

Urbanisation as a major cause for biodiversity erosion along the Bank of Kali river

■ SHILPI AGGARWAL AND VEENA GUPTA

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 governed by relationship between above ground and below ground flora in peri-urban region.

Key Words : Soil seed bank, Aboveground vegetation, Below ground vegetation, Plant genetic resources, 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 (Jutla, 2003).

Soil seed bank can be defined as "a group 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 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.

MATERIAL AND METHODS

The study was carried out at Bulandshahar (28°24' N lat. and 77°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 Bulandshahar. Kali river, a tributary of Ganga river in western U.P., originates from the plains of Muzaffarnagar, passes through Meerut, Bulandshahar 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.

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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 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 20cm x 20cm x 5 cm; n = 36). The seed bank density was estimated from three different (depth; 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 x 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 coefficient index (Southwood, 1978).

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

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

RESULTS 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 in seed 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).

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 unfavorable environmental condition etc. may contribute to lower species diversity for belowground (Hyat and Casper, 2000). The interaction of the above and below ground

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

| Family | Aboveground vegetation | Belowground vegetation |
|----------------|--|-------------------------------------|
| Aizoaceae | <i>Trianthema portulacastrum</i> L. | <i>Trianthema portulacastrum</i> L. |
| Amaranthaceae | <i>Achyranthes aspera</i> L. <i>Amaranthus viridis</i> L. <i>Alternanthera pungens</i> Humb., Bonpl and Kunth <i>Alternanthera sessilis</i> <i>Gomphrena globosa</i> L. | <i>Alternanthera sessilis</i> |
| Asclepiadaceae | <i>Calotropis procera</i> (Aiton) Dryander | |
| Asteraceae | <i>Ageratum conyzoides</i> L. <i>Blumea lacera</i> (Burm.f.) DC <i>Eclipta erecta</i> L. <i>Launaea aspleniifolia</i> (Willd.) Hook. f <i>Parthenium hysterophorus</i> L. <i>Sonchus asper</i> (L) Hill <i>Gnaphalium luteo-album</i> <i>Xanthium strumarium</i> L. | <i>Parthenium hysterophorus</i> |
| Brassicaceae | <i>Senebiera didyma</i> (L.) Persoon <i>Sisymbrium irio</i> L. | <i>Senebiera didyma</i> |
| Cannabaceae | <i>Cannabis sativa</i> L. | |

Table 1 contd....

Contd... Table 1

| | | | |
|---------------------------------|--|----------------------------------|---------------------------|
| Caryophyllaceae | <i>Stellaria media</i> (L.) Villars | | |
| Chenopodiaceae | <i>Chenopodium ambrosioids</i> L. | | |
| | <i>Chenopodium murale</i> L. | <i>Chenopodium murale</i> | |
| Commelinaceae | <i>Commelina benghalensis</i> L. | | |
| Cleomaceae | <i>Cleome gynandra</i> L. | | |
| Cyperaceae | <i>Cyperus iria</i> L. | | |
| | <i>Cyperus alopecuroides</i> Rott | | |
| | <i>Cyperus kyllingia</i> Endl. | | |
| | <i>Cyperus rotundus</i> L. | <i>Cyperus rotundus</i> | |
| | <i>Fimbristylis dichotoma</i> (L.) Vahl | | |
| | <i>Scirpus ternatanus</i> Reinwardt ex Miq. | | |
| Euphorbiaceae | <i>Croton bonplandianum</i> Baillon | <i>Croton bonplandianum</i> | |
| | <i>Euphorbia hirta</i> L. | | |
| | <i>Euphorbia thymifolia</i> L. | | |
| Fabaceae | <i>Dalbergia sisso</i> Roxb. | | |
| | <i>Medicago sativa</i> L. | | |
| | <i>Melilotus indica</i> (L.) Allioni | | |
| | <i>Trifolium alexandrinum</i> L. | | |
| Caesalpinaceae | <i>Cassia obtusifolia</i> L. | <i>Cassia obtusifolia</i> | |
| | <i>Cassia occidentalis</i> L. | <i>Cassia occidentalis</i> | |
| Lamiaceae | <i>Ocimum odorum</i> (L.) | | |
| Mimocaseae | <i>Prosopis juliflora</i> (Swartz) DC. | | |
| Malvaceae | <i>Abutilon indicum</i> (L.) Sweet | <i>Abutilon indicum</i> | |
| | <i>Malva sylvestris</i> L. | <i>Malva sylvestris</i> | |
| | <i>Malvastrum tricuspidatum</i> (R.Br.) A.Gray | | |
| | <i>Sida acuta</i> Burm f. | <i>Sida acuta</i> | |
| | <i>Sida cordifolia</i> L. | <i>Sida rhombifolia</i> | |
| | <i>Sida rhombifolia</i> L. | | |
| | <i>Urena lobata</i> L. | | |
| | Nyctaginaceae | <i>Boerhavia diffusa</i> L. | |
| | Oxalidaceae | <i>Oxalis corniculata</i> L. | <i>Oxalis corniculata</i> |
| | Papaveraceae | <i>Argemone Mexicana</i> L. | <i>Argemone mexicana</i> |
| Poaceae | <i>Acrachne racemosa</i> (Roemer &Schultes) | | |
| | <i>Cynodon dactylon</i> (L.) Persoon | <i>Cynodon dactylon</i> | |
| | <i>Digitaria ascendens</i> (Kunth) Henrad | | |
| | <i>Dactyloctenium aegypticum</i> P.Beauv | | |
| | <i>Dichanthium annulatum</i> (Forsk.) Stapf | | |
| | <i>Eleusine coracana</i> (L.) Gaertner | | |
| | <i>Panicum trypheron</i> Schultes | | |
| | <i>Paspalidium flavidum</i> (Retz.) A. Camus | <i>Paspalidium flavidum</i> | |
| | <i>Setaria glauca</i> (L.) P.Beauv | | |
| | <i>Eragrosti scilliaris</i> L. | | |
| | <i>Saccharum munja</i> Roxb. | | |
| | <i>Poa annua</i> | <i>Poa annua</i> | |
| | Polygonaceae | <i>Rumex dentatus</i> L. | <i>Rumex dentatus</i> |
| <i>Polygonum barbatum</i> L. | | | |
| <i>Polygonum glabrum</i> Willd. | | | |
| <i>Polygonum plebeium</i> R.Br. | | | |
| Primulaceae | <i>Anagallis arvensis</i> L. | | |
| Ranunculaceae | <i>Ranunculus sceleratus</i> L. | <i>Ranunculusscleratus</i> | |
| Scrophulariaceae | <i>Mazus japonicas</i> (Thunb.) Kuntze | | |
| Solanaceae | <i>Datura stramonium</i> L. | <i>Nicotiana plumbaginifolia</i> | |
| | <i>Solanum nigrum</i> L. | | |
| Sterculiaceae | <i>Celsia coromandeliana</i> Vahl | | |
| Tiliaceae | <i>Triumfetta rhomboidea</i> Jacquin | | |

Table 2 : Vertical distribution of seed bank density (seeds m⁻²) at Kali river bank. The values indicate the mean ± S.E. of three replicates

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

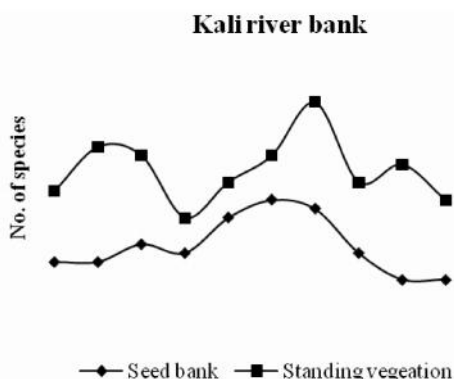


Fig. 1 : Changes in seed bank and above ground floristic counts in different months at Kali river bank

vegetation and the biotic factors appear 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).

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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