane growers generally relied on natural control for rodents and only few (15%) of the interviewed farmers use cultural practices. So, the present work aimed to shed light on the cultural practices that could be of value in suppressing populations of the rodents below economic injury level, besides to estimate the losses in cane and sugar yield caused by this pest.

Material and Methods

Experiments were carried out in Mallawi region, Minia Governorate, beginning of July 2009 to February 2010 and July 2010 to February 2011 to evaluate the effectiveness of the varieties and cultural practices against rodents and assessment of the yield losses.

The randomized complete block design was followed in the whole of experimental area. Four replicates were used for each treatment. Each treatment was planted in plots 6x7 meter plots (1/100 from a Fadden). The experimental area received the usual recommended agricultural treatments and no insecticides were applied for pest control except rodents control throughout the whole seasons. The plants were exposed to the normal field conditions and natural infestation. Biweekly observations were carried out from beginning of July to the end of February (harvest-time) in all experimental area in both seasons. The main

purpose of the present study is the following:

1.Effect of certain cultural practices on the incidence of rodent infesting sugarcane plants:

1.1. Varietal susceptibility of sugarcane to Nile grass rat, *Arvicanthis niloticus* infestation:

An area of one Fadden was selected to tested sugarcane varieties namely; G.T.54/9, G.88 /68, G.96/74, G.47/88, PH8013 and G368/75, were planted from March (2009) representing 1st year crop. The 1st ratoon crop continued to March (2011). Sample 25 stalks of each plot was randomly selected from each variety and examined to determine:

- 1- Total number of internodes (joints).
- 2- Number of rodents infested internodes on the lower, middle and upper (top) third of the mill able cane.
- 3- The percent of infested internodes =

$$\frac{\text{Total number of infested internodes (base + middle + top)}}{\text{Total number of internodes examined}} \times 100$$

Assessment of yield losses in sugarcane varieties due to rodents attack:

The effect of the rodent infestation on the cane and sugar production was studied in the test varieties in main plant and 1st ratoon. At harvest time, 100 stalks of mill able cane were collected at random from each variety and replicated four times. The intact and infested stalks/variety was weighed separately to determine the loss in sugarcane

yield due to rodent's injury (reduction percentages of cane weighed) from the following formula:

$$\frac{\text{Sound stalks weight} - \text{infested stalks weight}}{\text{Sound stalks weight}} \times 100$$

After weighting, the stalks samples/variety were milled separately and juice of infested and non infested stalks were weighed and analyzed to determine the sucrose percentage in the laboratory by using saccharemeter apparatus according to **A.O.A.C. (1970)**. The reduction percentages of sucrose content were estimated in different varieties according the following formula:

$$\frac{\text{Sucrose \% in sound stalks} - \text{sucrose \% in infested stalks}}{\text{Sucrose \% in sound stalks}} \times 100$$

1.2. Effect of rowing space on Nile grass rat, *A. niloticus* attack:

An area of 1/2 Fadden was selected also and divided to plots 6x7 m (1/100 Fadden). The commercial sugarcane variety (G.T.54/9) was planted 15 December in 2009 season (autumn plantation) with four different rowing system, i.e., and the distance between rows was 70, 90, 110 and 120 cm. Each type of rowing was replicated 4 times (randomized complete block design).

1.3. Evaluation of Nile grass rat, *A. niloticus* infestation on sugarcane aging:

An area of five Fadden's was selected this area was cultivated with the variety G.T. 54/9 in four cycles or with different cane aging in the field

during July 2009 to February 2010 and July 2010 to February 2011 seasons. These aging include: spring plantations, the first, second, third and fourth ratoon canes.

1.4. Effect the site of sugarcane fields from drainage and channel on the rodent infestations.

An area of two Faddens was selected of sugarcane fields. This area was cultivated with the variety G.T. 54/9 in July 2009 to February 2010 and July 2010 to February 2011 seasons. These sites include: fields near the drainage and another near the channel and the last far away from the drainage and the channel. Every site or group was replicated 4 times in randomized complete block design.

1.5. The relationship between the cane lodging and Nile grass rat, *A. niloticus* attack damage:

One Fadden of sugarcane lodging and another non lodged cane were selected.

1.6. Effect of flooding irrigation and burning of trash on rodents attack:

An area of two Fadden of sugarcane was selected at harvest-time. The area was divided into four equal parts, each part include 4 plots. Flooding irrigation only was applied separately in the first part, while the trashes and dry leaves was burned alone in the second part. The third part was specialized to the two previous treatments together. The last part was left without any treatment as a control.

Sampling technique:

A sample of 25 stalks of each treatment (Experiments) was

randomly selected from each plot at 15 days intervals starting from the beginning of July to the end of February (harvest –time). While it has been increased to 100 stalks / plot at harvest-time. Each stalk per treatment was carefully examined to determine:

- 1- Total number of internodes.
 - 2- Total number of infested internodes /stalk which include: number infested internodes in the base (lower), middle and upper (top) third of the mill able cane.
- The percentage of infested internodes was calculated from the following formula:

Total number of infested internodes (base + middle + top)

$$\% \text{ infested internodes} = \frac{\text{Total number of infested internodes}}{\text{Total number of internodes}} \times 100$$

2. Assessment of yield losses in sugarcane plantations due to rodents attack:

The damage caused by rodents to the base and to the top of sugar cane stalks in different ages of Giza 54/9 variety; spring plantation, first, second, third and fourth ratoon was estimated during July 2009 to February 2010 and July 2010 to February 2011 seasons.

At harvest time, 100 stalks of mill able cane from each age were randomly chosen per plot. Each stalk per age was carefully examined to determine:

- 1- Total number of internodes.
- 2- Total number of infested internodes /stalk which include: number infested internodes in the fresh and old Basel and the top of the mill

able cane.

- The percentage of infested internodes was calculated from the following formula:

$$\% \text{ infested internodes} = \frac{\text{No of infested internodes (old + fresh base + fresh top)}}{\text{x 100 Total number of internodes}}$$

The stalks of each group (age) were normally weighed, milled separately and the sugarcane juice was weighed and also chemical analyzed to record

- a- Brix percentage (Total soluble solids) was determine in the laboratory by using “Abbe” refractometer described by **Payane (1968)**.
- b- Sucrose percentage was determined by using saccharemeter apparatus according to **A.O.A.C. (1970)**.

The rat damage, the losses in cane weigh and sucrose content were estimated according to equation of **Metcafe and Thonas (1966)**.

$$\% \text{ rat damage} = \frac{\text{Number of infested internodes (old + fresh basel +fresh top)}}{\text{(Infested internodes)X=}} \times 100 \text{ Total number internodes}$$

$$\text{Cane yield loss \% (Y) = } 0.41 X + 0.1$$

Where X = % infested internodes

$$\text{Sugar yield loss \%} = \frac{n1 X F1 + n2 X F2 + n3 X F3 + n4 X F4}{N}$$

Where:

F = Changing coefficient each level of infestation levels

F1 = Changing coefficient in non infested internodes (sound stalks) = 0

F2 = Changing coefficient of infested internodes in fresh top parts of stalk = 0.0316

F3 = Changing coefficient of infested internodes in fresh

base parts of stalks = 0.0105

F4 = Changing coefficient in old Basel infested internodes = 0.179

n = Infested internodes number for each section (sugarcane age).

N = Total examined internodes (tested).

The theoretical sugar yield percent of cane was calculated using the formula Simple by **Hebert (1973)** as follows:

$$Y = 1.052 S - 0.0373 B$$

S = Sucrose % juice

B = Brix % juice

d = (sugar yield per Fadden); it was estimated by cane yield/Fadden X sucrose % cane

Statistical analysis:

Statistical analysis was done to show the significant differences among means of treatments according to Duncan's, 1955 method through SAS - computer program.

Results and Discussion

1- Effect of certain cultural practices on rodents infesting sugarcane plants:

1.1. Relative susceptibility of sugarcane varieties to rdent infestations:

This pest attacks sugarcane plants produced different symptoms, which used to test the relative susceptibility between the varieties as follows:

Percent infested internodes:

Response of sugarcane varieties against Nile grass rat, *Arvicanthis niloticus* attack, expressed as percent of infested internodes on the base (lower), middle and upper (top) parts of the stalks in main plant and 1st

ratoon cane is shown in Table (1). The results indicated that the highest percent infested internodes caused by rat was recorded in sugarcane variety, Giza 74/96 (10.39, 12.45%), while the moderate infestation was observed in varieties Giza 75/368 (7.40, 9.0%) and G.T. 54/9 (7.0, 9.33%) in main plant and 1st ratoon, respectively. The results indicated that the sugarcane varieties, Giza 47/88; PH8013 and Giza 88/68 were the least susceptible varieties from beginning of the season till harvest – time, showing an average 4.25; 4.75 and 5.48 % in main plant cane and 5.90; 5.20 and 6.43 % in the 1st ratoon, respectively. Statistical analysis of the data showed significant differences was found among means of the percentage of rat injured for the tested varieties in both main plant and 1st ratoon cane. Number of rat infested internodes on the lower part of stalk was higher than in the middle and top part of stalk in all tested varieties in both seasons. This may be due to the highest sucrose in the lower part compare with the other parts or the rear of the lower parts from the ground.

Percent reduction cane yield and sucrose content:

Data in Table (2) show the mean percent reduction in cane weight and sucrose content in different sugarcane varieties as results of rodent infestations in main plant and 1st ratoon cane. The results showed that the reduction percentage of cane weight caused by rodents was

high in Giza 74/96 variety (28.41 and 31.13) followed in Giza 75/368 (23.36 and 22.82 %) and G.T. 54/9 (20.0 and 22.70%), while the least reduction % was recorded on Giza 88/68 (16.87 and 17.78); Giza 47/88 (13.98 and 16.35) and PH8013 (14.75 and 15.27) in main plant and 1st ratoon, respectively. On the other hand, the same table indicated that the greatest reduction percentage of sucrose cane was noticed in Giza 74/96 variety (24.29 and 22.82), followed by Giza 75/368 (20.23 and 13.79) and Giza 54/9 (19.31 and 15.92), while lowest reduction was recorded in Giza 88/68 (15.72 and 9.65); Ph8013 (14.71 and 7.02) and Giza 47/88 (12.11 and 7.72) in main plant and 1st ratoon, respectively. Statistical analysis of the data showed significant differences was found among means of the reduction percentage of cane yield and sucrose % in cane as result of rat damage for the tested varieties in both main plant and 1st ratoon cane. There are positive correlation between the percent of rat infested internodes and the reduction percentage of weight in cane and sucrose regardless the varieties.

These results are supported by **Ali and Farghal (1995)** in Egypt, they found that the sugarcane varieties showed great variation in rate of infestation by rodents, the Nile grass rat (*Arvicantha niloticus*) and the white bellied rat (*Rattus rattus frugivours*). They showed the G.88/47 variety was the least infested one

in both main plants and ratoons. For all varieties tested; infestation by rodents caused a decrease in percentage sucrose of the juice, an increase in glucose ratio and a decrease in the purity of juice. (Martorell, 1967 and Bates, 1960) have report that the stouter cane with low fibre content are first attacked by rats. Also Bates, 1963 showed the rat damage preferred the soft and low- fibre canes such as Pindar and B.4362.

In conclusion, the tested varieties can be arranged based on infested internodes descending orders as follows: most susceptibility varieties was Giza 74/96 and moderately resistant varieties were G.T54/9 and Giza 75/368, while the least susceptibility varieties were Giza 47/88; Ph8013 and Giza 88/68.

1.2.: Effect of sugarcane rowing space on Nile grass rat, *A. niloticus* infestation as monitored by the number of infested internodes:

Percent of infested internodes caused by rodents in sugarcane plants using different rowing spaces are shown in Table (3). The results indicated that the infestation percentage expressed as number of infested internodes in the lower (base), middle and upper parts of canes has been decreased by increasing space between the rows. The mean percent of infested internodes were decreased from 13.43 to 3.45 % in main plant cane and from 15.40 to 4.65 % in 1st ratoon cane with increased the distance between sugarcane rows from 70

cm to 140 cm. cane. The highest number of rat infested internodes was found on the lower part of stalk, while the lowest number was noticed on the middle and top part of stalk in both seasons regardless of the row spacing.

Statistical analysis showed that significant differences for infested internodes percent were found among plant and 1st ratoon cane cultivated at 70 cm space and both ones cultivated at 90; 110 and 120 cm spaces. No significant differences were found between the plants cultivated at 110 and 120 cm spaces for infested internodes percent. Similar results were obtained by Engeman *et al.*, (1998) who indicated that rat damage levels may be positively related to the density of sugarcane stalks.

In conclusion, according to infestation by rodents, the rowing spaces could arrange in a descending orders as follows:

- 1-Group A (least infested plants): 110 and 120 cm distance between rows.
- 2-Group B (moderately infested plants): 90 cm distance between rows.
- 3-Group C (highly infested plants): 70 cm distance between rows.

It is evident that planting sugarcane on wide row distances, seemed to afford better ventilation since air circulation demonstrate better conditions to reduce rodents infestation. Humidity and plant density were negatively correlated with wide row spacing

and consequently infestation was less.

This it is important to note the sugarcane cultivated on the recommended row- width to help in control pest or minimize damage.

1.3. Evaluation of Nile grass rat, *A. niloticus* infestation as monitored by sugarcane aging:

Data in Table (4) showed that the infestation percentage caused by rodents expressed as number of infested internodes in the lower (base), middle and upper parts of stalks in different sugarcane aging during July 2009 to February 2010 and July 2010 to February 2011 seasons. The fourth ratoon cane (R) showed the highest infested internodes by rodents (13.35 and 15.80 %) followed by the third (10.22, 12.60 %); second (7.03, 8.6 %) and first ratoon cane (5.50, 6.30 %), while, the spring plantation (S.P.) were the least (3.0 and 4.0 %) in both seasons, respectively. The maximum number of rat infested internodes was noticed on the lower (base) parts of stalk, while the minimum number was found on the middle and top parts of stalk regardless of plantations type in both seasons.

Statistical analysis of data obtained in both percent infested internodes showed significant differences among different sugarcane plantations in both seasons.

Generally, it could be concluded from the obtained data that fourth and third ratoon were the most susceptible to rodents'

infestation and number of dead stalks. However, the first and second ratoon cane were moderately infested. Mean while, the autumn and spring received the least attack. These results supported by Samol (1972) who found that the rat-damage stalks was lowest in main plant cane and increased progressively in 1st and 2nd ratoon.

1.4. Effect of flooding irrigation and burning trash on rodent infestations (rat damage):

Data in Table (5) showed the number of infested internodes /100 stalks caused by rodents associated with it in sugarcane plots treated with both flooding irrigation burning trash separately (alone) and ones treated with flooding irrigation integrated with burning trash after harvesting the crop in 1st and 2nd ratoon. It is obvious that the using the flooding irrigation and burning trash together after harvesting, gave the significant least infested internodes (3.62 and 4.0%) with reduction 76.79 and 77.23%. In both seasons, respectively, when compared with the control area in the first and second ratoon canes, respectively. However, using the flooding irrigation alone gave the moderately percentage of infested internodes (7.40 and 8.0 %) with reduction of 52.56 and 54.47% followed by the plots treated with only burning trash in sugarcane fields (5.33 and 6.80%) with reduction of 65.83 and 61.30% in the 1st and 2nd ratoon crops, respectively. The reduction in mean number of infested/ 100 stalks was

significant higher in case using the flooding irrigation integrated with burning trash after harvesting than in plots treated with burning trash separately with these treated with flooding irrigation in both 1st and 2nd ratoon canes, respectively.

In conclusion, using flood irrigation integrated with burning the trash after harvesting the crop can be helps to reduce the infestation by rodents more than using any treatment separately or alone. These results are nearly in agreement with the findings of (Whisson, 1996).

Burning of the trash and the dry leaves left in the field after harvesting sugarcane stubble during March-April when rodents is usually found in big numbers in fresh ratoon sprouts, proves helpful in destroying the rodents in the early stages of its activity. However, treatment with mixtures of flood irrigation and burning when used together, gave an effective and economic control, without being phytotoxic.

1.5. Effect of cane lodging on Nile grass rat, *A. niloticus* rodent infestations (rat damage):

Data in Table (6) indicated that the highest percent infested internodes caused by rat was recorded in sugarcane lodging (23.63, 28.48%), while the least infestation was observed in no lodged sugarcane (normal sugarcane fields) (10.95, 13.45 %) in the main plants and 1st ratoon canes, respectively. Statistical analysis of the data showed significant differences was found

among means of the percentage of infested internodes for the sugarcane lodging and no lodged canes in both main plant and 1st ratoon cane. These results are nearly in agreement with the findings of Sayed *et al.*, (1980). In Jamaica Metcalfe and Thomas (1966) showed that the rat damage preferred the thin or lodged cane.

1.6 Effect the sugarcane fields sites on rodents attack:

Data in Table (7) showed the number of infested internodes/100 stalks caused by rodents. In sugarcane fields near drainage, channel and another far from it. The results indicated that the highest mean percent infested internodes by rodents was observed in sugarcane fields near of drainages (11.0, 15.35%), followed by near channels (8.05, 10.80 %) in main plant and 1st ratoon cane, respectively. The least infestation was found in sugarcane fields far from the drainages and channels (3.75, 5.15%) in main plant and 1st ratoon cane, respectively. The number of rat injured internodes on the base stalk was high followed by middle parts of stalk and the top of stalk was the least regardless of the site of the field. The mean of infested in the three treatments was significant. The previous findings are in agreement with the results obtained by using cultural practices to reduce any populations can also reduce densities of rodents by allowing natural enemies greater access.

2.Assessment of yield losses in

sugarcane plantations due to rodents attack:

The damage caused by rodents to the base and the top parts of sugar cane stalks in different ages of Giza 54/9 variety; was estimated during July 2009 to February 2010 and July 2010 to February 2011 seasons as shown in table (8). The highest number of rat damage internodes was found on the base parts of stalk, while the lowest was recorded on the free top parts of stalk in different sugar can plantations. The losses percentages in cane weight and sucrose content were estimated according to equation of Metcafe and Thonas (1966) as shown in table (9). Results showed that losses percentages in weight cane due to rodents was much lower in main plant and 1st ratoon (2.39, 4.11%) than in the 3rd and 4th ratoon (6.17 and 7.16 %), respectively. This may be due to the high plant density in ratoon cane or to the intensive agricultural practices in the main plant which interrupt rats. Similar results were recorded on the losses percentages in sucrose %, where the losses ranged from 0.84 in the spring plant to 2.70 % in fourth ratoon.

The same table showed the losses in cane weight was much higher, than in losses of sucrose % cane, where the losses in cane weight ranged from to 301.14 (L.E) in the main plant to 902.16 (L.E) in the 4th ratoon, while the losses in sucrose content varied from to 226.8 (L.E) in spring

plantation to 729.0 (L.E) in 4th ratoon cane.

Several investigators estimated the damage to sugarcane stalks due to rodents; (Bates, 1960, Collado and Ruano, 1963, Pope and Johnson 1996). Collado and Ruano, 1963 Collado and Ruano, (1963) have demonstrated losses of up to 21% in weight of cane and of 15 % in sucrose content and Abazaid (1990) in Egypt, indicated that the reduction in sugarcane yield was between 8.5% (main plant) and 29% (third ratoon) for the top injured plants. Whereas, it was between 13.9 % (main plants) and 41.7 % (third ratoon) for the base damaged plants. He also found the losses in cane and sugar yield in the main plants due to rat infestation were much lower than in ratoons. This was attributed to the low plant density and intensive agricultural practices in the main plants. Hoque and Sanchez, (2001) found the mean rat damage to canes ranged from 6.5% to 18.7% and average total sugar loss varied from 1.5% to 5.8% according the region. Ali *et al.*, (2003) showed the damage due to rodent activity has been estimated as 15+5% and 7.5+1.5% in Coconut and sugarcane, respectively. Khan (2007) estimated that one percent rate (1%) damage to canes was equal to 0.42 % loss in sugar recovery. The rat damage in cane on the treated plots with rodenticides varied from 1.1% to 2.5%, while on non-treated plots, the damage ranged from 13.0% to 29.9 %.

It could be concluded that the improved cultural practices including high yield and tolerant varieties for rats, largest space between rows, sowing sugarcane in three cycles, burning of trash residues after harvest flooding irrigation and the highest rate of reduction in infestation and will be improving sugar cane productivity and avoiding environmental pollution at the same time.

Table (1): Average percentage of infested internodes caused by rodents in different sugarcane varieties, in El- Minia Governorate, during July 2009 to February 2010 and July 2010 to February 2011 seasons.

Season Variety	July 2009 to February 2010 (Main plants)					July 2010 to February 2011 (First ratoon)				
	Site of no infested internodes/ 100 stalks				% infested internodes	Site of no infested internodes/ 100 stalks				% infested Internodes
	Base	Middle	Top	Total		Base	Middle	Top	Total	
G.T.54/9	92	33	15	140	7.00c	110	45	22	177	9.33bc
G. 74/96	125	59	24	208	10.39a	149	60	34	243	12.45a
G.88/68	78	28	4	110	5.48d	81	28	16	125	6.43de
G.75/368	86	42	20	148	7.40bc	97	50	24	171	9.00c
G. 47/88	61	24	0	85	4.25f	84	30	0	112	5.90ef
PH8013	66	29	0	95	4.75e	76	25	0	101	5.20f

Means = of the total infestation. % = having the different letters of each treatment/ season are significantly different at P <0.05, as determined by Duncan's (1995) multiple range test.

Table (2): Loss in cane and sugar yield as monitored by percentage of infested internodes caused by rodents in different sugarcane varieties, Mal-lawi, Minia, Governorate, during July 2009 to February 2010 and July 2010 to February 2011 seasons.

Season Variety	July 2009 to February 2010							July 2010 to February 2011						
	% infested internodes	Weight 100 canes (kg)			Sucrose content %			% infested internodes	Weight 100 canes (kg)			Sucrose content %		
		S	I	Red.	S	I	Red.		S	I	Red.	S	I	Red.
G.T.54/9	7.00	130	104	20.00	16.88	13.62	19.31c	9.33	141	109	22.70	17.34	14.58	15.92b
G. 74/96	10.39	88	63	28.41	16.14	12.22	24.29a	12.45	106	73	31.13	17.70	13.66	22.82a
G.88/68	5.48	83	69	16.87	18.89	16.92	15.72d	6.43	90	74	17.78	19.42	17.72	9.65d
G.75/368	7.40	137	105	23.36	17.55	14.00	20.23b	9.00	149	115	22.82	18.42	15.88	13.79c
G. 47/88	4.25	93	80	13.98	16.84	14.80	12.11f	5.90	104	87	16.35	17.23	15.90	7.72ef
PH8013	4.75	122	104	14.75	17.00	14.50	14.71ef	5.20	131	111	15.27	17.66	16.42	7.02f

S = Sound plants I = Infested plants Red = % Reduction

Table (3): Average percentage of infested internodes caused by rodents in different sugarcane row-width, at Mallawi, Minia, Governorate, plant cane during July 2009 to February 2010 and July 2010 to February 2011 seasons.

Season R.W	July 2009 to February 2010 (Main plants)					July 2010 to February 2011 (First ratoon)				
	Site of no infested internodes/ 100 stalks				% infested Internodes	Site of no infested internodes/ 100 stalks				% infested Internodes
	Base	Middle	Top	Total		Base	Middle	Top	Total	
70 cm	160	70	32	262	13.43a	177	87	45	309	15.40a
90 cm	90	51	25	166	8.50b	97	66	32	195	9.75b
110cm	51	23	12	86	4.43c	66	30	16	112	5.60c
120cm	47	20	0	67	3.45d	59	28	6	93	4.65d

Means = of the total infestation. % = having the different letters of each treatment/ season are significantly different at P <0.05, as determined by Duncan's (1995) multiple range test.

Table (4): Average percentage of infested internodes caused by rodents in different sugarcane ages, in El- Minia Governorate, during July 2009 to February 2010 to July 2010 to February 2011 seasons.

Season Ages	July 2009 to February 2010 (Main plants)					July 2010 to February 2011 (First ratoon)				
	Site of no infested internodes/ 100 stalks				% infested internodes	Site of no infested internodes/ 100 stalks				% infested Internodes
	Base	Middle	Top	Total		Base	Middle	Top	Total	
S.P	42	15	0	57	3.00f	62	18	0	80	4.00f
1 st R	69	23	13	105	5.50d	70	37	18	125	6.30d
2 nd R	77	35	22	134	7.03c	96	50	26	172	8.60c
3 rd R	98	60	36	194	10.23b	142	80	30	252	12.60b
4 th R	131	82	22	235	12.35a	185	70	41	296	14.80a

Means = of the total infestation. % = having the different letters of each treatment/ season are significantly different at P <0.05, as determined by Duncan's (1995) multiple range test.

Table (5): Average infested internodes caused by rodents in relation to flooding irrigation and burning of trash as monitored in the 1st and 2nd ratoon canes, Mallawi , Minia, Governorate, during July 2009 to February 2010 to July 2010 to February 2011 seasons.

Season	July 2009 to February 2010 (Main plants)					July 2010 to February 2011 (First ratoon)				
	Site of no infested internodes/ 100 stalks				% infested internodes	Site of no infested internodes/ 100 stalks				% infested Internodes
	Base	Middle	Top	Total		Base	Middle	Top	Total	
Burning trash	77	25	9	101	5.33c	87	35	14	136	6.80c
Flooding irrigation	86	35	20	141	7.40b	93	43	26	162	8.00b
Burning + flooding	55	14	0	69	3.62d	62	21	0	83	4.00d
Control	182	75	40	297	15.60a	193	97	62	352	17.57a

Means = of the total infestation. % = having the different letters of each treatment/ season are significantly different at P <0.05, as determined by Duncan's (1995) multiple range test .

Table (6): Effect of cane lodging on infestation by rodents in sugarcane fields, Mallawi, Minia, Governorate, during July 2009 to February 2010 to July 2010 to February 2011 seasons.

Season	July 2009 to February 2010 (Main plants)					July 2010 to February 2011 (First ratoon)				
	Site of no infested internodes/ 100 stalks				% infested internodes	Site of no infested internodes/ 100 stalks				%infested Internodes
	Base	Middle	Top	Total		Base	Middle	Top	Total	
Cane lodging	237	123	89	449	23.63	292	152	111	555	28.48
Control (No lodging)	112	66	25	208	10.95	136	79	46	261	13.40

Means = of the total infestation. % = having the different letters of each treatment/ season are significantly different at P <0.05, as determined by Duncan's (1995) multiple range test.

Table (7): Average percentage of infested internodes caused by rodents in different sites of sugarcane fields, Mallawi, Minia, Governorate, during July 2009 to February 2010 and July 2010 to February 2011 seasons.

Season Field Site	July 2009 to February 2010 (Main plants)				% infested internodes	July 2010 to February 2011 (First ratoon)				% infested Internodes
	Site of no infested internodes/ 100 stalks					Site of no infested internodes/ 100 stalks				
	Base	Middle	Top	Total	Base	Middle	Top	Total		
Near of drainage	120	72	23	215	11.00a	183	82	42	307	15.35a
Near of channel	94	41	18	153	8.05b	102	63	51	216	10.80b
Normal	58	13	0	71	3.75c	71	22	10	103	5.15c

Means = of the total infestation. % = having the different letters of each treatment/ season are significantly different at P <0.05, as determined by Duncan's (1995) multiple range test.

Table (8): Average percentage of infested internodes caused by rodents as monitored by (or based on) fresh top, fresh base and old base in different sugarcane plantations, Mallawi, Minia, Governorate, during July 2010 to February 2011 seasons.

Internodes number in	Ages				
	Spring plantation	1 st ratoon	2 nd ratoon	3 rd ratoon	4 th ratoon
Sound stalks	2469	2591	2719	2716	2571
Infested fresh top	10	17	20	25	33
Infested fresh base	120	239	316	390	434
Infested old base	17	25	29	35	47
Internodes total	2615	2872	3084	3166	3102
% infested internodes	5.58	9.78	11.84	14.21	17.12

Table (9): Loss in cane and sugar yield as monitored by percentage of infested internodes caused by rodents in different sugarcane plantations, Mallawi, Minia, Governorate, during July 2010 to February 2011 seasons.

Ages	% infested internodes	% loss in weight cane	% loss in sugar content	Loss in weight cane \$	Loss in sugar content \$
S. plantation	5.58	2.39	0.84	301.14	226.80
1 st ratoon	9.78	4.11	1.51	517.86	407.70
2 nd ratoon	11.84	4.95	1.86	623.70	502.20
3 rd ratoon	14.21	6.17	2.24	777.42	604.80
4 th ratoon	17.12	7.16	2.70	902.16	729.0

Cane yield loss % (Y) = 0.41 X + 0.1

Cane yield loss % in S.P. = 0.41 x 5.58 + 0.1 = 2.39

$$\begin{aligned} \text{Cane yield loss \% in 1}^{\text{st}} &= 0.41 \times 9.78 + 0.1 = 4.11 \\ \text{Cane yield loss \% in 2}^{\text{nd}} &= 0.41 \times 11.84 + 0.1 = 4.95 \\ \text{Cane yield loss \% in 3}^{\text{rd}} &= 0.41 \times 14.21 + 0.1 = 6.17 \\ \text{Cane yield loss \% in 4}^{\text{th}} &= 0.41 \times 17.12 + 0.1 = 7.16 \end{aligned}$$

$$\text{Sugar yield loss in S.P.} = \frac{10 \times 0.0316 + 120 \times 0.179 + 17 \times 0.0105}{2615} \times 100 = 0.84$$

$$\text{Sugar yield loss in 1}^{\text{st}} = \frac{17 \times 0.0316 + 239 \times 0.179 + 25 \times 0.0105}{2872} \times 100 = 1.51$$

$$\text{Sugar yield loss in 2}^{\text{nd}} = \frac{20 \times 0.0316 + 316 \times 0.179 + 29 \times 0.0105}{3084} \times 100 = 1.86$$

$$\text{Sugar yield loss in 3}^{\text{rd}} = \frac{25 \times 0.0316 + 390 \times 0.179 + 35 \times 0.0105}{3166} \times 100 = 2.24$$

$$\text{Sugar yield loss in 4}^{\text{th}} = \frac{33 \times 0.0316 + 434 \times 0.179 + 47 \times 0.0105}{3102} \times 100 = 2.70$$

$$\text{Loss in cane weight with pounds (L.E) in S.P.} = 45 \times 280 \times 2.39 / 100 = 301.14 \$$$

$$\text{Loss in cane weight with pounds (L.E) in 1}^{\text{st}} = 45 \times 280 \times 4.11 / 100 = 517.86 \$$$

$$\text{Loss in cane weight with pounds (L.E) in 2}^{\text{nd}} = 45 \times 280 \times 4.95 / 100 = 623.74 \$$$

$$\text{Loss in cane weight with pounds (L.E) in 3}^{\text{rd}} = 45 \times 280 \times 6.17 / 100 = 777.42 \$$$

$$\text{Loss in cane weight with pounds (L.E) in 4}^{\text{th}} = 45 \times 280 \times 7.16 / 100 = 902.16 \$$$

Where yield of cane per Fadden = 45 ton Price of one ton = 280 (L.E)

$$\text{Loss in sugar / fed with pounds (L.E) in S.P.} = 5.4 \times 5000 \times 0.84 / 100 = 226.80 \$$$

$$\text{Loss in sugar / fed with pounds (L.E) in 1}^{\text{st}} = 5.4 \times 5000 \times 1.51 / 100 = 407.70 \$$$

$$\text{Loss in sugar / fed with pounds (L.E) in 2}^{\text{nd}} = 5.4 \times 5000 \times 1.86 / 100 = 502.20 \$$$

$$\text{Loss in sugar / fed with pounds (L.E) in 3}^{\text{rd}} = 5.4 \times 5000 \times 2.24 / 100 = 604.80 \$$$

$$\text{Loss in sugar / fed with pounds (L.E) in 4}^{\text{th}} = 5.4 \times 5000 \times 2.70 / 100 = 729.0 \$$$

Where yield of sugar/Fadden= 45 x 12/100= 5.4 ton/fed.Price of sugar ton= 5000 L.E.

References:

- Abazaid, A.A. (1990). Efficiency of some common used rodenticides and some new alternatives against rodents in Qena Governorate. M.Sci Thesis Fac. Agric., Assiut Univ.
- Abd El-Gawad, K.H.; A.M. Salit and A. Maher Ali (1982). Damage caused by rodents in sugarcane plantation. Assiut J. Agric. Sci., 13 (2): 63- 70.
- Adsuar, J.(1962). Failure of rodents to transmit the causal agent of sugarcane ratoon-stunting disease. J. Dep. Agric. Univ. P. Rico, 46: 239- 240.
- Ali, M.K. and A.I. Farghal (1995). Damage caused by rodents to sugarcane varieties and juice quality in Sohag Governorate. Assiute J of Agric. Sci., 26(4):231 – 237.
- Ali, R.; S. Fatima and M.Farhanulah Khan (2003). Estimation of rodent damage on Coconut plantations and sugarcane in Sindh. Pakistan J. of Biolo. Sci., 6(12): 1051 -1053.
- A.O.A.C. (1970). Association of official agriculture chemists.

- Official Methods of Analysis 9th Ed. Washington D.C.
- Bates, J.F.(1960). Rodent control in sugarcane in British Guiana. Proc.Br.W. Indes Sug. Technol., 8: 61 -67.
- Bates, J.F. (1963). The canfield rat in British Guiana and its control. Proc.int Soc. Sug. Cane. Technol. , 11: 695 - 704.
- Collado, J.C. and M.A. Ruano (1963). The rat problem in the sugarcane plantations of Mexico. Proc. int Soc. Sug Cane Technol. . 11 : 705-711.
- Duncun, D. B. (1955). Multiple range and (F) tests Biometrics, 11: 1- 42.
- Engeman, R.M.; M.E. Tobin and R.T. Sugihara (1998). Relationship of rat damage to physical and yield characteristics of Hawaiian sugarcane. International Biodeterioration and Biodegradation, Hawaii, 42 (2/3): 123-127.
- Hebert (1973). Testing of sugarcane varieties for milling quality. Sugar Jour., 36 (4): 8 -12.
- Hilal, T. Y.; K.H. Abd El-Gawad and A.Maher Ali (1989). Damage caused by rodents in sugarcane plantations with relation to their behavior. Assiute J of Agric. Sci., 12 (2):157 – 164.
- Hoque, M.M. and D.C. Sanchez (2001). Reduction of rodent damage in sugarcane through baiting with brodifacoum rodenticide. Philippine Agric. Sci., 84 (2): 159- 165.
- Khan (2007). Comparative evaluation of two acute rodenticides in sugarcane fields. Sarhed J. of Agric Pakistan, 23 (3): 713 -718
- Martorell, L.F.(1967).A Preliminary report on rat damage in Puerto Rican cane field. Proc. Int. Soc. Sug. Cane Technol., 12: 1435 – 1443.
- Metcalfe, J.I. and G.Thonas(1966). Preliminary experiments in Jamaica with a method for determining loss of sugar resulting from rat damage to sugarcane. Proc. Br. W. Indes Sugar Technol., 1966: 276- 278.
- Parshad, V. R. (1998). Rodent control in India. Dep. Of Zoology, Punjab, Agric.Uni Ludhiana 14 too4, India.
- Payane, J.H.1968. Sugarcane factory analytica control. Elsevier Pub. Co. Ner York: 69 -78.
- Pope, G.M. and L. R. Johnson (1996). Assessment of pest damage in the Mulgrave area through extension of the extraneous matter analysis system. Proceedings of the 1996 Conference of the Australian Soc. of Sugarcane Technolo. Held at Mackay, Queensland , Australia from 30th April to 3rd May 1996, 82 -89
- Samol, H.H. (1972). Rat damage to sugarcane in Florida. Proce. of Interna. Soc. Of sugarcane Technolo. 14th Congress, 575 – 580.
- Sayed , G.E.K.; S.E. Nasr ; A. Hemaida and A.A. Badawi (1980). Effect of cane lodg-

- ing and rat damage on cane quality and deterioration after harvest. 7th Congress of Inter.Soc. of sugarcane , Technolo. Egypt, V (1): 296-301.
- Sta-Craz; P.C. and A Dobermann; Pham- Van – Du ; G.C. Hilb and R.S. Zeigler (2007). Nutrient – pest interactions under irrigated low land production system with farmer fertilizer practice and site- specific nutrient management southeast Asia. Philippine J. of crop Science.
- Tohamy, T.H. (1999). Ecological studies in certain sugarcane pests in Middle Egypt. Ph.D. , Thesis, Fac. Agric. , Minia Univ., Egypt.
- Whisson, D. (1996). The effect of two agricultural techniques on population of cane field rat (*Rattus sordidus*) in sugarcane crops of North Queensland. Wildl. Res., 23 (5): 589 – 604.

دور بعض العمليات الزراعية في تقليل الإصابة بالفئران مع تقدير الضرر في أعمار قصب السكر المختلفة في محافظة المنيا

تهامي حامد تهامي^١ ، ياسر محمد عبد القوى عبد الجليل^٢ ،

عبد الرحيم أحمد عبد الرحيم^٢ ، على محمد علوان^٢

^١معهد بحوث وقاية النباتات - معهد بحوث المحاصيل السكرية - الجيزة - مصر

تم عمل تجارب حقلية لتقييم دور العمليات الزراعية في خفض إصابة قصب السكر بالفئران وزيادة المحصول كما ونوعا في حقول قصب السكر في منطقة ملوى بمحافظة المنيا خلال موسمين زراعيين فقط ٢٠٠٩/٢٠١٠، ٢٠١٠/٢٠١١.

أثبتت النتائج أن النسب المئوية للعقل المصابة بجزر الحقل النيلى *Arvicanthus niloticus* لأصناف القصب المختبرة في كل من القصب الغرس والخلفة الأولى كانت قليلة مع أصناف جيزة ٨٨/٤٧ (٤،٢٥ ، ٤٠،٩٠)٪، Ph ٨٠١٣ (٤،٧٥ ، ٥،٢٠)٪، جيزة ٦٨/٨٨ (٥،٤٨ ، ٦،٤٣)٪ بينما سجل صنفى جيزة ٣٦٨/٧٥ (٧،٤٠ ، ٩،٠)٪، جيزة ٩/٥٤ (٧،٠ ، ٩،٣٣)٪ إصابة متوسطة أما صنف جيزة ٩٦/٧٤ فقد إستقبل أقل إصابة (١٠،٣٩ ، ١٢،٤٥)٪ على التوالي.

وسجلت أعلى نسبة مئوية لخفض نسبة السكر في العيدان المصابة بالفئران في أصناف جيزة ٩٦/٧٤ (٢٤،٢٩ ، ٢٢،٨٢)٪، جيزة ٣٦٨/٧٥ (٢٣،٢٣ ، ١٣،٧٩)٪ وجيزة ٩/٥٤ (١٩،٣١ ، ١٥،٩٢)٪ بينما سجل أقل نسبة مئوية لخفض السكر في النباتات المصابة في أصناف جيزة ٦٨/٨٨ (١٥،٧٢ ، ٩،٦٥)٪ ، Ph ٨٠١٣ (١٤،٧١ ، ٧،٠٠٢)٪ وجيزة ٨٨/٤٧ (١٢،١١ ، ٧،٧٢)٪ في موسمى الغرس والخلفة الأولى على التوالي، ووجد أن النسبة المئوية للعقل المصابة بالجزران تقل معنويا بزيادة مسافة الزراعة بين خطوط قصب السكر في كلا الموسمين على التوالي، ومن ناحية أخرى وجد أن الضرر بالجزران يكون منخفضا في قصب الغرس ويكون عاليا في الخلفة الرابعة بالمقارنة بالاعمار الأخرى، وأكثر من ذلك أدى حرق السفير (متخلفات المحصول) متكامل مع الري بالغمر الغزير بعد كسر المحصول إلى خفض معنوى في النسبة المئوية للعقل المصابة بالجزران بمقدار ٧٦،٩٢ ، ٧٧،٢٣٪ في كلا الموسمين على التوالي بالمقارنة بالكنترول.

وأوضحت النتائج أيضا أن أعلى نسبة إصابة للنباتات بالجزران كانت في حقول القصب القريبة من المصارف (١١،٠٠ ، ١٥،٣٥)٪ وكذلك القريبة من الترعة (٢٨،٠٥ ، ١٠،٨٠)٪ مقارنة بالحقول البعيدة (٣،٧٥ ، ٥،١٥)٪ في كل من قصب الغرس والخلفة الأولى على التوالي، ومن ناحية أخرى وجد أن النسبة المئوية لعقل القصب المصابة بالفئران تكون عالية في حقول القصب التي بها رقاد (٢٣،٦٣ ، ٢٨،٤٨)٪ بالمقارنة بالحقول الغير راقدة في كل من قصب الغرس والخلفة الأولى على التوالي.

وجد أيضا أن الخسائر في وزن المحصول ونتاجية السكر نتيجة الإصابة بالجزران تكون منخفضة في قصب الغرس مقارنة بقصب الخلفات، وتتراوح تكاليف الخسائر في وزن المحصول بالنسبة للقدان الواحد من ٣٠١،١٤ جنية في قصب الغرس إلى ٩٠٢،١٦ جنية في قصب الخلفة الرابعة، بينما تتراوح تكاليف الخسائر في كمية السكر بالنسبة للقدان الواحد من ٢٢٦،٨ جنية في قصب الغرس إلى ٧٢٩،٠ جنية في قصب الخلفة الرابعة، وعموما فإن متوسط النسبة المئوية للعقل المصابة بالجزران تكون عالية في الجزء السفلى من النباتات عن الجزء العلوى.