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A CASE STUDY

Urbanization as a major cause for biodiversity erosion-A case study along the bank of kali river

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SUMMARY : The present study was carried out upon polluted river bank to investigate the impact of urbanization on plant genetic resources. Soil seed bank study was carried out by seedling emergence method and phytosociology by quadrat method. A total of 21 plant species were recorded in belowground vegetation and 73 plant species were recorded in overlying vegetation. The dominance of species differed between above ground and below ground flora. The present study showed that the availability of plant genetic resources was governed by relationship between above ground and below ground flora in peri-urban region.

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Natural disturbance and human induced impacts have often been considered to the leading cause of species extinction and significant change in biodiversity especially, in regions which are under the process of development (Tilman and Lehman, 2001). These modifications along an urbanization gradient can be deleterious for vegetation (Whitford *et al.*, 2001). The impact of urbanization on seed-banks is poorly documented even though the seed bank is considered an important component of biodiversity, as seedling establishment is an important factor controlling the abundance of adult plants (Jutila, 2003).

Soil seed bank can be defined as "agroup of viable seeds that are stored in the soil and acts as a genetic reservoir". Seed bank also reflects the long-term effect of site conditions and land use practices on plant community. According to Grime (1979) the presence of seeds in the disturbed habitats is determined by the relationships between the original plant assemblage, the production of propagules and disturbances. This study can be used to predict the potential distribution of each species in disturbed ecosystem (Onaindia and Amezaga, 2000). River basins are natural sites for conservation of plant genetic resources which are going to be threatened due to increasing urban pressure.In present study, an attempt was made to investigate the threatened plant genetic resources from natural ecosystem on the river basin due to urbanization.

EXPERIMENTAL METHODOLOGY

The study was carried out at Bulandshahr (28º 24' N lat. and 77º 51' E long.), located at a distance of 72 km from New Delhi. An investigative study was undertaken along the bank of Kali river at Bulandshahr. Kali river, a tributary of Ganga river in western U.P., originates from the plains of Muzaffarnagar, passes through Meerut, Bulandshahr and Aligarh and finally merges with Ganga at Kannauj in Farukhabad district. It receives treated and partially treated industrial effluents and domestic sewage through heavily silted drains.

The climate is semi-arid and having three seasons: winter (November-February), summer (March-June) and rainy (July-October). Annual mean temperature was recorded 31°C (data

Table 1 : Species composition of seed bank and standing vegetation at Kali river bank. (The top dominated species have been characterized by bold letters in both floras)

Family	Aboveground vegetation	Belowground vegetation
Aizoaceae	*Trianthema portulacastrum* L.	*Trianthema portulacastrum* L.
Amaranthaceae	*Achyranthes aspera* L.	
	Amaranthus viridis L.	
	Alternanthera pungens Humb., Bonpl & Kunth	
	Alternanthera sessilis	*Alternanthera sessilis*
	Gomphrena globosa L.	
Asclepiadaceae	*Calotropis procera* (Aiton) Dryander	
Asteraceae	*Ageratum conyzoides* L.	
	Blumea lacera (Burm.f.) DC	
	Eclipta erecta L.	
	Launaea aspleniifolia (Willd.) Hook. f	
	Parthenium hysterophorus L.	*Parthenium hysterophorus*
	*Sonchus asper (*L.) Hill	
	Gnephalium luteo-album	
	Xanthium strumarium L.	
Brassicaceae	*Senebiera didyma* (L.) Persoon	*Senebiera didyma*
	Sisymbrium irio L.	
Cannabaceae	*Cannabis sativa* L.	
Caryophyllaceae	*Stellaria media* (L.) Villars	
Chenopodiaceae	*Chenopodium ambrosioids* L.	
	Chenopodium murale L.	*Chenopodiu murale*
Commelinaceae	*Commelina benghalensis* L.	
Cleomaceae	*Cleome gynandra* L.	
Cyperaceae	*Cyperus iria* L.	
	Cyperus alopecuroides Rott	
	Cyperus kyllingia Endl.	
	Cyperus rotundus L.	*Cyperus rotundus*
	Fimbristylis dichotoma (L.) Vahl	
	Scirpus ternatanus Reinwardt ex Miq.	
Euphorbiaceae	*Croton bonplandianum* Baillon	*Croton bonplandianum*
	Euphorbia hirta L.	
	Euphorbia thymifolia L.	
Fabaceae	*Dalbergia sisso* Roxb.	
	Medicago sativa L.	
	Melilotus indica (L.) Allioni	
	Trifolium alexandrinum L.	
Caesalpinaceae	*Cassia obtusifolia* L.	*Cassia obtusifolia*
	Cassia occidentalis L.	*Cassia occidentalis*
Lamiaceae	*Ocimum odorum*(L.)	
Mimocaseae	*Prosopis juliflora* (Swartz) DC.	
Malvaceae	*Abutilon indicum* (L.) Sweet	*Abutilon indicum*
	Malva sylvestris L.	*Malva sylvestris*
	Malvastrum tricuspidatum (R.Br.) A.Gray	
	Sida acuta Burm f.	*Sida acuta*
	Sida cordifolia L.	*Sida rhombifolia*
	Sida rhombifolia L.	
	Urena lobata L.	

Contd.......... Table 1.

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Nyctaginaceae	*Boerhavia diffusa* L.	
Oxalidaceae	*Oxalis corniculata* L.	*Oxalis corniculata*
Papaveraceae	*Argemone mexicana* L.	*Argemone mexicana*
Poaceae	*Acrachne racemosa* (Roemer &Schultes)	
	Cynodon dactylon (L.) Persoon	*Cynodon dactylon*
	Digitaria adscendens (Kunth) Henrard	
	Dactyloctenium aegypticum P.Beauv	
	Dichanthium annulatum (Forsk.) Stapf.	
	*Eleusine coracana (*L.) Gaertner	
	Panicum trypheron Schultes	
	Paspalidium flavidum (Retz.) A. Camus	*Paspalidium flavidum*
	Setaria glauca (L.) P.Beauv	
	Eragrosti scilliaris L.	
	Saccharum munja Roxb.	
	Poa annua	*Poa annua*
Polygonaceae	*Rumex dentatus* L.	*Rumex dentatus*
	Polygonum barbatum L.	
	Polygonum glabrum Willd.	
	Polygonum plebeium R.Br.	
Primulaceae	*Anagallis arvensis* L.	
Ranunculaceae	*Ranunculus sceleratus* L.	*Ranunculussceleratus*
Scrophulariaceae	*Mazus japonicas* (Thunb.) Kuntze	
Solanaceae	*Datura stramonium* L.	*Nicotiana plumbaginifolia*
	Solanum nigrum L.	
Sterculiaceae	*Celsia coromandeliana* Vahl	
Tiliaceae	*Triumfetta rhomboidea* Jacquin	

collected at Bulandshahr research station of Sardar Vallabhbhai Patel University of Agriculture and Technology). Annual mean rainfall (2001-2005, based on data available at Bulandshahr district head quarter) was 528 mm, of which about 87% occurred in rainy season.

Seed bank density and diversity was estimated through seedling emergence method. Soil samples were collected randomly by hammering a hollow metal frame into the soil (size 20 cm × 20 cm × 5 cm; n = 36).The seed bank density was estimated from three different depths (0-5 cm, 5-10 cm, 10-15 cm). The phytosociological study of standing vegetation was carried out by quadrat method (each of size 20 cm × 20 cm; n = 180). The plant species were identified according to description given by Gaur (1999). Plant density was quantitatively analyzed according to Curtis and McIntosh (1951). Similarity of soil seed flora and their standing vegetation were compared using modified Sorenson's similarity co-efficient index (Southwood, 1978).

$$\mathbf{SC} = \frac{\mathbf{2jN}}{\mathbf{aN} + \mathbf{bN}}$$

where, jN= total no. of species present in both flora; *aN* = total no. of all species in seed bank flora and *bN* = total no. of all species in standing vegetation.

EXPERIMENTAL FINDINGS AND DISCUSSION

The dominant species composition however, varied considerably in seed bank and phytosociological studies. The leading dominants in soil seed bank were *Chenopodium murale*, *Poa annua*, *Argemone mexicana* and *Rumex dentatus* and the dominants of overlying standing vegetation were *Cynodon dactylon*, *Alternanthera sessilis*, *Parthenium hysterophorus* and *Rumex dentatus* (Table 1). A total of 21 plant species were recorded inseed bank, which are comparable to plant species that recorded in phytosociological study *i.e.* 73 distributed over 28 families (Table 1). The seed bank density was relatively low (2221 seeds m^{-2}), and decreased with increasing depth. Highest density was observed in top most soil layer (1045±123 seeds m^{-2}) (Table 2). Similarity between belowground and aboveground flora was observed very low (46%). The species composition of seed bank flora and standing vegetation also varied (Fig. 1). Seed bank showed one diversity peak in winter, generally in the month of February. On the other hand, the standing vegetation showed generally two diversity peaks (one major in the winter and one minor generally in the rainy season).

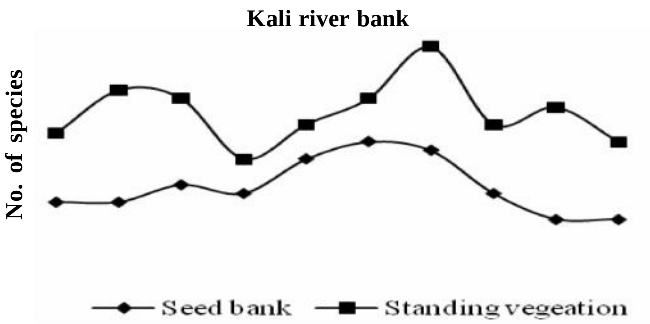

Fig. 1 : **Changes in seed bank and above ground floristic counts in different months at Kali river bank.**

The present study showed that the standing vegetation was more diverse than seed bank flora at river bank. The harshness of the environment appeared to generate less heterogeneity at river bank, whose complex environment was probably the result of biotic interference in the form of urban dumps along the bank, rampant movement of animals and pollutant concentrates carried off by Kali river waters. The mortality of seeds, seeds grazing by animals, predation and unfavourable environmental condition etc. may contribute to lower species diversity for belowground (Hyat and Casper, 2000). The interaction of the above and below ground vegetation and the biotic factors appeared likely to impact the composition of weed communities in future. In present study, seed density declined with increasing depth KRB sites, although vertical distribution of seeds was very heterogeneous. A depth related decrease in soil seed bank has been documented by several workers (Hutchings and Booth, 1996). However, relatively low seed density at Kali river bank was an indicative of the seed being swept off by the rise and fall of river waters after rains (Table 2).

Table 2 : **Vertical distribution of seed bank density (seeds m^{-2}) at Kali river bank.**

Depth	Kali River bank
0-5 cm	1045 ± 123
5-10 cm	763 ± 307
10-15 cm	413 ± 150
Total	2221

The values indicate the mean ± S.E. of three replicates

Temporal variation of species diversity in seed bank and associated standing vegetation indicated variable trends (Fig. 1). Generally, the species diversity of above ground vegetation was higher than the below ground.This may be due to the fact that seedling recruitment requires specific conditions and is often much more sensitive to environmental conditions than the established plants. Such inter-specific differences in conditions for seedling recruitment are considered important for the maintenance of species diversity (Kotorova and Leps, 1999).

The present result indicated preponderance of above ground weedy flora, reducing potential of seed bank flora to replace the eliminated standing flora, reflecting the ominous impact of polluted water courses and their banks being used as dumping ground of urban and industrial wastes.

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