Pak. J. Agri. Sci., Vol. 42(3-4), 2005

INTERNAL STRUCTURE OF BURROW SYSTEMS OF MOLE RAT (*NESOKIA INDICA*)

Syed Riaz Hussain
EDO Faisalabad.

Eleven burrow systems of *Nesokia indica*, located in the waste lands/fallow lands of Faisalabad district were excavated to know their internal structure. The burrow consisted of both superficial and deep seated tunnels. The former were generally located within 20 cm of ground surface while the latter were at depth ranging between 21 to 80 cm. The number of chambers, depending upon the size of the burrow system, varied between 1 and 5. Not more than one chamber was found lined with plant materials. Most of the chambers were located between 31 and 50 cm. Dead ends were numerous and about half of them were located within 20 cm of ground surface.

INTRODUCTION

Rats are a nuisance in human dwellings as well as on farm lands. They are carrier of a number of human diseases and inflict heavy losses to field crops and stored grains (Ashfaq *et al.*, 2001). Among the field rats, mole rat and bandicot rat are most notorious for digging burrows which are covered with large mounds of soil. The burrows are found in and along the edges of the crop fields of wheat, sugarcane, rice, etc. The rat also makes tunnels along the water channels and canal banks thus causing serious wastage of irrigation water.

Effective control strategies can not be developed without having sufficient knowledge of rat bioecology. Burrow is the fort of a rat and the rat uses its best abilities to construct it for its peaceful living and protection against its enemies.

Attempts have been made to study the burrow systems of mole rat particularly by workers like Lay (1967), Roberts (1977), Smiet (1978), Poch *et al.* (1987) and Husain (2005). Husain (2005) made extensive studies on the external structure of mole rat burrows and provided valuable information for developing reliable pest management strategies. The present study is an attempt to investigate thoroughly the internal structure of mole rat burrow systems.

MATERIALS AND METHODS

A total of 11 burrows of *N. indica* were excavated to know their internal structure. All these burrows were located in a wasteland with sandy loam soil about 34 km north-west of Faisalabad city. The vegetation of the wastelands comprised mainly of *Desmostachya bipinnata* and *Cynodon dactylon* with scattered tufts of *Saccharum bengalensis*. A few plants of reed (*Typha angustata*) and camel thorn (*Alhagi maurorum*) were also present in the area.

All the eleven burrows evidenced occupancy, as fresh soil had been excavated from them by the rat. The digging was started from the burrow entrance which evidenced most recent excavation. As the digging progressed, the tunnels, chambers and dead ends were mapped on a graph paper. The length and diameter of the tunnels, dimensions of the chambers, and dead ends were recorded along with their depth in the soil. Number, age and sex of the specimens captured from the dug burrow were recorded.

RESULTS

Burrow system of mole rat was not identical in all cases. It varied with the situation to meet specific requirements. It was, therefore, considered worthwhile to describe all the eleven burrows dug in order to properly understand the underlying idea.

Burrow systems viz., 1, 2, 8, 9, 10 and 11 (more than 50% of the burrow systems) were relatively simple in structure as compared to the others. Burrow number 1, for example, measured only 2.8 m long, 0.2 m wide and was spread over an area of 0.4 m^2. It had only one opening to the exterior, one dead end, one chamber, and had a total tunnel length of only 2.8 m. The other five burrow systems viz., 2, 8, 9, 10 and 11 were relatively more complex. The simplest one of these five was the burrow number 2 (Fig. 1a) which measured 3.3 m long, 2.6 m wide, and had an estimated expanse of 5.5 m^2. It had a tunnel length of 11.6 m with three openings to the soil surface and 10 dead ends; only one chamber was recorded for this burrow system (Table 1).

Burrow numbers 3 to 7 were considered as complex ones. Of these, burrow numbers 6 and 7 had relatively much longer system of tunnels which when placed end to end measured 61.4 m and 63.6 m long respectively. In burrow number 6, the tunnels were largely unidirectional (Fig. 1-d), whereas in the case of burrow number 7 the tunnels tended to form a complicated

network (Fig. 1-e). Burrow number 4, was also largely unidirectional in its layout but it had two relatively simple networks associated with it (Fig. 1-c). As compared to these, burrow systems 3 and 7 had relatively more complicated maze of tunnels which were confined to relatively smaller areas (Fig. 1-b and 1-c).

Table 1. Internal structure of the burrow systems of *N. indica* in non-croplands

Burrow Systems	Max. Length (m)	Max. Width (m)	Estimated Expanse (m^2)	No. of burrow openings	No. of dead ends	Total length of tunnels (m)	No. of chambers located
1	2.8	0.2	0.4	1	1	2.8	1
2	3.3	2.6	5.5	3	10	11.6	1
3	9.9	5.1	30.4	9	33	51.9	1
4	15.0	4.2	34.8	8	34	47.1	2
5	10.7	8.1	54.3	5	6	35.0	1
6	34.0	3.7	36.3	10	13	61.4	2
7	8.6	8.0	37.4	7	16	63.6	5
8	3.3	1.8	2.3	1	2	5.0	-
9	3.9	1.9	3.9	1	2	6.0	1
10	3.9	1.7	3.8	1	3	9.0	1
11	4.6	2.6	3.1	1	6	9.7	-
Mean	9.1	3.6	19.3	5.5	11.	27.6	0.9
S.D.	9.163	6.552	19.446	5.556	12.157	24.451	1.221

As regards the depth, significant portion (30%) of the tunnels was located within a depth of 20 cm from the ground surface, whereas 40% was located at a depth between 21 cm and 30 cm (Table 2). Thus, about 78% of the tunnel system did not go beyond a depth of 30 cm. About 12% of the tunnels were located 41 to 50 cm deep and only 4% at deeper levels.

Table 2. Depth-wise location of some components of the burrow systems of *N. indica* in the soil

	% Frequency (n)		
Depth (cm)	Tunnels	Dead ends	Chambers
< 20	38.2 (26)	47.6 (60)	(1)
21-30	39.7 (27)	15.1 (19)	(3)
31-40	5.9 (4)	4.0 (5)	(3)
41-50	11.8	21.4 (27)	(5)
51-60	2.9 (2)	11.9 (15)	(2)
61-70	-	-	-
71-80	1.5 (1)	0.0	(1)

A total of 126 dead ends from the 11 burrows were recorded. Some of these dead ends were expanded and looked like chambers. Most of the dead ends (47.6%) were superficial, being 20 cm or less in their location below the ground surface. About 40.5% of them were located at depths ranging from 21 cm to 50 cm. Only 11.9% of them were located deeper than 50 cm but none of these dead ends was found below 60 cm (Table 2).

A total of 15 chambers could be recorded from the 11 burrow systems. Generally, the complex burrows tended to have greater number of chambers. Only one of these chambers was located within 20 cm of the ground surface, three 21 to 30 cm, 10 between 31 and 60 cm, and one chamber was located at about 80cm depth (Table 2). These chambers were round to oval in shape with mean maximum length of 26.7 cm (range: 15-45) and mean maximum breath of 17.5 cm (range: 15-30). Out of the 15 chambers only five had nesting material which comprised of small pieces of leaves, stem, and roots of *Demostachya bipinnata*. In two of the chambers pellets were present while the remaining eight chambers were empty and unlined.

Only five burrow systems viz., 2, 6, 7, 9 and 10 yielded specimens of *N. indica*. From burrow number 2, an adult male and from burrow number 9 an adult female was caught. Both of these specimens were found in one of the superficial tunnels at the time of capture. From burrow number 6, two adults, one male and one female, were recovered at dead end about 8cm deep. Five specimens were recovered from burrow number 7. Of these five rats, one was an adult male and four were immature rats. The adult male was taken from a chamber while the immature animals were caught from tunnels in different parts of the burrow. Burrow systems 10 yielded two specimens, one adult female and one immature male, from a single chamber.

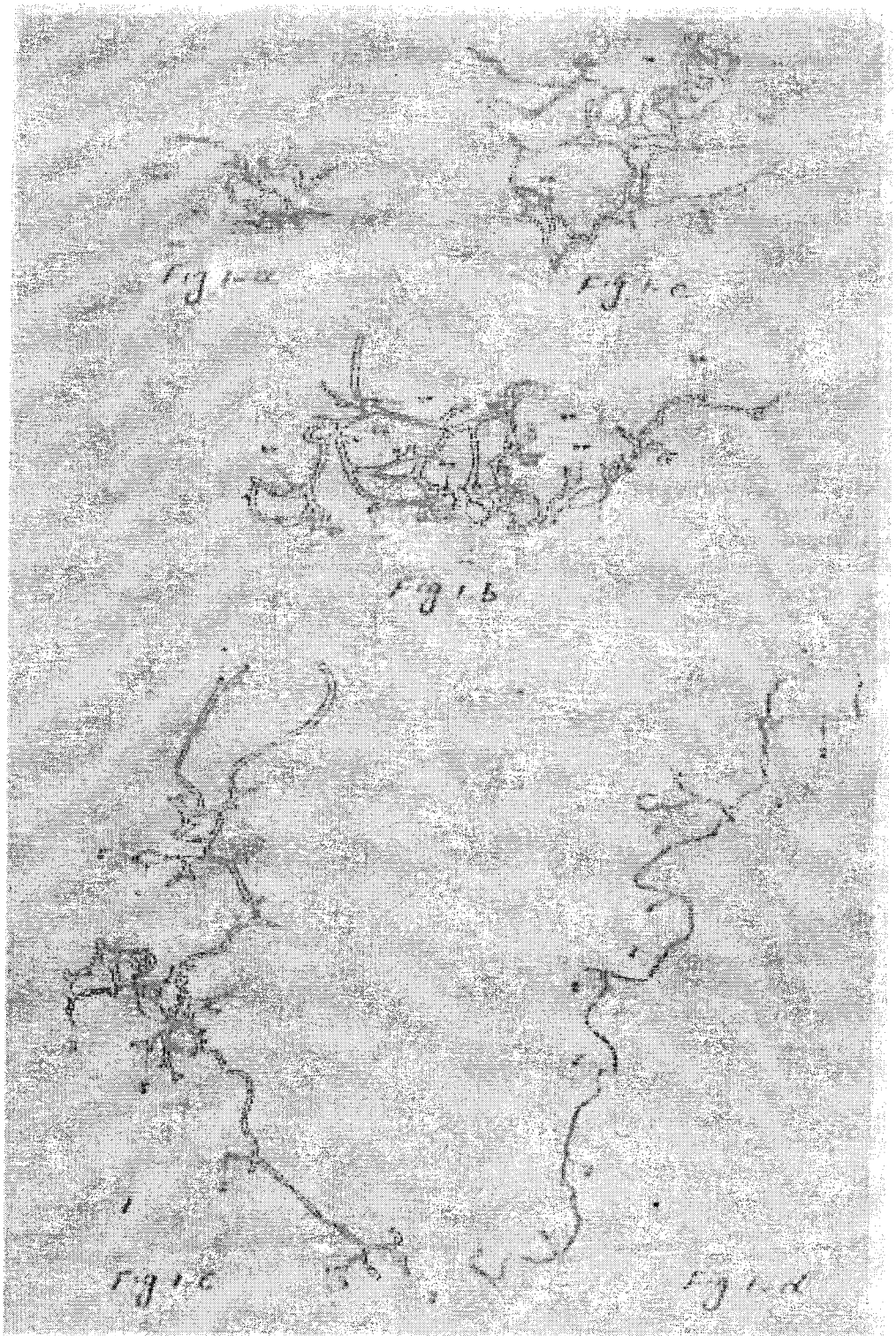

Fig. 1 Burrow Structure of Mole Rat (a,b,c,d,e)

DISCUSSION

The results of present study show that burrows of male rat generally comprised superficial and deep seated tunnels which ramify horizontally extending in some cases upto 34 m in length. The superficial tunnels are generally located within 20 cm of ground surface. It appears that superficial tunnels are used as foraging passages while 46% of deep seated tunnels observed in the present study were found located at 21-40 cm depth. Only a few of them (16%) were found deeper than 40 cm into the earth. Some of the deep seated tunnels were found connected with chambers. Most of the chambers were located at depth 31 and 50 cm, dead ends (48%) were superficial and did not exceed the depth of 20 cm.

Present findings are almost in conformity with those of Wagle (1927), who stated that rat burrows were 12.3 – 15.4 m long and the tunnels ramified at a depth of 15-61 cm below the surface. Harrison (1972) reported that the rat burrow consisted of a nest chamber which was filled with dry grass. The present findings are also in line with those of Lay (1967) and Poche *et al.* (1987), the latter workers found that mole rat maintained burrow systems in the rice field along the field edges in elevated ditch bunds and extended secondary tunnel into the field. Roberts (1977) also reported that the mole rate lined burrow chambers with finally chewed grasses and the opening of the burrows were plugged at intervals along the tunnels. The plugged passages were also noted, as were observed by Wagle (1927) and Smiet (1978). The present observations are, however, not in agreement with those of Lay (1967), Smiet (1978), Roberts (1977) and Poche *et al.* (1982) with regard to solitary existence and exclusive occupation of one particular burrow system.

LITERATURE CITED

Ashfaq, M., M.A. Saleem and F. Ahmad. 2001. Grain storage management (in Urdu). Uni. Agri. Press. 296pp.

Harrison, D.L. 1972. The mammals of Arabia. Vol.III, Ernest Benn Ltd. London.

Husain, S.R. 2005. External structure of *Nesokia indica* burrows and their distribution in cropland and some non-cropland sites. Pak. J. Agric. Sci., 42(1-2): 78-81.

Lay, D.N. 1967. A study of mammals of Iran resulting from the street expeditions of 1962-63. Fieldiana Zool., 54: 1-282.

Poche, R.M., P. Sultana, S.J. Evans, M.E. Haque, M.A. Karim and M.A. Siddique. 1982. *Nesokia indica* from Bangladesh. Mammalia, 64: 547-549.

Roberts, T.J. 1977. The mammals of Pakistan. Ernest Benn Ltd. London

Samiet, A.C. 1978. Laboratory studies on *Nesokia indica*, working paper, vertebrate pest control centre. Univ. Campus Karachi.

Wagle, P.V. 1927. The rice rats of lower Sind and their control. J. Bomb. Nat. Hist. Soc., 32: 330-338.