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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

**SYSTEMATICS AND BIOECOLOGICAL
CHARACTERISTICS OF CLOVER (*TRIFOLIUM* L., S.L.)
SPECIES DISTRIBUTED IN LANKARAN-LERIK REGION**

Speciality: 2417.01 – Botany

Field of science: Biology

Applicant: **Kamala Aydin Mammadyarova**

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Dissertation work was carried out at the Department of "Ecobotany and Systematics" of the Institute of Genetic Resources of MSE RA.

Scientific supervisor: Doctor of biological sciences, professor
corresponding member of ANAS
Honored Scientist,
Elshad Majnun Gurbanov

Official opponents: Doctor of biological sciences, professor
active member of ANAS
Honored Scientist
Tariyel Huseynali Talibov

Doctor of philosophy in biology associate
professor
Rana Tahmaz Abdiyeva

Doctor of philosophy in biology
Humira Zafar Huseynova

Dissertation council of ED 1.26 of the Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at the Institute of Botany of Ministry of Science and Education of the Republic of Azerbaijan

Chairman of the dissertation council:




Doctor of biological sciences, professor
Sayyara Jamshid Ibadullayeva

Scientific secretary of the dissertation council:



Doctor of philosophy in biology
Nuri Vagif Movsumova

Chairman of scientific seminar:



Doctor of philosophy in biology,
associate professor
Naiba Pirverdi Mehdiyeva

INTRODUCTION

Relevance and degree of development of the topic. Clover (*Trifolium* L.) is a plant with valuable fodder, medicinal, decorative, melliferous, nitrogen fixing, phytomeliorative and other useful properties. The clover (*Trifolium* L.) belonging to the legume (*Fabaceae* Lindl.) family has been included in the list of valuable, priority plant genera in the FAO Agreement on Genetic Resources, as well as in the Agreement on Central Asia and the South Caucasus. Some species of this genus have been planted in many Eurasian countries since ancient times¹. However, unfortunately, in Azerbaijan little attention is paid to the introduction of clover species into the culture.

The species of genus *Trifolium* L. has not been monographically studied in Azerbaijan and as well as in the Talysh flora. Since the status of many species remains controversial, it became necessary to clarify them. The study of the current state of species populations under natural conditions, the clarification of their phytocenotic features and role in vegetation were also one of the main issues under study². In addition, the enrichment of the descriptions of the species once described in Talysh with new studies, the collection of new herbarium and seed materials were one of the forthcoming issues.

Among scientists there are disagreements about the macrotaxonomic classification of genus, ie its division into independent genera, subgenera, sections and series.^{3,4}

A modern system of the genus *Trifolium* has not been developed in Azerbaijan, including in Lankaran-Lerik region. Systematic

¹ Akparov, Z.I., Asgerov, A.M., Mammadov, A.T. Agrodiversity in Azerbaijan // - Switzerland: Biodiversity, Conservation and Sustainability in Asia, - 2021. - p.479-499

² Ibadullayeva, S.J., Huseynova, I.M. An Overview of the Plant Diversity of Azerbaijan // - Switzerland: Biodiversity, Conservation and Sustainability in Asia, - 2021. - p.431-479

³ Zohary, M. The genus *Trifolium* / M. Zohary, D. Heller - Yerusalem, - 1984. - 606 p

⁴ Ellison, N.W. Molecular phylogenetics of the clover genus (*Trifolium* – *Leguminosae*) / N.W.Ellison, A.Liston, J.J.Steiner [et al.] // Molecular Phylogenetics and Evolution, - CIIIA: 2006, vol. 39, - p. 688-705

analysis of the genus was made out in the "Flora of Azerbaijan"⁵ about 50 years ago.

The intraspecific taxonomy of published polytypic species and descriptions of some species (*T. zardabii* Chalilov, *T. topezbashovii* Chalilov etc.) often do not comply with requirements of the International Code of Botanical Nomenclature. The newly developed system of the genus *Trifolium* of Lankaran-Lerik region, the clarification of the ranges and ecological characteristics of the species included in it, will play an important role in the protection of the genetic diversity of these species in the region as a whole.

Object and subject of the research. The object of the research work is clover (*Trifolium* L.) plant belonging to 39 species and 14 species diversity (varieties) distributed in Lankaran-Lerik region. The subject of the research includes determining the species composition of the clover genus of the area, their biomorphological and bioecological analysis, assessment of endangered species, investigation of potential uses of promising species.

Goals and objectives of the research. The main purpose of the research is to develop a new synopsis of the genus clover (*Trifolium* L.) distributed in Lankaran-Lerik region, to clarify the species composition and their ranges, to study the biomorphological and bioecological features and to make effective use of species on this basis and to develop scientific bases for their protection.

The following tasks have been implemented to achieve this goal:

- Study of distribution and taxonomic composition of species of clover (*Trifolium* L.) genus of Lankaran-Lerik region and compilation a new conspectus on this basis;
- Investigation of controversial taxa in the taxonomy of genus;
- Identification of the main diagnostic features used in the systematics of clover species and their use in the compilation of a new taxonomic conspectus;
- Bioecological and botanical-geographical analysis of species of the genus;

⁵ Флора Азербайджана [в 8 томах]. Под ред. И.И.Карягина. – Баку: АН Азерб. ССР, – т. 5, – 1954. – 579 с.

➤ Study of rare and endangered species of clover genus of the region and development of scientific bases of their protection on this basis;

➤ Investigation of the use opportunities of clover species in various areas of the economy and phytochemical study of some promising species.

Research methods. The following methods were used in the research: Comparative-morphological, biomorphological, systematic, phytocenological, botanical-geographical and other classical and modern methods.

Main provisions put on defense.

➤ The fact that the clover species distributed in the Lankaran-Lerik region make up 78% of clovers of the total flora of Azerbaijan, discovery of 1 species new for the Caucasus and new distribution areas of 19 species, distribution of clover species in most mountain belts and dominant phytocenoses in the region indicates that that this genus is in the stage of intensive speciation in the region.

➤ The fact that 63% of clover species in the Lankaran-Lerik region belong to the Ancient Mediterranean areal type is an indicator of the important role of the xerophilic and mesoxerophilic flora of the Ancient Mediterranean in the formation of this genus.

➤ The fact that more than 41% of clover species distributed in Lankaran-Lerik region are rare and endangered proves the high anthropogenic influence in the region.

Scientific novelty of the research. A new conspectus of the genus *Trifolium* L. of Lankaran-Lerik region has been developed for the first time. Distribution of 39 species, 14 species diversity belonging to the genus was determined here. Of these, 1 species - *T. patens* Schreb. is new to the flora of the Caucasus, including for the flora of Azerbaijan, new distribution areas of 19 species (*T. squamosum*, *T. angustifolium*, *T. striatum*, *T. scabrum*, *T. phleoides*, *T. grossheimii*, *T. hirtum*, *T. lappaceum*, *T. arvense*, *T. glomeratum*, *T. subterraneum*, *T. fragiferum*, *T. bonannii*, *T. talyschense*, *T. tumens*, *T. resupinatum*, *T. grandiflorum*, *T. aureum*, *T. patens*) have been identified.

For the first time, the micromorphological properties of seeds of 8 species belonging to 4 subgenera and 6 sections of the clover (*Trifolium* L.) genus collected from Lankaran-Lerik region of

Azerbaijan were studied under an electron microscope. It was found that size, shape, color, surface structure of seeds, shape and sizes of hilum have significant taxonomic significance. According to the results of the study, the structure of seeds in the studied species belongs to 4 seed types: seeds with granular surfaces; with "hilly" surfaces; with crystal-like protrusions; ring-shaped protrusions. Characteristics of the identified seed types can be used in the clarification of the genus sections (sect. *Lotoidea*, sect. *Trifolium*), while other morphological features in the identification of species with disputable status.

Phytocenological analysis of species was conducted, distribution of more species (16) in forest-shrub plant groupings was determined.

As a result of the florogenetic studies the range types of the species of the genus and their role in the formation of the genus were identified. It was found that 24 species (63.2%) of *Trifolium* L. genus in Talysh flora belong to the Ancient Mediterranean type of range, the Mediterranean geographical type. Species with Boreal, Pluriregional and coordinated ranges are relatively minor (14 species - 36.8%). Florogenetic analysis shows that the formation of the clover genus of the region took place mainly under the influence of xerophilic and mesoxerophilic florocenotic complexes of the flora of the ancient Mediterranean.

The current condition of the population of the genus species were studied, 16 species were determined as rare and endangered in the region. Their status was determined in accordance with the methodology developed by the International Union for Conservation of Nature. It was determined that 3 species are Critically Endangered (CR), 2 species - endangered (EN), 4 species - Near Threatened (NT) and 7 species - Vulnerable (VU). These results indicate that there are many anthropogenic impacts on clover *in situ* study area.

Theoretical and practical significance of research. The developed conspectus of the genus clover distributed in Lankaran-Lerik region will be used in the new edition of "Flora of Azerbaijan". The phytocenological properties of clover species can be used in practical phytocenology. 16 species of the genus were identified as rare and

endangered and their ecological assessment was carried out.

In addition, the results of the study can be used in the development of plant taxonomy, determinants and monographs on legume family. Plant samples collected during field studies were handed over to the Herbarium Funds of the Institute of Botany and the Institute of Genetic Resources of Ministry of Science and Education which played a role in their enrichment.

Approbation and application. The results of the research were presented at the III International Scientific Conference on “Ecology: Problems of Nature and Society” at Baku State University (Baku 2017), the international scientific conferences “Actual problems of modern biology and chemistry” of Ganja State University (Ganja, 2017; 2018), the International Scientific Conference “New Challenges in Botanical Research” of the Institute of Botany of ANAS and the Society of Azerbaijan Botanists (Baku, 2018), the International Conference “Biodiversity of South Russia and the Caucasus” (Ingushetia, 2019), Scientific seminar and Scientific Council of the Institute of Genetic Resources of MSE RA.

16 scientific articles, 2 theses reflecting the main provisions of the dissertation were published. Three of them were published in foreign journals with an impact factor.

The name of the institution where the dissertation work was performed. Dissertation work was carried out at the Department of “Ecobotany and Systematics” of the Institute of Genetic Resources of MSE RA.

The structure and scope of the dissertation. The dissertation is written in Russian and consists of 208 pages with an introduction, 8 chapters, conclusions, proposals and recommendations, and a list of references in 125 titles. In general, dissertation work consists of 14554570 symbols (introduction -11441 symbol, Chapter I-25218 symbol, Chapter II-425349 symbol, Chapter III-2867975 symbol, Chapter IV-4253685 symbol, Chapter V-2405348 symbol, Chapter VI-806104 symbol, Chapter VII-799035 symbol, Chapter VIII-2392073 symbol, Conclusions-3342 symbol, Proposals and recommendations-565 symbol). The main part of the dissertation contains 16 table, 148 figure.

CHAPTER I

A REVIEW OF THE LITERATURE ON THE STUDY OF GENUS CLOVER (*TRIFOLIUM* L.)

The history of the study of this genus originates from Tournefort (J.P.Tournefort, *Institutiones Rei Herbariae*, I, 404, 1700). A number of classical botanists have played a significant role in the study of Caucasian clovers: Boissier (Boissier, “*Flora Orientalis*”), De Candolle (De Candolle, “*Brodromus*”), Ledebour (Ledebour, “*Flora Rossica*”); Bieberstein (Marschalla Bieberstein “*Flora Taurico Caucasica*”); Schmalhausen (“*Flora of Central and Southern Russia*”, “*Crimea and the North Caucasus*”), Lipsky (“*Flora of the Caucasus and addition*”); Fomin and Voronov (“*Key to plants of the Caucasus and Crimea*”).

The study of the taxonomy of clovers was carried out by such scientists as Serenji, Hooker, Celakovsky, acad. A.A.Grosseim (Author of the multi-volume “*Flora of Caucasus*”), E.G.Bobrov (Researcher of this genus in the former USSR), A.Kh.Khalilov (Researcher of Caucasian clovers), Pakistan botanist M.Hussein (Studied clover in the Middle East - Iran, Turkey, Syria, Cyprus, Iraq and other countries), as well as Zohary, Heller (monographs of the genus *Trifolium* L.), and Y.Roskov, A.Shmakov (researchers of clovers of Russia).

CHAPTER II

MATERIAL AND METHODS OF RESEARCH

Materials for research were herbarium and seed samples collected during expeditions organized to Lankaran-Lerik region in 2017-2019, herbariums of the genus clover (*Trifolium* L.) stored in the Herbarium funds of the Institute of Botany and Genetic Resources of MSE RA (BAK, AGRI) and seed materials stored in the Central Gene Bank.

Micromorphological characteristics of seeds were studied in stereo Images Plus 2.0 ML and scanning electron microscope (SEM) - JEOLJSM 6060.

The following literature sources were used to clarify the nomenclature of species: “*Flora of Azerbaijan*”, “*The genus Trifolium*”, “*The*

plant world of Azerbaijan”⁶ and etc.

In addition, we used the International Plant Database such as IPNI (International Plant Names Index), ITIS (Integrated Taxonomic Information System), APWeb (Angiosperm Phylogeny Website), ILDIS (International Legume Database and Information Service).

The coordinates of the collected herbarium specimens were recorded by the GPS of the Garmin eTex 20 model. The life forms of the species were clarified according to I.G. Serebryakov’s work⁷. Cluster analysis was performed using the computer program SSPS Win (SPSS ver. 16.0).

The distribution of species in Lankaran-Lerik region and throughout Azerbaijan are given according to the botanical-geographical zoning in the “Flora of Azerbaijan”.

The geographical types of species were specified according to the monograph “The genus *Trifolium*”, “Flora of the Caucasus”⁸ by A.A.Grossheim as well as based on classification on geographical types of the Caucasus flora by Portenier⁹.

The characterization of rare and endangered species are carried out according to the International Union for Conservation of Nature (IUCN).

CHAPTER III

MORPHOLOGICAL CHARACTERISTICS OF SPECIES OF GENUS CLOVER (*TRIFOLIUM* L.)

3.1. General morphological structure of clover species

As a result of research in nature, the morphological features of individual species and their importance in the determination of intraspecific taxa were assessed.

For this purpose, the characteristics of the vegetative and generative organs of clover species distributed in Talysh were studied.

⁶ Əsgərov, A.M. Azərbaycanın bitki aləmi / A.Əsgərov. - Bakı: TEASPREs, - 2016 -444 s.

⁷ Серебряков, И.Г. Жизненные формы высших растений и их изучение (Полевая геоботаника): [в 3 - х т.] / И.Г.Серебряков, – М.- Л.: Изд. АН СССР, –1962. - т. 3,- 181 с

⁸ Флора Кавказа: [в 7 - х т.] / - Баку: Изд. АН АзССР, - т.5. – 1952. - 453 с

⁹ Портениер, Н.Н. Система географических элементов флоры Кавказа // -Санкт.-Петербург.: Ботанический журнал, - 2000. т.85.№ 9, - с.26-33

In total, 31 main features (height of plant, number, length, width of leaflets etc.) were analyzed, their variability was studied and cluster analysis was conducted.

Measurements were made by taking at least 2-3 samples from each population and the average value was calculated.

The taximetric (phenetic) relationship between the species of *Trifolium* genus was as follows (Fig. 1).

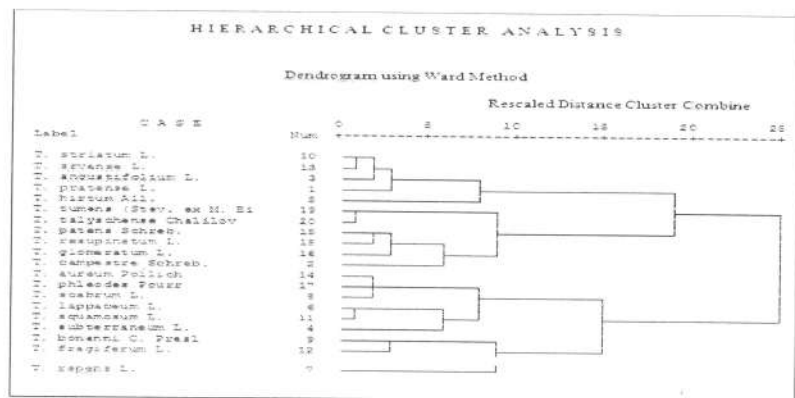


Figure 1. Cluster analysis of morphological features of the species of genus *Trifolium* L

According to the results of cluster analysis, high polymorphism was found in the species¹⁰.

3.1.1. Leaf morphology. As a rule, in the species *Trifolium* L. s. l., the leaf consists of 3 leaflets (three-leaf clover - *Trifolium*, the name is derived from here). However, in addition to this, plants with 2- or 4-leaflets are very rarely found in natural populations of some species (*T. repens*, *T. pratense*) of the genus.

3.1.2. Morphological features of the inflorescence

One of the main distinguishing features of species of genus *Trifolium* L.s.l. is that the inflorescence is a capitulum or capituliform cluster (Figure 2).

¹⁰ Mammadyarova, K.A., Asgarov, A.M., Akparov, Z.I. Studies on a clover (*Trifolium* L.) collection from Lenkaran-Lerik region of Azerbaijan // - Genetic Resources and Crop Evolution, - 2019. V.66, N3, - p. 611-618



T. aureum *T. hybridum* *T. caucasicum* *T. fragiferum*
Figure 2. Forms of inflorescence in different clover species

3.1.3. Morphological features of the flower

Two signs attract attention in the structure of the flower of the genus *Trifolium* s.l.: degree of fusion of petals (parts of papilionaceous flowers called vexillum, wing and carina) between itself and with a tube of stamens. According to these characteristics, within the genus four morphobiological types of species distributed in Talysh are observed:

Vexillum is free, wing, carina and stamen tubes fuse only at the base (in species of the *Chrysaspis* subgenus);

Vexillum is free, wing, carina cover the stamen tube and form a non-closed tube;

The 1/3 part of the vexillum fuses with the stamen tube, surround petals of the wing and carina;

Vexillum, wing and carina petals fuse with the stamen tube and form a closed tube (Fig. 3).

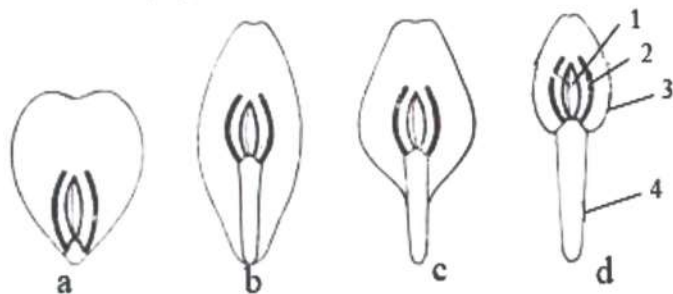


Fig.3. Biomorphological types depending on the structural features of the flower (a, b, c, d: 1-carina; 2-wing; 3-vexillum; 4-filament)

3.1.4. Morphology of the calyx

During the flowering of plants, much attention is drawn to the structural features of the calyx. So, in species of the *Chrysaspis* group, the calyx is zygomorphic in structure, bilabiate. In the species belonging to the group *Amoria*, *Galearia*, *Calycomorphum*, the weak zygomorphism is expressed and not bilabiate. In *Trifolium* subgenus calyx is closer to actinomorphic structure.

3.1.5. Morphological features of the bract

One of the main features of species of the genus *Trifolium* L. s. l. is the presence or absence of bract leaves in the flower, their size and shape. This feature is taken as the basis in most determinants of the genus. In *Amoria* group bracts are well developed (*T. repens*, *T. ambigum* and etc.); in *Chrysaspis* bracts are small, scaly; in the subgenus *Trifolium* L.s.str. bracts are not developed.

3.1.6. General structural characteristics of seeds and fruits.

One of the main features in species of the genus is the shape of the opening of fruits (beans) and the number of seeds in the fruits.

An evolutionary primitive structure is considered to be a multi-seeded bean that opens with a ventral suture (*Amoria* group), other forms of the bean noted were formed later as a result of adjustment and adaptations.

3.1.7. Micromorphological features of seeds in some clover species under electron microscope.

In monographs on the genus *Trifolium* L., in Atlas of seeds of higher plants of European flora¹¹ as well as in articles published in prestigious journals^{12,13}, the importance of micromorphological features of the seed in the taxonomy of the genus is emphasized (in particular, the shape and structure of the seed surface, the shape and size of the hilum, etc.). Considering this,

¹¹ Bojnansky, V. Atlas of seeds and fruits of Central and East – European Flora / V.Bojnansky, A.Fargasova - Springer, - 2007. - 961 p.

¹² Fahimeh, S., Sharifnia, M., Sharifnia, F. Micromorphologic Study of the Seed of the genus *Trifolium*, section *Lotoidea*, in Iran // Pakistan Journal of Biological Sciences, - 2007. Vol. 10, №3, - p. 378-382

¹³ Zoric, L. Comparative seed morphology of *Trifolium* L. species (*Fabaceae*) / L. Zoric, Lj. Merkulov, J. Lukovic [etal.] // Period Biol, - 2010, 112(3), - p. 263-272

we studied the micromorphological features of 8 species collected in Lankaran-Lerik region under an stereomicroscopy and scanning electron microscope (Fig. 4, 5, 6).

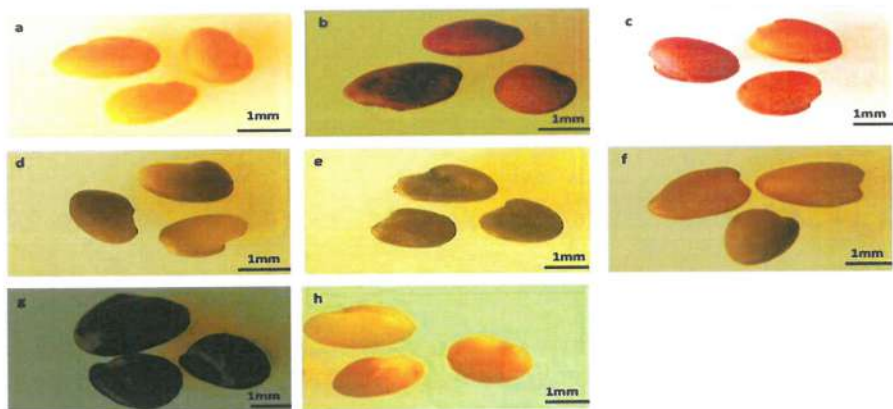


Fig.4. Shapes of seeds under stereomicroscopy: a-*T. angustifolium*; b-*T. campestre*; c-*T. lappaceum*; d-*T. pratense*; e-*T. repens*; f-*T. resupinatum*; g-*T. subterraneum*; h-*T. Tumens*

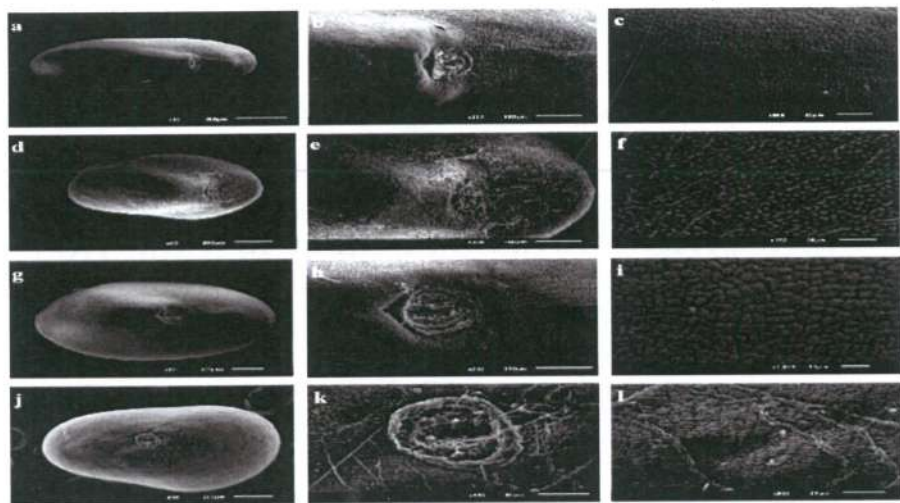


Fig. 5.View of seeds under scanning electron microscope (SEM): a-c *T. angustifolium*; d-f *T. repens*; g-i *T. pratense*; j-l *T. tumens*

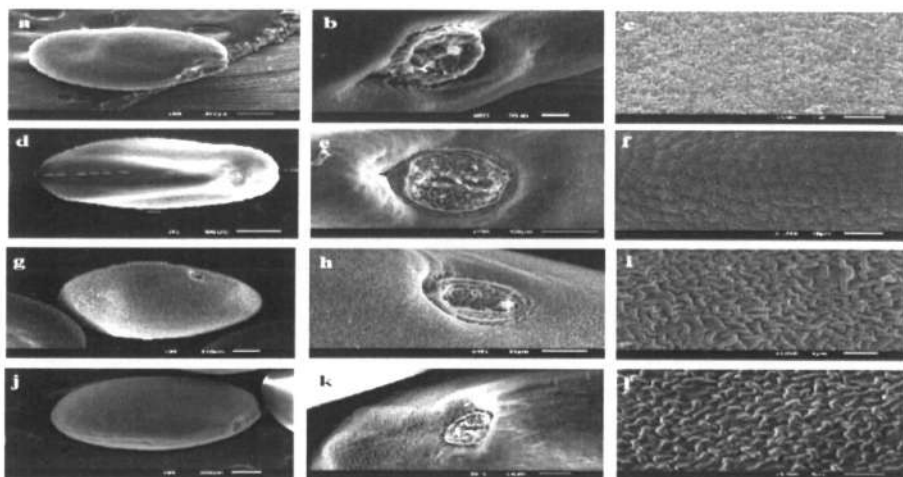


Fig. 6. View of seeds under scanning electron microscope (SEM): a-c *T. campestre*; d-f *T. subterraneum*; g-i *T. resupinatum*; j-l *T. lappaceum*

Based on our research on these species, 4 seed types have been identified based on the shape and structure of the seed surface: surface of seed is smooth, covered with dense granulars; surface of seed is smooth, dense hilly; surface of seed is smooth, crystal-like protrusions; located dense, uneven, sometimes rounded; surface of seed is smooth, ring-shaped protrusions, separated into parts by a network extending along its surface¹⁴.

CHAPTER IV SYSTEMATICS AND GEOGRAPHICAL DISTRIBUTION OF CLOVER (*TRIFOLIUM* L.) SPECIES OF LANKARAN-LERIK REGION

Currently, the most widely used system of the clover genus is the system proposed by M.Zohary and D. Heller. However, later Zoric et

¹⁴ Маммедярова, К.А., Аскеров, А.М. Исследования микроморфологических особенностей семян видов рода *Trifolium* L. Флоры Южного Кавказа (Азербайджанская Республика, Тальш) на электронном микроскопе (СЭМ) и их таксономическое значение // Ученые записки Крымского федерального университета имени В.И.Вернадского Биология. Химия, - 2020, Т. 6 (72), № 2, с. 138-148

al.¹⁵ studied the anatomical structure of species belonging to different sections of the genus under light and electron microscopy, as well as N.Ellison et al. studied many species of intra-genus taxa by molecular genetic methods and made some additions to the systematics of genus macrotaxon.

Studies by both methods did not consider it appropriate to divide the genus into 5 independent genera¹⁶ - *Trifolium* L. s.str., *Amoria* C. Presl, *Chrysaspis* Desv., *Calycomorphum* Presl, *Galearia* Presl. or 4 subgenera - subgen *Trifolium* L., subgen. *Chronosemium* (Ser.) Peterm., subgen. *Galearia* (C. Presl) Hossain, subgen. *Calycomorphum* C.Presl. A.Y.Magulayev¹⁷, who studied the clovers of North Caucasus, also widely accepted the classical system of genus, ie genus *Trifolium* L.

4.1. Taxonomic review of the genus clover (*Trifolium* L.) in Lankaran-Lerik region

There are more than 160 species distributed in the countries of Eurasia and Africa, especially the Mediterranean with temperate and subtropical climate¹⁸.

During our expeditions organized to the region in 2017-2019, herbarium and seed materials of these species were collected and their biomorphological analysis was conducted. New information was also important in clarifying the species distributed in the republic with disputable status. As a result, it was determined that there are 39 species and 14 species diversity of this genus belonging

¹⁵ Zoric L., Comparative analysis of qualitative anatomical characters of *Trifolium* L. (*Fabaceae*) and their taxonomic implications: preliminary results / L.Zoric, Lj.Merkulov, J.Lukovic [et al.] // Plant systematics and Evolution, - 2012. vol. 298, №1, - p. 205-219

¹⁶ Бобров, Е.Г. Об объеме рода *Trifolium* S.L. // - Санкт-Петербург: Ботанический журнал, - 1967. т. 52, №11. - с. 1593-1599

¹⁷ Магулаев, А.Ю. Род *Trifolium* L. (*Fabaceae* Lindl.) во флоре Северного Кавказа // - Ставрополь: Вестник СГУ, 2001. Вып. 28, - с. 84-93

¹⁸ Флора Европ. части СССР: [в 10 томах] / Под ред. Ан.А.Федорова. Л: Наука, - т. 6. - 1987. - 254 с

to 9 sections and 4 subgenera¹⁹ (Table 1).

Table 1
Subgenera, sections and species of *Trifolium* L. Genus of Talysh

| Subgenera | Sections | Species |
|-------------------------------------|---------------------------------|--|
| Subgen I. <i>Trifolium</i> | Sect. 1. <i>Stenostoma</i> | <i>T. canescens</i> , <i>T. topczibashovii</i> , <i>T. caucasicum</i> , <i>T. squamosum</i> , <i>T. echinatum</i> , <i>T. angustifolium</i> |
| | Sect. 2. <i>Probatostoma</i> | <i>T. striatum</i> , <i>T. scabrum</i> , <i>T. phleoides</i> , <i>T. incarnatum</i> |
| | Sect. 3. <i>Trifolium</i> | <i>T. medium</i> , <i>T. grossheimii</i> , <i>T. pratense</i> , <i>T. lenkoranicum</i> , <i>T. diffusum</i> , + <i>T. alexandrium</i> , <i>T. hirtum</i> , <i>T. lappaceum</i> , <i>T. issajevii</i> , <i>T. arvense</i> |
| | Sect. 4. <i>Lotoidea</i> | <i>T. hybridum</i> , <i>T. repens</i> |
| | Sect. 5. <i>Micrantheum</i> | <i>T. retusum</i> , <i>T. glomeratum</i> , <i>T. suffocatum</i> |
| | Sect. 6. <i>Vesicastrum</i> | <i>T. spumosum</i> |
| Subgen. II. <i>Calycomorphum</i> | Sect. 7. <i>Calycomorphum</i> | <i>T. subterraneum</i> |
| Subgen. III. <i>Galearia</i> | Sect. 8. <i>Galearia</i> | <i>T. fragiferum</i> , <i>T. bonannii</i> , <i>T. talyschense</i> , <i>T. tumens</i> , <i>T. resupinatum</i> , <i>T. tomentosum</i> |
| Subgen. IV. <i>Chronosemium</i> | Sect. 9. <i>Chronosemium</i> | <i>T. grandiflorum</i> , <i>T. aureum</i> , <i>T. campestre</i> , <i>T. sebastiani</i> , <i>T. micranthum</i> , <i>T. patens</i> |

+ - species found in the culture

¹⁹ Мамедьярова, К.А., Аскеров, А.М., Росков, Ю.П. *Trifolium patens* Schreb. (*Fabaceae*)- Новый вид для флоры Кавказа // Санкт-Петербург: Новости систематики высших растений, - 2018. т.49. - с.139-143

Below is a new conspectus of the genus Clover (*Trifolium* L.) of the Lankaran-Lerik region.

Fam. Fabaceae Lindl. (Leguminosae Juss.)

Gen. *Trifolium* L., s.l., 1753, Sp. Pl.:764; id. 1754, Gen. Pl.:33

Lectotypus: *T. pratense*

Subgen I. *Trifolium* L., s. str.

Lectotypus: Genus lectotype.

Sect. 1. *Stenostoma* Gibelli et Belli

Lectotypus: *T. angustifolium* L.

1. *T. canescens* Willd. 1802, Sp. Pl., 3 : 1369; Typus: [Turkey] Habitat in Cappadocia (Holo. B, photo).

2. • *T. topczibashovii* Chal., 1967, Докл. АН Азерб. ССР 23,9:60 (Cf. *T. caucasicum* Paush.). Typus: Azerbaijan SSR, Lerik district, Orandchay gorge, in the clear-boled forests; E.Kh. Khalilov, 26.VI.1963 (BAK; Herbarium Placement: Lehmann, mid, I, 128; Tropicos).

3. *T. caucasicum* Tausch, 1828, Syll. Ratisb. 2: 245; Typus: [Georgia] ex agro Georgipolitani Caucasi (LE, photo).

4. *T. squamosum* L. 1759, Amoen, Acad. 4: 105 (*T. maritimum* Huds.); Typus: Described from Europe (England). "At Lighe in Essex".

5. *T. echinatum* M. Bieb. 1808, Fl. Taur.-Cauc. 2 : 216; Typus: Described in Azerbaijan (Xachmaz, Guba): "Caucasum, *Bieberstein* (LE, photo)".

6. *T. angustifolium* L. 1753, Sp. Pl.: 769; Typus: Described from Europe (Italy), "Hb. Cliff."

Sect. 2. *Prosbatostoma* Gibelli

Lectotypus: *T. incarnatum* L.

7. *T. striatum* L. 1753, Sp. Pl.: 770; Typus: "Syntypes from Germany, France and Spain (Hb. Linn. 930/45, photo)"

8. *T. scabrum* L. 1753, Sp. Pl.: 770; Typus: Described from Western Europe ("In Anglia, Gallia, Italia").

9. *T. phleoides* Pourr. 1802, Willd. Sp. Pl. 3, 2: 1377; Typus: Described from Europe ("In Hispania").

10. *T. incarnatum* 1753, Sp. Pl.: 769; Typus: Described from Europe ("In Italia").

Sect 3. *Trifolium* sect. *Trichostoma* Bobr. (sect. *Hiantia* Bobr.)

Lectotypus: Genus lectotype.

11. *T. medium* L. 1759, Amoen Acad. 4: 105; Typus: Described from Europe (England) "Hb. Linn. 930/27, photo".

12. • *T. grossheimii* Chalilov 1969, Izv. Akad. Nauk Azerbajdzansk. S.S.R., Ser. Biol. Med. Nauk 4: 4; Typus: Azerbaijan SSR, Lankaran, Sagachula. Collected by A.A. Grossheim, 26. VII 1934 г. (BAK).

13. *T. pratense* L. 1753, Sp. Pl.: 768; Typus: Described from Europe ("Hb. Cliff").

14. • *T. lenkoranicum* (Grossh.) Roskov 1990, Бот. журн. 75, 5:719 (*T. zardabii* Chalilov, nom. nud.); Typus: Azerbaijan SSR, Hadrut district, village. Domi, in the forest clearings. Collected by E.Kh.Khalilov 15.VIII 1963 г. (BAK).

15. *T. diffusum* Ehrh. 1792, Beitr. Naturk. 7 :165; Typus: Described from Europe "Венгрия?" ("Hungaria?").

16. *T. alexandrium* L. 1755, Cent. Pl. 1: 25; Typus: Described from Egypt.

17. *T. hirtum* All. 1789, Auct. Fl. Pedem.: 20; Typus: Described from Europe (Italy). "In Monteserrato secus agros", Allioni (TO).

18. *T. lappaceum* L. 1753, Sp. Pl.: 768; Typus: Described from Europe (S. France) (Hb. Linn. 930/28, photo).

19. • *T. issajevii* Chalilov 1967, Dokl. Akad. Nauk Azerb. SSR, 11: 66 (Cf. *T. lappaceum*); Typus: Azerbaijan SSR, near the city of Astara, collected by Y.M. Isaev and E.Kh. Khalilov 21.V.1961 (BAK).

20. *T. arvense* L. 1753, Sp. Pl.: 769; Typus: Described from Europe ("Hb. Cliff").

Sect. 4. *Lotoidea* Grantz. (sect. *Amoria* (Presl) Lojac)

Lectotypus: *Trifolium repens* L.

21. *T. hybridum* L. 1753, Sp. Pl.: 766; Typus: Described from Europe: Described from a cultivated specim. (Hb. Linn. 930/15, photo).

22. *T. repens* L. 1753, Sp. Pl.: 767; Typus: Described from Northern Europe ("in Europae pascuis"); "Hb. Cliff."

Sect. 5. *Micrantheum* (C. Presl) Gib. et Belli

Lectotypus: Subgenus lectotype

23. *T. retusum* L. 1753, Höjer, Demonstr. Pl.: 21 (*T. parviflorum* Ehrh, *Amoria retusa* (L.) Dostal); Typus: Described from Europe (Spain).

24. *T. glomeratum* L. 1753, Sp. Pl.: 770 (*Amoria glomerata* (L.) Sojak); Typus: Described from Europe (England), "Hb. Cliff."

25. *T. suffocatum* L. 1771, Mant. 2: 276 (*Amoria suffocata* (L.) Roskov); Typus: Described from Europe ("Described from Sicily").

Sect. 6. *Vesicastrum* Ser. (sect. *Mistyllus* (Presl) Godr.; Subgenus *Mistyllus* (Presl) Hossain

Lectotypus: *M. spumosum* (L.) Bobr. (*Trifolium spumosum* L.)

26. *T. spumosum* L. 1753, Sp. Pl. 2: 771; Typus: Described from Europe (Southern France), "Hb. Cliff."

Subgen. II *Calycomorphum* C. Presl

Lectotypus: *C. subterraneum* (L.) Presl (= *Trifolium subterraneum* L.)

Sect. 7. *Calycomorphum* (C. Presl) Gren. et Godr. (= sect. *Trichosephalum* Koch)

Typus: Subgenus lectotype

27. *T. subterraneum* L. 1753, Sp. Pl.: 767 (*Calycomorphum subterraneum* (L.) Presl); Syntypes from France and Italy (Hb. Cliff.).

Subgen. III. *Galearia* (C. Presl) Hossain

Lectotypus: *G. fragifera* (L.) Bobr. (= *Trifolium fragiferum* L.)

Sect. 8. *Galearia* (C. Presl) Godr.

Lectotypus: Subgenus lectotype

28. *T. fragiferum* L. 1753, Sp. Pl.: 772 (*Amoria fragifera* (L.) Roskov); Typus: Described from Europe, (South Sweden), type stored in London.

29. *T. bonannii* C. Presl, 1822, Delic. Prag.: 51 (*Amoria bonannii* (C. Presl) Roskov); Typus: Described from Europe (in pascuis maritimis ad Cephalu).

30. • *T. talyschense* Chalilov (*Amoria talyschensis* (Chalilov) Roskov) (Cf. *T. tumens* Steven ex M. Bieb.); Typus: Described in Azerbaijan (Talysh), Lerik district, Orandchay gorge

31. *T. tumens* Steven ex M. Bieb., 1808, Fl. Taur.-Caucas. 2: 217 (*Amoria tumens* (Stev. ex Bieb.) Roskov); Lectotypus: "In Iberia ad fluvium Iberium et Alazanium, Steven" (H).

32. *T. resupinatum* L. 1753, Sp. Pl.: 771 (*Amoria resupinata* (L.) Roskov); Typus: Described from Western Europe ("In Anglia, Belgia", Hb. Cliff.)

33. *T. tomentosum* L. 1753, Sp. Pl.: 771 (*Amoria tomentosa* (L.)

Roskov); Typus: Described from Europe [France, Spain and Portugal (Hb. Linn. 930/53 photo)].

Subgen. IV. *Chronosemium*

Sect. 9. *Chronosemium*, Ser. 1825, in DC. Prodr.2: 204.

Typus: *Ch. spadicea* (L.) Greene (*Trifolium spadiceum* L.).

34. *T. grandiflorum* Schreb. 1767, Nova Ac. Acad. Leop.-Carol. 3: 477 (*T. speciosum* Willd.; *Chrysaspis grandiflora* (Schreb.) Hendr.); Typus: Crete, Hb. Willdenow, 14240 (holo, B, photo).

35. *T. aureum* Pollich, 1777, Hist. Plant. Palat. 2: 344 (*T. strepens* Crantz; *Chrysaspis aurea* (Poll.) Greene); Typus: Described from Europe (Germany, "In montosis sylvis circa Steinbach").

36. *T. campestre* Schreb. 1804, in Sturm, Deutschl. Fl. 1: 16 (*Chrysaspis campestris* (Schreb.) Desv.); Typus: Described from Central Europe ("In allen Provinzen Deutschlands").

37. *T. sebastiani* Savi ex Diar. 1815, Med. Flajani: 14 (*Chrysaspis sebastianii* (Savi) Hendr.); Typus: Described from Europe (Italy).

38. *T. micranthum* Viv. 1824, Fl. Lib.: 45 (*Chrysaspis micrantha* (Viv.) Hendrych 1976); Typus: Described from Eastern Libya ("Cyrenaica").

39. *T. patens* Schreb. 1804, in Sturm, Deutschl. Fl. 1,16, sine pag. (*Chrysaspis patens* (Schreb.) Holub); Typus: Icon in Sturm, 1804, loco citato: tab. 256.

Note: During the processing of herbarium materials for the genus *Trifolium* L., stored at the Institute of Botany of the Ministry of Education and Science of the Republic of Azerbaijan (BAK), among the herbarium materials for *Trifolium campestre* Schreb. we found herbarium material belonging to the Central European species *T. patens* Schreb. (*Chrysaspis patens* (Schreb.) Holub), which has not previously been reported both for the flora of Azerbaijan and for the flora of the Caucasus as a whole. This specimen, collected and originally identified by A. Grossheim as *Trifolium campestre* Schreb., was re-identified by Yu.R. Roskov in 1988 as *T. patens* (rejected clover). However, Yu.R. Roskov doubted this definition and this species was not indicated by him for the South Caucasus in the conspectus of clovers of the flora of the former USSR.

4.2. Controversial issues in the systematics of the genus Clover (*Trifolium* L.). When investigating controversial issues in the status of genus and related species, their protolog data, as well as the nomenclature types stored in the herbarium funds of the Institute of Botany of the RAS, Institute of Botany and Institute of Genetic Resources of MSE RA were analyzed. Monographs and major foreign journals were also used.

Controversial issues at the genus level

The species *T. repens* L. and *T. hybridum* L. distributed in Talysh flora are accepted as independent genus (genus *Amoria* C. Presl) or subgenus (subgenus *Amoria* (C.Presl) Hossain). However, we consider it expedient to include them in the section rank (sect. *Lotoidea* Grantz) of the *Trifolium* L. subgenus.

Controversial issues at the species level.

After the publication of the multi-volume work "Flora of Azerbaijan", the Azerbaijani botanist A.Kh.Khalilov²⁰ described 5 species of clover from the Talysh flora new to science: *T. topczibashovii* Chal., *T. grossheimii* Chal., *T. zardabii* Chal., *T. issajevii* Chal., *T. talyschense* Chal.

In addition, Y.Roskov raised the status of *Trifolium pratense* var. *lenkoranicum* Grossh. species diversity from Talysh to the species status and described it as *T. lenkoranicum* (Grossh.) Roskov species²¹. In the botanical literature both in Azerbaijan, the CIS countries, as well as far abroad countries, the attitude to the independence of these species is ambiguous. In some sources, they are accepted as independent species, some systematists do not accept them in the species status and give them as subspecies or species diversity (variety). In some sources they are not accepted at all and included in the synonymous of other species.

As a result of our research, it was determined that the 4 clover

²⁰ Халилов, Э.Х. Клевера Кавказа и их внутривидовая систематика / Э.Халилов. - Баку: Элм, - 1970. - 42 с

²¹ Росков, Ю.Р. Новые виды и новые номенклатурные комбинации в родах *Lupinaster*, *Chrysaspis*, *Trifolium* и *Amoria* (*Fabaceae*) // Санкт-Петербург: Ботанический журнал, - 1990. т. 75, № 5.- с. 715-720

species (*T. topczibashovii* Chal., *T. grossheimii* Chal., *T. issajevii* Chal., *T. talyschense* Chal.) described by A.Khalilov from Lankaran-Lerik region clearly differ in their morphobiological and ecological features, and we accept them as independent species.

T. zardabii Chal. species described by A.Khalilov does not meet the requirements of the International Code of Botanical Nomenclature and is considered a synonym for species *T. lenkoranicum* (Grossh.) Roskov.

CHAPTER V

ECOLOGICAL AND PHYTOCENOLOGICAL ANALYSIS OF SPECIES OF GENUS CLOVER (*TRIFOLIUM* L.)

5.1. Bioecological analysis of species. Life forms of species were studied based on the methods of C.Raunkiaer²² and I.G.Serebryakov. The clover species of the region under study belong to the annual (26 species) and perennial (13 species) life forms. They bloom mainly in May-June, and bear seeds and fruits in July-August.

Clover species of Lankaran-Lerik region are distributed as follows, depending on altitude above sea level: 8 species (*T. squamosum*, *T. incarnatum*, *T.alexandrium*, *T.issajevii*, *T. glomeratum*, *T. suffocatum*, *T. spumosum*, *T. tomentosum*) in the plains; 1 species in the lower mountain belt (*T. patens*); 1 species in the middle mountain belt (*T.lenkoranicum*); 2 species (*T.topczibashovii*, *T.grandiflorum*) in the upper mountain belt, the same species is found in several mountain ranges.

Species were analyzed according to vegetation types and adaptation to different biotopes: In forest and shrub phytocenoses - 16 species; in different meadow groupings - 10 species; on gravel and clay substrates - 2 species; in humid places - 8 species; in hayfields - 3 species. This information was obtained mainly during an expedition organized to the research region.

5.2. Phytocenological analysis of species. The main materials for ecological and phytocenological researches are herbarium materials stored at the Institute of Botany (BAK) and Genetic Resources

²² Raunkiaer, Ch. Plant life forms / Ch. Raunkiaer. - Oxford: Clarendon Press, - 1937 - 104 p

(AGRI) of Ministry of Science and Education of RA and collected by the author from nature in 2017-2019, as well as geobotanical descriptions made in nature. This section of the dissertation analysed the occurrence of species in phytocenoses, for this purpose 13 original descriptions are made.

CHAPTER VI

BOTANICAL-GEOGRAPHICAL ANALYSIS OF CLOVER (*TRIFOLIUM* L.) SPECIES IN LANKARAN-LERIK REGION

In order to study the flora under study, first of all, a classification of areal types or geographical types should be developed. A.A.Grossheim developed such a classification for Caucasian flora and analyzed the higher plants of Caucasian flora. Among the systems developed for the whole Caucasus after A.A.Grossheim, the geographical elements of the Caucasian flora compiled by N.I.Portenier can be noted.

Clover species of Talysh flora were identified as belonging to 3 areal types: Ancient Mediterranean, Boreal, Pluriregional.

Species with wide range (Pluriregional)-*T. medium* L., *T. pratense* L., *T. arvense* L., *T. aureum* Pollich, *T. fragiferum* L.

Mediterranean geographical type-The Talysh flora is dominated by clover species belonging to this geographical type. Thus, out of 36 species in the wild flora, 18 (*T. squamosum* L., *T. echinatum* Bieb., *T. angustifolium* L., *T. striatum* L., *T. scabrum* L., *T. phleoides* Pourr., *T. hirtum* All., *T. lappaceum* L., *T. retusum* L., *T. glomeratum* L., *T. suffocatum* L., *T. spumosum* L., *T. grandiflorum* Schreb., *T. sebastiani* Savi ex Diar., *T. resupinatum* L., *T. micranthum* Viv., *T. tomentosum* L., *T. subterraneum* L.) belong to this element.

Eastern Mediterranean geographical type-The species of clover - *T. echinatum* Bieb., *T. grandiflorum* Schreb., *T. sebastiani* Savi ex Diar. of Talysh flora belong to this geographical type.

Atlantic-Mediterranean geographical type-Our species *T. glomeratum* L., *T. suffocatum* L., *T. micranthum* Viv., *T. subterraneum* L. and *T. incarnatum* L. found as adventive belong to this geographical type.

The results of our monitoring showed that major of clover species with Mediterranean areal are xerophilous species distributed in the

forest, high mountain phytocenoses of Talysh (Lerik, Zuvand areas).

Of the boreal species, there are species (*T. campestre* Schreb., *T. diffusum* Ehrh.) with European, species (*T. patens* Schreb.) with Central European and species (*T. hybridum* L.) with Western European geographical types.

Palaearctic geographical type-The plants belonging to this type usually cover all three provinces (general, western and southern) of the Holarctic kingdom. This includes only 1 species *T. repens* L. of the clovers distributed in the flora of Talysh.

In addition to independent geographical types above, the clover species belong to the following connecting geographical types: Caucasian-Asia Minor (*T. canescens* Willd., *T. caucasicum* Tausch), Euro-Mediterranean element (*T. striatum* L.) and Hirkan-Euxin (*T. tumens* Steven ex M. Bieb.).

It can be assumed that the flora of nearby Iran and the flora of the Mediterranean as a whole played an important role in the formation of these species in this area.

Thus, it can be assumed that the ancient Mediterranean flora had an important influence on the formation of the species of genus *Trifolium* L. of Talysh. Boreal and Pluriregional species are represented by a few species in the genus *Trifolium* L.

CHAPTER VII

RARE AND ENDANGERED CLOVER SPECIES (*TRIFOLIUM* L.), THEIR ASSESSMENT AND PROTECTION MEASURES

As a result of the analysis of materials collected during the expeditions to the research area in 2017-2019, as well as materials stored in the Herbarium Funds of the Institute of Botany (BAK) and Genetic Resources of (AGRI) Ministry of Science and Education, 16 species were found to be rare and endangered in the study area. The populations of rare species were monitored, phytocenotic features studied, coordinates recorded, photographs taken, descriptor data collected and the causes of extinction clarified.

As a result of the analysis of the received information, certain measures for their protection were developed.

A list of these species and their status formula are given below:

| | |
|------------------------------------|---------------------|
| <i>Trifolium caucasicum</i> Tausch | CR B1b (i,v) |
| <i>T. suffocatum</i> L. | CR B1a (i,v) |
| <i>T. tomentosum</i> L. | CR B1a (i, ii) |
| <i>T. diffusum</i> Ehrh. | EN B1b (i, ii) |
| <i>T. hybridum</i> L. | EN B1a (i, ii) |
| <i>T. hirtum</i> All. | VU B1a (i, ii, iii) |
| <i>T. echinatum</i> Bieb. | NT |
| <i>T. scabrum</i> L. | NT |
| <i>T. spumosum</i> L. | NT |
| <i>T. sebastiani</i> Savi ex Diar. | NT |
| <i>T. angustifolium</i> L. | VU B1b (i) |
| <i>T. grossheimii</i> Chal. | VU B1a (i, ii) |
| <i>T. medium</i> L. | VU B1b (i, ii, iii) |
| <i>T. phleoides</i> Pourr. | VU B1a (i, iii) |
| <i>T. squamosum</i> L. | VU B1b (i,v) |
| <i>T. subterraneum</i> L. | VU B1a (i, ii, iii) |

Studies based on the IUCN classification shown that of these, three are Critically Endangered (CR), two species rare are Endangered (EN), four species are Near Threatened (NT) and seven species are Vulnerable (VU). These results indicate that the growing conditions of clover species in the study area are mainly affected by anthropogenic influences.

CHAPTER VIII

ECONOMIC IMPORTANCE AND PHYTOCHEMICAL ANALYSIS OF SOME SPECIES OF CLOVER (*TRIFOLIUM* L.) DISTRIBUTED IN LANKARAN-LERIK REGION

8.1. Economic importance of species. During the study of clover species of Lankaran-Lerik region, some useful features of their economic importance were revealed.

Species of the genus are valuable fodder, medicinal, green manure, as well as melliferous plants. In Azerbaijan, the seeds and green mass of these plants are mainly used in livestock, poultry and beekeeping. The green part of clovers normalizes the body of animals and birds

with amino acids, and also enriches them with proteins, various micro and macro elements, vitamins and mineral salts. The green mass of the plant also contains digestible proteins, phosphorus and calcium elements.

The following table provides indicators of economic importance of 12 more promising species (Table 2).

Table 2

Economic importance of clover species of Lankaran-Lerik region

| Name of species | Fodder | Medicinal | Decorative | Landscaping importance | Phytomeliorative | Melliferous | Anti-erosion | Green manure |
|-------------------------|--------|-----------|------------|------------------------|------------------|-------------|--------------|--------------|
| <i>T. pratense</i> | + | + | + | | | + | | |
| <i>T. medium</i> | + | | + | + | | + | + | |
| <i>T. repens</i> | + | + | + | + | + | + | + | + |
| <i>T. resupinatum</i> | + | | + | | | + | | + |
| <i>T. fragiferum</i> | + | | + | + | | + | | |
| <i>T. talyschense</i> | + | | + | | | + | + | |
| <i>T. bonanii</i> | + | + | + | | + | | | + |
| <i>T. caucasicum</i> | + | + | | | + | + | | |
| <i>T. subterraneum</i> | + | | | + | + | + | | + |
| <i>T. arvense</i> | + | | | | | | | |
| <i>T. angustifolium</i> | + | + | + | | + | | | |
| <i>T. tumens</i> | + | | | | | | | + |

Most of the species listed in the table can be introduced into culture as valuable fodder and melliferous plants.

8.2. Phytochemical indicators of some clover species. Phytochemical indicators of clover species, especially proteins and fats, are poorly studied in Azerbaijan. With this in mind, some indicators in some promising clover species have been studied (Table 3).

Table 3
Phytochemical indicators of some clover species

| No | Species | Raw protein, % | Moisture, % | Fatness, % |
|----|----------------------------|----------------|-------------|------------|
| 1 | <i>T.subterraneum</i> L. | 13.0 | 12.0 | 4.3 |
| 2 | <i>T.campestre</i> Schreb. | 11.3 | 10.0 | 5.5 |
| 3 | <i>T.resupiantum</i> L. | 15.7 | 12.0 | 4.7 |
| 4 | <i>T.pratense</i> L. | 13.3 | 11.0 | 4.3 |
| 5 | <i>T.repens</i> L. | 15.9 | 11.0 | 5.1 |
| 6 | <i>T.fragiferum</i> L. | 15.5 | 12.0 | 5.0 |
| 7 | <i>T.arvense</i> L. | 13.9 | | |

As can be seen from the table, these species contain the highest protein content: *T.repens* L. (15.9%), *T.resupiantum* L. (15.7%), *T.fragiferum* L. (15.5). Other species have average protein values, respectively - 13.0%; 11.3%; 13.3%; 13.9%. In species with low protein content, high fat content was observed. These species also differ in the degree of humidity.

CONCLUSIONS

1. A new taxonomic conspectus of the clover (*Trifolium* L.) genus of Lankaran-Lerik region was developed. It was determined that 39 species and 14 species diversity belonging to 4 subgenera, 9 sections were distributed in the study area. Independent species status of 4 species (*T. grossheimii* Chal., *T. issajevii* Chal., *T. talyschense* Chal., *T. topczibashovii* Chal.) which status was considered controversial in various sources was restored.
2. For the first time, new distribution areas of 19 species were identified in the study region: *T. squamosum*, *T. angustifolium*, *T. striatum*, *T. scabrum*, *T. phleoides*, *T. grossheimii*, *T. hirtum*, *T. lappaceum*, *T. arvense*, *T. glomeratum*, *T. subterraneum*, *T. fragiferum*, *T. bonannii*, *T. talyschense*, *T. tumens*, *T. resupinatum*, *T. grandiflorum*, *T. aureum*, *T. micranthum*:
3. As a result of studying the expedition materials collected from Lankaran-Lerik region, as well as herbarium samples stored in various Herbarium funds (LE, BAK, AGRI), one species new to Caucasus, Azerbaijan as well as Lankaran-Lerik region- *Trifolium*

patens Schreb. - was discovered.

4. A cluster analysis of important morphobiological traits obtained from the analysis of herbarium specimens collected from 56 populations of 20 species was carried out and on this basis the position of some species within sections was clarified.
5. Gradient analysis of species shows that they are widespread in most mountain zones, and analysis by vegetation type shows that they are unevenly distributed in different plant phytocenoses (16 species in forests and shrubs; 10 species in different meadow plant groupings, etc.).
6. For the first time, the micromorphological properties of seeds of 8 species belonging to 4 subgenera and 6 sections of the genus *Trifolium* L. were studied under an electron microscope. It was determined that the size, shape, color, surface structure of seeds, shape and size of the hilum are of great taxonomic importance. According to the results of the study, the structure of seeds in the studied species belongs to 4 seed types: seeds with granular surfaces; with "hilly" surfaces; with crystal-like protrusions; ring-shaped protrusions. Features on the discovered seed types were determined and included in the descriptions of the same species.
7. As a result of botanical-geographical analysis, it was determined that the clover (*Trifolium* L.) species of Lankaran-Lerik region belong to 3 areal types (Ancient Mediterranean, Boreal, Pluriregional) and 13 geographical types. Main part of the species of genus (63.2% or 24 species) belong to the ancient Mediterranean areal type. Based on this result, it can be assumed that the elements of the ancient Mediterranean flora took an active part in the formation of the clover species in the region and in Azerbaijan.
8. It was determined that 16 of the 39 clover species (*Trifolium* L.) found in Lankaran-Lerik region are rare and endangered species. Their status has been clarified using the classification of the International Union for Conservation of Nature: three species (*T. caucasicum*, *T. suffocatum*, *T. tomentosum*) are Critically Endangered (CR), two species (*T. diffusum*, *T. hybridum*) - rare (EN), four species (*T. spumosum*, *T. sebastiani*, *T. echinatum*, *T. scabrum*) - Near Threatened (NT) and seven species

(*T. squamosum*, *T. angustifolium*, *T. medium*, *T. hirtum*, *T. subterraneum*, *T. phleoides*, *T. grossheimii*) - Vulnerable (VU). These results indicate that the growing conditions of clover species in the study area are mainly affected by anthropogenic influences.

9. For the first time, the biochemical analysis of the more promising and widespread 7 species of clover (*Trifolium* L.) was made for the content of proteins, free nitrogen and fats. The results of the analysis showed that the studied species (*T. subterraneum*, *T. campestre*, *T. resupinatum*, *T. pratense*, *T. repens*, *T. fragiferum*, *T. arvense*) are high in protein (11-13%) and fat (4-5%).

PROPOSALS AND RECOMMENDATIONS

1. The original taxonomic conspectus of clover (*Trifolium* L.) species of Lankaran-Lerik zone can be used in the new edition of the multivolume "Flora of Azerbaijan"
2. As a result of the research, 1 species - *T. bithynicum* (*T. grossheimii*) of 16 rare and endangered clover species was included in the III edition of the "Red Book" of the Republic of Azerbaijan. *In situ* protection of other species is recommended.
3. Biochemical analysis of some species of high economic importance showed that they have a rich protein (*T. resupinatum*, *T. repens*, *T. fragiferum*) and fat (*T. campestre*, *T. repens*, *T. fragiferum*), which gives reason to recommend their use as a valuable fodder plant.

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Address: Badamdar highway 40, AZ1004, Baku, Azerbaijan

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