

# Rust Fungi of the Surkhan State Nature Reserve

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**Abstract** During 2020–2025, extensive field investigations were conducted in the Surkhan State Reserve, during which rust fungi (Pucciniales) specimens were collected and subjected to comprehensive mycological analyses. The results revealed a total of 59 rust species belonging to 4 families and 6 genera. The most species-rich genera were *Puccinia* (33 species), *Uromyces* (12 species), and *Phragmidium* (8 species), while *Gymnosporangium*, *Aecidium*, and *Melampsora* were represented by 2–3 species each. Notably, *Puccinia hsinganensis* (on *Fritillaria bucharica* Regel.) was recorded for the first time in the mycobiota of Uzbekistan. Rust fungi were found parasitizing 81 plant species representing 50 genera and 24 families. Moreover, seven fungal species were documented for the first time on new host plants within the flora of Uzbekistan, and three species were observed parasitizing plants listed in the Red Data Book of the Republic of Uzbekistan. These findings provide critical insights into the diversity of rust fungi and host–pathogen interactions within the unique ecosystems of southern Uzbekistan.

**Keywords** Pucciniales, Micromycete, Uzbekistan, *Uromyces*, *Phragmidium*, *Puccinia*

## 1. Introduction

Rust fungi (Pucciniales) represent the largest and biologically most significant group of obligate biotrophic micromycetes belonging to the division *Mycota*. According to modern phylogenetic classifications, they are united within a single order — *Pucciniales*, which comprises 14 families, 168 genera, and more than 7,000 species [15]. These obligate parasitic fungi possess a complex ontogenetic life cycle that includes five distinct spore stages: basidiospores, spermatia, aeciospores, urediniospores, and teliospores [38].

These pathogens cause significant economic losses in global agriculture every year. In particular, crops of strategic importance such as wheat, maize, coffee, and soybean are highly susceptible to rust infections, which have a direct negative impact on both yield and product quality. At the same time, some rust fungi species have been successfully used in the biological control of invasive weeds. For example, *Phragmidium violaceum* [35] and several *Puccinia* species [32,3] are considered effective biocontrol agents in this regard.

Rust fungi are among the most widely studied groups of phytopathogens worldwide, and research in this field has undergone several distinct stages of development in Uzbekistan as well. Studies on rust fungi in Uzbekistan were first initiated by Zaprometov between 1912 and 1926 [36,37], and later continued by Golovin from 1947 to 1950 [9]. During the period from 1950 to 1986, extensive investigations were carried out by N.I. Gaponenko, T.S. Panfilova, T.K. Rotkevich, S.S. Ramazanova, F.G. Akhmedova, and G.T. Baymuratova, which significantly expanded knowledge of rust fungi in the country. Notably, in 1986, Ramazanova and colleagues reported 261 species of rust fungi parasitizing 511 host plant species belonging to 43 families in their work “*Flora of Fungi of Uzbekistan*” [27].

In 1989, Soliyeva defended her doctoral dissertation on the micromycetes of higher plants in the Surkhandarya region. In this work, she reported 352 species of micromycetes belonging to 82 genera and 19 families occurring within the region. Among them, 70 species representing seven genera were identified as rust fungi [29].

In recent years, checklists showing the distribution of fungi and their host plants in different regions of Uzbekistan have been provided by [6,7,8,18,20,21,12,13]. In addition, several new species have been documented for the mycobiota of Uzbekistan [22,24].

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However, until the present study, the mycobiota of the Kugitang mountain range and the Surkhan State Reserve had not been sufficiently investigated. The aim of this study was to compile a comprehensive checklist of rust fungi occurring in the Surkhan State Reserve. This checklist serves as an important source for future mycological monitoring and for updating the national inventory of species diversity within this fungal group.

### Study area

Herbarium specimens of rust fungi were collected between 2020 and 2025 within the territory of the Surkhan State Reserve, located in southern Uzbekistan. The reserve is situated in the Sherobod District of the Surkhandarya Region, on the eastern slopes of the Kugitang Range, which forms the southwestern part of the Pamir–Alay mountain system. It was established on September 8, 1986, and covers a total area of 23,406 hectares. The altitude of the territory ranges from 850 to 3,137 meters above sea level and is characterized by a complex geomorphological structure (Fig. 1).

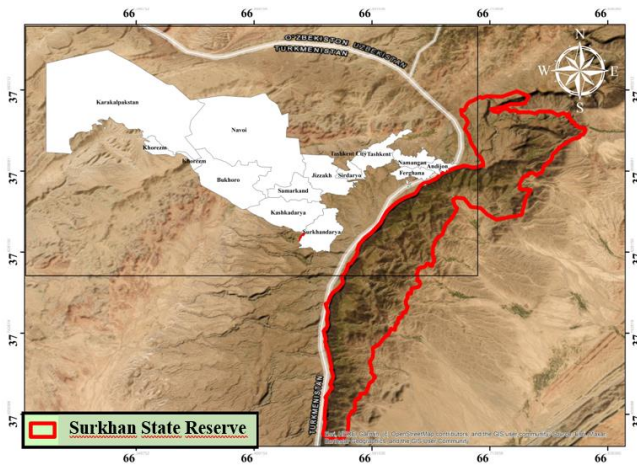


Figure 1. Map of the Surkhan State Reserve

The reserve is characterized by a sharply continental climate, with summer temperatures rising up to 41 °C and winter temperatures dropping as low as -15 °C. Annual precipitation ranges from 200 to 300 mm, primarily occurring during the winter and spring seasons. Dry winds, including the so-called “Afghan wind”, significantly affect soil moisture and vegetation cover. The flora of the Kugitang Range encompasses 1,435 species, while within the reserve territory, 77 families, 372 genera, and 743 species of higher plants have been recorded. Among these, 27 species are endemic, and 37 species are listed in the Red Data Book of the Republic of Uzbekistan [10].

The mycobiota of the Surkhan State Reserve has not been sufficiently studied to date. This study aims to identify the diversity of rust fungi occurring in this area and to compile a comprehensive checklist of these species.

## 2. Material and Methods

During the course of this research, herbarium specimens

of plants infected with rust fungi were collected from various sectors of the Surkhan State Reserve, totaling over 500 samples. The sectors of the reserve are abbreviated as follows: VdB — Vandob sector (37.433275 °N, 66.342535 °E), ShjB — Sherjon (37.445632 °N, 66.362533 °E), KtB — Kampirtepa sector (37.474580 °N, 66.874894 °E), ShqB — Shalqon sector (37.514741 °N, 66.380170 °E), QoB — Qizilolma sector (37.533045 °N, 66.415706 °E), XaB — Xo‘jaanqo sector (37.541551 °N, 66.444146 °E), and XtB — Xatak sector (37.561775 °N, 66.461714 °E).

The morphology of herbarium specimens was examined using a light microscope, and identification was carried out based on relevant literature [16,14,2,17,33,27]. Host plant species were determined using the “Flora of Uzbekistan” publications [4]. All collected specimens are deposited in the herbarium of the Botanical Institute of the Academy of Sciences of the Republic of Uzbekistan (TASM). Representative specimens of each rust fungus species are indicated in the checklist. The collector’s abbreviation is MM — Muslim Mallayev. The taxonomy and nomenclature of rust fungi follow the international database Index Fungorum [11], while host plant nomenclature is based on data from powo.science.kew.org [26].

## 3. Results

During 2020–2025, field studies were conducted by the authors in Surkhan State Reserve, Uzbekistan, focusing on the collection of herbarium specimens of rust fungi (Pucciniales) and their subsequent mycological analysis. The results of these investigations revealed a total of 59 species belonging to 6 genera and 4 families. In terms of species diversity, the genus *Puccinia* was the most species-rich, comprising 33 species, followed by *Uromyces* with 12 species and *Phragmidium* with 8 species. The remaining genera—*Gymnosporangium*, *Aecidium*, and *Melampsora*—were represented by two or three species each.

The rust fungi species identified exhibited high taxonomic diversity, with each species being confirmed based on morphological characteristics, microscopic structural features, and host plant specificity. Below is a list of rust fungi species belonging to the order Pucciniales recorded within the territory of Surkhan State Reserve.

### List of Rust Fungi Identified from the Study Area

Melampsoraceae

*Melampsora* Castagne

*M. euphorbiae* (Ficinus & C. Schub.) Castagne – on *Euphorbia esula* subsp. *esula*, ShqB, 25.V.2024, MM188; 11.V.2025, MM187.

*M. hissarica* Faizieva – on *Salix alba* L., ShqB, 25.V.2024 MM 418; ShjB, 20.V.2025 MM 427.

*M. laricis-tremulae* Kleb. – on *Populus alba* L., ShjB, 20.V.2025 MM 431; XtB, 23.IV.2025, MM 487.

Phragmidiaceae

*Phragmidium* Link

*Ph. asiae-mediae* L.I. Vassiljeva – on *Geum kokanicum*

Regel & Schmalh., ShqB, 11.V.2025, MM301.

**Ph. circumvallatum** Magnus – on *Geum kokanicum* Regel & Schmalh., ShqB, 11.V.2025, MM167; 15.VI.2024, MM168.

**Ph. devastatrix** Sorokin – on *Rosa kokanica* (Regel) Regel ex Juz., ShqB, 11.V.2025, MM036; XtB, 23.IV.2025, MM037; on *Rosa ecae* Kanitz, XtB, 01.VI.2025, MM039; XtB, 27.IV.2024, MM040; VdB, 02.V.2025, MM041.

**Ph. kamtschatkae** (H.W. Anderson) Arthur & Cummins – on *Rosa canina* L., XtB, 01.VI.2025, MM032; on *Rosa kokanica* (Regel) Regel ex Juz., QoB, 04.V.2025, MM35; ShqB, 24.IV.2025, MM38.

**Ph. mucronatum** (Pers.) Link – on *Rosa canina* L., XtB, 23.IV.2025, MM033.

**Ph. rosae-lacerantis** Dietel – on *Rosa ecae* Aitch., XtB, 01.VI.2025, MM302.

**Ph. sanguisorbae** (DC.) J. Schröt – on *Sanguisorba minor* Scop., ShqB, 11.V.2025, MM173; VdB, 02.V.2025, MM175; XaB, 25.IV.2025, MM193.

**Ph. tuberculatum** Jul. Müll. – on *Rosa canina* L., ShqB, 15.VI.2025, MM010; ShqB, 11.V.2025, MM031; on *Rosa ecae* Kanitz, ShqB, 23.VIII.2025, MM240.

Pucciniaceae

**Aecidium** Pers.

**Aecidium** sp. – on *Diarthron vesiculosum* (Fisch. & C.A.Mey. ex Kar. & Kir.) C.A.Mey., ShqB, 11.V.2025, MM303.

**A. thalictri-flavi** (DC.) G. Winter – on *Thalictrum* sp. ShjB, 20.V.2025, MM421.

**Puccinia** Pers.

**P. absinthii** DC. – on *Artemisia juncea* Kar. & Kir., ShjB, 20.V.2025, MM420; on *Artemisia oliveriana* J.Gay ex Besser, QoB, 04.V.2025, MM424; XaB, 17.VI.2025, MM422; on *Artemisia tenuisecta* Nevski, KtB, 14.VI.2025, MM 437.

**P. aegilopis** Maire – on *Solenanthes circinnatus* Ledeb., KtB, 14.VI.2025, MM298.

**P. achilleae** Cooke – on *Handelia trichophylla* (Schrenk) Heimerl, ShqB, 25.V.2025, MM499.

**P. bromina** Erikss., *Annls Sci.* – on *Bromus sterilis* L., ShjB, 20.V.2025, MM423;

**P. bulbocastani** (A. Cumino) Fuckel – on *Elwendia chaerophylloides* (Regel & Schmalh.) Pimenov & Kljuykov, XtB, 13.IV.2025, MM084; VDB, 2.V.2025, MM095; on *Bunium* sp., ShqB, 11.V.2025, MM096.

**P. calcitrapae** DC. – on *Centaurea virgata* subsp. *squarrosa* (Boiss.) Gugler, ShqB, 01.VI.2025, MM003; KtB, 14.VI.2025, MM083.

**P. centaureae** Mart. – on *Rhaponticum repens* (L.) Hidalgo, ShjB, 20.V.2025, MM439.

**P. cesatii** J. Schröt. – on *Bothriochloa ischaemum* (L.) Keng, VdB, 02.V.2025, MM239;

**P. cichorii** (DC.) Belynyck – on *Cichorium intybus* L., ShqB, 23.VIII.2025, MM430.

**P. cnici** H. Mart. – on *Picnomon acarna* (L.) Cass., ShqB, 25.V.2024, MM440.

**P. conclusa** Thüm. – on *Cyperus longus* L., ShqB,

23.VIII.2025, MM260.

**P. cousiniae** P. Syd. & Syd. – on *Cousinia integrifolia* Franch., XaB, 25.IV.2025, MM130; ShqB, 24.IV.2025, MM131; on *Cousinia glabriseta* Kult., XtB, 01.VI.2025, MM132; on *Cousinia coronata* Franch., ShqB, 15.VI.2025, MM133; XtB, 24.VIII.2025, MM210; on *Cousinia* sp., QoB, 04.V.2025, MM137; VdB, 02.V.2025, MM138; on *Cousinia radians* Bunge, QoB, 04.V.2025, MM139; ShqB, 25.V.2024, MM140; on *Cousinia resinosa* Juz., ShqB, 15.VI.2025, MM149; on *Cirsium arvense* var. *arvense*, ShqB, 11.V.2025, MM172.

**P. cynodontis** Lacroix ex Desm. – on *Delphinium* sp<sup>2</sup>., QoB, 04.V.2025, MM103.

**P. eremuri** Kom. – on *Eremurus kaufmannii* Regel, ShqB, 25.V.2024, MM304.

**P. ferulae-songaricae** Tranzschel & Erem – on *Ferula kuhistanica* Korovin, ShqB, 24.IV.2025, MM014; XaB, 25.IV.2025, MM043; QoB, 04.V.2025, MM044; XaB, 30.IV.2024, MM050.

**P. fuckelii** Kärn. – on *Jurinea gracilis* Iljin, XtB, 01.VI.2025, MM012; XaB, 25.IV.2025, MM097; KtB, 14.VI.2024, MM106; on *Jurinea maxima* C.Winkl., ShqB, 11.V.2025, MM015.

Note: Recorded for the first time on *J. maxima* (Fig. 2).

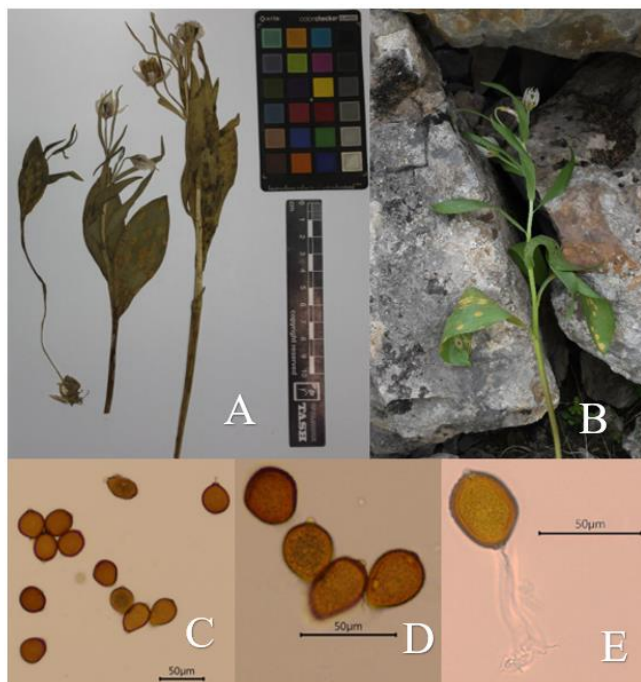


**Figure 2.** A – Herbarium specimen of *Jurinea maxima* C. Winkl. infected with *Puccinia fuckelii* Kärn. B – Microscopic image of *Puccinia fuckelii* spores

**P. hsinganensis** Miura – on *Fritillaria bucharica* Regel, XtB, 13.IV.2025, MM146; VdB, 6.IV.2025, MM147.

Note: The species *Puccinia hsinganensis* is recorded for the first time in the mycobiota of Uzbekistan (Fig. 3).

The teliospores of *P. hsinganensis* are located on both surfaces of the leaves, occurring scattered, occasionally confluent, or forming circular groups. They are rounded to ellipsoid in shape, prone to powdering, and vary in color from light to dark chestnut or black. The uredospores are borne on the teliospores; they are spherical, measuring 20–28 × 27 μm, with a brown wall exhibiting a verrucose (wart-like) texture, and are provided with approximately four germ pores.



**Figure 3.** A – Herbarium specimen of *Fritillaria bucharica* infected with *Puccinia hsinganensis*; B – Living *Fritillaria bucharica* plant; C – Microscopic image of *Puccinia hsinganensis* spores

The teliospores are oval to broadly ellipsoid, measuring  $30\text{--}35 \times 21\text{--}25 \mu\text{m}$ ; the apical and basal ends are rounded, slightly narrowed near the septum. The wall is thin, the apical part is not thickened and is smooth; the germ pore in the upper cell is slightly displaced below the cell apex, whereas in the lower cell it is located near the basal part. The pedicel is hyaline, short, and slender [33].

***P. jaceae*** G.H. – on *Centaurea virgata* subsp. *squarrosa* (Boiss.) Gugler, XaB, 17.VI.2025 MM431.

***P. libani*** Magnus – on *Prangos pabularia* Lindl., QoB, 04.V.2025, MM009; on *Prangos fedtschenkoi* (Regel & Schmalh.) Korovin, XtB, 01.VI.2025, MM075; KtB, 14.VI.2024, MM079; ShqB, 15.VI.2025, MM080; VdB, 02.VII.2024, MM081; on *Ferula ovina* Boiss., XtB, 23.IV.2025, MM105.

***P. litvinovii*** Tranzschel & Erem. – on *Alcea nudiflora* (Lindl.) Boiss, ShjB, 20.V.2025, MM441;

***P. littoralis*** Rostr. – on *Juncus compressus* Jacq, XtB, 24.VIII.2025, MM488.

***P. malvacearum*** Bertero ex Mont. – on *Malva neglecta* Wallr, ShqB 11.V.2025, MM487.

***P. medioasiaticae*** Uljan. – on *Hypericum scabrum* L., QoB, 04.V.2025, MM127; XtB, 01.VI.2025, MM223; on *H. perforatum* L., XtB, 23.IV.2025, MM128; on *Mentha longifolia* var. *asiatica* (Boriss.) Rech.f., XtB, 24.VIII.2025, MM246; ShqB, 23.VIII.2025, MM250; on *Mentha longifolia* (L.) L., XtB, 24.VIII.2025, MM253.

***P. melasmiioides*** Tranzschel – on *Aquilegia vicaria* Nevski, ShqB, 11.V.2025, MM305.

***P. menthae*** Pers. – on *Mentha longifolia* var. *asiatica* (Boriss.) Rech.f., XtB, 1.VI.2025, MM306.

***P. phlomidis*** Thüm. – on *Phlomooides kaufmanniana* (Regel) Adylov, Kamelin & Makhm., KtB, 14.VI.2024, MM406;

***P. prenanthis*** (Pers.) Lindr. – on *Chondrilla* sp., ShjB, 20.V.2025, MM490.

***P. punctata*** Link – on *Galium tricornutum* Dandy., QoB, 04.V.2025, MM001; on *Galium aparine* L., QoB, 04.V.2025, MM004; on *Galium* sp., ShqB, 23.VIII.2025, MM238.

***P. recondita*** Roberge ex Desm. – on *Anchusa azurea* Mill., ShqB, 11.V.2025, MM161; QoB, 04.V.2025, MM162; ShqB, 25.V.2024, MM163; XaB, 09.V.2025, MM174; on *Delphinium* sp., XtB, 23.IV.2025, MM104.

***P. sogdiana*** Kom. – on *Ferula kuhistanica* Korovin, XtB, 13.IV.2025, MM045; XtB, 23.IV.2024, MM047.

***P. taraxaci*** Plowr. – on *Taraxacum officinale* F.H.Wigg., VdB, 06.VI.2025, MM491.

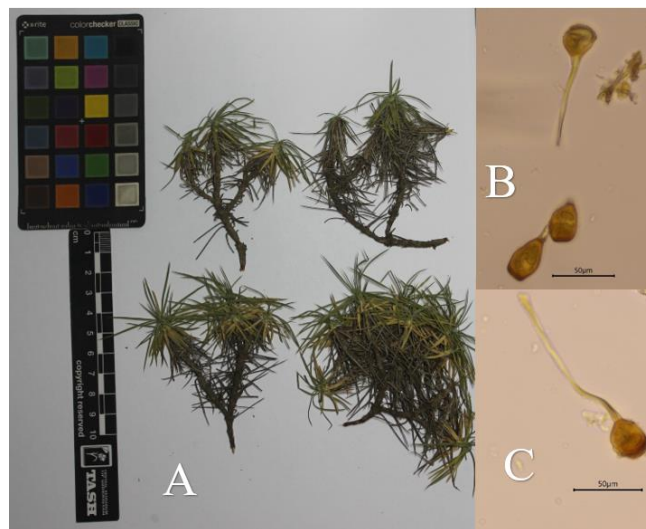
***P. virgae-aureae*** (DC.) Lib. – on *Galatella grimmii* (Regel & Schmalh.) Sennikov, XaB, 09.V.2025, MM374.

***P. ziziphorae*** P. Syd. & Syd. – on *Ziziphora clinopodioides* Lam., XaB, 09.V.2025, MM466.

#### **Uromyces (Link) Unger**

***U. acantholimonis*** Syd. & P. Syd. – on *Acantholimon erythraeum* Bunge., ShqB, 24.IV.2025, MM197; on *Acantholimon* sp., XaB, 25.IV.2025, MM198; on *Acantholimon majewianum* Regel., QoB, 04.V.2025, MM199; ShqB, 23.VIII.2025, MM259.

Note: Recorded for the first time on *A. majewianum* (Fig. 4).



**Figure 4.** A – Herbarium specimen of *Acantholimon majewianum* Regel infected with *Uromyces acantholimonis* Syd. & P. Syd.; B, C – Microscopic images of *Uromyces acantholimonis* spores

***U. arenariae*** Tranzschel – on *Eremogone griffithii* (Boiss.) Ikonn., QoB, 04.VII.2021, MM299;

***U. dactylidis*** G.H. Otth – on *Ranunculus* sp., XaB, 25.IV.2025, MM090; on *Ranunculus pinnatisectus* Popov. ShjB, 20.V.2025, MM 419.

***U. glycyrrhizae*** (Rabenh.) Magnus – on *Glycyrrhiza glabra* L., ShqB, 15.VI.2024, MM013; KtB, 14.VI.2025, MM107; XtB, 24.VIII.2025, MM245; ShqB, 23.VIII.2025, MM247.

*U. hedysari-obscuri* (DC.) Carestia & Picc. – on *Hedysarum magnificum* Kudr., QoB, 04.V.2025, MM307;

*U. inaequaltus* Lasch – on *Silene nevskii* Schischk., KtB, 14.VI.2025, MM308.

*U. lapponicus* Lagerh. – on *Astragalus* sp., XaB, 09.V.2025, MM309.

*U. pisi-sativi* (Pers.) Liro – on *Astragalus eximius* Bunge, VdB, 06.VI.2025, MM481.

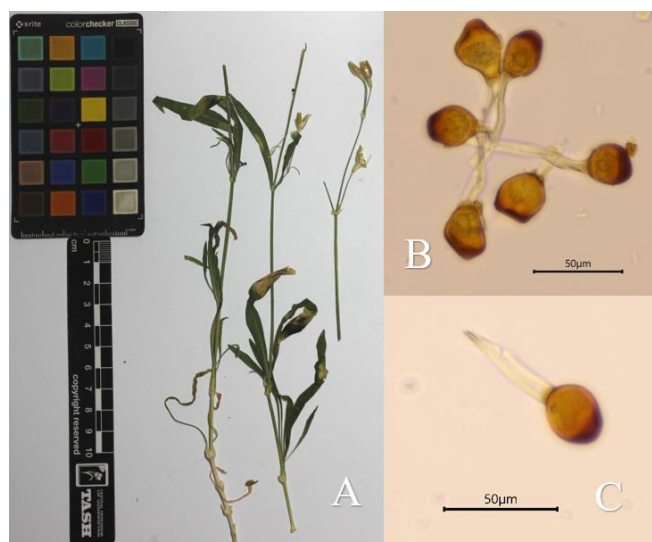
*U. polygoni-avicularis* (Pers.) G.H. Otth – on *Polygonum fibrilliferum* Kom., ShqB, 15.VI.2025, MM011.

*U. scrophulariae* (DC.) Fuckel – on *Scrophularia umbrosa* Dumort., ShqB, 15.VI.2024, MM446.

*U. striatus* J. Schröt. – on *Medicago sativa* L., ShqB, 15.VI.2025, MM444.

*U. verruculosus* J. Schröt. – on *Silene kuschakewiczii* Regel & Schmalh., XtB, 01.VI.2025, MM102;

Note: Recorded for the first time on *S. kuschakewiczii* (Fig. 5).



**Figure 5.** A – Herbarium specimen of *Silene kuschakewiczii* Regel & Schmalh. infected with *Uromyces verruculosus* J. Schröt.; B, C – Microscopic images of *Uromyces verruculosus* spores

#### Gymnosporangiaceae

##### *Gymnosporangium* Hedw.

*G. confusum* Plowr. – on *Crataegus turkestanica* Pojark., XtB, 01.VI.2025, MM002; ShqB, 15.VI.2025, MM055; KtB, 04.V.2021, MM056; on *Crataegus pontica* K.Koch XaB, 30.IV.2024, MM057; QoB, 04.V.2025, MM058; on *Pyrus regelii* Rehder., ShqB, 15.VI.2024, MM236; ShqB, 23.VIII.2025, MM235; on *Juniperus seravschanica* Kom., XtB, 24.VIII.2025, MM266; ShqB, 23.VIII.2025, MM267;

KtB, 14.VI.2025, MM268;

*G. fusisporum* E. Fisch. – on *Cotoneaster nummularioides* Pojark., VdB, 02.V.2025, MM034; XtB, 01.VI.2025, MM171; on *Cotoneaster nummularius* Fisch. & C.A.Mey., XtB, 01.VI.2025, MM170.

## 4. Discussion

Rust fungi were found parasitizing 81 plant species belonging to 50 genera and 24 families within the reserve. The most affected plant families were Asteraceae (21 species), Rosaceae (10 species), Apiaceae (6 species), Ranunculaceae (6 species), and Fabaceae (5 species). Additionally, seven rust fungi species were recorded for the first time on new host plants in the flora of Uzbekistan, including: *Gymnosporangium confusum* Plowr. on *Pyrus regelii* Rehder, *Puccinia punctata* Link on *Galium tricornutum* Dandy, *P. recondita* Roberge ex Desm. on *Delphinium* sp., *P. fockelii* Körn. on *Jurinea maxima* C. Winkl. (Fig. 2), *P. cynodontis* Lacroix ex Desm. on *Delphinium* sp. 2, *Uromyces verruculosus* J. Schröt. on *Silene kuschakewiczii* Regel & Schmalh. (Fig. 5), and *U. acantholimonis* Syd. & P. Syd. on *Acantholimon majewianum* Regel (Fig. 4).

It was also recorded that several rust fungi species parasitize three plant species listed in the Red Data Book of the Republic of Uzbekistan. These include *Uromyces hedysari-obscuri* (DC.) Carestia & Picc. on *Hedysarum magnificum* Kudr., *Puccinia cousiniae* P. Syd. & Syd. on *Cousinia glabriseta* Kult., and *P. fockelii* Körn. on *Jurinea gracilis* Iljin [28]. Additionally, rust diseases were observed on many medicinal plants within the reserve. These include *Ziziphora clinopodioides*, *Taraxacum officinale*, *Origanum vulgare* subsp. *gracile*, *Ferula kuhistanica*, *Glycyrrhiza glabra*, *Thalictrum isopyroides*, *Mentha longifolia* var. *asiatica*, *Malva neglecta*, *Cichorium intybus*, *Artemisia oliveriana*, *Hypericum scabrum*, *H. perforatum*, *Rosa canina*, among others.

It is widely recognized that the diversity of rust fungi exhibits a strong correlation with the richness of the vascular plant flora. The flora of Uzbekistan comprises over 4,500 species of higher plants, among which 261 species of rust fungi, belonging to 43 families, have been recorded on 511 plant species [27]. The flora of the Surkhan State Nature Reserve consists of 743 species distributed across 372 genera and 77 families. Within this flora, 59 species of rust fungi have been identified on 81 plant species representing 24 families.

**Table 1.** Comparative analysis of rust fungi diversity across different regions of Uzbekistan

Study area	Number of plant species in the flora	Number of rust fungi species	Number of host plant species (percentage of total flora)
Uzbekistan (Ramazanova et al., 1986)	4500	261	511 (13,35 %)
Angren River basin (Panfilova & Gaponenko, 1963)	1500	124	212 (14,13 %)
Fergana Valley (Gafforov et al., 2016)	2625	95	140 (5,33 %)
<b>Surkhan State Nature Reserve (Present study)</b>	<b>743</b>	<b>59</b>	<b>81 (10,9 %)</b>

It should be emphasized that studies on the diversity of rust fungi have been conducted by several mycologists in various regions of Uzbekistan, including the Angren River basin and the Fergana Valley [25,27,5]. The diversity of rust fungi in the Surkhan State Nature Reserve was comparatively analyzed against the results of these previous investigations (Table 1).

The diversity of rust fungi identified in the Surkhan State Nature Reserve comprises 59 species belonging to 6 genera, accounting for approximately 23% of the total rust fungi biota recorded in Uzbekistan to date. Among these, the genus *Puccinia* represents the most species-rich and widely distributed group, encompassing 33 species found on 50 host plant species, which corresponds to 61.7% of the total number of hosts.

The host plants of the identified rust fungi are predominantly members of the families Asteraceae, Apiaceae, Lamiaceae, Rubiaceae, Ranunculaceae, Boraginaceae, Malvaceae, and Hypericaceae. Species of the genus *Uromyces* were mainly associated with host plants from Fabaceae, Plumbaginaceae, Scrophulariaceae, Caryophyllaceae, Ranunculaceae, and Polygonaceae, while *Phragmidium* species were primarily confined to hosts within the Rosaceae family.

Rust diseases were relatively widespread within the reserve, causing significant damage to plant species belonging to the genera *Crataegus*, *Juniperus*, *Ferula*, *Artemisia*, *Rosa*, *Cousinia*, *Euphorbia*, *Galium*, *Mentha*, and *Pyrus*. This observation highlights the ecological significance of rust fungi as phytopathogens within the Surkhan State Nature Reserve ecosystem, indicating their potential role in shaping plant community dynamics and ecosystem health.

## 5. Conclusions

This catalogue provides the first comprehensive list of all rust fungi species recorded within the Surkhan State Nature Reserve since its establishment in 1986. The present work contributes to the development of a more complete synopsis of the rust fungi flora of Uzbekistan and serves as a foundation for further research on the diversity and distribution of mycomycetes across the region.

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