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Ecological-phytosenological features of tuberous orchids spread in the territory of the Nakhchivan Autonomous Republic

Raifa Salmanova
Nakhchivan State University, Nakhchivan, Azerbaijan

Abstract
The article presents information on eco-phytosenological features of tuberous orchids spread in the territory of the Nakhchivan Autonomous Republic. Biometric properties of the *Anacamptis coriophora, Dactylorhiza umbrosa, Orchis mascula* species have been studied. Based on the literature data, materials included in the herbarium fund and the results of the investigations, 17 tuberous orchid species belonging to 5 genera have been identified in the territory of Nakhchivan.

Keywords: *orchids, genus, species, tuberous, biometric*

Introduction
Morphological traits of plants are characterized by their life forms, anatomical structures of their stems and leaves, hair cover, the seed structure and ways of its opening. The analysis of changes gives information on amplitudes of changes, plant rarity, homology and parallelism in the kinship system of the phylogenetic lines and also about the nature of adaptive specializations. This, in turn, allows differentiating the taxonomic and diagnostic significance of symptoms and improving the traditional comparative-morphology method using the materials of biodiversity.
Representatives of the orchid family have not been studied comprehensively in the Nakhchivan Autonomous Republic. The study of the orchid family species spread in the Nakhchivan Autonomous Republic and establishing their biomorphological types is one of the important issues.

Materıals and Methods
The representatives of the orchid family distributed in the territory of the Nakhchivan Autonomous Republic have been studied since 2014. During expeditions to the regions of the Nakhchivan AR, species belonging to the orchid family have been studied. Phenological observations were conducted, the natural conditions of the habitats of the species, their phytocytosis, formations, associations were studied experimentally, and the descriptor data were recorded.
"Flora of USSR", "Flora of Caucasus" by A.A. Grosshaim, "Flora of Azerbaijan" and methodological instructions by L.I. Prilipko and data on the Iran and Turkey floras were used in the research [2, 10, 11, 13, 14].
Field surveys, scientific trips, local expeditions, stationary and semi-stationary phenological observations were organized.
On the territory of the Nakhchivan Autonomous Republic, observations were made to perform the eco-phytocenological analysis of the life forms of orchids. The *Orchis mascula, Dactylorhizaumbrosa, Dactylrhiza romana, Anacamptis coriophora* species were chosen as the study objects.

Experımental Part
According to the latest literature data and the results of the experiments, 57 species belonging to 20 genera of the *Orchidaceae* Juss. family are included in the Azerbaijan flora [1]. The representatives of tuberous orchids have annual (biennial), stolon-shaped resource organs. Annual monocarp shoots develop horizontally from the lower shoots due to the apical growth. The proximal part acts as stem (till the bud), the distal part (after the bud) as root. Root-stem tuberoids have a complex anatomical-morphological structure.
Tuberoid orchids occur more frequently in the region (species of the *Orchis, Ophrys, Platanthera, Dactylorhiza* genera). According to I.G. Serebryakova [7], this form is a perennial plant, whereas, I.V.Tatarenko [8, 9] considered it as a root-stem tuberoid.
Tuberoid orchids spread in various types of forests, mountain xerophyte steppes and mountain meadows throughout the region. They occur in small groups or scattered from low-altitude hills to high-altitude pastures. The widespread of tuberoid orchids is attributed to their dormancy leading to reducing life activity and specific organs contribute to their tolerance under high temperature and long-lasting drought.
Tuberoid orchids are mesophytes, mesocherophytes, and xerophytes. Species of *Anacamptis, Orchis, Ophrys* genera are adapted to long-lasting drought periods (up to 3 months) in some places of the Nakhchivan AR.
Some species grow on very dry soils containing pebbles (*Ophrys apifera, Orchis punctulata*, etc.) (Table 1).

Table 1: Biometric properties of the *Anacamptis coriophora* species

Indices	Age states			
	j	im	vv	g
	$x \pm m$	$x \pm m$	$x \pm m$	$x \pm m$
1	2	3	4	5

Number of leaves	1±0	2±0	4.2±0.08	6.24±0.64
Leaf length	6.42±0.32	7.0±0.33	9.42±0.66	10.16±0.55
Leaf width	0.45±0.02	0.99±0.08	1.02±0.18	1.46±0.27
Number of veins	2.04±0.12	6.57±0.25	13.29±0.23	16.5±0.16
Flower stalk height				30.06±0.36
Inflorescence length				10.22 ± 0.92
Number of flowers				22.66±2.84
Number of fruit				6.92±2.68

Most tuberoidous orchids are heliophytes, preferring well-illuminated conditions. Some species are found only in open areas (rocky cliffs, pebbles) - *Ophrys apifera, Orchis punctulata, Dactylorhiza euxina, Gymnadenia conopsea*, etc. Many species - *Orchis mascula, Dactylorhiza urvilleana* -occur in forest glades, forest surroundings, and shrubby places. Some species grow under the canopy of 40-70% of the forest trees (*Neottia ovata*, etc.). Obligatory sciophytes do not occur among tuberoidous orchids.

Most of the tuberoidous orchids are calciphiles (*Orchis punctulata, O. simia, Anacamptis pyramidalis* etc.), i.e. adapted to limestone soils. Tuberoid orchids are commonly found in sandy soils, clay soils or weakly ventilated and poor soils.

Some species are characterized by extensive ecological amplitude in relation to humidity (*Dactylorhiza urvilleana, D. umbrosa*, etc.) (Table 2.).

Table 2: Biometric properties of the *Dactylorhiza umbrosa* species

Indices	**Age states**			
	j	**im**	**vv**	**g**
	x ± m	*x ± m*	*x ± m*	*x ± m*
1	2	3	4	5
Number of leaves	1 ± 0.0	1.65±0.08	3±0.0	4.68±0.06
1	2	3	4	5
Leaf length	5.82±0.73	8.98±0.70	10.20±0.36	7.84±0.36
Leaf width	0.64±0.08	1.60±0.12	2.11±0.09	2.65±0.06
Number of veins	2±0.0	5.38±0.31	10.62±0.46	14.01±0.02
Tuber length	0.62±0.13	0.95±0.09	1.80±0.09	1.51±0.18
Tuber width	0.44±0.20	0.74±0.10	1.52±0.14	1.70±0.25
Number of tuber endings	1±0.0	2.24±0.22	4.76±0.68	7.55±1.34
Length of tuber endings	0.55±0.05	1.30±0.24	3.08±0.84	3.90±0.48
Number of roots	1.5±0.5	3.42±0.31	6.0±1.25	7.4±1.35
Root length	0.70±0.35	1.79±0.21	3.70±0.88	5.55±0.65
Root system diameter	1.2±0.33	3.13±0.52	6.33±0.88	9.3±0.82
Penetration length of roots	2.0±0.5	3.48±0.66	6.6±1.02	9.62±0.96
Location depth of the generative shoots	0.86±0.15	1.60±0.12	3.6±0.2	4.12±0.42
Flower stalk height				34.04±1.12
Inflorescence length				9.96±0.58
Number of flowers				20.16±0.46
Number of fruit				8.04±0.12

The ontogeny of *Orchis mascula* includes the following periods: The latent period (sleeping seed) is the time from which seeds germinate, disseminate, falling into the soil and swelling when there are optimal conditions. When using artificial plant nutrition, seeds begin to germinate immediately after the seeds have fallen in the soil. Under natural conditions, the seeds are successfully wintered in the soil and stored in the fruit shell. In Spring, a protocorm is formed after seed swelling following the rise of temperature and soil humidity.

The virginal period is characterized by two stages (underground and aboveground development), which have significant differences in nutritional method, vital activity, and morphological structure. The underground stage of the development (holo-mycotrophic) - lasts about three years, as evidenced by the presence of three groups of protocorms.

In the first year of the development, protocorm (pr1) is whitish, spherical, and tiny, 1-1.5 mm in size. In the second year, protocorm (pr2) is bigger, has an elongated cube shape, is 2-3 mm in length and 1.5-2 mm in diameter. The first scaly leaf appears at the base of the bud, in the third year of the development, the protocorm (pr3) has its first shoot, the first lateral root emerges in the second internode. The bud containing the embryo of the first photosynthetic leaf, tuber and above-ground shoot is in the axil of the second scaly leaf.

The sprout has a tuber, a lateral root and a narrow linear leaf of 4–6 cm long and 1-2 mm wide. The leaves of the sprout have a simpler anatomical structure compared with those of the mature plant. They express poor vascularization and have a reduced number of stomata. During the germination phase, the plant maintains contact with mycorrhizal fungi and realizes feeding at the expense of digestible hyphae in the cage of the lateral roots.

Juvenile age is characterized by the replacement of monopodial growth with sympodial growth maintained during the entire ontogeny. The first green leaf is linear with 1-2 veins, 5-7 cm long and 0.5-0.7 cm wide, the leaf is half-folded along the central vein. The tubers are small in size - 0.5-0.9 cm long and 0.5 cm wide. There are 1-2 lateral roots of white color, 0.4-0.7 cm long. This age period lasts 1-3 years. Autotrophic nutrition is characteristic of the juvenile age (Table 3).

Table 3: Biometric characteristics of the *Orchis mascula* species

Indices	Age states			
	j	im	vv	g
	$x \pm m$	$x \pm m$	$x \pm m$	$x \pm m$
1	2	3	4	5
Number of leaves	1±0	2±0	3.6±0.30	4±0.2
Leaf length	6.22±0.46	9.17±0.58	10.8±0.64	11.68±0.74
Leaf width	0.64±0.08	1.63±0.11	2.62±0.12	2.94±0.20
Number of veins	1.84±0.06	5.88±0.12	9.9±0.42	14.33±0.15
Depth of tuber location	0.76±0.33	2.14±0.13	2.7±0.21	3.66±0.41
Tuber width	0.7±0.09	1.50±0.12	1.65±0.55	2.2±0.31
Number of roots	2.56±0.41	3.0±1.0	5.0±0.31	7.0±1.26
Root length	0.69±0.27	1.00±0.22	2.18±0.37	2.85±0.41
Penetration length of roots	2.66±0.22	6.8±1.70	9.33±0.71	12.03±0.75
Location depth of the generative shoots	1.82±0.06	4.52±1.55	6.50±0.53	7.32±0.45

Immature individuals have 2 linear leaves with 4-6 veins, 5-10 cm long and 1-1.5 cm wide. Tubers are 1-1.2 cm long and 0.8 cm wide. There are 2-3 second leaves. The regenerative shoot is at the same depth as in the mature plants.

Mature virginal plants have 3-5 leaves with 8–10 veins, 10–12 cm long and 1.5–1.7 cm wide. The tuber is 2.5 cm long and 1.5 cm wide. There are 4-7 lateral roots in length of 2.0-3.5 cm. The mature virginal period lasts 2-3 years.

The Generative period is characterized as follows: Young generative plants begin to bloom for the first time and have 5-6 leaves performing photosynthesis that are 12 -15 cm long and 2.5-3.0 cm wide. The length of the generative shoot is 25-30 cm and the number of flowers is 10-15. There are 5-7 lateral roots of different lengths. This period lasts 1-3 years. Middle-aged generative plants have 5-6 leaves. Their width is 2.8-3.0 cm, length 14.0-17.0 cm, the number of veins is maximal. The generative shoots reach 35.0-37.0 cm, the number of flowers is 15-25. The tuber is 2.2-2.4 cm wide, 3.3-3.7 cm long and has 10-11 lateral roots. This age period lasts 5-7 years. Older generative individuals are characterized by a decrease in plant size and a decrease in the number of flowers (5–10). The vitality and generative function of plants are diminished; a flowering interval of 1-2 years is possible.

The senile period is characterized as follows: Subsenile (ss) plants have 2-3 leaves of immature type and retain the number of the previous veins (14). The size of the plant underground parts is also reduced. Thus, root forming is weakened. The senile (c) plants resemble juvenile individuals, but have 12–14 veins and differ in their physiological state.

In general, the ontogenesis of Orchis mascula plants lasts 20-25 years, sometimes 30 years. Spherical tuberoids occur also in other tuberous orchid species though the age states are different.

Observations in the Nakhchivan Autonomous Republic were conducted during 2014- 2018 years. The *Orchis mascula*, *Dactylorhiza umbrosa*, *Dactylorhiza romana*, *Anacamptis coriophora* were chosen as the research objects. Along with specific features, a characteristic system of formation and distribution was created in representatives of the orchid family during the evolutionary process. One of the main distinctive features of this family is the formation of a large number of seeds from the seed shell and reduced organs.

The number of leaves, fruit length, and width in top, middle and bottom parts of the plant have been determined in inflorescence of every species and average values were estimated. Depending on the size of the object, the fruit size was determined using calipers, a ruler of binocular microscopes MBS-10 and MBI-15. Fruits and seeds were weighed on electronic scales (Sartorius).

Orchid fruit is a capsule of various forms. The fruit length varies from 7.80 mm (*Anacamptis coriophora*) to 14.49 mm (*Dactylorhiza umbrosa*), and width from 2.57 mm (*Anacamptis coriophora*) to 4.32 mm (*Dactylorhiza umbrosa*). In all of the species studied, the lower capsules have larger size than the middle and upper ones. The calculations showed that the number of seeds in the capsule is regulated by the size of the fruit. The seed number is greater in species with larger fruit size. Flowers of the same group are bloomed and pollinated at the same time. First, the flowers bloom at the bottom and then on the top. Nevertheless, fruits ripen almost simultaneously. The fruit of the upper part grows faster than that of the lower part. For example, in the *Dactylorhiza umbrosa* species, the fruit of the lower part ripens in 25-35 days, but this period for the fruit in the upper part is 10-20 days. The latter usually has retarded and immature seeds. A decrease in the number of mature seeds and, accordingly, an increase in the proportion of abortive seeds in the lower fruit is detected in all species (Table 4).

In all the orchid species studied, large variations were observed in the length of the flowers, fruit, and flower groups. For example, in the *Orchis mascula* species, a flower group consists of 15-50 flowers, and a flower group of *Dactylorhiza umbrosa* includes 35-65 flowers. Flower groups of *Dactylorhiza romana* and *Anacamptis coriophora* contain, respectively, 15-49 and 10-20 flowers. Seed germination in the *Orchis mascula*, *Dactylorhiza romana* (Sebast.) Soó, *Dactylorhiza umbrosa* species takes place at the end of May - early June and in the *Anacamptis coriophora* species at the end of June - early July.

Table 4: Fruit size in orchids

Species	Fruit length, mm				Fruit width, mm			
	lower	middle	upper	Average value	lower	middle	upper	Average value
1	2	3	4	5	6	7	8	9
Orchis mascula	15.24 ±	13.21 ±	11.55 ± 0.32	13.13 ± 0.33	4.26 ±	4.01 ±	3.10 ±	3.79 ±

	0.32	0.34			0.24	0.11	0.18	0.18
Dactylorhiza umbrosa	16.20 ± 0.12	14.16 ± 0.33	13.12 ± 0.24	14.49 ± 0.23	4.99 ± 0.11	4.02 ± 0.12	3.96 ± 0.23	4.32 ± 0.15
1	2	3	4	5	6	7	8	9
Dactylrhiza romana	9.24 ± 0.10	8.76 ± 0.22	7.98 ± 0.14	8.66 ± 0.15	3.28 ± 0.06	2.82 ± 0.07	2.11 ± 0.16	2.74 ± 0.10
Anacamptis coriophara	9.62 ± 0.16	7.68 ± 0.11	6.12 ± 0.08	7.80 ± 0.12	3.22 ± 0.12	2.46 ± 0.08	2.02 ± 0.07	2.57 ± 0.37

The capsules of orchids 3 (6) unfold from the top to the bottom, and the ripe seeds scatter on the ground. According to the seed spread method, orchids are autochore plants. Thus, seeds spread without the participation of any agent (barochory). As the seed can be dispersed by the airflow, they are included in the anemochore group.

The study of coenopopulations of *Orchis mascula*, *Dactylorhiza umbrosa*, *Dactylorhiza romana* (Sebast.) Soó species revealed a high plant density. For *Dactylorhiza umbrosa*, 60 plants were observed per $2m^2$ (Paragha, Bilav), for *Orchis mascula*, 30-50 plants per 2 m^2 (Batabat, Julfa-Ordubad massive, etc.) and 25 plants per $1m^2$ (Daraboghazi). A higher plant density was registered for *Dactylorhiza romana* (Sebast.) Soó-40 plants per $1m^2$ (Shahbuz region, Kechili village surroundings). The lowest density was found for *Anacamptis coriophora*-10-15 plants per $2m^2$ (Batabat).

Thus, a generative plant located in the center is surrounded by juvenile, immature and mature individuals. However, in orchids, seed propagation is limited for some reason. Under damp and cool conditions, most flowers remain unpollinated, with less fruit being produced in hot and dry times. The reliability of the propagation system of orchids is ensured by vegetative reproduction of all species. All tuberous orchids have 2-3 shoots every year. One of them is a regenerative shoot and others enter a state of dormancy. Plant structures allowing vegetative propagation are formed after the period of dormancy.

In tuberoidous orchids, 2-3 buds emerge in lower scaly leaves, but the 2nd and 3rd buds are rarely realized in these sedentary vegetative plants. However, under extreme conditions and when plants are damaged, the formation of two or even three derivatives of the tuberoids is possible. Usually, there is no vegetative reproduction in juvenile and immature plants and this reproduction is observed only in mature vegetative and generative plants. The unity of seed and vegetative propagation ensures the stable existence of orchid senopopulations.

Conclusıon

1. For the first time, 17 orchid species of 5 genera spread in the territory of Nakhchivan AR have been established to be tuberoidous.
2. As a result of the analysis of collected herbarium and descriptor data, biometric properties of the species *Orchis mascula*, *Dactylorhizaumbrosa*, *Anacamptis coriophora* were determined and *Dactylorhiza umbrosa* was registered for the first time in the region flora.

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