

Comparative analysis of segetal vegetation in different climatic zones of the Northern Trans-Urals

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Abstract. The article presents the results on the species composition of the segetal component in different climatic zones of the Tyumen region based on an assessment of research data in the period of 2017-2019. The study of weed flora was carried out in crops of spring wheat in the Aromashevsk and Tyumen regions. The weed component in spring wheat crops is represented by species that are most often observed in these areas during phytosanitary monitoring. At the same time, the greatest variety of plant species adapted to grow in agricultural crops was recorded in the conditions of the northern forest-steppe. During the years of research, early spring segetal plants were most widespread, their number in the tillering phase of spring wheat was the highest among other biological groups. As a result of the research, it was determined that the change in the composition of the segetal component in the agrophytocenosis of spring wheat depends on the climatic and soil conditions of the study area.

1 Introduction

According to many authors weed (segetal) plants are a special component or an obligatory element of the structure of agricultural lands of modern vegetation cover [1]. Their study is of fundamental importance for understanding the processes of plant dispersal under human influence and the formation of anthropogenic variants of plant communities, as well as of great practical importance [2].

Segetal flora on the territory of the Russian Federation has been studied quite well. In the Sverdlovsk region, 256 species of higher vascular plants were found, and, for example, the species diversity of segetal plants of Udmurtia includes 376 species, Bashkiria - 281 species, Ryazan region - 263 species, Leningrad region - 298 species, Republic of Mordovia - 215 species [3]. On the territory of the Tyumen region, a description of the segetal vegetation is presented in terms of quantitative and species composition, depending on the varieties of spring wheat and tillage. Agrophytocenoses are mainly infested with *Atriplex patula*, *Chenopodium album*, *Echinochloa crusgalli*, *Eqisetum arvense*, *Galium aparine*, *Stellaria media*, and *Thlaspi arvense*, in the amount of 40 to 56 pcs/m² [4,5].

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Segetal (weedy) species are not included in the “formations” of cultivated plants but are considered as largely autonomous phenomena associated primarily with the nature of the soil.

The mutual influence of cultivated and segetal plants in agrophytocenoses is of great theoretical and practical importance in agricultural production [6]. Weeds cause significant and diverse damage to spring wheat crops, which is the main food crop [7]. They absorb moisture and nutrients from the soil, inhibit the processes of photosynthesis, shading cultivated plants, reduce soil temperature, and have a negative allelopathic effect [8].

The diversity of weeds in specific territories is determined by a complex of factors. Agrochemical indicators of soils, such as actual and hydrolytic acidity of soils, aeration porosity and humus content, distribution of mineral nutrition elements, and heterogeneity of soil microflora, have a great influence on the species composition of weeds [9,10].

For the successful development of agroecological aspects of weed control, it is necessary to know the relationship between cultivated and weeds, learn how to manage them. However, it must be remembered that weeds have a higher ecological plasticity compared to cultivated plants [11].

Options for the effectiveness of measures for the extermination of weeds depend on the availability of complete data on biological diversity, the distribution of weeds, data on soil reserves of seeds, vegetative primordia and their ecological and biological features.

2 Materials and methods

The purpose of the research is to compare the composition of the segetal flora in spring wheat crops in the conditions of the northern forest-steppe and subtaiga zone of the Northern Trans-Urals, depending on soil and climatic conditions.

The paper analyzes the results of studies of the species and quantitative composition of segetal plants carried out in industrial wheat crops in the Tyumen region of the Tyumen region in the conditions of the northern forest-steppe and in the Aromashevsk region of the Tyumen region in the subtaiga zone in 2017-2019. The weather conditions of the Tyumen region are formed solely from the conditions of the geographical location. The climate is characterized as sharply continental [12]. The object of field research is the segetal flora in spring wheat crops.

3 Research results

The influence of environmental factors on the species composition of weeds and the level of weed infestation of crops is most clearly seen when comparing areas located in different soil and climatic conditions. So, as a result of studies conducted in the subtaiga zone in 2017-2019 it was found that 23 species of weeds were found in the production crops of spring wheat, such as *Persicaria lapathifolia.*, *Dracocephalum ruyschiana*, *Chenopodium album*, *Avena fatua*, *Panicum ruderalis*, *Echinochloa crusgalli*, *Cirsium arvense*, *Atriplex sagittata*, *Cannabis ruderalis*, *Atriplex sagittata*, *Fumaria officinalis L.*, *Brassica campestris* and others belonging to 24 families. Of these, 82.6% were dicot species and 17.4% were monocot species. During the years of research, 32 species of segetal plants belonging to 17 families were found in spring wheat crops in the conditions of the northern forest-steppe. Of the botanical groups, the overwhelming majority were dicotyledonous plants (87.5%). Monocotyledonous segetal plants were represented by species of the *Poaceae* family. Of the 32 weed species, the following prevailed: among perennials - *Glechoma hederacea*, *Convolvulus arvensis*, *Sonchus arvensis*, *Equisetum arvense*, among young wintering species - *Erodium cicutarium*, *Matricaria perforata*, *Viola arvensis*, *Thlaspi arvense*, *Dracocephalum thymiflorum*; *spring juveniles* (early and late) - *Amaranthus retroflexus*,

Spergula arvensis, *Galeopsis speciosa*, *Chenopodium album*, *Atriplex patula*, *Fumaria officinalis*, *Galium aparine*, *Stellaria media*, *Avena fatua*. At the same time, the ratio of dicotyledonous and monocotyledonous plants in different soil and climatic conditions is almost the same (Figure 1).

In the subtaiga zone, during the tillering phase of spring wheat, early and late spring wheats (*Polygonum convolvulus*, *Chenopodium album*, *Cannabis ruderalis*, *Galeopsis tetrahit*, *Amaranthus retroflexus*) are most widespread (44%) and density - 16 pcs/m²; Wintering species (*Erigeron canadensis*, *Erodium cicutarium*, *Viola arvensis*) accounted for 17% and 3–5 pcs/m², respectively, and about 39% were perennial species. By the stage of wheat ripeness, perennial weeds accounted for the bulk of all segetal species.

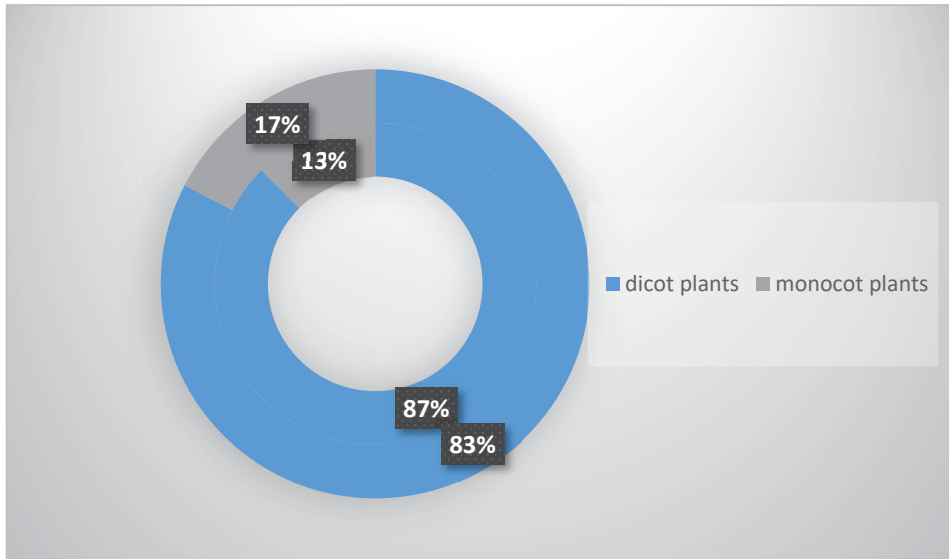


Fig. 1. The ratio of segetal vegetation classes in wheat agrophytocenosis in different climatic zones (2017-2019), %.

The dominant species in the crops were weeds of the families Asteraceae (*Sonchus arvensis*, *Cirsium arvense*, *Erigeron canadensis*) and Poaceae (*Setaria glauca*, *Avena fatua*, *Phragmites australis*). Weeds of the family Asteraceae accounted for the highest level of weed infestation. Their number in sowing varied from 6 to 15 pcs/m². *Erigeron canadensis* appeared in crops at the early stages of development of the main culture, occupying the most illuminated habitats. Infestation of *Cannabis ruderalis* crops was observed in areas with long-term use of organic fertilizers or the entry of this species from ruderal habitats. The number in the crop ranged from 4 to 8 pcs/m². The introduction of *Phragmites australis* into crops was observed in places of increased moisture, with a close standing of groundwater. The number of plants was from 10 to 15 pieces/m² (Figure 2).

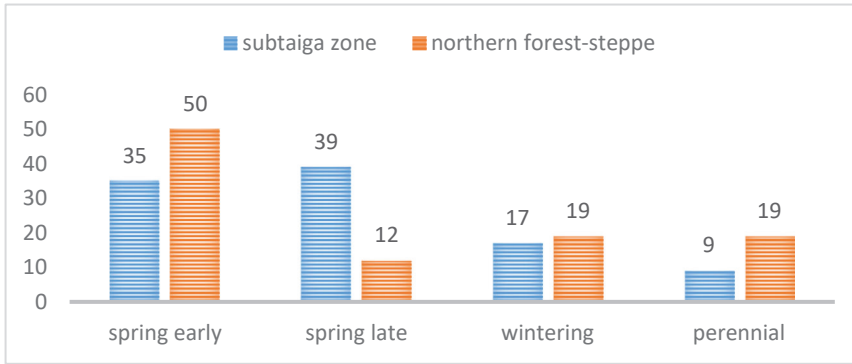


Fig. 2. The ratio of biological groups of segetal vegetation in wheat agrophytocenosis in different climatic zones (2017-2019), %.

It is shown in Figure 2, throughout the entire growing season of wheat in the forest-steppe zone, spring weeds (54.6%) with a density of 30 pcs/m² remained dominant species. Of the perennials, *Sonchus arvensis* prevailed, among the juveniles spring plants dominated - *Chenopodium album*, *Atriplex calotheca*, *Galium aparine*. In terms of abundance, young spring species prevailed (27-94 pcs/m²) with a distribution of 43-91.5%. In the earing phase of spring wheat, the predominance of early and late spring plants remained (84%).

By the end of the growing season, the number of segetal plants decreased to 14 pcs/m² and was represented by plants *Stellaria media*, *Spergula arvensis*, *Viola arvensis*, *Convolvulus arvensis* with a population of 2 pcs/m². *Equisetum arvense* increased its abundance to 6 pcs/m². Perennial weeds (*Convolvulus arvensis*, *Glechoma hederacea*, *Equisetum arvense*) slightly changed their numbers during the growing season.

After analyzing the data, it was noted that under different meteorological conditions, the rapid development of weed flora in the first vegetation period of spring wheat, its maximum number in the earing phase and then a gradual decrease were the same. The degree of contamination in the studied crops of spring wheat was 11.8% and it can be called medium.

Weather conditions, as already noted, largely determine the mass appearance or disappearance of weeds in crops. Correlation analysis of the data obtained showed a strong inverse correlation ($r = -0.86$) between the amount of precipitation and the number of perennial weeds. The share of influence of this factor was 74% of all influences taken together ($d_{xy} = 0.74$). Moreover, a similar relationship between the amount of precipitation and the number of young weeds is characterized by a direct relationship of an average degree ($r = 0.47$) with $d_{xy} = 0.22$.

The results of phytosanitary production surveys conducted annually by the Federal State Budgetary Institution "Russian Agricultural Center", a branch of the Federal State Budgetary Institution "Rosselkhozcenter" in the Tyumen Region, confirmed that the most common segetal plants in spring wheat crops are young spring early, young spring late, perennial rhizomatous and rhizomatous weeds. According to the results of a phytosanitary survey in 2019, the number of weeds in spring wheat crops was 39.1 pcs/m². The most common weeds were: *Avena fatua* - 25 pcs/m², *Setaria viridis* - 43.1 pcs/m², *Galium aparine* - 15.3 pcs/m², *Convolvulus arvensis* - 28.4 pcs/m², *Sonchus arvensis* - 21.8 pcs/m², *Taraxacum officinale* - 30.1 pcs/m².

4 Conclusion

In wheat agrophytocenosis in the conditions of the northern forest-steppe and subtaiga zone of the Northern Trans-Urals, the species composition of segetal plants is represented by the most common early and late spring forms (*Avena fatua*, *Stellaria media*, *Chenopodium album*, *Fumaria officinalis*, etc.), wintering (*Dracocephalum thymiflorum*, *Erodium cicutarium*, *Thlaspi arvense*, etc.) and perennials (*Sonchus arvensis*, *Cirsium arvense*, etc.). The largest share was made up of plants - *Stellaria media*, *Chenopodium album*, *Galium aparine*. During the years of research, early spring segetal plants were most widespread, their number in the tillering phase of spring wheat was the highest among other biological groups. The change in the composition of the segetal component in the agrophytocenosis of spring wheat depends on the climatic and soil conditions of the study area.

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