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Distribution and Ecobiological Research of Vetch (*Vicia L.*) Species in Azerbaijan

K. V. Asadova* and A. M. Asgarov

Genetic Resources Institute of ANAS, Azadlig Ave. 155, Baku, AZ1106, Azerbaijan

*Corresponding author.

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ABSTRACT

In this article was presented the results of seed samples and about 200 herbarium specimens of 17 vetch species collected on 36 routes from different regions of Azerbaijan in 2015-2017, distribution based on their descriptive data, evaluation based on morphological and ecological indicators. In the study, first main cluster is divided to 12 groups: *V. tenuifolia* subsp. *variabilis* (Z02, Z7, E8), which belongs to subgenus *Cracca* (according to Radghi, Fedchenko); *V. narbonensis* (K20)- which belongs to section *Faba*, *V. villosa* (Z3), *V. sativa* subsp. *sativa* (Q2, K14, A1-1) - to section *Vicia*, *V. lutea* (C4, K18), *V. pannonica* (Z4) - to section *Hypechusa* and *V. abbreviata* (Z11)- to section *Atossa* (according to Kupicha) and the fourth main cluster which is related to 10 samples.

Introduction

Vetch (*Vicia L.*) is one of the most widely spread genera of the *Fabaceae* Lindl. of the class *Magnoliopsida*. The species included into the genus are spread across the northern hemisphere, including the middle mountain ranges in Azerbaijan. The species of genus are precious fodder plants. It contains many proteins. Dry and green mass is best used by animals (Brainard, et al. 2012). *Vicia* was first described by K. Linney (Linneaus, 1753). In the world flora, there are 200 species of vetch (*Vicia L.*) (Tsvelyov, 1987) and 41-43 species of vetch in Azerbaijan (Asgarov, 2011).

Although different classical botanists in the Caucasus expressed interesting ideas about the genus *Vicia L.*, its classification, and the types in Azerbaijan, B. Fedchenko gave the first comprehensive system of this genus "in the USSR Flora". He divided this genus into 3 subgenera, 4 sections, 31 rows. Forty one species of vetch of Azerbaijan are grouped into 3 subgenera, 20 rows (Fedchenko, 1948).

Although Grossheim described the genus of the "Caucasian flora" (1952), he adopted the system of Fedchenko. He noted that that there are 150 species

of vetch in the world, 48 wild species and one cultivar in Caucasus (Grossheim, 1952). In 1970, Dagestani botanist A. D. Radghi published the Caucasian species of *Vicia* L. genus. In own proposed system, Radghi adopted a large number of subsections and series (Seriaes) within the sections, using the division of the genus into the sub-genera. She has shown the spread in total 36 species of this genus and has grouped them into 3 subgenera, 8 section, 19 subsection and 12 series (Radghi, 1971). 28 wild and 1 cultivated species of Azerbaijan were divided into 3 subgenera, 8 sections, 16 subsection and 11 series in this system.

In the 80's, the Petersburg botanic Tsvelyov developed the system of *Vicia* genus spreading in eastern Europe. Here, too, the division of genera into subgenera is accepted. The Caucasus, including Azerbaijan, is also reflected in this system. He has divided the *Vicia* genus into 3 subgenera (*Cracca*, *Ervum* and *Vicia*) and sections (*Oroboidea*, *Cracca*, *Lenticula*, *Ervum*, *Ervilia*, *Sepium*, *Hypechusa*, *Vicia*, *Lathyroides*, *Pseudolathyrus* and *Faba*), has given series of Radji within the subseries and has described several new sections (*Oroboidea*, *Lenticula*, *Ervilia*, *Hypechusa*, *Lathyroides* and *Pseudolathyrus*). In 1987, Tsvelyov improved the system of *Vicia*, which he proposed earlier in the "Flora of the European part of USSR" (Tsvelyov, 1987).

Systematic of the *Vicia* L. genus of Turkish flora were studied by P. Davis and U. Plitman (Davis, Plitmann, 1970). In this system vetch species has been distributed in 3 groups. Turkish species has been grouped into 58 wild and 1 cultural species in 3 groups, Azerbaijanian species has been grouped into 26 wild and 1 cultural species in 3 groups.

The only taxonomic study on the whole genus was conducted by F. K. Kupicha at the world level (Kupicha, 1973, 1975, 1976). Kupicha (1979) referred to this genus of *Vicieae* tribe in "The taxonomic studies in the tribe *Vicieae* (*Leguminosae*)" and gave information about 11 sections of genus. Although in the multivolume "Flora of Azerbaijan" have been described 41 wild species, 1 cultivar, in "The plant world of

Azerbaijan" of A. Asgarov it has been given the information on 43 wild species of and 1 cultivar (Asgarov, 2016), the varietal systematics of genus and the biomorphological diversity have not been widely studied.

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 too 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, locate 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 is 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 $2n = 10, 12, 14, 16, 18, 28$ (Davis and Plitmann, 1970; Kupicha, 1973; Tsvelyov, 1987).

Materials and methods

In 2015-2017, in the Department of Ecobotanics and Systematics of the Institute of Genetic Resources, under the guidance of A. Asgarov at the expeditions on 36 routes from different regions of Azerbaijan 17 species (about 200 herbarium specimens) 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 were used “Flora of Azerbaijan” and A. Asgarov's books (Asgarov, 2011 and 2016), in the analysis of other features were used Ch. Raunkiaer (Raunkiaer,

1937) and I. Serebryakov's classification (Serebryakov, 1964). Comparative morphological (Gunn and Kluge, 1969, 1970 and 1976) floristic (Tupikova, 1926), biomorphological, sistematic (Maxted, 1990 and 1995) phytocenological and experimental methods (Leht, 2005) were used in the research. Range maps of the collected species were compiled using DIVA-GIS computer program. The amount of annual rainfall, temperature information is based on the PAST program.

Results and discussion

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 and 5. Nakhchivan. Distribution of *Vicia* L. species in botanical-geographical regions of Azerbaijan is given in Table 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	<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> Turrill (<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. cordata</i> Wulf. ex Hoppe	+		+	+	+
16	<i>V. crocea</i> (Desf.) Fritsch	+	+		+	
17	<i>V. elegans</i> Guss.		+			+

No.	Name of species	Botanical-geographical regions				
		Greater Caucasus	Lesser Caucasus	Kura- Araks	Talysh	Nakhchivan
18	<i>V. ervilia</i> (L.) Willd.	+	+		+	+
19	<i>V. grandiflora</i> Scop.	+	+	+	+	+
20	<i>V. grossheimii</i> Ekvtim.	+	+			+
21	○ <i>V. hololasia</i> Woronow	+	+			
22	<i>V. hirsuta</i> (L.) S.F.Gray	+	+		+	+
23	<i>V. hybrida</i> L.	+	+	+	+	+
24	<i>V. hyrcanica</i> Fisch. et C.A.Mey.				+	+
25	<i>V. iberica</i> Grossh.	+				
26	<i>V. larissae</i> Prima	+				
27	<i>V. lathyroides</i> L.		+		+	
28	○ <i>V. loiseleurii</i> (Bieb.) Litv. (<i>V. meyeri</i> Boiss.)	+			+	
29	<i>V. lutea</i> L.	+			+	+
30	<i>Vicia monantha</i> ssp. <i>monantha</i> Retz. (<i>V. cinerea</i> Bieb.)	+	+	+	+	+
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.		+			
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

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. 36 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 (Fig. 1). The ecological and geographical data, including the name of species, collection areas with locality code, data about latitude and longitude, sea level, vegetation

period, ecological groups, of the collected species from the research area are presented in Table 2.

As can be seen from Table 2, the most types were collected from meadows (13 species), at least types from planting area (2 species). Ecological assessment of vetch species on climate parameters has been carried out. It was found that in the *min* height was observed in *V. cordata* (-20 m) from Apsheron region, Goradil settlement, and *V. bithynica* (-25m) in Masally region, Tekle village territory, *Max* height from Lerik region, Mistan village were collected *V. peregrina* (1723 m), and *V. elegans*, *V. nissoliana* from Ordubad region, Paragha village (1644 m).

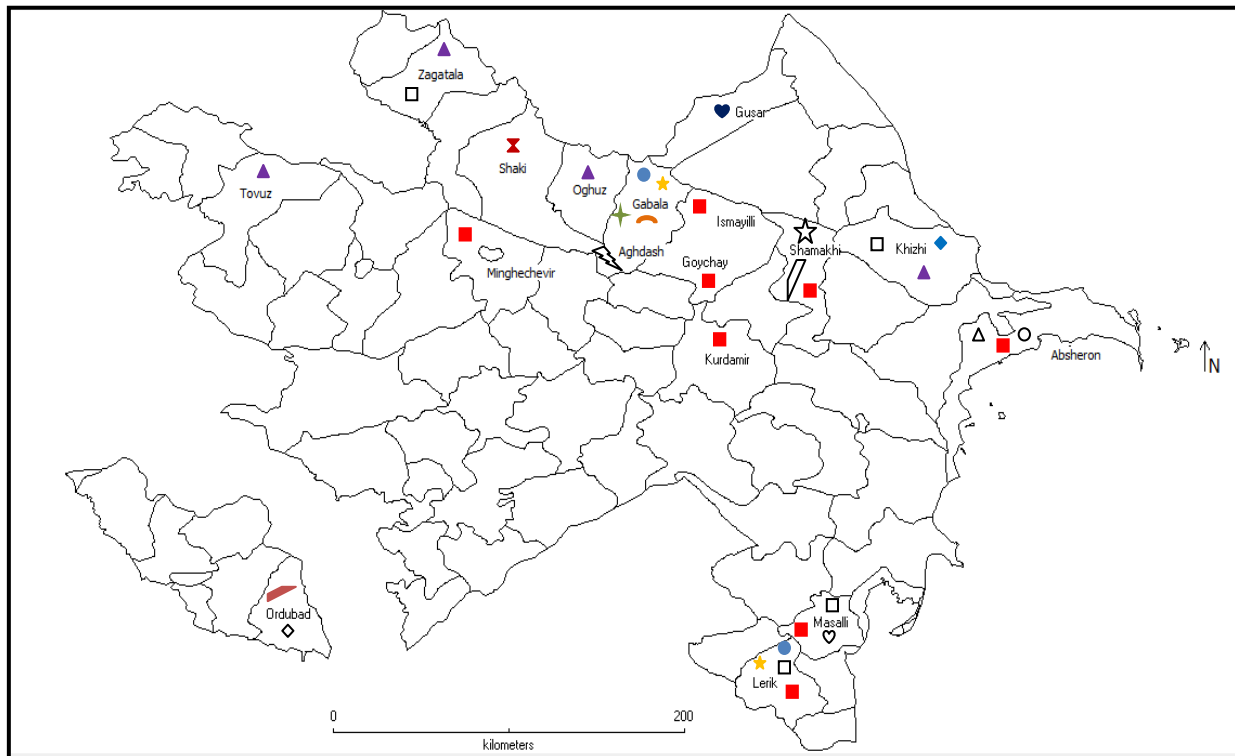


Fig. 1: ● - *V. peregrina*; ■ - *V. sativa* subsp. *nigra*; □ - *V. tetrasperma*; ▲ - *V. tenuifolia* subsp. *variabilis*; △ - *V. cordata*; ◇ - *V. elegans*; ◆ - *V. grandiflora*; ▽ - *V. lutea*; ▽ - *V. nissoliana*; ★ - *V. peregrina*; ☆ - *V. narbonensis*; ◡ - *V. villosa* subsp. *varia*; ⚡ - *V. monantha* subsp. *monantha*; ♡ - *V. bithynica*; ♥ - *V. hirsuta*; ✦ - *V. pannonica*; ✕ - *V. abbreviata*.

Table 2. Ecological and geographical information on *Vicia* L. species collected from the investigation area.

Nº	Name of collected species	Vegetation period	Ecological groups	Collection areas with locality code	Coordinates
1	<i>V. monantha</i> subsp. <i>monantha</i>	Fl. Apil-May; Fr. April-June	X	Apsheron region, Agricultural Institute, planting area; AZE15A1M1 Apsheron region, Muhammedy village, Yanardag Nature Reserve, meadow; AZE16A1-2M2 Agdash region, Agchayazi village, the right bank of Turyanchay; AZE17K9M3	N 40°31'951; E 49°52'576; H 12, 5 m N 40°29'791; E 49°53'672; H 54 m N 40°42'972; E 47°33'010; H 107 m
2	<i>V. peregrina</i>	Fl. Apil-May; Fr. June	X	Lerik region, Galasar village, Ovon sanctuary area; AZE15Q3M4 Lerik region, Mistan village, meadow; AZE16B2M5 Gabala region, Amirvan village, bank of river; AZE17Z9M6	N 38°,41',26,6 E 48°,23'53,7; H 1357 m N 38° 39'003; E 48° 24'940; H 1723 m N 40°81'906; E 47°88'421; H 535 m

No	Name of collected species	Vegetation period	Ecological groups	Collection areas with locality code	Coordinates
3	<i>V. sativa</i> subsp. <i>nigra</i>	Fl. May; Fr. May- June	X	Lerik region, Zaringala village, reserve area; AZE15LZM7 Shamakhi district, Shamakhi-Agsu highway, roadside; AZE16D6M8 Kurdamir region, Karrar village, bank of river; AZE17K3M9 Mingachevir city, the 7th km of road Chaldan, meadow; AZE17K7M10 Kurdamir region, Garis- Ayriband village, meadow; AZE17K2M11	N 38°40', 47.5 E 48°22', 48.5; H 1442 m N 40°38'550; E 48°28'450; H 794 m N 40°18'220; E 48°16'162; H 5 m N 40°44'260; E 47°08'460; H 28 m N 40°20'574; E 48°22'548; H 8 m
4	<i>V. sativa</i> subsp. <i>sativa</i>	Fl. May; Fr. May- June	M	Lerik region, Galasar village, bank of river; AZE15Q2M12 Binagadi region, Mechtiabad village, roadside; AZE16A1-1M13 İsmailly region, Kurdmashi village, meadow; AZE17K14M14 Goychay region, Bighyr village, meadow; AZE17K12M15 Masalli r., Sharafa village, roadside; AZE17M1M16	N 38°41'22; E 48°23'45.6; H 1329 m. N 40° 28' 480; E 49° 51' 195; H 3 m N 40°38'322; E 48°03'195; H 268 m N 40°37'773; E 47°53'674; H 151 m N 39°05'208; E 48°67'377; H -15
5	<i>V. tetrasperma</i>	Fl. May; Fr. May- July	M	Lerik region, Hamarmesha village, forest edge; AZE15L1M17 Zagatala region, Gabizdara village, The edge of the Katech river, the forest; AZE15Z01M18 Khizi district, the edge of the road leading to Altiagach, the coast of Atachay, river; AZE16E6M19 Masalli region, Shychlar village, around of the Vilash river; AZE17M2M20	N 38°44'52; E 48°35'51; H 351 m N 41°42' 286 E 46°35'733; H 496 m N 40° 53' 07; E 48° 57' 06; H 927 m N 38°58'48; E 48°33'54; H 98 m
6	<i>V. tenuifolia</i> subsp. <i>variabilis</i>	Fl. May-June Fr. June	MX	Tovuz region, Asrik village, forest strip; AZE15T1M21 Zagatala region, Yukhari Tala village, Parzivan area, roadside; AZE15Z02M22	N 40°47,462' E 45°35,636'; H 1130 m N 46°35'29 E 41°34',227; H 358 m

No	Name of collected species	Vegetation period	Ecological groups	Collection areas with locality code	Coordinates
				Khizi region, territory of Chistiy-Klyuch, meadow; AZE16E8M23	N 40° 49' 27; E 48° 52' 43; H 1529 m
				Oghuz region, Dashaghil village, forest; AZE17Z7M24	N 41°14'513; E 47°42'252; H 1010 m
7	<i>V. sativa</i> subsp. <i>cordata</i>	Fl. Apil-May; Fr. May-June	M	Apsheron region, Goradil settlement, planting area; AZE16A16M25	N 40°33'562; E 49°49'631; H -20 m
8	<i>V. elegans</i>	Fl. June; Fr. July-August	X	Ordubad region, Paragha village, roadside; AZE16E1-1M26	N 39° 5' 10; E 45°55'13; H 1644 m
9	<i>V. nissoliana</i>	Fl. June; Fr. July	MX		
10	<i>V. grandiflora</i>	Fl. and Fr. May	M	Khizi region, Vardah village, meadow; AZE16E4M27	N 40° 54' 412; E 48° 56' 046; H 1217 m
11	<i>V. lutea</i>	Fl. and Fr. May-June	M	Shamakhi region, Saghyan village, roadside ; AZE16C4M28	N 40°38'550; E 48°28'450; H 794 m
				Shamakhi region, Madrasa village, meadow; AZE17K18M29	N 40°38'650; E 48°36'061; H 696 m
12	<i>V. villosa</i> subsp. <i>varia</i>	Fl. and Fr. May	M	Gabala region, Kichik Pirali village, meadow; AZE17Z3M30	N 40°92'637; E 47°76'994; H 382 m
13	<i>V. bithynica</i>	Fl. May; Fr. May-June	M	Masally region, Tekle village, around of the railway station; AZE17M5M31	N 39°07'41; E 48°40'08; H -25 m
14	<i>V. pannonica</i>	Fl. May-June; Fr. July	M	Gabala region, Kichik Amili village, meadow; AZE17Z1M32	N 40°84'509; E 47°79'514; H 381 m
				Gabala region Yenikend village, meadow; AZE17Z4M33	N 40°84'938; E 47°85'043; H 589 m
15	<i>V. abbreviata</i>	Fl. May-June; Fr. June-July	MX	Shaki region, Kish village, forest; AZE17Z11M34	N 41°25'885; E 47°18'615; H 995
16	<i>V. hirsuta</i>	Fl. and Fr. May	X	Gusar region, Sudur village, meadow; AZE17V2M35	N 41°33'246; E 48°16'599; H 1298m
17	<i>V. narbonensis</i>	Fl. April-May; Fr. May-July	M	Shamakhi region, Mirzandiya village meadow; AZE17K20M36	N 40°34'737; E 48°43'648; H 584 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 (Fig. 2). The average annual rainfall has

been determined by the fact that on *min* rainfall was collected for *V. peregrina*, *V. sativa* subsp. *nigra*, *V. tetrasperma* from territory of Kurdamir region, Karrar village (360 mm), on the maximum rainfall *V. lutea* and *V. narbonensis* were collected 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 region, Bighyr 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 Mingachevir city, the 7th km of road Chaldan (20.5°C).

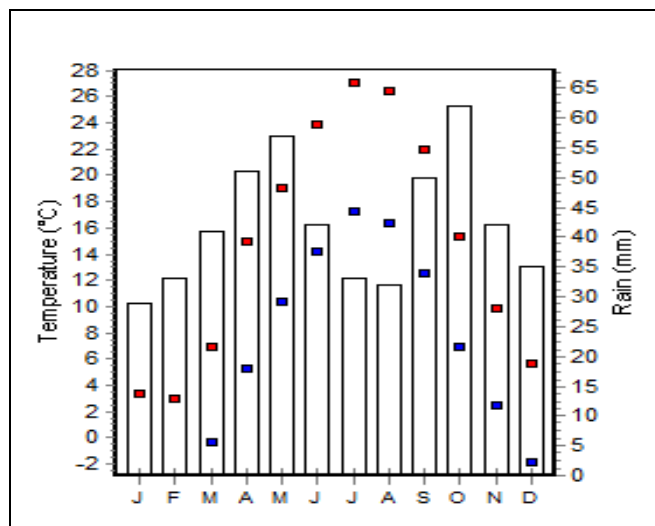


Fig. 2: Average annual rainfall and temperature of collected samples. ■ - The red square is the maximum temperature indicator (T_{max}); ■ - The blue square is the minimum temperature indicator (T_{min}); □ - Monthly precipitation (mm);

In 2015-2017, 17 species were selected for phenetical (taximetric) analysis of vetch species during the 36 expedition researches. At least two samples were studied from each population and each population was marked as Operational Taxonomic Unit (OTU). For the biomorphological analysis, 33 quantitative and qualitative characteristics 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 analyzes were conducted through the SPSS Win (SPSS 16.0) program. The phenomenon (taximetric) relationship between *Vicia* L. species is shown in Fig. 3.

As can be seen from the Table, 4 main clusters were observed at the 12 level. The first main cluster is divided to 12 groups: *V. tenuifolia* subsp. *variabilis* (Z02, Z7, E8), which belongs to subgenus *Cracca* (according to Radghi, Fedchenko); *V. narbonensis* (K20)- which belongs to section *Faba*, *V. villosa* (Z3), *V. sativa* subsp. *sativa* (Q2, K14, A1-1) - to section *Vicia*, *V. lutea* (C4, K18), *V. pannonica* (Z4) - to section *Hypechusa* and *V. abbreviata* (Z11)- to section *Atossa* (according to Kupicha).

The second cluster is related to 4 samples: *V. monantha* subsp. *monantha* (A1, A1-2, K9), *V. nissoliana* (E1-2), which belongs to section *Cracca* (according to Radghi, Kupicha). The third main cluster is composed of 4 samples: *V. tetrasperma* (L1, M2, E6), which belongs to section *Ervum*, *V. elegans* (E1-1) - to section *Cracca* (according to Radghi, Kupicha).

Finally, the fourth main cluster is related to 10 samples: *V. peregrina* (Q3, B2, Z9), which belongs to section *Peregrinae*, *V. sativa* subsp. *nigra* (LZ, D6, K2) - to section *Vicia*, *V. bithynica* (M5) - to section *Faba* (Kupicha). *V. sativa* subsp. *cordata* (A16), *V. grandiflora* (E4), which belongs to section *Vicia* and *V. hirsuta* (V2) - to section *Cracca* (according to Kupicha). The species studied belong to morphological and ecological groups. Some samples of the first cluster are mesophytes and annual plants-*V. narbonensis* (K20); *V. villosa* (Z3); *V. sativa* subsp. *sativa* (Q2, K14, A1-1); *V. lutea* (C4, K18), *V. pannonica* (Z4), and others are mesoxerophytes and perennial plants-*V. abbreviata* (Z11), *V. tenuifolia* subsp. *variabilis* (Z02, Z7, E8) (Serebryakov, 1964). Some samples of the second cluster are xerophytes and annual plants-*V. monantha* subsp. *monantha* (A1, A1-2, K9), but other is mesoxerophyte and perennial plant- *V. nissoliana* (E1-2).

In the third cluster 3 samples are mesophytes and annual plants- *V. tetrasperma* (L1, M2, E6), and other sample is xerophyte and perennial plant - *V. elegans* (E1-1). Finally, in the fourth cluster 7 samples are xerophytes and annual plants- *V. peregrina* (Q3, B2, Z9), *V. sativa* subsp. *nigra* (LZ, D6, K2), *V. hirsuta* (V2); but 3 others are mesophytes and annual plants- *V. bithynica* (M5), *V. sativa* subsp. *cordata* (A16) and *V. grandiflora* (E4). At the same time, the hipsometric analysis of these species showed that, this species were

found in middle and high mountain ranges (Prilipko, 1954). Ground color: brown, sandy - clay; water regime: free, without drainage; the side of the slope: south; relief: foothills; oat level: light.

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

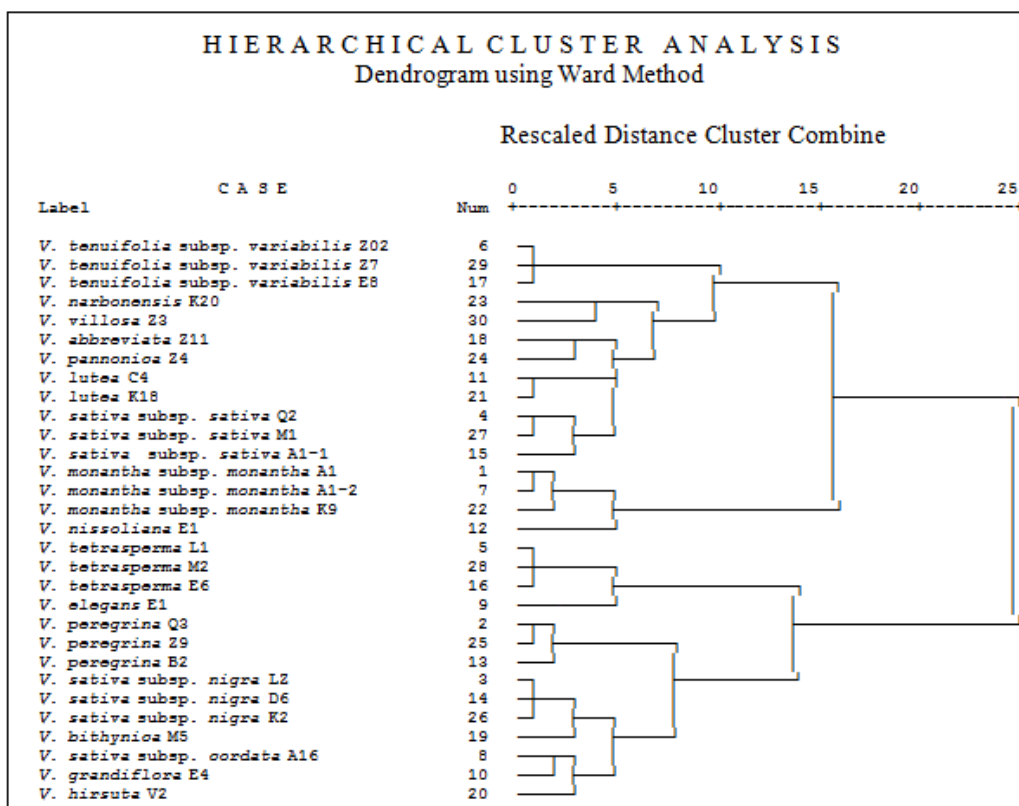


Fig. 3: Unified cluster analysis of morphological characteristics in *Vicia* L. species.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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