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ABOVEGROUND STANDING PHYTOMASS OF SOME GRASS-DOMINATED COMMUNITIES OF KARACHI: WINTER ASPECT

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ABSTRACT

Some 78 species (23 grasses, 2 sedges. and 53 dicotyledons including 9 legumes) were seen to compose winter aspect growth of 14 grass-dominated communities of Karachi, Pakistan. The mean number of species per site was 10.71 ± 1.25 (range: 3 – 20, CV= 44.1%). Sixty-one species occurred in one or two sites only. *Cenchrus setigerus, C pennisetiformis, Dichanthium. annulatum, Sporobolus arabicus, Cynodon dactylon* and *Tephrosia strigosa* were relatively more frequently occurring species.

Legumes were present invariably in all sites except *Urochondra setulosa* and *Sporobolus havolus* dominated communities. The number of species per site varied with the species dominating the site and the salinity status of the site. Halophytic communities were composed of lesser number of species as compared to the glycophytic communities. The aboveground standing phytomass (AGSP) varied from 37.6 g^{-2} for one of the *Cyanodon dactylon* community to 694.0 g^{-2} for *Desmostachya bipinnata* dominated site. Litter related with AGSP positively ($r = + 0.5577$; $p < 0.01$) as Litter (g^{-2}) = 15.37 + 0.0657 AGSP (g-2) ± 18.96. Percent proportion of legumes biomass (PPLB) related inversely with proportion of grasses' biomass ($r = - 0.5757$; $p < 0.03$) as PPLB = 39.483 – 0.4088 PPGB ± 7.362.

The communities in hand, with respect to their AGSP, were found to have an order: *D. bipinnata* > *U. setulosa* > *D. scindicum* > *S. arabicus* > *C. dactylon* = *S. halvolus* > *D. annulatum* >*C. pennisetiformis* = *C. aucherii* = *C. setigerus* > *S. verticillata*. AGSP of waterlogged and semi-moist halophytic sites was substantially higher than that of dry glycophytic sites. The biomass distribution amongst the constituent species of each site was geometric. Edaphic characteristics of these communities have also been described.

Key-words: Phytomass, winter aspect, communities, Karachi, Pakistan

INTRODUCTION

Herbaceous vegetation undergoes remarkable seasonal dynamics in arid and semi-arid areas (Babu, 1971). Khan *et al.* (1989, 1999, 2000, 2001, 2002) have described structure, composition and aboveground standing phytomass for some grass-dominated communities of coastal localities of Pakistan. In this region precipitation is scanty and somewhat bi-modal (Khan and Ahmad, 1992) – mostly occurring in summer but little in winter also. The aspect changes, likely, occurring in structure and phytomass of local herbaceous vegetation during summer and winter (cf.. Minchen, 1907) are still to undergo detailed analysis. Khan *et al.* (1999) have described structure, composition and aboveground standing phytomass for the summer aspect of some grass-dominated communities of Karachi and here in this paper we describe above ground standing phytomass for winter aspect of some grass-dominated communities of Karachi and its vicinity.

Description of the Area

The climate of Karachi is of BWh type and bioclimate as determined by Holdridge's system falls in the category of "Tropical Bush Formation" (Qadir *et al.*, 1966). Minchen (1907) recognized summer (May-October) and winter (November-April), two climatic extremes. The rainfall is irregular and averages below 200 mm a year-mostly in summer. The winter peak of precipitation is very low. Annual potential evapo-transpiration is c.1750 mm (Zubenok, 1977). Winter is the driest part of the year. The dew during October to March is reported to average around 6.2 mm per month (c. 6.6 mm in January, c 12 mm in February and 4.25 mm in March) (Ahmad *et al.*, 1986). Compared to summer, which is very hot, the winter in this part of world is mild. Mean monthly minimum temperature for the month of January remains around 10^{o}C, 12.5 ^{o}C for the month of February and 15 ^{o}C for the month of March. Occasionally, temperature may drop to around 5^{o}C due to the Siberian winds. Mean monthly maximum temperature for these months remains around 20, 25, and 26 ^{o}C, respectively. The insolation is intense with global solar radiation varying from 3580 Kcal.m-^{2}.day-^{1} for December to 5609 Kcal.m-^{2}.day-^{1} for May. The diffused radiation is 20-30% of the global radiation (Ahmad *et al.*, 1991).

MATERIALS AND METHODS

Fourteen grass-dominated sites of Karachi were sampled by 30 randomly placed quadrates of 1m^{2} each laid at random in the field to determine species abundance, after thirty days of c 20 mm rains in February [There was c 3 mm rain in January and 2 mm in March]. The criteria of selection of a stand were a) relative visual homogeneity of vegetation, and b) adequate size (not less than 0.1 ha) and c) relatively free from physical and biotic disturbance, as far as possible. All the sites were, however, exposed to certain degree of disturbance and historically subject to intense grazing in the past.

`Most of the grasses were bunch forming in nature and in such a case each bunch was regarded as an individual plant. In case of few sod-forming grasses any portion of plant possessing an independent shoot and root was considered as an individual (Singh and Yadava, 1974).

Aboveground standing phytomass (AGSP) was evaluated by harvesting 20, 50 x 50 cm quadrats placed randomly. *Urochondra setulosa* site, due to its relatively more openness, was sampled by $1m^2$ quadrat. All vegetation was harvested from the ground level and phytomass of each species was kept in separate bag. The litter was gathered after the plot had been cleared and it was washed through floatation. All samples of biomass and litter were dried at 80 ^{o}C for 24 h.

The importance value index (IVI) for each species was computed by direct summation of relative density and relative frequency following Curtis and McIntosh (1951) and relative abundance pattern for each site, based on biomass, was determined following Whittaker (1965).

Three soil samples were collected from each site from 15 cm depth. The portion finer than 2 mm of the composite soil sample was used for physical and chemical analysis e.g., texture, maximum water holding capacity, alkaline earth carbonates, organic matter, pH, Ec_e, and ions (Wilde *et al.*, 1972; USDA, 1954). Ec_e, ions and pH were determined using saturated soil extract. Cations were determined by Jarrel ash AA-782-Atomic Absorption Spectrophotometer and anions by titration (USDA, 1954).

RESULTS AND DISCUSSION

Seventy-eight species of plants (23 grasses, 2 sedges and 53 dicotyledons including 9 legumes) were encountered in 14 winter-aspect grass communities of Karachi with mean number of species per site, 10.71 ± 1.25 (range: 3 – 20, CV= 44.1%) (Table1). The density of the communities studied varied substantially- 3.36 individuals.m^{-2} in a *Urochondra setulosa* site to 364 individuals.m^{-2} in *S. verticillata* site. Maximum average IVI was exhibited by *U. setulosa* (119.7) followed by *S. arabicus* (96.2) and *Desmostachya bipinnata* (93.2) in their respective stands. Most of the species had low frequency of occurrence. Sixty-one species occurred in one or two sites only. *C. setigerus, C. pennisetiformis, D. annulatum, S. arabicus, C. dactylon* and *Tephrosia strigosa* were relatively more frequently occurring species (in ≥ 35 % of the sites) (Table 1).

On AGSP basis, twenty-seven species attained the rank of first, second and/or third order dominant and *Cenchrus pennisetiformis, C. setigerus, Chrysopogon aucherii, C. dactylon, Dactyloctenium scindicum, D. bippinata, Dichanthium annulatum, S. verticillata, S. arabicus, S. halvolus,* and *U. setulosa* were the leading dominant grasses (Table 1). Highest average biomass was presented by *D. bipinnata* (339 g.m^{-2}) followed by *U. setulosa* (303 g.m^{-2}), *S. halvolus* (98g.m^{-2}). *C. dactylon* (84g.m^{-2}), *S. arabicus* (62g.m^{-2}), etc. Average biomass of other species was even much lower.

Compared with the flora for summer aspect grass communities of Karachi (Khan *et al.*, 1999), only 4 species viz. *Anticharis linearis, Corchorus aestuans, Erigeron canadensis*, and *Melilotus indica* were exclusively winter occurring. This high inter-aspect similarity (95%) of flora for summer and winter aspects of grass-dominated communities of Karachi appears presumably due to the mildness of winter in this area and evolution of local flora under high temperature conditions prevailing for most part of the year - the true winter flora being, therefore, poorly developed in local grass communities.

Table 2 presents data on total above ground standing phytomass (AGSP), litter and density for the sites studied. The AGSP was lowest for one of the *C. dactylon* site (37.6g^{-2}) and highest for *D. bip*innata site (694g^{-2}). AGSP values for most communities were of low order and averaged to 258.5 g^{-2}. AGSP of the communities in hand lies in between the ranges of AGSP reported for extreme desert (0 – 200g^{-2}) and desert and semi-desert scrub vegetation (100 – 4000g^{-2}) (cf. Whittaker and Likens, 1975). Amongst the communities in hand, AGSP of halophytic communities of *D. bipinnata* (waterlogged), *U. setulosa* and *S. arabicus* (semi-moist) was, of course, substantially higher amongst the communities in hand but it was considerably lower than that of several halophytic communities e.g., *Distichlis spicata* (1164 g^{-2}), Spartina patens (2194 g^{-2}), *Juncus roemerianus* (1954 g^{-2}) and *Spartina alterniflora* (1473 g^{-2}), a dominant salt marsh plant of Louisiana (White *et al.*, 1978). AGSP around 400 g^{-2} in case of *Eleocharis rostellata* in a wet site in Byron-Bergen swamp, Genesse County, N.Y., is, however, comparable (Seischab *et al.*, 1985). The dry glycophytic communities dominated by C. *aucherii, C. setigerus, C. pennisetiformis, D. annulatum* and *S. halvolus* exhibited generally low AGSP.

Table 1. Phytosociological status and aboveground standing phytomass of the species encountered during sampling of some grass- dominated communities of Karachi (winter aspect).

Species	IVI Min	IVI Max	IVI Mean	Biomass (g/sq.m.) Min	Biomass (g/sq.m.) Max	Biomass (g/sq.m.) Mean	Occurrence	Dominant* (I	II	III)	Summer Presence***
1.*Abutilon indicum* (L.) Sweet	2.25	3.44	2.85	0.30	2.64	1.47	1	-	-	-	Y
2.*Achyranthes aspera* L.	3.44	7.67	5.56	0.32	4.96	2.64	2	-	-	-	Y
3.*Aeluropus lagopoides* (L.) Trin.	2.57	2.57	2.57	0.01	0.01	0.01	1	-	-	-	Y
4.*Alhagi maurorum* Baker	11.00	11.00	11.00	1.41	1.41	1.41	1	-	-	-	Y
5.*Amaranthes graecizens* subsp *silvestris* (Vill.) Brenan	1.45	1.45	1.45	1.49	1.49	1.49	1	-	-	-	Y
6.*A. virides* L	2.99	41.59	16.06	0.02	9.88	2.97	4	-	1	-	Y
7.*Anticharis linearis* (Bth.)Hochst. ex Asch.	4.45	4.45	4.45	0.26	0.26	0.26	1	-	-	-	N
8.*Aristida adscensionis* L.	5.52	25.86	15.59	0.05	1.34	0.69	2	-	-	-	Y
9.*A. mutabilis* Trin. & Rupr.	6.75	16.75	16.75	0.74	0.74	0.74	1	-	-	-	Y
10.*Atriplex griffithii* Moq	4.45	4.45	4.45	0.07	0.07	0.07	1	-	-	-	Y
11.*Blumea obliqua* (L.) Druce	9.99	9.99	9.99	0.88	0.88	0.88	1	-	-	-	Y
12.*Boerhavia verticillata* Poir	2.25	2.25	2.25	0.08	0.08	0.08	1	-	-	-	Y
13.*Cassia holosericea* Fresn	3.75	11.73	7.25	0.13	9.44	5.33	3	-	1	-	Y
14.*Cenchrus biflorus* Roxb.	9.95	9.95	9.95	5.52	5.52	5.52	1	-	-	-	Y
15.*C. pennisetiformis* Hochst. & Steud. ex Steud	5.12	114.54	30.91	14.10	55.84	26.50	5	1	1	-	Y
16.*C. setigerus* Vahl	3.23	75.79	22.80	1.58	43.64	14.51	6	1	-	1	Y
17.*Chenopodium album* L.	1.99	1.99	1.99	0.20	0.20	0.20	1	-	-	-	Y
18.*Chloris barbata* SW.	9.04	50.20	29.62	2.06	22.91	12.48	2	-	1	-	Y
19.*Chrysopogon aucheri* (Boiss.)Stapf.	3.97	72.91	27.66	12.43	54.24	28.60	3	1	-	-	Y
20.*Commelina albescens* Hasskari	3.44	3.44	3.44	0.06	0.06	0.06	1	-	-	-	Y
21.*Convolvulus glomeratus* Choisy	1.81	1.81	1.81	0.19	0.19	0.19	1	-	-	-	Y
22.*C. pleuricaulis*	1.81	1.81	1.81	0.85	0.85	0.85	1	-	-	-	Y
23.*Corchorus aestuans* L.	21.64	21.64	21.64	2.01	2.01	2.01	1	-	1	-	N
24.*C. depressus* (L.) Stocks	1.76	30.65	10.70	0.01	1.53	0.65	4	-	-	-	Y
25.*C. olitorius* L.	13.18	13.18	13.18	0.92	0.92	0.92	1	-	-	-	Y
26.*C. trilocularis* L.	15.22	15.22	15.22	0.80	0.80	0.80	1	-	-	-	Y
27.*Cressa cretica* L	2.86	13.22	8.60	0.01	3.37	1.65	3	-	1	-	Y
28.*Cyanodon dactylon* (L.) Pers.	4.10	135.43	46.66	0.27	353.65	84.30	5	2	-	-	Y
29.*Cymbopogon jwarancosa* (Jones) Schult.	55.30	55.30	55.30	22.56	22.56	22.56	1	-	1	-	Y
30.*C. schoenthus* (L.) Spreng.	4.50	4.50	4.50	18.22	18.22	18.22	1	-	-	1	Y
31.*Cyperus bulbosus* Vahl	6.12	9.09	7.61	0.03	2.54	1.29	2	-	-	-	Y
32.*C. rotundus* L.	7.99	28.07	16.27	0.67	9.81	4.07	4	-	-	1	Y
33.*Dactyloctenium scindicum* Boiss.	14.16	50.62	28.59	7.96	126.31	50.66	3	1	-	2	Y
34.*Desmostachya bipinnata* (L.) Stapf.	69.63	116.73	93.18	110.41	568.40	339.40	2	2	-	-	Y
35.*Dichanthium annulatum* (Forsk.) Stapf.	1.50	56.08	18.67	0.05	83.82	30.24	6	1	2	1	Y
36.*D. foveolatum* (del.) Roberty	3.52	3.52	3.52	2.62	2.62	2.62	1	-	-	-	Y
37.*Eclipta prostrata* (L.) L.	4.65	4.65	4.65	0.06	6.06	0.06	1	-	-	-	Y
38.*Enicostemma verticillatum* (L.) Engler	5.28	35.10	20.19	3.24	15.65	9.44	2	-	-	-	Y
39.*Eragrostis cilliaris* (L.) R. Br. **	-	-	-	-	-	-	1	-	-	-	Y
40.*Erigeron canadensis* Willd.	1.98	3.55	2.76	0.33	1.93	1.13	2	-	-	1	N
41.*Euphorbia clarkeana* Hook.f.	4.98	4.98	4.98	0.03	0.03	0.03	1	-	-	-	Y
42.*E. dracunculoides* Lam.	3.44	3.44	3.44	0.01	0.01	0.01	1	-	-	-	Y
43.*E. hirta* L.	2.11	7.55	4.83	0.29	0.50	0.40	2	-	-	-	Y
44.*E. prostrata* Ait.	1.76	1.76	1.76	0.05	0.05	0.05	1	-	-	-	Y
45.*Fagonia indica* Burm. f.	8.73	15.44	12.09	5.06	13.54	9.30	2	-	-	-	Y
46.*Heliotropium curassavicum* L.	9.88	9.88	9.88	26.90	26.90	26.90	1	-	1	-	Y
47.*H. ramossissimum* Sieb	1.76	1.76	1.76	5.65	5.65	5.65	1	-	-	-	Y
48.*Indigofera cordifolia* Heyne ex Roth	6.27	6.27	6.27	0.01	0.01	0.01	1	-	-	-	Y
49.*I. oblongifolia* Forsk.	3.92	30.95	11.28	0.11	87.74	25.73	4	-	1	-	Y
50.*Launaea nudicaulis* (L.) Hk. f.	2.31	12.63	8.27	0.09	3.52	1.32	4	-	-	1	Y
51.*Leptothrium senegalensis* (Kunth) W.D. Clayton	7.77	7.77	7.77	3.23	3.23	3.23	1	-	-	-	Y
52.*Limonium stocksii* (Boiss.) Ktze.	5.10	102.48	53.79	3.19	104.33	53.76	2	-	1	1	Y
53.*Melilotus indica* (L.) All.	10.86	11.85	11.36	0.93	1.28	1.11	2	-	-	-	N
54.*Ochthocloa compressa* (Forssk.) Hilu	6.12	18.97	12.54	6.88	51.57	29.22	2	-	-	-	Y
55.*Pentatropis spiralis* (Forssk.) Decne	2.25	2.25	2.25	5.35	5.35	5.35	1	-	-	-	Y
56.*Peristrophe bicalyculata* (Retz.) Nees	40.25	40.25	40.25	5.12	5.12	5.12	1	-	-	-	Y
57.*Phyllanthus niruri* L.	38.50	38.50	38.50	1.98	1.98	1.98	1	-	-	-	Y
58.*Polygala erioptera* DC.	5.29	5.29	5.29	0.07	0.07	0.07	1	-	-	-	Y
59.*Portulaca oleracea* L.	4.43	4.43	4.43	0.01	0.01	0.01	1	-	-	-	Y
60.*Portulaca* sp.	1.73	1.73	1.73	0.002	0.002	0.002	1	-	-	-	Y

Table 1 Cont'd…

61.*Rhynchosia minima* (L.) DC.	4.50	25.27	14.89	0.47	6.06	3.27	2	-	-	1	Y
62.*R. schimperii* Hochst ex Boiss.	6.27	6.27	6.27	11.07	11.07	11.07	1	-	-	1	Y
63.*Salvia santolinifolia* Boiss.	10.09	17.09	17.09	2.53	2.53	2.53	1	-	-	-	Y
64.*Senra incana* Cav.	6.27	6.27	6.27	6.13	6.13	6.13	1	-	-	-	Y
65.*Setaria verticillata* (L.) P. Beauv.	58.70	58.70	57.80	47.95	47.95	47.95	1	1	-	-	Y
66.*Sida pakistanica* S. Abedin	1.50	1.88	1.69	0.92	10.51	5.71	2	-	-	-	Y
67.*Solanum nigrum* L.	3.09	3.09	3.09	0.48	0.48	0.48	1	-	-	-	Y
68.*Sporobolus arabicus* Boiss.	4.45	61.85	21.85	0.55	166.61	62.31	6	1	2	2	Y
69.*S. halvolus* (Trin.) Dur & Schinz.	19.42	172.81	96.12	17.13	178.76	97.95	2	1	-	-	Y
70.*Suaeda fruticosa* (L.) Forssk.	2.25	17.68	7.58	0.02	0.69	0.26	4	-	-	-	Y
71.*S. nudiflora* (Willd.) Moq.	39.67	39.67	39.67	54.36	54.36	54.36	1	-	-	1	Y
72.*Tephrosia strigosa* (Delz.) Sant. & Maheshw.	2.73	17.09	7.26	0.04	2.80	1.08	5	-	-	-	Y
73.*T. subtriflora* Baker	5.03	7.17	6.10	0.03	0.96	0.49	2	-	-	-	Y
74.*Tribulus terrestris* L.	1.88	4.81	3.34	0.08	0.12	0.10	2	-	-	-	Y
75.*Trichodesma amplexicaule* Roth	6.88	6.88	6.88	4.24	4.24	4.24	1	-	-	-	Y
76.*Urochondra setulosa* (Trin.) C.E. Hubbard	84.19	155.30	119.72	292.05	314.05	303.05	2	2	-	-	Y
77.*Vernonia cinerea* (L.) Less.	1.99	1.99	1.99	0.001	0.001	0.001	1	-	-	-	Y
78.*Zygophyllum simplex* L.	3.00	3.00	3.00	4.31	4.31	4.31	1	-	-	-	Y

*, on the basis of biomass. **, Plant being sporadic did not occur in sampling, ***, Cf. Khan et al. (1999).

Table 2. AGSP (g.m^{-2}), density.m^{-2} and litter (g.$^{m-2}$) in 14-winter aspect grass-dominated communities of Karachi.

Vegetation type *	Density.m^{-2}	Biomass (g.m^{-2})	Litter (g.m^{-2})
1. *C. aucherii – C. jwarancosa – R. schimperii* **	10.3	96.9	12.7
2. *C. setigerus – C. pennisetiformis – R. minima*	54.4	86.6	9.6
3. *D. scindicum – I. Oblongifolia - S. arabicus*	86.4	328.0	38.9
4. *D. annulatum – C. barabata – C. jwarancosa*	10.8	169.5	40.3
5. *S. halvolus – D. annulatum – C. setigerus*	58.4	210.6	80.4
6. *D. bipinnata – S. arabicus – S. nudiflora*	12.2	694.0	56.6
7. *C. pennisetiformis – C. holosericea – D. scindium*	71.5	96.93	7.2
8. *U. setulosa – L. stockii – S. arabicus*	5.5	431.6	32.6
9. *S. arabicus – D. annulatum – S. halvolus*	73.6	261.9	52.3
10. *C. dactylon – H. curassavicum*	270.9	398.8	26.6
11. *U. setulosa*	3.4	322.4	30.9
12. *D. bipinnata – S. arabicus – D. annulatum*	38.1	417.5	49.8
13. *S. verticillata – A. virtidis*	364.2	66.3	3.98
14. *C. dactylon – C. aestuans*	125.6	37.6	18.5

*, on the basis of AGSP; **, The dominance sequence in these vegetation types, on the basis of IVI, changes as follows:

1. *C. aucherii – C. jwarancosa – T. strigosa* type
2. *C. setigerus – P. bicalyculata – R. minima* type
3. *D. scindicum – A. adscensionis – C. pennisetiformis* type
4. *D. annulatum – C. barbata – I. Oblongifolia* type
5. *S. halvolus – C. setigerus – D. annulatum* type
6. *D. bipinnata – S. nudiflora – S. arabicus* type
7. *C. pennisetiformis – C. setigerus – F. indica* type
8. *L. stocksii – U. setulosa type*
9. *S. arabicus – E. verticillatum – D. annulatum* type
10. *C. dactylon – L. nudicaulis* type
11. *U. setulosa – S. fruticosa* type
12. *D.bipinnata – S. arabicus – D. annulatum = O. compressa* type
13. *S. verticillata – A. viridis – P. niruri* type
14. *C. dactylon – C. depressus – C. aestuans* type

The litter component varied from 3.98 to 80.4g.m^{-2} and constituted 16.54 ± 3.44 % of the AGSP (range: 7.44 to 49.4%, CV= 77.7%). Although no correlation was observed between density and AGSP (r = + 0.2605, ns), Litter related to AGSP as:

Litter (g.m^{-2}) = 15.37 + 0.0657 AGSP (g.m-2) ± 18.96
t = 2.32, p < 0.038
r = 0.5577, p < 0.01 ; F = 5.4188

Table 3 presents data on compartmentalization of AGSP into various biological units. The biomass of grasses in the vegetation varied from 27.3 to 636.7 g^{-2}. The biomass of grass component was the highest in site # 6 dominated by *D. bipinnata* (636.7 g^{-2}) followed by moist *C. dactylon* site # 10 contributing 353.7 g^{-2} and *U. setulosa* site # 11 (315 g^{-2}). The number of grass species was highest (9) in *D. scindicum* site and minimum in *S. verticillata* site (3). The minimum grass biomass was represented by dry *C. dactylon* site (27.3 g^{-2}). Legumes were generally present in all sites except salinity affected site # 5 dominated by *S. havolus* and site 8 and 11 dominated by U. setulosa (Table 3). Maximum number of legumes occurred in non-saline coastal site dominated by *C. aucherii*. The biomass of legume component was very low ranging from 0 to 96 g^{-2}. It was highest in non-saline *D. scindicum* community. Unlike summer aspect of grass communities (Khan *et al.*, 1999), there was no correlation between number of legume and grass species occurring in these communities (r = 0.2640, ns) possibly due to disappearance of some legumes and grasses during winter drought. Percent proportion of legume biomass (PPLB), however, related inversely significantly with percent proportion of grass biomass (PPGB) as given below:

PPLB = 39.483 – 0.4088 PPGB ± 7.362
t = 2.81 t = 2.44
p < 0.016 p < 0.031
r = - 0.5757 F = 5.95

PPGB = 87.54 – 0.8106 PPLB ± 10.37
t = 26.34 t = 2.22
p < 0.001 p < 0.031
r = - 0.5757 F = 5.95

The implication of inverse relationship between PPLB and PPGB may be the competitive interactions among these components. Most of the tropical grasses being C_4 and tropical legumes C_3 plants have differential requirements with respect to the environmental resource (Mott and Popenoe, 1977). Grasses have competitive advantage over legumes (Sanford and Wangari, 1985). Grasses of the local flora, however, need to be screened for their photosynthetic characteristics.

Table 3. Apportionment of AGSP into various groups.

Site	Biomass (g.m^{-2}) Grasses	Legumes	Others	Dominant species *
1.	76.83 (3) **	17.50 (5)	2.66 (2)	*C. aucherii*
2.	67.04 (2)	6.12 9(2)	19.59 (9)	*C. setigerus*
3.	200.90 (9)	95.98 (3)	31.07 (8)	*D. scindicum*
4.	141.81 (5)	13.80 (3)	13.87 (7)	*D. annulatum*
5.	210.64 (3)	----------	----------	*S. halvolus*
6.	636.69 (2)	1.41 (1)	55.92 (2)	*D. bipinnata*
7.	76.66 (6)	9.51 (2)	10.47 (4)	*C. pennisetiformis*
8.	292.60 (2)	---------	139.03 (3)	*U. setulosa*
9.	245.34 (7)	0.97 (1)	15.69 (3)	*S. arabicus*
10.	353.65 (1)	1.28 (1)	43.90 (6)	*C. dactylon*
11.	315.14 (2)	---------	7.25 (4)	*U. setulosa*
12.	407.75 (8)	4.84 (1)	4.88 (5)	*D. bipinnata*
13.	47.95 (1)	0.93 (1)	17.44 (10)	*S. verticillata*
14.	27.31 (2)	0.60 (2)	9.65 (10)	*C. dactylon*

*, On the basis of AGSP; **, Figures in parenthesis denote the number of species.

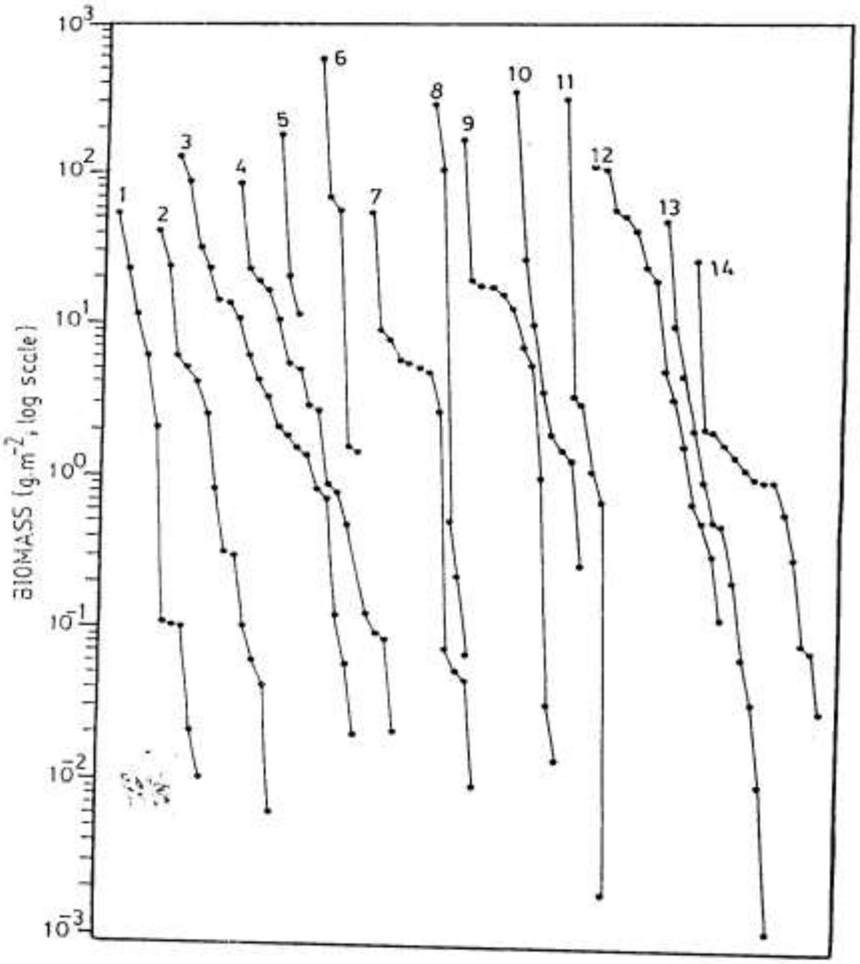

Fig.1. Relative abundance curves based on AGSP (winter aspect).

Table 4A. Physical soil characteristics for 14 winter aspect grass-dominated vegetation types of Karachi.

Vegetation type	Sand (%)	Silt (%)	Clay (%)	Soil Texture (%)	MWHC	Topography
1. *C. aucherii*	92.0	1.4	6.6	Sandy	23.12	Sandy Plain
2. *C. setigerus*	83.3	11.0	5.7	Loamy Sand	38.50	Sandy Plain
3. *D. scindicum*	88.5	8.4	3.1	Sandy	24.26	Sandy Plain
4. *D. annulatum*	84.9	11.1	4.0	Sandy- Loamy Sand	19.77	Rocky slope
5. *S. halvolus*	63.2	35.8	1.0	Sandyloam	40.52	Plain
6. *D. bipinnata*	67.0	17.9	15.0	Sandyloam	33.79	Plain
7. *C. pennisetiformis*	95.4	2.6	2.0	Sandy	24.90	Plain
8. *U. setulosa*	91.2	7.6	1.2	Sandy	27.32	Plain
9. *S. arabicus*	95.1	2.8	2.1	Sandy	30.37	Plain
10. *C. dactylon*	91.0	2.5	6.5	Sandy	33.92	Plain
11. *U. setulosa*	59.7	36.2	4.1	Sandy	25.53	Plain
12. *D. bipinnata*	81.4	16.9	1.7	Sandyloam	36.02	Plain
13. *S. verticillata*	92.7	4.0	3.3	Sandy	35.98	Plain (fallow Land)
14. *C. dactylon*	92.2	5.2	2.6	Sandy	29.4	Plain

Most of the sites (except *D. annulatum* community, which abounded theh rocky slopes consisting of thin soil layer at top) forming sandy plains. These sites were generally calcarious, basic in reaction and non-saline. Few of them e.g., site # 6 and 12 dominated by *D. bipinnata*, site # 8 and 11 dominated *U. setulosa*, and site # 9 dominated by *S. arabicus* were highly saline in nature (Table 4 –A & B). Such sites, in spite of being semi-moist, were generally poor in species richness. Moreover, the number of species in a site had some tendency to relate negatively with ECe of the site ($r = -0.4270$; $p < 0.15$). Comparatively high AGSP values in these communities, besides being species-specific, may presumably be also related to their alleviated moisture regime.

All the sites had geometric distribution of phytomass among constituent species, as relative abundance curves for these communities were characteristically linear on semi-log plot (Fig. **1**). Such distribution has already been reported in several grass-dominated communities (Sinha *et al.*, 1988; Khan *et al.*, 1989, 1999, 2000) and has been attributed to harsh stressed environmental conditions. In our case it may be due to winter drought in glycophytic communities and soil salinity in halophytic communities. This type of distribution indicates the monopolization of habitat by one or only few well-adapted species i.e., the most successful species pre-empting a fraction "k" of the available resource(s), the next a fraction of "k" of the remainder and so on (May, 1975). In salinity-affected areas, which are more severely stressed habitats, such a phenomenon is more rigorous. The sharing of some limiting resource by the member species is proportionately related with the dominance of the species, which become more distinct with low diversity (Yodzis, 1978).

Table 4B. Soil chemical characteristics of 14 winter aspect grass-dominated vegetation types of Karachi.

	Site (%)	$CaCO_3$ (%)	Humus (%)	EC_e $dS.m^{-1}$	pH	Na^+	K_+	Ca^{++}	Mg^{++}	CO_3^{-}	HCO_3^-	Cl^-	SO_4^{--}
							meq. L^{-1}						
1.	35.58	2.45	0.90	8.55	14.35	0.31	12.48	55.09	0.31	0.67	6.5	3.3	
2.	27.33	0.90	0.93	8.85	7.83	0.70	2.50	8.22	0.05	0.07	15.0	2.9	
3.	50.62	1.32	0.46	8.95	11.30	0.60	0.74	0.50	0.05	0.43	2.0	2.9	
4.	49.35	3.65	2.41	8.60	26.52	1.20	6.98	10.69	0.05	0.18	15.0	13.9	
5.	19.81	2.96	3.20	8.55	39.13	1.00	9.48	6.58	0.10	0.18	22.0	6.57	
6.	30.70	4.51	132.0	7.55	2174.0	212.8	6.98	823.6	-	0.65	3160	248.5	
7.	13.60	0.80	0.50	8.85	10.43	0.30	0.52	0.35-	0.47	2.50	2.91		
8.	45.20	3.14	32.98	8.15	678.2	6.14	20.94	29.60	0.16	0.31	447.5	26.0	
9.	13.08	0.76	55.90	7.65	887.0	4.08	2.50	71.55	-	0.16	865.5	33.2	
10.	39.50	2.95	4.89	8.65	8.26	0.68	16.96	3.78	0.08	0.26	20.5	29.5	
11.	36.92	3.46	55.10	7.65	565.0	7.68	62.37	59.20	-	0.85	860.0	32.7	
12.	13.08	2.28	27.50	8.65	217.4	9.60	12.97	98.68	0.24	1.06	314.0	89.8	
13.	35.36	0.45	1.18	9.25	14.35	1.98	4.99	2.22	0.69	1.01	3.5	5.5	
14.	38.47	2.28	0.81	8.85	9.13	0.38	0.46	0.35	0.05	0.22	2.0	1.99	

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