# Regional features of the weed flora of geographically remote territories

**Luneva Natalya Nikolayevna**

*Candidate of Biological Sciences, Lead Research Officer*

*All-Russian Institute of Plant Protection*

**Abstract.** A significant similarity of the family-generic structure of the compared floras was revealed, but the coefficient of their species similarity is rather low (0.28). More hygrophilous species, hemicryptophytes and polycarpic species are registered in the weed flora of the Leningrad Oblast, which is characterized by a higher moisture supply of the territory and mild winters. In the weed flora of the Lipetsk Oblast, which is less supplied with moisture and is characterized by summer dry periods, more drought-resistant plants, theophytes, and monocarpic species have been recorded. These regional differences increase the role of phytosanitary monitoring, the results of which underlie the forecast and development of regional systems for the protection of cultivated plants from weeds.

**Keywords:** weeds, heat supply, moisture supply, floristic analysis

## Introduction

As soon as a person began to cultivate plants for his own use, he began to notice other plants in the crops, which later became known as "weeds". For a long time, the growth of these plants was associated mainly with the arable land, which was reflected in the formulation: weeds are those that grow in communities of cultivated plants against the will of the farmer and reduce the yield and quality of products (Rosskopf at al., 1999; Molinar, 2002 ; Bazdyrev et al., 2004;). Similar definitions of weeds were also given by the American Scientific Society for Weed Control (Herbicide Handbook, 2002), the European Society for Weed Control (Zimdahl, 2018), and Russian botanists (Baranova et al., 2018).

At the same time, as a result of many years of research on weeds by the end of the last century in Russia, an idea was formed about them not so much as harmful objects that reduce the yield of agricultural crops, but as species confined to secondary habitats with disturbed vegetation and soil cover, which are formed both with human participation and in a natural way (Grossheim, 1948; Maltsev, 1962; Nikitin, 1983; Ulyanova, 1998, Luneva, 2018, 2021a). Recently, in the field of plant protection, weeds have been understood to mean all plants. inhabiting land used as agricultural land, for afforestation or recreation (GOST 21507…, 2015, http://docs.cntd.ru/document/1200111134). A fundamental definition of weeds has been formed - these are wild plants of secondary habitats, both anthropogenic, with regularly disturbed

vegetation and soil cover (segetal habitats), or with once disturbed (occasionally disturbed) plant and soil cover (ruderal, defilement), and natural, natural by way of disturbed habitats (Luneva, 2021b). This approach makes it possible to show the natural and anthropogenic factors in the formation of this peculiar group of plants, which determine the regular replenishment of weed species of arable land with species from the surrounding types of secondary habitats (Luneva and Mysnik, 2017).

It follows from this that the spread of weed species is determined, like all plant species, primarily by natural and climatic factors, of which the most important are heat and moisture (Alekhin et al., 1961). Correspondence of the level of heat and moisture supply of the territory to the level of demanding plant species for heat and moisture underlies the formation of regional natural floras. The totality of plant species confined to certain types of habitats (in this case, to disturbed secondary habitats) is an ecological element of the flora (Yurtsev and Kamelin, 1991), which in this case is more expedient to be called weed flora. Weed flora is a territorial aggregate of wild plants of secondary habitats with naturally or anthropogenically disturbed vegetation and soil cover, characteristic of each individual territory, corresponding to the level of demanding species of this aggregate for heat and moisture factors, which has a complex structure, formed over a long historical period and associated with species composition with native flora of primary habitats and weed flora of adjacent regions. (Luneva, 2021b).

In the structure of the weed flora, as in any other, complexes of plant species are distinguished that form in certain ecotopes, which are proposed to be called ecotopic flora or partial flora (Yurtsev, 1974), one of which is the flora of a set of segetal habitats, or segetal flora. It is this partial flora that includes weeds as harmful objects, but only the totality of all partial flora (field roads, pastures, fallow lands, wastelands, etc.) forms a weed flora, which includes not objects, but plant species. The results of comparative studies of segetal floras in other geographically distant regions (Luneva et al., 2017a; Terekhina, Luneva, 2018; Tretyakova et al., 2020) revealed the peculiarities of the composition and structure of the segetal flora in each of them. The aim of the study is to establish regional differences in the weed flora of two regions located in geographically remote regions: Leningrad (Northwestern Federal District) and Lipetsk (Central Black Earth region).

## Materials and methods

The analysis was carried out on the results of field research in two regions of geographically remote regions during three years of field research (Leningrad Oblast - 2015-2017, Lipetsk Oblast- 2016-2018). To identify the floristic similarity of the compared samples, the Jaccard coefficient was used (Jaccard, 1991). Comparison of samples according to the

composition of ecological groups and life forms of K. Raunkier (Raunkiær, 1937) and I.G. Serebryakov (1955). A comparative analysis of floristic richness and taxonomic diversity has been carried out (Tolmachev, 1986; Schmidt, 1980). To determine the indicators of heat and moisture supply of the analyzed territories, electronic maps of the sums of active temperatures (SAT) above 5°C and the hydrothermal coefficient (HTC) were used, posted on the Internet resource "Agroecological Atlas of Russia and Neighboring States: Agricultural Plants, Their Pests, Diseases and weeds"(Afonin et al., 2008).

**Results and discussion**

The territories of the compared regions differ in terms of heat and moisture supply (Table 1).

Table 1. Indicators of heat and moisture supply of the territory of individual regions analyzed in the work.

| indicators | HTC min | HTC max | HTC avg | SAT min | SAT max | SAT avg |
|---|---|---|---|---|---|---|
| Leningrad Oblast | | | | | | |
| northern border | 1.63 | 2.05 | 1.78 | 1736 | 1947 | 1854 |
| southern border | 1.51 | 2.06 | 1.78 | 1838 | 2129 | 2044 |
| Lipetsk Oblast | | | | | | |
| northern border | 1.14 | 1.46 | 1.28 | 2434 | 2586 | 2483 |
| southern border | 1.04 | 1.28 | 1.16 | 2531 | 2767 | 2656 |

Indicators of floristic richness and taxonomic diversity of the composition of weed floras in both regions practically do not differ, which indicates the similarity of their family-generic structure (table 2).

Table 2. Floristic richness and taxonomic diversity of weed flora of Lipetsk and Leningrad Oblasts.

| Oblasts | Lipetsk | Leningrad |
|---|---|---|
| Number of species | 119 | 104 |
| Number of genuses | 85 | 82 |
| Number of families | 27 | 26 |
| Average number of species in a family (s/f) | 4,41 | 4,00 |
| Average number of genuses in a family (g/f) | 3,15 | 3,16 |
| Average number of species in a genus (s/g) | 1,4 | 1,27 |

However, there are only 48 species recorded in both regional weed floras, and the floristic similarity coefficient Kj is 0.28. Differential species (registered only in one of the compared floras), distinguishing the weed flora of Lipetsk Oblast, were identified 69, and differential species in the weed flora of Leningrad Oblast - 56.

The distinctive characteristics of weed floras of geographically distant regions were revealed in a comparative analysis. The analysis of the distribution of species by ecological groups showed the predominance in the flora of the Leningrad Oblast, which is better supplied with moisture than the Lipetsk Oblast, of such species that gravitate towards habitats with increased moisture (hygrophytes, hygromesophytes, hygromesophytes, mesohygrophytes). Accordingly, less moisture-loving species (mesoxerophytes, xeromesophytes and xerophytes) prevail in the weed flora in Lipetsk Oblast (table 3).

Table 3. Distribution of species of weed flora of Lipetsk and Leningrad Oblasts by ecological groups (%).

| Eco groups | Lipetsk Oblast | Leningrad Oblast |
|---|---|---|
| Hygrophytes | 1.45 | 8.93 |
| Hygromesophytes | 2.9 | 5.36 |
| Mesohygrophytes | 0 | 5.36 |
| Mesophytes | 71 | 76.77 |
| Meso-xerophytes | 1.45 | 0 |
| Xeromesophytes | 18.8 | 3.57 |
| Xerophytes | 1.45 | 0 |
| Helophytes | 1.45 | 0 |

We also analyzed the distribution of species by groups of Raunkier life forms, a system that classifies plants according to the position and method of protecting the buds of renewal during an unfavorable period (cold or dry) (table 4).

Table 4. Distribution of species of weed flora of Lipetsk and Leningrad Oblasts by groups of Raunkier life forms (%).

| Raunkier life forms | Lipetsk Oblast | Leningrad Oblast |
|---|---|---|
| hemicryptophyte | 33.33 | 60 |
| geophyte | 1.52 | 9.1 |
| therophyte | 65.15 | 27.27 |
| therophyte, hemicryptophyte | 0 | 1.82 |
| hamefit, terophyte | 0 | 1.82 |

The analysis showed the predominance of hemicryptophytes (plants bearing renewal buds on the soil surface, in the surface layer or under the litter) in the weed flora of Leningrad Oblast,

and therophytes (annual plants experiencing an unfavorable period in the form of seeds) in Lipetsk Oblast. The reason for this, apparently, lies in the fact that winter is an unfavorable period for plants in the North-West region, but the relatively mild conditions of the winter period contribute to the successful overwintering of hemicryptophytes, with the preservation of bud renewal. In the Central Black Earth Region, summer droughts are unfavorable, which are much easier to survive in the form of seeds (therophytes) than in the form of renewal buds on the soil surface (hemicritpophytes).

One of the types of floristic analysis is the analysis of the composition of life forms according to the system of I.G. Serebryakova. Under the life form, as a unit of ecological classification, I.G. Serebryakov understands the totality of adult generative individuals of a given species under certain growing conditions, possessing a peculiar appearance, including aboveground and underground organs. This analysis revealed the predominance of monocarpic (annual) herbaceous species, which are predominantly theophytes, in the weed flora of Lipetsk Oblast, and polycarpic (perennial) species, most of which are hemicryptophytes, in the weed flora of Leningrad Oblast (table 5).

Table 5. Distribution of species of weeds of weed flora of Lipetsk and Leningrad Oblasts by groups of life forms according to the system of IG Serebryakov (%).

| The name of the groups of life forms according to Serebryakov | Lipetsk Oblast | Leningrad Oblast |
|---|---|---|
| Annuals | 57.58 | 18.18 |
| Short-rhizome polycarpics | 9.09 | 3.64 |
| Annuals - biennials | 6.06 | 5.46 |
| Biennials | 4.55 | 9.09 |
| Long-rhizome polycarpics | 4.55 | 14.55 |
| Core-root polycarpics | 6.07 | 14.55 |
| Above-ground polycarpics | 0 | 3.64 |
| Root-scion polycarpics | 1.52 | 5.46 |
| Loose-bush polycarpics | 1.52 | 5.46 |
| Polycarpics in general | 13.66 | 52.75 |

**Conclusion**

Observation of plants growing on arable land and causing harm to cultivated plants inevitably leads to the conclusion that the same species grow in other secondary habitats. This determines the approach to them not just as harmful objects, but as plant species confined to habitats with disturbed vegetation and soil cover. This approach explains the ecological and geographical conditionality of the formation of territorial aggregates of these plants, which only

with the use of this approach can be called the weed flora of a given territory, which will differ from the weed flora of another territory, which differs in hydrothermal parameters.

The revealed differences in the composition of weed flora in areas of geographically distant regions increase the importance of phytosanitary monitoring aimed at identifying the full species composition of the regional weed flora. The species composition of the weed flora of a certain territory is stable for a very long period, and its ecological elements, including the weed flora, are also stable. This is the basis for a long-term regional forecast that prescribes the growth of weed species in the region for at least 5 years, and, consequently, the regional features of the system for protecting cultivated plants from the harmful effects of weeds.

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