

Poisonous and harmful plants of pastures in the Kyzylkum desert (Uzbekistan)

*Habibullo Shomurodov*¹, *Rizamat Khayitov*², *Ozodbek Abduraimov*^{1*}, *Azizbek Maxmudov*¹, and *Azizbek Abduraimov*³

¹Institute of Botany Academy of Science Republic of Uzbekistan, Tashkent, 100125, Uzbekistan

²Navoi State Pedagogical Institute, Str. Ibn Sina, Navoi, 210100, Uzbekistan

³Gulistan State University, 4, Gulistan Street, Gulistan, 120100, Uzbekistan

Abstract. The paper studied poisonous and harmful plants that were distributed in Kyzylkum desert condition (Uzbekistan). The research was conducted over the years 2012-2024. The forage flora of Kyzylkum consists of 908 species of vascular plants belonging to 345 genera and 68 families. During the research, 34 families, 73 poisonous plants belonging to 55 genus and 6 families, 39 harmful plants belonging to 13 genera were identified. The vast majority of poisonous and harmful plants are xerophytes. The analysis of poisonous plants of the studied territory in relation to soil moisture showed that the vast majority of them belong to xerophytes, which confirms the arid nature of the pastoral flora of Kyzylkum. The dominant positions of annual plants in the forage flora of the study area have been revealed, which are an alarming indicator of increasing anthropogenic pressure on pasture vegetation. The colossal role of haze and compound flowers in the pasture vegetation of Central Asia has been established and the expediency of separating them into separate groups according to economic relations has been proved.

1 Introduction

Meadows and grasslands are one of the most important natural resources in the region. These areas are the cheapest sources of production where our need for animal nutrition is met, as well as where the need for roughage is met so that animals can produce high yields. As a result of continuous excessive and uncontrolled grazing of meadows and grasslands, losses have occurred in the existing vegetation cover [1]. Meadows and pastures are of great importance for the future and the continuity of life [2].

In the vegetation cover of the Kyzylkum desert, there are many species containing biologically active substances that can cause various kinds of poisoning in animals. The toxicity of most plants is due to the presence of alkaloids in them [3]. In addition, there are a number of plants in the region's pastures that cause mechanical damage to animal organs when consumed [4].

The history of studying harmful and poisonous plants of Kyzylkum dates back to the publication of the 3-volume book "Fodder plants of haymaking and pastures of the USSR"

* Corresponding author: ozodbek88@bk.ru

edited by I. V. Larin [5]. This work provides information about the toxicity of 56 plant species found on the territory of Kyzylkum. Later, L. Gayevskaya, describing the main types of pastures in Central Asia in connection with their use in Karakul farming, identifies the most harmful types of cereals (*Hordeum leporinum* Link.) and *Taeniatherum crinitum* (Schreb.) Nevski), as well as 6 poisonous pasture plants (*Ceratocephala falcata* (L.) Pers., *Ranunculus sewerzowii*, *Peganum harmala*, *Acanthophyllum pungens* (Bunge) Boiss., *Anabasis aphylla* L., *Ammodendron conollyi*).

The alkaloid of the Kyzylkum flora was studied by T. A. Adylov [6]. The author emphasizes that out of 433 species of vascular plants distributed in Southwestern Kyzylkum, 360 (83.1%) were alkaloid-bearing. He also identifies 3 groups: poisonous alkaloid plants (*Eminium lehmannii* (Bunge) Kuntze, *Merendera robusta* Bunge, *Anabasis aphylla*, *Ceratocephala falcata* (L.) Pers., *Leontice eversmannii* Bunge, *Papaver pavoninum* Schrenk, *Goebelia alopecuroides* (L.) Bunge ex Boiss., *G. pachycarpa* Bunge ex Boiss., *Ammothamnus lehmannii* Bunge, *Peganum harmala*, *Heliotropium dasycarpum* Ledeb., *Bryonia melanocarpa* Nabiev, *Ammodendron conollyi*); alkaloid-bearing plants not eaten or poorly eaten by livestock (*Ephedra strobilifera* Bunge, *Delphinium camptocarpum* Fisch. et C. A. Mey., *D. rugulosum* Boiss., *Eremosparton flaccidum* Litw., *Smirnowia turkestanica*) and alkaloid-bearing plants eaten by animals without harm (*Carex physodes*, *C. pachystylis* J. Gay., *Eremopyrum orientale*, *Agrophyllum latifolium*, *Astragalus unifoliolatus*, *A. villosissimus*, species of the genus *Calligonum*, *Salsola*). Some information on harmful and poisonous plants of Kyzylkum is also found in the multi-volume book "Plant resources of the USSR" [7], S. E. Erezhepov [8] and etc [9-10].

2 Materials and methods

The object of the study is harmful and poisonous plants that spread in the Kyzylkum (Uzbekistan). In the detection of harmful and poisonous plants techniques were used I. V. Larin [5]. In field research It was carried out using techniques developed by A. I. Tolmachev, B.A. Yursev, A.V. Shcherbakov, S.R. Mayorov.

In determining the taxonomic units of the species, 11 volumes of the work "Determinant of plants in Central Asia" [11] were used. The names of the categories and species "Determinant of plants in Central Asia" (1968-2015) and International Plants Names Index [12], Plant of the world online [13]. Authors of taxis "Authors of Plant Names" R.K. Brummit, C.E. The Powell manual was used. In the determination of the areal types, it was carried out using the published publications on flora.

3 Results and Discussion

Poisonous plants of the Kyzylkum. Analysis of the pastoral flora of Kyzylkum shows that 73 species of poisonous plants grow here, belonging to 55 genera and 34 families.

The most abundant poisonous plants are Fabaceae (7 genera, 9 species), Amaranthaceae (Chenopodiaceae) (5 genera, 6 species), Ranunculaceae (3 genera, 6 species), Solanaceae (3 genera, 5 species), Boraginaceae (2 genera, 4 species), Euphorbiaceae (2 genera, 4 species) and Brassicaceae (3 genera, 3 species). Such a richness (18.2%) of poisonous plants of the first two families is quite logical, since they are the leading ones in the entire flora of Kyzylkum, and, in addition, most of the species of these families are known as alkaloid-bearing. As emphasized by T. A. Adylov [5], most of the analyzed species from the families Chenopodiaceae (100%) and Boraginaceae (95, 6%) were alkaloid-bearing. Species of the Ranunculaceae and Euphorbiaceae families are also rich in alkaloids, although of course it is known that not all alkaloids are poisonous. Poisonous plants of

Kyzylkum were distributed by life forms according to V.V. Nikitin's [14] classification (Table 1.).

Table 1. Life forms poisonous plants of the Kyzylkum.

Life form	Number of species	Number of poisonous species, %
Trees	1	1.4
Bushes	6	8.2
Shrubs	2	2.7
Subshrubs	4	5.5
Semi-shrubs	0	0
Perennial grass	36	49.3
Annual and Biennial	24	32.8

The flora of Kyzylkum is dominated by herbaceous (annual, perennial and biennial) poisonous plants. They make up 82.1% of the total number of poisonous plants in the study area. This indicates that in wetter years, the probability of poisoning by herbaceous plants is much higher compared to dry years, since in favorable precipitation years, herbaceous plants predominate in the vegetation cover of the desert. Semi-shrubs, shrubs and trees, as edificers of desert pastures, are the main food of the desert, regardless of weather conditions, and in the case of excessive eating them with a lack of juicy herbaceous plants, there are also cases of animal poisoning.

Analysis of poisonous plants in the study area in relation to soil moisture showed that more than half are xerophytes, which confirms the arid nature of the pastoral flora of Kyzylkum (Figure 1).

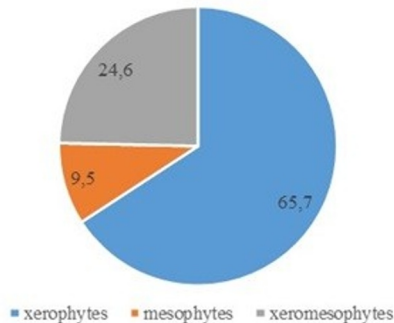


Fig. 1. Distribution of poisonous plants in relation to soil moisture.

Analysis of poisonous plants of Kyzylkum by types of areas showed that they are mainly formed by species of ancient Mediterranean Genesis. The second place is occupied by boreal species, the vast majority of which are mesophytes. The analysis of literature data shows that the toxicity of one or another of the various authors are treated differently. For example, T. A. Adylov [9] notes that *Heliotropium dasy carpum* is a poisonous plant, while other authors consider it a food plant [5, 14]. Another example is *N. ellipticum* Ledeb., which according to I. V. Larin [5] and T. A. Adylov [6] is considered poisonous, and according to S. E. Erejepov [8] and "Plant resources of the USSR" [7] is a good food for camels and sheep. Similar contradictions can be found in many other taxa (*Kalidium foliatum* (Pall.) Moq., *Suaeda physophora*, *Ammodendron conollyi*, *Ammothamnus lehmanni*, *Psoralea drupacea*, *Iris songarica*, *Papaver pavoninum*). There is an opinion that the forage species growing in the conditions of continental and severe climate contains more alkaloids in comparison with those from the humid territory. Therefore, the concept of venom of a species should be considered not only in the chemical aspect, but it is also necessary to consider specific environmental factors that affect the biochemical

composition of the taxon. In Kyzylkum, many poisonous plants in the initial stages of development are not eaten by animals at all, while after autumn precipitation and frost they can be harmless and used as food. Such plants include *Peganum harmala*, *Vexibia alopecuroides* (L.) Yakovlev, *V. pachycarpa* (Schrenk ex C. A. Mey.) Yakovlev, *Ammothamnus lehmannii*, *Ammodendron conollyi*, *Anabasis aphylla*. On the other hand, there are several species, when eaten even in a dry state, poisoning is observed, often ending in the death of animals. In this regard, poisonous plants of Kyzylkum can be divided into two groups: not eaten (causing acute poisoning with a fatal outcome) and eaten. The first group includes: *Eminium lehmannii*, *Heliotropium lasiocarpum*, *Trichodesma incanum* (Bunge) DC., *Bryonia melanocarpa*, *Thalictrum isopyroides*, *Ephedra distachya*, *E. equisetina*, *Smirnovia turkestanica* Bunge, *Merendera robusta*, *Datura stramonium*. The other types listed in table 2 belong to the second group. Data on the most poisonous plants that pose a threat to animal husbandry are given below.

Eminium lehmannii (Bunge) Kuntze. Herbaceous plant of the family Araceae. It occurs unevenly in saxaul-shrubs groups throughout Kyzylkum. It is also often found on small-bumpy and ridge-bumpy fixed Sands. According to T. Adylov (1970), its tubers contain poisonous saponin. Sheep are usually poisoned.

Heliotropium lasiocarpum Fisch. & C.A. Mey. An annual plant from family Boraginaceae. In natural conditions, it is found on the cliffs of ravines, along roads and fences, near housing. Plants in green and dry form are poisonous. Especially poisonous are its seeds, whose mass maturation is observed in August. In the aboveground parts, it contains about 4% of alkaloids (heliotropin and lasiocarpine). Cattle and sheep are usually poisoned. According to the observations of shepherds, it is established that poisoning occurs in flocks of sheep that do not receive enough water. Due to the lack of other succulent food plants, sheep try to quench their thirst by eating succulent heliotrope grass. As a result, there are signs of dropsy, before death – a comatose state, convulsions.

Trichodesma incanum (Bunge) A. DC. Perennial plant of the family. Boraginaceae. In Eastern Kyzylkum, it is found near settlements, in neglected areas of rain-fed grain crops. From the aerial parts of plants selected tradesmen alkaloid, and the seeds inkinen. Poisoning of animals most often occurs when eating seeds. Stems and leaves are also dangerous (100 g of trichodesma grass causes the death of cattle).

Ephedra distachya L. Leafless shrub with a creeping rhizome from family Ephedraceae. It grows in patches among sagebrush thickets on remnant hills. In Turkmenistan, mass poisoning of goats was repeatedly observed in the summer, which shepherds preferred to cut for meat, since recovery is rare. The goats began to have diarrhea, then convulsions with a fatal outcome appeared.

Thalictrum isopyroides C.A. Mey. a perennial plant from family Ranunculaceae. It grows in groups on fine-grained, fine-grained-gravelly and stony slopes of all the remaining mountains of Kyzylkum. All parts of the plant are poisonous and contain alkaloids talisayan and talisien. Mostly horses are poisoned.

Datura stramonium L. an annual plant with a thick, smooth, fork-branched stem from the family Solanaceae. It grows in weeds near homes, roads, and gardens. The leaves contain the alkaloids hyoscyamine, the roots contain hyoscyamine and scopolamine, and the seeds contain hyoscyamine. *Datura* poisoning is observed in horses, cattle, and rarely sheep. For fatal poisoning of young animals with *Datura*, 0.8-1.2 kg of green mass is enough.

Harmful plants of the Kyzylkum. Harmful to livestock is usually called such plants that spoil livestock products. I. V. Larin [5] in the same group included plants that cause animal disease due to mechanical damage to various organs. Harmful plants are divided into 3 groups: plants that spoil dairy products (taste of milk, smell); spoiling wool and mechanical damage to various organs of animals. Table 3 shows plants from groups 2 and 3 that are

well eaten by animals at the beginning of the growing season and are considered valuable forage plants. The negative impact of these species occurs during the fruiting period, when hard spines are formed in cereals and sticky fruits in the family species. Boraginaceae. If we consider the fact that large and small cattle are grazed in Kyzylkum, then wool spoilage should be considered as a conditionally "harmful" effect, since camels and cows do not suffer from these plants at all. For example, in spring and early summer, herbaceous shoots of *Calligonum* species serve as juicy vitamin food until the fruit maturation phase.

Table 2. Harmful plants of the Kyzylkum desert.

Species	Life form	Harmful plant organs	Character of damage	Suffering animal
Boraginaceae				
<i>Asperugo procumbens</i> L.	Annual	fruit	Fruits and stems, studded with spines, clog the wool	Sheep, goats
<i>Heterocaryum zovitsianum</i> (Fisch. et C. A. Mey.) DC.	Annual	fruit	The fruit gets tangled in the wool and clogs it	Sheep, goats
<i>Rochelia bungei</i> Trautv.	Annual	fruit	Same	Sheep, goats
<i>R. leiocarpa</i> Ledeb.	Annual	fruit	Same	Sheep, goats
Poaceae Barnhart				
<i>Aegilops triuncialis</i> L.	Annual	Inflorescences	When eating inflorescences of a grain equipped with a solid awn, the mouth, nasopharynx, and eyes are injured	Horse
<i>Avena fatua</i> L.	Annual	Twisted awns	Same	Cattle, sheep, horses
<i>Setaria glauca</i> (L.) Beauverd	Annual	Inflorescences	When eating inflorescences of a grain equipped with a solid awn, the mouth, nasopharynx, and eyes are injured. Undigested inflorescences cause globular formations in the stomach, which often leads to the death of animals	Sheep and rarely cattle
<i>S. verticillata</i> (L.) Beauverd	Annual	Inflorescences	Same	Sheep and rarely cattle
<i>S. viridis</i> (L.) Beauverd	Annual	Inflorescences	Same	Sheep and rarely cattle
<i>Stipa aktauensis</i> Roshev.	Perennial	fruit	The grain is screwed into the wool and leather	Sheep, goats
<i>S. capillata</i> L.	Perennial	fruit	Same	Sheep, goats
<i>S. arabica</i> Trin. et Rupr. ssp. <i>caspica</i> (C. Koch) Tzvelev	Perennial	fruit	Same	Sheep, goats
<i>S. caucasica</i> Schmalh.	Perennial	fruit	Same	Sheep, goats
<i>S. hohenackeriana</i> Trin. et Rupr.	Perennial	fruit	Same	Sheep, goats
<i>S. karataviensis</i> Roshev.	Perennial	fruit	Same	Sheep, goats
<i>S. lipskyi</i> Roshev.	Perennial	fruit	Same	Sheep, goats
<i>Taeniatherum crinitum</i> (Schreb.) Nevski	Annual	fruit	Hard awns affect the oral cavity	Sheep, goats, cattle, horses
Asteraceae				
<i>Xanthium spinosum</i> L.	Annual	fruit	The fruit gets tangled in the wool and clogs it.	Sheep, goats
<i>Centaurea squarrosa</i> Willd.	Perennial	fruit	Same	Sheep, goats
Zygophyllaceae R. Br.				
<i>Tribulus macropterus</i> Boiss.	Annual	fruit	Fruits covered with spines, when eaten, injure the mouth and stomach.	Sheep, goats, cattle
<i>T. terrestris</i> L.	Annual	fruit	Same	Sheep, goats, cattle
Solanaceae Juss.				
<i>Lycium ruthenicum</i> Murray	Bushes	Prickly stems	Prickles cause deep wounds on the udder, snout, get tangled in the wool	Sheep and camels
<i>L. ruthenicum</i> Murray	Bushes	Prickly stems	Same	Sheep and camels
Polygonaceae Juss.				
<i>Calligonum arborescens</i> Litv.	Bushes	fruit	Fruits covered with bristles get tangled in the wool and clog it	Goats, sheep and camels
<i>C. caput-medusae</i> Schrenk	Bushes	fruit	Same	Same
<i>C. colubrinum</i> Borszczow	Bushes	fruit	Same	Same
<i>C. densum</i> Borszczow	Bushes	fruit	Same	Same
<i>C. elatum</i> Litv.	Bushes	fruit	Same	Same
<i>C. erinaceum</i> Borszczow	Bushes	fruit	Same	Same
<i>C. eriopadum</i> Bunge	Bushes	fruit	Same	Same
<i>C. litvinowii</i> Drobov	Bushes	fruit	Same	Same
<i>C. macrocarpum</i> Borszczow	Bushes	fruit	Same	Same
<i>C. microcarpum</i> Borszczow	Bushes	fruit	Same	Same
<i>C. malle</i> Litv.	Bushes	fruit	Same	Same
<i>C. murex</i> Bunge	Bushes	fruit	Same	Same
<i>C. paletzkianum</i> Litv.	Bushes	fruit	Same	Same
<i>C. rotula</i> Borszczow	Bushes	fruit	Same	Same
<i>C. setosum</i> Litv.	Bushes	fruit	Same	Same
<i>C. squarrosus</i> Pavlov	Bushes	fruit	Same	Same

In autumn and winter, fallen dry shoots and fruits are well eaten, especially after they are softened by precipitation. The high protein content of the *Calligonum* fruit can be explained by its good eating ability, although, of course, the *Calligonum* fruits (from the *Calligonum* and *Medusae* sections) have branched bristles and stick to the animal's fur, reducing its quality. The same can be said about the types of families *Boraginaceae*, *Asteraceae*, listed in Table 2 the most harmful plants in Kyzylkum are species of the genus *Tribulus* L. (*T. Macropterus* Boiss. and *T. terrestris* L.), which are eaten when there is a lack of juicy food, as a result of which the thorns severely damage the oral cavity. The same thing happens when eating species of the genus *Lycium* L. with prickly stems, which cause deep wounds on the body of animals and get tangled in the wool. Most types of cereals, which are valuable forage plants, can also cause harm to animals during the earing phase.

For example, according to I. V. Larin et al. [5], grains of *Aegilops triuncialis* L. and *Avena fatua* L., equipped with a solid spine, when eaten, injure the oral cavity, nasopharynx, or eyes of animals. Inflorescences of species of the genus *Setaria* cause a globular formation in the stomach, which often leads to a fatal outcome. Species of the genus *Stipa* have grains ending in bent-knee awns, which also cause harm to animals. In General, 39 species of harmful plants belonging to 13 genera and 6 families grow in Kyzylkum. The largest number of harmful plant species has been recorded in the *Polygonaceae*, *Poaceae*, and *Boraginaceae* families.

In recent years, it is in the desert region that a number of effective studies are carried out [16].

4 Conclusion

Poisonous plants are found everywhere and, therefore, poisoning of animals with plant poisons is observed both in pastures and in hayfields, as when stalled when fed with hay, silage, haylage, ie. shredded green mass-animals it is difficult to choose edible herbs and they indiscriminately eat poisonous herbs from fodder. Thus, all the shepherds, shepherds, zoovets are obliged to know and constantly monitor the growth and development of poisonous and harmful herbs in order to prevent disease and loss of livestock, from plant poisons. Thus, 73 poisonous and 39 harmful plants were registered on the pastures of Kyzylkum. The vast majority of poisonous and harmful plants is xerophytes. Most poisonous and harmful plants are represented by herbaceous plants. Some poisonous plants containing acute toxic substances in the dry state are partially eaten. Therefore, there are different opinions in the literature on the toxicity of the plants listed in Table 1. some authors consider the same species to be poisonous, while others indicate it as forage. Examples include *Trichomitum lancifolium*, *Calystegia sepium.*, *Heliotropium dasycarpum*, *N. ellipticum*, *Kalidium foliatum*, *Suaeda physophora*, *Ammodendron conollyi.*, *Ammothamnus lehmanni*, *Psoralea drupacea*, *Iris songarica*, *Papaver pavoninum*, and etc. Or some species are poisonous to a particular animal species, while others are eaten harmlessly. These plants include *Acroptilon repens* (L.) DC., which is poisonous to horses, but is well eaten by small cattle. In this regard, the concept of "poisonous plants" should not be taken in the direct sense, but it would be correct to understand in the indirect sense, i.e., to consider plants containing active biological substances, excessive eating of which causes poisoning in animals. You can also talk about harmful plants that are "harmful" mainly during the fruiting period. Given that they are excellent forage plants before fruiting and in a dry state, you can look at them as plants that reduce the quality of pasture at a certain time, and not as plants that litter pastures in the full sense.

Acknowledgement

The study was carried out within the framework of the research program “Assessment of the current state of populations and the creation of a living collection of economically valuable species of wild relatives of cultivated plants of the flora of Uzbekistan” of the laboratory “Population biology and plant ecology” of the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan.

References

1. C.Aysu, The available situation of meadows in Şanlıurfa and the usage areas of useful and harmful plants, *Eurasian journal of forest Science*, **8**, **3**, 152-162 (2020)
2. G.B. Stewart, A.S. Pullin, The relative importance of grazing stock type and grazing intensity for conservation of mesotrophic ‘old meadow’ pasture, *Journal for Nature Conservation*, **16**, **3**, 175-185 (2008)
3. O.S. Abduraimov, A.V. Maxmudov, I.N. Kovalenko, A.L. Allamurotov, B.J. Mavlanov, S.U. Shakhnoza, O.T. Mamatkasimov, Floristic diversity and economic importance of wild relatives of cultivated plants in Uzbekistan (Central Asia). *Biodiversitas*, **24**, 1668-1675 (2023) <https://doi.org/10.13057/biodiv/d240340>
4. O.S. Abduraimov, Li. Wenjun, H.F. Shomurodov, F. Ying, The Main Medicinal Plants in Arid Regions of Uzbekistan and Their Traditional Use in Folk Medicine, *Plants*, **12**, **16**, 2950 (2023) DOI:<https://doi.org/10.3390/plants12162950>
5. I.V. Larin, Sh.M. Agababyan, T.A. Rabotnov, V.K. Larina, Fodder plants of hayfields and pastures of the USSR, *M.-L.*, **1**, 246-264 (1950)
6. T.A. Adylov, Poisonous and alkaloid-bearing plants of Karakul-growing pastures of Uzbekistan, *Tashkent*, 30-145 (1970)
7. *Plant resources of the USSR*, Science, Leningrad, 440-460 (1984)
8. S.E. Erejepov, Wild fodder plants and weeds, *Karakalpakstan, Nukus*, 254-289 (1974)
9. H.F. Shomurodov, O.S. Abduraimov, B.A. Adilov, Assessment of the state of *Tulipa lehmanniana* Mercklin populations under the conditions of the Kyzylkum Desert, *Arid Ecosystems*, **11**, **1**, 83–90 (2021)
10. S. Saribaeva, O. Abduraimov, A. Allamuratov, Assessment of the population status of *Allium oschaninii* O. Fedtsch. in the mountains of Uzbekistan. *Ekológia (Bratislava)*, **41**, **2**, 147–154 (2022)
11. Determinant of plants in Central Asia. Critical synopsis of flora, In I-XI, Fan, Tashkent (1968- 2015)
12. International Plant Names Index, www.ipni.org
13. Science.kew, <http://powo.science.kew.org/>
14. V.V. Nikitin, Life forms of plants of the flora of Turkmenistan, *Botanical journal*, **50**, **1**, 44-49 (1965)
15. Sh.U. Saribaeva, Kh.F. Shomurodov, O.S. Abduraimov, Ontogenesis and Ontogenetic Structure of Local Populations of the *Astragalus holargyreus* Bunge (Fabaceae) of the Narrow-Local Endemic of Kyzylkum. *Arid Ecosystems*, **12**, **1**, 78–84 (2022)