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Cover: Digital illustration of *Impatiens chamchumroonii* in Krita by Dupati Poojitha.



Checklist of rust fungi of the Nuratau Nature Reserve, Uzbekistan

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Abstract: A checklist of rust fungi of the Nuratau Nature Reserve (Nuratau Mountains, Uzbekistan) was compiled for the first time as a result of field research conducted in 2009–2022. In total, 70 species of rust fungi belonging to six genera and four families have been identified. Three of these species (*Puccinia behenis*, *P. onopordi*, *Uromyces helichrysi*) were found for the first time for the mycobiota of Uzbekistan. Thirteen species of rust fungi were recorded on 15 new host plant species. Most species of rust fungi belong to the genera *Puccinia* and *Uromyces*. The annotated checklist includes data on host plant, location, date and collection number of every species.

Keywords: Basidiomycetes, host plants, mycobiota, new records, Nuratau Mountains, protected mountain ecosystems, Pucciniales.

Annotatsiya: Nurota davlat qo'riqxonasi (Nurota tog'lari, O'zbekiston) hududida tarqalgan zang zamburug'larining cheklisi 2009–2022-yillarda olib borilgan dala tadqiqotlari natijalari asosida ilk bor tuzildi. Tadqiqot davomida oltita turkum va to'rtta oilaga mansub jami 70 tur zang zamburug'i aniqlandi. Shulardan uch tur — *Puccinia behenis*, *P. onopordi* hamda *Uromyces helichrysi* — O'zbekiston mikrobiotasi uchun birinchi marta qayd etildi. Bundan tashqari, 13 tur zang zamburug'i 15 ta yangi xo'jayin o'simlik turlarida aniqlangan. Aniqlangan turlar orasida *Puccinia* va *Uromyces* turkumlariga mansub vakillar ustunlik qiladi. Ushbu ro'yxat har bir tur bo'yicha xo'jayin o'simlik nomi, topilgan joyi, yig'ilgan sanasi hamda kolleksiya raqamiga oid ma'lumotlarni o'z ichiga oladi.

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INTRODUCTION

Rust fungi are the larger and the most important obligate biotrophic plant group of Mycota. These fungi comprise more than 7,000 species belonging to a single order (Pucciniales), with an estimated 14 families and 168 genera (Kirk et al. 2008). Rust fungi parasitize a wide range of host plants including ferns, conifers, and angiosperms.

Research related to the rust fungi in Uzbekistan mainly began with Zaprometov in 1912–1926s and by Golovin in 1947–1950. Studies on rust fungi in Uzbekistan were intensified between 1950 and 1986 by N.I. Gaponenko, T.S. Panfilova, T.K. Rotkevich, S.S. Ramazanova, F.G. Akhmedova, and G.T. Baymuratova. The synopsis of the rust fungi was published in “Fungal flora of Uzbekistan” in 1986 (Ramazanova et al. 1986). During the last two decades, a large number of new species of rust fungi and host records have been added (Nuraliev 1999; Solieva & Gafforov 2001, 2002; Gafforov et al. 2016; Mustafaev 2020).

Study area

All specimens of the rust fungi were collected in 2009–2021 in the territory of Nuratau Nature Reserve (NNR) located between 40.468–40.562° N and 66.659–66.927° E in the central part of the Nuratau Ridge, a major ridge of the Nuratau Mountains in Uzbekistan. (Figure 1).

The NNR is a strictly protected area of IUCN Category I established in 1975. The area is 177.52 km², and altitudes range 530–2,169 m. The Nuratau Mountains with the adjacent small insular ridges are the peripheral northwestern branches of the Pamir-Alay Mountain System, wedged deeply into the Kyzylkum Desert. The climate regime is temperate continental semi-arid with a mean annual temperature of 14°C and a mean annual precipitation of 300–400 mm. The flora of the Nuratau Mountains includes 1,289 species of vascular plants, 34 of them are local endemics; the checklist of the flora of Nuratau Nature Reserve includes 820 species belonging to 385 genera and 81 families (Tojibaev et al. 2017). The mycobiota of the Nuratau Mountains and the NNR was poorly studied until the author began in 2009 and then intensified (Mustafaev & Nuraliev 2012a,b; Mustafaev 2014a,b, 2015, 2016, 2017, 2022; Mustafaev et al. 2019, 2021; Mustafaev & Khujanov 2020; Mustafaev & Islomiddinov 2022; Islomiddinov et al. 2022). The current study aims to compile a checklist of the rust fungi of the NNR.

METHODS

Around 1,000 samples of the rust fungi were collected in 2009–2021 in different habitats of NNR which are designated in the checklist by following abbreviations: AbV—Andibarout valley (40.521° N, 66.741° E) | AnV—Andigen Valley (40.547° N, 66.689° E) | BMt—Beshbarmoq Mt. (40.479° N, 66.811° E) | GV—Gurdara Valley (40.502° N, 66.918° E) | HMt—Hayatbashi Mt. (40.498° N, 66.729° E) | HV—Hayat Valley (40.517° N, 66.748° E) | MV—Majrum Valley (40.565° N, 66.702° E) | PMt—Parandaz Mt. (40.484° N, 66.791° E) | QV—Qarisoy Valley (40.498° N, 66.807° E) | TV—Tikcha Valley (40.488° N, 66.763° E).

Specimens were examined with a light microscope and identified using the relevant literature (Kuprevich & Tranzchel 1957; Karbonskaya 1969; Azbukina 1974; Kuprevich & Ulyanishchev 1975; Uljanishev 1978; Ramazanova et al. 1986). Host plant species were identified using “Conspectus Florae Asiae Mediae” (1968–1993) and “Flora of Uzbekistan” (1941–1962). All collected specimens are stored in Fungarium of the Institute of Botany in Tashkent. Voucher specimens for each species of rust fungi are cited in the checklist below. Name of collector is designated by abbreviation: IM—Ilyor Mustafaev. The taxonomy and nomenclature of rust fungi in the checklist follows international databases “Index Fungorum” (2022). The nomenclature of host plants is given according to powo.science.kew.org/results (2022).

RESULTS

Checklist of rust fungi of the Nuratau Nature Reserve is compiled for the first time as a result of field research conducted by authors in 2009–2021. In total, 70 species of rust fungi belonging to six genera and four families were found. The largest genera are *Puccinia* (44), *Uromyces* (15), *Phragmidium* (6), and other genera (*Tranzschelia*, *Aecidium*, *Melampsora*) are represented with 1–3 species. Among them, four species – *Puccinia behenis* G.H.Otth – on *Silene obtusedentata* B.Fedtsch. et Popov, *P. onopordi* P.Syd. et Syd. – on *Onopordum olgae* Regel et Schmalh., *Uromyces helichrysi* Lagerh. – on *Helichrysum nuratavicum* Krasch. were recorded for the first time for the mycobiota of Uzbekistan. Rust fungi parasitize 92 host species belonging to 24 families and 68 genera on territory of the NNR. The most representative host families are: Asteraceae (14 rust species), Rosaceae (8), Fabaceae (7), Apiaceae (6), Lamiaceae (6), Poaceae

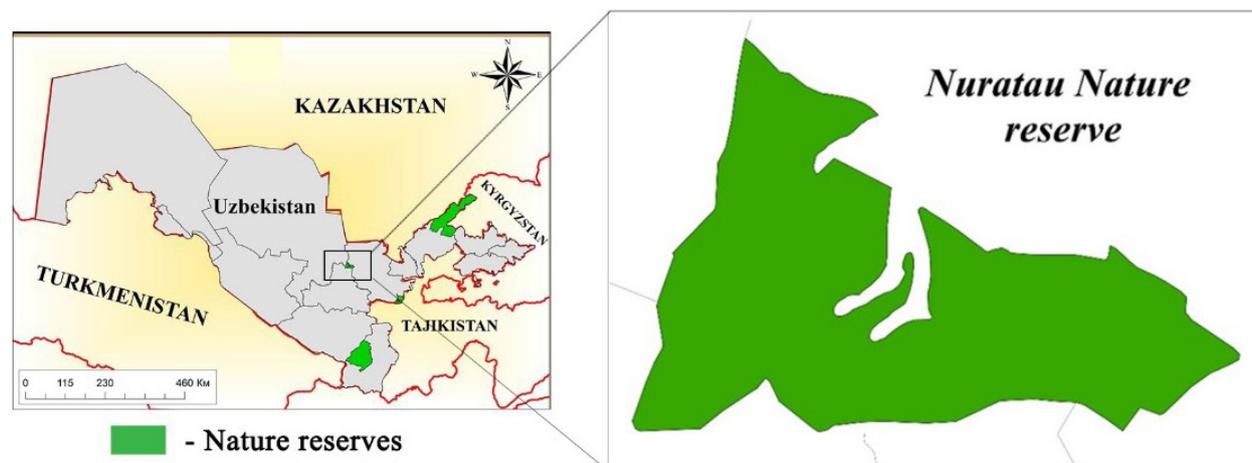


Figure 1. Location of the study area: Nuratau Nature Reserve.

Table 1. Comparison of the rust diversity of Nuratau Nature Reserve with other regions of Uzbekistan.

Study areas	Plant flora species	Rust species	Rust host plant species (Percentage towards to overall 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%)
Nuratau Nature Reserve (This research)	820	70	92 (11.13%)

(4), Euphorbiaceae (3), Ranunculaceae (3). Thirteen species of rust fungi were recorded for the first time on 15 new host plant species in the host plant index of Uzbekistan: *Uromyces dactylidis* G.H.Oth. – *Ranunculus mindshelkensis* B.Fedtsch., *Puccinia cousiniae* P.Syd. et Syd. – *Cousinia pseudodshisakensis* Tschern. et Vved., *P. phlomidis* Thüm. – *Leonurus turkestanicus* V.I.Krecz. et Kuprian. and *Phlomis nubilans* Zakirov, *P. monticola* Kom. – on *Geranium linearilobum* DC., *Puccinia tanacetii* DC. – *Tanacetopsis karataviensis* (Kovalevsk.) Kovalevsk., *P. sogdiana* Kom. – *Ferula angreni* Korovin, *P. echinopsis* DC. – *Echinops nuratavicus* A.D.Li, *P. galii-cruciatae* Duby – *Galium karakulense* Pobed., *P. recondita* Roberge ex Desm. – on *Thalictrum isopyroides* C.A.Mey, *P. behenis* – on *Silene obtusedentata*, *P. onopordi* – on *Onopordum olgae*, *P. thymi* (Fuckel) P.Karst. – on *Thymus seravschanicus*, *Uromyces helichrysi* – on *Helichrysum nuratavicum*, *U. acantholimonis* Syd. et P.Syd. – on *Acantholimon nuratavicum* Zakirov.

Among them, *Acantholimon nuratavicum*, *Helichrysum nuratavicum*, *Phlomis nubilans* are endemic species to the Nuratau Ridge and *Phlomis nubilans* and *Helichrysum nuratavicum* are listed in the Red Data Book of Uzbekistan since 2009 (Red 2019).

The recorded rust species were found on 24 medicinal species such as *Ziziphora clinopodioides*, *Taraxacum officinale*, *Origanum vulgare* subsp. *gracile*, *Ferula moschata*, *Tanacetopsis karataviensis*, *Atraphaxis virgata*, *Mentha longifolia* var. *asiatica*, *Malva neglecta*, *Cichorium intybus*, *Urtica dioica*, *Helichrysum nuratavicum*, and *Rosa canina*.

List of 70 species of rust fungi from study area:

Melampsoraceae

Melampsora Castagne

M. euphorbiae (Ficinus & C.Schub.) Castagne — on *Euphorbia helioscopia* L., HV, 29 V 2009, IM062.

M. hissarica Faizieva — on *Salix alba* L., HV, 6 VI 2012, IM153.

M. populnea (Pers.) P.Karst. — on *Populus alba* L., HV, 15 VII 2017, IM355. (Image 1).

Phragmidiaceae

Phragmidium Link

Ph. bulbosum F.Strauss — on *Rubus caesius* L., HV, 24.ix.2010, IM259.

Ph. circumvallatum Magnus — on *Geum kokanicum* Regel & Schmalh. (= *Orthurus kokanicus* Juz.), HMT,



Image 1. *Melampsora populnea* (Pers.) P. Karst.—on *Populus alba* L.

25.vi.2015, IM139, 15.vii.2017, IM350, PMt, 10.v.2010, IM183, 3.v.2011, IM074, BMT, 16.v.2017, IM344.

Ph. devastatrix Sorokĭn — on *Rosa canina* L., HV, 28.v.2009, IM063.

Ph. rosae-lacerantis Dietel — on *Rosa webbiana* Wall. ex Royle (= *Rosa maracandica* Bunge), HV, 14.vii.2010, IM096, HV, 15.vii.2017, IM356.

Ph. sanguisorbae (DC.) J.Schröt. — on *Sanguisorba minor* subsp. *lasiocarpa* (Boiss. Et Hausskn.) Nordborg (= *Poterium lasiocarpum* Boiss. et Hausskn), HV, 13.vii.2010, IM142.

Ph. tuberculatum Jul.Müll. — on *Rosa canina* L., MV, 03.viii.2009, IM064; on *Rosa persica* Michaut ex Juss. (= *Hulthemia persica* (Michaut ex Juss.) Bornm.), HV, 11.v.2010, IM297. (Image 2).

Pucciniaceae

Aecidium Pers.

Aecidium thalictri Grev. — on *Thalictrum sultanabadense* Stapf, PMt, 10.v.2010, IM178, MV, 5.v.2012, IM071.

Puccinia Pers.

P. chrysanthemi Roze — *Artemisia juncea* Kar. et Kir.: HV, 14.iv.2010, IM008. *Artemisia oliveriana* J.Gay ex Besser (= *Artemisia sogdiana* Bunge), MV, 2.v.2011, IM065, HV, 15.vii.2017, IM357, *Artemisia tenuisecta* Nevski, HV, 13.vii.2010, IM036.

P. cnici-oleracei Pers. — on *Dieteria canescens* (Pursh) Nutt. (= *Aster canescens* Pursh), BMT, 15.v.2010, IM301.



Image 2. *Phragmidium tuberculatum* Jul. Müll.—on *Rosa canina* L.

P. behenis G.H.Oth — on *Silene obtusidentata* B.Fedtsch. et Popov, QV, 12.v.2010, IM505.

P. bromina Erikss. — on *Bromus sterilis* L., TV, 29.v.2009, IM049, HV, 1.v.2011, IM225; on *Bromus inermis* Leyss., HV, 09.v.2010, IM199.

P. bulbocastani (Cumino) Fuckel — on *Elwendia chaerophylloides* (Regel et Schmalh.) Pimenov et Kljuykov (= *Bunium chaerophylloides* (Regel et Schmalh.) Drude), QV, 07.vi.2012, IM258.

P. caricina DC. — on *Urtica dioica* L., QV, 12.v.2010, IM015, MV, 19.vi.2011, IM378,

P. galii-cruciatae Duby — *Galium pamirolalaicum* Pobed., PMt, 10.v.2010, IM027, BMT, 15.vii.2010, IM010, BMT, 16.vii.2017, IM351; *Galium karakulense* Pobed., MV, 16.vii.2011, IM 224. First record on *Galium karakulense* in Uzbekistan.

P. carthami Corda — on *Leuzea repens* (L.) D.J.N. Hind (= *Acroptilon repens* (L.) DC.), HV, 25.ix.2010, IM020, MV, 3.vii.2009, IM058.

P. cesatii J.Schröt. — *Bothriochloa ischaemum* (L.) Keng, HV, 5.vii.2011, IM229.

P. hieracii (Röhl.) H.Mart. — *Cichorium intybus* L., HV, 5.vii.2009, IM326, 13.v.2010, IM013.

P. cnici H.Mart. — on *Picnomon acarna* (L.) Cass., HV, 9.v.2010, IM022, HV, 30.v.2016, IM324, 6.vi.2011, IM039.

P. conferta Dietel et Holw. — on *Artemisia juncea* Kar. et Kir., MV, 19.vii.2011, IM326.

P. cousiniae P.Syd. et Syd. — on *Arctium umbrosum* (Bunge) Kuntze (= *Cousinia umbrosa* Bunge), HV, 24.ix.2010, IM035, *A. korolkowii* Kuntze (≡ *Cousinia korolkowi* Regel et Schmalh.), HV, 14.v.2010, IM018, HV, 18.vii.2011, IM277; *Cousinia radians* Bunge, HV, 29.v.2010, IM033; *C. resinosa* Juz., HV, 13.vii.2010,

IM019; *C. eriotricha* Juz., HMT, 27.vii.2015, IM137; *C. pseudodshizakensis* Tschern. et Vved., HMT, 27.vii.2015, IM037, MV, 3.viii.2009, IM243. HMT, 15.vii.2015, IM358, 27.v.2009, IM450. First record on *C. pseudodshizakensis* Uzbekistan.

P. cynodontis Lacroix ex Desm. — on *Cynodon dactylon* (L.) Pers., HV, 13.vii.2010, IM012. HV, 14.v.2010, IM295.

P. droborii Solkina — on *Mediasia macrophylla* Pimenov, GV, 28.v.2014, IM125, PMt, 27.vii.2016, IM237, BMT, 16.vii.2017, IM342. (Image 3).

P. echinopsis DC. — on *Echinops nuratavicus* A.D. Li, TV, 27.vii.2016, IM162. First record on *Echinops nuratavicus* in Uzbekistan.

P. eremuri Kom. — on *Eremurus olgae* Regel, HV, 10.v.2010, IM009; on *Eremurus sogdianus* (Regel) Benth. et Hook. f., TV, 29.v.2009, IM044. (Image 4).

P. falcariae Fuckel — on *Falcaria vulgaris* Bernh., HV, 11.v.2010, IM005, 1.v.2011, IM263, 18.v.2011, IM042.

P. fuckelii P.Syd. et Syd. — on *Jurinea olgae* Regel et Schmalh., MV, 2.v.2011, IM061.

P. hieracii (Röhl.) H.Mart. — on *Centaurea besseriana* DC. (= *Centaurea squarrosa* Willd.), QV, 15.v.2010, IM003.

P. komarovii Tranzschel — on *Impatiens parviflora* DC., 28.v.2014, IM128.

P. kupreviczii Golovin — on *Scutellaria ramosissima* Popov, HV, 30.v.2015, IM194.

P. libani Magnus — on *Prangos pabularia* Lindl., GV, 10.iv.2013, IM034; *Ferula ovina* (Boiss.) Boiss., PMt, 10.v.2010, IM011.

P. littoralis Rostr. — on *Juncus inflexus* L., MV, 30.x.2009, IM198.

P. litvinovii Tranzschel et Erem. — on *Alcea litvinovii*

(Iljin) Iljin, HV, 13.v.2010, IM050.

P. malvacearum Bertero ex Mont. — on *Malva neglecta* Wallr., HV, 16.v.2010, IM021; on *Alcea litvinovii* (Iljin) Iljin, HV, 13.v.2010, IM302.

P. medioasiatica Uljan. — on *Hypericum scabrum* L., PMt, 3.v.2011, IM031, BMT, 15.vii.2010, IM030, MV, 26.iii.2015, IM188.

P. menthae Pers. — on *Mentha longifolia* var. *asiatica* (Boriss.) Rech.f. (= *Mentha asiatica* Boriss.), QV, 5.vii.2010, IM029, MV, 30.x.2009, IM046.

P. monticola Kom. — on *Geranium linearilobum* DC., MV, 26.iii.2015, IM145. First record on *Geranium linearilobum* in Uzbekistan.

P. onopordi P.Syd. et Syd. — on *Onopordum leptolepis* DC. (= *Onopordum olgae* Regel et Schmalh.), TV, 11.v.2010, IM434.

P. recondita Roberge ex Desm. — on *Thalictrum isopyroides* C.A.Mey., GV, 6.vi.2012, IM043. First record on *Thalictrum isopyroides* in Uzbekistan.

P. phlomidis Thüm. — on *Phlomis thapsoides* Bunge, HV, 13.vii.2010, IM023, IM024, IM383; on *Phlomis nubilans* Zakirov, HV, 3.vii.2019, IMe001; on *Phlomoides kaufmanniana* (Regel) Adylov, Kamelin et Makhm. (= *Eremostachys kaufmanniana* Regel), TV, 29.v.2009, IM047, BMT, 12.v.2010, IM025, MV, 2.v.2011, IM222, QV, 7.vi.2012, IM129; on *Leonurus turkestanicus* V.I.Krecz. et Kuprian., BMT, 12.v.2010, IM026. First record on *Leonurus turkestanicus* and *Phlomis nubilans* in Uzbekistan.

P. platypoda Syd. et P.Syd. — on *Atraphaxis virgata* (Regel) Krasn., MV, 24.vii.2015, IM146.

P. plicata Kom. — on *Prangos pabularia* Lindl., HV, 13.vii.2010, IM006.

P. poarum E.Nielsen — on *Poa pratensis* L., HV, 9.v.2010, IM052.



Image 3. *Puccinia droborii* Solkina—on *Mediasia macrophylla* Pimenov.



Image 4. *Puccinia eremuri* Kom.—on *Eremurus olgae* Regel.



Image 5. *Puccinia violae* DC.—on *Viola suavis* M. Bieb.

P. maculosa Schwein. — on *Chondrilla* sp., HV, 3.viii.2009, IM048.

P. punctata Link — on *Asperugo procumbens* L., HV, 9.v.2010, IM233; on *Galium tricorutum* Dandy (= *Galium spurium* L.), HV, 11.v.2010, IM028, QV, 15.vii.2010, IM353; on *Galium humifusum* M. Bieb., QV, 15.vii.2010, IM007; on *Galium pamirolaicum* Pobed., PMt, 3.v.2011, IM040, HMT, 30.v.2015, IM261; on *G. aparine* L., HV, 14.v.2010, IM038.

P. tanacetii DC. — on *Lepidolopsis turkestanica* (Regel et Schmalh.) Poljakov, HV, 27.vii.2017, IM369; on *Tanacetopsis karataviensis* (Kovalevsk.) Kovalevsk., TV, 27.vii.2016, IM165. First record on *Tanacetopsis karataviensis* in Uzbekistan.

P. thymi (Fuckel) P.Karst. — on *Thymus seravschanicus* Klovov, BMt, 15.vi.2010, IM002.

P. sogdiana Kom. — on *Ferula moschata* (H.Reinsch) Koso-Pol., PMt, 10.v.2010, IM246; *F. kokanica* Regel et Schmalh., PMt, 3.v.2011, IM262; on *F. angreni* Korovin, HV, 15.vii.2017, IM367. First record on *Ferula angreni* in Uzbekistan.

P. stipina Tranzschel — on *Origanum vulgare* subsp. *gracile* (K.Koch) Letsw., MV, 13.v.2010, IM051.

P. hieracii (Röhl.) H.Mart. — on *Taraxacum* sect. *Taraxacum* F.H.Wigg. (= *Taraxacum officinale* Webb), HV, 25.ix.2010, IM016.

P. violae DC. — on *Viola suavis* M. Bieb., HV, 9.v.2010, IM017, 4.viii.2009, IM013, 15.vii.2017, IM361. (Image 5).

P. ziziphorae P.Syd. et Syd. — on *Ziziphora clinopodioides* Lam., HV, 14.v.2010, IM004, BMt, 16.vii.2017, IM352.



Image 6. *Uromyces acantholimonis* Syd. et P. Syd.—on *Acantholimon erythraeum* Bunge.

Uromyces (Link) Unger

U. acantholimonis Syd. et P.Syd. — on *Acantholimon nuratavicum* Zakirov, AbV, 7.vi.2014, IM057; on *Acantholimon erythraeum* Bunge, BMt, 12.v.2010, IM184 (Image 6).; on *A. tataricum* Boiss., PMt, 3.v.2011, IM250, AbV, 16.vii.2014, IM266. First record on *A. nuratavicum* in Uzbekistan.

U. arenariae Tranzschel — on *Eremogone griffithii* (Boiss.) Ikonn. (= *Arenaria griffithii* Boiss.), HMT, 25.vii.2015, IM138, 15.vii.2017, IM360.

U. astragali-lasiosemi Vienn.-Bourg.— on *Astragalus lasiosemius* Boiss., QV, 16.vii.2017, IM341.

U. tuberculatus (Fuckel) Fuckel— on *Euphorbia* sp., TV, 27.vii.2016, IM189.

U. flectens Lagerh. — on *Trifolium repens* L., HV, 3.viii.2009, IM060, 14.vii.2012, IM144.

U. glycyrrhizae (Rabenh.) Magnus — on *Glycyrrhiza glabra* L., AbV, 9.vii.2011, IM186, AnV, 16.vii.2014, IM267, 6.vi.2012, IM155. (Image 7).

U. hedsari-obscuri (DC.) Carestia et Picc. — on *Hedysarum mogianicum* (B.Fedtsch.) B.Fedtsch., BMt, 15.vii.2010, IM307.

U. helichrysi Lagerh. — on *Helichrysum nuratavicum* Krasch. BMt, 12.v.2010, IMh001

U. pisi-sativi (Pers.) Liro— on *Astragalus sewertzowii* Bunge, BMt, 12.v.2010, IM316, 15.vii.2010, IM054; on *A. eximius* Bunge, MV, 3.viii.2009, IM379.

U. scrophulariae (DC.) Berk. et Broome ex J.Schröt. — on *Scrophularia oblongifolia* Loisel. (= *Scrophularia umbrosa* Dumort.), HMT, 30.v.2016, IM173

U. scutellatus (Schrank) Lév. — on *Euphorbia falcata*



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Image 7. *Uromyces glycyrrhizae* (Rabenh.) Magnus—on *Glycyrrhiza glabra* L.

L., QV, 15.vii.2010, IM059.

U. striatus J.Schröt. — on *Medicago sativa* L., HV, 3.viii.2009, IM053, 9.v.2010, IM305.

U. trifolii (R.Hedw. ex DC.) Fuckel — on *Trifolium repens* L., HV, 20.vii.2011, IM055.

U. vesicatorius (Bubák) Nattrass — on *Leontice ewersmanni* Bunge, GV, 3.v.2012, IM056.

U. dactylidis G.H.Otth. — on *Ranunculus mindshelkensis* B. Fedtsch., PMt, 3.v.2011, IM177; on *R. paucidentatus* Schrenk, BMt, 12.v.2010, IM405.

Tranzscheliaceae

Tranzschelia Arthur

T. pruni-spinosae (Pers.) Dietel — on *Prunus bucharica* (Korsh.) Hand.-Mazz. (= *Amygdalus bucharica* Korsh.), HV, 14.vii.2010, IM032, TV, 27.vii.2016, IM172; on *Prunus spinosissima* (Bunge) Franch. (= *Amygdalus spinosissima* Bunge), HMt, 14.vii.2010, IM248.

DISCUSSION

It is known that the diversity of the rust fungi is closely related to the diversity of the plant flora. The Uzbekistan plant flora consists of more than 4,500 species and 261 rust species were registered on 511 host plant species from 43 families (Ramazanova et al. 1986). The flora of NNR includes 820 species belonging to 385 genera and 81 families and were found 70 rust species on 92 host plant species from 24 families. It is noted that studies on rust fungi of many regions of Uzbekistan including Angren River basin (5220 km²), Fergana Valley carried out by some mycologists (Panfilova & Gaponenko 1963; Ramazanova et al. 1986; Gafforov et al. 2016). The

diversity of rust fungi of NNR have been compared with their research results (Table 1).

This diversity of rust fungi of NNR is represented by six genera and 70 species and has approximately 27% of the currently known rust biota of Uzbekistan. However, territory of NNR (177.52 km²) is smaller than that of other studied areas: Angren River basin (5,220 km²), Fergana Valley (Uzbekistan part 18,540 km²). This represents the significance of the NNR not only from a botanical point of view, but also from a mycological one. Among the recorded rust genera, the most species rich and widespread genus is *Puccinia*, frequently found on 59 host plant species (64% of the total number of host plant species) from Asteraceae, Apiaceae, Lamiaceae, Poaceae, Urticaceae, Violaceae, Geraniaceae, Asphodelaceae; *Uromyces* species are found on Fabaceae, Polygonaceae, Scrophulariaceae, Euphorbiaceae, Plumbaginaceae; species of the genus *Phragmidium* are mainly found on Rosaceae. On the territory of NNR, the rust diseases occur frequently and severely damage plants belonging to *Acantholimon*, *Artemisia*, *Rosa*, *Ferula*, *Cousinia*, *Trifolium*, *Euphorbia*, *Viola*, *Galium*, *Leontice*, *Mentha*, *Salix*, *Populus*. It should be noted that species of the genus *Gymnosporangium* have not been found in the NNR. However, species of *Gymnosporangium* are widespread in many mountainous areas of Uzbekistan.

It has been found that the distribution of species of *Gymnosporangium* within mountainous areas of Uzbekistan depends largely on the distribution of juniper woodlands. While the aecial hosts, species of *Crataegus* and *Cotoneaster*, are common in all studied areas, the telial hosts, *Juniperus* species, are dominant in mountain forests in Ugam-Chatkal and Zaamin National Parks as well as in the Boysun Mountains, but extremely rare in the Nuratau Range. Respectively, *Gymnosporangium* species are widespread in all studied areas of Uzbekistan with the exception of the Nuratau Range, where representatives of this genus have not been found despite the long-term surveys. This fact indicates that species of *Juniperus* play the main role in the life cycle of species of *Gymnosporangium* (Mustafaev et al. 2021). Aeciospores of *Gymnosporangium* species spread over long distances by the wind. At the same time, it has been found that these aeciospores infect only junipers (Cummins & Hiratsuka 2003; Deacon 2006; Kellerhals 2012).

The checklist of the rust fungi presents the first complete list of all rust fungi in the NNR since 1975 when the NNR was established. This publication serves towards to the complete checklist of rust fungi of Uzbekistan.

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