

Segetal complex – pioneer stages of syntrophic communities in the Meshchovski Opole of the non-Chernozem Zone of Russia

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Abstract. In the conditions placor soil Meshchovski Opole the Central economic region of the Nonchernozem zone of the Russian Federation on agro-gray forest middle loamy soils defined by the main species composition of segetal complex field agrophytocoenoses in the structure of five fields grain and grain-grass crop rotation in the limit of syntaxon *Stellarietea mediae* R. Tx. et al. ex von Rochow 1951. The combinations of weed and field species specific to field crops are established and the influence of minimization of basic tillage is shown, including No-till, and applying calculated norms of mineral fertilizers (NPK) on the dynamics of the species composition and number of the main components of the segetal complex is shown. The original synanthropic plant communities on the fallow lands of Meshchovsky Opole develop from the segetal complex of previous agrophytocoenoses. The core of the cenoflora is represented by 104 species of higher herbage plants from 29 families. Synanthropic communities have a low species saturation – 8 species per 100 m² and a projection coverage of 57.6%. In aciesite territories the advantage is given to the types of anemochory edificatory. Phytomass of secondary phytocoenoses without comprehensive measures to improve their floristic composition cannot be used for bulk feed production

1 Introduction

Field community segetal species are formed in specific agro-climatic conditions and depending on between the cenofloras floristic regions, agricultural crops, structure of crop rotation, intensification of agricultural technology and level of environmental and economic development entity, developing floristically impoverished local segetal complexes, but with a relatively constant set of species, one of the regular causes of the declining productivity of arable land.

Modern adaptive landscape systems of agriculture are aimed at regulating the number of segmental price elements in agrophytocoenoses at a level below their economic threshold of

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harmfulness [1-5]. The floral composition of pioneer communities developing on fallow lands is diverse and varies from the previous segetal complex, a set of crops on arable land, and the ecological and soil conditions of the area. The analysis of successional variability of naturally formed vegetation cover on a temporarily abandoned arable land removed from active agricultural turnover is of scientific and practical significance for assessing the economic potential and developing technologies for their targeted accelerated development [6-8].

2 Materials and methods

Research on the floristic composition of weed-field communities was conducted in 1999-2019 at the Kaluga research Institute of agricultural in biologized five-field crop rotation (total area - 4950 m², area of 1 plot - 110 m², repeatability - 3 times, location-tiered) with varying degrees of saturation of the structure with leguminous and leguminous perennial grasses: crop rotations without complete fallow – 30% (*Pisum sativum* L. – *Solanum tuberosum* L. – *Fagopyrum esculentum* Moench – *Vicia sativa* L. + *Avena sativa* L. – *Triticum aestivum* L. / X *Triticosecale* Witm. ex A. Gamus) and 40% (*Vicia faba* L. – *S. tuberosum* L. – *Hordeum vulgare* L. + *Trifolium pratense* L.- *T. pratense* – *T. aestivum*), grain-grass – 60% (*L. angustifolius* – *T. aestivum* + *T. pratense* - *T. pratense* - *T. pratense* – *Triticosecale*) on agro-gray forest middle loamy soils on placor.

Research on the floristic composition of the pioneer stages of synanthropic plant communities was conducted in 2006-2019 at the Kaluga research Institute in a field experiment to study the evolution of secondary phytocenoses and the development of alternative technologies for accelerated development of abandoned land on a plot of 110.0 hectares located on a smooth hillslope of the over-floodplain terrace of the South-Eastern exposure in the Oka – Vyssa rivers interfluvium. Analysis (cenoflora) of abandoned lands by a set of plant species forming communities of any rank and any type of vegetation in 2009-2019 in the Peremyshl'skiy, Sukhinicheskoy, Babyninskiy and Meshchovskiy districts of the Kaluga region.

3 Results and discussion

In agrophytocenoses, synanthropic field communities classified by J Braun-Blanquet [9, 10], derivatives were formed in the syntaxon limit *Stellarietea mediae* R. Tx. et al. ex von Rochow 1951. The core of the complex was determined by the types presented by us in descending order of their projective coverage:

- moderately (*numerosae*) - *Achillea millefolium* L., *Capsella bursa-pastoris* (L.) Medik., *Centaurea cyanus* L., *Chenopodium album* L., *Cirsium arvense* L., *Convolvulus arvensis* L., *Echinochloa crusgalli* (L.) Beauv., *Elytrigia repens* (L.) Nevski, *Equisetum arvense* L., *Galeopsis tetrahit* L., *Galium aparine* L., *Matricaria chamomilla* L., *Polygonum aviculare* L. s. l., *P. bistorta* L., *P. convolvulus* L., *Rumex acetosella* L., *Stelaria media* L., *Taraxacum officinalis* Wigg., *Thlaspi arvense* L., *Trifolium arvense* L., *Stachys arvensis* L.;
- few (*paucos*) - *Agrostis tenuis* Sibth., *Atriplex patula* L., *Cirsium setosum* (Willd.) Bess., *Consolida regalis* S.P. Gray, *Galeopsis speciosa* Mill., *Linaria vulgaris* Mill., *Matricaria perforata* Merat., *Menta arvensis* L., *Polygonum lapathifolium* L., *P. persicaria* L., *Raphanus raphanistrum* L., *Sonchus arvensis* L., *Spergula arvensis* L.;
- rarely (*rarae*) - *Barbarea vulgaris* R. Br., *Bunias orientalis* L., *Euphorbia helioscopia* L., *Fumaria officinalis* L., *Stachys palustris* L.

Revealed increased phytocenotic role rhizomatous segetal components in the period 2009 - 2019, relative to previous decades (figure 1).

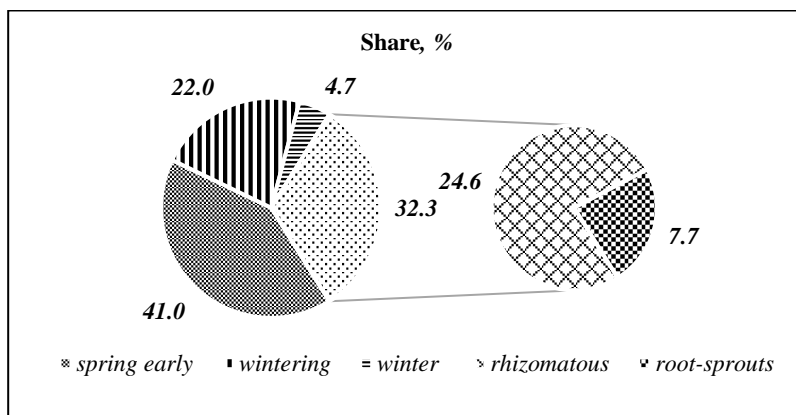


Fig. 1. Structure of a segetal complex

In agrophytocenoses, stable culturally specific combinations of segetal complex species were formed after the third rotation in the crop rotation (table 1).

Table 1. Main intra-field combinations of segetal species

Agrophytocenos	Combination of species
<i>H. vulgare</i> , <i>T. aestivum</i> , <i>Triticosecale</i> , <i>V. sativa</i> + <i>A. sativa</i>	I – <i>A. millefolium</i> , <i>E. repens</i> , <i>Eq. arvensis</i> , <i>C. cyanus</i> , <i>Ch. album</i> , <i>C. arvensis</i> , <i>M. arvensis</i> , <i>P. aviculare</i> , <i>P. convolvulus</i> , <i>S. arvensis</i> , <i>S. media</i> ,
	II – <i>A. tenuis</i> , <i>B. vulgaris</i> , <i>Eu. helioscopia</i> , <i>P. persicaria</i> , <i>T. officinalis</i> , <i>Th. arvensis</i>
<i>F. esculentum</i>	I – <i>C. cyanus</i> , <i>Ch. album</i> , <i>P. aviculare</i> , <i>P. convolvulus</i> , <i>S. arvensis</i> , <i>S. media</i> , <i>T. arvensis</i>
	II – <i>A. millefolium</i> , <i>E. repens</i> , <i>Eq. arvensis</i> , <i>M. arvensis</i> , <i>R. acetosella</i>
<i>L. angustifolius</i> , <i>P. sativum</i> , <i>V. faba</i>	I – <i>C. setosum</i> , <i>R. acetosella</i> , <i>S. arvensis</i>
	II – <i>A. tenuis</i> , <i>B. vulgaris</i> , <i>Eq. arvensis</i> , <i>E. repens</i> , <i>Eu. helioscopia</i> , <i>M. arvensis</i> , <i>P. persicaria</i>
<i>T. pratense</i>	I – <i>A. millefolium</i> , <i>E. repens</i> , <i>Eq. arvensis</i>
	II – <i>C. arvensis</i> , <i>P. persicaria</i> , <i>R. acetosella</i> , <i>S. arvensis</i> , <i>S. media</i> , <i>T. officinalis</i>

Note: I – characteristic, II – accompanying

In the link of crop rotation legumes - winter cereals, the use of basic shallow tillage (disking-BDU-2.5) contributed to an increase in weed infestation of crops on average in one field by 52%, and the technology (direct seeding) No-till (RAPID A600) – by 65%, relative to the annual plow up (PLN-3-35) – 28 copies/m². The application of mineral fertilizers (NPK) in the norms calculated using the full balance method increased the participation of components of the segetal complex by 6 ... 15% in the structure of agrophytocenoses.

Communities of fallow period were assigned to syntaxons to the class Stellarietea mediae Tx. et al. ex von Rochow 1951, later ones belong to the class Artemisietea vulgaris Lohmeyer et al. ex von Rochow 1951. The syngenetic series was limited by pyrogenic influence. Derivatives were prone to frequent fluctuations. Cenoses had a low saturation – 8 species per 100 m², the projection coverage-57.6% on average. The spectrum consisted of 104 species of higher plants of 29 families, the most frequent of which were: *Achillea millefolium* L., *Agrostis capillaris* L., *Alchemilla vulgaris* L., *Apera spica-venti* (L.) Beauv., *Artemisia absinthium* L., *A. abrotanum* L., *A. vulgaris* L., *Barbarea vulgaris* R. Br., *Berteroa incata*

(L.) DC., *Capsella bursa-pastoris* (L.) Medik, *Carex* spp., *Carum carvi* L., *Centaurea jacea* L., *Chenopodium album* L., *Convolvulus arvensis* L., *Cichorium intybus* L., *Cirsium setosum* (Willd.) Bess., *Dactylis glomerata* L., *Deschampsia caespitosa* (L.) Beauv., *Echinochloa crus-galli* (L.) Beauv., *Equisetum arvense* L., *Elytrigia repens* (L.) Nevski, *Erodium cicutarium* (L.) L` Her., *Erigeron canadensis* L., *Euphorbia virgata* Waldst. et Kit., *Galingosa parviflora* Cav., *Galeopsis tetrahit* L., *Glechoma hederacea* L., *Festuca* spp., *Hypericum perforatum* L., *Juncus* spp., *Leontodon autumnalis* L., *Leucanthemum vulgare* Lam., *Matricaria discoidea* DC., *Phleum pratense* L., *Plantago media* L., *P. major* L., *Poa annua* L., *P. pratensis* L., *P. trivialis* L., *Polygonum aviculare* L. s. l., *Potentilla anserina* L., *Ranunculus acer* L., *R. repens* L., *Rumex acetosella* L., *R. confertus* Willd., *Sonchus arvensis* L., *Spergula arvensis* L., *Stellaria media* (L.) Vill., *S. graminea* L., *Tanacetum vulgare* L., *Taraxacum officinale* Wigg., *Thlaspi arvense* L., *Trifolium* spp., *Tussilago farfara* L., *Vicia* spp., *Viola arvensis* Murr.

The community was presented agrobiological groups of grasses (55%), cereals (25%), legumes (15%), spore (10%) and sedge-juncaceae (5%). Cenoses with adventive participation were more variable in productivity and quality of biomass, the yield was 1.5 times higher than that of native plants [11, 12]. The number of species in communities was due to the diversity of the segetal complex, and its increase was due to the possibility and availability of immigration of diaspores. Species abundance was determined by the prevailing groups. Mutually complementary relationships appeared between cereals and legumes, herbs, and spores, sedge-juncaceae in other combinations - antagonistic (Table 2).

Table 2. Correlation coefficient ($r \pm r_s$) relationships of agrobiological groups

Agrobiological group	Legumes	Motley grass	Sedge-juncaceae	Spore
Cereal	0.95±0.04	-0.98±0.01	-0.60±0.21	-0.88±0.10
Legumes	-	-0.99±0.01	-0.33±0.26	-0.95±0.04
Motley grass		-	0.40±0.24	0.92±0.06
Sedge-juncaceae	-	-	-	0.32±0.29

In the motley grass group *Compositae* the proportion species was 20% and 5 advents (*Erigeron annuus* (L.) Pers., *E. canadensis* L., *Galingosa parviflora* Cav., *Matricaria discoidea* DC., *Solidago gigantea* Ait.). Share of species *Amaranthaceae*, *Chenopodiaceae*, *Convolvulaceae*, *Fumariaceae*, *Hypericaceae*, *Onagraceae*, *Papaveraceae*, *Violaceae* was low – 6,4% (Fig. 2).

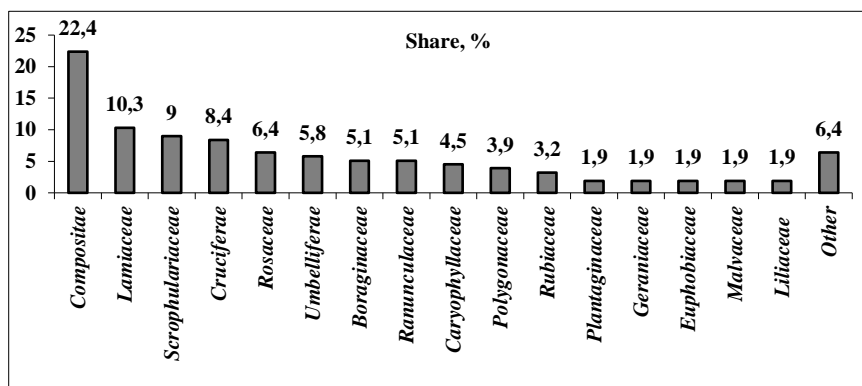


Fig. 2. Distribution of families in the motley grass group

Communities *in statu nascendi* were subjected to anemochoric invasion of diaspores. Aggregations developed that correlated with the structure of bordering communities. The degree of abundance on the Drode scale for *Salix* spp. was – Sol_{gr}/Sp-Cop₁, *Betula* spp. – Sol_{gr}-Sp/Cop₁, *Populus tremula* L. – Un-Sol/Sp, *Pinus sylvestris* L. – Un_{gr}/Sol_{gr}, and (neophyte) *Acer nedugo* L. – Un/Un-Sol. Advantages in ecesis were anemochora species - edificators *Salicaceae*, *Betulaceae*, *Pinaceae*.

4 Conclusion

The main floral composition of the segetal complex of field agrophytocenoses in the syntaxon limit in the conditions of Meshchovskiy Opole was determined *Stellarietea mediae* R. Tx. et al. ex von Rochow 1951. Cultural-specific combinations of weed-field vegetation species have been established. Minimization of the main tillage and introduction of calculated norms of mineral fertilizers contributes to an increase in the degree of contamination of crops by 52 ... 65% in biologized farming systems. Characteristics of secondary phytocenoses indicate that without a complex of agrotechnological techniques to improve their floral composition, phytomass cannot be important in the production of bulky feed. Communities are formed by 104 species of higher herbage plants from 29 families have low species saturation and low projective coverage and develop from the segmental complex of previous agrophytocenoses. In ecesis anemochores edificators have an advantage.

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