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INTRAPOPULATION VARIABILITY AND OPTIONS OF REPRODUCTIVE STRATEGY OF ALLIUM BULBOUS SPECIES (AMARYLLIDACEAE)

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ABSTRACT

Allium species of Melanocrommyum subgenus, belonging to different sections and affecting in various ecological and geographical conditions of Uzbekistan, have been studied. It is established that generative plants within a population differ on morphological features and parameters of seed growing potential, manifestation degree of which is in direct correlative dependence on the number of leaves per stem.

It is shown that productivity of reproductive strategy is determined by various mechanisms, existence and manifestation degree of which is defined by belonging of explored species to a bulbous vital form and largely depends on their ecological confinedness.

KEYWORDS: *population, bulbous geophytes, seed growing potential, correlative connection.*

INTRODUCTION

It is known that individuals of plants in population differ on age, ontogenetic state, vitality, morphological structure, etc. [14]. Establishment of condition variety of individuals as structural elements of population is the major problem of population ecology of plants.

At the same time physiological activity, biological and seed productivity of plants is determined by stability or reliability of biological system, its capability to regulate and establish a balance between internal organization and environment breached in case of condition chance during a process of ecological adaptation at a new level.

At the same time, exploration of plants self-regulation, elucidation of endogenous coordination mechanisms of various organs functions and physiological processes inside a system of a whole plant is important. The features of reproductive processes regulation present particular interest.

Allium L. genus, numbering over 130 species in flora of Uzbekistan has hardly been studied in this respect. Only in Cheremushkina's work [2], we have managed to find evidence of a large variability in seed productivity of certain bulbous species,

according to which it is possible to conclude about variability of the number of flowers.

The object of research is *Melanocrommyum* subgenus (Webb et Berth.) Royu. Over 30 species grow in Uzbekistan, among which there are edible, medicinal and a large number of decorative representatives [1, 4, 6, 7, 8, 10, 12].

The following genus have been studied (systematic affiliation according to Khasanov, 2008): *Allium suworowii* Regel (*Acmopetala* R.M. Fritsch section), *A. giganteum* Regel (*Compactoprason* R.M. Fritschsection), *A. karataviense* Regel (*Miniprason* R.M. Fritsch section), *A. cupuliferum*Regel (*Regeloprason* (Wendelbo) Kamelinsection),*A.protensum* Wendelbo (= ***A. schubertii*** Zucc. sensu Vved.) (*Kaloprason* C. Koch.section).

The purpose of the work is exploration of intrapopulation diversity of *Allium* species of *Melanocrommyum* subgenus of flora of Uzbekistan and identification of interspecific differences in their reproductive strategy.

MATERIALS AND METHODS

Study area and data analysis. Randomized samples are collected in the wild:

A. cupuliferum - Pamir-Alay, the northern foothills of Nurata Ridge, Hayotsay (40˚31'445"N,66˚48'228"E,880 m asl).Open rocky and gravelly slopes.The annual precipitation is 400 mm (Fig. 1).

A. giganteum - Pamir-Alay, Kugitangtau Ridge, vicinities of Oktosh settlement (37˚35'815"N, 66˚43'947"E, 880 m asl). Open small grained slopes with variegated species yields. The annual precipitation is 405 mm.

A. karataviense – Western Tien Shan, Chatkal Ridge, Chatkal Biosphere Reserve (41˚14'944"N, 69˚49'805"E, 1450 m asl). Open rocky and gravelly limestone slopes. The annual precipitation is 850 mm. (41˚14'944"N, 69˚49'805"E,1450 m asl). Open rocky and gravelly limestone slopes. The annual precipitation is 850 mm.

A.protensum – Pamir-Alay, Zeravshan Ridge Tahtakaracha Pass, vicinities of Amankutan settlement (39˚17'242"N, 66˚56'34"E, 1650 m asl). The northern rocky and gravelly slopes. The annual precipitation is 960 mm.

A.suworowii –Pamir-Alay, Malguzar Ridge, to the East from Bakhmalsay settlement, (40˚03'138"N,67˚42'507"E, 770 masl).Open slopes with soft soils. The annual precipitation is 400 mm.

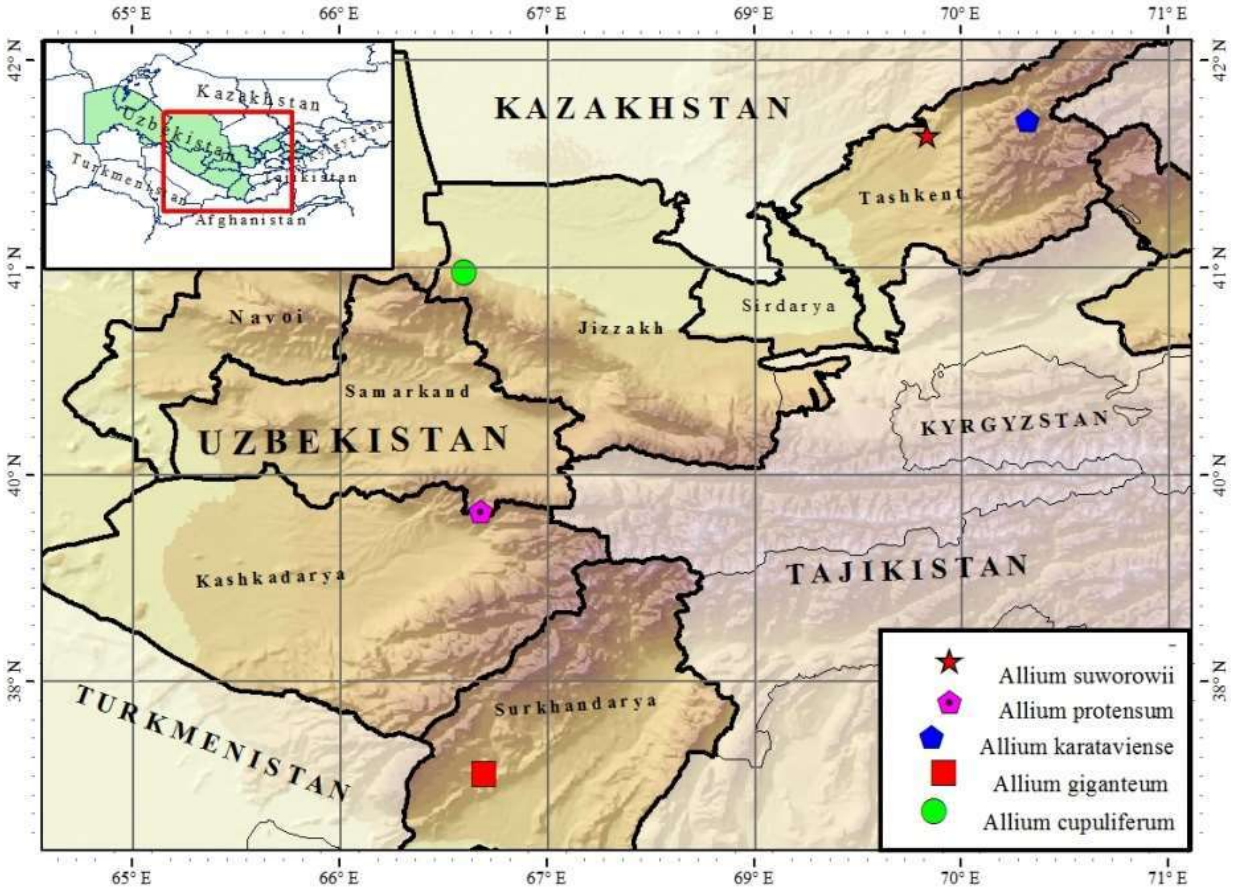

Fig. 1.The map of places of initial material collection.

All known species are bulbous geophytes with ephemeroid development rhythm. On vital form they belong to bulbous unparticular monocentric onions [2].

Selection volume is 40-50 generative plants. The exception was *A.protensum* - it was possible to find only 15 preserved fruit-bearing plants. In presence of sufficient number of plants in fruiting phase, the volume of samples on groups with various number of leaves led up to 10.

We take into account a number of leaves, a lower leaf size, a peduncle height and a number of flowers.

Elements of seed productivity in connection with changeable number of ovules in ovary were determined for generative shoot in general [2], on which the number of fruits and seeds were counted. Seeds weighing of each plant was carried out on analytical scales - OHAUS Explorer Pro EP 214 C.

Statistical data processing was carried out on a PC using Excel and standard criteria [9].

RESULTS AND DISCUSSION

The analysis revealed that all studied species have considerable variability in selected morphometric parameters (Table 1).

On a variation of vegetative sphere indicators (the number of leaves, a size of lower leaf and peduncle) it is possible to distinguish slightly variable species - the maximum values in the sample exceed the minimum in 1.8-3.0 times - (*A.giganteum*), medium variable - in 2.5-4.4 times (*A.protensum, A.suworowii*) and highly variable - in 3.0-4.7 times (*A.cupuliferum, A.karataviense*). The lower the minimum number of leaves on generative shoot the more variability. The most variable were *A.cupuliferum* and *A.karataviense*, capable to blossom with one leaf.

Table 1.
Variation of studied parameters of generative plants of *Allium* species

Species	n	Number of leaves	Length of lower leaf, cm	Width of lower leaf, cm	Peduncle height, cm	Number of flowers
A. cupuliferum	41	1-3	8-24	1.0-4.4	11.5-52	16-63
A.giganteum	42	4-7	26-51	6-12	70-134	263-2681
A. karataviense	40	1-4	12.5-41	4.4-14.3	10-31	37-395
A. protensum	15	2-5	16-34	1.6-7	11-31	71-422
A. suworowii	50	2-6	20-53	0.8-2.0	33-91	20-328

From selected for analysis parameters the most informative is the number of leaves, used not only in systematic diagnosis of onions (Seregin, 2007), but also reflecting an area of the plant photosynthetic surface. In this regard, this feature has been chosen for plants separation into groups (Table 2).

Apparently from Table 2, all species with increase of the number of leaves have rising dimensions of the lower leaf, peduncle and the number of flowers in inflorescence. Thus, the peduncle height of the plants with the extreme values of the number of leaves increases among *A.giganteum*from 82.3±2.66 to 118.8±2.43 cm (P<0.001), the number of flowers - from 444.9±41.9 to 1257±213.0 (P<0.01); *A.karataviense* - respectively, from 14.5±1.52 to 19.3±4.06 cm and from 52.8±5.19 to 343.0±47.6 units. (P<0.001). The length of the lower leaf of *A.karataviense* increases from 20.5±0.86 to 32.0±2.65 cm (P<0.001), width - from 5.5±0.28 to 12.8±0.96 cm (P<0.001), *A.suworowii*- respectively, 23.6±0.72 to 37.8± 2.16 (P<0.001) and 0.9±0.03 to 1.6±0.08 cm (P<0.001). The lack of significant differences in the number of cases is due to the small volume of samples.

Table 3 details indicators of elements of seed productivity of *Allium* species, which shows that with increase of the number of leaves of all species the number of seeds formed on generative shoot also increase. Thus, the indicator of *A.giganteum*, increases from 246.4±47.1 to 692.6±165.3 (P<0.05); *A.protensum* one - from 47.0±23.0 to 1318±638.8 (P<0.05). Only *A.protensum* fruit set increases (from 36.0±12.03 to 76.5±5.62, P<0.01) and *A.suworowii* one (from 45.4±3.42 to 63.7±3.09, P<0.001).

Table 2
Morphometric parameters of Allium species depending on the number of leaves on generative shoot

Species	Number of leaves	n	Length of lower leaf, cm	Width of lower leaf, cm	Peduncle height, cm	Number of flowers
A. cupuliferum	1	35	14.1±0.61	1.9±0.15	23.6±1.49	27.3±2.48
	2	5	18.0±2.26	3.1±0.40	27.4±4.31	51.3±3.33
A. giganteum	4	11	30.4±0.82	6.8±0.14	82.3±2.66	444.9±41.9
	5	10	38.8±1.27	8.9±0.18	91.8±2.86	615.9±51.2
	6	10	41.5±1.44	9.9±0.39	105.2±2.49	835.6±99.2
	7	11	45.7±0.85	10.3±0.40	118.8±2.43	1257±213.0
A. karataviense	1	6	20.5±0.86	5.5±0.28	14.5±1.52	52.8±5.19
	2	25	23.3±0.93	7.4±0.37	17.0±0.56	88.6±7.65
	3	8	29.3±1.95	10.4±0.73	19.6±2.30	185.4±24.0
	4	3	32.0±2.65	12.8±0.96	19.3±4.06	343.0±47.6
A. protensum	2	2	18.5±2.50	2.3±0.70	16.5±5.50	85.5±14.5

	3	6	29.0±1.86	4.3±0.59	27.0±1.46	138.3±30.4
	4	4	27.4±3.21	3.9±0.42	26.0±3.03	155.3±15.1
	5	3	24.3±4.98	5.3±0.83	23.0±3.51	312.0±76.1
A. suworowii	2	10	23.6±0.72	0.9±0.03	46.0±2.29	45.7±5.73
	3	10	29.8±1.38	1.0±0.04	56.8±1.69	76.6±3.96
	4	10	30.1±1.39	1.2±0.06	62.1±1.26	102.4±7.82
	5	10	35.0±1.38	1.3±0.12	65.7±2.21	122.6±9.12
	6	10	37.8±2.16	1.6±0.08	75.9±2.59	223.3±15.3

Note: The highlighted values significantly differ from the plant parameters with the fewest number of leaves (P<0.05).

Table 3
Indicators of seed productivity of
***Allium* species depending on the number of leaves on generative shoot**

Species	Number of leaves	n	Fruit set, %	Number of seed per stem	Number of seed in fruit	Absolute mass of seeds, g
1	2	3	4	5	6	7
A. cupuliferum	1	9	18.2±4.33	24.1±3.88	5.7±0.46	2.3±0.14
	2	8	24.1±3.83	79.5±16.1	6.3±0.44	2.4±0.15
A giganteum	4	11	49.4±6.40	246.4±47.1	1.0±0.01	2.6±0.13
	5	10	42.9±4.90	269.8±33.4	1.0±0.01	2.7±0.15
	6	9	45.0±5.27	412.3±75.4	1.0±0.01	2.6±0.19
	7	11	48.8±5.34	692.6±165.3	1.0±0.01	3.1±0.15
A. karataviense	1	6	32.1±4.77	24.8±3.89	1.5±0.10	5.2±0.89
	2	21	40.6±4.40	54.4±8.66	1.5±0.05	6.4±0.40
	3	7	39.8±6.89	129.0±29.35	1.7±0.10	5.2±0.36
	4	3	43.4±11.06	255.7±42.85	1.8±0.27	5.1±0.61
1	**2**	**3**	**4**	**5**	**6**	**7**
A. protensum	2	2	36.0±12.03	47.0±23.0	1.4±0.02	2.2±0.28
	3	6	66.6±6.44	194.5±56.2	2.0±0.22	3.1±0.09
	4	4	76.5±5.62	302.5±58.0	2.5±0.30	2.4±0.26
	5	3	73.5±18.70	1318±638.8	4.1±1.34	2.6±0.20
A. suworowii	2	10	45.4±3.42	91.6±15.7	4.3±0.39	2.2±0.07
	3	10	44.7±1.81	184.2±16.2	5.4±0.30	2.2±0.10
	4	10	55.2±3.46	274.2±24.1	4.9±0.26	2.4±0.05
	5	10	58.9±3.06	341.7±20.9	4.9±0.24	2.5±0.09
	6	10	63.7±3.09	844.5±80.8	6.0±0.35	2.5±0.12

Note: The highlighted values significantly differ from the plant parameters with the fewest number of leaves (P<0.05).

Among explores species only *A.giganteum* is characterized by a constant number of seeds in fruit, the rest demonstrate their increase with growth of the number of leaves on generative shoot. Thus, *A.protensum* indicator increases from 1.4±0.02 to 4.1±1.34 (P<0.05), *A. suworowii* one - from 4.3±0.39 to 6.0±0.35 (P<0.01). Absence of significant differences of *A.karataviense* and *A.cupuliferum*are explained by small volume of samples.

The absolute mass of seeds increases among *A. giganteum*, *A. suworowii* and *A. protensum*.

In order to determine the level of relationship between the number of leaves and the rest of selected indicators correlation the analysis was conducted (Table 4).

Table 4
The correlation dependence between the number of leaves (*y*) and the rest parameters (*x*) of generative plant of *Allium* species

Species	n	Morphometric parameters				Seed productivity indicators			
		Length of lower leaf, cm	Width of lower leaf, cm	Peduncle height, cm	Number of flowers	Fruit set, %	Number of seed sper stem	Number of seedsin fruit	Absolute mass of seeds, g
A. cupuliferum	18	0.50	0.80**	0.79**	0.83**	0.25	0.67**	0.24	0.10
A. giganteum	42	0.84**	0.79**	0.86**	0.62**	0.03	0.49**	0.01	0.27
A. karataviense	42	0.60**	0.75**	0.36	0.81**	0,13	0.76**	0.38	-0.08
A. protensum	15	0.10	0.51	0.16	0.67*	0.48	0.64*	0.65*	-0.13
A. suworowii	50	0.72**	0.72**	0.83**	0.78**	0,61**	0.81**	0.37*	0.39*

*Note: The highlighted values having P<0.05; * - values having P<0.01; ** - values having P<0.001.*

Apparently from Table 4, there are significant correlations between the number of leaves and other morphometric parameters detected in 18 cases out of 20 (90.0±6.71%), whereas for seed productivity parameters this indicator is considerably smaller - in 10 cases out of 20 (50.0±11.18%, P<0.01).

It is obvious that the number of initiated flowers, fruit set and the number of seeds in fruit determine the real seed productivity (RSP). A significant correlation dependence on the number of leaves is stably detected for the first indicator only, while for the others it is observed not in all species and in different ratio.

In order to determine degree of participation of each indicator in RSP increase while rising the number of leaves, we analyzed the data presented in Tables 2 and 3. Moreover, we took into account significant differences between extreme groups (P<0.05), but in case of absence thereof - the presence of a pronounced tendency (Fig. 2).

Apparently from Fig. 2, *A.giganteum's* RSP increases exclusively through inception and development of additional quantity of flowers. Among *A.karataviense*, *A.suworowii*, *A.cupuliferum*and *A.protensum*there are also processes that control fruit set and development of seeds in fruit. Mostly it is pronounced between last two species, whose share of RSP obtained by increasing fruit set and seeds in it is more than half.

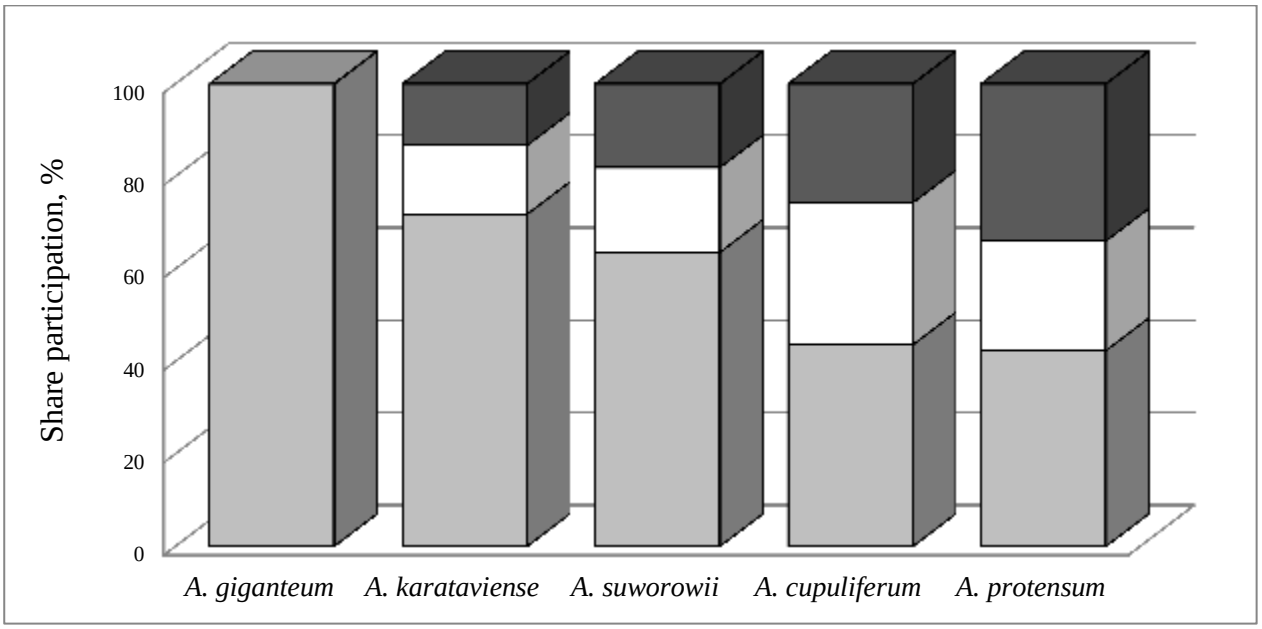

Fig. 2. Share participation of various indicators in formation of RSP,%.

Before turning to a discussion of the results, it is necessary to stay on main stages of lifecycle of the studied bulbous species. They have laying organs of monocarpic sprout during autumn [1, 2, 3]. In spring, with the beginning of vegetation, the main flow of nutrients produced in the leaves is directed to formation of replacing bulb. By the time of blossoming, the leaves begin to wither, so that the formation of seeds is due to nutrients accumulated in underground leaves' sheaths and photosynthetic activity of peduncle.

The presence of correlative connection between the number of leaves and the rest of morphometric parameters of the studied *Allium* species suggests coordination of stage of development inside bulb. This coordination is due to belonging of studied species to vital form of bulbous plants.

Various programs determine seed productivity representing main outcome of reproductive strategy. Peduncle size and number of flowers are determined by nutrients reserves in the bulb accumulated during the previous year, while fruit set and the number of seeds in it is determined by nutrients accumulated in leaves' sheaths in spring and photosynthetic activity produced by peduncle. This is also the indicator of absolute mass of seeds, affecting their germination and growth rates of future plants.

The interesting is the fact that explored species have dependence of reproductive strategy option on environmental confinement (according to Vvedensky) [13]. The least labile is *A.giganteum*'s one that affects on small grained slopes mainly in areas of variegated species' outcrops with almost absence of competition from the side of herbaceous vegetation. RSP of this species depends only on the number of laying flowers, although mechanism of regulation of absolute seed mass is also involved.

A.karataviense, growing on movable limestone screes, have several mechanisms involved in seeds growing potential: increasing of flowers quantity, fruit set and the number of seeds in it, although the contribution of last two does not exceed 30%.

A.protensum, affecting in a variety of conditions: on sandy and clay soils, in deserts, on variegated and gravelly slopes, has the most labile reproductive strategy. More than half of seeds of this species is formed as the result of increasing fruit set and number of seeds in it. Tendency of absolute seed mass increase is clearly expressed.

CONCLUSIONS

Thus, by the example of five *Allium* species of *Melanocrommyum* subgenus, belonging to different sections and affecting in various ecological and geographical conditions of Uzbekistan, the intrapopulation variability of main morphological features of generative plants and seed productivity parameters were established. Correlative analysis showed that explored characteristics and indicators are directly depend on the number of leaves.

The effectiveness of reproductive strategy is determined by various mechanisms, the presence and manifestation degree of which depends as on accessory of explored species to vital bulbous form as on their ecological confinement.

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REFERENCES

1. *Baytulin I.O., Rakhimbaev I.R. et al. 1986. Introduction and morphogenesis of wild Allium of Kazakhstan. Almaty: Publishing house Science, 156.*
2. *Cheremushkina V.A. 2004. Biology of Allium species of Eurasia. Novosibirsk: Publishing house Science, 280.*
3. *Filimonova Z.N. 1958. Ontogenesis and morphology of some species of Allium L. genus: Abstract of dissertation..... Candidate of Biological Sciences. Tashkent, 18.*
4. *Fritsch R.M., Abbasi M. A. 2013. Taxonomic Review of Allium subg. Melanocrommyum in Iran. Germany: Gatersleben, 218.*
5. *Hasanov F.O. 2008. Allium L. genus in flora of Central Asia: Abstract of dissertation. ….. Doctor of Biological Sciences. Tashkent, 35.*
6. *Kamenetsky R. RabinowitchH.D. 2006. Allium genus: A Developmental and Horticultural Analysis. Horticultural Reviews, 32. 329-37.*
7. *Keusgen M., Fritsch R.M.et al.2006. Wild Allium species (Alliaceae) used in folk medicine of Tajikistan and Uzbekistan. Journal of Ethnobiology and Ethnomedicine.1. 1-25.*
8. *Khasanov F.O., Umarov T.A. 1989.Agrarian edible species of Allium L. genus of Western Tien Shan. Uzbek Biological Journal. 6. 24-26.*
9. *Lakin G.F. Biometrics. 1990. Moscow: Publishing house Higher School, 352*
10. *Pechenitsyn V.P., Uralov A.I. 2017. Intrapopulation variability and options reproductive strategy bulbous species of Allium (Amaryllidaceae). Journal of Rastitelnye Resursy. Volume 2. Санкт-ПетербургAkademknig Publishing, 210-219.*
11. *Seregin A.P. 2007. Allium L. (Alliaceae) Genus in flora of Eastern Europe: Abstract of dissertation. ..... Candidate of Biological Sciences. Moscow, 26*
12. *Volkova G.A., Motorina N.A. et al. 2012. The results of introduction of Central Asian species of onion (Allium L. genus) in the European Northeast. Tidings of Samara Scientific Center of Russian Academy of Sciences, V. 14 1(9). 2195-2197.*
13. *Vvedensky A.I. 1971. Allium L. Genus - Onion. Determinant of plants of Middle Asia. Volume 2. Tashkent, Publishing house FAN, 39-89.*
14. *Zlobin U.A. 2009.Population ecology of plants: current state, growing-points. Sumy: Publishing house University book, 263*