

Segmental Vegetation in the Wheat Agrophytocenosis of the Northern Transural Region

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Abstract — Data on the species and quantity composition of weed plants in wheat agrophytocenosis are given, depending on agroclimatic conditions. Features of changes in the composition and abundance of different biological groups of weed plants during the vegetative period are considered. During the years of research in the field of spring wheat, there were 16 species of weed plants belonging to 11 families. The seasonal dynamics of the weed component is analyzed depending on the biological characteristics of weed plants, the development phase of the cultivated plant and the weather conditions of vegetation. The degree of contamination of wheat agrophytocenosis during three years of research was determined, which amounted to 10.8% (2001), 3.7% (2002) and 21.9% (2003). It is determined that the composition of the flora of weed plants is affected not only by biological features, but also by weather conditions. Weather conditions determine the massive appearance or disappearance of species of weeds. The dominant species of weed plants in wheat agrophytocenosis are established. The accumulation of dry mass by weeds was studied, as well as the relationship between the biomass of weeds and cultivated plants and their numbers.

Keywords — *weeds; weediness; agrophytocenosis; segmental vegetation; weed cenosis; components of agrophytocenosis.*

I. INTRODUCTION

Weed vegetation is an indispensable element in the structure of agrophytocenosis, while the idea of total destruction of weeds is meaningless and practically unworkable [1,2].

For successful development of agroecological aspects of weed control, it is necessary to know the relationship between cultivated and weed plants, and learn how to manage them [3,4]. The use of the biological properties of the cultural plant itself, its environment-forming role, should be put first. Cultivated plants, planted by humans, are edificators and the degree of their influence on agrophytocenosis largely depends on the weediness of crops [5,6].

Most of the works of the present time are aimed at studying the influence of various types of soil cultivation,

including resource-saving, on the degree of weediness of crops of crops [7]. Only a few works of researchers consider the influence of these weed control methods on the potential weediness - stock and species composition of seeds in the soil [8,9,10]. This is confirmed by N.I. Vavilov [11]: "Undoubtedly, wild forms, related to modern cultural plants, deserve the same study as the cultural plants themselves" have not lost their relevance to this day. The main trend in characterizing the role of weed plants, according to some authors, is the assessment of their harmfulness in crops of crops [12,13,14,15].

The lack of research on this topic has made it necessary to address the results of studies conducted between 2001 and 2003.

For the study of segment vegetation in wheat agrophytocenosis, depending on agroclimatic conditions, it is necessary: to study the species and quantity composition of weeds; to study the influence of agroclimatic conditions on the species and quantity composition of weeds; to analyze the seasonal dynamics of biological groups of weed plants of wheat agrophytocenosis; determine the relationship between the amount of weeds and their biomass.

II. MATERIALS AND METHODS

The investigations were carried out in the zone of the northern forest-steppe. The climate of the zone is typically continental, characterized by a prolonged winter and a short, moderately warm summer.

According to the temperature regime and peculiarities of the distribution of precipitation during the vegetative period, the years of research were characterized as follows: 2001 - typical for hydration to an average long-term norm (102.1%) and hot (107%); 2002 - cool (97%) and wet (148%); 2003 - relatively warm (104%) and arid (81.8%). The soil of the experimental site is chernozem leached with the content in the

plowing layer: humus - 7.6% [16], pH - 4.9; N-NO₃ - 1.44, P₂O₅ - 7.7, K₂O - 9.3 mg / 100 g of soil.

Species and quantitative weed plants in agrophytocenosis were studied in field experiments. The scheme of the experiment included two options: the first - a culture with weeds, the second - a culture without weeds. The study of weed plants was carried out in a massif of the culture under study with an aligned stalk. The area of the registered plot is 4 m², the protective plot is 2 m². Repeat in the experiment 6-fold.

Basic methods of research: field and laboratory. Weediness on the variant - a culture with weeds was determined by the quantitative method in the phases of tillering, earing of spring wheat; before harvesting the culture by a quantitative-weight method in 6-fold replication. On the variant - a culture without weeds, weediness was determined by a quantitative-weight method in 6-fold repetition in the phase of wheat tillering. Weed removal was carried out manually.

The basic and presowing soil cultivation corresponded to the zonal system (autumn: plowing to a depth of 20-22 cm, spring: harrowing in two tracks + cultivation for 6-8 cm, seeding + packing). Spring wheat and spring rape were sown at the optimal time. Sow wheat of Tulunskaya-12 grade was drilled with SZ-3,6 drill to a depth of 4-5 cm. The seeding rate was 6.2 mln.

Phenological observations were carried out using the GSO technique.

The mathematical processing of the results of the experiments was carried out by the method of variational statistics for B.A. Dospekhov (1985) and O.D. Sorokin (2004) [17,18].

III. RESULTS

It is known that agrophytocenosis is characterized by a certain floral composition, structure, relationships with each other and the environment.

During the years 2001-2003, we studied the species and quantitative composition of weed plants in wheat agrophytocenosis. For three years of research in sowing spring wheat, there were 16 species of weed plants belonging to 11 families.

Among 16 species of weed plants in different years prevailed: from perennial - *Glechoma hederacea*, *Convolvulus arvensis*, *Sonchus arvensis*, *Equisetum arvense*, from juvenile wintering - *Erodium cicutarium*, *Matricaria perforata*, *Viola arvensis*, *Thlaspi arvense*. Of the young adults - *Amaranthus retroflexus*, *Spergula arvensis*, *Galeopsis speciosa*, *Chenopodium album*, *Atriplex patula*, *Fumaria officinalis*, *Galium aparine*, *Stellaria media*.

Field observations made it possible to establish some peculiarities in changing the composition and abundance of different biological groups of weed plants during the growing season.

Seasonal dynamics of the weed component is characterized by its individual formation, the manifestation of relationships and established links in this agrophytocenosis.

Favorable soil and climatic conditions in 2001 contributed to the active development of cultural and weed components. The degree of contamination of agrophytocenosis was average and amounted to 10.8%. Species composition of weeds changed during vegetation. So, in 2001, 11 species of weed plants grew in the phase of tillering of spring wheat in the plots of the clogged variant. Among them, 73.7% and density (19 pcs / m²) were most widely distributed in early and late spring (*Chenopodium album*, *Galeopsis speciosa*, *Amaranthus retroflexus*); 16% and 4 pieces / m² were wintering (*Erodium cicutarium*, *Thlaspi arvense*), respectively, with a minimum number of perennials - 10%.

During the earing phase of spring wheat, the predominance of early and late spring weeds persisted (84%), the number of wintering to 8.9% decreased, and the number of perennial weed plants remained the same (Table 1)

TABLE I
QUANTITY OF WEED PLANTS IN WHEAT AGROPHYTOCENOSIS
(CLOGGED VARIANT), PIECES / M²

Weed species	Year 2001		
	tillering	crushing	ripeness
Perennial			
1. <i>Glechoma hederacea</i>	1	1	1
2. <i>Convolvulus arvensis</i>	1	1	-
3. <i>Sonchus arvensis</i>	-	-	-
4. <i>Equisetum arvense</i>	-	-	-
Juvenile spring plants			
5. <i>Fumaria officinalis</i>	-	8	9
6. <i>Stellaria media</i>	4	5	2
7. <i>Amaranthus retroflexus</i>	4	4	2
8. <i>Atriplex patula</i>	2	2	-
9. <i>Spergula arvensis</i>	-	-	-
10. <i>Chenopodium album</i>	3	7	-
11. <i>Galeopsis speciosa</i>	4	4	-
12. <i>Galium aparine</i>	2	3	1
Juvenile wintering			
13. <i>Erodium cicutarium</i>	2	2	-
14. <i>Viola arvensis</i>	-	-	-
15. <i>Matricaria perforata</i>	-	-	-
16. <i>Thlaspi arvense</i>	2	1	-
all in all	25	38	15
SSD (smallest significant difference) _{0,5}	1.9	2.7	1.9

According to Krasnozhan SM. (2012) in comparable conditions of the forest-steppe zone of the Chelyabinsk region in 2002-2011. In the phase of tillering of spring wheat, 19 species of weed plants grew in the plots of the control variant. Among them, early and late spring dicotyledonous weeds were most widely spread (52.1%); 27.2% were in early and late spring cereals; 12.3% were hibernating with a minimum number of perennial dicotyledons (8.4%). During the earing phase of spring wheat, the prevalence of early and late spring weeds persisted (64.5%), the number of wintering to 7.4% decreased, the number of perennial weeds increased to 14.2% due to the appearance of new root offspring. The number of

early and late spring grass weeds was reduced to 13.9% because of their inhibition by culture and other groups of weeds [19].

By the end of the spring wheat vegetation period, weed plants such as *Chenopodium album*, *Atriplex patula*, *Galeopsis speciosa*, *Erodium cicutarium*, *Thlaspi arvense* disappeared from the agrophytocenosis. This is due to their biological characteristics, since they germinate in the spring and mature ripen, mature and fruit their life cycle by the ripening period of spring wheat.

The prevalence of early and late spring weeds was also established in 2003. They were represented by *Fumaria officinalis*, *Galeopsis speciosa*, *Atriplex patula*, *Spergula arvensis*, *Amaranthus retroflexus*, *Stellaria media*. The content of juvenile, perennial and wintering weeds in the phase of wheat tillering was 65.2%, 21.5% and 13.3%, respectively. By the end of the vegetation period, the number of perennial weed plants decreased to 16.4% (*Equisetum arvense* with a number of 7 pieces / m², *Glechoma hederacea* and *Sonchus arvensis* with a number of 2 and 1 pc / m², respectively).

The number of wintering species increased by the end of the vegetative period to 29%. By the time wheat was harvested, spring weeds (54.6%) with a density of 30 pieces / m² remained the dominant species throughout the entire vegetation period.

In studies Tursumbekova G.Sh. (2016) in the zone of the northern forest-steppe of the Tyumen region in 2012 in agrophytocenoses of spring wheat varieties, 15 species of weed plants were found. Agrophytocenoses were predominantly clogged with *Atriplex patula*, *Chenopodium album*, *Echinochloa crusgalli*, *Equisetum arvense*, *Galium aparine*, *Stellaria media*, *Thlaspi arvense*. In 2013, 10 species of weed plants were found in agrophytocenoses of spring wheat varieties. In general, the weediness of agrophytocenoses of all varieties was low compared to 2012. Dominant species among weeds in most varieties were *Amaranthus retroflexus* and *Setaria glauca* [20].

Based on the results of the research, VV Rzayeva, NV Fisunov (2017), on average for three years of research (2014-2016), before harvesting spring wheat for the share of the cultural component, there were 489-512 pieces / m², the share of the weaker component was 7.5-12.7 pieces / m², while the degree The contamination was 1.69-2.53% for the variants with the main treatment. The largest number of weed plants was found in young dicotyledonous weeds [21].

Good heat and moisture supply throughout the vegetation period of 2003 contributed to the maintenance of a stable number of weeds.

The cold and wet summer of 2002 inhibited the development of the weed component, so the degree of weediness of the wheat agrophytocenosis was less and amounted to 3.7%. At the same time, the largest number of weed plants was in the phase of earwaxing of spring wheat (23 pcs / m²). Of these, 56.1% are spring early (*Atriplex patula* with 4 pcs / m², *Fumaria officinalis* 4 pcs / m², *Galeopsis speciosa* - 3 pcs / m²), 37.3% are perennial (*Convolvulus arvensis*, *Glechoma hederacea*, *Equisetum arvense*), 6.5% -

wintering (*Viola arvensis* with a number of 1 pc / m²). By the end of the vegetation the number of weed plants decreased to 14 pieces / m² and was represented by plants *Stellaria media*, *Spergula arvensis*, *Viola arvensis*, *Convolvulus arvensis* with a number of 2 pieces / m². *Equisetum arvense* increased the number to 6 pcs / m² (Table 2).

TABLE II QUANTITY OF WEED PLANTS IN WHEAT AGROPHYTOCENOSIS (CLOGGED VARIANT), PIECES / M²

Weed species	Year 2002		
	tillering	crushing	ripeness
Perennial			
1. <i>Glechoma hederacea</i>	1	1	-
2. <i>Convolvulus arvensis</i>	2	1	2
3. <i>Sonchus arvensis</i>	-	-	-
4. <i>Equisetum arvense</i>	4	6	6
Juvenile spring plants			
5. <i>Fumaria officinalis</i>	3	4	-
6. <i>Stellaria media</i>	3	1	2
7. <i>Amaranthus retroflexus</i>	-	-	-
8. <i>Atriplex patula</i>	2	4	-
9. <i>Spergula arvensis</i>	2	2	2
10. <i>Chenopodium album</i>	-	-	-
11. <i>Galeopsis speciosa</i>	3	3	-
12. <i>Galium aparine</i>	-	-	-
Juvenile wintering			
13. <i>Erodium cicutarium</i>	-	-	-
14. <i>Viola arvensis</i>	1	1	2
15. <i>Matricaria perforata</i>	-	-	-
16. <i>Thlaspi arvense</i>	-	-	-
all in all	21	23	14
SSD (smallest significant difference) _{0,5}	1.7	1.8	3.4

The common for all three years of research was the rapid development of weed plants in the first half of the vegetation, the attainment of a maximum in the phase of earing of spring wheat, and then gradually reducing them.

The composition of the flora of weed plants is affected not only by their biological features, but also by weather conditions. Weather conditions determine the massive appearance or disappearance of species of weeds.

So, the dominant *Chenopodium album* in 2001, disappears from agrophytocenosis in 2002 and 2003. The appearance of *Fumaria officinalis* in 2001 in the sowing of spring wheat during the earing phase was promoted by an increase in air temperature in June to 14.6 ° C and a plentiful amount of precipitation (89.2 mm) that fell during the month. Reserves of moisture in the soil at the end of June - early July were 75.4 mm, and soil temperature 14.5 ° C.

In the wet year, *Spergula arvensis* appears and is most developed in 2003. And it maintains a dominant position in relation to other species. At the same time from the cenosis in 2002 fell *Erodium cicutarium*, *Chenopodium album*, *Galium aparine*, *Amaranthus retroflexus*, *Thlaspi arvense*. Conversely, the greatest development in 2002 was *Equisetum arvense*, *Spergula arvensis* in relation to other species, *Atriplex patula*,

Fumaria officinalis disappeared to harvesting wheat. According to L.D. Protasova and G.E. Larina (2004), in the Moscow region, a high sensitivity to humidification conditions was observed by the species of the piculist and the field torus, whose abundance was the highest in the wet years of 2001 and 2003 [22].

In general, the contamination of crops in 2003 was significantly higher than in 2001-2002. Strong infestation (21.9%) of agrophytocenosis in 2003 is due to the high air temperature and moisture content of the soil during vegetation (Table 3).

TABLE III- NUMBER OF WEED PLANTS IN WHEAT AGROPHYTOCENOSIS (CLOGGED VARIANT), PCS / M²

Weed species	Year 2003		
	tillering	crushing	ripeness
Perennial			
1. <i>Glechoma hederacea</i>	6	2	2
2. <i>Convolvulus arvensis</i>	-	-	-
3. <i>Sonchus arvensis</i>	2	1	1
4. <i>Equisetum arvense</i>	2	5	7
Juvenile spring plants			
5. <i>Fumaria officinalis</i>	6	6	3
6. <i>Stellaria media</i>	6	7	5
7. <i>Amaranthus retroflexus</i>	2	5	6
8. <i>Atriplex patula</i>	3	5	4
9. <i>Spergula arvensis</i>	6	9	7
10. <i>Chenopodium album</i>	-	-	-
11. <i>Galeopsis speciosa</i>	5	6	3
12. <i>Galium aparine</i>	2	3	4
Juvenile wintering			
13. <i>Erodium cicutarium</i>	-	-	2
14. <i>Viola arvensis</i>	3	6	8
15. <i>Matricaria perforata</i>	1	2	3
16. <i>Thlaspi arvense</i>	2	2	4
all in all	46	59	59
SSD (smallest significant difference) _{0,5}	2.1	2.5	2.7

From Table 4 it can be seen that during the years of research the early spring weeds developed most, their number was the highest among other biological groups in the phase of tillering of spring wheat. It increased to the phase of earing and decreased to the phase of ripeness of spring wheat. This feature is explained by the biology of weeds. In the phase of tillering of spring wheat, these weeds are at the initial stage of vegetation.

In the phase of ear of spring wheat, they bloom and bear fruit, and by the time of ripeness of wheat, most of them die. This is particularly evident in 2001 and 2002.

Perennial weeds (*Convolvulus arvensis*, *Glechoma hederacea*, *Equisetum arvense*) during the period of vegetation slightly changed their numbers. They gradually passed through all stages of their development. The greatest number of them was recorded in 2003 in the phase of tillering and ripeness - 10 pieces / m².

TABLE IV SEASONAL DYNAMICS OF BIOLOGICAL GROUPS OF WEED PLANTS OF WHEAT AGROPHYTOCENOSIS

Year	Phase of development of culture	Number, pieces / m ²				
		Perennial	hibernating	spring		all in all
				early	late	
2001	Tillering	2	4	15	4	25
	Crushing	2	3	29	4	38
	Ripeness	1	-	12	2	15
2002	Tillering	7	1	13	-	21
	Crushing	8	1	14	-	23
	Ripeness	8	2	4	-	14
2003	Tillering	10	6	28	2	46
	Crushing	8	10	36	5	59
	Ripeness	10	17	26	6	59
SSD (smallest significant difference) _{0,5}		1.6	6.8	11.4	3.2	17.5

Warm weather in April-May 2001 contributed to the emergence of early spring shoots of wintering weeds, which by the phase of ripeness of wheat finished vegetation. In 2003, on the contrary, wintering increased their number in the phase of earing and full ripeness of spring wheat. They were actively promoted by optimal soil and climatic conditions.

As a result of our studies, we can distinguish two tiers occupied by weeds - the middle and lower. Such weeds as, *Stellaria media*, *Glechoma hederacea*, *Fumaria officinalis*, *Viola arvensis* occupy the lower tier and reach a height of no more than 25 cm. Weed plants above 25 cm belong to the middle tier and are represented in the studies - *Chenopodium album*, *Amaranthus retroflexus*, *Galeopsis speciosa*, *Erodium cicutarium*, *Thlaspi arvense*. Determining the stratification of agrophytocenosis allows us to determine not only their number, but also the actual distribution along the height, and also indirectly indicates the state of the species in the community.

Thus, we can say that the abundance of weed plants is an important indicator in the period of the formation of agrophytocenosis. At the beginning of the vegetation, the abundance of weeds can predict how the relationship between the cultural and weed components will develop.

In different periods of vegetation of spring wheat, the relationship between culture and weeds has specific features and depends on the nature of the formation of agrophytocenosis in the initial and subsequent stages of development, and primarily on the intensity of the growth of the biomass of crops and weeds.

According to Eremin DI, Konishcheva VA. (2014) in unfavorable agroclimatic conditions, mineral fertilizers remain unclaimed wheat throughout the growing season, which leads to a burst of contamination due to an increase in the mass of the weed component. During the years of research (2009-2011), the yield of spring wheat in variants with a high agrophone (NPK by 5.0 and 6.0 t / ha) did not exceed 4.0 t /

ha, which created conditions for excess nutrient content throughout the vegetation. This led to a significant increase in the phytomass of weeds, which reached 48.7 g / m², and their specific gravity reached the maximum values of 2.9% of the phytocenosis mass [23].

An important indicator characterizing the level of development of the weed component of agrophytocenosis is the accumulation of dry mass by weeds.

Between the amount of weeds and their biomass there is a relationship, which is confirmed by the correlation coefficient ($r = 0.85$).

At the beginning of vegetation, the mass of weed plants is negligible and is not an important indicator of contamination. At the end of the growing season, the mass of weed plants becomes decisive, and their number practically does not reflect the impact on the culture.

In favorable weather conditions, with the accumulation of a sufficiently high biomass, spring wheat is able to effectively suppress weed plants. The relationship between the biomass of weeds and cultivated plants is expressed by the correlation coefficient ($r = -0.63$), that is, the greater the biomass of weeds, the less the biomass of the cultivated crop, in this case spring soft wheat.

IV. CONCLUSIONS

1. In the wheat agrophytocenosis, the species composition of weed plants is represented by early and late spring (50%) forms, wintering (25%) and perennial (25%). Dominate among them are spring weeds.
2. The species and quantity composition of the weed component depends substantially on agroclimatic conditions during the vegetative period.
3. There is an inverse relationship between the biomass of cultural and weed plants ($r = -0.63$). A close direct relationship was established between the amount of weeds and their biomass ($r = 0.85$).
4. The development of weed plants occurs unevenly, both during the vegetation period and for three years. The growth of the biomass of cultural and weed plants depends on the nature of the formation of agrophytocenosis.

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