

Deterioration Impact of Indian Crested Porcupine, *Hystrix indica*, on Irrigated Forest Plantations in Punjab, Pakistan

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Abstract.- Eight man-made forest plantations located in different regions of the Punjab province, Pakistan, were sampled to assess the tree and nursery stock damage caused by the Indian crested porcupine, *Hystrix indica*. The incidence of damage to *Morus alba*, *Dalbergia sissoo* and *Eucalyptus camaldulensis* averaged 9.36, 10.82 and 8.0%, respectively, and the overall damage to all species estimated was 9.4%. However, the degree of damage to different tree species between the plantations showed highly significant difference ($F= 5.31; P<0.01$). Damage to mature trees of *Acacia modesta*, *Populus deltoides*, *Bombax ceiba* and *Tamarix sumba* was not recorded in any plantation. On an average plant nurseries of *Dalbergia sissoo*, *Morus alba* and *Bombax ceiba* received 9.0, 14.97 and 27.05% damage, respectively. Up-rooting stumps of *Dalbergia sissoo*, *Bombax ceiba*, *Phoenix dactylifera* and *Euclyptus camaldulensis* after transplanting, a characteristic behaviour of Indian crested porcupine, was commonly observed in the plantations.

Keywords: Deterioration impact, forest plantations, girdling, *Hystrix indica*.

INTRODUCTION

The Indian crested porcupine, *Hystrix indica*, is commonly found in man-made and natural forest plantations, agriculture landscape, sandy deserts of Punjab and Sindh, in the mountainous areas of Khyber Pakhtunkhwa province, and abundant in steppe mountain regions of Balochistan upto 2,750 m elevation (Greaves and Khan, 1978; Geddes and Iles, 1991; Roberts, 1997; Khan *et al.*, 2000; Mushtaq *et al.*, 2008). Also, it is found in the upland valleys of Jehlum and Neelum of Azad Jammu and Kashmir and has been recorded in moist temperate deciduous forests of Machiara National Park at 3,200 m elevation, the highest point so far recorded of its distribution (Awan *et al.*, 2004). In addition to these habitats, the high raised, soil dirt built embankments of link and barage canals of Indus river system have provided the most suitable denning sites for porcupines which have helped in their expanded distribution in the crop lands of Punjab and Sindh provinces.

The Indian crested porcupine, *H. indica*, is a generalist forager that exploits a wide variety of cultivated and wild plants, and consume above

ground as well as sub-surface plant material (Gutterman, 1982; Alkon and Saltz, 1985; Ahmad *et al.*, 1987; Brooks *et al.*, 1988; Khan *et al.*, 2000; Pervez, 2006). The most important porcupine damage in Pakistan, however, occurs in forestry and reforestation areas. As early as 1967, a common occurrence of girdling of *Morus alba* was reported in the croplands of Punjab (Taber *et al.*, 1967), while Ahmad and Chaudhry (1977) reported that damage to the same species and to *Melia azedarach* is generally very serious in irrigated plantations of Punjab. Nawaz and Ahmad (1974) calculated a loss of increment amounting to 3853 cubic meter of wood in various blocks of Changa Manga plantation (5263 ha). Greaves and Khan (1978) investigated porcupine damage in Chichawatni plantation and quantified damage to different mature tree species. Accordingly, *M. azedarach* and *M. alba* received 72 and 50% porcupine damage, respectively, followed by 4% to *Dalbergia sissoo*. Damage to *Azadirachta indica* in the range lands of Sindh and 5-28% damage to wild pistachio (*Pistacia khinjuk*) in Balochistan have, also, been reported (Ahmad *et al.*, 2003; Pervez, 2006). In India, *H. indica*, as a vertebrate pest, cause damage to *Acacia* spp., *Zizyphus mauritiana*, *A. catechu*, *A. leucophloea*, *Butea monosperma*, *Pinus roxburghii*, *A. indica*, *Eucalyptus* spp. and up-rooting of young coconut plants (Sharma and Prasad, 1992; Idris and Rana,

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0030-9923/2014/0006-1691 \$ 8.00/0
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2001; Girish *et al.*, 2005). In Iran, *H. indica* is one of the important pests on reforestation in western oak forests (Fattahi, 1997).

The main objective of the study was to estimate the degree of porcupine damage to trees in irrigated forest plantation of Punjab. Also, to identify tree species which were highly vulnerable to porcupine injury or least susceptible to it.

MATERIALS AND METHODS

Study area

The Punjab (27.5–34.10 N and 69.5–75.20 E) is the north-eastern province of Pakistan. Leaving aside the northern parts, the main part of the province is plain, where 79 irrigated plantations have been established. These man-made forests have been established on sub-marginal lands where irrigation water was available. These plantations were raised after the lands were cleared off the thorn vegetation. Size of such plantations varied from 2000–8000 ha. Of these, Changa Manga plantation was established in 1866 by the British Government and is the oldest man-made plantation in the world, for the purpose of providing wood for the steam engines of the train system in the western part of the sub-continent. The eight surveyed plantations were located in different eco-zones of Punjab, having different soil types, temperature and rainfall patterns (Fig 1). These are mixed plantations, being raised for different commercial uses. Major species in these forests include *D. sissoo*, *M. alba*, *Bombax ceiba*, *E. camaldulensis*, *A. nilotica*, *M. azedarach*, *Populus* spp., *Tamarix sumba* and *Salix* spp. (Sheikh, 1993). Of the eight plantations surveyed, two were located in the southern region, three in the central part and three in the western part of Punjab.

Damage sampling

According to forest management plans, each plantation is divided into blocks and compartments, varying in size and species composition. One to four compartments of each plantation were selected randomly, irrespective of the species composition. Within the selected compartment ten tree lines were selected randomly and within each line fixed point sampling of 10th tree was examined at DBH for the injury inflicted by porcupine. The size of compartments sampled varied from 6–10 ha.

Nurseries examined were located within the plantations. The nursery plots varied in size ranging from 0.2 to 5.26 ha. Nursery plots were demarked randomly and sampled for porcupine damage by throwing quadrates of 1x1 m made of wooden frame. From each quadrate clipped/up-rooted and undamaged seedlings were recorded. The number of quadrates sampled from a nursery ranged from 4 to 11. One – way ANOVA test was employed for data analysis at the significance level of $P < 0.05$.

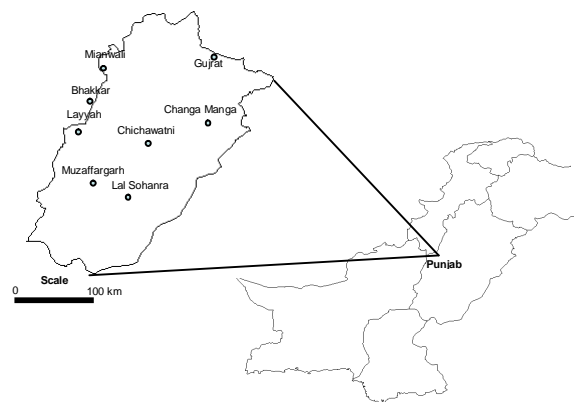


Fig. 1. Map of Punjab, Pakistan showing locations of irrigated forest plantations sampled for *Hystrix indica* damage to trees.

RESULTS AND DISCUSSION

Eight man-made irrigated plantations of the Punjab province were sampled to assess incidence of porcupine damage to trees of different species, the results of which are summarized in Table I. The major species *i.e.*, *M. alba*, *D. sissoo* and *E. camaldulensis* were examined for porcupine injury during the months of May and June, 2007. The forest officers of these plantations informed us that porcupine inflicts most of the damage in winter months (November – February) and slow down in the months of March and April. During the months of summer (May – July) negligible fresh damage is caused to forest trees and nursery stocks as alternate food is available to porcupines within the plantations and on crops nearby the peripheral boundary of a plantation. The damage, therefore, recorded during this study was caused to trees in the winter months.

Table I.- Estimates of Indian crested porcupine, *Hystrix indica*, damage to trees in different man-made irrigated forest plantations, Punjab, Pakistan

Tree species	Location of plantation	No. of compartments/ sampled area (ha)	Total no. of trees examined	No. of damaged trees	% damage
<i>Morus alba</i>	Changa Manga	2 (20.24)	634	90	14.19
	Gujrat (Daphar)	1 (20.00)	816	37	4.53
<i>Dalbergia sissoo</i>	Mianwali (Kundian)	4 (43.72)	869	154	17.72
	Bhakhar	4 (25.70)	721	107	14.84
	Layyah	1 (6.00)	139	17	12.23
	Muzaffargarh	1 (6.11)	166	25	15.06
	Chichawanti	1 (16.19)	375	0.00	0.00
	Changa Manga	4 (32.18)	1335	31	2.32
	Lal-Sohanra	3 (30.00)	990	27	2.73
<i>Eucalyptus camaldulensis</i> .	Mianwali (Kundian)	3 (30.36)	851	120	14.01
	Bhakhar	2 (18.22)	821	133	16.20
	Layyah	1 (12.15)	79	1	1.26
	Chichawatni	1 (20.24)	274	0.00	0.00
	Changa Manga	3 (42.92)	983	5	0.51

Table II.- Estimates of Indian crested porcupine, *Hystrix indica*, damage to nursery plants in different man- made irrigated forest plantations, Punjab, Pakistan.

Plant species	Location of plantation	No. of quadrates/ sampled area (ha)	Total no. of seedling examined	No. of damaged seedling	% damage
<i>Dalbergia sissoo</i>	Mianwali (Kundian)	5 (4.05)	388	79	20.36
	Bhakhar	9 (3.64)	555	61	10.99
	Layyah	4 (0.60)	137	5	3.65
	Muzaffargarh	8 (6.81)	889	9	1.01
<i>Bombax ceiba</i>	Mianwali (Kundian)	7 (2.61)	368	140	38.04
	Changa Manga	11 (6.10)	2092	336	16.06
<i>Morus alba</i>	Changa Manga	7 (2.41)	882	132	14.97

Assessment of damage to trees

The degree of damage to a tree varied from slight injury to complete girdling, the majority of damaged trees received multiple damage at intervals to complete the process of girdling. The analysis of damage data of all the plantations indicated highly significant difference of damage between the plantations ($F=5.31$, $P<0.01$). The degree of damage between *E. camaldulensis* and *D. sissoo* was non-significant ($F=0.33$, $P>0.57$). The estimated incidence of average damage to *M. alba*, *D. sissoo* and *E. camaldulensis* was 9.36, 10.82 and 8.0%,

respectively, and the overall damage estimated was 9.4% (Table I). Among these plantations, three plantations (*i.e.*, Changa Manga, Chichawatni and Mianwali, Kundian) were revisited to assess damage which earlier to this was sampled for porcupine damage by various workers (Nawaz and Ahmad, 1974; Ahmad and Chaudhry, 1977; Greaves and Khan, 1978) while the other five plantations were sampled for damage for the first time. In the folds of these surveys, damages to *M. azedarach*, *M. alba* and *D. sissoo* were estimated while damage to *E. camaldulensis* in five plantations is being estimated

for the first time in this paper. Earlier, Khan *et al.* (2000) reported porcupine damage to *E. camaldulensis* near Rawalpindi where 12-13 mature trees were observed completely girdled. Nawaz and Ahmad (1974) assessed, for the first time in Pakistan, porcupine damage in Changa Manga plantations and recorded damage to *M. alba* (24.9%), *D. sissoo* (10.2%), and *M. azedarach* (52.54%), respectively. Ahmad and Chaudhry (1977) recorded much higher damage to *D. sissoo* (11%) in Chichawatni plantation, while in the present study it was not recorded because more susceptible species such as *M. alba* and *M. azedarach* were widely planted. All these studies, including the present one, indicated that in mixed plantations *M. azedarach* and *M. alba* are the most susceptible species for porcupine injury while *E. camaldulensis* was less susceptible. Porcupine damage to *E. camaldulensis* was much higher in the Mianwali, Kundian (16.42%) and Bhakhar (19.35%) plantations than in Layyah (1.26%) and Changa Manga (0.51%) plantations. Plant density of *E. camaldulensis* was much higher where more damage was observed or the porcupine population was at a higher density. It may be inferred that relative proportions of resources utilization by porcupines is more dependent on their abundance within the compartments or in a plantation as a whole.

Observations suggest that Indian crested porcupine damage in a mixed plantation may be restricted to a specific tree species. In the present study, *M. azedarach* was preferred over *M. alba* and *D. sissoo*. Similarly, young trees were preferred over matured or old trees because of changes in bark structure. Elitis and Hennon (1987) observed that Sitka spruce (33% damage) appeared to be preferred over western hemlock (15% damage) by *Erethizon dorsatum* as a host tree in conifer stands in southeast Alaska. Similarly, Woods and Zeglen (2003) reported *E. dorsatum* damage to Sitka spruce (80% damage) forests of north-coastal British Columbia, Canada, where the coniferous host Sitka spruce was most preferred. In Kundian, *D. sissoo* was preferred over *E. camaldulensis* and the opposite of that appeared in Bhakhar plantation. In AJ&K, Ahmad (1990) observed that *P. roxburghii* and *M. azedarach* were the most preferred trees while

Ailanthus altissima and *Robinia pseudoacacia* were least preferred ones to porcupine damage. In India, porcupine preference for coconut palms (46% damage) was significant over *Agave americana* (15-30%) and *Caryota urens* (15-20%) in Dakshina in Kannada region of Karnataka (Girish *et al.*, 2005). The debarking activity varied within young palms (< 5 years) and palms (> 30 years), young palms receiving more damage than the old ones.

Damage to plant nursery and stockings

Nursery plots of *D. sissoo*, *B. ceiba* and *M. alba* were examined in five plantations, the results of which are presented in Table 2. Among these, a nursery of *B. ceiba* was seriously damaged in Kundian (38.04%) followed by a nursery in Changa Manga (16.06%). Stumps of this species, particularly the basal part, is extremely succulent and soft, and thus received more damage compared to nursery plants of other two species in the same plantation. The mature trees of *B. ceiba* seem to become invulnerable to attack because of the thorns on the trunk. The highest damage (20.36%) to a nursery of *D. sissoo* was recorded at Kundian (Mianwali), where as the lowest damage (1.01%) was recorded at Muzaffargarh. The mean percent damage of four nurseries of *D. sissoo* was $9.85\% \pm 6.66$. Earlier, Ahmad and Chaudhry (1977) reported that in a 4 ha, six month old *D. sissoo* nursery at Kundian, only 25% of the plants escaped porcupine damage, while the rest were found clipped and thrown on the ground. They also observed that porcupine damage has become a limiting factor in raising *D. sissoo* and *B. ceiba* nurseries in Jhang where only 11% living plants were found in a mixed nursery of the two damaged species. Greaves and Khan (1978) observed the same type of damage to *M. azedarach* in a nursery at Chichawatni with more than 90% of the seedlings destroyed, while the seedlings of *D. sissoo* were virtually untouched, showing a preference to *M. azedarach*. During the survey, the Forest Officer of Chichawanti informed that damage to *M. azedarach* nurseries was 100 and 75% in 1972 and 1973, respectively. Only one nursery of *M. alba* was sampled at Changa Manga and 14.97% damage to plants was recorded. Reports from India indicate that 30% of the seedlings of Neem (*A. indica*) and 12% of *Eucalyptus* spp. were

damaged by cutting the plants at 5-7 cm above the ground level in Araveli hills near Jodhpur.

Up-rooting and pulling out of transplants/stockings is a characteristic behaviour of Indian crested porcupine. Ahmad and Chaudhry (1977) reported that in scrub forests, *Agave* spp. was completely wiped out several times soon after transplanting but *A. modesta* was quite immune to this kind of damage. Also, newly planted *D. sissoo* stumps were usually pulled. A similar kind of damage to *Eucalyptus* spp. was observed by the first author of this paper on an agro-forestry farm near Bhakhar, where 1900-2000 plants were removed overnight after transplanting. Nawaz and Ahmad (1974) reported up-rooting of 4700 *B. ceiba* plants from two compartments (31 ha) at Changa Manga plantation. Damage to suckers of date palm (*Phoenix dactylifera*) by up-rooting is also very serious in Punjab and Balochistan. One of the farmers (Dr. Jasra, per. comm.) reported the loss of 500 suckers (100% damage) within a month on a farm near Bhakhar. Management of porcupine in these forest plantations should be carried before the start of winter months. Also, habitat analysis is highly desired before planting susceptible species to porcupine damage

ACKNOWLEDGEMENTS

We thank the Divisional and Range Forest Officers and their local staff for facilities made available during these surveys. The financial support for this study was provided by the Pakistan Agricultural Research Council under the Agricultural Linkages Programme.

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(Received 3 June 2014, revised 20 September 2014)