Characteristics of Damage by Porcupine to Groundnuts in District Malakand, Khyber Pakhtunkhwa, Pakistan

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Abstract— *Hystric Indica* (Indian porcupine) is a nocturnal species which affect the crop and yield of the roundnuts. Moreover, it is a cash crop and could be found everywhere in the research area. Furthermore, the aim of the current study is 1) To assess damages to groundnut in District Malakand and 2) To quantify the damage and yield loss of groundnuts by Indian porcupine (*Hystric Indica*). A detail questioner was used for collecting the field data. Total 33 numbers of fields were examined at 11 sites and harvest it in the period of October to September 2019. Evidence of porcupine was found in 24 fields (73%) and damaged plants were found in 21 fields (64%).

Index Terms— Indian Porcupine, Roundnuts, *Hystric Indica*, Damage Crops.

1 Introduction

Pakistan is basically an agricultural country. Agriculture sector contributes about 24% in the gross domestic product (GDP) of this country, and is the largest source of its foreign exchange earnings. Moreover, about 44.8% of its population work in agriculture sector. On one hand, 65.9 % of the population living rural areas are dependent on this sector for their livelihood. In fact, agriculture has become the main source in ensuring the food security of the nation [1].

In addition, agriculture in the country also relies on sustainable supply of water and fertile soil. This case is only possible when the forests and watersheds, located in the hilly tracts, are intact. There are several purposes to increase the area under tree cover; to meet the material needs of the growing human population and to enhance the environmental and ecological services provided by the forests [2].

Porcupines belong to the order Rodentia (gnawing mammals). Rodents are characterized by having a pair of upper and a pair of lower incisors. These incisors are large and growing constantly throughout the life of the animal and are used to gnaw. Rodents have no canines and often no pre-molars, leaving a large gap between the incisors and molars, called 'diastema'. The living porcupines are represented by two families, i.e., Erethizontidae (New World Porcupines) and Hystricidae (Old World Porcupines). Erethizontidae has four genera (Erethizontidae, Coendou, Echinoprocta rufescens and *Chaetomys* subspinosus) and 23 species, while Hystricidae also has four genera (Thecurus, Hystric, Atherurus and Trichys) but 20 species [3].

Indian crested porcupine (Hystric Indica) is the largest rodent species found in Asia, with the exception of the beaver (Castor fiber) of the far northern boreal zone. It is the thickest rodent with adults weighing around 11-18 Kg [4]. This porcupine species is characterized by a massive size, head and body measuring 640-740 mm in length in adult, and a very short tail clothed with short hollow white quills. A crest of long black spines on the crown and neck is well developed [5]. Beneath the longer and thinner quills, lies a layer of shorter and thicker quills. The quills vary in length; the neck and the shoulder quills being the longest, measuring 15 to 30 cm [6]. Apart from long quills along the centre of head, neck and back, the sides and back half of the body is covered with stout, cylindrical quills, up to 35 cm long, and mostly marked with alternating light and dark bands. The tail is covered with shorter quills, which are white in color. Amongst these there are longer, hollow, rattling quills, which are used to alarm the potential predator [7].

In Pakistan, the Indian crested porcupine is found throughout the Himalayan mountains, up to an elevation of 2,400 m above sea line (ASL) [8] and the steppe mountains of Balochistan up to 2,750 m ASL [8]. This porcupine species is also widely distributed in irrigated and scrub forest plantations and the sandy deserts of the provinces of Punjab and Sindh, as well as the upland valleys of the state of Azad Jammu and Kashmir and the North Western Frontier Province (NWFP), in the districts of Kohistan, Malakand, Hazara, Kaghan and Naran, up to an altitude of 3,500 m ASL (Kingdon, 1974; Medway, 1978; Roberts, 1997; Khan et al., 2000; Siddique and Arshad, 2004). Pervez et al. [9] reported a high density of porcupine burrows in Potohar (0.98 ± 0.2/ hectare) and irrigated and forest habitat (0.67 ± 0.01/ hectare) of the Indus Valley. Kayani et al. [10] reported a burrow density of 0.05 / hectare for the forest plantation of the central Punjab (Pakistan). Khan et al. [11] estimated average burrow density of 0.80 / hectare for forest plantation of central Punjab (Pakistan).

2 Objectives

The objectives of the survey of Indian porcupine (*Hystric Indica*) damages to groundnut fields in District Malakand are such follows;

1. To assess damages to groundnut in District Malakand.
2. To quantify the damage and yield loss of groundnuts by Indian porcupine (*Hystric Indica*).

3 Review of Literature

The Indian crested porcupine (*Hystric Indica*) is a serious pest of the agricultural crops, orchards, forests and rangelands in different parts of Pakistan and associated [12,13,14,15]. Country-wide estimates on the damages ascribable to porcupine are not available, yet scattered reports hint towards seriousness of the problem. Khan et al. [16] have compiled the available information on porcupine damage to different crops and forest plantations, suggesting

the severity of the problem. The species heavily depends upon a variety of crop plants to satisfy its food requirements, resulting in a significant pre-harvest loss for agriculture. Ahmed et al. [17] suggested different level of porcupine damage caused to cultivate potato, groundnut, maize and lucerne. Their observations Indicated that maize and groundnut are more susceptible to porcupine attack than potato and lucerne. Brooks et al. [18] reported that one porcupine can uproot up to 30 plants of groundnut during a night. Mian et al. [19] recorded that porcupine claimed 20.2% of the groundnut crop in Rawalpindi Division (Pakistan). Asimilarly high porcupine damage, averaging to10.70%, to maize crop in the State of Azad Jammu and Kashmir (AJ and K) has been ascribed to porcupine [20].

Amongst vegetables, potato is the most seriously effected crop through the porcupine damage. In a study conducted around Taxila (Pakistan), Khan et al. [21] estimated that porcupine claims 17.56% of the total harvestable potato crop. Pervez [22] suggested that, in the Balochistan (Pakistan), the porcupine damage to potato crop ranges between 2 and 20%. An equally heavy damage has been reported for the irrigated potato crop in desert tract of Israel [23,24]. Alkon and Saltz [25] reported that 1.3 tons / ha or 0.6% of potato crop was damaged by Indian crested porcupine.

Vertebrate pest porcupin (*Hystric Indica)*, wild boar (*Sus scrofus*), rat (*Rattus*) damage to groundnuts in Pakistan may begin as early as mid-July and continues until harvest 3 months later. Groundnuts are particularly vulnerable to attack by vertebrates because of this long maturation period. Also, because plant density is usually not very high (5,000 to 15,000 plants per ha), it is easy for vertebrates to damage considerable areas within fields in periods as short as 1 to 2 weeks. Very little quantified information on vertebrate pest damage to groundnut is published. There were references to damage by rats occurring in Senegal, Sierra Leone, Sudan, India, Thailand, East Malaysia, Tonga, and the West Indies but no quantified details were given [26]. Hoarding of groundnuts by *Rattus norvegicus* has been reported from Japan [27]. In India, Bindra and Sagar [28] estimated average losses of groundnut yield due to field rats in three villages of 50 kg per ha.

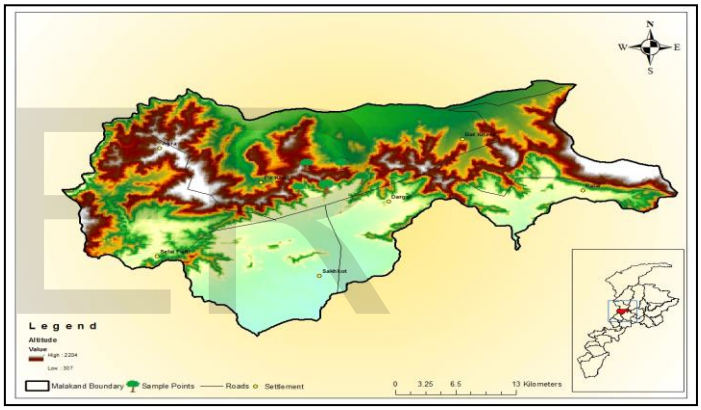
Groundnut (*Arachis hvpogea*) is a major oilseed crop in Pakistan. It is grown as a cash crop by the farmers. The groundnuts are not used for oil, however, but are consumed locally, either fresh, roasted, or as nutmeats added to sweets. The area planted to groundnuts and its production peaked in 1984 [29] when 72,600 ha yielded an estimated 88,000 mt valued at 686 million Pakistan rupees (US $49 million) on the wholesale market at that time. About 70% of the total groundnut production in Pakistan occurs in rainfed (barani) areas in the districts of Attock, Chakwal and Rawalpindi in northern Punjab Province. Groundnuts normally are planted in sandy and sandy-loam soils. Sowing begins in April and harvest is in October. Some varieties mature in 170 days but others may require 200-day s or slightly more. Plants sprout after sowing but then remain essentially dormant until the monsoon rains, beginning in July, trigger flowering and nut formation.

Porcupines are large rodents with a coat of sharp spines, or quills,that protect against predators. The term covers two families of animals, the Old World porcupines of family *Hystricidae*, and the New World porcupines of family *Erethizontidae*. Both families belong to the infraorder *Hystricognathi* within the profoundly diverse order Rodentia and display superficially similar coats of quills: despite this, the two groups are distinct from each other and are not closely related to each other within the Hystricognathi. The Old-World porcupines live in Southern Europe, Asia (Western and Southers), and most of Africa. They are large, terrestrial, and strictly nocturnal. In taxonomic terms, they form the family *Hystricidae* [30].

4 METHODS AND MATERIALS

4.1 Study Area

Tehsil Dargai is located on 34.5093° latitude and 71.9105° longitude. Dargai is one of the administrative areas of Malakand division located on the main highway from Peshawar to Swat, Dir and Chitral. The town of Dargai is experiencing an economic revival due to its well-known status as a hub for trade between the upper regions of Pakistan and the lower regions of Khyber Pakhtunkhwa. It is also acknowledged economically as a major market for timber and historically as the last train station into Northern Pakistan.



4.2 Habitat

The study area falls under the subtropical scrub evergreen forest. The landscape ecology of study area has forests, agriculture fields and rivers. The major forest type is sub- tropical dry deciduous forest. The dominant vegetation types of the study area include *Delbergia sisoo, Eucalyptus, Acacia modesta, Morus alba, Acacia nilotica, Dodonaea viscosa*. Most of the study area consists of agriculture field and the local people cultivate different crops like maize, sugar, wheat etc.

4.3 Climate

In the study area, summer is hot from May to September and winter is cold from October to April. The average annual rainfall is 743 mm and average annual temperature is 19.9 °C in the study area. Maximum temperature is 45°C and minimum is 12°C [31].

TABLE 1
THE DOMINANT FLORAL DIVERSITY OF TEHSIL DARGAI

S. No.	Species	Scientific Name	Local Name
1	Shisham	*Delbergia sisoo*	Shewa
2	Safeeda	*Eucalyptus*	Lachi
3	Pulai	*Acacia modesta*	Palosa
4	Toot	*Morus alba*	Toot
5	Kikar	*Acacia nilotica*	Kikar
6	Sanatha	*Dodonaea viscose*	Ghwarhaski
7	Malta	*Citurus sinenssis*	Malta
8	Anzer	*Ficus racemosa*	Enzar
9	Jaman	*Syzigium cumini*	Jamoo
10	Poplar	*Populous*	Supedar

TABLE 2
THE MAJOR MAMALIAN SPECIES OF TEHSIL DARGAI

S. No.	*Species*	*Scientific Name*	*IUCN Status*
1	Indian Jackal	*Canis aureus indicus*	Least concern
2	Indian fox	*Vulpes bengalensis*	Least concern
3	Indian grey-mongoose	*Herpestes edwardsii*	Least concern
4	House Mouse	*Mus musculus*	Least concern
5	Indian crested Porcupine	*Hystric Indica*	Least concern
6	Indian Hare	*Lepus nigricollis*	Least concern
7	Hodgson's bat	*Myotis formosus*	Least concern
8	Grey goral	*Naemorhedus goral*	Least concern
9	Grey langur	*Semnopithecus*	Near threatened

5 METHODOLOGY

A detailed questionnaire-based survey was conducted in the Tehsil Dargai District Malakand. Total sixty number of questionnaires were filled in the study area from local farmers. Moreover, different questions were asked from the local farmers about crop damage in the study area.

The fields were surveyed in early January 2018 by stopping at 5-km intervals along roads traversing the groundnut growing areas. At each stop, two fields along each side of the road were selected, one adjacent to the road and another about 100 meters away from the road. Furthermore, four quadrants were set in each field. Ten to 20 paces were walked down the field border and then 10 paces were walked into the field to locate each quadrant. Quadrants measured 1 x 5 m in size. The number of damaged and undamaged plants within each quadrant was counted. Damaged plants appeared either dead and dried or withered and dying [32].

6 RESULT AND DISCUSSION

Total 33 numbers of fields were examined at 11 sites and harvest it in the period October to September 2019. Evidence of porcupine was found in 24 fields (73%) and damaged plants were found in 21 fields (64%) (Table 4.1).

TABLE 3
PLANT DAMAGE OF PORCUPINE IN PERCENTAGE

Total Fields	*Damage Plants Totals %*	
Examined	33	--
With evidence of porcupine	24	0.73
With damaged plants	21	0.64
Total		1.4

The table above described about the extent of porcupine (*Hystric Indica*) damage to groundnut fields at harvest, October to September 2019 (damage based on 4006 plants counted in 90.56 ha of fields). Crested porcupines (*Hystric Indica*) damage and kill the plants by clawing the groundnuts from under the roots. The damage extends into the soil about 2.5 to 7 cm, leaving loose soil under the plant, or an extracted plant. Intact, partially consumed, and empty groundnut shells are scattered about the clawed area. Damag occurred at field edge and 30 to 40 number of plants might be damaged in one night. Moreover, Porcupine presence was spotted from their footprints, fecal droppings and nearby burrow openings.

In addition, average plants density was 5.1/m² (range 1.0-9.9/m²). The higher plant densities were found in areas where erect varieties of groundnut were grown on loam soils. The spreading varieties generally were grown on sandy soils and in lower plant densities. Porcupone appeared to be more frequent in fields with higher plant densities (Table 4.2). Our results are in concordance with [33]. Farmers in Pakistan who attempt to grow groundnuts are faced with a multitude of pest problems and a long vulnerable period between flowering and early nut formation in mid July until harvest in early October. Farmers lack effective methods for reducing vertebrate pest/porcupine infestations in groundnut fields.

TABLE 4
RELATIONSHIP BETWEEN GROUNDNUT PLANT DENSITY AND PRESENCE OF PORCUPINE IN 33 FIELDS

Plant Density	*Fields*	*% Fields with*
(m²)	**(No.)**	**Porcupine**
3-Jan	19	3.9
5-Mar	17	12
7-May	23	15.2
9-Jul	11	30
9>	3	55.3

It was suspected that above-ground observations of damaged groundnut plots underestimated the real extent of the damage below ground. To test this, I sampled four quadrants of damaged and undamaged plants in groundnut fields at the village of

Ghwar kali district Malakand. Two quadrant counts (2 x 5 m^2) were taken in areas of obvious porcupine activity i.e., burrows; pathways, dead plants, and two were taken in areas of the same fields where there was no surface evidence of damage. After counting all the plants in each quadrant, the groundnuts from all plants were removed, bagged, air-dried, and weighed. The average percent plant damage as determined from quadrant counts for the four fields was 25%, and the average difference in weight of groundnuts between the damaged and undamaged parts of the same fields was 67.5% (Table 4.3).

Overall damage in these fields was estimated at 1.4 %, if this overall groundnut damage is also applied to the 1984 average groundnut production in Pakistan of 1,212 kg/ha, yield losses would average 17 kg/ ha. While [34] applied the 5.3% damage to the 1984 average groundnut production in Pakistan of 1,212 kg/ha, their yield losses were averaged 67 kg/ ha, similar to the 50 kg/ha figure reported for Indian Punjab by Bindra and Sagar [35]. Difference between the resuls might be due to species, we reported only damages of porcupinewhile other two studies addressed the damages of many vertebrate pests like lesser bandicoot rat (*Bandicota bengalensis*), short-tailed mole rat (*Nesokia Indica*), wild boar (*Sus scrofa*), desert hares (*Lepus nigricollis*), crested porcupines (*Hystric Indica*) and house crows (*Corvus splendens*).

7 Conclusions

It is concluded that *Hystric Indica* (Indian porcupine) species is keen destroyer of agriculture crop in research area. Moreover, which ultimately effect the economy of the farmers. Inaddition, it is concluded that proper fencing is needed around the agriculture crops to minimize the damage of groundnuts.

8 Recommendations

The adoption of groundnut varieties with a shorter growing period (120-140 days) could reduce the time during which the plants are vulnerable to vertebrate attack-with one exception. These varieties, planted in July, are harvested in late October and early November. Farmers should practice good weed and grass control in their groundnut fields. Removal of Desmostachva (kusha/darbha grass) and Sorghum halapense (Jhonson grass) from the fields in June and July could reduce the rodents i.e., porcupine subsistence food supply, i.e., the rhizomes of these plants, and possibly prevent many other rodent infestations from spreading into the fields. Grass seeds probably play a minor dietary role.

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