

Evaluation of Biomorphological Diversity and Distribution of Vetch (*Vicia* L.) Species in Azerbaijan

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The article presents the results of the study of the estimation of the biomorphological diversity of 12 *Vicia* L. species covering 33 populations. Expedition materials and descriptor information collected by authors in various botanical and geographical regions of Azerbaijan are analyzed.

Keywords: *Vetch, biomorphological diversity, species, genus, areal*

INTRODUCTION

Vetch (*Vicia* L.) is one of the most widely spread genera of the *Fabaceae* Lindl. of the *Magnoliopsida* class. The species included into the genus spread across the northern hemisphere, including the middle mountain ranges in Azerbaijan. *Vicia* was first described by K. Linney (Linnaeus, 1753). There are 200 species of vetch (*Vicia* L.) (Tsvelyov, 1987) in the world flora, and 41–43 species of vetch in Azerbaijan (Asgarov, 2011). B.A. Fedchenko grouped 83 species of vetch for the USSR flora into 3 subgenera, 4 sections, 31 rows; 41 species of vetch of Azerbaijan were grouped into 3 subgenera, 20 rows (Fedchenko, 1948). In the "Caucasian Flora" it has been noted that there are 150 species of vetch in the world, 48 wild species and one cultivar in Caucasus (Grossheim, 1952). Caucasian species were studied by A.Radghi (Radghi, 1971) and N.Tsvelyov worked with the vetch species of the eastern part of Europe (Tsvelyov, 1987). Turkish species were studied by P.Davis and U.Plitman (Davis, Plitman, 1970). The only taxonomic study on the whole genus was conducted by F. K. Kupicha at the world level (Kupicha, 1973, 1975, 1976). Although in the multivolume "Flora of Azerbaijan" 41 wild species and 1 cultivar have been described, in "The plant world of Azerbaijan" of A. Asgarov the information on 43 wild species and 1 cultivar have been given (Asgarov, 2016). The varietal systematic biomorphological diversity of genus has not been widely studied and evaluation of the status of rare species on international standards has not been carried out.

MATERIALS AND METHODS

In 2017, in the Department of Ecobotanics and Systematics of the Institute of Genetic Resources, under the guidance of A. Asgarov at the expeditions 12 species, 33 populations of herbarium and seeds

were collected and studied. Moreover, collections of the Herbarium Funds of the Institute of Botany of ANAS, the Genetic Resources Institute (AGRI) and the Institute of Botany of the Republic of Georgia (TBI) were studied as a research material. The literature and Internet data have been analyzed. The definition of the nomenclature issues is based on The International Botanical Code (Austria, Vienna, 2005; Allkin et al., 1986) In the determination of species and identification of their nomenclature "Flora of Azerbaijan" and A. Asgarov's books were used (Asgarov, 2011, 2016), in the analysis of other features Ch. Raunkier (Raunkiaer, 1937) and I.Serebryakov's classification (Serebryakov, 1964) were used. Comparative morphological (Gunn and Kluge, 1969; 1970; 1976) floristic (Tupikova, 1926), biomorphological, sistematic (Maxted, 1990, 1995) phytocenological and experimental methods (Leht, 2005) were used in the research.

RESULTS AND DISCUSSION

Vetch (*Vicia* L.) is one of the highest quality, two and perennial fodder grass. Morphological signs are important in systematic of vetch species, as well as in the design of the prescribed keys. The main characteristic of the genus is the column, correlation of crown and calyx lobe, and the leaf finish with clasper. The calyx tube is usually curved from the base. The vexillum is hollow or full. The wing petals are joined to slipcover. The column is thoroughly hirsute or unilateral bearded on the top, rarely naked.

Species are distinguished by the color of the crown, the shape of the flower, the characteristics of the leaf and stipule, the fruit and seeds.

The leaves are pair featherlike, ends with many or less branched beads, or with a sharp end, sometimes with a single leaf. **Stipules** are often semi-gothic shaped. **The flowers** are 1 or 2-3, lo-

cate in the axillary bud, almost as a sessile or cluster is multi-flowered. The peduncle is longer than the leaves, or equal to it, and sometimes is shorter. **The corolla** is yellow, red, purple, blue, blue, matte or dark purple, red-purple, blue, yellowish-orange, bright purple, pale blue, bright blue and so on in colors. **Calyx** is 5 toothed, usually it has 3 upper are longer than 2 down teeth. **The corolla resembles** is a common butterfly structure. 9 adjacent stamens form a pipe, and 1stamen is free. **The vexillum** is undescribed claw, the wings are almost equal to the claw, slipcover are blunt, shorter than the vexillum, sometimes with the same length. **The stem** is gentle or sloppy, externally tight or sparse, sometimes almost naked, flat shield or creeping. **Legume** is on short or long stalk; Legume is too or less squeezed; it is hirsute or sliced; cylindrical, bead shaped. Usually it is multi-seeded, and sometimes it is two-seeded. Legume is soft, fluffy, or

bare. Cytological studies show that the genus has a chromosome set of $2n=10, 12, 14, 16, 18, 28$.

The distribution of the vetch species is based on five major botanical-geographical regions of Azerbaijan: 1. Greater Caucasus, 2. Lesser Caucasus, 3. Kura-Araks, 4. Talysh region, 5. Nakhchivan. The results of our research show that the vetch is more widely spread in the Greater Caucasus region of Azerbaijan (34 species). From the species of vetch 27 spread in Talysh region, 26 in the Lesser Caucasus, 24 in Nakhchivan, and 12 species in Kura-Araks. You can see this in the table blow (Table 1).

33 routes were selected in different regions of Azerbaijan for exploration of vetch species, distinguished by certain bioecological characteristics, and were coded for identification. Range maps of the collected species were compiled using DIVA-GIS computer program (Figure 1).

Table 1. Distribution of *Vicia* L. species in botanical-geographical regions

No	Name of species	Botanical-geographical regions				
		Greater Caucasus	Lesser Caucasus	Kura-Araks	Talysh	Nakhchivan
1	2	3	4	5	6	7
1	<i>Vicia abbreviata</i> Fisch.ex Spreng. (<i>V.truncatula</i> Fisch.ex Bieb.)	+	+	+	+	+
2	<i>V. alpestris</i> Stev.	+				
3	<i>V.amphicarpa</i> Lam.	+	+		+	
4	<i>V. anatolica</i> Turill (<i>V.hajastana</i> Grossh.)					+
5	<i>V. angustifolia</i> Reichard	+	+	+	+	+
6	<i>V. antiqua</i> Grossh.	+	+			
7	<i>V. balansae</i> Boiss.	+	+			+
8	<i>V. bithynica</i> (L.) L.	+			+	
9	<i>V. boissieri</i> Freyn	+	+		+	
10	<i>V. cappadocica</i> Boiss.et Bal. (<i>V. paucijuga</i> (Trautv.) B.Fedtsch.)				+	+
11	<i>V.cassubica</i> L.	+			+	
12	<i>V.caucasica</i> Ekvim.	+				
13	○ <i>V. ciceroidea</i> Boiss.(<i>V. rafigae</i> Tamamsch.)					+
14	<i>V.cilliatula</i> Lipsky	+			+	
15	<i>V. cinerea</i> Bieb.	+	+	+	+	+
16	<i>V. cordata</i> Wulf. ex Hoppe	+		+	+	+
17	<i>V. crocea</i> (Desf.) Fritsch	+	+		+	
18	<i>V. elegans</i> Guss.		+			+
19	<i>V. ervilia</i> (L.) Willd.	+	+		+	+
20	<i>V. grandiflora</i> Scop.	+	+	+	+	+
21	<i>V. grossheimii</i> Ekvim.	+	+			+
22	○ <i>V. hololasia</i> Woronow	+	+			
23	<i>V.hirsuta</i> (L.) S.F.Gray	+	+		+	+
24	<i>V. hybrida</i> L.	+	+	+	+	+
25	<i>V. hyrcanica</i> Fisch. et C.A.Mey.				+	+
26	<i>V. iberica</i> Grossh.	+				
27	<i>V. larissae</i> Prima	+				
28	<i>V. lathyroides</i> L.		+		+	
29	○ <i>V. loiseleurii</i> (Bieb.) Litv. (<i>V. meyeri</i> Boiss.)	+			+	
30	<i>V. lutea</i> L.	+			+	+
31	<i>V. narbonensis</i> L. (<i>V. johannis</i> Tamamsch.)	+	+	+	+	+
32	<i>V. nissoliana</i> L.(<i>V.variegata</i> Willd.)		+			+
33	<i>V. pannonica</i> Crantz	+	+	+	+	+
34	<i>V. peregrina</i> L.	+	+	+	+	+
35	<i>V. pilosa</i> Bieb.		+			

Continued table 1

1	2	3	4	5	6	7
36	<i>V. sativa</i> L.	+	+	+	+	+
37	<i>V. semiglabra</i> Rupr.ex Boiss	+				
38	<i>V. serratifolia</i> Jacq.				+	
39	<i>V. sepium</i> L.	+	+			
40	<i>V. tetrasperma</i> (L.) Schreb.	+	+		+	+
41	<i>V. variabilis</i> Freyn et Sint.	+	+	+	+	+
42	<i>V. varia</i> Host (<i>V. dasicarpa</i> auct.)	+	+	+	+	+
43	<i>V. villosa</i> Roth	+				
Total		34	26	12	27	24

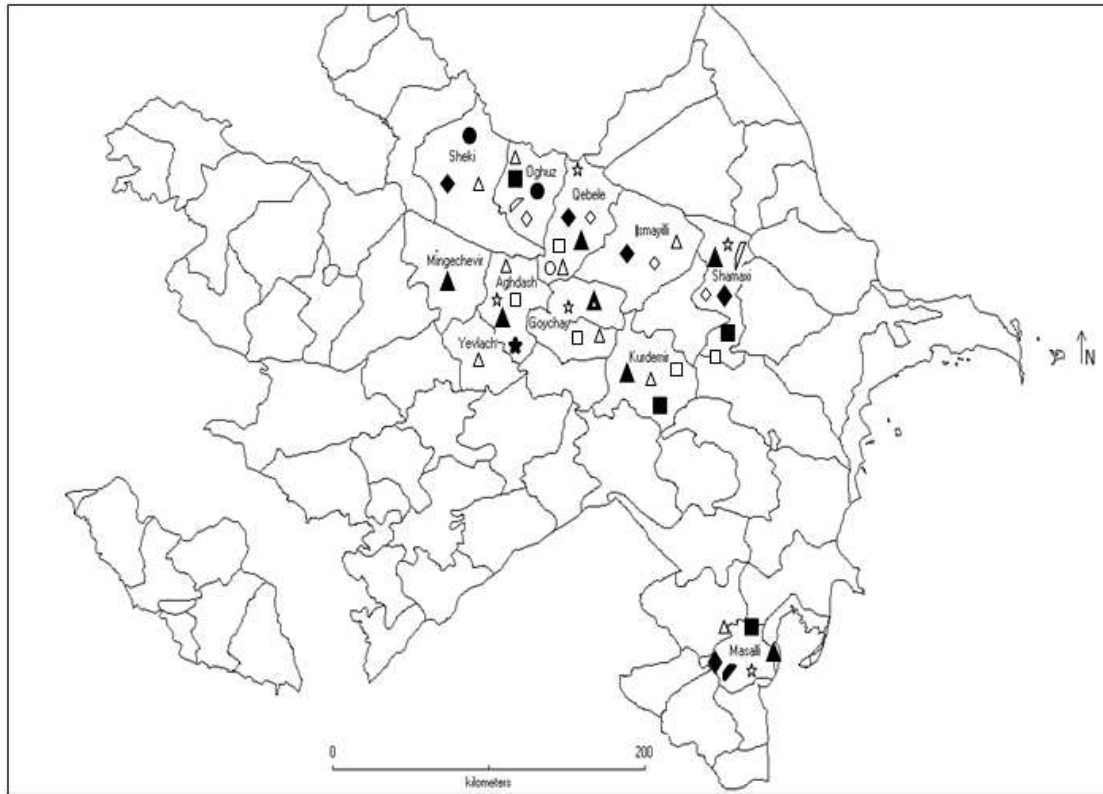


Figure 1. Distribution of *Vicia* L. species in Azerbaijan: Δ - *V. sativa* subsp. *nigra*; \blacktriangle - *V. sativa* subsp. *sativa*; \square - *V. peregrina*; \blacksquare - *V. tetrasperma*; \star - *V. lutea*; \star - *V. monantha* subsp. *monantha*; \blacklozenge - *V. narbonensis*; \diamond - *V. pannonica*; \circ - *V. villosa*; \bullet - *V. abbreviata*; ▮ - *V. tenuifolia* subsp. *variabilis*; ▮ - *Vicia bithynica*.

As you can see from the table (Table 2) the most types were collected from meadows (17 species), at least types from forest area (4 species).

Ecological assessment of vetch species on climate parameters has been carried out. It was found that in the *min* height were collected *V. lutea*, *V. bithynica* (-25 m) in Masally region, Tekle village territory, *Max* height from Shamakhi city, Pirgulu village, were collected *V. narbonensis*, *V. peregrina*, *V. variabilis* and *V. sativa* subsp. *nigra* (1430 m).

Due to environmental factors in the biomorphological structure of species have been observed significant changes. Information about the amount of annual rainfall, temperature (T_{\min} - minimum temperature, T_{\max} - maximum temperature for month and T_{oi} - average annual temperature) is established by using program DIVA-GIS and is as follow (Scheme1).

The average annual rainfall has been determined by the fact that on *min* rainfall were collected *V. peregrina*, *V. sativa* subsp. *nigra*, *V. tetrasperma* from territory of Kurdamir region, Karrar village (360 mm), on the maximum rainfall were collected *V. lutea*, *V. narbonensis* from territory of Masally region, Kalinovka village (701 mm). *Min* temperature for January was encountered in territory of Oguz region, Dashagil village (-17.4°C), max temperature in territory of Geokchay city, Mirzaguseynly village (33.2°C). *Min* average annual temperature was observed in territory of Oguz region, Dashagil village (-7.5°C), max average annual temperature in territory of Yevlach region, Haciselly village (20.5°C).

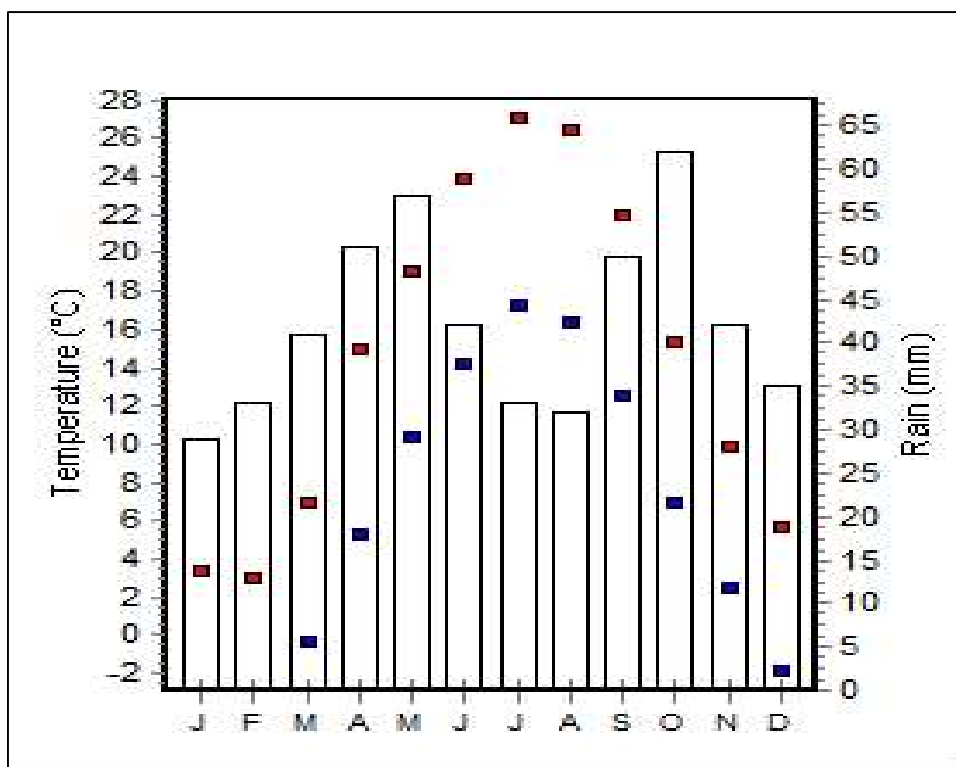
Table 2. Vetch species seeds and herbariums collected from research sites and their ecological-geographical data

Locality code	Name of collected species	Date	Locality and site description	Relief	Slope	ST	Latitude and longitude	Alt (m)
1	2	3	4	5	6	7	8	9
AZE17K2 M1	<i>Vicia sativa</i> subsp. <i>nigra</i> <i>V. sativa</i> subsp. <i>sativa</i>	15.05.2017	Kurdami region, Garis-Ayriband village, GR	L2	N	SC	N 40°20' 574 E 048° 22' 548	8
AZE17K3 M2	<i>V. peregrina</i> ; <i>V. sativa</i> subsp. <i>nigra</i> <i>V. tetrasperma</i>	15.05.2017	Kurdami region, Karrar village, WS, around of the swamp	L2	N	SC	N 40° 18' 220 E 048° 16' 162	5
AZE17K4 M3	<i>V. sativa</i> subsp. <i>nigra</i>	16.05.2017	Yevlach region, Haciselly village, GR	L2	S	SA	N 40° 43' 105 E 047° 07' 143	20
AZE17K5 M4	<i>V. sativa</i> subsp. <i>nigra</i>	16.05.2017	Yevlach region, road of Xaldan, RS	L2	S	CY	N 40° 43' 582 E 047° 11' 810	21
AZE17K6 M5	<i>V. sativa</i> subsp. <i>nigra</i>	16.05.2017	Agdash region, Upper Nematabad village, GR	L2	S	SC	N 40° 41' 794 E 047° 18' 360	12
AZE17K7 M6	<i>V. sativa</i> subsp. <i>sativa</i>	16.05.2017	Mingachevir city, the 7th km of road Chaldan, GR	L2	W	CY	N 40° 44' 260 E 047° 08' 460	28
AZE17K9 M7	<i>V. lutea</i> , <i>V. monantha</i> subsp. <i>monantha</i> , <i>V. peregrina</i> , <i>V. sativa</i> subsp. <i>sativa</i> , <i>V. tetrasperma</i>	17.05.2017	Agdash region, Agchayazi village, the right bank of Turyanchay	O5	S	SC	N 40° 42' 972E 047° 33' 010	107
AZE17K10 M8	<i>V. sativa</i> subsp. <i>sativa</i>	17.05.2017	Agdash region, Xosrov village, GR	L2	E	SC	N 40° 38' 277 E 047° 34' 847	34
AZE17K11 M9	<i>V. lutea</i> <i>V. peregrina</i>	17.05.2017	Geokchay city, Mirzaguseynly village, Upper-Shirvan kanal, RS	L2	N	SC	N 40° 38' 871 E 047° 37' 512	55
AZE17K12 M10	<i>V. sativa</i> subsp. <i>nigra</i> <i>V. sativa</i> subsp. <i>sativa</i>	18.05.2017	Geokchay city, Bygyr village, GR	O5	W	SC	N 40° 37' 773 E 047° 53' 674	151
AZE17K13 M11	<i>V. lutea</i> <i>V. sativa</i> subsp. <i>nigra</i>	18.05.2017	Geokchay city, Karayazy village, GR	O5	N	CY	N 40° 37' 186 E 047° 59' 107	173
AZE17K14 M12	<i>V. narbonensis</i> <i>V. pannonica</i> <i>V. sativa</i> subsp. <i>nigra</i> <i>V. sativa</i> subsp. <i>sativa</i>	18.05.2017	Ismaily region, Kurdmashy village, GR	O5	N	CY	N 40° 38' 322 E 048° 03' 195	268
AZE17K15 M13	<i>V. lutea</i> <i>V. sativa</i> subsp. <i>nigra</i>	18.05.2017	Geokchay city, Karamaryam village, the grain area of Chermodil, GR	O5	W	CY	N 40° 35' 303 E 048° 01' 146	199
AZE17K16 M14	<i>V. sativa</i> subsp. <i>nigra</i>	19.05.2017	The right side of road Shamakhy - Akhsu	O5	W	SA	N 40° 36' 233 E 048° 26' 209	739
AZE17K17 M15	<i>V. lutea</i> <i>V. pannonica</i> <i>V. sativa</i> subsp. <i>sativa</i>	19.05.2017	Shamakhy city, Sagyan village, GR	E6	N	CY	N 40° 38' 912 E 048° 29' 266	745
AZE17K18 M16	<i>V. lutea</i> , <i>V. pannonica</i> , <i>V. narbonensis</i> , <i>V. peregrina</i> <i>V. sativa</i> subsp. <i>nigra</i> , <i>V. tenuifolia</i> subsp. <i>variabilis</i> , <i>V. sativa</i> subsp. <i>sativa</i>	19.05.2017	Shamakhy city, Madrasy village, GR	O5	N	SC	N 40° 38' 650 E 048° 36' 061	696
AZE17K19 M17	<i>V. narbonensis</i> , <i>V. peregrina</i> , <i>V. variabilis</i> , <i>V. sativa</i> subsp. <i>nigra</i>	20.05.2017	Shamakhy city, Pirgulu village, FO	E6	S	SC	N 40° 46' 864 E 048° 36' 168	1430
AZE17K20 M18	<i>Vicia peregrina</i> , <i>V. pannonica</i> , <i>V. narbonensis</i> , <i>V. lutea</i> , <i>V. sativa</i> subsp. <i>nigra</i> , <i>V. sativa</i> subsp. <i>sativa</i> , <i>V. villosa</i> subsp. <i>varia</i>	20.05.2017	Shamakhy city, Mirzandiya village, GR	L2	S	SC	N 40° 34' 737 E 048° 43' 648	584
AZE17Z1 M19	<i>V. pannonica</i> , <i>V. sativa</i> subsp. <i>sativa</i>	19.06.2017	Kabala region, Lesser Amily village, GR	O5	E	SC	N 40° 84' 509 E 047° 79' 514	381
AZE17Z3 M20	<i>V. pannonica</i> , <i>V. villosa</i> subsp. <i>varia</i>	19.06.2017	Kabala region, Lesser Piraly village, GR	O5	N	SC	N 40° 92' 637 E 047° 76' 994	552
AZE17Z4 M21	<i>Vicia narbonensis</i> , <i>V. pannonica</i> , <i>V. sativa</i> subsp. <i>nigra</i>	20.06.2017	Kabala region, Yenikand village, GR	E6	S	SC	N 40° 84' 938 E 047° 85' 043	589
AZE17Z6 M22	<i>V. pannonica</i>	21.06.2017	Oguz region, Bayan village, RS	L2	W	S C	N 41° 03' 521 E 047° 44' 025	463

Continued Table 2

1	2	3	4	5	6	7	8	9
AZE17Z7 M23	<i>V. abbreviata</i> , <i>V. variabilis</i> , <i>V. sativa</i> subsp. <i>nigra</i>	21.06.2017	Oguz region, Dashagil village, FO	O5	N	SC	N 41° 14' 513 E 047° 42' 252	1010
AZE17Z9 M24	<i>V. lutea</i> , <i>V. narbonensis</i> , <i>V. pannonica</i> , <i>V. peregrina</i> , <i>V. sativa</i> subsp. <i>nigra</i>	22.06.2017	Kabala region, Amirvan village, WS	O5	S	CY	N 40° 81' 906 E 047° 88' 421	535
AZE17Z10 M25	<i>V. sativa</i> subsp. <i>nigra</i> , <i>V. tetrasperma</i>	23.06.2017	Oguz region, Muchas village, WS	O5	N	GR	N 41° 09' 619 E 047° 36' 447	708
AZE17Z11 M26	<i>V. abbreviata</i>	23.06.2017	Sheki region, Kysh village, FO	E6	S	SC	N 41° 25' 885 E 047° 18' 615	995
AZE17Z12 M27	<i>V. narbonensis</i> , <i>V. sativa</i> subsp. <i>nigra</i>	23.06.2017	Sheki region, Juma village, FO	O5	W	GR	N 41° 22' 496 E 046° 89' 632	262
AZE17Ma1 M28	<i>V. sativa</i> subsp. <i>sativa</i>	12.07.2017	Masally region, Sharafa village, RS	L2	N	CY	N 39° 05.205 ' E 48° 67.377 '	-15 d.s.h
AZE17Ma2 M29	<i>V. sativa</i> subsp. <i>nigra</i> <i>V. tetrasperma</i>	12.07.2017	Masally region, Shychlar village, around of the Shychlar river	O5	W	SC	N 38° 58.48 ' E 48° 33.54 '	98 d.s.h
AZE17Ma3 M30	<i>V. sativa</i> subsp. <i>nigra</i>	13.07.2017	The road of Masally – Yardymly, RS	O5	S	SC	N 38° 57.43' E 48° 31.19'	154 d.s.h
AZE17Ma5 M31	<i>V. bithynica</i> <i>V. lutea</i>	13.07.2017	Masally region, Tekle village, around of the railway station, RS	L2	S	SY	N 39° 07.41' E 48° 40.08 '	-25 d.s.h
AZE17Ma6 M32	<i>V. bithynica</i> <i>V. lutea</i>	14.07.2017	Masally region, Kyzylagach village, around of the garden area, GR	L2	W	SC	N 39° 03.0' E 48° 49.4'	-23 d.s.h
AZE17Ma7 M33	<i>V. lutea</i> <i>V. narbonensis</i>	14.07.2017	Masally region, Kalinovka village, GR	L2	N	SC	N 39° 2.29' E 48° 46.44'	24 d.s.h

Locality code the code given to the location of collected samples. **Slope** E- east, N- north, S- south, W- west. **Site description** FO – forest, RS- side of road, GR- meadow, WS- bank of river. **Relief** E6- steep slope 30°; L2-plain 0°–3°; O5- foothills 16°–30°, **ST soil texture** CY- alumina; CG-clay-gravel, SA- sandy SC- sandy-clay; GR- gravel



Scheme 1. Average annual rainfall and temperature of collected samples

- - The red square is the maximum temperature indicators (T_{max})
- - The blue square is the minimum temperature indicators (T_{min})
- - Monthly precipitation (mm).

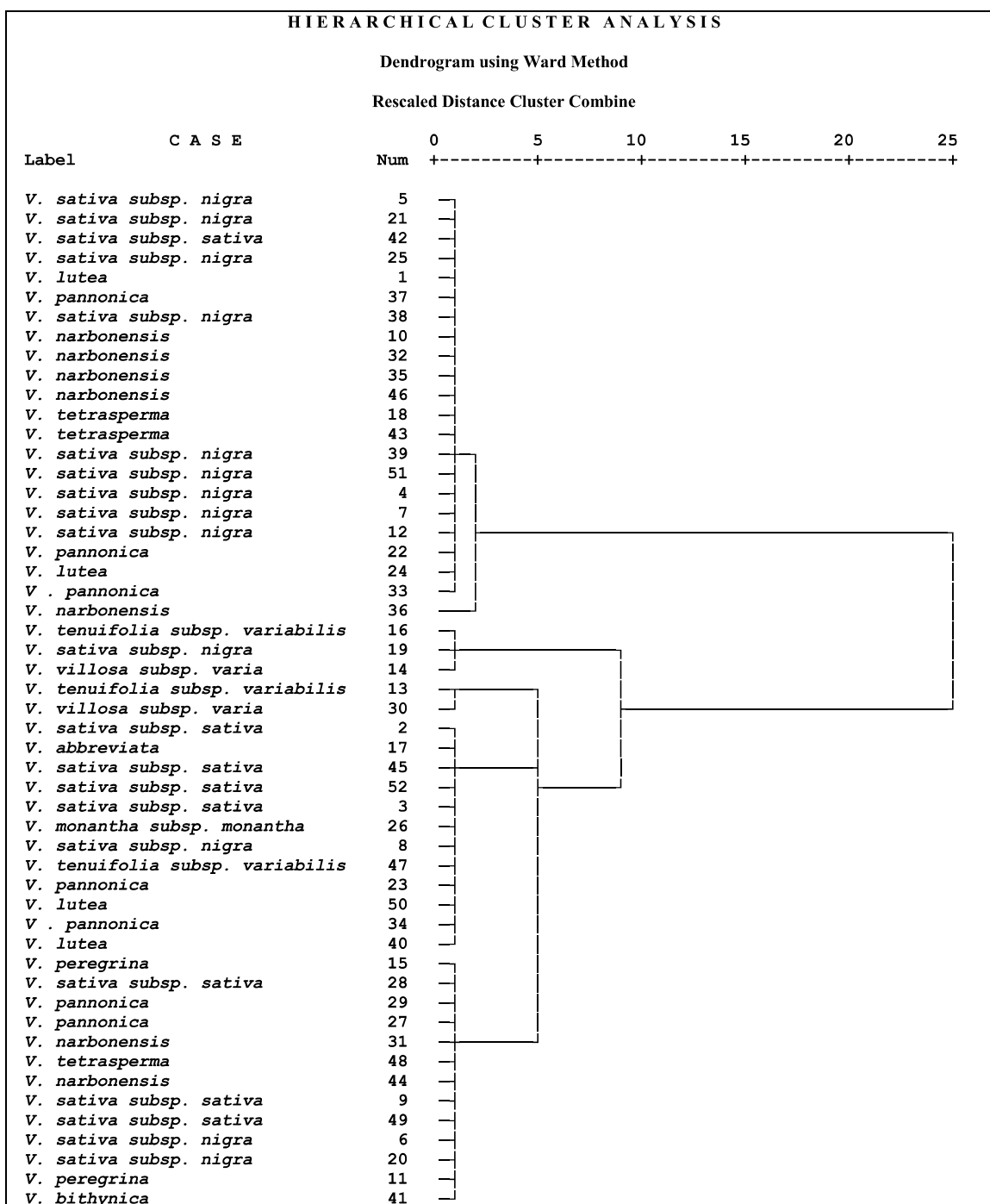


Figure 2. Unified Cluster analysis of morphological characteristics in *Vicia* L. species.

In 2017, 11 species and 33 populations were selected for phenetical (taximetric) analysis of vetch species. At least two samples were studied from each population and each population was marked as Operational Taxonomic Unit (OTU). For the biomorphological analysis, 8 quantitative characteristics (plant height, number, length, width of leaflet, number, length, width of beans, number of seeds) were selected. At least 2-3 sample parameters taken from

each population were measured and the average score was calculated. Based on the results, by using the Cluster Analysis method was carried out a taximetric analysis. The analyses were conducted through the SPSS Win (SPSS 16.0) program. The phenomenon (taximetric) relationship between *Vicia* L. species is shown in the following figure (Figure2). As we can see from the table 3 main clusters observed at the 12 level.

The first main cluster is divided to 22 groups: *V. sativa* subsp. *nigra* (4,5,7,12,21,25,38,39,51), *V. lutea* (1,33), *V. sativa* subsp. *sativa* (42), *V. pannonica* (22, 33, 37), *V. narbonensis* (10,32,35,36, 46), *V. tetrasperma* (18,43) which belongs to subgenus *Vicia* (according to Tsvelyov).

The second cluster is related to *V. tenuifolia* subsp. *variabilis* (16), *V. sativa* subsp. *nigra* (19), *V. villosa* subsp. *varia* (14) which belongs to section *Craccoide* (according to Fedchenko).

The third main cluster is composed of *V. tenuifolia* subsp. *variabilis* (8, 13), *V. villosa* subsp. *varia* (2, 30, 47), *V. abbreviata* (17), *V. sativa* subsp. *sativa* (3, 9, 28, 45, 49, 52), *V. monantha* subsp. *monantha* (26), *V. pannonica* (23, 27, 29, 34), *V. lutea* (40, 50), *V. peregrina* (11, 15), *V. narbonensis* (31, 44), *V. sativa* subsp. *nigra* (6, 20), *V. bithynica* (41) which belongs to section *Hypechusa*.

In our research three main clusters are differentiated from each other for having characters: the height of the plant, the number of leaflets, the number of legumes and the number of seeds.

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Azərbaycanın Lərgə (*Vicia* L.) Növlərinin Yayılması və Biomorfoloji Müxtəlifliyinin Qiymətləndirilməsi

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Məqalədə 2017-ci ildə Azərbaycanın müxtəlif bölgələrindən toplanılmış 12 növə, 33 populyasiyaya aid lərgə növləri, onların deskriptor məlumatları əsasında yayılması və biomorfoloji qiymətləndirilməsi nəticələr verilmişdir.

Açar sözlər: Lərgə, biomorfoloji müxtəliflik, növ, cins, areal

Распространения Видов Рода *Vicia* L. в Азербайджане и Оценка Их Биоморфологического Разнообразия

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В статье приводятся результаты исследования оценки биоморфологического разнообразия видов рода *Vicia* L. (12 видов, 33 популяции). Анализируются экспедиционные материалы и данные дескрипторов, собранные авторами в различных ботанико-географических районах Азербайджана.

Ключевые слова: Вика, биоморфологическое разнообразие, вид, род, ареалы