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Population dynamics and structure of rodents in arid ecosystem of district Hisar (Haryana) India

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Abstract
The present investigation was carried out in arid zone of CCS Haryana Agricultural University Hisar (Haryana) where *Tatera indica* was found most prevalent as field rodent followed by *Rattus rattus* and *Funambulus penneti*. The maximum population of *T. indica* had been observed during November followed by October and December, whereas *Mus musculus* was meager in dry land area comparatively. The trap indices were highest in the month of October and rodent numbers were highest in first week of experimental time period.

Keywords: Rodents, population dynamics, structure, trap index and arid ecosystem

Introduction
Rodents are economically important organisms, some of them are reported to be serious pest of damaging different crops/commodities by eating them, indirect loss by spoilage, during on-farm and off-farm periods. In India, they are responsible for 10–15% loss to total national production [12]. In India, rodents are major pests in farm lands, inhabitants, both in villages and towns. They have a high breeding rate and many show periodic increase in the population which coincides with the availability of food [10]. Rodents create primary damage to number of crops by gnawing, eating and indirect loss by spoilage, during on-farm & off-farm periods [4].
The most widespread species of rats are *R. norvegicus* (Norway or brown rat), *R. rattus* (roof rat), *R. exulans* (Polynesian rat), *B. bengalensis* (Lesser bandicoot rat) are cosmopolitan; they show commensalism, cause considerable damage to stored products, buildings and associated with various types of diseases; destroy approximately 33 million tons of food worldwide every year [6, 9].
Knowledge of the population biology, social behaviour, taxonomy and community ecology of rodent pests is an important foundation for developing effective management strategies [14]. This has happened because of the introduction of the canal system and more over because of the adoption of latest methods of irrigation. There is a shift in the environment which is probably because of the changing scenario of the ecological conditions [11]. It is therefore very important to assess the latest population structure of the rodents in the dry land area, so that an effective control strategy could be evolved accordingly.
So, keeping above facts in mind, the present investigations were carried out to study the population dynamics of rodents in dry land research farm area.

Materials and Methods
The present investigations were carried out in arid zone of dry land area (29º7’13” NL to 75º42’2” NL) and rodentology laboratory at CCS Haryana Agricultural University, Hisar (Haryana) India, the field experiments were conducted following standard methods; using digital camera, polythene bag, protective gloves, wonder traps, bait, jaggery (*gur*), chapatti, mustard oil. The population dynamics of rodents was evaluated by wonder traps/rat traps set in research farm area as per standard technique; the rodent species trapped in aforesaid area were identified as predominant species and population structure observed. The index of population abundance (trap index), counting of rodents and species composition were observed at different stages of crop growth by setting 24 wonder traps/rat traps at 2x2m distance of row to row and trap to trap using *chapatti* with jaggery coated with mustard oil as a bait material; after four days of pre-baiting. The rats trapped were removed after capturing of four days of pre-baiting and the rodents trapped per day per trap was estimated from October to December,

2016 following Barnett and Prakash (1975) [2]. The populations distribution calculated and compared by trap index (I) expressed in percentage.

Trap index (I) = M/XT × 100 rodents/traps/day; Where, M is total number of rodents trapped, X is number of traps used in trap lines and t is number of days during which traps were set.

The data was analyzed by statistical analysis using variance (ANOVA). The critical difference (CD) was worked out at 5% of significance to judge significance of difference between two treatment means.

Results and Discussion

The results of the present investigations of rodents' field incidences revealed that maximum population of rodents was recorded during November and minimum in December, 2016 in dry land area (Table 1) and similar observations were recorded by Massawe *et al.,* (2006) [8].

Table 1: Population dynamics of rodents during October

Population dynamics of rodents*					
Observation period	***Mus musculus***	***Rattus rattus***	***Tatera indica***	***Funambulus pennati***	**Mean**
1st week	0.66 ± 0.33	4.00 ± 0.57	4.68 ± 1.45	0.33 ± 0.23	2.41^{b}
2nd week	0.66 ± 0.33	1.66 ± 0.88	3.00 ± 0.57	1.00 ± 0.57	$1.58^{a,b}$
3rd week	1.33 ± 0.33	0.69 ± 0.33	1.33 ± 0.33	1.33 ± 0.33	1.16^{a}
4th week	0.66 ± 0.33	1.67 ± 0.33	0.68 ± 0.66	1.33 ± 0.33	1.08^{a}
Mean	0.83^{a}	2.00^{b}	2.42^{b}	1.00^{a}	

*Mean ±S.E.

CD (p= 0.05) for Observation period 0.83; S.E. (m) =0.28

CD (p= 0.05) for Species 0.83; S.E. (m) =0.28

CD (p= 0.05) for Observation period × Species 1.67; S.E. (m) =0.57

Values with same superscript do not differ significantly

Species composition

The population dynamics of *T. indica* (2.42) was more prevalent as compare to *R. rattus* (2.00), *F. pennati* **(**1.00) and *M. musculus* (0.83). The number of *T. indica* and *R. ratus* were at par with each other. Similarly no significant difference was observed between the number of *F. pennati* and *M. musculus*. When compared with duration wise, maximum population of rodents (2.41) was observed during 1st week in comparison to 2nd, 3rd and 4th weeks, the least (1.08) was observed in 4th week (Table 1). The population dynamics of rodents in 3rd week were at par with 4th week during the rodents counts; the interaction between observation periods and species were statistically significant differ from each other, similar observations were recorded by Brown and Earnst (2002) [3]; Yates *et al.,* (2002) [15], similarly Liu *et al.,* (2009) [7] capture 340 (165 males and 175 females) gerbils, it was observed that standing crops & grass fields provide better habitat than fields in which the crops have been harvested and only plant residues remains or grass fields that were not actively growing in early spring.

Table 2: Population dynamics of rodents during November

Population dynamics of rodents*					
Observation period	***Mus musculus***	***Rattus rattus***	***Tatera indica***	***Funambulus pennati***	**Mean**
1st week	1.33 ± 0.34	2.00 ± 0.33	5.33 ± 0.33	1.33 ± 0.31	2.50
2nd week	0.33 ± 0.31	1.66 ± 0.31	3.33 ± 0.35	0.33 ± 0.30	$1.41^{a,b}$
3rd week	0.33 ± 0.20	1.66 ± 0.25	2.00 ± 0.27	1.00 ± 0.28	1.25^{a}
4th week	0.33 ± 0.28	1.68 ± 0.27	1.33 ± 0.28	2.66 ± 0.28	$1.50^{a,b}$
Mean	0.58^{a}	1.75^{b}	3.00	$1.33^{a,b}$	

*Mean ±S.E.

CD (p= 0.05) for Observation period 0.92;S.E. (m) =0.318

CD (p= 0.05) for Species 0.92; S.E. (m) =0.318

CD (p= 0.05) for Observation period × Species 1.84;S.E. (m) =0. 63

Values with same superscript do not differ significantly

The population dynamics of rodents revealed that *T. indica* (3.00) was more predominant followed by *R. rattus* (1.75), *F. pennati* **(**1.33) and *M. musculus* (0.58). The population of *R. rattus* was at par with *F. pennati* but the population of *T. indica* was totally different from the other species; when compared duration wise, the maximum and minimum population of rodents was observed during 1st week and 3rd week respectively; populations of rodents and interaction between observation periods, the species were found statistically significant in November 2016 (Table 2). While in the month of December 2016, the population dynamics of *T. indica, R. rattus, F.* pennati, *M. musculus* and *T. indica* (1.50) were more predominant. The trend showed that the *R. rattus* (1.33), *F. pennati* **(**0.91) and *M. musculus* (0.55) with respect to number and; the number of *M. musculus* was at far greater than *F. pennati* and while comparing duration wise, maximum population of rodents (1.50) was observed during 2nd week that in comparison to 1st week and found statistically significant (table 3). Similar observations were observed for population dynamics of rodents for the months of October, November and December 2016 by Kasso and Bekele (2011) [5].

Table 3: Population dynamics of rodents during December

Population dynamics of rodents*					
Observation period	***Mus musculus***	***Rattus rattus***	***Tatera indica***	***Funambulus pennati***	**Mean**
1st week	0.33 ± 0.26	1.67 ± 0.25	3.00 ± 0.25	0.66 ± 0.16	1.41^{b}

2nd week	0.66 ± 0.18	2.33 ± 0.18	2.00 ± 0.17	1.00 ± 0.19	1.50[b]
3rd week	0.20 ± 0.16	1.00 ± 0.15	0.66± 0.17	1.33 ± 0.16	0.75[a]
4th week	1.00 ± 0.19	0.33 ± 0.22	0.33 ± 0.26	0.66 ± 0.25	0.58[a]
Mean	0.55[a]	1.33[b]	1.50[c]	0.91[ab]	

*Mean ±S.E.

CD (p= 0.05) for Observation period 0.53; S.E. (m) =0.18

CD (p= 0.05) for Species 0.53; S.E. (m) =0.18

CD (p= 0.05) for Observation period × Species 1.06; S.E. (m) =0.36

Values with same superscript do not differ significantly

The maximum populations of rodents were observed during November, followed by October and December, 2016 and maximum during 1st week of three months observations (Figure 1).

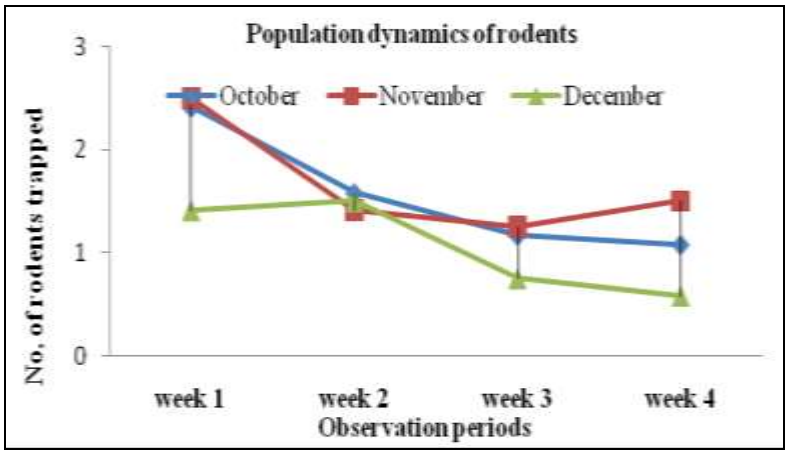

Fig 1: Population dynamics of rodents during the months of October, November and December

Trap index is related with the presence of rodents count in a given month and observed to be highest in November, 2016 followed by October and December, 2016. Simultaneously, the population dynamics of rodents were maximum in the first week of all the three months that followed by 2nd week, 3rd week and 4th week (figure 3). Our observations are similar to the work done by Anju *et al.*, (2020) [1], where the trap indices were depending up on many factors *viz*. Rainfall, food availability, type of food, activities of other animals, forest cover, types of habitat and trap shyness by rodents (figure 2).

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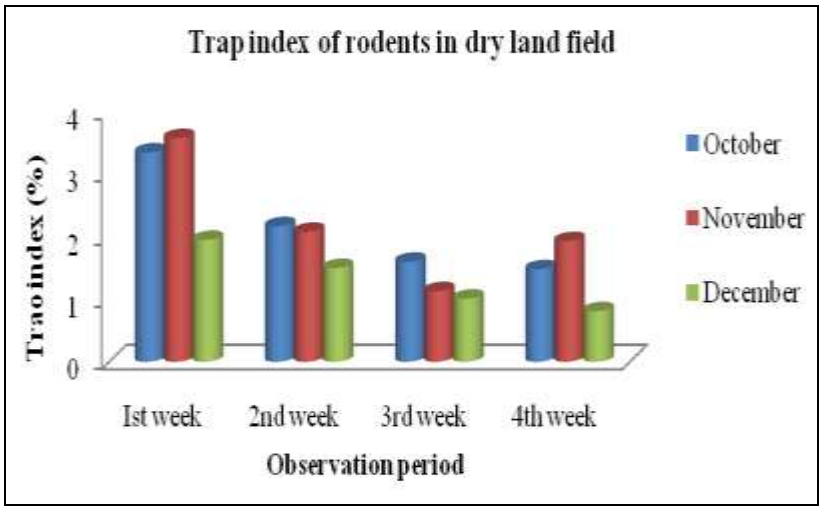

Fig 2: Trap index of the rodents during October, November and December, 2016

The present investigations were carried out in dry land area, where *T. indica* was found most prevalent as field rodent followed by *R. rattus* and *F. penneti*. The maximum population of *T. indica* had been observed during November 2016 followed by October and December 2016 whereas *M. musculus* was meager in dry land area comparatively. The trap indices were highest in the month of October 2016 and rodent numbers were highest in first week of all the three months i.e. October, November and December 2016 and similar observations were reported by Singla and Babbar (2010) [13].

Conclusion

As our present study showed that maximum population of *T. indica* was observed during November. Climate change is a particular reason in decrease and increase the population of rodents. Temperature is also the major factor influencing the reproductive potential of rodents. Population of rodents changed over time in response to the availability of food resources. Favorable environmental conditions, such as higher summer rainfall and mild winters, have been associated with increases in rodent population densities.

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