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EXTERNAL STRUCTURE OF *NESOKIA INDICA* BURROWS AND THEIR DISTRIBUTION IN CROPLAND AND SOME NON-CROPLAND SITES

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Studies on the external burrow structure of *Nesokia indica* were carried out in the central region of Punjab province of Pakistan. As many as 130 active burrow systems located in non-crop sites and 287 in crop land having three different soil type viz., clayey loam, sandy loam and saline soil were examined. On non-cropland sites the burrows located in sandy loams averaged longer (2.6 m) than those of saline soils (1.8 m) and wider (1.1 m) than those of clayey loams (0.8 m) at statistically significant levels. Irrespective of the soil types of non-crop burrows, carried 4.4 mounds of average size of 2.1 x 0.98 m. Cropland burrow systems located in sugarcane fields carried, on an average, 5.9 mounds measuring 3.5 m long and 2.0 m wide. Infield mounds measured larger than those located in the field bunds and margins and embankment of water courses.
An average rice field burrow system had 4.7 mounds measuring 2.3 m long and 1.3 m wide. The mounds of infield burrows averaged smaller than those located on field margins and bunds and embankments of water courses.

INTRODUCTION

Rodents as pests of agriculture crops attracted attention of agricultural scientists in the twenties of the last century when the efficacy of field scale baiting and fumigation for rat destruction was demonstrated in the Punjab province of Pakistan (Hussain and Pruthi, 1921 and Hussain and Das, 1923). Extensive studies on the systematics, biology and ecology were undertaken by scientists like Taber *et al.* (1967), Begum and Beg (1980) and Hussain *et al.* (1995) in the last quarter of that century.

Short tailed rat, *N. indica* and *Bandicota bangalensis* are the most important rodent species which are most abundantly met with in various parts of the world. According to Taber *et al.* (1967) canal irrigation has provided favourable conditions for foraging and harbouring of *N. indica*. It has, however, been reported to be entirely absent from the extensive deserts and sand dunes (Roberts, 1977). In the past a few decades mole rat has been the subject of a number of studies within and outside Pakistan (Volozhenivo, 1971; Greaves 1977; Smiet *et al.*, 1980; Fulk *et al.*, 1981 a&b; Beg *et al.*, 1981, Poche *et al.*, 1982, Ali and Mian, 1984; Hussain *et al.*, 1995; Hussain *et al.*, 2002).

In the present study, an attempt has been made to investigate the external burrow systems of mole rat located in the crop lands and non-crop lands in the central region of the Punjab province of Pakistan.

MATERIALS AND METHODS

A total of 417 burrow systems of *N. indica* were examined in three different soil type viz. clayey loam, sandy loam and saline soil in the croplands (287) and non-crop lands (130) in the district of Faisalabad, Jhang, T. T. Singh and Sheikhupura. The number of mounds per burrow system and length and breath of each burrow was recorded. From the croplands the study was carried out in the recently harvested fields of sugarcane (64 burrows) and rice (223 burrows).

RESULTS AND DISCUSSION

General observation

Presence of *N. indica* is always indicated by a pile of fresh earth that a rat throws up outside the mouth of burrow forming mounds roughly 30 cm in height and 60-90 cm in diameter. There may be 1-5 large mounds and several smaller mounds associated with a single burrow. The shape and number of mounds as well as expanse of a burrow system depends upon the nature of soil and site where it has been dug. On slope of embankments or on 'bunds' between the fields, the mounds usually take the form of an oblong pile below the burrow mouth while it is usually 6 to 7 cm in diameter, and is generally kept plugged with fresh soil. If a freshly plugged burrow is opened, the rat usually returns to replug it. Plugging is done so neatly that it is often difficult to locate the hole from outside. On open grounds the burrow system is more extensive and the excavated earth is thrown up in small piles at intervals along the course of the tunnel. The main excavated soil mounds usually have faecal pellets and pieces of grass stems (about 2 cm long) mixed with excavated soil. The main entrances usually run deep into soil through slanting tunnels. However, sometimes the main entrances open into a recess which in turn often leads into two separate tunnels.

External characteristics of burrow systems in non-cropland sites and croplands

The results regarding number of mounds per burrow in non-croplands and croplands are described and discussed as under:

Non croplands: Table 1 shows that average maximum length and breath of mounds in non-cropland sites burrows was different in relation to soil type. The average length x breath of a burrow was found to be 2.1 x 0.8 m (clayey loams), 2.6 x 1.1 m in sandy loams and 1.8 x 0.9 m in saline soils. The mean breath of burrow systems located in clayey loams and sandy loams were found to be significantly different (T=1.695) from those in the saline soils.

The maximum length of burrow systems located in sandy loams and saline soils were also significantly different (T=2.002). From the pooled data of the three soil types, it was found that an average burrow system located on non-cropland sites had 4.4 (range 1-17) mounds and measured 2.1 m (Range = 1.3 to 4.5) long and 0.9 (R = 0.3 – 3.6 m) m wide.

Croplands: In croplands, study was carried out in the recently harvested fields of sugarcane and rice.

Table 1. External characteristics of the burrow systems of *N. indica* on non-crop lands

		Soil Type			
		Clayey loam (n = 64)	Sandy loam (n=26)	Saline loam (n=40)	Overall average (n=130)
Number of mounds/burrow system	Mean	4.3	5.0	4.0	4.4
	Range	1-17	1-16	1-9	1-17
	S.E.	0.313	0.689	0.290	0.227
Max. length (m)	Mean	2.1	2.6	1.8	2.1
	Range	0.3-4.5	0.9-6.0	0.6-3.6	0.3-4.5
	S.E.	0.133	0.261	0.137	0.095
Max. Breadth (m)	Mean	0.8	1.1	0.9	0.9
	Range	0.3-3.6	0.3-3.0	0.3-2.4	0.3-3.6
	S.E.	0.056	0.121	0.074	0.044

n= number of burrows observed

Sugarcane fields: The data regarding external structure of rat burrows in sugarcane harvested fields are given in Table-2. Besides soil type, observations on length x breath of burrows in relation to site viz., in field, field bunds, margins and embankments, of water courses were also recorded.

The in-field burrows (those burrows located inside the fields) had on an average 8.7 (Range: 5-12) mounds as compared to 6.2 (Range; 3-9) and 3.5 (Range; 3-4)

Table 2. External characteristics of the burrow systems *N. indica* located in recently harvested sugarcane fields.

		Burrow Site			Soil type		
		Infield (17)	Field bunds & margins (26)	Embankments of water courses (21)	Clayey loam (18)	Sandy loam (46)	Average (64)
Number of mounds/burrow system	Mean	8.7	6.2	3.5	5.4	6.1	5.9
	Range	5-12	3-9	3-4	3-10	3-12	3-12
	S.E.	0.533	0.284	0.112	0.493	0.364	0.296
Max. length (m)	Mean	5.1	3.7	2.1	3.3	3.6	3.5
	Range	2.5-6.5	1.5-5.5	1.5-2.9	1.5-6.5	1.5-6.5	1.5-6.5
	S.E.	0.274	0.150	0.069	0.311	0.199	0.167
Max. breadth (m)	Mean	2.9	2.1	1.2	1.9	2.1	2.0
	Range	1.5-3.5	1.0-2.9	1.0-1.4	1.0-3.5	1.0-3.5	1.0-3.5
	S.E.	0.140	0.073	0.061	0.168	0.111	0.091

Number of burrows examined are given in parentheses of the ones located on field bunds and margins and embankments of water courses, respectively. The mean number of loose soil mounds associated with the burrow systems located at three sites were statistically different.

In cane fields with sandy loam soil, the number of mounds per burrow systems averaged 6.1 (Range; 3-12) as compared to 5.4 (Range; 3-10) on clayey lands. The difference was, however, not statistically significant.

Without having considerations for location and condition of the soil, burrow systems of cane fields had, on an average, 5-9 mounds, measuring 3.5 m long and 2.0 meter wide (Table 2).

Rice fields: A total of 223 rice field burrows examined (Table 3), revealed that on an average infield burrow had 4.6 mounds as compared to 5.4 mounds on the field bunds and margins and 3.7 mounds in case of burrow systems of embankment of water courses. Site related difference in the mean number of mounds was statistically significant. An average infield, bund and field margin and water course embankment burrows in the rice fields measured respectively, 2.3 (r=1.0 to 4.5), 2.5 (r= 1.0–4.5) and 2.0 (r=1–3.2) long. The burrows at field margins measured longer than those located at the embankments of water courses. of in fields (1.3 m) and on the embankments of water courses (1.1 m) at statistically significant levels.

The differences in burrow width related to the conditions of the soil of the fields were not statistically significant as recorded for sugarcane burrows. The burrows of the sandy loams (1.4 m) were wider than those located in the saline soil (1.2 m) and clayey loams (1.3 m).

An average field burrow system had 4.7 mounds and measured 2.3 long x 1.3 wide. An average burrow system of cane fields were found to be more complex as it had larger number of mounds associated with it and also measured longer than an average burrow system from non-cropland or from paddy fields. An average rice field burrow system had neither larger number of mounds nor it measured longer than an average burrow system from the non-cropland sites. However, the ones from the former habitat averaged wider than the non cropland burrow systems.

As regards size and complexity of the burrow systems, much seems to depend on the site where these are present. On ground level inside the cane fields, the burrows were more extensive and complex than those located on the field margins, bunds and embankments of water courses. In case of rice fields, the infield burrows were shorter than those on the margins and

Table 3. External characteristics of the burrow system of *N. indica* located in recently harvested rice fields.

		Burrow Site			Soil type			
		Infield (65)	**Field bunds and margins (105)**	**Embankment of water courses (53)**	**Clayey loam (93)**	**Sandy loam (100)**	**Saline loam (30)**	**Combined (223)**
Average number of mounds/burrow system	Mean Range S.E.	4.6 2-9 0.209	5.4 1-10 0.166	3.7 2-6 0.164	4.6 2-9 0.104	5.0 2-10 0.180	4.5 3-8 0.278	4.7 2-10 0.115
Max. length (m)	Mean Range S.E.	2.3 1.0-4.5 0.091	2.5 1.0-4.5 0.068	2.0 1.0-3.2 0.081	2.3 1.0-3.9 0.068	2.5 1.0-4.5 0.078	2.2 1.0-3.9 0.120	2.3 1.0-4.5 0.048
Max. breadth (m)	Mean Range S.E.	1.3 0.5-2.9 0.048	1.5 0.5-2.9 0.041	1.1 0.5-1.4 0.031	1.3 0.5-2.4 0.037	1.4 0.5-2.9 0.046	1.20. 5-2.4 0.067	1.3 0.5-2.9 0.027

In parentheses are given the number of burrows examined

There was also very little variation in the length of the burrows related to the soil conditions of the paddy field. The burrow located in sandy loams (2.5 m) measured longer than those of the clayey loam (2.3 m) and saline soils (2.2 m). The differences were, however, not statistically significant.

Site related variations in the mean maximum width of paddy field burrows were relatively greater than those noted for their lengths. The burrow located at the field bunds and margins (1.5 m) averaged wider than those bunds. The difference in the complexity of burrows of cane and rice fields might have been related to the stability and adaphic conditions of these habitats. The cane fields are relatively more stable as a habitat as cane crop remains in the field for about 10-12 months in comparison to rice crops that remains in the fields for 4-5 months. Furthermore, very hydric conditions exist in the rice fields throughout the growing period of crop whereas in cane fields hydric conditions prevail only for small durations when crop is irrigated. This encourages the rat to colonize in cane fields in greater number. It is because the tunneling inside the cane fields will lead to fresh food supply (sugarcane roots) at a predictable distance. The rat, therefore, tends to extend its burrow system rather than shifting its activity to a new site. Probably this results in larger burrow systems in the cane fields. Poche *et al.* (1982) reported that in the cane fields in Bangladesh, the rat seldom surfaces rather it severs the stalks beneath the ground level.

In the rice fields, the rat was found to maintain the main burrow system along the field edges and bunds which are elevated and suitably drained. Secondly tunnels radiate into the field to gain access to the stalks of the rice plants. Persistence hydric conditions seem to limit the rat activity from burrowing inside the fields. Near crop maturity the soil in the fields becomes dry enough to permit in the field digging by the rats. Fulk *et al.* (1979) reported that trappability in surface traps increased when crop was close to the harvest.

Relatively smaller size of the burrows in non-cropland sites might be the result of frequent shifting of the home range by the rat. According to Fluk *et al.* (1981a) rat exhibits a pattern of shifting its home range to adjacent but non-overlapping area. The presence of new burrows in the vicinity of recently abandoned ones support this contention. It is because of this reason that rat moves to new areas in search of food when the principal food e.g. grasses and sedges become exhausted.

On account of this, large extensive burrows are expected in those places where food is reasonably abundant and uniformly distributed.

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