Lesson 3

Topic: «Angiosperm Plants of the Kyrgyz Republic. Class Dicotyledons. Orders Ranunculales, Berberidales, Papaverales, Paeoniales. Rare and Endemic Species».

Aim of the lesson: To study the systematic position, morphological features and distribution of representatives of the orders Ranunculales, Berberidales, Papaverales and Paeoniales in the flora of the Kyrgyz Republic; to become familiar with rare and endemic species (including Kashgarian barberry) and measures for their conservation.

Learning objectives:

1. To study the theoretical aspects of systematics and morphology of representatives of the families Ranunculaceae, Berberidaceae, Papaveraceae and Paeoniaceae of the flora of the KR.

2. To understand the importance of rare and endemic species, the reasons for their vulnerability and the principles of conserving biodiversity of mountain ecosystems of the Tien Shan and Pamir-Alai.

The student should know:

1. The systematic position and diagnostic characters of the families Ranunculaceae, Berberidaceae, Papaveraceae and Paeoniaceae.

2. The main genera and species of these families occurring in the territory of Kyrgyzstan; their ecology and economic importance.

3. The characteristics of rare and endemic species (including Berberis kaschgarica), their status in the Red Data Book of the KR and conservation measures.

The student should be able to:

Identify plants by morphological characters, analyse ranges and draw conclusions about the degree of rarity and endemism of species; summarise data on the impact of anthropogenic factors on populations of rare plants.

INFORMATION BLOCK

General characteristics of the class Dicotyledons

The class Dicotyledons (Magnoliopsida, Dicotyledones) comprises about three-quarters of all angiosperm species. The embryo of the seed has two cotyledons, the root system is usually taproot, leaves have reticulate venation, and vascular bundles are open. In the flora of Kyrgyzstan dicotyledons constitute the absolute majority of species (about 80% of the flora). The richest families are Asteraceae, Fabaceae, Poaceae, Brassicaceae, Lamiaceae and Ranunculaceae.

The orders under consideration (in the traditional system) belong to the group Polycarpicae and are characterised by primitive floral features: spiral arrangement of parts, a large and indefinite number of stamens and carpels, and often an apocarpous gynoecium.

Order Ranunculales. Family Ranunculaceae (Buttercup family)

The family includes predominantly herbaceous perennials, less often shrubs and lianas. Leaves are alternate, usually without stipules, often dissected. Flowers are actinomorphic or zygomorphic, bisexual. The perianth is simple or double. Stamens are numerous. The gynoecium is apocarpous. The fruit is a multiple follicle or a multiple achene (nutlet).

In the flora of Kyrgyzstan the family is represented by more than 100 species. The most important genera: Ranunculus (buttercup), Aconitum (monkshood), Delphinium (larkspur), Aquilegia (columbine), Pulsatilla (pasqueflower), Anemone (anemone), Thalictrum (meadow-rue), Adonis (pheasant's-eye), Trollius (globeflower).

Many species are poisonous (they contain the alkaloids aconitine, delphinine, etc.); some are used in folk and scientific medicine. A number of species are ornamental. The following are included in the Red Data Book of the KR: Knorring's larkspur (Delphinium knorringianum), Kostychev's pasqueflower (Pulsatilla kostyczewii), obtuse-lobed anemone (Anemone obtusiloba).

Family Berberidaceae (Barberry family)

Shrubs or perennial herbs. Leaves are simple or compound, often with spines (modified leaves). Flowers are usually in racemes or panicles, yellow. The perianth consists of 6–9 segments. There are 6 stamens. The fruit is a berry.

In Kyrgyzstan the most well-known are species of the genus Berberis (barberry). Kashgarian barberry (Berberis kaschgarica Rupr.) is a rare species included in the Red Data Book of the Kyrgyz Republic. It is a strongly branched shrub 0.5–1 m tall with three-parted spines. Leaves are small and leathery. It grows on stony slopes and old moraines of the Central Tien Shan (Sary-Jaz river basin) at altitudes up to 3500–4300 m. The overall range also covers Western China (Kashgaria) and the Eastern Pamir. The number of individuals is low; it usually occurs as solitary plants. Limiting factors are economic development of habitats. Study of populations and establishment of protected areas are recommended.

Other representatives of the family in the flora of the KR: Albert's gymnospermium (Gymnospermium albertii), Leontice, etc.

Family Papaveraceae s.l. (including Fumariaceae)

Herbaceous plants, often with milky sap. Leaves are alternate and dissected. Flowers are large, actinomorphic or zygomorphic. Sepals 2, caducous. Petals 4. Stamens numerous or 6. The fruit is a capsule.

In the flora of Kyrgyzstan species of the genera Papaver (poppy), Chelidonium (celandine), Corydalis (corydalis) and Fumaria (fumitory) occur. Greater celandine (Chelidonium majus) is used in folk medicine. The Red Data Book of the KR includes false-hooked corydalis (Corydalis pseudoadunca).

Family Paeoniaceae (Peony family)

Perennial herbs with powerful rhizomes or tuberous roots. Leaves are large, ternately or pinnately dissected. Flowers are large, solitary, with numerous stamens. The fruit is a multiple follicle.

In the flora of Kyrgyzstan grows intermediate peony (Paeonia intermedia C.A. Mey.), also known as "Mary's root". It occurs in mountainous areas on meadows, in shrub thickets and sparse forests. The plant is ornamental and medicinal (rhizomes contain biologically active substances with a sedative effect). It requires protection in places of mass collection.

Rare and endemic species. Conservation

The flora of Kyrgyzstan is characterised by a high level of endemism (at least 10% of species are endemic or subendemic). The mountain systems of the Tien Shan and Pamir-Alai serve as centres of speciation. The main threats to rare species are: overgrazing, ploughing, collection of medicinal and ornamental plants, climate change, and habitat fragmentation.

Conservation is carried out by including species in the Red Data Book of the KR, establishing specially protected natural areas (nature reserves, national parks, sanctuaries), monitoring populations and prohibiting unregulated collection.

Self-check tests

Choose one or more correct answers:

1. The class Dicotyledons includes plants in which:

A. the seed embryo has one cotyledon;

B. the seed embryo has two cotyledons;

C. the root system is fibrous;
D. leaf venation is parallel.

2. Kashgarian barberry (Berberis kaschgarica) grows in Kyrgyzstan:

A. everywhere in lowland areas;
B. in the Sary-Jaz river basin (Central Tien Shan);
C. only in the Fergana Valley;
D. in the Chui Valley.

3. The fruit of representatives of the family Ranunculaceae is most often:

A. a berry;
B. a multiple follicle or multiple achene;
C. a pod;
D. an achene (cypsela).

4. Which of the listed species is included in the Red Data Book of the Kyrgyz Republic?

A. creeping buttercup;
B. Kashgarian barberry;
C. greater celandine;
D. corn poppy.

5. The family Paeoniaceae is characterised by:

A. small flowers aggregated in a capitulum;
B. large solitary flowers and a multiple follicle fruit;
C. flowers with a simple perianth;
D. the presence of milky sap.

6. Endogenous factors affecting plant distribution do NOT include:

A. climatic conditions;
B. anthropogenic impact;
C. edaphic factors;
D. biotic interactions.

7. The main reason for the rarity of Kashgarian barberry is:

A. high competition with other shrubs;
B. economic development of habitats and a limited range;
C. damage by pests;
D. excessive soil moisture.

8. Intermediate peony (Paeonia intermedia) is known in folk medicine as:

A. Mary’s root;
B. golden root;
C. ginseng;
D. liquorice.

9. Characters typical of the family Papaveraceae are:

A. presence of milky sap;
B. caducous sepals;
C. fruit — a capsule;
D. all of the above.

Self-check questions

1. Give a general characterisation of the class Dicotyledons. How does it differ from the class Monocotyledons?

2. Describe the diagnostic characters of the family Ranunculaceae. Give examples of genera and species from the flora of Kyrgyzstan.

3. What is the systematic position and importance of Kashgarian barberry? Why does it need protection?

4. List the main rare and endemic species of the families under consideration that are included in the Red Data Book of the KR.

5. What measures for the conservation of rare plants are applied in Kyrgyzstan?

6. Characterise the family Paeoniaceae and the importance of intermediate peony.

Situational tasks

Task 1

During a geobotanical survey of the highlands of the Central Tien Shan (Sary-Jaz river basin) a population of a low spiny shrub with small leathery leaves and three-parted spines was found. The fruits are dark berries. The plant occurs as solitary individuals on stony slopes at about 3500 m.

Question: To which species does the found plant most likely belong? What is its conservation status and what recommendations can be given for preserving the population?

Task 2

Students on practical training collected a herbarium of herbaceous plants with large bright-yellow and blue-violet flowers, an apocarpous gynoecium and a multiple follicle fruit. Among the specimens were species of the genera Aconitum, Delphinium and Trollius.

Question: To which family do these plants belong? What features of chemical composition make many species of this family poisonous and at the same time valuable medicinal plants?

Task 3

In the Red Data Book of the Kyrgyz Republic a number of species of Ranunculaceae and Berberidaceae are given the status of rare. At the same time Kashgarian barberry has a limited range, while some larkspurs and pasqueflowers occur sporadically over considerable territories, but the number of individuals in their populations is low.

Question: What is the difference between the concepts “endemic species” and “rare species”? Give examples from the flora of Kyrgyzstan for the families under consideration. Which factors primarily threaten high-mountain endemics?

Task 4

A pharmaceutical enterprise is considering the possibility of using raw material of wild intermediate peony (Mary’s root) for the production of sedative phytopreparations. Populations of the species in accessible areas are declining because of unregulated collection.

Questions:
1. What morphological characters allow intermediate peony to be reliably identified?
2. What alternative sources of raw material can be proposed in order to conserve natural populations?
3. What measures for regulating the collection of wild medicinal raw material are necessary at the republican level?

Task 5

When three populations of Kashgarian barberry located in different localities of the Sary-Jaz basin were compared, differences were noted in the density of individuals, age structure and the degree of damage to plants by grazing.

Question: What population parameters need to be monitored in order to assess the state of the species? Propose a scheme for a simple field census and criteria by which a population can be considered relatively healthy or threatened.

Laboratory practical work

“Study of morphological features of representatives of the families Ranunculaceae, Berberidaceae, Papaveraceae and Paeoniaceae of the flora of Kyrgyzstan. Identification of rare and endemic species”

Assignment

1. Study herbarium specimens and living (or fixed) plants of representatives of the families Ranunculaceae, Berberidaceae, Papaveraceae and Paeoniaceae.

2. Compile morphological descriptions of 3–4 species (one from each family), noting life form, structure of leaves, flower and fruit.

3. Determine the systematic position of Kashgarian barberry and intermediate peony; indicate their conservation status and features of distribution in the KR.

4. Compare the characters of the families and draw a conclusion about the primitive features of floral structure in the groups under consideration.

Procedure

1. Using a key (Flora of the Kirghiz SSR, Vol. VI, or modern keys) establish the specific identity of the specimens provided.

2. Fill in the comparative table of family characters:

Character	Ranunculaceae	Berberidaceae	Papaveraceae	Paeoniaceae
Life form				
Leaves				
Flower (symmetry, perianth)				
Androecium				
Gynoecium / fruit				
Examples of species from the KR flora				
Conservation status (if any)				

3. On a contour map of Kyrgyzstan mark the known localities of Kashgarian barberry and other rare species of the families under consideration.

4. Formulate conclusions about the importance of these families in the flora of the KR, the degree of their study and the priorities of conservation.

Recommended literature: Flora of the Kirghiz SSR. Vol. VI. — Frunze, 1955; Red Data Book of the Kyrgyz Republic. — Bishkek, 2007; Lazkov G.A., Umralina A.R. Endemic and rare plant species of Kyrgyzstan (Atlas). — 2015; modern checklists and keys to the flora of Kyrgyzstan.