

## **BIOLOGY AND ECOLOGY**

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### **A SHORT HISTORICO-FLORAL OVERVIEW OF SPECIES COMPOSITION OF CULTIVATED AND WEED PLANTS OF TILLABLE LANDS IN UDMURT REPUBLIC**

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#### **Abstract**

The purpose of the studying is description of species composition of the main cultivated and weed plants in Udmurt Republic (UR). We short stated the history of cultivation of useful plants and its weeds. As a result of the scientific investigation the dynamics of species composition of the main cultivated and weed plants in the studied territory was revealed. It was concluded that in the entire agricultural history of the species composition of weeds on UR's cultivated fields has undergone minor changes and also the soil seediness of generative and vegetative plant rudiments on agrotechnically aged fields is not a factor that reduces the productivity of agricultural crops.

**Keywords:** Cultivated plants, weeds, agrophytes, history of cultivation, crop rotation, agriculture, weediness, seediness, archeology, paleobotanics, palaeobotany, Vyatka-

### 3d the International Conference on Recent Trends in Science and Technology Management 2015

Kama Cis-Urals, Udmurt Republic, Bronze Age, Middle Ages, Little Ice Age, Modern history, Contemporary history.

The article studies species composition of agrophytocenoses from the historical angle in the Udmurt Republic. For this purpose we have analyzed the published studies on this theme and our field data in the investigated territory that were collected (in 1967-2012) according to the proven methods [1], [2], [3], [4], [5], [6].

The agriculture in the Vyatka-Kama Cis-Urals (VKCU), where Udmurt Republic are include and it has, known since the Bronze Age (approximately 4000-3500 years ago). The local population is apparently borrowed methods of cultivation of field crops from the Balanovo and the Abashevo cultures. The space for cultivated plants was exempted from the forest with the aid of an ax and fire [2]. This agriculture is known as the slash-and-burn (shifting cultivation). There was also the swidden farming [2].

The first cultures were *Setaria italica* (L.) P. Beauv. = *Panicum italicum* L., *Triticum dicoccum* Schrank, *Hordeum vulgare* L. subsp. *vulgare* and *Hordeum lagunculiforme* Bracht. There is evidence in favor of the conception of the extension on the territory under consideration the hemp (*Cannabis sativa* L.) [1], [2]. Gradually the range of field crops becomes more diverse. Moreover, the development of field crops were grown blend of cultures in the early stages (*Secale cereale* L. (vernal rye), *Hordeum vulgare* L., *Hordeum lagunculiforme* Bracht., *Triticum aestivum* L., *Triticum compactum* Host, *Avena sativa* L., *Panicum miliaceum* L., *Panicum italicum* L.), as were cultivated mainly cereal cultures. Later, the Little Ice Age (from the XIV to the beginning of XIX centuries AD) heat-loving plants are disappearing from the fields in the era [2].

In this period begins active expansion of Russians, the fallow system (ley farming) was introduced in agriculture and begins the practice of application organic fertilizer to the soil in the form of manure [1]. The dominant culture becomes rye and oats in the fields [1]. The three-field system retains its position until the 1930-1990-ies, and then gives way its place the manyfield system, comprising perennial grasses (*Trifolium pratense* L., *Medicago sativa* L. and others) in the crop rotation [1]. In the 1960s is becoming popular intensive farming system with deep tillage of soils to 20-30 cm, increasing the dose of application of mineral fertilizers, the use of herbicides and other

### 3d the International Conference on Recent Trends in Science and Technology Management 2015

plant protection products. Breeding “strong” cultivars, the increasing role of spring wheat in the fields, a decrease in the proportion of crops of winter rye, increasing of the proportion of row crops (the potato (*Solanum tuberosum* L.), the maize (*Zea mays* L.) for silage) in the fields [1]. Since 1990-ies, that is, after the collapse of the Soviet Union there was stagnation in the development of agriculture, a significant part of the arable land was abandoned, became more intensive the agriculture in the form of private farming, but it does not become a factor of progressive development. Currently, the agriculture is in the state of search of the right direction in its development. The agriculture rests on various associations of peasant farms and due to budget financing of agricultural individual and collective structures.

In the entire the agricultural history of VKCU (where Udmurt Republic are include and it has), the composition of weeds has undergone minor changes. So, disappeared from the fields burdensome in the past, such weeds as *Agrostemma githago* L., *Bromus secalinus* L., there is a degree of onerousness decreased for *Centaurea cyanus* L., *Delphinium consolida* L., many members of the family *Brassicaceae*, a total of about 20 species. Intensified activity in the combining of structure of agrophytocenosis such weed plants as *Stachys neglecta* Klokov ex Kossko, *Amaranthus retroflexus* L., *Cirsium setosum* (Willd.) Besser ex M. Bieb., *Convolvulus arvensis* L. and others, a total of about 20 species. The weediness of fields as a whole is maintained at 10-15%, it is an index of middle weediness of crops [2].

It is worth noting that in the neglected vegetable gardens (allotment gardens or community gardens) in the early years developing tall grasses from ruderal, weed-field and weed-garden plants (*Chenopodium album* L., *Artemisia vulgaris* L., *Artemisia absinthium* L., *Galeopsis ladanum* L., *Sonchus arvensis* L., *Galeopsis speciosa* Mill. and others). From year to year the role of pratal and ruderal plants (*Artemisia absinthium* L., *Conium maculatum* L., *Descurainia sophia* (L.) Webb., *Leonurus quinquelobatus* Gilib., *Pastinaca sylvestris* Miller., *Agrostis tenuis* Sibth. and others) strengthens on long fallows (set-asides). It is observed in the event that application of long fallows as pasture. In case of establishment of haying regimen phytocenoses with complete domination of the couch grass or the witchgrass (*Elytrigia repens* (L.) Desv. ex Nevski) are formed. *Poa angustifolia* L. dominates on fallows of 4-10 years

### 3d the International Conference on Recent Trends in Science and Technology Management 2015

of age with pascual regimen. A pratal vegetation with an abundance of *Agrostis tenuis* Sibth., *Achillea millefolium* L., *Trifolium medium* L., *Trifolium repens* L. and *Elytrigia repens* (L.) Desv. ex Nevski develops on fallow lands, subject to grazing.

No wonder, that the development of long fallow vegetation is largely determined by the regimen of its use.

Trees and shrubs are growing on unused vegetable garden long fallows since the 3rd-4th years, the vegetation of abandoned fields also is developing towards of the formation at first pratal, then sod-shrubby vegetation, but in all cases, the regenerative dynamics of vegetation is mainly determined by the nature of anthropogenic impact.

Below are listed the species of cultivated and weed plants which were grown in arable lands approximately for the last 15 centuries.

In V-X centuries AD cultivated plants in VKCU's fields were *Triticum aestivum* L., *T. compactum* Host, *T. diccicum* Schrank, *Panicum miliaceum* L., *P. italicum* L., *Avena sativa* L., *Secale cereale* L. (vernal rye), *Hordeum vulgare* L., *H. lagunculiforme* Bracht., *Pisum sativum* L. (microspermae), *Lens culinaris* Medik. (microspermae), *Cannabis sativa* L. Weed plants in VKCU's fields during this period were *Chenopodium album* L., *Convolvulus arvensis* L., *Elisanthe noctiflora* (L.) Rupr., *Elytrigia repens* (L.) Desv. ex Nevski, *Galeopsis ladanum* L., *G. speciosa* Mill., *Galium aparine* L., *Polygonum aviculare* L., *Fallopia convolvulus* (L.) A. Löve, *Polygonum scabrum* Moench., *Rumex acetosella* L. (here and further the main weeds that dominated on occurrence and/or abundance will be listed) [2].

In IX-XIII centuries AD cultivated plants in VKCU's fields were *Triticum diccicum* Schrank, *Avena sativa* L., *Hordeum vulgare* L., *Triticum aestivum* L., *Secale cereale* L., *Panicum miliaceum* L., *P. italicum* L., *Pisum sativum* L., *Hordeum lagunculiforme* Bracht., *Triticum compactum* Host, *Cannabis sativa* L., *Lens culinaris* Medik., *Brassica rapa* L., *B. napus* L., *Vicia* sp. [2], [3]. In this time weed plants in VKCU's fields were *Brassica campestris* L., *Chenopodium album* L., *Cirsium setosum* (Willd.) Besser ex M. Bieb., *Galium aparine* L., *Lapsana communis* L., *Neslia paniculata* L., *Stachys neglecta* Klokov ex Kolosko, *Stellaria media* L., *Viola arvensis* Murray, *Agrostemma githago* L., *Convolvulus arvensis* L., *Galeopsis bifida* L., *G. ladanum* L., *G. speciosa* Mill.,

### 3d the International Conference on Recent Trends in Science and Technology Management 2015

*Polygonum aviculare* L., *Fallopia convolvulus* (L.) A. Löve, *Setaria viridis* (L.) P. Beauv., *Thlaspi arvense* L., *Trifolium repens* L. [2], [3].

Cultivated plants in VKCU's fields from the XVI century AD up to the beginning of XIII century AD were *Triticum aestivum* L., *Secale cereale* L. (winter and vernal forms), *Hordeum vulgare* L., *Linum usitatissimum* L., *Pisum sativum* L., *Triticum diccocom* Schrank, *Fagopyrum esculentum* Moench., *Solanum tuberosum* L., *Cannabis sativa* L., *Avena sativa* L. [2].

In the composition of widespread weed-field plants of VKCU from the middle of XIX century AD to the beginning of XX century AD were *Apera spica-venti* (L.) P. Beauv., *Achillea millifolium* L., *Agrostemma githago* L., *Artemisia vuligaris* L., *Brassica campestris* L., *Convolvulus arvensis* L., *Cirsium setosum* (Willd.) Besser ex M.Bieb., *Chenopodium album* L., *Centaurea cyanus* L., *Crepis tectorum* L., *Cerastium holosteoides* Fr., *Capsella bursa-pastoris* (L.) Medik., *Equisetum arvensis* L., *Euphorbia virgata* Waldst. & Kit., *Elytrigia repens* (L.) Desv. ex Nevski, *Erysimum cheiranthoides* L., *Galeopsis bifida* L., *G. ladanum* L., *G. speciosa* Mill., *Knautia arvensis* (L.) Coult., *Linaria vulgaris* Mill., *Lappula myosotis* Moench., *Myosotis arvensis* (L.) Hill., *Polygonum aviculare* L., *Fallopia convolvulus* (L.) A. Löve, *Rumex acetosella* L., *Stachys palustris* L., *Sonchus arvensis* L., *Spergula arvensis* L., *Tripleurospermum inodorum* (L.) Sch. Bip., *Vicia cracca* L., *V. hirsuta* (L.) Gray, *Viola arvensis* Murray [1].

The main groups of agricultural crops (in descending order of acreage planted) growing on Udmurt Republic's tillable lands in 2012 were perennial grasses (43.7%), annual grasses (15.3%), spring barley (12.8%), spring wheat (7.51%), winter rye (4.2%), oat (3.75%), maize (1.95%). Any other agricultural crop was grown on the territory of less than 1% of the total planted area in the Republic; they do not have permanent status of cultivation as “classical” agricultural crops. Total number of cultivated plant species in the studied area is more than 50.

At the present time (2001-2012) weeds in fields and vegetable gardens are 382 species. 72 species (*Convolvulus arvensis* L., *Brassica campestris* L., *Fumaria officinalis* L. and others) have stable phytocenotic positions which successfully grow in intensively cultivated plots, in sowings and plantings of

### 3d the International Conference on Recent Trends in Science and Technology Management 2015

tilled and spring crops. Hemiagrophytes are 82 species of plants (*Achillea millefolium* L., *Artemisia vulgaris* L., *Bunias orientalis* L., *Berteroa incana* (L.) DC., *Filago arvensis* L., *Potentilla argentea* L. and others), i.e. species that successfully thrives in poorly cultivated fields and their plots, in gaps and field margins, in sowings of perennial grasses of the 1st and 2nd year of use. Casual/unstable agrophytes are atypical plant species for cultivated plots and fields (*Campanula patula* L., *Trifolium montanum* L., *T. medicum* L. and others); their quality is 228 species.

That is, in cultivated fields the environment is so specific that only a small group of plants called euagrophytes that make up the basic core of detrimental weeds' group here finds ecological optimum. Within this group there are: suckering (*Cirsium setosum* (Willd.) Besser ex M. Bieb., *Sonchus arvensis* L., *Convolvulus arvensis* L. *Rumex acetosella* L.) and rootstock weeds-perennials (*Equisetum arvense* L., *E. sylvaticum* L., *Elytrigia repens* (L.) Desv. ex Nevski, *Achillea millefolium* L.), for which the intensive tillage, including the deep plowing, is not a limiting factor, spring and wintering weeds-annuals (*Chenopodium album* L., *Polygonum scabrum* Moench., *Stellaria media* (L.) Vill., *Fumaria officinalis* L., *Centaurea cyanus* L., *Erysimum cheirantoides* L., *Galeopsis speciosa* L., *G. bifida* L., *G. ladanum* L., *Tripleurospermum inodorum* (L.) Sch. Bip., *Capsella bursa-pastoris* (L.) Medik., *Raphanus raphanistrum* L., *Fallopia convolvulus* (L.) A. Löve, *Thlaspi arvense* L., *Polygonum aviculare* L., *Spergula sativa* L., *Lappula squarrosa* (Retz.) Dumort., *Lapsana communis* L., *Scleranthus annuus* L.) that avoid direct and intensive competition with cultivated plants. Having similar to cultivated plants the biological rhythm, or being able to find vacant ecological niches, they are developing successfully in sowings and plantings of agricultural crops.

It is worth noting that in recent years, when there was a severe summer drought, and continues fields' processing with herbicides, "surrendered" their phytocenotic positions of the family *Brassicaceae* (*Raphanus raphanistrum* L., *Brassica campestris* L., *Erysimum cheirantoides* L.), as well as *Tussilago farfara* L., but considerably more actively began to show themselves *Stachys neglecta* Klokov ex Kossko, *Neslia paniculata* (L.) Desv., *Sinapis arvensis* L., *Amaranthus retroflexus* L., *Elisanthe noctiflora* (L.) Rupr., *Avena fatua* L.

### **3d the International Conference on Recent Trends in Science and Technology Management 2015**

It is interesting that according to our data the actual and potential soil seediness of generative and vegetative plant rudiments on agrotechnically high-quality cultivated plots are characterized by rather high degree of weediness but the seediness on agrotechnically aged fields which is not a factor that reduces the productivity of agricultural crops.

So, we want to say that the study of the history of agriculture by archaeological (paleoethnobotanical) materials and by means of long-term environmental monitoring for agrophytocenoses of tillable lands in the long term will give a valuable material to understand the processes of productivity management of agroecosystems.

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