Microlevel phytosanitary zoning of the territory in relation to weeds: criterion and principle of isolation

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Abstract: The formation of territorial complexes of weed species is due to the differentiation of weed flora in different ecotopes at three agrolandscape levels of phytosanitary zoning. The microlevel is determined by the ecosystem of the elementary agricultural landscape, which includes all types of secondary habitats that form the elementary flora. Crop rotation, as well as a separate field, cannot be the level of zoning, since they are the territory of formation only of the flora of segetal ecotopes, but not of the entire weed flora of the agroecosystem.
Keywords: weed flora, agrolandscape, agroecosystem, ecotope, ecotope flora.

In the system of plant protection from harmful objects, phytosanitary zoning is of great importance, since the content of protective measures depends on knowledge of the area of distribution of both a separate species and a complex of harmful objects in a certain territory.

Zoning is a process, as well as the result of dividing a territory into districts. On the other hand, zoning is a way of differentiating a certain object according to existing territorial units, taking into account their specifics. The object of zoning may be a separate species of weed plant, but it is extremely important for the plant protection system to show the formation of extensive complexes of weed species in individual territories. Such zoning belongs to the category of general, in which not one leading characteristic is taken into account, but a combination of characteristics, according to which the regions are distinguished, reflecting the specificity and hierarchy of the zoned space, while the districts of both the same and different levels of the hierarchy must meet predetermined classification characteristics (Gorkin, 2006). Consequently, there must be a criterion on the basis of which it is possible to implement regionalization at different hierarchical levels.

The criterion for phytosanitary zoning in relation to weeds cannot be linked to the distribution of agricultural crops over the territory of the regions, since there are very few specialized species of weeds (Ulyanova, 2005), and the same species are involved in the formation of agrophytocenoses with the participation of the overwhelming majority of agricultural crops. The basis of phytosanitary zoning is a weed plant with its requirements for habitat conditions and, since in any

secondary habitat there is not one species, but a complex of weed species, the criterion can be a territorial aggregate of species associated with secondary, disturbed habitats, that is, a weed flora as a predetermined classification characteristic at all hierarchical levels (Gorkin, 2006; Luneva, 2020, 2021).

The macrolevel of phytosanitary zoning is determined by the regional weed flora, which includes the entire species composition of weeds growing in all disturbed habitats of the region (oblast) (Luneva, 2018; Luneva, 2020). These are plants not only of agrophytocenoses, but of all secondary habitats on agricultural lands, technogenically disturbed lands and in residential areas (Veselova, 2017), lands intended for afforestation and recreation (GOST 21507 ..., 2015), as well as in habitats, soil and vegetation. whose cover is naturally disturbed (Luneva, 2021). Due to the fact that the principle of phytosanitary zoning consists in the equivalent and irreplaceable action of both natural and anthropogenic factors (Luneva 2019), phytosanitary zoning can only be applied to anthropogenically disturbed habitats (GOST 21507 ..., 2015) and is still used, mainly way, for zoning agricultural land.

It is known that "the main unit of complex natural zoning" is landscapes (Vynaev, 1987, p. 29), the natural differentiation of which is due to geological-morphological and natural-climatic factors (Latypova, 2016). In agricultural zoning, the allocation of districts is based on the differentiation of the regional agricultural landscape, which is understood as a natural landscape modified by agricultural activity with the inclusion of not only arable land, but also other lands intended to support all activities for the cultivation of products (crop and livestock) (Nikolaev, 1999). Regional agrolandscape is defined by anthropogenic boundaries that fit into the natural regional landscape. A lower hierarchical level of zoning (after the macrolevel) is fixed in agroclimatic regions, which are identified by the combination of the above differentiation factors (Zhurina, 2002). The agrolandscape of each agroclimatic region is limited by the boundaries of the natural landscape, which underlies the allocation of a separate agroclimatic region. The zoning of the region into agroclimatic regions illustrates not only the difference in the natural and climatic conditions of the territory of each agroclimatic region (and the agrolandscape within it) from all others, but also the commonality of these conditions for all agroecosystems located within a separate agroclimatic region. The weed flora of the agrolandscape at the level of the agroclimatic region consists of weed species growing in all secondary habitats of all agroecosystems located within the agroclimatic region and is the basis for identifying the meso-level of phytosanitary zoning (Luneva, 2019b, 2020, 2021).

In agricultural ecology, many researchers associate the formation of an agroecosystem with the agrolandscape level (Novozhilov, 1996, 1997; Pavlyushin, Voronin, 2004, 2007), which includes all the diversity of agricultural lands. The point of view that the agroecosystem is also a

large agrolandscape complex is adhered to by A.A. Zhuchenko (1990). Since the agroecosystem is characterized by the same properties as the natural (natural) ecological system (Hart, 1987), different levels are distinguished in its structure: from the agroecosystem of a large agricultural landscape (Zhuchenko, 1990) to the agroecosystem of crop rotation (Zubkov, 1992).

If the agroecosystem of crop rotation is understood only as the aggregate of all fields that form a separate crop rotation, then, in this case, such an agroecosystem does not correspond to the concept of a minimum agricultural landscape, since it includes only segetal habitats, not taking into account the adjacent territories, which are mandatory elements of the agricultural landscape and ensure the production of crop rotation: field roads, boundaries, drainage ditches, etc. (Nikolaev, 1999). In some cases, the concept of "agroecosystem" is associated with a separate field (Odum, 1987; Hart, 1987) and then it is part of the "supersystem" of an agricultural enterprise, which, in addition to "agroecosystems of fields and socio-economic subsystems, within which agroecosystems are managed - the crops grown" (Zubkov, 1995, p. 292). Such a "supersystem" does not contradict the understanding of the agroecosystem as an elementary agricultural landscape that includes not only fields for cultivation of crops, but the entire territory that is intended to support activities aimed at obtaining products (Nikolaev, 1999; Mirkin et al., 2003).

It was previously shown that the microlevel of phytosanitary zoning is distinguished on the basis of the weed flora of the agroecosystem (Luneva, 2020, 2021). The weed flora of a separate agroecosystem is formed under the influence of both natural (natural and climatic characteristics of an agroclimatic region) and anthropogenic (administrative isolation of the territory of an agroecosystem of a particular agricultural enterprise) circumstances, which corresponds to the principle of phytosanitary zoning, which consists in the equivalent and irreplaceable action of a natural and anthropogenic factor (Luneva, 2019a).

An attempt to link the microlevel of phytosanitary zoning to the level of an individual field, as is often done in the implementation of agroecological zoning (Mukhamadyarov and Ashikhmin, 2012; Mukhamadyarov et al., 2013, 2015), seems inappropriate. First, because the basis for identifying the microlevel, as the lowest level, can only be an elementary flora, and the complex of weed species in a separate field does not meet the flora criteria (Luneva, 2020). Secondly, each weed flora, including elementary ones, is characterized by a certain structure due to the diversity of secondary habitats in agroecosystems. This structure includes segetal (formed by species from all segetal habitats of all agroecosystems within the region), synanthropic (formed from species growing on ruderal habitats, young fallow lands and in low-aged crops of perennial grasses of the same agroecosystems) and synanthropic (formed by species growing on pastures, old fallow lands and in old-growth crops of perennial grasses located in the same grow ecosystems) of the group of

weed species (Mirkin et al., 2003). Such groupings of species, formed in certain ecotopes within landscapes, are ecotope floras or partial floras (Yurtsev, 1974).

Thus, the weed flora of all levels, formed by the complex of weed plants of agroecosystems, includes several partial floras. Segetal flora consists of partial floras formed in crops (plantings) of types of crops (flora of grain or row crops), as well as in fields under one specific crop. The regional segetal flora is formed in all fields of the region (oblast), the segetal flora of an agroclimatic region consists of weed species growing in all fields of all agroecosystems located in this agroclimatic region. And, finally, the segetal flora of the agroecosystem includes all types of weeds registered in all fields on its territory. At all three levels, the segetal flora is subdivided into partial flora of individual crops (crops of barley, spring wheat, potatoes, cabbage, etc.).

The complex structure, prescribed, among other things, of the elementary flora, does not allow assigning the rank of flora to a complex of weed species of the same field. Most often, such a complex is only part of the partial flora formed in the agroecosystem in the fields where the same crop is cultivated. In addition, the concept of flora is always tied to a specific locality (Tolmachev, 1974), and this is inherent only in the complex of weed species of the entire agroecosystem, or at least crop rotation, but not in the field under a specific crop. The environment-forming role of a cultivated plant, which plays a dominant role in the agrophytocenosis due to its biological characteristics and measures determined by the technology of growing it, affects the formation of the species composition of weeds and, especially, the indicators of their abundance (Markov, 1972). Therefore, on the same contour of the field, where different crops are cultivated every year, the species composition and indices of the number of species are not similar to the previous field season, and they will change in the next field season (Filippova, 2012).

In some cases, in the process of agroecological zoning, the micro level is associated with crop rotation (Agricultural zoning ..., 2015). This is due to the fact that this type of zoning is based on a cultivated plant with its requirements for growing conditions, and each type of crop rotation includes such a set of crops that can grow in conditions of one field contour, replacing each other over a number of years, and also be located on nearby fields, similar in terms of growing conditions to this field.

Analysis of the possibility of considering crop rotation as the microlevel of phytosanitary zoning in relation to weeds shows the following. Each field included in the crop rotation develops its own species composition of weeds, formed from a bank of seeds and vegetative primordia of those species for which the conditions for the technology of cultivation of an agricultural crop grown on a given field contour in a given field season turned out to be suitable (Markov, 1972). The soil source of the regeneration of weeds is formed over many years in each individual field under the influence of annually changing conditions of agrotechnical and protective measures during the

cultivation of annually changing crops, and the same happens in all crop rotation fields. Therefore, within its boundaries, a segetal flora of crop rotation is formed, as a set of species confined to fields, which is a partial flora of a given ecotope (arable land) in the structure of weed flora of the entire agroecosystem (Luneva, 2021). The segetal partial flora of crop rotation cannot be distinguished geographically as a single massif, since it is intertwined in a mosaic manner into the structure of field roads, drainage ditches, border areas, garbage places, wastelands, adjoining territories, pastures, fallow lands and other secondary habitats included in the territorial structure of the agroecosystem (Mirkin et al. others, 2003). The regular introduction of weeds from these habitats to the fields and back is the determining factor that forms the weed flora of the agroecosystem as a whole (Luneva, 2020, 2021). It follows from this that crop rotation can be an object of study of the segetal flora at the level of the agroecosystem (just as the totality of many crop rotations can be an object of study of the segetal flora at the level of an agroclimatic region or region), but it cannot be a criterion for identifying the microlevel of phytosanitary zoning, since it is only a composite part of the weed flora of the agroecosystem.

Agrolandscape and agroecosystem, as well as weed flora, are formed on the basis of the action of both natural and anthropogenic factors. The differentiation of weed flora, following the spatial differentiation of the agricultural landscape, occurs under the influence of both of these factors, which expresses the principle of their indispensability: phytosanitary zoning cannot be carried out, taking into account the action of only one factor. The equivalence of the action of the natural factor lies in the fact that in the course of regionalization, the complex of weeds is tied to the territory, all parts of which are equally characterized in natural and climatic terms. The equivalence of the action of the anthropogenic factor lies in the fact that the complex of weeds is tied to the territory formed by one type of secondary habitat within each level (Luneva, 2019a).

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