

The alien fraction of the flora of Bukhara oasis

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Abstract: As a result of the study of the flora of Bukhara oasis (Republic of Uzbekistan) alien plants have been discovered and taxonomic content has been formed. Alien plants of Bukhara oasis include 29 families, 116 species which belong to 94 genera.

Zusammenfassung: Nach der Erforschung der Flora des Gebiets Buchara wurden die adventiven Arten definiert und die taxonomische Klassifikation entwickelt. Die adventiven Pflanzen haben sich im Gebiet Buchara 29 Familien, 116 Arten gebildet, die zu 94 Gattungen gehören.

Keywords: Bukhara oasis, Uzbekistan, alien plants, taxonomy.

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INTRODUCTION

The first research on the flora of Central Asia, including Uzbekistan dates back to the beginning of XIX century. Most of the herbarium samples which were collected as a result of the research, have been made during the 100 years and are kept in Tashkent (TASH), St. Petersburg (LE) and in Moscow (MW). On the basis of the collected data fundamental works such as “Flora of Uzbekistan” (1941-1962), “Conspectus florae Asiae Mediae” (1968-1993), “Vegetable cover of Uzbekistan” (1971-1984) have been published. The studies which have been done were mainly devoted to the inventory of the flora. However, the study of the fraction of alien plants has not been carried out so far. Therefore, there is very little information about such species in Central Asia as well as in Uzbekistan at present. In the last few 20-30 years very few studies have been carried out on alien plants of the flora (МАХКАМОВ 2009, LAZKOV et al. 2011).

Nowadays research in the flora Bukhara Oasis on species which came from abroad has began. Such studies are being carried out in the natural and anthropogenic spheres of the oasis. Alien plants and their coming, spheres of extension, areas and the impact on the natural plant layer are being studied.

MATERIALS AND METHODS

Bukhara Oasis is located at the western bank of the river Zarafshan and is included in south-west Kyzylkum. Total area of the oasis is 2870 km². It is bordered on the desert Kyzylkum from the north and north west, from the west on Korakul plato, from the south Urtachul from south east and east on Oftobachi, Kuyimozor (216 m) and Kiziltepa (NUROV, 1981). Administratively it is included in the Bukhara region of the Republic of Uzbekistan (Fig. 1).

According to botanical – geographical regionalization of Uzbekistan Bukhara Oasis is a part of Kyzylkum district of the Turan province (TOJIBAEV et al. 2012).

Research material – alien plants of the flora of Bukhara Oasis. To form a list of alien plants specimens of Central Herbarium of Uzbekistan (TASH), herbarium materials collected by the author and “Flora of Uzbekistan” (1941-1962), “Conspectus florae Asiae Mediae” (1968-1993) have been used. Scientific names of species have been given according to www.ipni.org, authors of species according to R.K. BRUMMIT, C.E. POWELL (1992), synonyms of species www.theplantlist.org. Life forms have been introduced according to C. RAUNKIER classification (1934). Sources of “Flora of Uzbekistan” (1941-1962), “Conspectus florae Asiae Mediae” (1968-1993) and

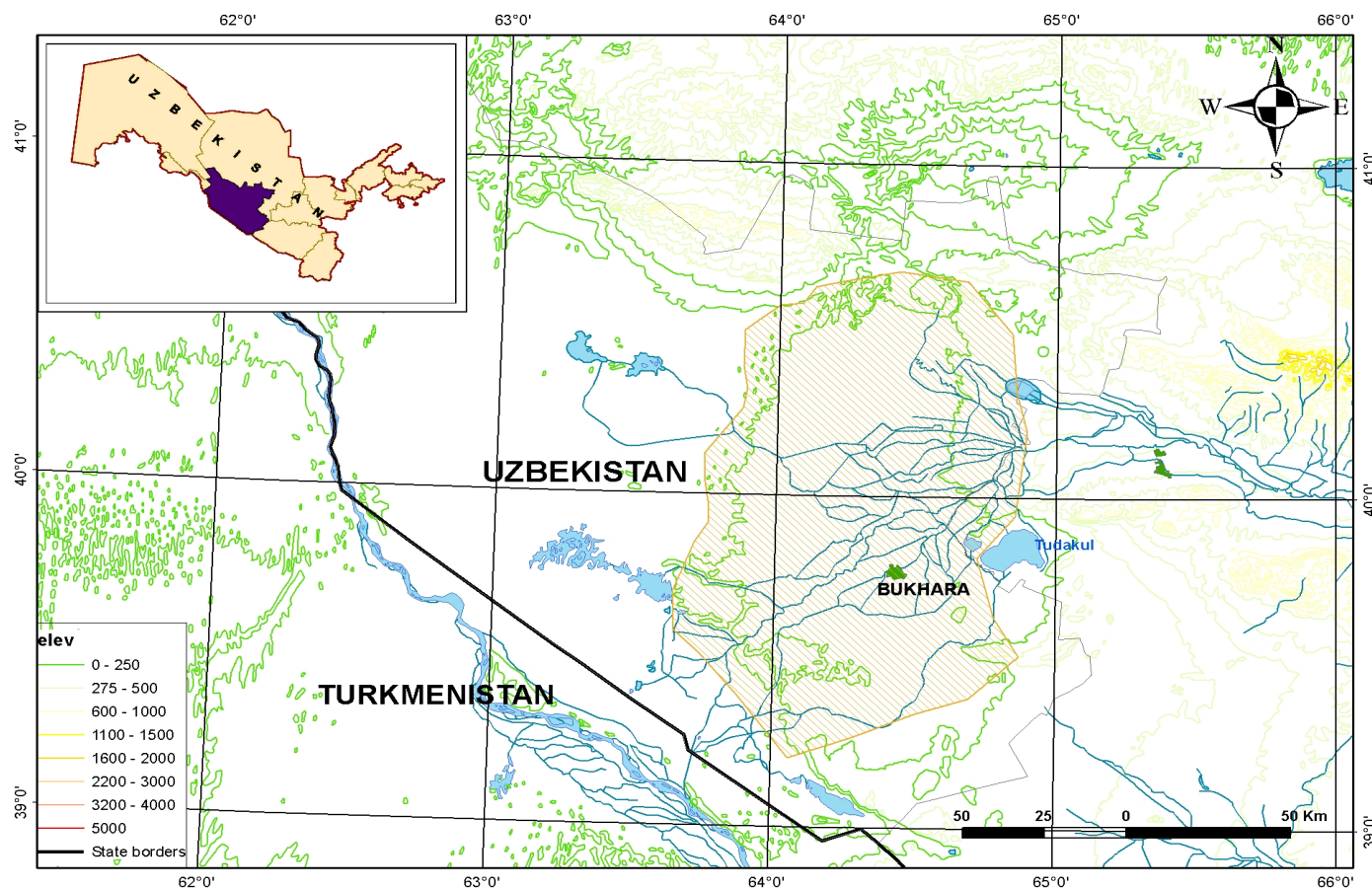


Fig. 1: Map of research area.

“Flora of USSR” (1934-1964) have been used. Furthermore, while studying the origin of the alien plants various literature (MAYOROV et al. 2012, VINOGRADOVA et al. 2010, 2011, CHANDRA 2012, AISTOVA, 2009) and web site <http://efloras.org> have been used to identify geographical extension of alien plants.

Most part of the Bukhara Oasis occupies agricultural zones with fruit gardens, cotton and wheat fields and others. There are some native landscapes (Fig. 2).

In the table there given abbreviation of some words: Phanerophytes – Ph, Hemicryptophytes – H, Cryptophytes – C, Therophytes – Th, along roadside –AR, along irrigation ditch – AI, plantation – P, along railway - AL, ruderal – R, sand soil –SS, flower garden – FG, aquatic – A.

RESULTS

As the result of the research 63 families, 476 species of 294 genera of the natural flora of the oasis have been identified (non published). The fraction of alien plants comprises 116 species from 29 families and 94 genera. 25 of the families mentioned above comprising 95 species in 77 genera belong to Magnoliopsida, whereas 4 families with 21 species in 17 genera are considered Liliopsida. Introduced species for Bukhara Oasis have not been given.

Comparison of the fraction of alien species with the overall flora shows a high degree of alien species in this region (Fig. 3). Alien plants comprise 46% of all families, 32% of all genera and 24% of all species, respectively.

During the process of research taxonomic content of alien plants of the flora of the oasis has been formed (Tab. 1).

Geographical origin of alien plants of Bukhara Oasis is various. A large number of them belong to Eurasia (93 species). From other territories – North America 7 species (*Equisetum ramosissimum*, *Amaranthus albus*, *Amaranthus retroflexus*, *Xanthium strumarium*, *Datura stramonium*, *Typha angustifolia*,

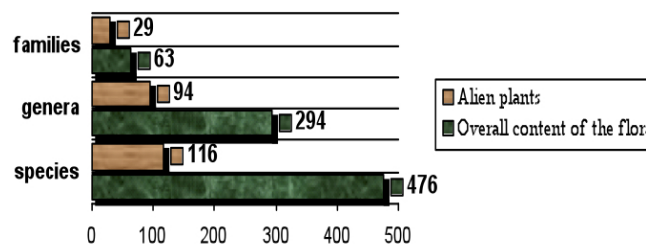


Fig. 3: Overall content and taxonomic analysis of alien plants of the flora of the oasis.

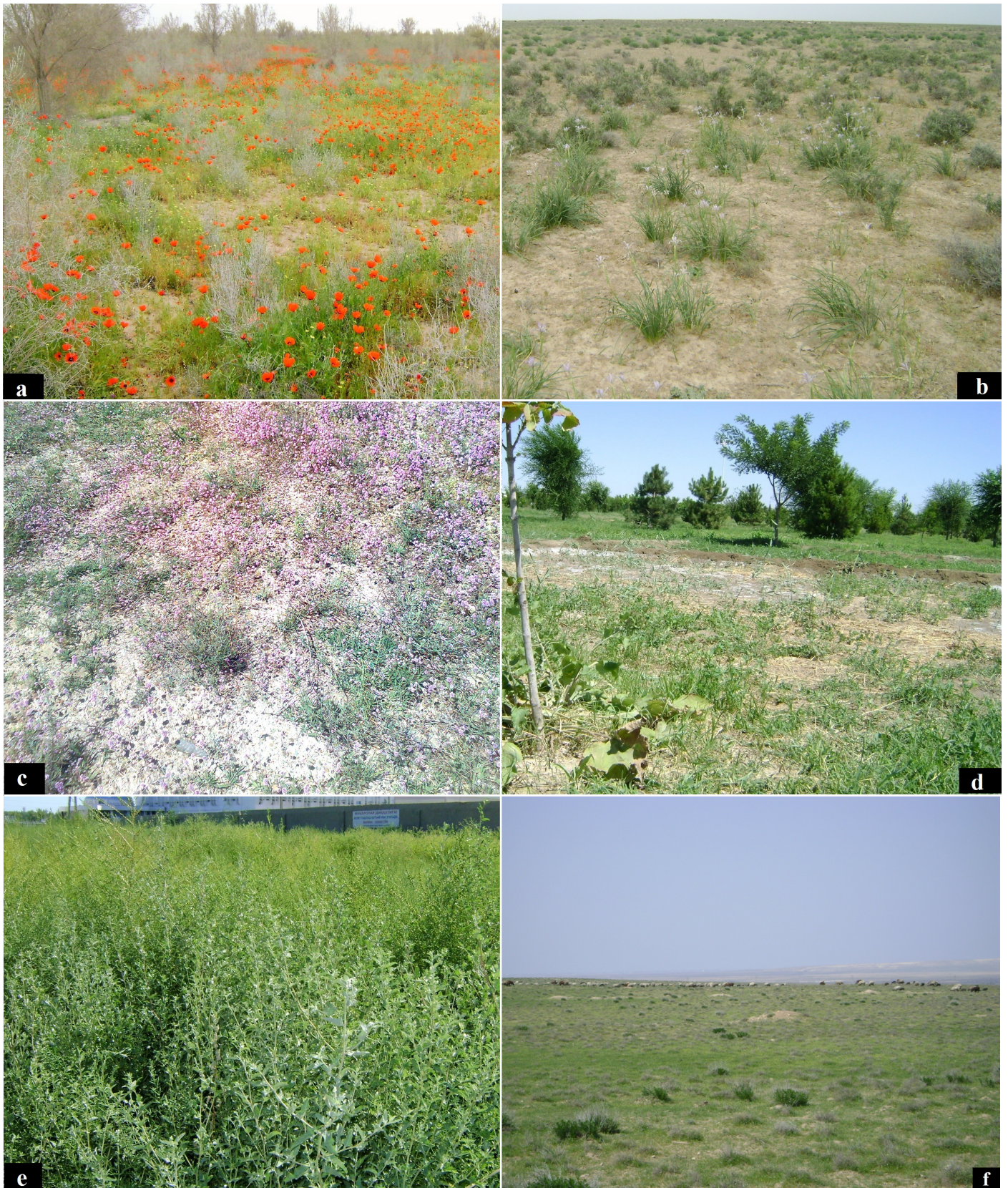


Fig. 2: Types of landscapes of the Bukhara Oasis. **a)** Sandy places with spring vegetation (*Roemeria refracta* (STEV.) DC., *Haloxylon persicum* BUNGE). **b)** Iris steppe (*Iris sogdiana* BUNGE). **c)** Salinity places (*Psylliostachys anceps* (REGEL) ROSHKOVA). **d)** Cultural zones (*Sophora japonica* L., *Aesculus hippocastanum* L.). **e)** Ruderal zones (*Atriplex tatarica* L., *Suaeda arcuata* BUNGE). **f)** Artemisia steppe (*Artemisia turanica* KRASCH., *Convolvulus hamadae* (VVED.) PETROV).

Tab. 1. Check-list of alien plant species of Bukhara Oasis.

| Family | Species | Geographic origin | Life Form | Habitat |
|--|---|---------------------------------|-----------|---------|
| Equisetaceae | <i>Equisetum ramosissimum</i> DESF. | North America | C | AR, AI |
| Ranunculaceae | <i>Ranunculus arvensis</i> L. | Eurasia, Europe, Mediterranean | Th | P |
| Portulacaceae | <i>Portulaca oleracea</i> L. | South America | Th | P |
| Caryophyllaceae | <i>Spergularia salina</i> (L.) JAUB. et C. PRESL | Eurasia, Europe, Sout-West Asia | Th | AI |
| Amaranthaceae | <i>Amaranthus albus</i> L. | North America | Th | AL |
| | <i>Amaranthus blitum</i> L. | Mediterranean | Th | P |
| | <i>Amaranthus retroflexus</i> L. | North America | Th | P |
| Chenopodiaceae | <i>Atriplex tatarica</i> L. | Eurasia | Th | R |
| | <i>Atriplex hastata</i> L. | Eurasia | Th | R |
| | <i>Bassia hyssopifolia</i> (PALL.) KUNTZE | Eurasia | Th | R |
| | <i>Chenopodium album</i> L. | Europe | Th | P |
| Primulaceae | <i>Dysphania botrys</i> (L.) MOSYAKIN & CLEMANTS | Mediterranean | Th | R |
| | <i>Anagallis arvensis</i> L. | Europe | Th | AI |
| Brassicaceae | <i>Brassica elongata</i> EHRH. | Eurasia | Th | P |
| | <i>Camelina microcarpa</i> ANDRZ. ex DC. | Eurasia | Th | P |
| | <i>Chorispora tenella</i> (PALL.) DC. | Eurasia | Th | P |
| | <i>Goldbachia sabulosa</i> (KAR. et KIR.) D.A. GERMAN ET AL-SHEHBAZ | Asia | Th | SS |
| | <i>Descurainia sophia</i> (L.) WEBB ex PRANTL | North Africa, Eurasia | Th | P, R |
| | <i>Eruca sativa</i> MILL. | Mediterranean | Th | P |
| | <i>Euclidium syriacum</i> (L.) W.T. AITON | S Eurasia | Th | P |
| | <i>Hornungia procumbens</i> (L.) HAYEK | S Europe, Asia | Th | P |
| | <i>Lepidium chalepense</i> L. | North America, S America | H | AR, P |
| | <i>Lepidium latifolium</i> L. | Southern Eurasia | H | AR |
| | <i>Lepidium perfoliatum</i> L. | Southern Eurasia | Th | P |
| | <i>Lepidium ruderalis</i> L. | Europe | Th | R |
| | <i>Meniocus linifolius</i> (STEPH. ex WILLD.) DC. | Eurasia | Th | SS |
| | <i>Rorippa sylvestris</i> (L.) BESS. | Europe | Th | FG |
| | <i>Sinapis arvensis</i> L. | Mediterranean | Th | P |
| <i>Sisymbrium altissimum</i> L. | Mediterranean | Th | P | |
| <i>Sisymbrium loeselii</i> L. | Eurasia | Th | R, AR | |
| <i>Strigosella africana</i> (L.) BOTSCH. | Mediterranean | Th | P, R | |
| Malvaceae | <i>Abutilon theophrastii</i> MEDIK. | Southern Asia | Th | P |
| | <i>Althaea officinalis</i> L. | Eurasia | H | AR |
| | <i>Malva mauritina</i> L. | Mediterranean | H | AR |
| | <i>Hibiscus trionum</i> L. | Mediterranean | Th | P |
| Urticaceae | <i>Urtica dioica</i> L. | N Africa, N America, Eurasia | Th | AI, P |
| Rosaceae | <i>Duchesnea indica</i> (ANDREWS) FOCKE. | Sout-East Asia | H | AR, FG |
| | <i>Potentilla supina</i> L. | Europe | H | AI |
| | <i>Rosa canina</i> L. | Eurasia | Ph | AR |
| Fabaceae | <i>Halimodendron halodendron</i> (PALL.) VOSS | Eurasia | Ph | AI |
| | <i>Medicago lupulina</i> L. | Eurasia | Th | P, AR |
| | <i>Melilotus albus</i> Medik. | Eurasia | Th | AI, AR |
| | <i>Melilotus officinalis</i> (L.) PALL. | Eurasia | Th | AI, AR |
| | <i>Trifolium pratense</i> L. | Eurasia | H | FG |
| | <i>Trifolium repens</i> L. | Eurasia | H | FG |
| | <i>Vicia villosa</i> Roth | Eurasia | Th | P |
| | <i>Vicia hyrcanica</i> FISCH. et C.A. MEY. | Eurasia | Th | P |
| <i>Vexibia alopecuroides</i> (L.) YAKOVLEV | Eurasia | H | AI, AR | |
| Oxalidaceae | <i>Oxalis corniculata</i> L. | Europe | Th | FG |
| Zygophyllaceae | <i>Tribulus terrestris</i> L. | Eurasia | Th | P, AR |
| Elaeagnaceae | <i>Elaeagnus angustifolia</i> L. | Eurasia | Ph | AI |
| Apiaceae | <i>Apium nodiflorum</i> (L.) LAG. | Europe | C | A |
| | <i>Daucus carota</i> L. | Eurasia | Th | P |
| | <i>Turgenia latifolia</i> (L.) Hoffm. | Southern Eurasia | Th | P |
| Asteraceae | <i>Arctium leiospermum</i> JUZ. et YE.V. SERG. | Eurasia | Th | P |
| | <i>Artemisia annua</i> L. | Eastern Asia | Th | P, AR |
| | <i>Bidens tripartita</i> L. | Eurasia | Th | AI |
| | <i>Carthamus oxyacanthus</i> M. BIEB. | Asia | Th | AR, P |
| | <i>Centaurea iberica</i> TREV. ex SPRENG. | Eurasia | H | AI |
| <i>Centaurea solstitialis</i> L. | Mediterranean | H | AL | |

Tab. 1. (continued)

| Family | Species | Geographic origin | Life Form | Habitat |
|---|--|---------------------------------|-----------|---------|
| Asteraceae | <i>Cichorium intybus</i> L. | Eurasia | H | P |
| | <i>Cnicus benedictus</i> L. | Eurasia | Th | P |
| | <i>Erigeron canadensis</i> L. | South America | Th | R, P |
| | <i>Galinsoga parviflora</i> CAV. | South America | Th | P |
| | <i>Erigeron bonariensis</i> L. | South America | Th | P, R |
| | <i>Handelia trichophylla</i> (SCHRENK) HEIMERL | Asia | H | AR |
| | <i>Lactuca tatarica</i> (L.) C.A. MEY. | Eurasia | H | P |
| | <i>Lactuca serriola</i> L. | Europe, W Asia, N Africa | Th | P |
| | <i>Lactuca altaica</i> FISCH. et C.A. MEY. | Eurasia | Th | P |
| | <i>Inula britannica</i> L. | Eurasia | H | AI, R |
| | <i>Sonchus asper</i> (L.) HILL | Mediterranean | Th | P |
| | <i>Sonchus oleraceus</i> L. | Mediterranean | Th | P |
| | <i>Symphotrichum graminifolium</i> (Spreng.) G.L.Nesom | South America | Th | P, R |
| | <i>Taraxacum bicorne</i> DAHLST. | Eurasia | H | P |
| | <i>Tripolium pannonicum</i> (JACQ.) DOBROZ. | Eurasia | Th | AR |
| <i>Xanthium albinum</i> (WIDDER) | South America | Th | P, AI | |
| <i>Xanthium spinosum</i> L. | South America | Th | P | |
| <i>Xanthium strumarium</i> L. | North America | Th | P | |
| Rubiaceae | <i>Galium tricoratum</i> DANDY | Southern Europe, N Africa, Asia | Th | P |
| Solanaceae | <i>Datura stramonium</i> L. | North America | Th | P |
| | <i>Solanum nigrum</i> L. | Eurasia | Th | P |
| Convolvulaceae | <i>Convolvulus arvensis</i> L. | Europe | H | P, AR |
| Boraginaceae | <i>Arnebia transcaspica</i> POPOV | Caspian Sea, Turkmenistan | Th | SS |
| | <i>Asperugo procumbens</i> L. | Europe | Th | P |
| | <i>Lithospermum officinale</i> L. | Eurasia | H | AI |
| | <i>Lycopus europaeus</i> L. | Eurasia | Th | AI |
| Scrophulariaceae | <i>Dodartia orientalis</i> L. | Eastern Europe, Asia | H | AR, P |
| | <i>Phelipanche aegyptiaca</i> (PERS.) POMEL | Eurasia | H | P |
| | <i>Veronica anagalloides</i> GUSS. | Europe | H | A |
| | <i>Veronica persica</i> Poir. | Asia Minor | Th | P |
| Plantaginaceae | <i>Veronica polita</i> Fries | Europe | Th | R, P |
| | <i>Plantago major</i> L. | Eurasia | H | P, AI |
| | Verbenaceae | <i>Verbena officinalis</i> L. | Europe | H |
| Lamiaceae | <i>Lamium amplexicaule</i> L. | Eurasia | Th | P |
| Juncaceae | <i>Juncus gerardii</i> Loisel. | Eurasia | H | AI |
| Cyperaceae | <i>Cyperus iria</i> L. | Africa | H | AI |
| | <i>Cyperus rotundus</i> L. | Eurasia, Africa | H | P |
| | <i>Scirpus mucronatus</i> L. | Eurasia, Africa | H | A |
| Poaceae | <i>Agropyron repens</i> (L.) P. BEAUV. | Eurasia | H | AI |
| | <i>Aegilops cylindrica</i> HOST | Eurasia | Th | P |
| | <i>Arundo donax</i> L. | Mediterranean | H | AI |
| | <i>Avena fatua</i> L. | Eurasia, North Africa | Th | P |
| | <i>Bromus tectorum</i> L. | Mediterranean, Europe, SW Asia | Th | P, SS |
| | <i>Bromus oxyodon</i> SCHRENK | Asia | Th | P |
| | <i>Cynodon dactylon</i> (L.) PERS. | Eurasia, Africa, | H | P |
| | <i>Digitaria sanguinalis</i> (L.) SCOP. | Europe, Caucasus, Asia | Th | P |
| | <i>Echinochloa crus-galli</i> (L.) P. BEAUV. | Southern Asia | Th | P, AI |
| | <i>Eremopyrum triticeum</i> (GAERTN.) NEVSKI | Eastern Europe, Asia | Th | SS |
| | <i>Hordeum murinum</i> L. | Southern Europe, N Africa, Asia | Th | AI, AR |
| | <i>Lolium temulentum</i> L. | Europe, Asia Minor | Th | P |
| | <i>Secale sylvestre</i> Host | Eurasia | Th | AR |
| <i>Setaria viridis</i> (L.) P. BEAUV. | Eurasia | Th | P, R | |
| <i>Setaria verticillata</i> (L.) P. BEAUV. | Europe | Th | P | |
| <i>Stipagrostis plumose</i> MUNRO ex T.ANDERSON | Mediterranean, Asia Minor | H | SS | |
| Typhaceae | <i>Typha laxmannii</i> LEPECH. | Eurasia | C | A |
| | <i>Typha angustifolia</i> L. | North America | C | A |
| 29 | 116 | | | |

Tab. 2. Analysis of the largest plant families of the flora of Bukhara Oasis.

| Families | Total number of species | Number of species | | | | | |
|-------------------------|-------------------------|--------------------------|----------|------|-------------------------|----------|------|
| | | Fraction of native flora | | | Fraction of alien flora | | |
| | | Number of species | Place №№ | % | Number of species | Place №№ | % |
| <i>Asteraceae</i> | 70 | 46 | 2 | 66 | 24 | 1 | 34 |
| <i>Chenopodiaceae</i> | 58 | 54 | 1 | 93 | 4 | 6 | 7 |
| <i>Brassicaceae</i> | 43 | 25 | 4 | 58 | 18 | 2 | 42 |
| <i>Poaceae</i> | 40 | 24 | 5 | 60 | 16 | 3 | 40 |
| <i>Fabaceae</i> | 40 | 31 | 3 | 77,5 | 9 | 4 | 22,5 |
| <i>Polygonaceae</i> | 19 | 19 | 6 | 100 | 0 | - | 0 |
| <i>Scrophulariaceae</i> | 9 | 4 | 7 | 44 | 5 | 5 | 56 |

Lepidium chalepense), 8 species (*Portulaca oleracea*, *Erigeron canadensis*, *Galinsoga parviflora*, *Erigeron bonariensis*, *Symphotrichum graminifolium*, *Xanthium albinum*, *Xanthium spinosum*, *Echinochloa crus-galli*) from South America, 8 species (*Descurainia sophia*, *Urtica dioica*, *Galium tricornutum*, *Hordeum murinum*, *Cynodon dactylon*, *Cyperus rotundus*, *C. iria*, *Scirpus mucronatus*) have come from Africa. Species from Australia have not been found (Fig. 4). Species originated to Eurasia have come from Europe, from different regions of Asia and from neighborhood territories of the Mediterranean.

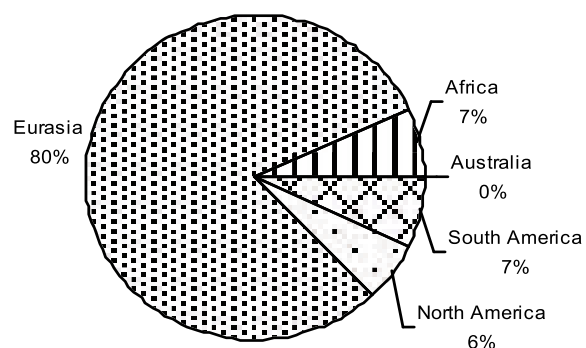
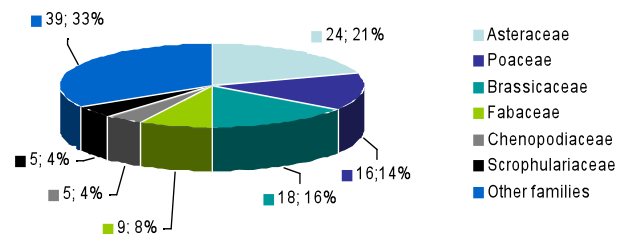
When analyzed according to families of alien plants 6 families have been dominant (Fig. 5).

It is evident that in Bukhara Oasis species which come from outside are found mostly in Asteraceae (24 species or 21%). This case can also be met in the flora of alien plants of the Earth. For instance, 14,5 % in south – east Ukraine (OSTAPKO et al. 2009), 13% for Moscow region (MAYOROV et al. 2012) and 16 % in Himalayan Region of Indian (CHANDRA 2012). After Asteraceae, from 1 up to 3 species are met in the families of Brassicaceae (18 species), Poaceae (16), Fabaceae (9), Chenopodiaceae and Scrophulariaceae (5). 67% of alien plants of Bukhara Oasis are in the portion of leading polymorphous families.

When local and alien fractions of the families of the flora of the Bukhara Oasis had been compared the following results were found (Tab. 2).

The condition of leading families of local and alien plant fractions of the flora of Bukhara Oasis is various. The number of alien plants in Scrophulariaceae family is more than native species. Alien plants are not typical for family Polygonaceae. In the flora of the oasis members of Chenopodiaceae are basically formed of native species (54 species). This case shows the connection of the origin of this family in this area. During the research process coming of alien plants is dynamically high in the natural flora of the oasis especially in Asteraceae, Brassicaceae and Poaceae. In the leading families of the flora of Bukhara Oasis the number of alien plants is high. This process is still going on.

During the studies it was defined that the natural flora of Bukhara Oasis comprises 476 species, 24,3% of which (116 species) are alien plants. This determines that the role of alien plants in the formation of the flora of the oasis is substantial. It has been found that most alien plants are members of the native flora of Europe and of other Asian countries.

**Fig. 4.** Origin of alien plant species of Bukhara Oasis.**Fig. 5.** Polymorphous families of the flora of Bukhara Oasis

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