Article

Interspecific associations and community structure: A local survey and analysis in a grass community

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Received 18 July 2014; *Accepted 23 August 2014*; *Published online 1 September 2014*

Abstract
Interspecific associations in the plant community may help to understand the self-organizing assembly and succession of the community. In present study, Pearson correlation, net correlation, Spearman rank correlation, and point correlation were used to detect the interspecific (inter-family) associations of grass species (families) using the sampling data collected in a grass community of Zhuhai, China. We found that most associations between grass species (families) were positive associations. The competition/interference/niche separation between grass species (families) was not significant. A lot of pairs of grass species and families with statistically significant interspecific (inter-family) associations based on four correlation measures were discovered. Cluster trees for grass species/families were obtained by using cluster analysis. Relationship among positive/negative associations, interspecific relationship and community succession/stability/robustness was discussed. I held that species with significant positive or negative associations are generally keystone species in the community. Although both negative and positive associations occur in the community succession, the adaptation and selection will finally result in the successful coexistence of the species with significant positive associations in the climax community. As the advance of community succession, the significant positive associations increase and maximize in climax community, and the significant negative associations increase to a maximum and then decline into climax community. Dominance of significant positive associations in the climax community means the relative stablility and equilibrium of the community. No significant associations usually account for the majority of possible interspecific associations at each phase of community succession. They guarantee the robustness of community. They are candidates of keystone species. Lose of some existing keystone species might be filled with some species previously with no significant associations. In addition, a Java program, associCoeff, re-writed from my earlier work, was introduced. A large number of data were thus given also.

Keywords interspecific associations; community analysis; grass; Pearson correlation; net correlation; Spearman rank correlation; point correlation; cluster analysis; Zhuhai.

Selforganizology
URL: http://www.iaees.org/publications/journals/selforganizology/online-version.asp
RSS: http://www.iaees.org/publications/journals/ selforganizology /rss.xml
E-mail: selforganizology@iaees.org
Editor-in-Chief: WenJun Zhang
Publisher: International Academy of Ecology and Environmental Sciences

1 Introduction

Interspecific association refers to between-species interconnectedness on the spatial distribution, which is usually resulted from differences in the environment and habitat (Greig-Smith, 1983; Kuželová and Chytry, 2004; Meyer, 2006; Waterman and Roth, 2007; Chu et al., 2008; Menzel et al., 2008; Haugaasen and Peres, 2009; Nansen et al., 2009; Desbiez et al., 2010; Oliveira and Dietz, 2011; Ladygina and Rineau, 2012; Lan et al., 2012; Lin et al., 2012; Gonzalez-Moreno et al., 2013; Zhang et al., 2013). It is the representation of interactions of species-species and species-environment. Interspecific association is the basis for assembly and succession of biological communities (Zhang, 2012c). It is important to understand the structure, function and classification of communities. It also plays the fundamental role in the maintainence of biodiversity (Altieri, 1994; IRRI, 1998; Stang et al., 2007; Zhang, 2012a; Jayakumar et al., 2011; Ahmad et al., 2013). So far a lot of research on interspecific association have been published. Kuželová and Chytry (2004) reviewed the difference of interspecific associations in phytosociological data sets between local and regional scale. Waterman and Roth (2007) compared the benefit and cost of interspecific associations of Cape ground squirrels with two mongoose species. Desbiez et al. (2010) determined the interspecific association between an ungulate and a carnivore or a primate. Oliveira and Dietz (2011) studied the interspecific association of two Brazilian Atlantic forest primates in cabruca agroforest. Lan et al. (2012) combined the spatial distribution in the interspecific associations of tree species in a tropical seasonal rain forest.

There are many measures for interspecific association, including $\chi 2$ test, variance ratio method, coupling coefficient, co-occurrence percentage, point correlation, the similarity percentage for distribution, Spearman rank correlation, Pearson correlation, etc (Schoenly and Zhang, 1999; Zhang, 2007, 2011, 2012a, 2012b). Cluster analysis is based on the similarity between communities/species. It is widely used in the classification of communities and other objects (Qi, 2003; Zhang, 2012a).

In present study, Pearson correlation, net correlation, Spearman rank correlation, point correlation, and cluster analysis were used to detect and compare the interspecific (inter-family) associations of grass species (families) collected in a grass community of Zhuahai, in order to further understand the structure and succession of grass community.

2 Materials and Methods

2.1 Sampling survey

Sampling survey was conducted on April 22, 2007 in a grass community of Zhuhai, China (Fig. 1). In total of 50 samples were taken along a linear transect. Each sample had a size of 1m × 1m, and had an interval of 1m with the adjacent samples. Grass species and cover (%) in each sample were recorded.

2.2 Interspecific (inter-family) associations

Positive association refers to that two species (families) tend to spatially occur together and negative association means that two species (families) tend to occur exclusively (Schoenly and Zhang, 1999; Zhang, 2007, 2011, 2012a, 2012b).

Pearson correlation between species (families) *i* and *j* is

$$r_{ij}=\sum_{k=1}^{n}((a_{ik}-a_{ibar\Gamma})(a_{jk}-a_{jbar}))/[\sum_{k=1}^{n}(a_{ik}-a_{ibar})^2\sum_{k=1}^{n}(a_{jk}-a_{jbar})^2]^{1/2}$$

where, $-1\leq r_{ij}\leq 1$, a_{ik} and a_{jk} are *k*-th sample of sampling set of species (families) *i* and *j* respectively, a_{ibar} and a_{jbar} are means of a_{ik} and a_{jk} respectively, *n* is the number of samples. The *t*-test values of Pearson correlation is

$$t=r_{ij}/[(1-r_{ij}^2)/(n-2)]^{1/2}$$

where m is the number of species (families). If $t>t_\alpha$, then the interspecific (inter-family) correlation (association) is statistically significant; $r_{ij}>0$, positive correlation (association) (mutulism, parasitism, or they require the similar environmental conditions (niche overlap)); $r_{ij}<0$, negative correlation (association) (competition, interference, or they require the distinct environmental conditions (niche separation)).

Pearson correlation (association) is a linear association (Zhang, 2011, 2012a, 2012b).

Fig. 1 A profile of the grass community.

Net correlation is an extension of Pearson correlation. Net correlation between species (families) i and j is calculated as (Zhang, 2012a)

$$R_{ij}=-r_{ij}/(r_{ii}*r_{jj})^{1/2}$$

where $-1\leq R_{ij}\leq 1$, and r_{ij} is the element in inverse matrix of Pearson correlation matrix.

The t-test values of net correlation is

$$t=R_{ij}/[(1-R_{ij}^2)/(n-m)]^{1/2}$$

where m is the number of species (families), and n is the number of samples. If $t>t_\alpha$, then the interspecific (inter-family) correlation (association) is statistically significant.

Spearman rank correlation is (Spearman, 1904; Schoenly and Zhang, 1999; Zhang, 2011, 2012a, 2012b)

$$r_{ij}=1-6*\sum d^2/[n(n^2-1)]$$

where $-1\leq r_{ij}\leq 1$, $d=r(i)-r(j)$, and $r(i)$ and $r(j)$ are rank of an element in the sampling set of species (families) i and j, from the smaller to the larger values in n elements. The above t-test can be used in the significance test of Spearman rank correlation. If $t>t_\alpha$, then the interspecific (inter-family) correlation (association) is statistically significant; $r_{ij}>0$, positive correlation (association); $r_{ij}<0$, negative correlation (association).

Point correlation is defined as (Zhang, 2007)

$$d_{ij}=(ad-bc)/((a+b)(c+d)(a+c)(b+d))^{1/2}$$

where $-1\leq d_{ij}\leq 1$, both species (family) i and species (family) j take values 0 or 1. a is number of samples that both species (family) i and species (family) j take value 0, b is number of samples that species (family) i takes 0 and species (family) j takes 1, c is number of samples that species (family) i takes 1 and species (family) j takes 0, and d is number of samples that both species (family) i and species (family) j take value 1. The χ^2-test value of point correlation is

$$\chi^2=n(ad-bc)^2/[(a+b)(c+d)(a+c)(b+d)].$$

If $\chi^2>\chi^2_\alpha(1)$ ($\chi^2_{0.01}(1)=6.64$, $\chi^2_{0.05}(1)=3.84$), then interspecific (inter-family) association is statistically significant; $d_{ij}>0$, positive association; $d_{ij}<0$, negative association.

I have re-writed the program in Zhang (2012a) for easier use. The re-writed Java program, based on JDK 1.1.8, in which several classes and an HTML file is included (http://www.iaees.org/publications/software/index.asp; associCoeff.html; Fig. 2). In sampling data file, the first row is sample ID numbers and the first column is taxon ID numbers.

2.3 Cluster analysis

Fussy cluster analysis (Qi, 2003) was used to classify grass families and species. In the algorithm, cosine coefficient, which is an unstandardized form of Pearson correlation, was chosen as the similarity measure between families (species).

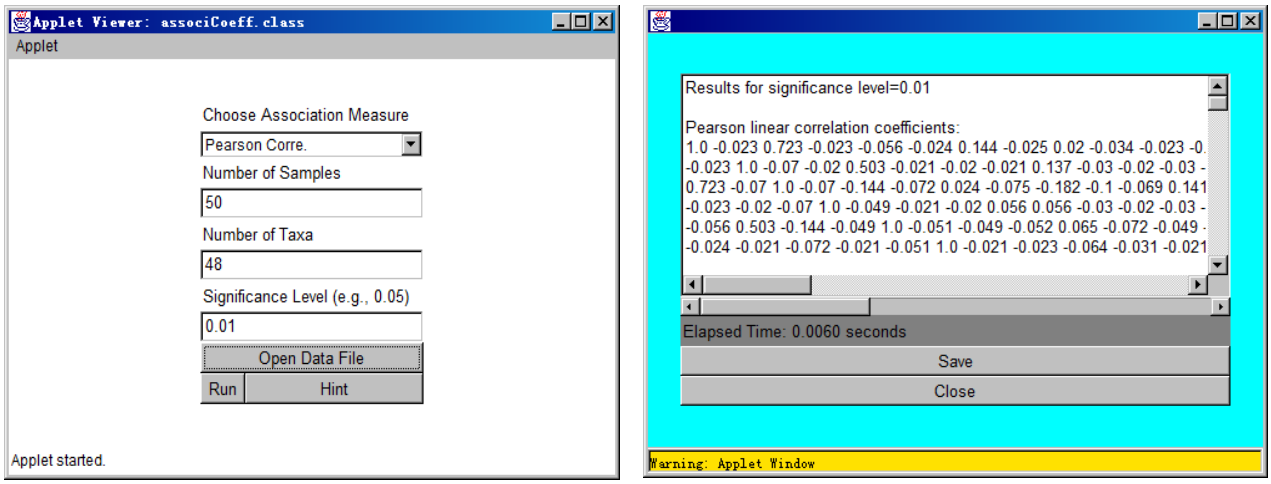

Fig. 2 Applet window of the program.

3 Results

According to the sampling survey, in total of 48 grass species, belonging to 17 families, were recorded in the meadow, as indicated in Table 1 and 2.

Fig. 3 indicates that the sampling is complete for creating a fuller species/families list, i.e., most of taxa have been collected in the sampling survey.

Table 1 Grass families found in the survey.

1	Euphorbiaceae	10	Connaraceae
2	Leguminosae	11	Umbelliferae
3	Pteridaceae	12	Cyperaceae
4	Lygodiaceae	13	Lycopodiaceae
5	Gramineae	14	Amaranthaceae
6	Apocynaceae	15	Convolvulaceae
7	Malvaceae	16	Commelinaceae
8	Asteraceae	17	Oxalidaceae
9	Onagraceae		

Table 2 Grass species found in the survey.

1	*Euphorbia hirta*	17	*Lophatherum gracile*	33	*Pterocypsela indica*
2	*Sapium sebiferum*	18	*Panicum repens*	34	*Vernonia cinerea*
3	*Atylosia scarabaeoides*	19	*Paspalum scrobiculatum*	35	*Wedelia triloba*
4	*Desmodium gangeticum*	20	*Rhynchelytrum repens*	36	*Jussiaea linifolia*
5	*Desmodium triflorum*	21	*Catharanthus roseus*	37	*Pteroloma triquetrum*
6	*Sesbania cannabina*	22	*Sida rhombifolia*	38	*Centella asiatica*
7	*Pteris vittata*	23	*Urena sp.*	39	*Cayerus exaltatus*
8	*Lygodium japonicum*	24	*Urena lobata*	40	*Cyperus compressus*
9	*Axonopus compressus*	25	*Ageratum conyzoides*	41	*Kyllinga brevifolia*
10	*Chrysopogon aciculatus*	26	*Aster subulatus*	42	*Lycopodium cernuum*
11	*Cymbopogon citratus*	27	*Bidens bipinnata*	43	*Alternanthera philoxeroides*
12	*Cynodon dactylon*	28	*Bidens pilosa*	44	*Alternanthera sessilis*
13	*Echinochloa crusgalli*	29	*Emilia sonchifolia*	45	*Ipomoea triloba*
14	*Eragrostis minor*	30	*Erigeron acer*	46	*Pharbitis purpurea*
15	*Eragrostis pilosa*	31	*Eupatorium chinense*	47	*Zebrina pendula*
16	*Ischaemum aristatum*	32	*Mikania micrantha*	48	*Oxalis corniculata*

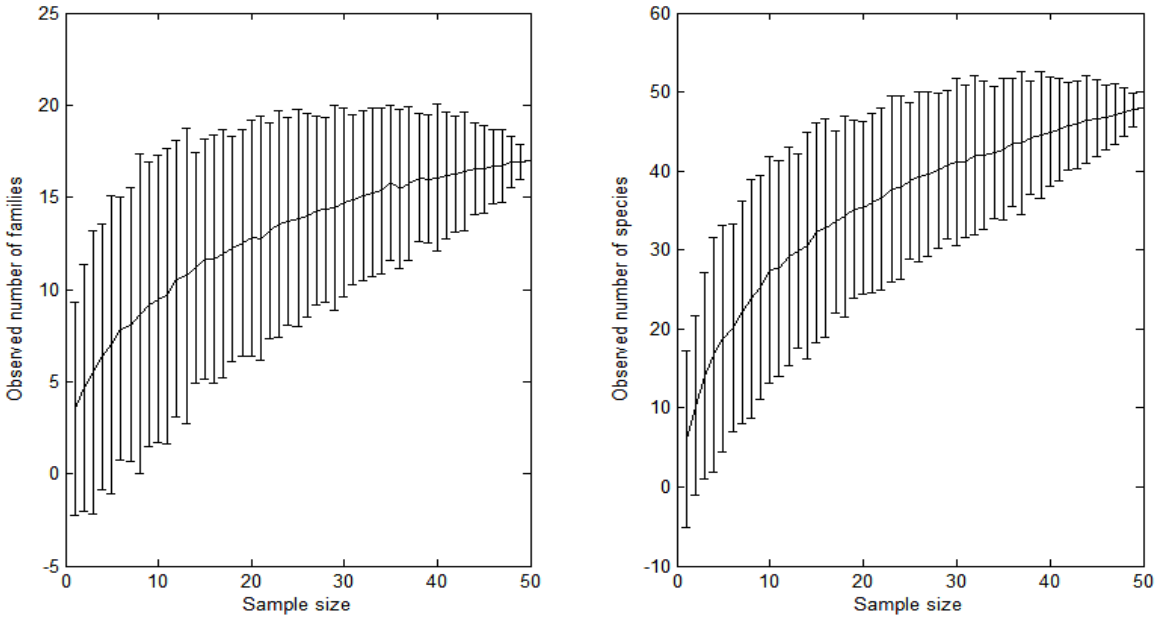

Fig. 3 Illustration of sampling completeness for creating a fuller species/families list. 100 times of randomizations were conducted for each sample size. Error bars are confidential intervals with 95% siginificance level (p=0.05).

3.1 Associations measured by Pearson correlation

Inter-family Pearson correlation coefficients are shown in Table 3.

Table 3 Inter-family Pearson correlation coefficients.

	Euphorbiaceae	Leguminosae	Pteridaceae	Lygodiaceae	Gramineae	Apocynaceae	Malvaceae	Asteraceae	Onagraceae
Euphorbiaceae	1	0.393	0.067	-0.032	0.016	-0.03	0.308	0.114	0.555
Leguminosae	0.393	1	0.019	-0.078	-0.273	-0.076	0.422	0.248	0.724
Pteridaceae	0.067	0.019	1	-0.021	0.048	-0.02	-0.039	-0.059	-0.021
Lygodiaceae	-0.032	-0.078	-0.021	1	0.191	-0.021	-0.041	-0.106	-0.023
Gramineae	0.016	-0.273	0.048	0.191	1	-0.118	-0.093	-0.308	0.039
Apocynaceae	-0.03	-0.076	-0.02	-0.021	-0.118	1	-0.039	0.063	-0.021
Malvaceae	0.308	0.422	-0.039	-0.041	-0.093	-0.039	1	0.423	0.573
Asteraceae	0.114	0.248	-0.059	-0.106	-0.308	0.063	0.423	1	-0.008
Onagraceae	0.555	0.724	-0.021	-0.023	0.039	-0.021	0.573	-0.008	1
Connaraceae	-0.03	-0.076	-0.02	-0.021	-0.105	-0.02	-0.039	-0.09	-0.021
Umbelliferae	-0.067	-0.124	-0.044	-0.048	0.151	-0.044	0.138	0.053	0.012
Cyperaceae	-0.054	-0.136	-0.036	-0.039	0.354	-0.036	-0.069	-0.087	-0.039
Lycopodiaceae	-0.03	-0.029	-0.02	0.056	0.037	-0.02	-0.039	-0.107	-0.021
Amaranthaceae	0.784	-0.033	-0.024	-0.026	0.036	-0.024	-0.023	0.124	-0.026
Convolvulaceae	0.378	0.485	-0.044	-0.047	0.054	-0.044	0.396	-0.093	0.723
Commelinaceae	-0.053	-0.133	-0.035	-0.038	0.242	-0.035	-0.068	-0.009	-0.038
Oxalidaceae	-0.042	-0.102	-0.028	-0.03	0.056	-0.028	-0.041	-0.055	-0.03

n=50.

Table 3 Inter-family Pearson correlation coefficients (Continue).

	Connaraceae	Umbelliferae	Cyperaceae	Lycopodiaceae	Amaranthaceae	Convolvulaceae	Commelinaceae	Oxalidaceae
Euphorbiaceae	-0.03	-0.067	-0.054	-0.03	0.784	0.378	-0.053	-0.042
Leguminosae	-0.076	-0.124	-0.136	-0.029	-0.033	0.485	-0.133	-0.102
Pteridaceae	-0.02	-0.044	-0.036	-0.02	-0.024	-0.044	-0.035	-0.028
Lygodiaceae	-0.021	-0.048	-0.039	0.056	-0.026	-0.047	-0.038	-0.03
Gramineae	-0.105	0.151	0.354	0.037	0.036	0.054	0.242	0.056
Apocynaceae	-0.02	-0.044	-0.036	-0.02	-0.024	-0.044	-0.035	-0.028
Malvaceae	-0.039	0.138	-0.069	-0.039	-0.023	0.396	-0.068	-0.041
Asteraceae	-0.09	0.053	-0.087	-0.107	0.124	-0.093	-0.009	-0.055
Onagraceae	-0.021	0.012	-0.039	-0.021	-0.026	0.723	-0.038	-0.03
Connaraceae	1	-0.044	-0.036	-0.02	-0.024	-0.044	-0.035	-0.028
Umbelliferae	-0.044	1	-0.08	-0.044	-0.023	0.113	-0.01	0.166
Cyperaceae	-0.036	-0.08	1	-0.036	-0.044	-0.03	0.291	-0.05
Lycopodiaceae	-0.02	-0.044	-0.036	1	-0.024	-0.044	-0.035	-0.028
Amaranthaceae	-0.024	-0.023	-0.044	-0.024	1	-0.053	-0.043	-0.034
Convolvulaceae	-0.044	0.113	-0.03	-0.044	-0.053	1	-0.077	0.001
Commelinaceae	-0.035	-0.01	0.291	-0.035	-0.043	-0.077	1	0.531
Oxalidaceae	-0.028	0.166	-0.05	-0.028	-0.034	0.001	0.531	1

n=50.

At the 99 % confidence level, no significant negative association is found between grass families. Family pairs with positive associations (mutualism, commensalism, proto-cooperation, complementary resource-partitioning, or they require the similar environmental conditions (nich overlap)) include

Euphorbiaceae-: Leguminosae (0.393), Onagraceae (0.555), Amaranthaceae (0.784), Convolvulaceae (0.378);

Leguminosae-Convolvulaceae (0.485);

Malvaceae-: Asteraceae (0.423); Onagraceae (0.573), Convolvulaceae (0.396);

Onagraceae-Convolvulaceae (0.723).

Interspecific Pearson correlation coefficients can be found in Table 4.

Table 4 Interspecfic Pearson correlation coefficients.

	E. hirta	*S. sebiferum*	*A. scarabaeoides*	*D. gangeticum*	*D. triflorum*	*S. cannabina*	*P. vittata*	*L. japonicum*	*A. compressus*	*C. aciculatus*	*C. citratus*	*C. dactylon*
E. hirta	1	-0.023	0.723	-0.023	-0.056	-0.024	0.144	-0.025	0.02	-0.034	-0.023	-0.035
S. sebiferum	-0.023	1	-0.07	-0.02	0.503	-0.021	-0.02	-0.021	0.137	-0.03	-0.02	-0.03
A. scarabaeoides	0.723	-0.07	1	-0.07	-0.144	-0.072	0.024	-0.075	-0.182	-0.1	-0.069	0.141
D. gangeticum	-0.023	-0.02	-0.07	1	-0.049	-0.021	-0.02	0.056	0.056	-0.03	-0.02	-0.03
D. triflorum	-0.056	0.503	-0.144	-0.049	1	-0.051	-0.049	-0.052	0.065	-0.072	-0.049	-0.074
S. cannabina	-0.024	-0.021	-0.072	-0.021	-0.051	1	-0.021	-0.023	-0.064	-0.031	-0.021	-0.032

P. vittata	0.144	-0.02	0.024	-0.02	-0.049	-0.021	1	-0.021	0.343	-0.03	-0.02	-0.03
L. japonicum	-0.025	-0.021	-0.075	0.056	-0.052	-0.023	-0.021	1	-0.081	-0.032	-0.021	-0.033
A. compressus	0.02	0.137	-0.182	0.056	0.065	-0.064	0.343	-0.081	1	-0.108	0.098	-0.128
C. aciculatus	-0.034	-0.03	-0.1	-0.03	-0.072	-0.031	-0.03	-0.032	-0.108	1	0.003	-0.045
C. citratus	-0.023	-0.02	-0.069	-0.02	-0.049	-0.021	-0.02	-0.021	0.098	0.003	1	-0.03
C. dactylon	-0.035	-0.03	0.141	-0.03	-0.074	-0.032	-0.03	-0.033	-0.128	-0.045	-0.03	1
E. crusgalli	-0.033	-0.029	-0.1	-0.029	-0.07	-0.03	-0.029	-0.031	0	-0.042	-0.029	-0.044
E. minor	-0.07	-0.06	-0.181	0.767	0.124	-0.063	-0.06	-0.001	0.013	-0.089	-0.06	-0.091
E. pilosa	-0.04	-0.034	-0.104	-0.034	-0.083	-0.036	-0.034	-0.037	-0.134	-0.051	-0.034	-0.052
I. aristatum	-0.062	-0.054	-0.17	-0.054	0.026	-0.056	-0.054	0.59	-0.159	-0.079	-0.054	-0.081
L. gracile	-0.03	-0.026	0.031	-0.026	-0.064	-0.028	-0.026	-0.028	-0.113	-0.039	-0.026	-0.04
P. repens	-0.066	0.012	-0.212	-0.107	-0.074	0.125	-0.082	-0.105	-0.13	-0.079	0.029	-0.158
P. scrobiculatum	-0.041	-0.061	-0.012	-0.01	0.221	-0.064	0.118	-0.062	0.105	-0.091	-0.061	-0.055
R. repens	0.581	-0.058	0.665	-0.058	-0.007	-0.06	-0.058	-0.062	-0.21	-0.085	-0.058	0.074
C. roseus	-0.023	-0.02	-0.07	-0.02	-0.049	-0.021	-0.02	-0.021	0	-0.03	-0.02	-0.03
S. rhombifolia	-0.028	-0.024	0.079	-0.024	-0.059	-0.026	-0.024	-0.026	-0.105	-0.036	-0.024	-0.019
U. sp.	-0.023	-0.02	0.002	-0.02	-0.049	-0.021	-0.02	-0.021	-0.086	-0.03	-0.02	-0.03
U. lobata	0.918	0.011	0.652	-0.028	-0.047	-0.03	-0.028	-0.031	-0.066	-0.042	-0.028	-0.043
A. conyzoides	-0.071	-0.062	0.173	-0.062	-0.149	-0.065	-0.062	-0.066	-0.197	-0.091	-0.062	0.053
A. subulatus	-0.029	-0.025	-0.084	-0.025	-0.06	0.029	-0.025	-0.027	-0.106	-0.037	-0.025	-0.038
B. bipinnata	-0.043	-0.037	0.183	-0.037	-0.09	-0.039	-0.037	-0.04	-0.148	-0.055	-0.037	-0.014
B. pilosa	0.247	0.482	0.272	-0.033	0.198	-0.035	-0.033	-0.036	0.064	-0.049	-0.033	-0.051
E. sonchifolia	-0.12	-0.096	-0.12	-0.062	-0.183	-0.109	-0.104	-0.024	-0.142	0.039	-0.104	0.228
E. acer	0.071	0.333	-0.023	-0.046	0.093	0.458	0.714	-0.05	0.25	-0.068	-0.046	-0.07
E. chinense	-0.055	-0.059	-0.002	-0.047	-0.139	0.05	0.023	-0.037	0.109	-0.087	-0.059	-0.075
M. micrantha	-0.032	-0.028	-0.096	-0.028	-0.067	-0.029	-0.028	-0.03	0.066	-0.041	-0.028	-0.042
P. indica	-0.023	-0.02	-0.052	-0.02	-0.049	-0.021	-0.02	-0.021	-0.086	-0.03	-0.02	-0.03
V. cinerea	-0.056	0.567	-0.066	-0.049	0.215	-0.051	-0.049	-0.053	-0.008	-0.072	-0.049	-0.051
W. triloba	-0.049	0.526	-0.148	-0.042	0.204	-0.018	-0.042	-0.046	0.319	-0.054	0.031	-0.065
J. linifolia	0.983	-0.021	0.721	-0.021	-0.052	-0.022	-0.021	-0.023	-0.042	-0.032	-0.021	-0.033
P. triquetrum	-0.023	-0.02	-0.07	-0.02	-0.049	-0.021	-0.02	-0.021	0.085	-0.03	-0.02	-0.03
C. asiatica	-0.051	-0.044	-0.117	-0.044	-0.042	-0.047	-0.044	-0.048	-0.183	0.033	-0.044	-0.067
C. exaltatus	-0.023	-0.02	-0.07	-0.02	-0.049	-0.021	-0.02	-0.021	-0.086	-0.03	-0.02	-0.03
C. compressus	-0.023	-0.02	-0.07	-0.02	-0.049	-0.021	-0.02	-0.021	0.152	-0.013	-0.02	-0.03
K. brevifolia	-0.032	-0.028	-0.097	-0.028	-0.067	-0.029	-0.028	-0.03	-0.113	-0.041	-0.028	-0.042
L. cernuum	-0.023	-0.02	-0.07	0.999	-0.049	-0.021	-0.02	0.056	0.056	-0.03	-0.02	-0.03
A. philoxeroides	-0.023	-0.02	-0.024	-0.02	0.464	-0.021	-0.02	-0.021	-0.064	-0.03	-0.02	-0.03
A. sessilis	-0.023	0.999	-0.07	-0.02	0.503	-0.021	-0.02	-0.021	0.137	-0.03	-0.02	-0.03
I. triloba	-0.023	-0.02	-0.052	-0.02	-0.049	-0.021	-0.02	-0.021	-0.086	-0.03	-0.02	-0.03
P. purpurea	0.743	-0.043	0.515	-0.043	-0.104	-0.045	-0.043	-0.046	-0.132	0.26	-0.043	0.207
Z. pendula	-0.041	-0.035	-0.123	-0.035	-0.085	-0.037	-0.035	-0.038	-0.121	-0.052	-0.035	-0.054
O. corniculata	-0.032	-0.028	-0.095	-0.028	-0.068	-0.029	-0.028	-0.03	-0.089	0.005	-0.028	-0.042

n=50.

Table 4 Interspecfic Pearson correlation coefficients (Continue).

	E. crusgalli	*E. minor*	*E. pilosa*	*I. aristatum*	*L. gracile*	*P. repens*	*P. scrobiculatum*	*R. repens*	*C. roseus*	*S. rhombifolia*	*U. sp.*	*U. lobata*
E. hirta	-0.033	-0.07	-0.04	-0.062	-0.03	-0.066	-0.041	0.581	-0.023	-0.028	-0.023	0.918
S. sebiferum	-0.029	-0.06	-0.034	-0.054	-0.026	0.012	-0.061	-0.058	-0.02	-0.024	-0.02	0.011
A. scarabaeoides	-0.1	-0.181	-0.104	-0.17	0.031	-0.212	-0.012	0.665	-0.07	0.079	0.002	0.652
D. gangeticum	-0.029	0.767	-0.034	-0.054	-0.026	-0.107	-0.01	-0.058	-0.02	-0.024	-0.02	-0.028
D. triflorum	-0.07	0.124	-0.083	0.026	-0.064	-0.074	0.221	-0.007	-0.049	-0.059	-0.049	-0.047
S. cannabina	-0.03	-0.063	-0.036	-0.056	-0.028	0.125	-0.064	-0.06	-0.021	-0.026	-0.021	-0.-03
P. vittata	-0.029	-0.06	-0.034	-0.054	-0.026	-0.082	0.118	-0.058	-0.02	-0.024	-0.02	-0.028
L. japonicum	-0.031	-0.001	-0.037	0.59	-0.028	-0.105	-0.062	-0.062	-0.021	-0.026	-0.021	-0.031
A. compressus	0	0.013	-0.134	-0.159	-0.113	-0.13	0.105	-0.21	0	-0.105	-0.086	-0.066
C. aciculatus	-0.042	-0.089	-0.051	-0.079	-0.039	-0.079	-0.091	-0.085	-0.03	-0.036	-0.03	-0.042
C. citratus	-0.029	-0.06	-0.034	-0.054	-0.026	0.029	-0.061	-0.058	-0.02	-0.024	-0.02	-0.028
C. dactylon	-0.044	-0.091	-0.052	-0.081	-0.04	-0.158	-0.055	0.074	-0.03	-0.019	-0.03	-0.043
E. crusgalli	1	-0.086	0.063	0.163	-0.038	0.181	-0.088	-0.082	-0.029	-0.035	-0.029	-0.041
E. minor	-0.086	1	-0.103	-0.161	-0.079	-0.305	-0.046	0.054	-0.06	-0.073	-0.06	-0.085
E. pilosa	0.063	-0.103	1	0.054	-0.045	0.168	0.07	-0.099	-0.034	0.15	-0.034	-0.036
I. aristatum	0.163	-0.161	0.054	1	-0.07	0.119	-0.114	-0.153	-0.054	-0.056	-0.054	-0.067
L. gracile	-0.038	-0.079	-0.045	-0.07	1	-0.125	-0.081	0.03	-0.026	-0.032	0.927	-0.037
P. repens	0.181	-0.305	0.168	0.119	-0.125	1	-0.187	-0.223	-0.033	-0.065	-0.107	0.068
P. scrobiculatum	-0.088	-0.046	0.07	-0.114	-0.081	-0.187	1	-0.118	0.041	-0.025	-0.061	-0.079
R. repens	-0.082	0.054	-0.099	-0.153	0.03	-0.223	-0.118	1	-0.058	-0.056	0.055	0.535
C. roseus	-0.029	-0.06	-0.034	-0.054	-0.026	-0.033	0.041	-0.058	1	-0.024	-0.02	-0.028
S. rhombifolia	-0.035	-0.073	0.15	-0.056	-0.032	-0.065	-0.025	-0.056	-0.024	1	-0.024	-0.035
U. sp.	-0.029	-0.06	-0.034	-0.054	0.927	-0.107	-0.061	0.055	-0.02	-0.024	1	-0.028
U. lobata	-0.041	-0.085	-0.036	-0.067	-0.037	0.068	-0.079	0.535	-0.028	-0.035	-0.028	1
A. conyzoides	0.19	-0.184	0.166	-0.058	0.131	-0.067	-0.109	-0.126	0.198	0.657	-0.062	-0.079
A. subulatus	-0.035	-0.074	0.043	-0.052	-0.032	0.339	-0.048	-0.071	-0.025	-0.008	-0.025	0.33
B. bipinnata	-0.053	-0.111	-0.064	-0.099	0.906	-0.143	-0.114	0	-0.037	-0.037	0.813	-0.053
B. pilosa	-0.048	-0.099	-0.057	-0.089	-0.044	-0.052	-0.102	0.095	-0.033	-0.041	-0.033	0.245
E. sonchifolia	0.152	-0.237	0.175	0.332	-0.136	0.168	0.138	-0.206	0.401	-0.045	-0.104	-0.072
E. acer	-0.066	-0.138	-0.079	-0.123	-0.061	0.13	0.008	-0.115	-0.046	-0.056	-0.046	-0.051
E. chinense	-0.085	-0.11	-0.088	-0.114	-0.078	0.193	0.046	0.045	-0.059	-0.073	-0.059	0.015
M. micrantha	0.717	-0.084	0.092	-0.012	-0.037	0.11	-0.067	-0.08	-0.028	-0.022	-0.028	-0.039
P. indica	-0.029	-0.06	0.757	-0.015	-0.026	0.005	0.144	-0.058	-0.02	0.223	-0.02	-0.028
V. cinerea	-0.07	-0.146	0.395	-0.06	-0.064	0.024	0.162	-0.118	0.567	0.015	-0.049	-0.021
W. triloba	-0.061	-0.112	-0.073	-0.114	-0.056	0.074	-0.13	-0.122	-0.042	-0.052	-0.042	-0.038
J. linifolia	-0.031	-0.064	-0.037	-0.057	-0.028	-0.029	-0.066	0.592	-0.021	-0.026	-0.021	0.955
P. triquetrum	-0.029	-0.023	-0.034	-0.054	-0.026	-0.107	0.247	-0.058	-0.02	-0.024	-0.02	-0.028
C. asiatica	-0.064	-0.133	0.286	0.004	-0.058	0.364	0.019	-0.108	-0.044	0.04	-0.044	0.265
C. exaltatus	0.699	-0.06	0.123	0.27	-0.026	0.224	-0.061	-0.058	-0.02	-0.024	-0.02	-0.028
C. compressus	-0.029	-0.06	-0.034	-0.054	-0.026	0.104	-0.061	-0.058	-0.02	-0.024	-0.02	-0.028
K. brevifolia	-0.04	-0.07	-0.048	0.121	-0.036	0.342	-0.085	-0.08	-0.028	-0.034	-0.028	-0.039

L. cernuum	-0.029	0.767	-0.034	-0.054	-0.026	-0.107	-0.01	-0.058	-0.02	-0.024	-0.02	-0.028
A. philoxeroides	-0.029	-0.06	-0.034	0.257	-0.026	0.122	-0.061	-0.058	-0.02	-0.024	-0.02	-0.028
A. sessilis	-0.029	-0.06	-0.034	-0.054	-0.026	0.012	-0.061	-0.058	-0.02	-0.024	-0.02	0.011
I. triloba	-0.029	-0.06	0.757	-0.015	-0.026	0.005	0.144	-0.058	-0.02	0.223	-0.02	-0.028
P. purpurea	-0.062	-0.126	0.21	-0.089	-0.056	-0.079	-0.05	0.427	-0.043	0.03	-0.043	0.702
Z. pendula	0.331	-0.106	0.466	0.232	-0.046	0.287	-0.027	-0.101	-0.035	-0.043	-0.035	-0.05
O. corniculata	-0.04	-0.084	0.049	0.15	-0.037	0.065	0.09	-0.08	-0.028	-0.034	-0.028	-0.018

n=50.

Table 4 Interspecfic Pearson correlation coefficients (Continue).

	A. conyzoides	*A. subulatus*	*B. bipinnata*	*B. pilosa*	*E. sonchifolia*	*E. acer*	*E. chinense*	*M. micrantha*	*P. indica*	*V. cinerea*	*W. triloba*	*J. linifolia*
E. hirta	-0.071	-0.029	-0.043	0.247	-0.12	0.071	-0.055	-0.032	-0.023	-0.056	-0.049	0.983
S. sebiferum	-0.062	-0.025	-0.037	0.482	-0.096	0.333	-0.059	-0.028	-0.02	0.567	0.526	-0.021
A. scarabaeoides	0.173	-0.084	0.183	0.272	-0.12	-0.023	-0.002	-0.096	-0.052	-0.066	-0.148	0.721
D. gangeticum	-0.062	-0.025	-0.037	-0.033	-0.062	-0.046	-0.047	-0.028	-0.02	-0.049	-0.042	-0.021
D. triflorum	-0.149	-0.06	-0.09	0.198	-0.183	0.093	-0.139	-0.067	-0.049	0.215	0.204	-0.052
S. cannabina	-0.065	0.029	-0.039	-0.035	-0.109	0.458	0.05	-0.029	-0.021	-0.051	-0.018	-0.022
P. vittata	-0.062	-0.025	-0.037	-0.033	-0.104	0.714	0.023	-0.028	-0.02	-0.049	-0.042	-0.021
L. japonicum	-0.066	-0.027	-0.04	-0.036	-0.024	-0.05	-0.037	-0.03	-0.021	-0.053	-0.046	-0.023
A. compressus	-0.197	-0.106	-0.148	0.064	-0.142	0.25	0.109	0.066	-0.086	-0.008	0.319	-0.042
C. aciculatus	-0.091	-0.037	-0.055	-0.049	0.039	-0.068	-0.087	-0.041	-0.03	-0.072	-0.054	-0.032
C. citratus	-0.062	-0.025	-0.037	-0.033	-0.104	-0.046	-0.059	-0.028	-0.02	-0.049	0.031	-0.021
C. dactylon	0.053	-0.038	-0.014	-0.051	0.228	-0.07	-0.075	-0.042	-0.03	-0.051	-0.065	-0.033
E. crusgalli	0.19	-0.035	-0.053	-0.048	0.152	-0.066	-0.085	0.717	-0.029	-0.07	-0.061	-0.031
E. minor	-0.184	-0.074	-0.111	-0.099	-0.237	-0.138	-0.11	-0.084	-0.06	-0.146	-0.112	-0.064
E. pilosa	0.166	0.043	-0.064	-0.057	0.175	-0.079	-0.088	0.092	0.757	0.395	-0.073	-0.037
I. aristatum	-0.058	-0.052	-0.099	-0.089	0.332	-0.123	-0.114	-0.012	-0.015	-0.06	-0.114	-0.057
L. gracile	0.131	-0.032	0.906	-0.044	-0.136	-0.061	-0.078	-0.037	-0.026	-0.064	-0.056	-0.028
P. repens	-0.067	0.339	-0.143	-0.052	0.168	0.13	0.193	0.11	0.005	0.024	0.074	-0.029
P. scrobiculatum	-0.109	-0.048	-0.114	-0.102	0.138	0.008	0.046	-0.067	0.144	0.162	-0.13	-0.066
R. repens	-0.126	-0.071	0	0.095	-0.206	-0.115	0.045	-0.08	-0.058	-0.118	-0.122	0.592
C. roseus	0.198	-0.025	-0.037	-0.033	0.401	-0.046	-0.059	-0.028	-0.02	0.567	-0.042	-0.021
S. rhombifolia	0.657	-0.008	-0.037	-0.041	-0.045	-0.056	-0.073	-0.022	0.223	0.015	-0.052	-0.026
U. sp.	-0.062	-0.025	0.813	-0.033	-0.104	-0.046	-0.059	-0.028	-0.02	-0.049	-0.042	-0.021
U. lobata	-0.079	0.33	-0.053	0.245	-0.072	-0.051	0.015	-0.039	-0.028	-0.021	-0.038	0.955
A. conyzoides	1	-0.051	0.229	-0.102	0.084	-0.141	-0.16	0.144	0.103	0.136	-0.13	-0.066
A. subulatus	-0.051	1	-0.046	-0.041	0.072	-0.029	0.204	-0.03	0.067	-0.004	-0.052	0.045
B. bipinnata	0.229	-0.046	1	-0.062	-0.094	-0.086	-0.11	-0.052	-0.037	-0.09	-0.079	-0.04
B. pilosa	-0.102	-0.041	-0.062	1	-0.168	0.332	-0.022	-0.046	-0.033	0.23	0.216	0.253
E. sonchifolia	0.084	0.072	-0.094	-0.168	1	-0.213	0.065	0.218	-0.104	0.313	-0.215	-0.097
E. acer	-0.141	-0.029	-0.086	0.332	-0.213	1	0.082	-0.064	-0.046	0.117	0.123	-0.049
E. chinense	-0.16	0.204	-0.11	-0.022	0.065	0.082	1	-0.07	-0.059	-0.08	-0.105	-0.045
M. micrantha	0.144	-0.03	-0.052	-0.046	0.218	-0.064	-0.07	1	0.022	-0.007	-0.059	-0.03

P. indica	0.103	0.067	-0.037	-0.033	-0.104	-0.046	-0.059	0.022	1	0.259	-0.042	-0.021
V. cinerea	0.136	-0.004	-0.09	0.23	0.313	0.117	-0.08	-0.007	0.259	1	0.24	-0.052
W. triloba	-0.13	-0.052	-0.079	0.216	-0.215	0.123	-0.105	-0.059	-0.042	0.24	1	-0.046
J. linifolia	-0.066	0.045	-0.04	0.253	-0.097	-0.049	-0.045	-0.03	-0.021	-0.052	-0.046	1
P. triquetrum	-0.062	-0.025	-0.037	-0.033	0.089	-0.046	-0.034	-0.028	-0.02	-0.049	-0.042	-0.021
C. asiatica	-0.026	0.855	-0.082	-0.074	0.055	-0.056	0.215	-0.036	0.344	0.126	-0.094	0.012
C. exaltatus	0.139	-0.025	-0.037	-0.033	0.064	-0.046	-0.059	0.022	-0.02	-0.049	-0.042	-0.021
C. compressus	-0.062	-0.025	-0.037	-0.033	-0.104	-0.021	-0.001	-0.028	-0.02	-0.049	0.328	-0.021
K. brevifolia	-0.085	-0.034	-0.052	-0.046	0.001	-0.064	-0.083	-0.039	-0.028	-0.068	0.251	-0.03
L. cernuum	-0.062	-0.025	-0.037	-0.033	-0.062	-0.046	-0.047	-0.028	-0.02	-0.049	-0.042	-0.021
A. philoxeroides	-0.062	-0.025	-0.037	-0.033	-0.02	-0.046	-0.059	-0.028	-0.02	-0.049	-0.042	-0.021
A. sessilis	-0.062	-0.025	-0.037	0.482	-0.096	0.333	-0.059	-0.028	-0.02	0.567	0.526	-0.021
I. triloba	0.103	0.067	-0.037	-0.033	-0.104	-0.046	-0.059	0.022	1	0.259	-0.042	-0.021
P. purpurea	-0.064	-0.012	-0.08	0.155	-0.074	-0.099	-0.115	-0.043	0.3	0.033	-0.011	0.754
Z. pendula	0.129	-0.043	-0.065	-0.059	0.392	-0.081	-0.084	0.109	-0.035	0.129	-0.075	-0.038
O. corniculata	0.001	-0.01	-0.052	-0.047	0.171	-0.064	-0.022	0.022	-0.028	0.039	-0.059	-0.03

n=50.

Table 4 Interspecfic Pearson correlation coefficients (Continue).

	P. triquetrum	*C. asiatica*	*C. exaltatus*	*C. compressus*	*K. brevifolia*	*L. cernuum*	*A. philoxeroides*	*A. sessilis*	*I. triloba*	*P. purpurea*	*Z. pendula*	*O. corniculata*
E. hirta	-0.023	-0.051	-0.023	-0.023	-0.032	-0.023	-0.023	-0.023	-0.023	0.743	-0.041	-0.032
S. sebiferum	-0.02	-0.044	-0.02	-0.02	-0.028	-0.02	-0.02	0.999	-0.02	-0.043	-0.035	-0.028
A. scarabaeoides	-0.07	-0.117	-0.07	-0.07	-0.097	-0.07	-0.024	-0.07	-0.052	0.515	-0.123	-0.095
D. gangeticum	-0.02	-0.044	-0.02	-0.02	-0.028	0.999	-0.02	-0.02	-0.02	-0.043	-0.035	-0.028
D. triflorum	-0.049	-0.042	-0.049	-0.049	-0.067	-0.049	0.464	0.503	-0.049	-0.104	-0.085	-0.068
S. cannabina	-0.021	-0.047	-0.021	-0.021	-0.029	-0.021	-0.021	-0.021	-0.021	-0.045	-0.037	-0.029
P. vittata	-0.02	-0.044	-0.02	-0.02	-0.028	-0.02	-0.02	-0.02	-0.02	-0.043	-0.035	-0.028
L. japonicum	-0.021	-0.048	-0.021	-0.021	-0.03	0.056	-0.021	-0.021	-0.021	-0.046	-0.038	-0.03
A. compressus	0.085	-0.183	-0.086	0.152	-0.113	0.056	-0.064	0.137	-0.086	-0.132	-0.121	-0.089
C. aciculatus	-0.03	0.033	-0.03	-0.013	-0.041	-0.03	-0.03	-0.03	-0.03	0.26	-0.052	0.005
C. citratus	-0.02	-0.044	-0.02	-0.02	-0.028	-0.02	-0.02	-0.02	-0.02	-0.043	-0.035	-0.028
C. dactylon	-0.03	-0.067	-0.03	-0.03	-0.042	-0.03	-0.03	-0.03	-0.03	0.207	-0.054	-0.042
E. crusgalli	-0.029	-0.064	0.699	-0.029	-0.04	-0.029	-0.029	-0.029	-0.029	-0.062	0.331	-0.04
E. minor	-0.023	-0.133	-0.06	-0.06	-0.07	0.767	-0.06	-0.06	-0.06	-0.126	-0.106	-0.084
E. pilosa	-0.034	0.286	0.123	-0.034	-0.048	-0.034	-0.034	-0.034	0.757	0.21	0.466	0.049
I. aristatum	-0.054	0.004	0.27	-0.054	0.121	-0.054	0.257	-0.054	-0.015	-0.089	0.232	0.15
L. gracile	-0.026	-0.058	-0.026	-0.026	-0.036	-0.026	-0.026	-0.026	-0.026	-0.056	-0.046	-0.037
P. repens	-0.107	0.364	0.224	0.104	0.342	-0.107	0.122	0.012	0.005	-0.079	0.287	0.065
P. scrobiculatum	0.247	0.019	-0.061	-0.061	-0.085	-0.01	-0.061	-0.061	0.144	-0.05	-0.027	0.09
R. repens	-0.058	-0.108	-0.058	-0.058	-0.08	-0.058	-0.058	-0.058	-0.058	0.427	-0.101	-0.08
C. roseus	-0.02	-0.044	-0.02	-0.02	-0.028	-0.02	-0.02	-0.02	-0.02	-0.043	-0.035	-0.028
S. rhombifolia	-0.024	0.04	-0.024	-0.024	-0.034	-0.024	-0.024	-0.024	0.223	0.03	-0.043	-0.034
U. sp.	-0.02	-0.044	-0.02	-0.02	-0.028	-0.02	-0.02	-0.02	-0.02	-0.043	-0.035	-0.028

U. lobata	-0.028	0.265	-0.028	-0.028	-0.039	-0.028	-0.028	0.011	-0.028	0.702	-0.05	-0.018
A. conyzoides	-0.062	-0.026	0.139	-0.062	-0.085	-0.062	-0.062	-0.062	0.103	-0.064	0.129	0.001
A. subulatus	-0.025	0.855	-0.025	-0.025	-0.034	-0.025	-0.025	-0.025	0.067	-0.012	-0.043	-0.01
B. bipinnata	-0.037	-0.082	-0.037	-0.037	-0.052	-0.037	-0.037	-0.037	-0.037	-0.08	-0.065	-0.052
B. pilosa	-0.033	-0.074	-0.033	-0.033	-0.046	-0.033	-0.033	0.482	-0.033	0.155	-0.059	-0.047
E. sonchifolia	0.089	0.055	0.064	-0.104	0.001	-0.062	-0.02	-0.096	-0.104	-0.074	0.392	0.171
E. acer	-0.046	-0.056	-0.046	-0.021	-0.064	-0.046	-0.046	0.333	-0.046	-0.099	-0.081	-0.064
E. chinense	-0.034	0.215	-0.059	-0.001	-0.083	-0.047	-0.059	-0.059	-0.059	-0.115	-0.084	-0.022
M. micrantha	-0.028	-0.036	0.022	-0.028	-0.039	-0.028	-0.028	-0.028	0.022	-0.043	0.109	0.022
P. indica	-0.02	0.344	-0.02	-0.02	-0.028	-0.02	-0.02	-0.02	1	0.3	-0.035	-0.028
V. cinerea	-0.049	0.126	-0.049	-0.049	-0.068	-0.049	-0.049	0.567	0.259	0.033	0.129	0.039
W. triloba	-0.042	-0.094	-0.042	0.328	0.251	-0.042	-0.042	0.526	-0.042	-0.011	-0.075	-0.059
J. linifolia	-0.021	0.012	-0.021	-0.021	-0.03	-0.021	-0.021	-0.021	-0.021	0.754	-0.038	-0.03
P. triquetrum	1	-0.044	-0.02	-0.02	-0.028	-0.02	-0.02	-0.02	-0.02	-0.043	-0.035	-0.028
C. asiatica	-0.044	1	-0.044	-0.044	-0.062	-0.044	0.084	-0.044	0.344	0.079	-0.01	0.166
C. exaltatus	-0.02	-0.044	1	-0.02	-0.028	-0.02	-0.02	-0.02	-0.02	-0.043	0.499	-0.028
C. compressus	-0.02	-0.044	-0.02	1	-0.028	-0.02	-0.02	-0.02	-0.02	-0.043	-0.035	-0.028
K. brevifolia	-0.028	-0.062	-0.028	-0.028	1	-0.028	-0.028	-0.028	-0.028	0.005	-0.049	-0.039
L. cernuum	-0.02	-0.044	-0.02	-0.02	-0.028	1	-0.02	-0.02	-0.02	-0.043	-0.035	-0.028
A. philoxeroides	-0.02	0.084	-0.02	-0.02	-0.028	-0.02	1	-0.02	-0.02	-0.043	-0.035	-0.028
A. sessilis	-0.02	-0.044	-0.02	-0.02	-0.028	-0.02	-0.02	1	-0.02	-0.043	-0.035	-0.028
I. triloba	-0.02	0.344	-0.02	-0.02	-0.028	-0.02	-0.02	-0.02	1	0.3	-0.035	-0.028
P. purpurea	-0.043	0.079	-0.043	-0.043	0.005	-0.043	-0.043	-0.043	0.3	1	-0.076	0.004
Z. pendula	-0.035	-0.01	0.499	-0.035	-0.049	-0.035	-0.035	-0.035	-0.035	-0.076	1	0.531
O. corniculata	-0.028	0.166	-0.028	-0.028	-0.039	-0.028	-0.028	-0.028	-0.028	0.004	0.531	1

n=50.

It can be found from Table 4 that at the 99 % confidence level, all significant grass species pairs are positive associated. They are

E. hirta-: *A. scarabaeoides* (0.723), *R. repens* (0.581), *U. lobata* (0.918), *J. linifolia* (0.983);

S. sebiferum-: *D. triflorum* (0.503), *B. pilosa* (0.482), *V. cinerea* (0.567), *W. triloba* (0.526), *A. sessilis* (0.999);

A. scarabaeoides-: *R. repens* (0.665), *U. lobata* (0.652), *J. linifolia* (0.721), *P. purpurea* (0.515);

D. gangeticum-: *E. minor* (0.767), *L. cernuum* (0.999);

D. triflorum-: *A. philoxeroides* (0.464), *A. sessilis* (0.503);

S. cannabina-E. acer (0.458)

P. vittata-E. acer (0.714)

L. japonicum-I. aristatum (0.59)

E. crusgalli-: *M.micrantha* (0.717), *C. exaltatus* (0.699);

E. minor-L. cernuum (0.767)

E. pilosa-: *P. indica* (0.757), *V. cinerea* (0.395), *I. triloba* (0.757), *Z. pendula* (0.466);

L. gracile-: *U. sp.* (0.927), *B. bipinnata* (0.906);

P. repens-C. asiatica (0.364)
R. repens-: *U. lobata* (0.535), *J. linifolia* (0.592), *P. purpurea* (0.427);
C. roseus-: *E. sonchifolia* (0.401), *V. cinerea* (0.567);
S. rhombifolia-A. conyzoides (0.657);
U. sp.-B. bipinnata (0.813);
U. lobata-: *J. linifolia* (0.955), *P. purpurea* (0.702);
A. subulatus-C. asiatica (0.855);
B. pilosa-A. sessilis (0.482);
E. sonchifolia-Z. pendula (0.392)
V. cinerea-A. sessilis (0.567);
W. triloba-A. sessilis (0.526);
J. linifolia-P. *purpurea* (0.754);
C. exaltatus-Z. pendula (0.499);
Z. pendula-O. corniculata (0.531)

3.2 Associations measured by net correlation coefficient

Inter-family net correlation coefficients are indicated in Table 5.

Table 5 Inter-family net correlation coefficients.

	Euphorbiaceae	Leguminosae	Pteridaceae	Lygodiaceae	Gramineae	Apocynaceae	Malvaceae	Asteraceae	Onagraceae
Euphorbiaceae	1	-0.195	0.491	0.071	-0.213	-0.051	-0.098	0.19	0.822
Leguminosae	-0.195	1	0.164	0.002	-0.347	-0.216	-0.259	0.395	0.541
Pteridaceae	0.491	0.164	1	-0.08	0.186	0.023	0.067	-0.151	-0.426
Lygodiaceae	0.071	0.002	-0.08	1	0.217	-0.002	0.028	-0.046	-0.055
Gramineae	-0.213	-0.347	0.186	0.217	1	-0.149	-0.089	-0.081	0.311
Apocynaceae	-0.051	-0.216	0.023	-0.002	-0.149	1	-0.125	0.137	0.142
Malvaceae	-0.098	-0.259	0.067	0.028	-0.089	-0.125	1	0.553	0.373
Asteraceae	0.19	0.395	-0.151	-0.046	-0.081	0.137	0.553	1	-0.364
Onagraceae	0.822	0.541	-0.426	-0.055	0.311	0.142	0.373	-0.364	1
Connaraceae	-0.009	-0.131	-0.01	-0.015	-0.151	-0.059	-0.01	-0.066	0.063
Umbelliferae	-0.259	-0.194	0.091	-0.07	0.111	-0.059	0.067	0.148	0.207
Cyperaceae	0.086	-0.003	-0.097	-0.12	0.298	-0.002	0.016	-0.015	-0.085
Lycopodiaceae	0.044	0.022	-0.055	0.022	0.039	-0.011	0.037	-0.104	-0.041
Amaranthaceae	0.972	0.168	-0.482	-0.08	0.227	0.037	0.07	-0.142	-0.786
Convolvulaceae	0.12	-0.001	-0.101	-0.063	0.016	-0.031	0.014	-0.121	0.171
Commelinaceae	0.001	-0.069	-0.023	-0.058	0.16	-0.026	-0.073	0.14	0.057
Oxalidaceae	0.063	-0.017	-0.037	-0.005	-0.072	-0.013	0.01	-0.094	-0.06

n=50.

Table 5 Inter-family net correlation coefficients (Continue).

	Connaraceae	Umbelliferae	Cyperaceae	Lycopodiaceae	Amaranthaceae	Convolvulaceae	Commelinaceae	Oxalidaceae
Euphorbiaceae	-0.009	-0.259	0.086	0.044	0.972	0.12	0.001	0.063
Leguminosae	-0.131	-0.194	-0.003	0.022	0.168	-0.001	-0.069	-0.017

Pteridaceae	-0.01	0.091	-0.097	-0.055	-0.482	-0.101	-0.023	-0.037
Lygodiaceae	-0.015	-0.07	-0.12	0.022	-0.08	-0.063	-0.058	-0.005
Gramineae	-0.151	0.111	0.298	0.039	0.227	0.016	0.16	-0.072
Apocynaceae	-0.059	-0.059	-0.002	-0.011	0.037	-0.031	-0.026	-0.013
Malvaceae	-0.01	0.067	0.016	0.037	0.07	0.014	-0.073	0.01
Asteraceae	-0.066	0.148	-0.015	-0.104	-0.142	-0.121	0.14	-0.094
Onagraceae	0.063	0.207	-0.085	-0.041	-0.786	0.171	0.057	-0.06
Connaraceae	1	-0.031	-0.01	-0.033	0.004	-0.057	0	-0.031
Umbelliferae	-0.031	1	-0.085	-0.026	0.239	0.151	-0.128	0.193
Cyperaceae	-0.01	-0.085	1	-0.056	-0.099	0.008	0.28	-0.22
Lycopodiaceae	-0.033	-0.026	-0.056	1	-0.047	-0.058	-0.016	-0.019
Amaranthaceae	0.004	0.239	-0.099	-0.047	1	-0.126	-0.016	-0.061
Convolvulaceae	-0.057	0.151	0.008	-0.058	-0.126	1	-0.094	0.039
Commelinaceae	0	-0.128	0.28	-0.016	-0.016	-0.094	1	0.576
Oxalidaceae	-0.031	0.193	-0.22	-0.019	-0.061	0.039	0.576	1

n=50.

Table 5 showed that there are significant direct negative associations (competition, interference, or they require the distinct environmental conditions) for family pairs Pteridaceae-Amaranthaceae (-0.48), and Onagraceae-Amaranthaceae (-0.79). Family pairs with significant direct positive associations include: Euphorbiaceae-Pteridaceae (0.491), Euphorbiaceae-Onagraceae (0.822), Leguminosae-Onagraceae (0.541), Malvaceae-Asteraceae (0.553), and Commelinaceae-Oxalidaceae (0.576).

Interspecific net correlation coefficients are shown in Table 6.

Table 6 Interspecific net correlation coefficients.

	E. hirta	*S. sebiferum*	*A. scarabaeoides*	*D. gangeticum*	*D. triflorum*	*S. cannabina*	*P. vittata*	*L. japonicum*	*A. compressus*	*C. aciculatus*	*C. citratus*	*C. dactylon*
E. hirta	1	0	0.072	0	-0.022	0.857	0.999	0.566	-0.141	0.529	0.855	-0.673
S. sebiferum	0	1	0	-0.011	0	0	0	0	0	0	0	0
A. scarabaeoides	0.072	0	1	0	-0.166	-0.513	-0.082	0.247	-0.351	0.335	0.241	0.685
D. gangeticum	0	-0.011	0	1	0	0	0	0	0	0	0	0
D. triflorum	-0.022	0	-0.166	0	1	0.016	0.022	-0.188	0.083	0.188	0.05	0.017
S. cannabina	0.857	0	-0.513	0	0.016	1	-0.863	-0.308	-0.049	-0.221	-0.558	0.953
P. vittata	0.999	0	-0.082	0	0.022	-0.863	1	-0.561	0.139	-0.522	-0.85	0.681
L. japonicum	0.566	0	0.247	0	-0.188	-0.308	-0.561	1	0.005	-0.41	-0.671	0.174
A. compressus	-0.141	0	-0.351	0	0.083	-0.049	0.139	0.005	1	-0.034	0.094	0.165
C. aciculatus	0.529	0	0.335	0	0.188	-0.221	-0.522	-0.41	-0.034	1	-0.735	0.017
C. citratus	0.855	0	0.241	0	0.05	-0.558	-0.85	-0.671	0.094	-0.735	1	0.345
C. dactylon	-0.673	0	0.685	0	0.017	0.953	0.681	0.174	0.165	0.017	0.345	1
E. crusgalli	-0.651	0	-0.588	0	-0.029	0.202	0.642	0.671	-0.23	0.744	0.872	0.044
E. minor	0.099	0	-0.555	0	0.303	-0.336	-0.104	0.11	-0.536	-0.171	-0.031	0.396
E. pilosa	-0.653	0	0.702	0	-0.011	0.947	0.66	0.125	0.18	0.031	0.322	-0.996

I. aristatum	-0.526	0	-0.398	0	0.261	0.21	0.52	0.883	-0.235	0.301	0.626	-0.065
L. gracile	-0.78	0	0.465	0	-0.094	0.955	0.785	0.271	0.131	0.209	0.519	-0.943
P. repens	-0.61	0	-0.632	0	-0.012	0.146	0.601	0.658	-0.266	0.716	0.842	0.1
P. scrobiculatum	0.078	0	-0.082	0	0.672	-0.183	-0.081	0.296	-0.234	-0.269	-0.058	0.17
R. repens	-0.06	0	0.8	0	0.274	0.396	0.068	-0.253	-0.017	-0.417	-0.253	-0.528
C. roseus	-0.691	0	0.56	0	0.075	0.911	0.697	0.361	0.165	0.027	0.408	-0.945
S. rhombifolia	-0.654	0	0.672	0	0.004	0.938	0.661	0.184	0.197	0.016	0.334	-0.988
U. sp.	0.651	0	-0.669	0	0.015	-0.937	-0.659	-0.166	-0.201	-0.026	-0.333	0.986
U. lobata	0.805	0	-0.57	0	0.015	-0.993	-0.811	-0.265	-0.101	-0.183	-0.505	0.977
A. conyzoides	0.695	0	-0.627	0	0.024	-0.951	-0.702	-0.221	-0.206	-0.086	-0.396	0.984
A. subulatus	-0.916	0	0.412	0	-0.019	0.99	0.92	0.389	0.014	0.32	0.659	-0.911
B. bipinnata	-0.268	0	0.899	0	0.153	0.696	0.278	-0.07	0.248	-0.352	-0.099	-0.853
B. pilosa	-0.657	0	-0.559	0	-0.002	0.212	0.648	0.67	-0.232	0.751	0.87	0.031
E. sonchifolia	0.625	0	0.268	0	-0.228	-0.344	-0.62	-0.882	0.036	-0.442	-0.743	0.204
E. acer	0.631	0	0.602	0	0.027	-0.174	-0.622	-0.668	0.221	-0.765	-0.864	-0.073
E. chinense	0.458	0	0.637	0	0.113	-0.012	-0.449	-0.438	0.247	-0.794	-0.727	-0.235
M. micrantha	0.623	0	0.612	0	0.032	-0.164	-0.614	-0.658	0.238	-0.744	-0.856	-0.084
P. indica	0	0	0	0	0	0	0	0	0	0	0	0
V. cinerea	0	0	-0.038	0	0.031	0	0	-0.806	0.223	-0.76	0	0.882
W. triloba	-0.75	0	0.618	0	-0.003	0.979	0.757	0.213	0.119	0.087	0.425	-0.988
J. linifolia	0.936	0	0.234	0	0.023	-0.624	-0.933	-0.643	0.258	-0.638	-0.91	0.374
P. triquetrum	-0.438	0	-0.434	0	-0.081	0.17	0.433	0.526	-0.176	0.33	0.535	-0.036
C. asiatica	-0.635	0	-0.501	0	-0.024	0.225	0.627	0.636	-0.2	0.833	0.837	0.006
C. exaltatus	-0.43	0	0.824	0	-0.004	0.833	0.44	-0.072	0.234	-0.178	0.057	-0.948
C. compressus	0.942	0	-0.286	0	0.021	-0.942	-0.944	-0.486	-0.011	-0.42	-0.763	0.839
K. brevifolia	0.632	0	0.607	0	0.023	-0.172	-0.623	-0.677	0.223	-0.741	-0.86	-0.078
L. cernuum	0	0.011	0	0.999	0	0	0	0	0	0	0	0
A. philoxeroides	0.633	0	0.6	0	0.131	-0.188	-0.624	-0.687	0.188	-0.78	-0.864	-0.056
A. sessilis	0	0.999	0	0.011	0	0	0	0	0	0	0	0
I. triloba	0	0	0	0	0	0	0	0	0	0	0	0
P. purpurea	0.634	0	-0.716	0	0.008	-0.939	-0.642	-0.109	-0.188	0.002	-0.297	0.995
Z. pendula	0.642	0	-0.71	0	0.011	-0.943	-0.65	-0.113	-0.183	-0.02	-0.308	0.995
O. corniculata	-0.642	0	0.709	0	-0.011	0.943	0.65	0.114	0.183	0.02	0.309	-0.995

n=50.

Table 6 Interspecific net correlation coefficients (Continue).

	E. crusgalli	*E. minor*	*E. pilosa*	*I. aristatum*	*L. gracile*	*P. repens*	*P. scrobiculatum*	*R. repens*	*C. roseus*	*S. rhombifolia*	*U. sp.*	*U. lobata*
E. hirta	-0.651	0.099	-0.653	-0.526	-0.78	-0.61	0.078	-0.06	-0.691	-0.654	0.651	0.805
S. sebiferum	0	0	0	0	0	0	0	0	0	0	0	0
A. scarabaeoides	-0.588	-0.555	0.702	-0.398	0.465	-0.632	-0.082	0.8	0.56	0.672	-0.669	-0.57
D. gangeticum	0	0	0	0	0	0	0	0	0	0	0	0
D. triflorum	-0.029	0.303	-0.011	0.261	-0.094	-0.012	0.672	0.274	0.075	0.004	0.015	0.015
S. cannabina	0.202	-0.336	0.947	0.21	0.955	0.146	-0.183	0.396	0.911	0.938	-0.937	-0.993

P. vittata	0.642	-0.104	0.66	0.52	0.785	0.601	-0.081	0.068	0.697	0.661	-0.659	-0.811
L. japonicum	0.671	0.11	0.125	0.883	0.271	0.658	0.296	-0.253	0.361	0.184	-0.166	-0.265
A. compressus	-0.23	-0.536	0.18	-0.235	0.131	-0.266	-0.234	-0.017	0.165	0.197	-0.201	-0.101
C. aciculatus	0.744	-0.171	0.031	0.301	0.209	0.716	-0.269	-0.417	0.027	0.016	-0.026	-0.183
C. citratus	0.872	-0.031	0.322	0.626	0.519	0.842	-0.058	-0.253	0.408	0.334	-0.333	-0.505
C. dactylon	0.044	0.396	-0.996	-0.065	-0.943	0.1	0.17	-0.528	-0.945	-0.988	0.986	0.977
E. crusgalli	1	-0.275	0.074	-0.722	-0.161	-0.993	-0.104	0.469	-0.05	0.06	-0.063	0.135
E. minor	-0.275	1	0.431	-0.428	0.373	-0.341	-0.579	0.189	0.325	0.431	-0.446	-0.367
E. pilosa	0.074	0.431	1	-0.004	-0.94	0.132	0.22	-0.534	-0.926	-0.985	0.985	0.974
I. aristatum	-0.722	-0.428	-0.004	1	-0.155	-0.734	-0.502	0.243	-0.268	-0.06	0.037	0.159
L. gracile	-0.161	0.373	-0.94	-0.155	1	-0.102	0.277	-0.307	-0.919	-0.95	0.96	0.965
P. repens	-0.993	-0.341	0.132	-0.734	-0.102	1	-0.151	0.482	0	0.118	-0.123	0.077
P. scrobiculatum	-0.104	-0.579	0.22	-0.502	0.277	-0.151	1	-0.179	0.058	0.196	-0.224	-0.196
R. repens	0.469	0.189	-0.534	0.243	-0.307	0.482	-0.179	1	-0.406	-0.493	0.486	0.435
C. roseus	-0.05	0.325	-0.926	-0.268	-0.919	0	0.058	-0.406	1	-0.958	0.949	0.927
S. rhombifolia	0.06	0.431	-0.985	-0.06	-0.95	0.118	0.196	-0.493	-0.958	1	0.994	0.963
U. sp.	-0.063	-0.446	0.985	0.037	0.96	-0.123	-0.224	0.486	0.949	0.994	1	-0.962
U. lobata	0.135	-0.367	0.974	0.159	0.965	0.077	-0.196	0.435	0.927	0.963	-0.962	1
A. conyzoides	0.003	-0.449	0.981	0.086	0.968	-0.057	-0.231	0.436	0.959	0.994	-0.994	-0.972
A. subulatus	-0.333	0.285	-0.901	-0.303	-0.942	-0.279	0.161	-0.316	-0.883	-0.894	0.892	0.975
B. bipinnata	0.471	0.426	-0.853	0.173	-0.671	0.515	0.036	-0.734	-0.798	-0.858	0.848	0.746
B. pilosa	-0.989	-0.282	0.061	-0.727	-0.162	-0.99	-0.136	0.431	-0.06	0.05	-0.055	0.147
E. sonchifolia	0.736	0.128	0.147	0.891	0.308	0.727	0.349	-0.269	0.419	0.215	-0.194	-0.3
E. acer	0.993	0.269	-0.101	0.716	0.134	0.993	0.106	-0.488	0.026	-0.087	0.09	-0.107
E. chinense	0.875	0.167	-0.241	0.451	-0.013	0.877	-0.058	-0.524	-0.193	-0.244	0.238	0.052
M. micrantha	0.999	0.288	-0.113	0.713	0.123	0.994	0.107	-0.487	0.01	-0.1	0.103	-0.095
P. indica	0	0	0	0	0	0	0	0	0	0	0	0
V. cinerea	0.948	-0.101	0.852	0.76	0	0.895	-0.093	0.035	0.914	0.854	-0.851	0
W. triloba	-0.049	0.351	-0.985	-0.117	-0.953	0.005	0.174	-0.489	-0.931	-0.972	0.971	0.991
J. linifolia	0.84	0.075	0.347	0.65	0.532	0.817	0.004	-0.171	0.428	0.355	-0.352	-0.547
P. triquetrum	-0.624	-0.323	0	-0.625	-0.165	-0.635	-0.092	0.307	-0.16	-0.03	0.021	0.13
C. asiatica	-0.923	-0.177	0.026	-0.655	-0.183	-0.917	-0.06	0.427	-0.08	0.018	-0.021	0.169
C. exaltatus	0.35	0.482	-0.96	0.2	-0.837	0.403	0.238	-0.633	-0.854	-0.942	0.943	0.877
C. compressus	0.48	-0.226	0.824	0.409	0.903	0.429	-0.13	0.206	0.834	0.822	-0.82	-0.923
K. brevifolia	0.992	0.284	-0.109	0.73	0.127	0.994	0.117	-0.487	0.021	-0.093	0.097	-0.102
L. cernuum	0	0	0	0	0	0	0	0	0	0	0	0
A. philoxeroides	0.977	0.208	-0.082	0.715	0.159	0.974	0.035	-0.518	0.049	-0.064	0.066	-0.123
A. sessilis	0	0	0	0	0	0	0	0	0	0	0	0
I. triloba	0	0	0	0	0	0	0	0	0	0	0	0
P. purpurea	-0.102	-0.436	0.999	-0.012	0.933	-0.16	-0.219	0.545	0.924	0.985	-0.985	-0.968
Z. pendula	-0.089	-0.435	0.999	-0.007	0.936	-0.147	-0.222	0.541	0.923	0.984	-0.985	-0.971
O. corniculata	0.088	0.434	-0.999	0.006	-0.936	0.146	0.222	-0.54	-0.923	-0.985	0.985	0.971

n=50.

Table 6 Interspecific net correlation coefficients (Continue).

	A. conyzoides	*A. subulatus*	*B. bipinnata*	*B. pilosa*	*E. sonchifolia*	*E. acer*	*E. chinense*	*M. micrantha*	*P. indica*	*V. cinerea*	*W. triloba*	*J. linifolia*
E. hirta	0.695	-0.916	-0.268	-0.657	0.625	0.631	0.458	0.623	0	0	-0.75	0.936
S. sebiferum	0	0	0	0	0	0	0	0	0	0	0	0
A. scarabaeoides	-0.627	0.412	0.899	-0.559	0.268	0.602	0.637	0.612	0	-0.038	0.618	0.234
D. gangeticum	0	0	0	0	0	0	0	0	0	0	0	0
D. triflorum	0.024	-0.019	0.153	-0.002	-0.228	0.027	0.113	0.032	0	0.031	-0.003	0.023
S. cannabina	-0.951	0.99	0.696	0.212	-0.344	-0.174	-0.012	-0.164	0	0	0.979	-0.624
P. vittata	-0.702	0.92	0.278	0.648	-0.62	-0.622	-0.449	-0.614	0	0	0.757	-0.933
L. japonicum	-0.221	0.389	-0.07	0.67	-0.882	-0.668	-0.438	-0.658	0	-0.806	0.213	-0.643
A. compressus	-0.206	0.014	0.248	-0.232	0.036	0.221	0.247	0.238	0	0.223	0.119	0.258
C. aciculatus	-0.086	0.32	-0.352	0.751	-0.442	-0.765	-0.794	-0.744	0	-0.76	0.087	-0.638
C. citratus	-0.396	0.659	-0.099	0.87	-0.743	-0.864	-0.727	-0.856	0	0	0.425	-0.91
C. dactylon	0.984	-0.911	-0.853	0.031	0.204	-0.073	-0.235	-0.084	0	0.882	-0.988	0.374
E. crusgalli	0.003	-0.333	0.471	-0.989	0.736	0.993	0.875	0.999	0	0.948	-0.049	0.84
E. minor	-0.449	0.285	0.426	-0.282	0.128	0.269	0.167	0.288	0	-0.101	0.351	0.075
E. pilosa	0.981	-0.901	-0.853	0.061	0.147	-0.101	-0.241	-0.113	0	0.852	-0.985	0.347
I. aristatum	0.086	-0.303	0.173	-0.727	0.891	0.716	0.451	0.713	0	0.76	-0.117	0.65
L. gracile	0.968	-0.942	-0.671	-0.162	0.308	0.134	-0.013	0.123	0	0	-0.953	0.532
P. repens	-0.057	-0.279	0.515	-0.99	0.727	0.993	0.877	0.994	0	0.895	0.005	0.817
P. scrobiculatum	-0.231	0.161	0.036	-0.136	0.349	0.106	-0.058	0.107	0	-0.093	0.174	0.004
R. repens	0.436	-0.316	-0.734	0.431	-0.269	-0.488	-0.524	-0.487	0	0.035	-0.489	-0.171
C. roseus	0.959	-0.883	-0.798	-0.06	0.419	0.026	-0.193	0.01	0	0.914	-0.931	0.428
S. rhombifolia	0.994	-0.894	-0.858	0.05	0.215	-0.087	-0.244	-0.1	0	0.854	-0.972	0.355
U. sp.	-0.994	0.892	0.848	-0.055	-0.194	0.09	0.238	0.103	0	-0.851	0.971	-0.352
U. lobata	-0.972	0.975	0.746	0.147	-0.3	-0.107	0.052	-0.095	0	0	0.991	-0.547
A. conyzoides	1	0.915	0.818	0.01	-0.255	0.022	0.177	0.036	0	-0.914	0.974	-0.408
A. subulatus	0.915	1	-0.604	-0.343	0.435	0.307	0.135	0.296	0	0	-0.949	0.719
B. bipinnata	0.818	-0.604	1	0.45	-0.063	-0.494	-0.62	-0.506	0	0.309	-0.794	-0.06
B. pilosa	0.01	-0.343	0.45	1	0.741	0.995	0.867	0.988	0	0.955	-0.062	0.841
E. sonchifolia	-0.255	0.435	-0.063	0.741	1	-0.738	-0.48	-0.721	0	-0.888	0.239	-0.706
E. acer	0.022	0.307	-0.494	0.995	-0.738	1	-0.884	-0.993	0	-0.92	0.019	-0.827
E. chinense	0.177	0.135	-0.62	0.867	-0.48	-0.884	1	-0.884	0	-0.685	-0.143	-0.678
M. micrantha	0.036	0.296	-0.506	0.988	-0.721	-0.993	-0.884	1	0	-0.91	0.01	-0.823
P. indica	0	0	0	0	0	0	0	0	1	0	0	0
V. cinerea	-0.914	0	0.309	0.955	-0.888	-0.92	-0.685	-0.91	0	1	0.995	0
W. triloba	0.974	-0.949	-0.794	-0.062	0.239	0.019	-0.143	0.01	0	0.995	1	0.475
J. linifolia	-0.408	0.719	-0.06	0.841	-0.706	-0.827	-0.678	-0.823	0	0	0.475	1
P. triquetrum	0.063	-0.251	0.238	-0.62	0.587	0.619	0.444	0.619	0	0.633	-0.092	0.543
C. asiatica	0.043	-0.349	0.407	-0.942	0.705	0.943	0.855	0.921	0	0.919	-0.077	0.797
C. exaltatus	0.92	-0.753	-0.933	0.335	-0.07	-0.374	-0.471	-0.387	0	0.534	-0.911	0.09
C. compressus	-0.853	0.974	0.482	0.487	-0.54	-0.454	-0.269	-0.446	0	0	0.889	-0.786
K. brevifolia	0.029	0.304	-0.497	0.988	-0.737	-0.993	-0.88	-0.993	0	-0.924	0.019	-0.833

L. cernuum	0	0	0	0	0	0	0	0	0	0	0	0
A. philoxeroides	-0.002	0.318	-0.482	0.974	-0.74	-0.983	-0.876	-0.977	0	-0.921	0.034	-0.821
A. sessilis	0	0	0	0	0	0	0	0	0	0	0	0
I. triloba	0	0	0	0	0	0	0	0	-0.999	0	0	0
P. purpurea	-0.979	0.89	0.866	-0.09	-0.129	0.13	0.268	0.141	0	-0.824	0.982	-0.324
Z. pendula	-0.979	0.895	0.859	-0.076	-0.134	0.117	0.254	0.128	0	-0.836	0.983	-0.334
O. corniculata	0.98	-0.895	-0.859	0.075	0.135	-0.116	-0.253	-0.128	0	0.837	-0.983	0.334

n=50.

Table 6 Interspecific net correlation coefficients (Continue).

	P. triquetrum	*C. asiatica*	*C. exaltatus*	*C. compressus*	*K. brevifolia*	*L. cernuum*	*A. philoxeroides*	*A. sessilis*	*I. triloba*	*P. purpurea*	*Z. pendula*	*O. corniculata*
E. hirta	-0.438	-0.635	-0.43	0.942	0.632	0	0.633	0	0	0.634	0.642	-0.642
S. sebiferum	0	0	0	0	0	0.011	0	0.999	0	0	0	0
A. scarabaeoides	-0.434	-0.501	0.824	-0.286	0.607	0	0.6	0	0	-0.716	-0.71	0.709
D. gangeticum	0	0	0	0	0	0.999	0	0.011	0	0	0	0
D. triflorum	-0.081	-0.024	-0.004	0.021	0.023	0	0.131	0	0	0.008	0.011	-0.011
S. cannabina	0.17	0.225	0.833	-0.942	-0.172	0	-0.188	0	0	-0.939	-0.943	0.943
P. vittata	0.433	0.627	0.44	-0.944	-0.623	0	-0.624	0	0	-0.642	-0.65	0.65
L. japonicum	0.526	0.636	-0.072	-0.486	-0.677	0	-0.687	0	0	-0.109	-0.113	0.114
A. compressus	-0.176	-0.2	0.234	-0.011	0.223	0	0.188	0	0	-0.188	-0.183	0.183
C. aciculatus	0.33	0.833	-0.178	-0.42	-0.741	0	-0.78	0	0	0.002	-0.02	0.02
C. citratus	0.535	0.837	0.057	-0.763	-0.86	0	-0.864	0	0	-0.297	-0.308	0.309
C. dactylon	-0.036	0.006	-0.948	0.839	-0.078	0	-0.056	0	0	0.995	0.995	-0.995
E. crusgalli	-0.624	-0.923	0.35	0.48	0.992	0	0.977	0	0	-0.102	-0.089	0.088
E. minor	-0.323	-0.177	0.482	-0.226	0.284	0	0.208	0	0	-0.436	-0.435	0.434
E. pilosa	0	0.026	-0.96	0.824	-0.109	0	-0.082	0	0	0.999	0.999	-0.999
I. aristatum	-0.625	-0.655	0.2	0.409	0.73	0	0.715	0	0	-0.012	-0.007	0.006
L. gracile	-0.165	-0.183	-0.837	0.903	0.127	0	0.159	0	0	0.933	0.936	-0.936
P. repens	-0.635	-0.917	0.403	0.429	0.994	0	0.974	0	0	-0.16	-0.147	0.146
P. scrobiculatum	-0.092	-0.06	0.238	-0.13	0.117	0	0.035	0	0	-0.219	-0.222	0.222
R. repens	0.307	0.427	-0.633	0.206	-0.487	0	-0.518	0	0	0.545	0.541	-0.54
C. roseus	-0.16	-0.08	-0.854	0.834	0.021	0	0.049	0	0	0.924	0.923	-0.923
S. rhombifolia	-0.03	0.018	-0.942	0.822	-0.093	0	-0.064	0	0	0.985	0.984	-0.985
U. sp.	0.021	-0.021	0.943	-0.82	0.097	0	0.066	0	0	-0.985	-0.985	0.985
U. lobata	0.13	0.169	0.877	-0.923	-0.102	0	-0.123	0	0	-0.968	-0.971	0.971
A. conyzoides	0.063	0.043	0.92	-0.853	0.029	0	-0.002	0	0	-0.979	-0.979	0.98
A. subulatus	-0.251	-0.349	-0.753	0.974	0.304	0	0.318	0	0	0.89	0.895	-0.895
B. bipinnata	0.238	0.407	-0.933	0.482	-0.497	0	-0.482	0	0	0.866	0.859	-0.859
B. pilosa	-0.62	-0.942	0.335	0.487	0.988	0	0.974	0	0	-0.09	-0.076	0.075
E. sonchifolia	0.587	0.705	-0.07	-0.54	-0.737	0	-0.74	0	0	-0.129	-0.134	0.135
E. acer	0.619	0.943	-0.374	-0.454	-0.993	0	-0.983	0	0	0.13	0.117	-0.116
E. chinense	0.444	0.855	-0.471	-0.269	-0.88	0	-0.876	0	0	0.268	0.254	-0.253
M. micrantha	0.619	0.921	-0.387	-0.446	-0.993	0	-0.977	0	0	0.141	0.128	-0.128

P. indica	0	0	0	0	0	0	0	0	-0.999	0	0	0
V. cinerea	0.633	0.919	0.534	0	-0.924	0	-0.921	0	0	-0.824	-0.836	0.837
W. triloba	-0.092	-0.077	-0.911	0.889	0.019	0	0.034	0	0	0.982	0.983	-0.983
J. linifolia	0.543	0.797	0.09	-0.786	-0.833	0	-0.821	0	0	-0.324	-0.334	0.334
P. triquetrum	1	-0.559	0.175	0.343	0.623	0	0.627	0	0	-0.015	-0.009	0.008
C. asiatica	-0.559	1	0.284	0.475	0.922	0	0.944	0	0	-0.058	-0.041	0.04
C. exaltatus	0.175	0.284	1	0.639	-0.38	0	-0.352	0	0	0.966	0.964	-0.964
C. compressus	0.343	0.475	0.639	1	-0.453	0	-0.463	0	0	-0.809	-0.816	0.816
K. brevifolia	0.623	0.922	-0.38	-0.453	1	0	-0.978	0	0	0.136	0.124	-0.123
L. cernuum	0	0	0	0	0	1	0	-0.011	0	0	0	0
A. philoxeroides	0.627	0.944	-0.352	-0.463	-0.978	0	1	0	0	0.111	0.098	-0.097
A. sessilis	0	0	0	0	0	-0.011	0	1	0	0	0	0
I. triloba	0	0	0	0	0	0	0	0	1	0	0	0
P. purpurea	-0.015	-0.058	0.966	-0.809	0.136	0	0.111	0	0	1	-0.999	0.999
Z. pendula	-0.009	-0.041	0.964	-0.816	0.124	0	0.098	0	0	-0.999	1	0.999
O. corniculata	0.008	0.04	-0.964	0.816	-0.123	0	-0.097	0	0	0.999	0.999	1

n=50.

The significant species pairs, with 99% significant level, are listed as bellow

E. hirta-P. vittata, *E. hirta-J. linifolia*, *E. hirta-C. compressus*;

S. sebiferum-A. sessilis;

D. gangeticum-L. cernuum;

S. cannabina-C. dactylon, *S. cannabina-E. pilosa*, *S. cannabina-L. gracile*, *S. cannabina-S. rhombifolia*, *S. cannabina-U. sp.*, *S. cannabina-U. lobata*, *S. cannabina-A. conyzoides*, *S. cannabina-A. subulatus*, *S. cannabina-W. triloba*, *S. cannabina-C. compressus*, *S. cannabina-P. purpurea*, *S. cannabina-Z. pendula*, *S. cannabina-O. corniculata*;

P. vittata-J. linifolia, *P. vittata-C. compressus*;

C. dactylon-E. pilosa, *C. dactylon-L. gracile*, *C. dactylon-C. roseus*, *C. dactylon-S. rhombifolia*, *C. dactylon-U. sp.*, *C. dactylon-U. lobata*, *C. dactylon-A. conyzoides*, *C. dactylon-W. triloba*, *C. dactylon-C. exaltatus*, *C. dactylon-P. purpurea*, *C. dactylon-Z. pendula*, *C. dactylon-O. corniculata*;

E. crusgalli-P. repens, *E. crusgalli-B. pilosa*, *E. crusgalli-E. acer*, *E. crusgalli-M. micrantha*, *E. crusgalli-V. cinerea*, *E. crusgalli-K. brevifolia*, *E. crusgalli-A. philoxeroides*;

E. pilosa-L. gracile, *E. pilosa-S. rhombifolia*, *E. pilosa-U. sp.*, *E. pilosa-U. lobata*, *E. pilosa-A. conyzoides*, *E. pilosa-W. triloba*, *E. pilosa-C. exaltatus*, *E. pilosa-P. purpurea*, *E. pilosa-Z. pendula*, *E. pilosa-O. corniculata*;

L. gracile-S. rhombifolia, *L. gracile-U. sp.*, *L. gracile-U. lobata*, *L. gracile-A. conyzoides*, *L. gracile-A. subulatus*, *L. gracile-W. triloba*, *L. gracile-P. purpurea*, *L. gracile-Z. pendula*, *L. gracile-O. corniculata*;

P. repens-B. pilosa, *P. repens-E. acer*, *P. repens-M. micrantha*, *P. repens-K. brevifolia*, *P. repens-A. philoxeroides*;

C. roseus-S. rhombifolia, *C. roseus-U. sp.*, *C. roseus-A. conyzoides*;

S. rhombifolia-U. sp., *S. rhombifolia-U. lobata*, *S. rhombifolia-A. conyzoides*, *S. rhombifolia-W. triloba*, *S. rhombifolia-C. exaltatus*, *S. rhombifolia-P. purpurea*, *S. rhombifolia-Z. pendula*, *S. rhombifolia-O. corniculata*;

U. sp.-U. lobata, U. sp.-A. conyzoides, U. sp.-W. triloba, U. sp.-C. exaltatus, U. sp.-P. purpurea, U. sp.-Z. pendula, U. sp.-O. corniculata;

U. lobata-A. conyzoides, U. lobata-A. subulatus, U. lobata-W. triloba, U. lobata-P. purpurea, U. lobata-Z. pendula, U. lobata-O. corniculata;

A. conyzoides-W. triloba, A. conyzoides-P. purpurea, A. conyzoides-Z. pendula, A. conyzoides-O. corniculata;

A. subulatus-W. triloba, A. subulatus-C. compressus;

B. bipinnata-C. exaltatus;

B. pilosa-E. acer, B. pilosa-M. micrantha, B. pilosa-V. cinerea, B. pilosa-C. asiatica, B. pilosa-K. brevifolia, B. pilosa-A. philoxeroides;

E. acer-M. micrantha, E. acer-C. asiatica, E. acer-K. brevifolia, E. acer-A. philoxeroides;

M. micrantha-K. brevifolia, M. micrantha-A. philoxeroides;

P. indica-I. triloba;

V. cinerea-W. triloba;

W. triloba-P. purpurea, W. triloba-Z. pendula, W. triloba-O. corniculata;

C. asiatica-A. philoxeroides;

C. exaltatus-P. purpurea, C. exaltatus-Z. pendula, C. exaltatus-O. corniculata;

K. brevifolia-A. philoxeroides;

P. purpurea-Z. pendula, P. purpurea-O. corniculata;

Z. pendula-O. corniculata.

3.3 Associations measured by Spearman rank correlation coefficient

Inter-family Spearman rank correlation coefficients are listed in Table 9.

Table 9 Inter-family Spearman rank correlation coefficients.

	Euphorbiaceae	Leguminosae	Pteridaceae	Lygodiaceae	Gramineae	Apocynaceae	Malvaceae	Asteraceae	Onagraceae
Euphorbiaceae	1	0.56	0.939	0.85	0.451	0.882	0.827	0.467	0.911
Leguminosae	0.56	1	0.54	0.466	-0.329	0.472	0.475	0.343	0.505
Pteridaceae	0.939	0.54	1	0.91	0.491	0.939	0.78	0.46	0.91
Lygodiaceae	0.85	0.466	0.91	1	0.503	0.91	0.743	0.391	0.879
Gramineae	0.451	-0.329	0.491	0.503	1	0.445	0.26	-0.159	0.487
Apocynaceae	0.882	0.472	0.939	0.91	0.445	1	0.78	0.501	0.91
Malvaceae	0.827	0.475	0.78	0.743	0.26	0.78	1	0.567	0.87
Asteraceae	0.467	0.343	0.46	0.391	-0.159	0.501	0.567	1	0.495
Onagraceae	0.911	0.505	0.91	0.879	0.487	0.91	0.87	0.495	1
Connaraceae	0.882	0.472	0.939	0.91	0.45	0.939	0.78	0.453	0.91
Umbelliferae	0.708	0.317	0.78	0.743	0.468	0.78	0.766	0.378	0.809
Cyperaceae	0.79	0.287	0.855	0.822	0.517	0.855	0.673	0.401	0.822
Lycopodiaceae	0.882	0.53	0.939	0.969	0.486	0.939	0.78	0.439	0.91
Amaranthaceae	0.914	0.524	0.91	0.879	0.484	0.91	0.797	0.451	0.879
Convolvulaceae	0.775	0.424	0.78	0.743	0.376	0.78	0.76	0.317	0.812
Commelinaceae	0.819	0.347	0.882	0.85	0.519	0.882	0.708	0.465	0.85
Oxalidaceae	0.79	0.357	0.855	0.822	0.469	0.855	0.731	0.395	0.822

n=50.

Table 9 Inter-family Spearman rank correlation coefficients (Continue).

	Connaraceae	Umbelliferae	Cyperaceae	Lycopodiaceae	Amaranthaceae	Convolvulaceae	Commelinaceae	Oxalidaceae
Euphorbiaceae	0.882	0.708	0.79	0.882	0.914	0.775	0.819	0.79
Leguminosae	0.472	0.317	0.287	0.53	0.524	0.424	0.347	0.357
Pteridaceae	0.939	0.78	0.855	0.939	0.91	0.78	0.882	0.855
Lygodiaceae	0.91	0.743	0.822	0.969	0.879	0.743	0.85	0.822
Gramineae	0.45	0.468	0.517	0.486	0.484	0.376	0.519	0.469
Apocynaceae	0.939	0.78	0.855	0.939	0.91	0.78	0.882	0.855
Malvaceae	0.78	0.766	0.673	0.78	0.797	0.76	0.708	0.731
Asteraceae	0.453	0.378	0.401	0.439	0.451	0.317	0.465	0.395
Onagraceae	0.91	0.809	0.822	0.91	0.879	0.812	0.85	0.822
Connaraceae	1	0.78	0.855	0.939	0.91	0.78	0.882	0.855
Umbelliferae	0.78	1	0.673	0.78	0.797	0.701	0.762	0.797
Cyperaceae	0.855	0.673	1	0.855	0.822	0.73	0.851	0.759
Lycopodiaceae	0.939	0.78	0.855	1	0.91	0.78	0.882	0.855
Amaranthaceae	0.91	0.797	0.822	0.91	1	0.743	0.85	0.822
Convolvulaceae	0.78	0.701	0.73	0.78	0.743	1	0.708	0.79
Commelinaceae	0.882	0.762	0.851	0.882	0.85	0.708	1	0.913
Oxalidaceae	0.855	0.797	0.759	0.855	0.822	0.79	0.913	1

n=50.

Table 9 indicates that at the 99 % confidence level, Most of family pairs show positive associations. All family pairs are associated positively and significantly, *other than the following family pairs*

Leguminosae-: Gramineae, Asteraceae, Umbelliferae, Cyperaceae, Commelinaceae, Oxalidaceae;
Gramineae-: Malvaceae, Asteraceae;
Asteraceae-Convolvulaceae.

Interspecific Spearman rank correlation coefficients are shown in Table 10.

Table 10 Interspecfic Spearman rank correlation coefficients.

	E. hirta	*S. sebiferum*	*A. scarabaeoides*	*D. gangeticum*	*D. triflorum*	*S. cannabina*	*P. vittata*	*L. japonicum*	*A. compressus*	*C. aciculatus*	*C. citratus*	*C. dactylon*
E. hirta	1	0.91	0.612	0.91	0.768	0.879	0.969	0.879	0.559	0.822	0.91	0.768
S. sebiferum	0.91	1	0.521	0.939	0.87	0.91	0.939	0.91	0.563	0.855	0.939	0.804
A. scarabaeoides	0.612	0.521	1	0.521	0.351	0.501	0.581	0.465	-0.123	0.435	0.556	0.698
D. gangeticum	0.91	0.939	0.521	1	0.804	0.91	0.939	0.969	0.549	0.855	0.939	0.804
D. triflorum	0.768	0.87	0.351	0.804	1	0.768	0.804	0.768	0.457	0.701	0.804	0.638
S. cannabina	0.879	0.91	0.501	0.91	0.768	1	0.91	0.879	0.513	0.822	0.91	0.768
P. vittata	0.969	0.939	0.581	0.939	0.804	0.91	1	0.91	0.573	0.855	0.939	0.804
L. japonicum	0.879	0.91	0.465	0.969	0.768	0.879	0.91	1	0.487	0.822	0.91	0.768
A. compressus	0.559	0.563	-0.123	0.549	0.457	0.513	0.573	0.487	1	0.485	0.556	0.268

C. aciculatus	0.822	0.855	0.435	0.855	0.701	0.822	0.855	0.822	0.485	1	0.913	0.701
C. citratus	0.91	0.939	0.556	0.939	0.804	0.91	0.939	0.91	0.556	0.913	1	0.804
C. dactylon	0.768	0.804	0.698	0.804	0.638	0.768	0.804	0.768	0.268	0.701	0.804	1
E. crusgalli	0.879	0.91	0.465	0.91	0.768	0.879	0.91	0.879	0.492	0.822	0.91	0.768
E. minor	0.595	0.64	-0.001	0.716	0.667	0.595	0.64	0.669	0.208	0.508	0.64	0.426
E. pilosa	0.822	0.855	0.452	0.855	0.701	0.822	0.855	0.822	0.345	0.759	0.855	0.701
I. aristatum	0.653	0.694	0.153	0.694	0.566	0.653	0.694	0.725	0.239	0.573	0.694	0.498
L. gracile	0.879	0.91	0.585	0.91	0.768	0.879	0.91	0.879	0.426	0.822	0.91	0.768
P. repens	0.456	0.509	0.011	0.446	0.293	0.505	0.478	0.402	0.141	0.473	0.515	0.223
P. scrobiculatum	0.672	0.657	0.275	0.704	0.583	0.613	0.717	0.659	0.46	0.529	0.657	0.52
R. repens	0.638	0.608	0.618	0.608	0.496	0.561	0.608	0.561	-0.184	0.469	0.608	0.659
C. roseus	0.91	0.939	0.521	0.939	0.804	0.91	0.939	0.91	0.542	0.855	0.939	0.804
S. rhombifolia	0.879	0.91	0.581	0.91	0.768	0.879	0.91	0.879	0.426	0.822	0.91	0.824
U. sp.	0.91	0.939	0.576	0.939	0.804	0.91	0.939	0.91	0.486	0.855	0.939	0.804
U. lobata	0.886	0.911	0.493	0.855	0.763	0.822	0.855	0.822	0.431	0.759	0.855	0.701
A. conyzoides	0.613	0.657	0.413	0.657	0.449	0.613	0.657	0.613	0.125	0.529	0.657	0.706
A. subulatus	0.822	0.855	0.483	0.855	0.701	0.879	0.855	0.822	0.308	0.759	0.855	0.701
B. bipinnata	0.768	0.804	0.677	0.804	0.638	0.768	0.804	0.768	0.237	0.701	0.804	0.864
B. pilosa	0.856	0.891	0.572	0.829	0.737	0.794	0.829	0.794	0.492	0.729	0.829	0.669
E. sonchifolia	0.418	0.509	-0.075	0.516	0.354	0.418	0.48	0.501	0.21	0.411	0.48	0.465
E. acer	0.809	0.842	0.468	0.78	0.676	0.809	0.847	0.743	0.495	0.723	0.78	0.608
E. chinense	0.532	0.532	0.227	0.575	0.311	0.544	0.588	0.568	0.201	0.422	0.532	0.378
M. micrantha	0.768	0.804	0.298	0.804	0.638	0.768	0.804	0.768	0.406	0.701	0.804	0.638
P. indica	0.91	0.939	0.569	0.939	0.804	0.91	0.939	0.91	0.486	0.855	0.939	0.804
V. cinerea	0.768	0.869	0.419	0.804	0.709	0.768	0.804	0.768	0.407	0.701	0.804	0.694
W. triloba	0.794	0.891	0.337	0.829	0.737	0.853	0.829	0.794	0.562	0.838	0.884	0.669
J. linifolia	0.942	0.91	0.553	0.91	0.768	0.879	0.91	0.879	0.475	0.822	0.91	0.768
P. triquetrum	0.91	0.939	0.521	0.939	0.804	0.91	0.939	0.91	0.552	0.855	0.939	0.804
C. asiatica	0.743	0.78	0.409	0.78	0.665	0.743	0.78	0.743	0.211	0.732	0.78	0.608
C. exaltatus	0.91	0.939	0.521	0.939	0.804	0.91	0.939	0.91	0.486	0.855	0.939	0.804
C. compressus	0.91	0.939	0.521	0.939	0.804	0.91	0.939	0.91	0.568	0.911	0.939	0.804
K. brevifolia	0.879	0.91	0.465	0.91	0.768	0.879	0.91	0.879	0.455	0.822	0.91	0.768
L. cernuum	0.91	0.939	0.521	1	0.804	0.91	0.939	0.969	0.549	0.855	0.939	0.804
A. philoxeroides	0.91	0.939	0.574	0.939	0.866	0.91	0.939	0.91	0.522	0.855	0.939	0.804
A. sessilis	0.91	1	0.521	0.939	0.87	0.91	0.939	0.91	0.563	0.855	0.939	0.804
I. triloba	0.91	0.939	0.569	0.939	0.804	0.91	0.939	0.91	0.486	0.855	0.939	0.804
P. purpurea	0.812	0.78	0.501	0.78	0.608	0.795	0.78	0.743	0.305	0.739	0.78	0.674
Z. pendula	0.85	0.882	0.411	0.882	0.734	0.85	0.882	0.85	0.445	0.79	0.882	0.734
O. corniculata	0.822	0.855	0.444	0.855	0.701	0.822	0.855	0.822	0.417	0.816	0.855	0.701

n=50.

Table 10 Interspecfic Spearman rank correlation coefficients (Continue).

	E. crusgalli	*E. minor*	*E. pilosa*	*I. aristatum*	*L. gracile*	*P. repens*	*P. scrobiculatum*	*R. repens*	*C. roseus*	*S. rhombifolia*	*U. sp.*	*U. lobata*
E. hirta	0.879	0.595	0.822	0.653	0.879	0.456	0.672	0.638	0.91	0.879	0.91	0.886
S. sebiferum	0.91	0.64	0.855	0.694	0.91	0.509	0.657	0.608	0.939	0.91	0.939	0.911
A. scarabaeoides	0.465	-0.001	0.452	0.153	0.585	0.011	0.275	0.618	0.521	0.581	0.576	0.493
D. gangeticum	0.91	0.716	0.855	0.694	0.91	0.446	0.704	0.608	0.939	0.91	0.939	0.855
D. triflorum	0.768	0.667	0.701	0.566	0.768	0.293	0.583	0.496	0.804	0.768	0.804	0.763
S. cannabina	0.879	0.595	0.822	0.653	0.879	0.505	0.613	0.561	0.91	0.879	0.91	0.822
P. vittata	0.91	0.64	0.855	0.694	0.91	0.478	0.717	0.608	0.939	0.91	0.939	0.855
L. japonicum	0.879	0.669	0.822	0.725	0.879	0.402	0.659	0.561	0.91	0.879	0.91	0.822
A. compressus	0.492	0.208	0.345	0.239	0.426	0.141	0.46	-0.184	0.542	0.426	0.486	0.431
C. aciculatus	0.822	0.508	0.759	0.573	0.822	0.473	0.529	0.469	0.855	0.822	0.855	0.759
C. citratus	0.91	0.64	0.855	0.694	0.91	0.515	0.657	0.608	0.939	0.91	0.939	0.855
C. dactylon	0.768	0.426	0.701	0.498	0.768	0.223	0.52	0.659	0.804	0.824	0.804	0.701
E. crusgalli	1	0.595	0.879	0.768	0.879	0.534	0.613	0.561	0.91	0.879	0.91	0.822
E. minor	0.595	1	0.508	0.239	0.595	-0.237	0.408	0.466	0.64	0.595	0.64	0.508
E. pilosa	0.879	0.508	1	0.8	0.822	0.534	0.647	0.469	0.855	0.884	0.855	0.815
I. aristatum	0.768	0.239	0.8	1	0.653	0.519	0.43	0.183	0.694	0.702	0.694	0.63
L. gracile	0.879	0.595	0.822	0.653	1	0.413	0.613	0.623	0.91	0.879	0.971	0.822
P. repens	0.534	-0.237	0.534	0.519	0.413	1	0.173	-0.166	0.5	0.472	0.446	0.506
P. scrobiculatum	0.613	0.408	0.647	0.43	0.613	0.173	1	0.277	0.711	0.674	0.657	0.582
R. repens	0.561	0.466	0.469	0.183	0.623	-0.166	0.277	1	0.608	0.603	0.669	0.549
C. roseus	0.91	0.64	0.855	0.694	0.91	0.5	0.711	0.608	1	0.91	0.939	0.855
S. rhombifolia	0.879	0.595	0.884	0.702	0.879	0.472	0.674	0.603	0.91	1	0.91	0.822
U. sp.	0.91	0.64	0.855	0.694	0.971	0.446	0.657	0.669	0.939	0.91	1	0.855
U. lobata	0.822	0.508	0.815	0.63	0.822	0.506	0.582	0.549	0.855	0.822	0.855	1
A. conyzoides	0.736	0.17	0.755	0.579	0.684	0.345	0.449	0.283	0.724	0.746	0.657	0.578
A. subulatus	0.822	0.508	0.88	0.681	0.822	0.538	0.645	0.469	0.855	0.88	0.855	0.883
B. bipinnata	0.768	0.426	0.701	0.498	0.898	0.242	0.449	0.591	0.804	0.823	0.87	0.701
B. pilosa	0.794	0.519	0.729	0.535	0.794	0.454	0.489	0.573	0.829	0.794	0.829	0.852
E. sonchifolia	0.555	0.004	0.493	0.57	0.418	0.297	0.467	0	0.57	0.466	0.48	0.441
E. acer	0.743	0.387	0.673	0.462	0.743	0.529	0.525	0.394	0.78	0.743	0.78	0.732
E. chinense	0.477	0.266	0.429	0.258	0.477	0.152	0.545	0.319	0.532	0.477	0.532	0.512
M. micrantha	0.891	0.426	0.88	0.83	0.768	0.585	0.562	0.382	0.804	0.824	0.804	0.701
P. indica	0.91	0.64	0.918	0.745	0.91	0.505	0.72	0.608	0.939	0.969	0.939	0.855
V. cinerea	0.768	0.426	0.876	0.653	0.768	0.46	0.689	0.434	0.869	0.825	0.804	0.818
W. triloba	0.794	0.515	0.729	0.535	0.794	0.508	0.489	0.425	0.829	0.794	0.829	0.788
J. linifolia	0.879	0.595	0.822	0.653	0.879	0.515	0.613	0.638	0.91	0.879	0.91	0.946
P. triquetrum	0.91	0.687	0.855	0.694	0.91	0.446	0.724	0.608	0.939	0.91	0.939	0.855
C. asiatica	0.743	0.387	0.802	0.692	0.743	0.545	0.638	0.398	0.78	0.806	0.78	0.804
C. exaltatus	0.97	0.64	0.912	0.761	0.91	0.533	0.657	0.608	0.939	0.91	0.939	0.855
C. compressus	0.91	0.64	0.855	0.694	0.91	0.524	0.657	0.608	0.939	0.91	0.939	0.855
K. brevifolia	0.879	0.638	0.822	0.716	0.879	0.548	0.613	0.561	0.91	0.879	0.91	0.822

L. cernuum	0.91	0.716	0.855	0.694	0.91	0.446	0.704	0.608	0.939	0.91	0.939	0.855
A. philoxeroides	0.91	0.64	0.855	0.759	0.91	0.526	0.657	0.608	0.939	0.91	0.939	0.855
A. sessilis	0.91	0.64	0.855	0.694	0.91	0.509	0.657	0.608	0.939	0.91	0.939	0.911
I. triloba	0.91	0.64	0.918	0.745	0.91	0.505	0.72	0.608	0.939	0.969	0.939	0.855
P. purpurea	0.743	0.429	0.792	0.568	0.743	0.383	0.525	0.491	0.78	0.804	0.78	0.799
Z. pendula	0.909	0.551	0.91	0.792	0.85	0.555	0.627	0.514	0.882	0.85	0.882	0.79
O. corniculata	0.822	0.508	0.878	0.747	0.822	0.512	0.645	0.469	0.855	0.822	0.855	0.819

n=50.

Table 10 Interspecfic Spearman rank correlation coefficients (Continue).

	A. conyzoides	*A. subulatus*	*B. bipinnata*	*B. pilosa*	*E. sonchifolia*	*E. acer*	*E. chinense*	*M. micrantha*	*P. indica*	*V. cinerea*	*W. triloba*	*J. linifolia*
E. hirta	0.613	0.822	0.768	0.856	0.418	0.809	0.532	0.768	0.91	0.768	0.794	0.942
S. sebiferum	0.657	0.855	0.804	0.891	0.509	0.842	0.532	0.804	0.939	0.869	0.891	0.91
A. scarabaeoides	0.413	0.483	0.677	0.572	-0.075	0.468	0.227	0.298	0.569	0.419	0.337	0.553
D. gangeticum	0.657	0.855	0.804	0.829	0.516	0.78	0.575	0.804	0.939	0.804	0.829	0.91
D. triflorum	0.449	0.701	0.638	0.737	0.354	0.676	0.311	0.638	0.804	0.709	0.737	0.768
S. cannabina	0.613	0.879	0.768	0.794	0.418	0.809	0.544	0.768	0.91	0.768	0.853	0.879
P. vittata	0.657	0.855	0.804	0.829	0.48	0.847	0.588	0.804	0.939	0.804	0.829	0.91
L. japonicum	0.613	0.822	0.768	0.794	0.501	0.743	0.568	0.768	0.91	0.768	0.794	0.879
A. compressus	0.125	0.308	0.237	0.492	0.21	0.495	0.201	0.406	0.486	0.407	0.562	0.475
C. aciculatus	0.529	0.759	0.701	0.729	0.411	0.723	0.422	0.701	0.855	0.701	0.838	0.822
C. citratus	0.657	0.855	0.804	0.829	0.48	0.78	0.532	0.804	0.939	0.804	0.884	0.91
C. dactylon	0.706	0.701	0.864	0.669	0.465	0.608	0.378	0.638	0.804	0.694	0.669	0.768
E. crusgalli	0.736	0.822	0.768	0.794	0.555	0.743	0.477	0.891	0.91	0.768	0.794	0.879
E. minor	0.17	0.508	0.426	0.519	0.004	0.387	0.266	0.426	0.64	0.426	0.515	0.595
E. pilosa	0.755	0.88	0.701	0.729	0.493	0.673	0.429	0.88	0.918	0.876	0.729	0.822
I. aristatum	0.579	0.681	0.498	0.535	0.57	0.462	0.258	0.83	0.745	0.653	0.535	0.653
L. gracile	0.684	0.822	0.898	0.794	0.418	0.743	0.477	0.768	0.91	0.768	0.794	0.879
P. repens	0.345	0.538	0.242	0.454	0.297	0.529	0.152	0.585	0.505	0.46	0.508	0.515
P. scrobiculatum	0.449	0.645	0.449	0.489	0.467	0.525	0.545	0.562	0.72	0.689	0.489	0.613
R. repens	0.283	0.469	0.591	0.573	0	0.394	0.319	0.382	0.608	0.434	0.425	0.638
C. roseus	0.724	0.855	0.804	0.829	0.57	0.78	0.532	0.804	0.939	0.869	0.829	0.91
S. rhombifolia	0.746	0.88	0.823	0.794	0.466	0.743	0.477	0.824	0.969	0.825	0.794	0.879
U. sp.	0.657	0.855	0.87	0.829	0.48	0.78	0.532	0.804	0.939	0.804	0.829	0.91
U. lobata	0.578	0.883	0.701	0.852	0.441	0.732	0.512	0.701	0.855	0.818	0.788	0.946
A. conyzoides	1	0.637	0.775	0.488	0.404	0.411	0.103	0.732	0.715	0.679	0.488	0.613
A. subulatus	0.637	1	0.701	0.729	0.417	0.734	0.578	0.757	0.915	0.816	0.729	0.884
B. bipinnata	0.775	0.701	1	0.669	0.303	0.608	0.27	0.638	0.804	0.638	0.669	0.768
B. pilosa	0.488	0.729	0.669	1	0.27	0.824	0.45	0.669	0.829	0.736	0.763	0.856
E. sonchifolia	0.404	0.417	0.303	0.27	1	0.207	0.26	0.552	0.48	0.516	0.27	0.485
E. acer	0.411	0.734	0.608	0.824	0.207	1	0.54	0.608	0.78	0.675	0.756	0.743
E. chinense	0.103	0.578	0.27	0.45	0.26	0.54	1	0.383	0.532	0.393	0.372	0.556
M. micrantha	0.732	0.757	0.638	0.669	0.552	0.608	0.383	1	0.86	0.753	0.669	0.768

P. indica	0.715	0.915	0.804	0.829	0.48	0.78	0.532	0.86	1	0.861	0.829	0.91
V. cinerea	0.679	0.816	0.638	0.736	0.516	0.675	0.393	0.753	0.861	1	0.736	0.768
W. triloba	0.488	0.729	0.669	0.763	0.27	0.756	0.372	0.669	0.829	0.736	1	0.794
J. linifolia	0.613	0.884	0.768	0.856	0.485	0.743	0.556	0.768	0.91	0.768	0.794	1
P. triquetrum	0.657	0.855	0.804	0.829	0.549	0.78	0.58	0.804	0.939	0.804	0.829	0.91
C. asiatica	0.57	0.872	0.608	0.64	0.483	0.633	0.505	0.72	0.843	0.73	0.64	0.809
C. exaltatus	0.719	0.855	0.804	0.829	0.54	0.78	0.532	0.86	0.939	0.804	0.829	0.91
C. compressus	0.657	0.855	0.804	0.829	0.48	0.833	0.586	0.804	0.939	0.804	0.886	0.91
K. brevifolia	0.613	0.822	0.768	0.794	0.48	0.743	0.477	0.768	0.91	0.768	0.858	0.879
L. cernuum	0.657	0.855	0.804	0.829	0.516	0.78	0.575	0.804	0.939	0.804	0.829	0.91
A. philoxeroides	0.657	0.855	0.804	0.829	0.527	0.78	0.532	0.804	0.939	0.804	0.829	0.91
A. sessilis	0.657	0.855	0.804	0.891	0.509	0.842	0.532	0.804	0.939	0.869	0.891	0.91
I. triloba	0.715	0.915	0.804	0.829	0.48	0.78	0.532	0.86	1	0.861	0.829	0.91
P. purpurea	0.517	0.791	0.608	0.707	0.297	0.577	0.313	0.667	0.842	0.721	0.755	0.812
Z. pendula	0.736	0.79	0.734	0.761	0.585	0.708	0.474	0.911	0.882	0.794	0.761	0.85
O. corniculata	0.685	0.82	0.701	0.729	0.553	0.673	0.487	0.823	0.855	0.816	0.729	0.822

n=50.

Table 10 Interspecfic Spearman rank correlation coefficients (Continue).

	P. triquetrum	*C. asiatica*	*C. exaltatus*	*C. compressus*	*K. brevifolia*	*L. cernuum*	*A. philoxeroides*	*A. sessilis*	*I. triloba*	*P. purpurea*	*Z. pendula*	*O. corniculata*
E. hirta	0.91	0.743	0.91	0.91	0.879	0.91	0.91	0.91	0.91	0.812	0.85	0.822
S. sebiferum	0.939	0.78	0.939	0.939	0.91	0.939	0.939	1	0.939	0.78	0.882	0.855
A. scarabaeoides	0.521	0.409	0.521	0.521	0.465	0.521	0.574	0.521	0.569	0.501	0.411	0.444
D. gangeticum	0.939	0.78	0.939	0.939	0.91	1	0.939	0.939	0.939	0.78	0.882	0.855
D. triflorum	0.804	0.665	0.804	0.804	0.768	0.804	0.866	0.87	0.804	0.608	0.734	0.701
S. cannabina	0.91	0.743	0.91	0.91	0.879	0.91	0.91	0.91	0.91	0.795	0.85	0.822
P. vittata	0.939	0.78	0.939	0.939	0.91	0.939	0.939	0.939	0.939	0.78	0.882	0.855
L. japonicum	0.91	0.743	0.91	0.91	0.879	0.969	0.91	0.91	0.91	0.743	0.85	0.822
A. compressus	0.552	0.211	0.486	0.568	0.455	0.549	0.522	0.563	0.486	0.305	0.445	0.417
C. aciculatus	0.855	0.732	0.855	0.911	0.822	0.855	0.855	0.855	0.855	0.739	0.79	0.816
C. citratus	0.939	0.78	0.939	0.939	0.91	0.939	0.939	0.939	0.939	0.78	0.882	0.855
C. dactylon	0.804	0.608	0.804	0.804	0.768	0.804	0.804	0.804	0.804	0.674	0.734	0.701
E. crusgalli	0.91	0.743	0.97	0.91	0.879	0.91	0.91	0.91	0.91	0.743	0.909	0.822
E. minor	0.687	0.387	0.64	0.64	0.638	0.716	0.64	0.64	0.64	0.429	0.551	0.508
E. pilosa	0.855	0.802	0.912	0.855	0.822	0.855	0.855	0.855	0.918	0.792	0.91	0.878
I. aristatum	0.694	0.692	0.761	0.694	0.716	0.694	0.759	0.694	0.745	0.568	0.792	0.747
L. gracile	0.91	0.743	0.91	0.91	0.879	0.91	0.91	0.91	0.91	0.743	0.85	0.822
P. repens	0.446	0.545	0.533	0.524	0.548	0.446	0.526	0.509	0.505	0.383	0.555	0.512
P. scrobiculatum	0.724	0.638	0.657	0.657	0.613	0.704	0.657	0.657	0.72	0.525	0.627	0.645
R. repens	0.608	0.398	0.608	0.608	0.561	0.608	0.608	0.608	0.608	0.491	0.514	0.469
C. roseus	0.939	0.78	0.939	0.939	0.91	0.939	0.939	0.939	0.939	0.78	0.882	0.855
S. rhombifolia	0.91	0.806	0.91	0.91	0.879	0.91	0.91	0.91	0.969	0.804	0.85	0.822
U. sp.	0.939	0.78	0.939	0.939	0.91	0.939	0.939	0.939	0.939	0.78	0.882	0.855

U. lobata	0.855	0.804	0.855	0.855	0.822	0.855	0.855	0.911	0.855	0.799	0.79	0.819
A. conyzoides	0.657	0.57	0.719	0.657	0.613	0.657	0.657	0.657	0.715	0.517	0.736	0.685
A. subulatus	0.855	0.872	0.855	0.855	0.822	0.855	0.855	0.855	0.915	0.791	0.79	0.82
B. bipinnata	0.804	0.608	0.804	0.804	0.768	0.804	0.804	0.804	0.804	0.608	0.734	0.701
B. pilosa	0.829	0.64	0.829	0.829	0.794	0.829	0.829	0.891	0.829	0.707	0.761	0.729
E. sonchifolia	0.549	0.483	0.54	0.48	0.48	0.516	0.527	0.509	0.48	0.297	0.585	0.553
E. acer	0.78	0.633	0.78	0.833	0.743	0.78	0.78	0.842	0.78	0.577	0.708	0.673
E. chinense	0.58	0.505	0.532	0.586	0.477	0.575	0.532	0.532	0.532	0.313	0.474	0.487
M. micrantha	0.804	0.72	0.86	0.804	0.768	0.804	0.804	0.804	0.86	0.667	0.911	0.823
P. indica	0.939	0.843	0.939	0.939	0.91	0.939	0.939	0.939	1	0.842	0.882	0.855
V. cinerea	0.804	0.73	0.804	0.804	0.768	0.804	0.804	0.869	0.861	0.721	0.794	0.816
W. triloba	0.829	0.64	0.829	0.886	0.858	0.829	0.829	0.891	0.829	0.755	0.761	0.729
J. linifolia	0.91	0.809	0.91	0.91	0.879	0.91	0.91	0.91	0.91	0.812	0.85	0.822
P. triquetrum	1	0.78	0.939	0.939	0.91	0.939	0.939	0.939	0.939	0.78	0.882	0.855
C. asiatica	0.78	1	0.78	0.78	0.743	0.78	0.835	0.78	0.843	0.701	0.762	0.797
C. exaltatus	0.939	0.78	1	0.939	0.91	0.939	0.939	0.939	0.939	0.78	0.941	0.855
C. compressus	0.939	0.78	0.939	1	0.91	0.939	0.939	0.939	0.939	0.78	0.882	0.855
K. brevifolia	0.91	0.743	0.91	0.91	1	0.91	0.91	0.91	0.91	0.8	0.85	0.822
L. cernuum	0.939	0.78	0.939	0.939	0.91	1	0.939	0.939	0.939	0.78	0.882	0.855
A. philoxeroides	0.939	0.835	0.939	0.939	0.91	0.939	1	0.939	0.939	0.78	0.882	0.855
A. sessilis	0.939	0.78	0.939	0.939	0.91	0.939	0.939	1	0.939	0.78	0.882	0.855
I. triloba	0.939	0.843	0.939	0.939	0.91	0.939	0.939	0.939	1	0.842	0.882	0.855
P. purpurea	0.78	0.701	0.78	0.78	0.8	0.78	0.78	0.78	0.842	1	0.708	0.79
Z. pendula	0.882	0.762	0.941	0.882	0.85	0.882	0.882	0.882	0.882	0.708	1	0.913
O. corniculata	0.855	0.797	0.855	0.855	0.822	0.855	0.855	0.855	0.855	0.79	0.913	1

n=50.

Using the ID numbers of species in Table 2, the significant species pairs are listed as bellow

(1,2) (1,3) (1,4) (1,5) (1,6) (1,7) (1,8) (1,9) (1,10) (1,11) (1,12) (1,13) (1,14) (1,15) (1,16) (1,17) (1,18) (1,19) (1,20) (1,21) (1,22) (1,23) (1,24) (1,25) (1,26) (1,27) (1,28) (1,29) (1,30) (1,31) (1,32) (1,33) (1,34) (1,35) (1,36) (1,37) (1,38) (1,39) (1,40) (1,41) (1,42) (1,43) (1,44) (1,45) (1,46) (1,47) (1,48)
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3.4 Associations measured by point correlation coefficient

Inter-family point correlation coefficients are shown in Table 11.

Table 11 Inter-family point correlation coefficients.

	Euphorbiaceae	Leguminosae	Pteridaceae	Lygodiaceae	Gramineae	Apocynaceae	Malvaceae	Asteraceae	Onagraceae
Euphorbiaceae	1	0.214	0.565	-0.051	0	-0.036	0.383	0.074	0.378
Leguminosae	0.214	1	0.121	-0.033	0	-0.167	0.226	0.197	-0.033
Pteridaceae	0.565	0.121	1	-0.029	0	-0.02	-0.057	0.042	-0.029
Lygodiaceae	-0.051	-0.033	-0.029	1	0	-0.029	-0.082	0.06	-0.041
Gramineae	0	0	0	0	1	0	0	0	0
Apocynaceae	-0.036	-0.167	-0.02	-0.029	0	1	-0.057	0.042	-0.029
Malvaceae	0.383	0.226	-0.057	-0.082	0	-0.057	1	0.118	0.505
Asteraceae	0.074	0.197	0.042	0.06	0	0.042	0.118	1	0.06
Onagraceae	0.378	-0.033	-0.029	-0.041	0	-0.029	0.505	0.06	1
Connaraceae	-0.036	-0.167	-0.02	-0.029	0	-0.02	-0.057	0.042	-0.029
Umbelliferae	-0.101	-0.007	-0.057	-0.082	0	-0.057	0.335	0.118	0.211
Cyperaceae	-0.074	-0.346	-0.042	-0.06	0	-0.042	-0.118	0.086	-0.06
Lycopodiaceae	-0.036	0.121	-0.02	0.699	0	-0.02	-0.057	0.042	-0.029
Amaranthaceae	0.378	0.173	-0.029	-0.041	0	-0.029	0.211	0.06	-0.041
Convolvulaceae	0.14	0.226	-0.057	-0.082	0	-0.057	0.335	0.118	0.211
Commelinaceae	-0.063	-0.296	-0.036	-0.051	0	-0.036	-0.101	0.074	-0.051
Oxalidaceae	-0.074	-0.047	-0.042	-0.06	0	-0.042	0.093	0.086	-0.06

n=50.

Table 11 Inter-family point correlation coefficients (Continue).

	Connaraceae	Umbelliferae	Cyperaceae	Lycopodiaceae	Amaranthaceae	Convolvulaceae	Commelinaceae	Oxalidaceae
Euphorbiaceae	-0.036	-0.101	-0.074	-0.036	0.378	0.14	-0.063	-0.074
Leguminosae	-0.167	-0.007	-0.346	0.121	0.173	0.226	-0.296	-0.047
Pteridaceae	-0.02	-0.057	-0.042	-0.02	-0.029	-0.057	-0.036	-0.042
Lygodiaceae	-0.029	-0.082	-0.06	0.699	-0.041	-0.082	-0.051	-0.06
Gramineae	0	0	0	0	0	0	0	0
Apocynaceae	-0.02	-0.057	-0.042	-0.02	-0.029	-0.057	-0.036	-0.042
Malvaceae	-0.057	0.335	-0.118	-0.057	0.211	0.335	-0.101	0.093
Asteraceae	0.042	0.118	0.086	0.042	0.06	0.118	0.074	0.086
Onagraceae	-0.029	0.211	-0.06	-0.029	-0.041	0.211	-0.051	-0.06
Connaraceae	1	-0.057	-0.042	-0.02	-0.029	-0.057	-0.036	-0.042
Umbelliferae	-0.057	1	-0.118	-0.057	0.211	0.169	0.14	0.305
Cyperaceae	-0.042	-0.118	1	-0.042	-0.06	0.093	0.235	-0.086
Lycopodiaceae	-0.02	-0.057	-0.042	1	-0.029	-0.057	-0.036	-0.042
Amaranthaceae	-0.029	0.211	-0.06	-0.029	1	-0.082	-0.051	-0.06
Convolvulaceae	-0.057	0.169	0.093	-0.057	-0.082	1	-0.101	0.305
Commelinaceae	-0.036	0.14	0.235	-0.036	-0.051	-0.101	1	0.546
Oxalidaceae	-0.042	0.305	-0.086	-0.042	-0.06	0.305	0.546	1

n=50.

Table 11 indicates that at the 99 % confidence level, the associations of Gramineae to other families is not significant and all remaining family pairs are significantly associated and about half of them are positive

associations.

Interspecific point correlation coefficients are shown in Table 12.

Table 12 Interspecfic point correlation coefficients.

	E. hirta	*S. sebiferum*	*A. scarabaeoides*	*D. gangeticum*	*D. triflorum*	*S. cannabina*	*P. vittata*	*L. japonicum*	*A. compressus*	*C. aciculatus*	*C. citratus*	*C. dactylon*
E. hirta	1	-0.029	0.221	-0.029	-0.075	-0.041	0.699	-0.041	0.188	-0.06	-0.029	-0.075
S. sebiferum	-0.029	1	-0.131	-0.02	0.386	-0.029	-0.02	-0.029	0.131	-0.042	-0.02	-0.052
A. scarabaeoides	0.221	-0.131	1	-0.131	-0.093	0.016	0.154	-0.188	-0.194	0.023	0.154	0.4
D. gangeticum	-0.029	-0.02	-0.131	1	-0.052	-0.029	-0.02	0.699	0.131	-0.042	-0.02	-0.052
D. triflorum	-0.075	0.386	-0.093	-0.052	1	-0.075	-0.052	-0.075	0.093	-0.108	-0.052	-0.136
S. cannabina	-0.041	-0.029	0.016	-0.029	-0.075	1	-0.029	-0.041	-0.016	-0.06	-0.029	-0.075
P. vittata	0.699	-0.02	0.154	-0.02	-0.052	-0.029	1	-0.029	0.131	-0.042	-0.02	-0.052
L. japonicum	-0.041	-0.029	-0.188	0.699	-0.075	-0.041	-0.029	1	-0.016	-0.06	-0.029	-0.075
A. compressus	0.188	0.131	-0.194	0.131	0.093	-0.016	0.131	-0.016	1	0.124	0.131	-0.153
C. aciculatus	-0.06	-0.042	0.023	-0.042	-0.108	-0.06	-0.042	-0.06	0.124	1	0.484	-0.108
C. citratus	-0.029	-0.02	0.154	-0.02	-0.052	-0.029	-0.02	-0.029	0.131	0.484	1	-0.052
C. dactylon	-0.075	-0.052	0.4	-0.052	-0.136	-0.075	-0.052	-0.075	-0.153	-0.108	-0.052	1
E. crusgalli	-0.041	-0.029	-0.188	-0.029	-0.075	-0.041	-0.029	-0.041	-0.016	-0.06	-0.029	-0.075
E. minor	-0.127	-0.089	-0.396	0.229	0.318	-0.127	-0.089	0.1	-0.139	-0.183	-0.089	-0.23
E. pilosa	-0.06	-0.042	0.023	-0.042	-0.108	-0.06	-0.042	-0.06	-0.171	-0.086	-0.042	-0.108
I. aristatum	-0.108	-0.075	-0.199	-0.075	-0.047	-0.108	-0.075	0.137	0.102	-0.156	-0.075	-0.196
L. gracile	-0.041	-0.029	0.221	-0.029	-0.075	-0.041	-0.029	-0.041	-0.221	-0.06	-0.029	-0.075
P. repens	0.14	0.097	0.116	-0.208	-0.142	0.14	0.097	-0.078	0.141	0.202	0.097	-0.142
P. scrobiculatum	0.111	-0.084	0.001	0.241	0.061	-0.12	0.241	0.111	0.272	-0.174	-0.084	-0.078
R. repens	0.078	-0.097	0.399	-0.097	0.01	-0.14	-0.097	-0.14	-0.485	-0.202	-0.097	0.406
C. roseus	-0.029	-0.02	-0.131	-0.02	-0.052	-0.029	-0.02	-0.029	0.131	-0.042	-0.02	-0.052
S. rhombifolia	-0.041	-0.029	0.221	-0.029	-0.075	-0.041	-0.029	-0.041	-0.221	-0.06	-0.029	0.238
U. sp.	-0.029	-0.02	0.154	-0.02	-0.052	-0.029	-0.02	-0.029	-0.154	-0.042	-0.02	-0.052
U. lobata	0.316	0.484	0.023	-0.042	0.117	-0.06	-0.042	-0.06	-0.023	-0.086	-0.042	-0.108
A. conyzoides	-0.12	-0.084	0.093	-0.084	-0.218	-0.12	-0.084	-0.12	-0.093	-0.174	-0.084	0.342
A. subulatus	-0.06	-0.042	0.171	-0.042	-0.108	0.316	-0.042	-0.06	-0.319	-0.086	-0.042	-0.108
B. bipinnata	-0.075	-0.052	0.4	-0.052	-0.136	-0.075	-0.052	-0.075	-0.276	-0.108	-0.052	0.621
B. pilosa	0.272	0.428	0.227	-0.047	0.082	-0.068	-0.047	-0.068	0.173	-0.098	-0.047	-0.123
E. sonchifolia	-0.23	0.126	-0.313	0.126	0.203	-0.23	-0.161	0.18	0.313	-0.035	-0.161	0.079
E. acer	0.211	0.354	0.205	-0.057	0.028	0.211	0.354	-0.082	0.141	0.093	-0.057	-0.148
E. chinense	0.024	-0.126	-0.009	0.161	-0.203	0.024	0.161	0.23	0.009	-0.112	-0.126	-0.079
M. micrantha	-0.075	-0.052	-0.217	-0.052	-0.136	-0.075	-0.052	-0.075	0.093	-0.108	-0.052	-0.136
P. indica	-0.029	-0.02	0.154	-0.02	-0.052	-0.029	-0.02	-0.029	-0.154	-0.042	-0.02	-0.052
V. cinerea	-0.075	0.386	0.029	-0.052	0.053	-0.075	-0.052	-0.075	0.093	-0.108	-0.052	0.053
W. triloba	-0.068	0.428	-0.173	-0.047	0.082	0.272	-0.047	-0.068	0.173	0.393	0.428	-0.123
J. linifolia	0.479	-0.029	0.016	-0.029	-0.075	-0.041	-0.029	-0.041	-0.016	-0.06	-0.029	-0.075
P. triquetrum	-0.029	-0.02	-0.131	-0.02	-0.052	-0.029	-0.02	-0.029	0.131	-0.042	-0.02	-0.052

C. asiatica	-0.082	-0.057	0.09	-0.057	0.028	-0.082	-0.057	-0.082	-0.205	0.093	-0.057	-0.148
C. exaltatus	-0.029	-0.02	-0.131	-0.02	-0.052	-0.029	-0.02	-0.029	-0.154	-0.042	-0.02	-0.052
C. compressus	-0.029	-0.02	-0.131	-0.02	-0.052	-0.029	-0.02	-0.029	0.131	0.484	-0.02	-0.052
K. brevifolia	-0.041	-0.029	-0.188	-0.029	-0.075	-0.041	-0.029	-0.041	-0.016	-0.06	-0.029	-0.075
L. cernuum	-0.029	-0.02	-0.131	1	-0.052	-0.029	-0.02	0.699	0.131	-0.042	-0.02	-0.052
A. philoxeroides	-0.029	-0.02	0.154	-0.02	0.386	-0.029	-0.02	-0.029	0.131	-0.042	-0.02	-0.052
A. sessilis	-0.029	1	-0.131	-0.02	0.386	-0.029	-0.02	-0.029	0.131	-0.042	-0.02	-0.052
I. triloba	-0.029	-0.02	0.154	-0.02	-0.052	-0.029	-0.02	-0.029	-0.154	-0.042	-0.02	-0.052
P. purpurea	0.211	-0.057	0.205	-0.057	-0.148	0.211	-0.057	-0.082	-0.09	0.093	-0.057	0.028
Z. pendula	-0.051	-0.036	-0.233	-0.036	-0.093	-0.051	-0.036	-0.051	0.064	-0.074	-0.036	-0.093
O. corniculata	-0.06	-0.042	0.023	-0.042	-0.108	-0.06	-0.042	-0.06	0.124	0.184	-0.042	-0.108

n=50.

Table 12 Interspecfic point correlation coefficients (Continue).

	E. crusgalli	*E. minor*	*E. pilosa*	*I. aristatum*	*L. gracile*	*P. repens*	*P. scrobiculatum*	*R. repens*	*C. roseus*	*S. rhombifolia*	*U. sp.*	*U. lobata*
E. hirta	-0.041	-0.127	-0.06	-0.108	-0.041	0.14	0.111	0.078	-0.029	-0.041	-0.029	0.316
S. sebiferum	-0.029	-0.089	-0.042	-0.075	-0.029	0.097	-0.084	-0.097	-0.02	-0.029	-0.02	0.484
A. scarabaeoides	-0.188	-0.396	0.023	-0.199	0.221	0.116	0.001	0.399	-0.131	0.221	0.154	0.023
D. gangeticum	-0.029	0.229	-0.042	-0.075	-0.029	-0.208	0.241	-0.097	-0.02	-0.029	-0.02	-0.042
D. triflorum	-0.075	0.318	-0.108	-0.047	-0.075	-0.142	0.061	0.01	-0.052	-0.075	-0.052	0.117
S. cannabina	-0.041	-0.127	-0.06	-0.108	-0.041	0.14	-0.12	-0.14	-0.029	-0.041	-0.029	-0.06
P. vittata	-0.029	-0.089	-0.042	-0.075	-0.029	0.097	0.241	-0.097	-0.02	-0.029	-0.02	-0.042
L. japonicum	-0.041	0.1	-0.06	0.137	-0.041	-0.078	0.111	-0.14	-0.029	-0.041	-0.029	-0.06
A. compressus	-0.016	-0.139	-0.171	0.102	-0.221	0.141	0.272	-0.485	0.131	-0.221	-0.154	-0.023
C. aciculatus	-0.06	-0.183	-0.086	-0.156	-0.06	0.202	-0.174	-0.202	-0.042	-0.06	-0.042	-0.086
C. citratus	-0.029	-0.089	-0.042	-0.075	-0.029	0.097	-0.084	-0.097	-0.02	-0.029	-0.02	-0.042
C. dactylon	-0.075	-0.23	-0.108	-0.196	-0.075	-0.142	-0.078	0.406	-0.052	0.238	-0.052	-0.108
E. crusgalli	1	-0.127	0.316	0.384	-0.041	0.14	-0.12	-0.14	-0.029	-0.041	-0.029	-0.06
E. minor	-0.127	1	-0.183	-0.331	-0.127	-0.527	0.036	0.145	-0.089	-0.127	-0.089	-0.183
E. pilosa	0.316	-0.183	1	0.555	-0.06	0.202	0.161	-0.202	-0.042	0.316	-0.042	0.184
I. aristatum	0.384	-0.331	0.555	1	-0.108	0.26	0.015	-0.364	-0.075	0.137	-0.075	0.021
L. gracile	-0.041	-0.127	-0.06	-0.108	1	-0.078	-0.12	0.078	-0.029	-0.041	0.699	-0.06
P. repens	0.14	-0.527	0.202	0.26	-0.078	1	0.015	-0.264	0.097	0.14	-0.208	0.202
P. scrobiculatum	-0.12	0.036	0.161	0.015	-0.12	0.015	1	-0.113	0.241	0.111	-0.084	-0.006
R. repens	-0.14	0.145	-0.202	-0.364	0.078	-0.264	-0.113	1	-0.097	0.078	0.208	-0.044
C. roseus	-0.029	-0.089	-0.042	-0.075	-0.029	0.097	0.241	-0.097	1	-0.029	-0.02	-0.042
S. rhombifolia	-0.041	-0.127	0.316	0.137	-0.041	0.14	0.111	0.078	-0.029	1	-0.029	-0.06
U. sp.	-0.029	-0.089	-0.042	-0.075	0.699	-0.208	-0.084	0.208	-0.02	-0.029	1	-0.042
U. lobata	-0.06	-0.183	0.184	0.021	-0.06	0.202	-0.006	-0.044	-0.042	-0.06	-0.042	1
A. conyzoides	0.344	-0.369	0.497	0.345	0.111	0.211	0.168	-0.113	0.241	0.344	-0.084	-0.006
A. subulatus	-0.06	-0.183	0.456	0.199	-0.06	0.202	0.161	-0.202	-0.042	0.316	-0.042	0.456
B. bipinnata	-0.075	-0.23	-0.108	-0.196	0.552	-0.142	-0.218	0.274	-0.052	0.238	0.386	-0.108
B. pilosa	-0.068	-0.059	-0.098	-0.177	-0.068	0.228	-0.197	0.057	-0.047	-0.068	-0.047	0.393

E. sonchifolia	0.18	-0.165	0.112	0.373	-0.23	0.169	0.341	-0.255	0.126	-0.024	-0.161	0.112
E. acer	-0.082	-0.251	-0.118	-0.214	-0.082	0.276	0.023	-0.153	-0.057	-0.082	-0.057	0.093
E. chinense	-0.18	0.075	-0.112	-0.081	-0.18	-0.082	0.393	0.082	-0.126	-0.18	-0.126	0.035
M. micrantha	0.552	-0.23	0.571	0.695	-0.075	0.253	0.061	-0.253	-0.052	0.238	-0.052	-0.108
P. indica	-0.029	-0.089	0.484	0.268	-0.029	0.097	0.241	-0.097	-0.02	0.699	-0.02	-0.042
V. cinerea	-0.075	-0.23	0.571	0.249	-0.075	0.253	0.342	-0.121	0.386	0.238	-0.052	0.344
W. triloba	-0.068	-0.059	-0.098	-0.177	-0.068	0.228	-0.197	-0.228	-0.047	-0.068	-0.047	0.147
J. linifolia	-0.041	-0.127	-0.06	-0.108	-0.041	0.14	-0.12	0.078	-0.029	-0.041	-0.029	0.692
P. triquetrum	-0.029	0.229	-0.042	-0.075	-0.029	-0.208	0.241	-0.097	-0.02	-0.029	-0.02	-0.042
C. asiatica	-0.082	-0.251	0.305	0.342	-0.082	0.276	0.286	-0.153	-0.057	0.211	-0.057	0.305
C. exaltatus	0.699	-0.089	0.484	0.268	-0.029	0.097	-0.084	-0.097	-0.02	-0.029	-0.02	-0.042
C. compressus	-0.029	-0.089	-0.042	-0.075	-0.029	0.097	-0.084	-0.097	-0.02	-0.029	-0.02	-0.042
K. brevifolia	-0.041	0.1	-0.06	0.137	-0.041	0.14	-0.12	-0.14	-0.029	-0.041	-0.029	-0.06
L. cernuum	-0.029	0.229	-0.042	-0.075	-0.029	-0.208	0.241	-0.097	-0.02	-0.029	-0.02	-0.042
A. philoxeroides	-0.029	-0.089	-0.042	0.268	-0.029	0.097	-0.084	-0.097	-0.02	-0.029	-0.02	-0.042
A. sessilis	-0.029	-0.089	-0.042	-0.075	-0.029	0.097	-0.084	-0.097	-0.02	-0.029	-0.02	0.484
I. triloba	-0.029	-0.089	0.484	0.268	-0.029	0.097	0.241	-0.097	-0.02	0.699	-0.02	-0.042
P. purpurea	-0.082	-0.123	0.305	0.064	-0.082	0.153	0.023	-0.029	-0.057	0.211	-0.057	0.305
Z. pendula	0.378	-0.157	0.546	0.475	-0.051	0.173	0.042	-0.173	-0.036	-0.051	-0.036	-0.074
O. corniculata	-0.06	-0.183	0.456	0.377	-0.06	0.202	0.161	-0.202	-0.042	-0.06	-0.042	0.184

n=50.

Table 12 Interspecfic point correlation coefficients (Continue).

	A. conyzoides	*A. subulatus*	*B. bipinnata*	*B. pilosa*	*E. sonchifolia*	*E. acer*	*E. chinense*	*M. micrantha*	*P. indica*	*V. cinerea*	*W. triloba*	*J. linifolia*
E. hirta	-0.12	-0.06	-0.075	0.272	-0.23	0.211	0.024	-0.075	-0.029	-0.075	-0.068	0.479
S. sebiferum	-0.084	-0.042	-0.052	0.428	0.126	0.354	-0.126	-0.052	-0.02	0.386	0.428	-0.029
A. scarabaeoides	0.093	0.171	0.4	0.227	-0.313	0.205	-0.009	-0.217	0.154	0.029	-0.173	0.016
D. gangeticum	-0.084	-0.042	-0.052	-0.047	0.126	-0.057	0.161	-0.052	-0.02	-0.052	-0.047	-0.029
D. triflorum	-0.218	-0.108	-0.136	0.082	0.203	0.028	-0.203	-0.136	-0.052	0.053	0.082	-0.075
S. cannabina	-0.12	0.316	-0.075	-0.068	-0.23	0.211	0.024	-0.075	-0.029	-0.075	0.272	-0.041
P. vittata	-0.084	-0.042	-0.052	-0.047	-0.161	0.354	0.161	-0.052	-0.02	-0.052	-0.047	-0.029
L. japonicum	-0.12	-0.06	-0.075	-0.068	0.18	-0.082	0.23	-0.075	-0.029	-0.075	-0.068	-0.041
A. compressus	-0.093	-0.319	-0.276	0.173	0.313	0.141	0.009	0.093	-0.154	0.093	0.173	-0.016
C. aciculatus	-0.174	-0.086	-0.108	-0.098	-0.035	0.093	-0.112	-0.108	-0.042	-0.108	0.393	-0.06
C. citratus	-0.084	-0.042	-0.052	-0.047	-0.161	-0.057	-0.126	-0.052	-0.02	-0.052	0.428	-0.029
C. dactylon	0.342	-0.108	0.621	-0.123	0.079	-0.148	-0.079	-0.136	-0.052	0.053	-0.123	-0.075
E. crusgalli	0.344	-0.06	-0.075	-0.068	0.18	-0.082	-0.18	0.552	-0.029	-0.075	-0.068	-0.041
E. minor	-0.369	-0.183	-0.23	-0.059	-0.165	-0.251	0.075	-0.23	-0.089	-0.23	-0.059	-0.127
E. pilosa	0.497	0.456	-0.108	-0.098	0.112	-0.118	-0.112	0.571	0.484	0.571	-0.098	-0.06
I. aristatum	0.345	0.199	-0.196	-0.177	0.373	-0.214	-0.081	0.695	0.268	0.249	-0.177	-0.108
L. gracile	0.111	-0.06	0.552	-0.068	-0.23	-0.082	-0.18	-0.075	-0.029	-0.075	-0.068	-0.041
P. repens	0.211	0.202	-0.142	0.228	0.169	0.276	-0.082	0.253	0.097	0.253	0.228	0.14
P. scrobiculatum	0.168	0.161	-0.218	-0.197	0.341	0.023	0.393	0.061	0.241	0.342	-0.197	-0.12

R. repens	-0.113	-0.202	0.274	0.057	-0.255	-0.153	0.082	-0.253	-0.097	-0.121	-0.228	0.078
C. roseus	0.241	-0.042	-0.052	-0.047	0.126	-0.057	-0.126	-0.052	-0.02	0.386	-0.047	-0.029
S. rhombifolia	0.344	0.316	0.238	-0.068	-0.024	-0.082	-0.18	0.238	0.699	0.238	-0.068	-0.041
U. sp.	-0.084	-0.042	0.386	-0.047	-0.161	-0.057	-0.126	-0.052	-0.02	-0.052	-0.047	-0.029
U. lobata	-0.006	0.456	-0.108	0.393	0.112	0.093	0.035	-0.108	-0.042	0.344	0.147	0.692
A. conyzoides	1	0.161	0.482	-0.197	0.157	-0.239	-0.249	0.482	0.241	0.342	-0.197	-0.12
A. subulatus	0.161	1	-0.108	-0.098	-0.035	0.093	0.184	0.117	0.484	0.344	-0.098	0.316
B. bipinnata	0.482	-0.108	1	-0.123	-0.168	-0.148	-0.327	-0.136	-0.052	-0.136	-0.123	-0.075
B. pilosa	-0.197	-0.098	-0.123	1	-0.241	0.441	-0.026	-0.123	-0.047	0.082	0.111	0.272
E. sonchifolia	0.157	-0.035	-0.168	-0.241	1	-0.222	0.136	0.203	-0.161	0.203	-0.241	-0.024
E. acer	-0.239	0.093	-0.148	0.441	-0.222	1	0.222	-0.148	-0.057	0.028	0.249	-0.082
E. chinense	-0.249	0.184	-0.327	-0.026	0.136	0.222	1	-0.079	-0.126	-0.079	-0.161	0.024
M. micrantha	0.482	0.117	-0.136	-0.123	0.203	-0.148	-0.079	1	0.386	0.242	-0.123	-0.075
P. indica	0.241	0.484	-0.052	-0.047	-0.161	-0.057	-0.126	0.386	1	0.386	-0.047	-0.029
V. cinerea	0.342	0.344	-0.136	0.082	0.203	0.028	-0.079	0.242	0.386	1	0.082	-0.075
W. triloba	-0.197	-0.098	-0.123	0.111	-0.241	0.249	-0.161	-0.123	-0.047	0.082	1	-0.068
J. linifolia	-0.12	0.316	-0.075	0.272	-0.024	-0.082	0.024	-0.075	-0.029	-0.075	-0.068	1
P. triquetrum	-0.084	-0.042	-0.052	-0.047	0.126	-0.057	0.161	-0.052	-0.02	-0.052	-0.047	-0.029
C. asiatica	0.155	0.518	-0.148	-0.134	0.241	0.003	0.106	0.205	0.354	0.205	-0.134	0.211
C. exaltatus	0.241	-0.042	-0.052	-0.047	0.126	-0.057	-0.126	0.386	-0.02	-0.052	-0.047	-0.029
C. compressus	-0.084	-0.042	-0.052	-0.047	-0.161	0.354	0.161	-0.052	-0.02	-0.052	0.428	-0.029
K. brevifolia	-0.12	-0.06	-0.075	-0.068	-0.024	-0.082	-0.18	-0.075	-0.029	-0.075	0.272	-0.041
L. cernuum	-0.084	-0.042	-0.052	-0.047	0.126	-0.057	0.161	-0.052	-0.02	-0.052	-0.047	-0.029
A. philoxeroides	-0.084	-0.042	-0.052	-0.047	0.126	-0.057	-0.126	-0.052	-0.02	-0.052	-0.047	-0.029
A. sessilis	-0.084	-0.042	-0.052	0.428	0.126	0.354	-0.126	-0.052	-0.02	0.386	0.428	-0.029
I. triloba	0.241	0.484	-0.052	-0.047	-0.161	-0.057	-0.126	0.386	1	0.386	-0.047	-0.029
P. purpurea	0.023	0.305	-0.148	0.057	-0.106	-0.162	-0.125	0.028	0.354	0.205	0.249	0.211
Z. pendula	0.426	-0.074	-0.093	-0.084	0.223	-0.101	-0.054	0.684	-0.036	0.165	-0.084	-0.051
O. corniculata	0.329	0.184	-0.108	-0.098	0.261	-0.118	0.035	0.344	-0.042	0.344	-0.098	-0.06

n=50.

Table 12 Interspecfic point correlation coefficients (Continue).

	P. triquetrum	*C. asiatica*	*C. exaltatus*	*C. compressus*	*K. brevifolia*	*L. cernuum*	*A. philoxeroides*	*A. sessilis*	*I. triloba*	*P. purpurea*	*Z. pendula*	*O. corniculata*
E. hirta	-0.029	-0.082	-0.029	-0.029	-0.041	-0.029	-0.029	-0.029	-0.029	0.211	-0.051	-0.06
S. sebiferum	-0.02	-0.057	-0.02	-0.02	-0.029	-0.02	-0.02	1	-0.02	-0.057	-0.036	-0.042
A. scarabaeoides	-0.131	0.09	-0.131	-0.131	-0.188	-0.131	0.154	-0.131	0.154	0.205	-0.233	0.023
D. gangeticum	-0.02	-0.057	-0.02	-0.02	-0.029	1	-0.02	-0.02	-0.02	-0.057	-0.036	-0.042
D. triflorum	-0.052	0.028	-0.052	-0.052	-0.075	-0.052	0.386	0.386	-0.052	-0.148	-0.093	-0.108
S. cannabina	-0.029	-0.082	-0.029	-0.029	-0.041	-0.029	-0.029	-0.029	-0.029	0.211	-0.051	-0.06
P. vittata	-0.02	-0.057	-0.02	-0.02	-0.029	-0.02	-0.02	-0.02	-0.02	-0.057	-0.036	-0.042
L. japonicum	-0.029	-0.082	-0.029	-0.029	-0.041	0.699	-0.029	-0.029	-0.029	-0.082	-0.051	-0.06
A. compressus	0.131	-0.205	-0.154	0.131	-0.016	0.131	0.131	0.131	-0.154	-0.09	0.064	0.124
C. aciculatus	-0.042	0.093	-0.042	0.484	-0.06	-0.042	-0.042	-0.042	-0.042	0.093	-0.074	0.184

C. citratus	-0.02	-0.057	-0.02	-0.02	-0.029	-0.02	-0.02	-0.02	-0.02	-0.057	-0.036	-0.042
C. dactylon	-0.052	-0.148	-0.052	-0.052	-0.075	-0.052	-0.052	-0.052	-0.052	0.028	-0.093	-0.108
E. crusgalli	-0.029	-0.082	0.699	-0.029	-0.041	-0.029	-0.029	-0.029	-0.029	-0.082	0.378	-0.06
E. minor	0.229	-0.251	-0.089	-0.089	0.1	0.229	-0.089	-0.089	-0.089	-0.123	-0.157	-0.183
E. pilosa	-0.042	0.305	0.484	-0.042	-0.06	-0.042	-0.042	-0.042	0.484	0.305	0.546	0.456
I. aristatum	-0.075	0.342	0.268	-0.075	0.137	-0.075	0.268	-0.075	0.268	0.064	0.475	0.377
L. gracile	-0.029	-0.082	-0.029	-0.029	-0.041	-0.029	-0.029	-0.029	-0.029	-0.082	-0.051	-0.06
P. repens	-0.208	0.276	0.097	0.097	0.14	-0.208	0.097	0.097	0.097	0.153	0.173	0.202
P. scrobiculatum	0.241	0.286	-0.084	-0.084	-0.12	0.241	-0.084	-0.084	0.241	0.023	0.042	0.161
R. repens	-0.097	-0.153	-0.097	-0.097	-0.14	-0.097	-0.097	-0.097	-0.097	-0.029	-0.173	-0.202
C. roseus	-0.02	-0.057	-0.02	-0.02	-0.029	-0.02	-0.02	-0.02	-0.02	-0.057	-0.036	-0.042
S. rhombifolia	-0.029	0.211	-0.029	-0.029	-0.041	-0.029	-0.029	-0.029	0.699	0.211	-0.051	-0.06
U. sp.	-0.02	-0.057	-0.02	-0.02	-0.029	-0.02	-0.02	-0.02	-0.02	-0.057	-0.036	-0.042
U. lobata	-0.042	0.305	-0.042	-0.042	-0.06	-0.042	-0.042	0.484	-0.042	0.305	-0.074	0.184
A. conyzoides	-0.084	0.155	0.241	-0.084	-0.12	-0.084	-0.084	-0.084	0.241	0.023	0.426	0.329
A. subulatus	-0.042	0.518	-0.042	-0.042	-0.06	-0.042	-0.042	-0.042	0.484	0.305	-0.074	0.184
B. bipinnata	-0.052	-0.148	-0.052	-0.052	-0.075	-0.052	-0.052	-0.052	-0.052	-0.148	-0.093	-0.108
B. pilosa	-0.047	-0.134	-0.047	-0.047	-0.068	-0.047	-0.047	0.428	-0.047	0.057	-0.084	-0.098
E. sonchifolia	0.126	0.241	0.126	-0.161	-0.024	0.126	0.126	0.126	-0.161	-0.106	0.223	0.261
E. acer	-0.057	0.003	-0.057	0.354	-0.082	-0.057	-0.057	0.354	-0.057	-0.162	-0.101	-0.118
E. chinense	0.161	0.106	-0.126	0.161	-0.18	0.161	-0.126	-0.126	-0.126	-0.125	-0.054	0.035
M. micrantha	-0.052	0.205	0.386	-0.052	-0.075	-0.052	-0.052	-0.052	0.386	0.028	0.684	0.344
P. indica	-0.02	0.354	-0.02	-0.02	-0.029	-0.02	-0.02	-0.02	1	0.354	-0.036	-0.042
V. cinerea	-0.052	0.205	-0.052	-0.052	-0.075	-0.052	-0.052	0.386	0.386	0.205	0.165	0.344
W. triloba	-0.047	-0.134	-0.047	0.428	0.272	-0.047	-0.047	0.428	-0.047	0.249	-0.084	-0.098
J. linifolia	-0.029	0.211	-0.029	-0.029	-0.041	-0.029	-0.029	-0.029	-0.029	0.211	-0.051	-0.06
P. triquetrum	1	-0.057	-0.02	-0.02	-0.029	-0.02	-0.02	-0.02	-0.02	-0.057	-0.036	-0.042
C. asiatica	-0.057	1	-0.057	-0.057	-0.082	-0.057	0.354	-0.057	0.354	0.169	0.14	0.305
C. exaltatus	-0.02	-0.057	1	-0.02	-0.029	-0.02	-0.02	-0.02	-0.02	-0.057	0.565	-0.042
C. compressus	-0.02	-0.057	-0.02	1	-0.029	-0.02	-0.02	-0.02	-0.02	-0.057	-0.036	-0.042
K. brevifolia	-0.029	-0.082	-0.029	-0.029	1	-0.029	-0.029	-0.029	-0.029	0.211	-0.051	-0.06
L. cernuum	-0.02	-0.057	-0.02	-0.02	-0.029	1	-0.02	-0.02	-0.02	-0.057	-0.036	-0.042
A. philoxeroides	-0.02	0.354	-0.02	-0.02	-0.029	-0.02	1	-0.02	-0.02	-0.057	-0.036	-0.042
A. sessilis	-0.02	-0.057	-0.02	-0.02	-0.029	-0.02	-0.02	1	-0.02	-0.057	-0.036	-0.042
I. triloba	-0.02	0.354	-0.02	-0.02	-0.029	-0.02	-0.02	-0.02	1	0.354	-0.036	-0.042
P. purpurea	-0.057	0.169	-0.057	-0.057	0.211	-0.057	-0.057	-0.057	0.354	1	-0.101	0.305
Z. pendula	-0.036	0.14	0.565	-0.036	-0.051	-0.036	-0.036	-0.036	-0.036	-0.101	1	0.546
O. corniculata	-0.042	0.305	-0.042	-0.042	-0.06	-0.042	-0.042	-0.042	-0.042	0.305	0.546	1

n=50.

Using the ID numbers of species in Table 2, the significant species pairs are listed as bellow

(1,2) (1,3) (1,4) (1,5) (1,6) (1,7) (1,8) (1,9) (1,10) (1,11) (1,12) (1,13) (1,14) (1,15) (1,16) (1,17) (1,18) (1,19) (1,20) (1,21) (1,22) (1,23) (1,24) (1,25) (1,26) (1,27) (1,28) (1,29) (1,30) (1,31) (1,32) (1,33) (1,34) (1,35)

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3.5 Cluster analysis

The fuzzy cluster trees for family classification and species classification are indicated in Fig. 4 and 5 respectively. ID numbers for families and species can be found in Table 1 and Table 2.

It can be found from Table 1 and 2 that in the family classification, the family pair, Euphorbiaceae-Amaranthaceae is the most associated, seconded by the family pair, Commelinaceae-Oxalidaceae. In the species classification, the species pairs, *S. sebiferum-A. sessilis*, *D. gangeticum-S. rhombifolia*, and *P. indica-I. triloba*, are the most associated.

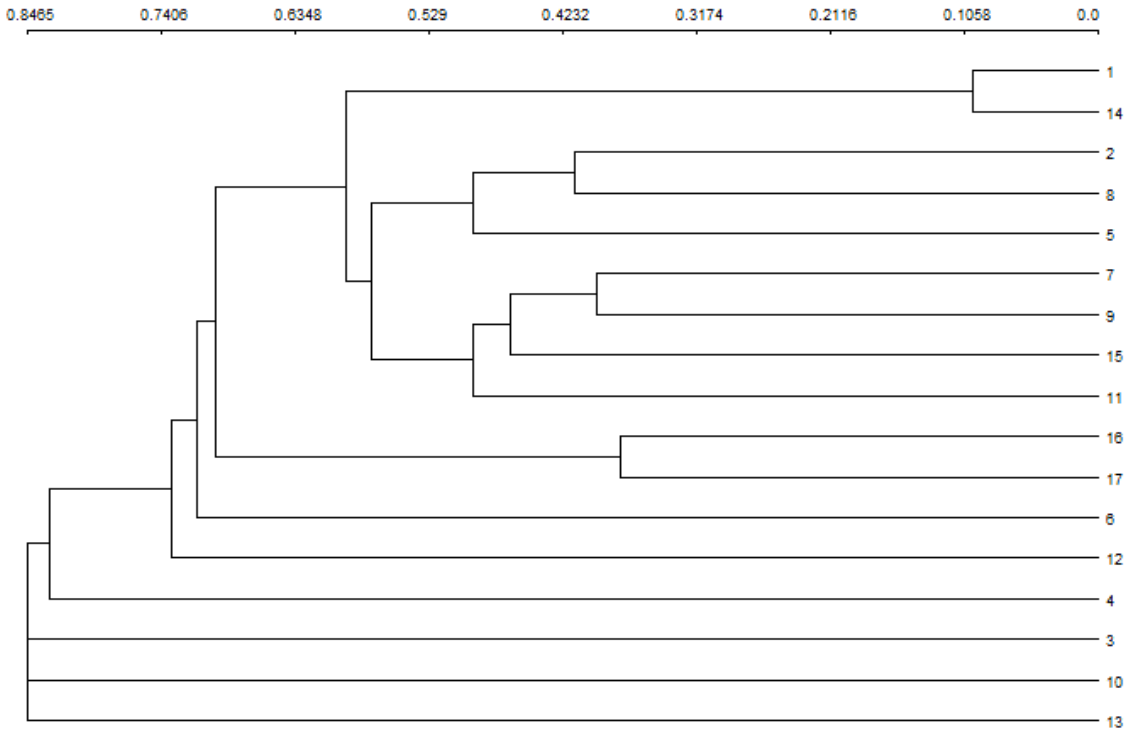

Fig. 4 Fuzzy cluster tree for family classification.

4 Discussion

In summary, most of the significant associations between grass species/families are positive. Similar to the results of Zhang (2011), the present study further proves that most associations are weak; positive associations accounted for the most of the significant associations. It means that the competition/interference between grass species/families is not significant.

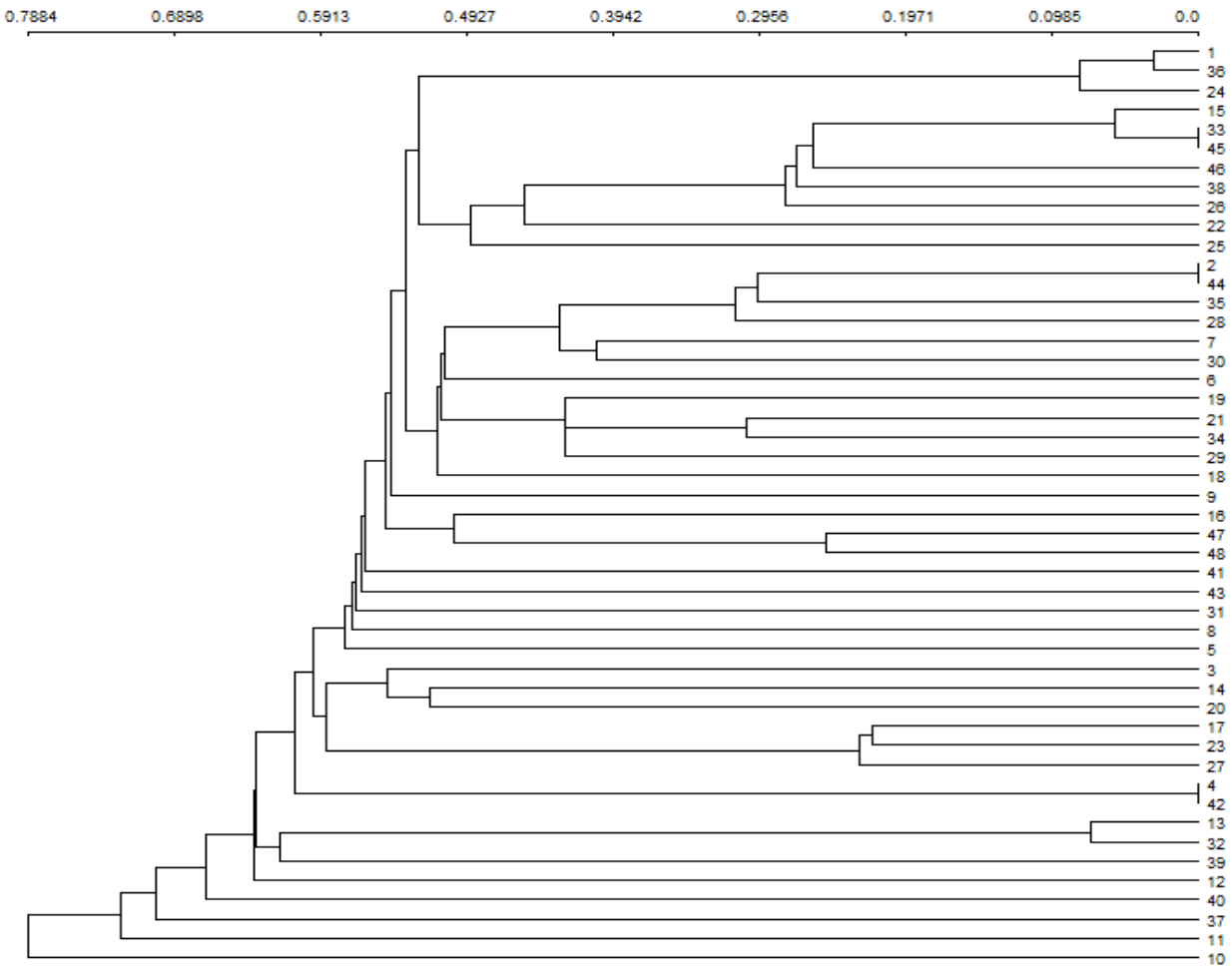

Fig. 5 Fuzzy cluster tree for species classification.

Spearman correlation (association) is a quasi-linear association (Zhang, 2011, 2012a, 2012b). A significant Pearson correlation (association) usually means a strong Spearman rank correlation (association) but a weak Pearson correlation (association) does not mean that Spearman rank correlation (association) is certainly weak. A significant Spearman rank correlation (association) may likely implicit a stronger linear correlation (association). A weak Spearman rank correlation (association) will certainly mean a weak linear correlation (association).

We always want to know direct interspecific associations (Schoener, 1993). A direct interspecific association (actually the interspecific interaction in this case) can be obtained by using net correlation measure. The other measures, Pearson correlation, Spearman rank correlation and point correlation may yield both indirect and direct associations. So net correlation is particullarly suggested for using in such studies. To achieve better results, in particular for that from net correlation analysis, more samples are suggested to be collected in the sampling survey.

For plant communities, a direct and positive association (direct interaction) means the facilitation (Bruno et al., 2003; Ollerton et al., 2003), mutualism, commensalism, proto-cooperation, complementary resource-partitioning, or parasitism (it rarely occurs in the nature) between two plant species (Callaway, 1995; Palmer et al., 2003; Hegland et al., 2009), if the possibility for sharing the similar requirements of environmental conditions has been excluded. However, the negative association in the same case means the

interspecific competition or inerspecfic interference (excretion of poisonous chemicals, etc.), or two species have different resource-utilizing patterns: They require different habitats and their ecological niches are separated, and co-existence of the two species in the same community is nearly impossible.

Community succession is the process of change in the species structure of an ecological community over time. It is a self-organizing process by which an ecological community undergoes orderly and predictable changes following initial colonization of new habitat or a disturbance (Wikipedia: http://en.wikipedia.org/wiki/Ecological_succession). I hold that species with significant positive or negative associations are generally keystone species in the community. About why the significant positive associations (interactions), with respect to significant negative associations, always dominate the community, a reasonable explanation is that although both negative and positive associations (interactions) occur in the process of assembly and successsion of community, the adaptation and selection will finally result in the successful coexistence of the species with significant positive associations in the climax community (Fig. 6). Dominance of significant positive associations (interactions) means the relative stablility and equilibrium of the community. According to Clements (1916), community succession involves several phases as follows, and here I use "-" for significant negative association, "+" for significant positive association and "*" for no significant association in order to show the change of negative *vs*. positive associations

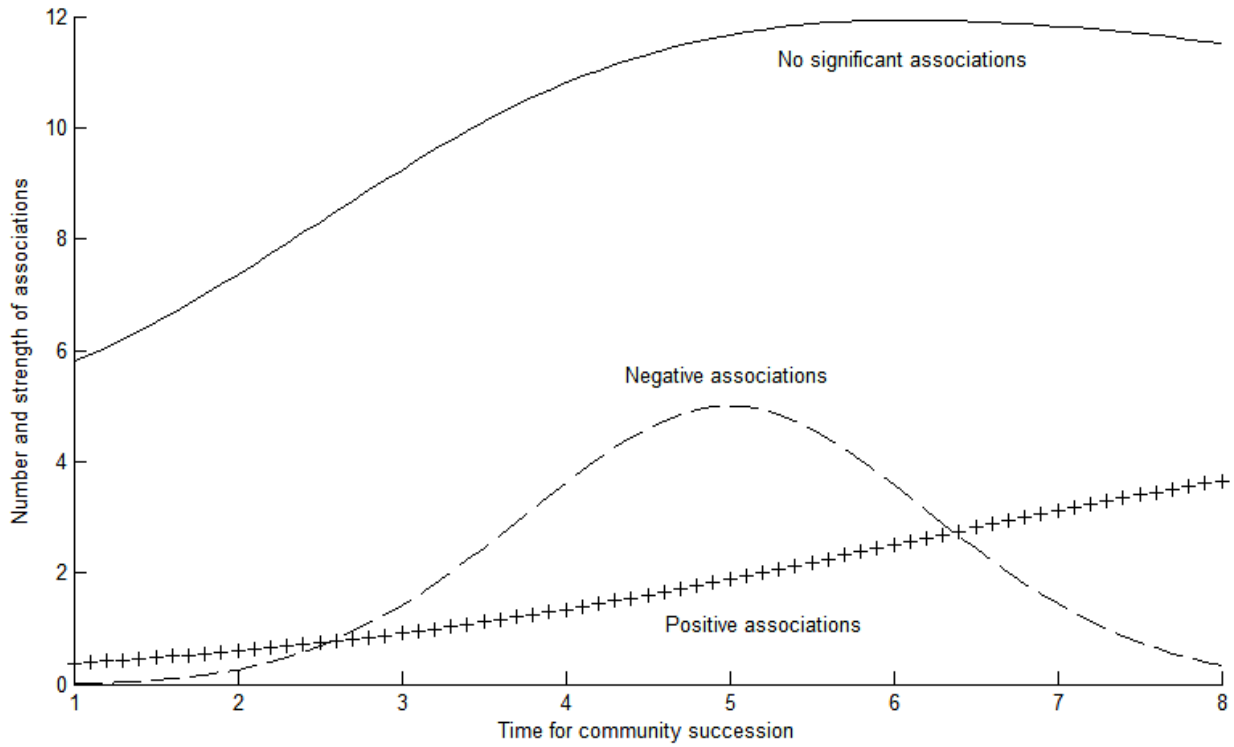

Fig. 6 Illustration of change of significant positive/negative interspecific associations. No significant associations account for the majority of possible interspecific associations.

(1) Nudation (******): Succession begins with the development of a bare site, i.e., disturbance.

(2) Migration (**********-+): It refers to arrival of propagules.

(3) Ecesis (********---+): It involves establishment and initial growth of vegetation.

(4) Competition (******-----+): As vegetation became well established, grew, and spread, various species began to compete for space, light and nutrients.

(5) Reaction (Go to step (1) for re-starting; and near the end stage: ******---+++): During this phase autogenic changes affect the habitat resulting in replacement of one plant community by another.

(6) Stabilization (******-+++++): Reaction phase leads to development of a climax community.

It should be noted that no significant associations usually account for the majority of possible interspecific associations at each phase of community succession. They guarantee the robustness of community. They are candidates of keystone species, i.e., lose of some existing keystone species might be filled with some species previously with no significant associations.

Acknowledgment

I would like to thank all students of Department of Ecology, Sun Yat-sen University, for their field sampling in Zhuai.

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