

The morphological markers of Different phenotypes *Echinacea purpurea*

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ABSTRACT

Analysis germplasm resources genetic diversity of different phenotypes *Echinacea purpurea*. The phenotypic trait data of different morphology samples were measured and the correlation coefficient calculation and cluster analysis were conducted. Different samples differed in many quantitative traits and fake quality traits; there were certain correlation between some morphological characters; samples growth in the same habitat clustered into a major category. Results provide a theoretical basis for preliminary judgment of germplasm field screening; growth environment may have a greater impact on the external form of *Echinacea*.

INTRODUCTION

Echinacea purpurea (L.) Moench, Belonging to the composite family, is a traditional Indian herbal medicine native to North America, it contains active ingredients such as polysaccharides, polyphenols, alkylamide which can obviously improve the body's immunity, mainly used in the treatment of colds, typhoid, diphtheria, and tuberculosis and other bacterial infections disease, also can treat sexually transmitted diseases, ulcers, diabetes, etc (Bauer et al, 1991; Bukovsky et al, 1995; Li et al, 2002; Barrett et al, 2003). In recent years, *E. purpurea* become one of the top ten popular herbal medicine herbs in international market (Dieter et al, 1999). Beginning in the 1990 s, it was introduced to China as a medicinal plant and cultivated in different provenance. But there were many variations in plant height, stem color, flower color, and content of effective components, showing a certain genetic diversity. Morphological marker refers to the morphological characteristics can be observed with naked eyes in plant's growth process, in addition to the above traits, it also include the pigment, physiological characteristics, reproductive characteristics, resistance to diseases and pests, etc (Han, 2009).

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With the advantages of intuitive, simple and economical, this method still is the most basic ways of studying germplasm resources.

The goal of this investigation was to provides theory basis for the preliminary judgment of plant germplasm in fields by measured the morphological character data of 14 different phenotypes *E. purpurea* samples, calculated the correlation and analysed the cluster.

MATERIALS AND METHODS

Material

With stem color, flower color and shape of ligule petals index as main morphological identification indicators, 14 samples with obviously different phenotypes were chosen as the materials of this experiment and were collected from Tongcheng in Anhui and medicinal botanical garden in Shandong University of Traditional Chinese Medicine in July 2010, each taking 10 strains, as shown in the table 1. The samples were identified as compositae *Echinacea* (*Echinacea purpurea* (L.) Moench) by professor Zhou Fengqin of SDUTCM.

Table. 1: The morphological traits of different phenotypes *echinacea* (n=10)

Number	Origin	Altitude (m)	Height (cm)	Diameter (cm)	Leaf numbers (piece)	Leaf length (cm)	Leaf width (cm)	Petiole length (cm)
J2	Tongcheng, Anhui	73.4	130.80±0.020	0.76±0.197	15.00±0.169	17.78±0.071	4.30±0.151	2.60±0.144
J3	Tongcheng, Anhui	73.4	116.50±0.053	0.68±0.242	7.60±0.150	17.52±0.077	5.12±0.103	2.06±0.459
JD1	Tongcheng, Anhui	33.5	103.60±0.039	0.78±0.190	9.00±0.111	15.80±0.053	7.28±0.210	1.10±0.203
JD4	Tongcheng, Anhui	33.5	86.40±0.070	0.76±0.303	9.8±0.046	10.40±0.146	3.70±0.144	1.00±0.412
JD5	Tongcheng, Anhui	33.5	78.50±0.030	0.40±0.177	8.60±0.104	11.24±0.050	3.04±0.106	1.44±0.093
D1	Tongcheng, Anhui	365	81.60±0.042	0.64±0.178	10.00±0.158	14.48±0.101	5.06±0.122	1.86±0.118
D2	Tongcheng, Anhui	365	82.10±0.048	0.74±0.121	10.00±0.141	12.70±0.082	4.20±0.150	1.80±0.152
D5	Tongcheng, Anhui	365	104.6±0.051	0.74±0.074	9.40±0.161	13.80±0.197	5.84±0.148	2.30±0.248
L	Linyi, Shandong*	50.2	57.20±0.087	0.50±0.200	27.00±0.216	10.60±0.131	3.66±0.063	1.74±0.119
Z3	Chunan, Zhejiang*	50.2	64.00±0.062	1.50±0.026	13.00±0.167	10.68±0.131	2.96±0.237	1.80±0.171
Z9	Chunan, Zhejiang *	50.2	66.00±0.042	1.00±0.196	12.00±0.158	6.63±0.225	2.18±0.322	1.55±0.065
Z10	Chunan, Zhejiang *	50.2	46.00±0.069	0.50±0.218	8.00±0.179	7.13±0.221	1.93±0.286	2.05±0.205
T1	Tongcheng, Anhui *	50.2	44.00±0.056	0.70±0.196	13.00±0.175	6.53±0.084	1.83±0.114	1.13±0.204
T2	Tongcheng, Anhui *	50.2	70.00±0.059	1.10±0.189	13.00±0.153	8.10±0.141	2.62±0.125	1.80±0.152

Table. 1:

Inflor-escence numbers (number)	Inflor- Escence width (cm)	Ligule petals Width (cm)	Ligule Petal numbers	Seed length (cm)	Seed width (cm)	Stem colour	Flower colour
4.80±0.445	2.93±0.219	1.18±0.063	20.40±0.114	0.56±0.006	0.22±0.035	green bottom purple spots	light pink
4.60±0.567	2.71±0.204	0.88±0.095	22.00±0.000	0.49±0.011	0.22±0.0010	green	light pink
3.80±0.343	3.08±0.236	1.40±0.071	20.20±0.054	0.50±0.136	0.26±0.0013	green bottom purple spots	rose red
4.20±0.057	2.22±0.256	1.12±0.075	19.20±0.068	0.54±0.036	0.22±0.103	green bottom purple spots	rose red
2.60±0.439	2.00±0.154	0.80±0.088	17.80±0.122	0.39±0.148	0.16±0.097	green	white
4.20±0.310	2.52±0.225	1.22±0.069	18.80±0.095	0.52±0.762	0.21±0.125	green bottom purple spots	rose red
4.80±0.342	2.05±0.255	0.88±0.095	21.00±0.216	0.41±0.208	0.20±0.226	green bottom purple spots	rose red
3.80±0.390	2.48±0.235	1.30±0.089	21.40±0.053	0.51±0.056	0.18±0.360	green bottom purple spots	pink
15.20±0.157	3.78±0.172	0.94±0.207	18.60±0.090	0.45±0.154	0.24±0.201	dark green	rose red
8.00±0.231	3.30±0.193	1.02±0.082	13.00±0.144	0.52±0.084	0.20±0.106	purple bottom purple spots	pink
5.00±0.254	3.50±0.168	1.40±0.071	15.00±0.094	0.53±0.216	0.26±0.200	green	light pink
5.00±0.225	3.90±0.290	1.23±0.094	17.40±0.239	0.44±0.077	0.22±0.069	green bottom purple spots	pink
4.00±0.231	3.30±0.246	1.00±0.000	18.00±0.198	0.50±0.214	0.26±0.036	purple	pink
7.00±0.213	4.12±0.130	1.20±0.102	17.20±0.104	0.49±0.069	0.25±0.200	purple bottom purple spots	light pink

note : * These were cultivated in botanical garden in Shandong University of Traditional Chinese Medicine.

Table. 2: The correlation coefficient between phenotypic traits.

	Height	Diameter	Leaf numbers	Leaf length	Leaf width	Petiole length	Inflor-escence numbers	Inflor-escence width	Inflor-escence height	Ligule petals length	Ligule petals width	Ligule Petal numbers	Seed length
Diameter	-0.0475												
Leaf numbers	-0.259	0.0021											
Leaf length	0.9020**	-0.1450	-0.1490										
Leaf width	0.7421**	-0.1287	-0.1889	0.8330**									
Leaf length	0.4082	0.0117	0.0743	0.4180	0.112								
Inflor-escence numbers	-0.3180	0.1040*	0.8520*	-0.2060	-0.1780	0.0430							
Inflor-escence width	-0.4896	0.2960	0.4533	-0.4960	-0.4288	0.0856	0.4310						
Inflor-escence height	0.0383	0.2766	0.4082	0.0200	0.1022	-0.0336	0.3910	0.7381**					
ligule petals length	-0.1243	0.0957	-0.1436	-0.0800	-0.0603	0.3795	-0.0810	0.6469*	0.4248				
Ligule P width	0.1088	0.2494	-0.1613	-0.0630	0.2297	0.0360	-0.1890	0.3512	0.3075	0.4447			
Ligule Petal numbers	0.6604*	-0.5797	-0.1791	0.6730**	0.6656**	0.2298	-0.2230	-0.4842	-0.0382	-0.0867	-0.1079		
Seed length	0.3527	0.4933	0.0305	0.1940	0.1735	0.0993	0.0060	0.1434	0.2951	0.2016	0.5844	-0.0853	
sSeed width	-0.2399	0.1982	0.3088	-0.3010	-0.1318	-0.3489	0.2440	0.6663**	0.7862**	0.3300	0.4427	-0.1493	0.3814

注 : * : P < 0.05 ; ** : P < 0.01.

Methods

Scale was used to measure the following morphological characteristics data, as shown in table 1. The following measurement methods were used:

- Plant height: for the height of the aerial parts of plant;
- Diameter : for the maximum rough of stem;

Leaf length and width, petiole length: for the maximum of length, width and petiole length value of the second leaf since the stem top.

Inflorescence width and height: for the maximum of width and height of inflorescence;

Ligule petals length and width: for the maximum of length and width of tongue petals;

Seed length and width: 10 seeds were arranged in lines and columns respectively, measured their total length, calculated the average;

Leaf numbers, numbers of inflorescence per plant and ligule petal numbers of each inflorescence were counted.

RESULTS AND DISCUSSION

Morphological traits

Table 1 lists the related morphological data of 14 samples, there are many differences in quantitative and fake quality traits of different samples, and the obviously difference occurred in the plant height, leaf numbers, length and width of leaf, numbers of inflorescence per plant. Plant height of the J2 is about 3 times that of the T1; leaf numbers per plant of the L can reach 27 pieces but the average of leaf number of all the other samples is only 10.5.

Correlation between morphological traits

In order to study the correlations among the phenotypic traits, the correlation coefficient between them were shown in table 2. It can be found that plant height, leaf length, leaf width and leaf numbers formed a group of significantly positive correlation.

Higher the plant is, larger the leaf is, and much more ligule petals on the inflorescence. Another group of obvious positive correlation appeared in width and height of inflorescence and seed width. Wider the inflorescence toby is, higher it is, bigger the whole is, and wider the seed is.

Morphological traits clustering analysis

According to the cluster analysis results, D1,D5,D2 and JD1 cluster first, and then gradually with J3,JD4,JD5,J2 cluster for the first I categories, all these samples were cultivated in Anhui. The samples grown in medicinal botanical garden of SDUTCM were clustered two groups, Z9,T1,T2 and Z10,Z3 as II categories, the sample originated in Linyi separately for the III class.

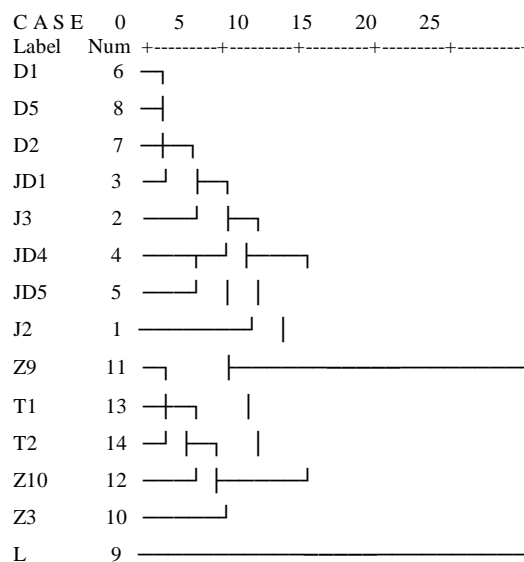


Fig.1: Morphology clustering analysis of different phenotypic *E. purpurea*

CONCLUSION

The 14 samples were selected in this experiment with different stem color, flower color and shape of ligule petals. According to the results, there are many differences in quantitative and fake quality traits of them. There is correlation among some morphological traits. Quantitative analysis of the fake quality traits has yet to be further research.

Clustering analysis showed that the *E. purpurea* samples cultivated in same habitat gathered for a class, which suggested that growth environment has a great influence on *E. purpurea*.

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