POPULATION DYNAMICS OF RODENT PESTS IN SUGARCANE, (*SACCHARUM OFFICINARUM* L.) IN LOWER SINDH, PAKISTAN

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ABSTRACT

A year round study was carried out on sugarcane fields at Thatta, lower Sindh. Bimonthly snap-trapping for five successive trap nights was carried out from January to December. Two snap traps were set every 10 meters in a line of 50 traps along the edge of sugarcane fields, about 1—2 meters into the crop field. The percent trap success and the relative abundance was calculated to determine rodent species abundance. Results showed that bandicoot rat, *Bandicota bengalensis* (Gray and Hardwicke) was the most prevailing rat (54.26%), followed by the short tailed mole rat, *Nesokia indica* (Gray and Hardwicke) (33.19%). The other species, trapped from the fields were soft-furred field rat *Millardia meltada* (Gray) (8.66%) and gerbil *Tatera indica* (Hardwicke) (3.91%). The overall trap success was 27.11%.

Key Words: *Bandicota bengalensis, Nesokia indica, Millardia meltada, Tatera indica,* trap success, relative abundance.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is a major, widespread cash crop of Pakistan. It is a highly valued crop for making sugar, sugar-related products, chipboard, paper etc. The crop accounts for 3.1% value added share in agriculture and 0.6% share in GDP of the country, with 65.5 million tonnes sugarcane production during 2015-16 (GOP, 2016). Sugarcane is a commercial crop for growers but some pests and diseases however associate with sugarcane. Among the pests, rodent invasion is a serious problem for the growers. Rodents have great economic importance as agricultural pests, globally inflicting heavy losses to crops, fruit gardens, orchards, and stored food grain (Singleton, *et al*., 2011). Addison, (2012) quoted (as per an estimate in United States) 3.5 million rats birth every day worldwide, further he reported the presence of approximately 1.25 billion rats worldwide causing at least $19 billion crop losses every year. Sugarcane is a perennial crop for the whole year thus provides an ideal situation for a complex of rodent population to exist and cause widespread damage to internodes, roots and follow-on exposure to fungus, microorganisms, diseases, insect deterioration, and reduction of weight and sugar recovery. Sugarcane crop is severely damaged by a complex of rodent species including *Nesokia indica, Bandicota bengalensis, Millardia meltada* and *Mus booduga* (Hussain, 2005; Smiet *et al.*, 1980; Beg *et al*.,, 1979; Khan, 1982; Hampson, 1984; Roberts, 1997; Mishkat *et al*., 2006). Monetary damages by rodents to sugarcane in Pakistan are documented by some scientists, such as Beg *et al*., (1979) quoted 11% damage to sugarcane in central Punjab. Fulk *et al* (1980) evaluated 7.2 and 4.4% damaged canes and assessed 10.7% and 7.7% reduction in sugar production in four districts of Punjab and Sindh respectively. Mishkat *et al*., (2006) assessed 10.77% decrease in sugar recovery because of rat damage in sugarcane growing areas of Mandi Bahauddin, Phalia, Balwal and Khushab. Smiet *et al*., (1980) estimated 24% damage to canes in Thatta district of lower Sindh. Khan and Munir (2006) claimed 74% decrease in rodent population after 2% Zinc Phosphide baiting in sugarcane growing areas of Army Welfare Sugar Mills, Badin district. Besides their direct damage, they also expose the cane, increasing the risk of infection by bacteria and fungi (Meyer and Fenwick (2003), Meyer, *et al*., (2009). Rao (2003) reported that rodents in Australian cane fields destroyed approximately 825,000 tonnes of sugarcane valued at US$ 50 million during 1999-2000 harvest seasons. Numerous scientists of Vertebrate Pest Control Institute conducted widespread surveys, laboratory and field studies associated to rodent management and developed models & packages for the cultivators (Smythe, 1977; Khan, 1983; Smythe and Khan, 1980; Fulk *et al*., 1978 and 1980; Smiet *et al*., 1980; Greaves (1989); Shafi and Khan, 1983; Brooks *et al*., 1989; Khokhar and Rizvi, 1999; Pervez *et al*., 1999 and 2005; Tariq *et al*., 2009).

Studies on population dynamics, biology, behavior and movement of the pest species serve as the basis for crop modification, correct poison baiting time and damage control strategies. Keeping these facts in mind a study regarding population dynamics of rodent pests was carried out on sugarcane fields at Thatta, lower Sindh that aims to develop better control planning.

MATERIALS AND METHODS

Snap-trapping was carried out bimonthly in randomly selected fields (twelve field/ blocks (four acres each) from January to December, 2015. Every time a new field was used for the snap trapping. The bimonthly trappings continued for five successive nights each time. For the purpose each night two snap traps were set every 10 meters in a line of 50 traps (size:12cm x 6cm) along the edge of sugarcane fields, about 1—2 meters into the crop on the selected fields. The snap traps consisted of bait material (bread with butter). Traps were rearranged for all the successive nights, and trapped rodents collected and counted. Each of the trapped rodent was given a field number and brought to the laboratory for identification. Trap success (number of animals captured / trap night), was used to estimate the abundance and diversity of the rodent populations distressing sugarcane fields for the whole year. The relative abundance (%) of each rodent species was estimated.

The results of Snap-trapping were subjected to analysis of variance (ANOVA), followed by Duncan's multiple range test and Fisher's least significant difference (LSD) test at P=0.05 was also performed (Zar, 2009).

RESULTS AND DISCUSSION

Trap success and relative abundance of rodent species invading the sugarcane fields were determined for the entire year. In different growth stages of the sugarcane the trap success varied among the trapped species. Trap success data of different species from the sugar cane fields is given in Table I. On the basis of the trapping data four species of rodents namely the lesser bandicoot rat, *Bandicota bengalensis*, short tailed mole rat, *Nesokia indica*, soft-furred field rat *Millardia meltada*, and Indian gerbil *Tatera indica*, were abundant in the trial sugarcane fields. The overall trap success was 27.11 as compared to the findings of Takele *et.al.* (2008): 12.9% (in Ethiopia), Siddique and Arshad (2003): 4.1% (in Pakistan) trap success in sugarcane plantations. It may be due to the day by day increasing rodent population, climatic change or poor pest management due to negligence of the farmers. The maximum trapping was achieved during maturity period of Sugarcane when the crop ripened. During maturity stage sugar synthesis, accumulation and deposition starts from bottom to the top portion resulting in rodent attack to the canes. The gnawed roots, lower nodes and internodes were observed in the fields. The lowest trapping was achieved during the tiller stage of the crop, which may be due to the reason that at this stage the plants have little sugar contents to attract the rats, as well as less shelter places (refugia) for nesting and hiding are available. Whereas as during ripening stage rodents reside all the time due to enormous availability of food and shelter. More over the rodents from adjacent fields also attack the sugarcane at the ripening stage. Greaves (1982) also reported that the rodent damage in sugarcane fields was more severe at the harvesting stage of the crop. During grand growth stage the trap success was less than the maturity but higher than the tiller stage, probably due to better ground cover-up that attract rodents from the neighboring farms too. In these studies trap success rate was found higher even with comparison of trap success in some other agricultural crops, carried out by some earlier researchers; Such as, 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. Among the rodent species in the plantation, *Bandicota begalensis and Nesokia indica* spp. were the major pests. Their abundance in the farm was very high. Bandicoot Rat (*Bandicota bengalensis*) attained highest level of population abundance in the experimental area. The population of rats increased up to maturity and at that time bandicoots become most abundant species. This was in line with the findings with many earlier workers who have reported these species as the most serious rodent pests in sugarcane fields (Fulk *et al*., (1980), Khan and Munir (2006). Mishkat *et al*., (2006). Smiet, *et al*., (1980). Tariq, *et al*., (2009). Certain other rodent pests such as *Mus* spp., *Rattus rattus* and *Porcupine* (*Hystrix cristata*) were also occasionally observed to damage sugarcane. The bandicoot rats inhabited grassy and moist banks of the irrigation channels, while the gerbils restricted themselves to the areas of bushes in the observed fields. The trap success for Indian gerbil *Tatera indica was* only 0.55% at tiller, 1.02% at growth and 1.6% at maturity stage. This trend is similar with the

The findings of Beg *et al*., (2010) in which the gerbil was trapped occasionally from the cane fields. More over in the same studies they observed average trap success (5.9%) for the *Millardia* in mature sugarcane crop, where as we found 4.87% trap success at maturity with 2.35% over all trap success for the entire year. In Lower Sindh, the *Millardia* does not reproduce become sluggish during December to January (Smiet *et al*., 1980, Fulk *et al*., 1981, Rana *et al*., 2006; Khan, 1982; Smiet *et al*., 1980). In lower Sindh, these species are known to maintain almost year round resident populations in the cane fields and regularly forage in the nearby cereal fields causing damage to the crops (Smiet *et al*., 1980). So it may be possible that during our studies the species moved out to the adjacent fields of some other crops. Many active burrows of the bandicoot rat were observed in the cane fields, and signs of

digging, fecal droppings of the short tailed mole rat in the fields confirmed their presence. Moreover, sugarcane and wheat had been reported as the staple food of these rodents during the fall and winter months (Beg *et al.*, 1979, 1980; Butt *et al.*, 2003) which confirm their invasion on the matured canes. The association of the murid rodents that affect the sugarcane agro system causes substantial damage to crop all over Pakistan (Greaves *et al*., 1982, 1989; Beg *et al.*, 1979, Fulk *et al*., 1980, Brooks *et al*., 1988; Hussain *et al*., 2003). Thus, the small mammal pests should be managed wisely with the Integrated Pest Management models.

Furthermore, two way ANOVA was performed on the data of relative abundance of rodent specie complex invading the sugarcane fields for the entire year. The results showed that the months were significant, stages were significant and interaction of months and stages were also significant in case of *Bandicota bengalensis*, *Nesokia indica* and *Tatera indica.* While *Millardia meltada* stages were significant but months and interaction of month and stages were non significant.

RECOMMENDATIONS

Sugarcane is a long duration crop, therefore provides a perfect habitation for a complex of rodent populations to live and cause extensive damage to the sugarcane, standing or lodged. The rodent control often performed is inadequate, poorly timed or is after the damage has been done. Present results revealed that four rodent species, bandicoot rat (*B. bengalensis*), soft furred field rat (*M. meltada*), short tailed mole rat (*N. indica*) and gerbil *Tatera indica* were observed in the sugarcane fields. Bandicoot rat (*B. bengalensis*) and short tailed mole rat (*N. indica*) were found as predominant pest species. The growers need a better understanding of the rodent damage as per the variety, rodent species identification and its biology in relation to crop timings. A cost-benefit analysis should be conducted for rodent management. An Integrated Pest Management approach is being practiced to manage rodent's damage in sugarcane crop by Vertebrate Pest Control Institute, Southern-zone Agricultural Research Centre, Pakistan Agricultural Research Council. The package is successfully developed for rodent management after a series of trails and is ready for adoption by the end-users.

Table 1. Results of bimonthly snap trapping of rodents for five successive nights for the entire year. Mean followed by Standard Error.

Crop growth stages	**Trapping months**	**Species complex**			
		B. bengalensis	***N. indica***	***M. meltada***	***T. indica***
Tillering	January	145 ± 13	87 ± 6	6 ± 2	5 ± 1
	February	66 ± 12	72 ± 9	4 ± 2	7 ± 3
	March	84 ± 10	67 ± 5	3 ± 1	6 ± 1
	April	101 ± 20	64 ± 8	9 ± 2	4 ± 1
Grand growth	May	119 ± 9	66 ± 4	8 ± 4	9 ± 2
	June	98 ± 9	73 ± 5	14 ± 3	4 ± 0
	Jully	96 ± 10	70 ± 10	19 ± 2	18 ± 4
	August	113 ± 8	87 ± 6	24 ± 5	10 ± 2
Maturity	September	178 ± 4	91 ± 7	37 ± 11	9 ± 3
	October	328 ± 14	129 ± 15	49 ± 9	17 ± 2
	November	238 ± 9	114 ± 8	62 ± 7	11 ± 1
	December	199 ± 8	159 ± 7	47 ± 4	27 ± 3
Total trapped	3253	1765	1079	282	127
Trap Success	27.11(overall)	14.71	8.99	2.35	1.06
Relative abundance (%)		54.26	33.19	8.66	3.91

Trap Success= Total number of animal trapped/ Total number of trap night (120)

Table-2: Seasonal variation in relative abundance among the trapped species of the rodents

Season(crop stage)	Rodent Species	No. of Trapped	Trap success	Relative abundance(%)
Tillering	*Bandicota bengalensis*	396	9.9	74.71
	Nesokia indica	290	2.25	16.98
	Millardia meltada	22	0.55	4.15
	Tetra indica	22	0.55	4.15
Grand growth	*Bandicota bengalensis*	426	10.65	51.47
	Nesokia indica	296	7.4	35.76
	Millardia meltada	65	1.62	7.82
	Tetra indica	41	1.02	4.92
Maturity	*Bandicota bengalensis*	943	23.57	55.64
	Nesokia indica	493	12.32	29.08
	Millardia meltada	195	4.87	11.49
	Tetra indica	64	1.6	3.77

Table 3. Two factors ANOVA table of *Bandicota bengalensis* invading the sugarcane fields.

Source	**SS**	**df**	**MS**	**F**	**P**
Main Effect					
Months	2768.5	3	922.833	3.5133	0.05*
Stages	9315	2	46576.5	177.321	0.001***
Interaction					
Month × Stages	31875	6	5312.5	20.225	0.001***
Error	3152	12	262.66		

$LSD_{0.05}$= (Factor months) 20.387 (Factor stages) 17.656

Table 4. Two factor ANOVA table of *Nesokia indica* invading the sugarcane fields.

Source	SS	Df	MS	F	P
Main Effect					
Months	1715.33	3	571.77	4.37	0.05*
Stages	13209.3	2	6604.6	50.481	0.001***
Interaction					
Month × Stages	4142.66	6	690.44	5.277	0.01**
Error	1570	12	130.83		
Total	20637.3	23			

$LSD_{0.05}$= (Factor months) 14.388 (Factor stages) 12.466

Table 5. Two factor ANOVA table of *Millardia meltada* invading the sugarcane fields.

Source	SS	df	MS	F	P
Main Effect					
Months	443.33	3	147.7	2.654	0.0960n.s
Stages	8113	2	4056.5	72.8712	0.001***
Interaction					
Month × Stages	513.66	6	85.611	1.537	0.2473n.s
Error	668	12	55.66		
Total	9738	23			

$LSD_{0.05}$= (Factor months) 9.385 (Factor stages) 8.128

Table 6. Two factor ANOVA table of *Tatera indica* invading the sugarcane fields.

Source	SS	Df	MS	F	P
Main Effect					
Months	124.5	3	41.5	4.22	0.05*
Stages	442.33	2	442.3	22.491	0.001***
Interaction					
Month × Stages	479	6	479	8.1186	0.01**
Error	118	12	118		
Total	1163.83	23	1163.83		

$LSD_{0.05}$= (Factor months) 3.944 (Factor stages) 3.416

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