EFFECTS OF ENVIRONMENTAL AND MANAGEMENT FACTORS ON WEEDS AND RANGELAND SPECIES DISTRIBUTION

Elham Abbasvand, Sirous Hassannejad, Jalil Shafagh-Kolvanagh

***Abstract*— Knowledge about vegetation communities and survey of affecting factors on their behavior would allow choosing the best strategy for the moderate of them. In this research, we're looking to find relationships between plant species and their correlations with environmental and management methods. Investigations in 9 hills of Khalatposhan-Tabriz rangelands and data analyses with principal component analysis (PCA) and canonical correspondence analysis (CCA) showed relationships between weeds and rangelands species each other, with altitude, geographical direction, and woody and non-woody of sampling areas. *Achillea tenuifolia*, *Alyssum dasycarpum*, and *Salvia nemerosa* were found in all sampling units, whereas *Lepidium perfoliatum*, *Medicago sativa* and *Taeniatherum crinitum*. were only found in the first hill, due to its high altitude and other differential parameters. A CCA ordination showed that altitude and geographical direction had the highest and lowest effect on species composition, respectively. So that maximum richness was observed in the first hill. *Capsella bursa-pastoris*, *Centaurea virgata*, *Dianthus crinitus* and *Hordeum spontaneum* had a special correlation to woody hills, but *Bromus tectrom*, *Euphorbia Szovitsii* and *Salvia nemorosa* had not special attachment to certain conditions.**

***Index Terms*—** Altitude, CCA, Geographical direction, PCA, Weed, Woody areas

I. INTRODUCTION

Survey of plant community pattern has become one of the focuses of the plant ecology research (Li and Zhang, 2003). Ecological studies of each vegetation communities are necessary for understanding the relationships between each community wanted (crops and rangelands species) and unwanted species (weeds). Investigations showed that plant community distribution pattern is influenced by many environmental (climate, soil and topographic features) and management factors (Graham *et al.*, 2005; Udoh *et al.*, 2007; Cannone *et al.*, 2008; Zare *et al.*, 2011; Lousada *et al.* 2013; Hassannejad and Porheidar-Ghafarbi, 2013). So studying of these factors may increase our knowledge about the best moderate and usage of each vegetation community.

Studies of plant communities by multivariate analysis technology such as principal component analysis (PCA) and canonical correspondence analysis (CCA) plays an important role in assessing the relationships between plant species distribution and environmental factors (Kenkel *et al.*, 2002; Li and Zhang, 2003; Andreasen and Stryhn, 2008; Hassannejad and Porheidar-Ghafarbi, 2013).

PCA and CCA as ordination techniques are widely used to obtain unconstrained and constrained ordination of species abundance data and the corresponding biplots or triplots which are extremely useful for ecological interpretation (Legendre and Gallagher, 2001; Leps and Smilauer, 2003).

The objective of this work was to study relationships between weeds and rangeland species and survey of environmental and management factors effects on their distribution in Khalatposhan rangelands of Tabriz county.

II. MATERIAL AND METHODS

A. Survey of area and Data sampling

Our study area is located in Khalatposhan rangelands at 8 Km Tabriz-Basmenj road in Tabriz-Iran. During the summer 2013, 176 plots (0.5m × 0.5m) were chosen using a grid method in 9 hills of these rangelands (Table 1). Each sampling plot was located in interceptions of grid lines (20m × 40m). The sampling was done in woody and non-woody areas. Weed and rangeland species in each plot were identified, counted, and recorded for subsequent data entry and analysis. The collected plant specimens were cataloged, pressed, and identified with the help of flora Iranica (Rechinger 1963–2007) and Turkey (Davis 1965–85). The altitude of each hill was derived by GPS (Global positioning system) in center of them, and direction of these hills was used for found relationships with vegetation distribution.

Manuscript received July 10, 2014

Elham Abbasvand, Department of Plant Eco-Physiology, University of Tabriz, Iran
Sirous Hassannejad, Department of Plant Eco-Physiology, University of Tabriz, Iran
Jalil Shafagh-Kolvanagh, Department of Plant Eco-Physiology, University of Tabriz, Iran

Table 1. Number of hills, woody and non-woody areas, geographical direction and altitude in Khalatposhan rangelands

Number of hills	woody and non-woody areas	Geographical direction	Altitude
1	2	1	1693.32
2	2	4	1631.5
3	2	3	1634.5
4	2	1	1636.5
5	1	1	1596
6	2	1	1602.5
7	1	3	1600.5
8	1	1	1613.5
9	1	1	1626.5

B. Multivariate analysis

Data of plant species distribution in different hills were collected and analyzed through multivariate techniques such as PCA and CCA. PCA ordination method was done considering the presence and/or absence of 100 plant species using PC-ORD version 4.17 (MjM Software, Gleneden Beach, OR, USA) program (McCune and Mefford, 1999). PCA was defined as unconstrained ordination method seeking one or more (mutually independent) gradients representing optimal predictors for fitting the regression models of linear or unimodal species response (Leps and Smilauer, 2003). Subsequently we tested effects of altitude, geographical direction, and woody or non-woody areas on species composition using CCA as a constrained ordination method by CANOCO v. 4.5 (Leps and Smilauer, 2003). In CCA, correlation and regression of floristic data and environmental, soil and management factors analyzed altogether. The environmental and management factors used as follows for CCA analysis: Geographical direct (D): north=1, south=2, east=3, west= 4, site altitude (H) and wooded and non-wooded (M); wooded=1, non wooded=2, (Table 1). The geographic position of each hill measures by a GPS receiver (Table 2).

Number of hills	Longitude	Latitude	Altitude
1	38°01′708″	46°25′547″	1693
2	38°01′715″	46°24′113″	1631
3	38°01′707″	46°24′175″	1634
4	38°01′692″	46°24′285″	1636
5	38°01′822″	46°23′649″	1596
6	38°01′818″	46°23′613″	1602
7	38°01′827″	46°23′622″	1600
8	38°01′733″	46°24′063″	1613
9	38°01′738″	46°24′122″	1626

Table 2- Number of hills, longitude, latitude and altitude of sampling hills in Khalatposhan rangelands.

III. RESEULTS AND DISCUTION

A. Plant species ordination in khalatposhan rangelands

One hundred species (73 weed species and 27 rangeland species) belonging to 20 plant families were recorded in Khalatposhan rangelands (Table 3).

PCA was used to ordination plant species and sampling hills in order to survey of similarity and difference due to their distantness and nearness each other. Distance of sampling points (P) and plant species (their cods) indicates the degree of similarity or difference between the plant species and sampling units each other, according to ecological demands and existing conditions (Figure 1). Presence of plant species in around of sampling hills indicates their presence and high density in sampling units (Figure 1). Presence or absence and density of each plant species in different sampling hills was shown in Table 3.

Plant species that inclined towards the center of PCA axes attended in most of sampling hills. For example, species such as *Achillea tenuifolia* lam. (code 1), *Alyssum dasycarpum* stapf (code 10), and *Salvia nemerosa* L. (code 80) that observed in all sampling hills were located in center of PCA biplot (Figure 1 and Table 3).

In this research, we found that first sampling hill (P1) is different from other hills, because this hill was located very far from others and also from center of PCA biplot (Figure 1). On the other hand, some species such as *Lepidium perfoliatum* L. (code 57), *Medicago sativa* L. (code 63) and *Taeniatherum crinitum* (Shreb.) Nevski. (code 90) were only found in this hill (Figure 1 and Table 3). Also observation shows that third and fourth hills in terms of vegetation type are located in less distance relative to each other, but are far fromothers (Figure 1 and Table 1)

Table 3

Figure 1

B. Correlation between plant species with environmental and management factors

A CCA ordination showed relationships between 73 weed species and 27 rangeland species observed in Khalatposhan rangelands with environmental and management factors. The first two CCA axes explained 79٪ of the variation in plant species distribution in these rangelands (Table 4). In CCA biplot, first axis had positively correlation with altitude (H). In this research we found that altitude with longer vector had the highest effect on weed species distribution. Geographical direction had the least effect on plant distribution (Figure 2). Investigations showed that altitude and relating climatic parameters can influence the microclimatic and mesoclimatic condition of the site (Lososova *et al.* 2004; Pink *et al.* 2012). Khademolhosseini *et al.* (2007) and Hassannejad and Porheidar-Ghafarbi (2013) reported that altitude is one of the most important factors on vegetation distribution patterns. Weed species diversity and richness increased with site altitude (Begon *et al.* 1990; Pysek *et al.* 2002). The first hill with highest altitude had maximum richness (56 species, Table 3). *Medicago sativa* L. (code 63), *Noea Mucronata* L. (code 67), *Thymus Kotschyanus* Boiss.& Hohen. (code 93) and *Tragopogon kotsschys* boiss (code94), and other plant species that located in the first hill had markedly positive relationship with altitude (Figure 2 and Table 3). *Capsella bursa-pastoris* (code 26), *Centaurea virgata* Lam. (code 28), *Dianthus crinitus* SM. (code 36) and *Hordeum spontaneum* L. (code 51) were species that only founded in the woody hills, but species such as *Bromus tectrom* L. (code 23), *Euphorbia Szovitsii* Fisch. Et Mey. (code 44) and *Salvia nemorosa* L. (code 81) were founded in woody and non-woody areas, any geographical direction and also in any altitude, so that this species were observed in the center of CCA biplot (Figure 2). So we can say that these plants had a wide range of ecological needs.

Table 4. Eigenvalues of CCA axes that explained the variation in plant species distribution affected by environmental and management factors. All four eigenvalues reported in this table are canonical and correspond to axes that are constrained by the environmental and management variables.

Axes	**1**	**2**	**3**
Eigenvalues	0.133	0.178	0.324
Species-environment correlations	0.923	0.964	0.984
Cumulative percentage variance of species data	46.4	36.7	23.7
Cumulative percentage variance of species-environment relation	100	79	51

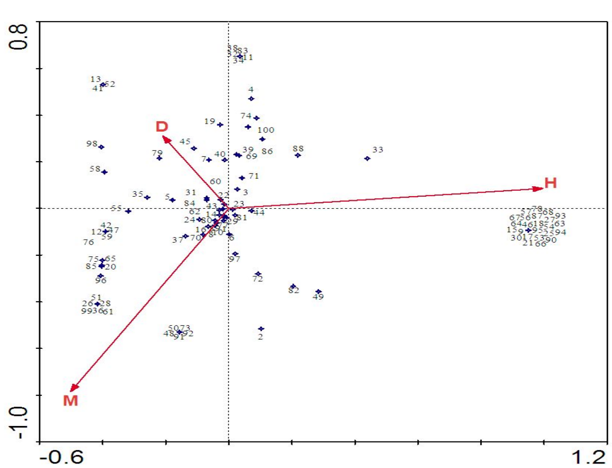

Figure 2. CCA biplot from the first two canonical variates describing the relationship between plant species with environmental and management factors (see table 3 for a description of codes for plant species) in Khalatposhan rangelands.Note: H= altitude, D= heographical direction, M= woody and non-woody areas.

CONCLUSION

Information about plant composition and their relationships with environmental and management factors in each rangeland would be beneficial in the selection of management methods and necessary to sufficiently describe the relative ranking of weeds and rangeland species. CCA results suggest the effective role of environmental and management factors in plant structure. So that altitude of each district had the highest effect in plant distribution.

REFERENCES

1. **Andreasen C., Stryhn H. 2008.** Increasing weed flora in Danish arable fields and its importance for biodiversity. Weed Research 48, 1–9.
2. **Begon M., Harper J.L., Townsend C.R. 1990.** Ecology. Individuals, populations and communities. 2nded. Oxford (UK): Blackwell.
3. **Cannone N., Wagner D., Hubberten H.W., Guglielmin M. 2008.** Biotic and abiotic factors influencing soil properties across a latitudinal gradient in Victoria Land, Antarctica. *Geoderma,* 144: 50–65.
4. **Davis P.H. 1965-1985.** Flora of Turkey. Edinburgh at the University of Press. V: 1-10.
5. **Graham C.H., Smith T.B., Languy M. 2005.** Current and historical factors influencing patterns of species richness and turnover of birds in the Gulf of Guinea Highlands.Journal of Biogeography, 32: 1371–1384.
6. **Kenkel N.C., Derksen D.A., Thomas A.G., Watson P.R. 2002.** Multivariate analysis in weed science research. Weed Science 50, 281–292.
7. **Khademolhosseini Z., Shokri M., Habibian S.H. 2007.** Effects of topographic and climatic factors on vegetation distribution in Arsanjan shrublands. Rangeland Journal, 3:222-235.
8. **Hassannejad S., Porheidar-Ghafarbi S. 2013.** Weed flora survey in alfalfa (*Medicago sativa* L.) fields of Shabestar (northwest of Iran). Archives of Agronomy and Soil Science. 971-991.
9. **Legendre P., Gallagher E.D. 2001.** Ecologically meaningful transformations for ordination of species data. Oecologia 129:271-280.
10. **Leps J., Smilauer P. 2003.** Multivariate Analysis of Ecological Data using CANOCO. Cambridge University Press. 283 p.
11. **Li B., Zhang J.T. 2003.** Ecological interaction of vegetation community on Loess Plateau. Journal of Agro-Environment Science, 22(4): 471–473.
12. **Lousada L.L, Freitas S.P, Marciano C.R., Bsteves B.S., Muniz R.A., Siqueira D. 2013.** CORRELATION OF SOIL PROPERTIES WITH

WEED OCURRENCE IN SUGARCANE AREAS. Planta Daninha, 31(4). 765-775.

13. **McCune B., Mefford M.J. 1999.** PC-ORD multivariate analysis of ecological data. Version 4. Gleneden Beach (OR): MjM Software Design.
14. **Pinke G., Karacsony P., Czucz B., Botta-Dukat Z., Lengyel A. 2012.** The influence of environment, management and site context on species composition of summer arable weed vegetation in Hungary. Appl Vegetation Sci. 15:136–144.
15. **Pysek P., Kucera T., Jarosik V. 2002.** Patterns of invasion in temperate nature reserves. Biol Conserv.104:13–24.
16. **Rechinger K.H. 1963-2007.** Flora Iranica. Akademische Durck-u.Verlagsanstalt Graz-Austria. V: 1-170.
17. **Udoh B.T., Ogunkunle A.O., Ndaeyo N.U. 2007.** Influence of soil series and physico-chemical properties on weed flora distribution at Moor Plantation Ibadan, Southwestern Nigeria. J AgriSocSci, 3(2): 55- 58.
18. **Zare S., Jafari M., Tavili A., Abbasi H., Rostampour M. 2011.** Relationship between environmental factors and plant distribution in arid and semi-arid area (Case Study: Shahriyar Rangelands, Iran). American-Eurasian J Agric and Environ Science, 10(1): 97-105.

Table 3. Scientific name and sampling hills (P1: P9) in Khalatposhan rangelands.

Row	Scientifis name	P1	P2	P3	P4	P5	P6	P7	P8	P9
1	***Achillea tenuifolia* Lam.**	11.2	3.25	5.89	3.73	4.235	13.5	10.13	15.73	20
2	***Achillea Wilhelmsii* C.Koch.**	0.16	0	0	0	0	0	0	0.8	3.6
3	***Acroptilon repens* L.**	1.28	1.5	0.84	2.93	0.706	2.5	0	1.6	0
4	***Aegilops ovata* L.**	0	0	9.05	11.2	0	0	0	0	0
5	***Agropyron repens* L.**	0	0	3.16	0	0	2.75	12.8	0	12
6	***Alhagi persarum* Boiss. & Buhse.**	0.32	0	0.21	0.27	0.706	0	0.533	0	0.4
7	***Alkana bracteosa* Boiss.**	0	0.75	3.79	0.8	0	0.25	0.267	0.533	0
8	***Allium ampeloprasum* L.**	0.48	1.25	0.42	2.4	0.941	1.5	1.067	1.067	5.6
9	***Allyssum sp.***	0.08	0	0	0	0	0	0	0	0
10	***Alyssum dasycarpum* stapf**	12.24	18.8	9.05	1.87	39.76	8.75	17.07	33.87	4
11	***Artemisia fragrans* Willd.**	0	0	16.8	0	0	0	0	0	0
12	***Artemisia sp.***	0	0	0	0	0	0	3.733	0	0
13	***Artemisia splendens* Willd.**	0	0	0	0	0	5.5	0	0	0
14	***Astragalus (Hymenostegis) lagopoides* Lam.**	0.24	0	0	0	0.471	0.25	0	0	0
15	***Astragalus (Onobrychium) effusus*.**	0.24	0	0	0	0	0	0	0	0
16	***Astragalus (Tragacantha) parrowianus.***	0.24	0.75	0.42	0.53	1.647	1.75	0	2.4	1.2
17	**Astragalus (Tragacantha) strictifolius**	0.08	0	0	0	0	0	0	0	0
18	***Astragalus sp.***	1.28	0	0	0	0	0	0	0	0
19	***Astragalus(Grammocalyx) grammocalyx* Boiss.&hohen.**	0	0	0	3.2	0	0.25	0	0	0
20	***Atrriplex tatarica* L.**	0	0	0	0	0.235	0	0.267	0	0
21	***Bromos sterilis* L.**	8.96	26.8	32.6	8	8	1.75	15.73	37.6	0
22	***Bromus arvensis* L.**	1.04	0	19.2	5.6	13.41	11	11.2	13.87	30.8
23	***Bromus japonicus* Thub**	3.44	0	0	0	0	0	0	0	0
24	***Bromus tectrom* L.**	36.48	49	9.26	11.7	9.647	7.5	49.07	0.533	8.8
25	***Camelina rumelica* L.**	0.08	0	0	0	0	0	0	0	0
26	***Capsella bursa-pastoris***	0	0	0	0	0.471	0	0	0	0
27	***Centaurea pulchella* ledeb.**	0.08	0	0	0	0	0	0	0	0
28	***Centaurea virgata* Lam.**	0	0	0	0	2.588	0	0	0	0
29	***Ceratocarpus arenarius* L.**	16	45.8	22.5	26.1	7.059	9.75	14.67	62.4	20.4
30	***Chenopodium album* L.**	0.16	0	0.42	0	0	0.25	1.6	0	0.4
31	***Couisnia urumiensis* L.**	0	0	0.21	0	0	0	0	0	0
32	***Crepis foetida* L.**	0.72	0	0.21	0.53	0	0	0	0	0
33	***Cynodon dactylon* L.**	0	0	5.26	0	0	0	0	0	0
34	***Descurainia sophia* L.**	0	0.25	0.21	0	0.706	0.25	0.533	0	0
35	***Dianthus crinitus* SM.**	0	0	0	0	2.118	0	0	0	0
36	***Dianthus orientalis* Adams**	0	0	0.84	0	0	0	5.333	0	3.6
37	***Echinops pachyphyllus* Rech.f.**	0	0	0.42	0	0	0	0	0	0
38	***Erodium cicutarium* (L.) L'Her.**	1.28	2.25	4.21	1.87	0	2.75	3.2	0	0
39	***Ersimum persicum* Boiss.**	0.08	0	3.79	3.2	1.647	0	0	0	0
40	***Erygnium coeruleum* Bieb.**	0	0	0	0	0	0.75	0	0	0
41	***Erysimum repandum* L.**	0	0	0	0	0	0	0.267	0	0
42	***Euphorbia seguieriana* NECK.**	3.04	1.25	2.53	1.07	1.412	12	0.8	3.467	2
43	***Euphorbia Szovitsii* Fisch. Et Mey.**	0	0.25	0	0	0	0	0	0	0
44	***Ferula Behboudiana* (Rech. F. & Esfand.) Chamberlain**	0	0.25	0.42	0.27	0	1	0	0.267	0
45	***Ferula szowitsiana* Dc.**	0.72	0	0	0	0	0	0	0	0

46	*Fumaria asepala* Boiss.	0	0	0	0	0	0	0.8	0	0
47	*Gypsophila bicolor* (freyn&sint) Grosh.	0	0	0	0	0	0	0	0.267	0
48	*Heliotropium lasiocarpum* fich. C.A. Mey	0.24	0	0	0	0	0	0	0.533	0
49	*Hordeum glaucum* Steud.	0	0	0	0	0	0	0	0.8	0
50	*Hordeum spontaneum* L.	0	0	0	0	0.941	0	0	0	0
51	*Hyoscyamus pusillus* L.	0	0	0	0	0	0.25	0	0	0
52	*Iris barnumae* Baker	0.16	0	0	0	0	0	0	0	0
53	*Jurinea Iptoloba* DC.	0	0	0	0	0	2.25	1.6	1.6	0
54	*Koelpinia linearis* L.	0.08	0	0	0	0	0	0	0	0
55	*Lactuca scariola* L	0	0	0	0	0	0.25	0.533	0	0
56	*Lappula barbata* (M.B.) Gurke	0	0	0	0	0	0	0.533	0	0
57	*Lepidium perfoliatum* L.	0.08	0	0	0	0	0	0	0	0
58	*Lepidium vesicarium* L.	6.16	0.25	1.47	0	3.059	5.25	2.933	0.533	0
59	*Linaria lineolata* sonsu. Groossh.	0	0	0	0	0.471	0	0	0	0
60	*Linum usitatissimum* L.	0.08	2.25	0.84	0.8	0	2	0	3.733	3.6
61	*Lolium rigidum* L.	38.96	0	0	0	0	0	0	0	0
62	*Lycium ruthenicum* Murray	0.32	0	0	0	0	0	0	0	0
63	*Medicago sativa* L.	0	0	0	0	0	0	0.533	0	0
64	*Melilotus officinalis* (L.) Pall.	0.32	0	0	0	0	0	0	0	0
65	*Moltkia longiflora* (Bertol.) wettst	1.36	0	0	0	0	0	0	0	0
66	*Muscari tenuiflorum* Tausch	1.68	0	0	0	0	0	0	0	0
67	*Noea Mucronata* L.	0.64	2	2.32	0	0	1	0.8	0	0
68	*Nonnea persica* Boiss.	0	0.25	0	1.6	0.471	0	0	0.533	0
69	*Onobrychis atropatana* Boiss.	0.48	0	2.95	3.47	0	0	2.667	0.533	0
70	*Onobrychis Hohenackeriana* C.A.MEY.	2.8	7.5	0	0	0	0	2.667	4.267	7.2
71	*Onopordon acanthium* L.	0	0	0	0	0	0	0	0.267	0
72	*Peganum Harmala* L.	0	0	0.21	2.67	0	0	0	0	0
73	*Pimpinella aurea* DC.	0	0	0	0	0.941	0	1.333	0	0
74	*Pimpinella saxifraga* L.	0	0	0	0	0	0	7.2	0	0
75	*Poa bulbosa* L.	102.3	102	98.3	112	101.9	105.3	68.8	121.6	82.8
76	*Rochelia macrocalyx* Bge.	3.92	0	0	0	0	0	0	0	0
77	*Salsola kali* L. subsp. *iberica* Sennen & Pau	1.68	0	0	0	0	0	0	0	0
78	*Salsola dendroides* pallas.	0	0	0.84	0.8	0.471	1.25	1.6	0	0
79	*Salsola kali L. subsp. Tragus* (L.) Nyman	10.32	27	21.1	26.7	12	31.25	19.47	17.87	9.6
80	*Salvia nemerosa* L.	9.76	5	5.68	3.47	1.176	3.25	4.267	7.733	4.4
81	*Scariola orientalis* L.	0.16	0.5	0	0	0	0	0	0	1.6
82	*Scrophularia striata* Boiss.	0	0	1.26	0	0	0	0	0	0
83	*Senecio glaucus* L.	0.32	0	0	0	0	0	0	0	0
84	*Senecio vulgaris* L.	0.24	0.5	0.42	0.27	1.882	2.75	0	0	0.8
85	*Sisymbrium altisimum* L.	0	0	0	0	0.235	0	0.533	0	0
86	*Solanum nigrum* L. Var *nigrum*	0	0	0	0.27	0	0	0	0	0
87	*Sonchus oleraceus* L.	0.16	0	0	0	0	0	0	0	0
88	*Stackys inflata* Benth	0.8	7	3.58	1.6	0	0	0	0	0
89	*Stipa sp.*	6.24	16.5	6.32	9.07	29.41	23.25	7.2	16.27	20
90	*Taeniatherum crinitum* (Shreb.) Nevski.	0.88	0	0	0	0	0	0	0	0
91	*Teucrium polium* L.	0	0	0	0	0	0	0	0.533	0
92	*Thesium arvence* Horvatovsky	0	0	0	0	0	0	0	0.267	0
93	*Thymus Kotschyanus* Boiss.& Hohen.	0.4	0	0	0	0	0	0	0	0
94	*Tragopogon kotsschys* boiss	0.48	0	0	0	0	0	0	0	0
95	*Trigonella fischeriana* Ser.	0.08	0	0	0	0	0	0	0	0
96	*Trilobus terresteris* L.	0	0	0	0	4.706	0	1.067	0	0
97	*Verbascum kurdicum* Hub.Mor.	0	0	0.21	0.53	0	0	0	0.267	2.8
98	*Verbascum nudicaule* (WYDL.) TAKHT.	0	0	0	0	0.235	2	0	0	0
99	*Xeranthemum squarrosum* Boiss.	0	0	0	0	1.882	0	0	0	0
100	*Ziziphora tenuir* L.	0	4	11.4	0.53	0	0	0	0	0

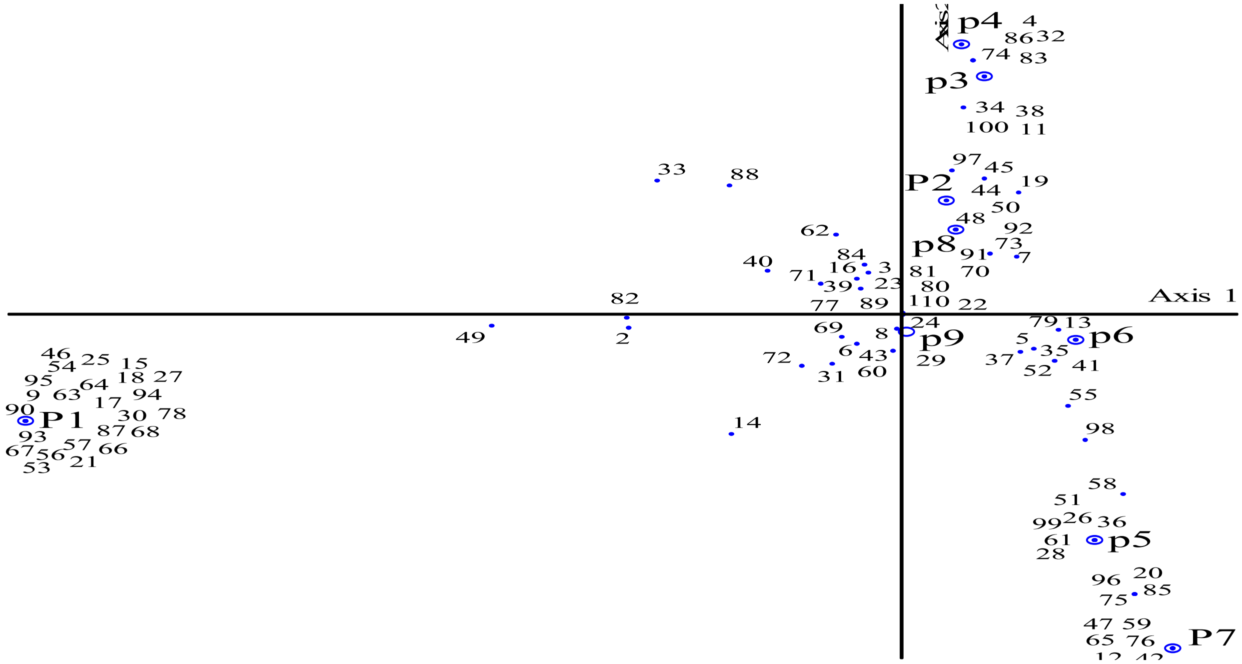

Figure 1. Two-dimensional; scatter plot of principal component analysis (PCA) ordination method for 100 plant species in Khalatposhan rangelands. See Table 3 for description of plants code and found their scientific name).