Analysis of the phytosanitary condition of agrocenoses depending on soil treatment in the Urals conditions

T N Vasilyeva¹, O V Alyaeva¹, F H Biktasheva², E A Ivanova³, S Lebedev¹,⁴

¹Federal Scientific Center of Biological Systems and Agrotechnologies of the Russian Academy of Sciences, 29, January 9 str., Orenburg, 460000, Russia
²Bashkir State Agrarian University, 34, 50 years of October str., Ufa, 450001, Russia
³Orenburg Experimental Station of Horticulture and Viticulture of the All-Russian Scientific and Technological Institute of Horticulture and Nursery, 10, Nezhinskoe Highway, Orenburg, 460041, Russia
⁴Orenburg State University, build. 16, 13, Pobedy ave., Orenburg, 460018, Russia,
+7(3532)776770

E-mail: vtn1972@mail.ru

Abstract. One of the urgent problems of reducing crop yields is the unsatisfactory phytosanitary condition of the fields, leading to economic losses in agriculture, especially when switching to resource-saving technologies [1, 2]. The aim of the work is to study the phytosanitary condition of agrocenoses depending on the method of tillage. For this, plots were laid in the Orenburg district of the Orenburg region. As a result of the experiments carried out with various processing methods, it was noticed that in experiments with small loosening, the amount of weed-field vegetation increased by 2 times, for example, FPV (phenoceptic threshold of harmfulness) of Panicum miliaceum L. exceeded by 36 times revealed a change in life forms towards xerophytic flora. On the same experimental plots conducted a study on the presence of root rot. In the experiment with deep tillage (plowing) of spring wheat, 46% of the plants affected by Fusarium rot were observed, and 50% of the plants affected by the pathogen were counted on the experience in tillage.

1. Introduction

Today, in agriculture, resource-saving technologies are used. One of the urgent problems of reducing crop yields is the unsatisfactory phytosanitary condition of the fields, leading to economic losses in agriculture, especially when switching to resource-saving technologies [1, 2]. For example, a decrease in yields only due to weeds during the agricultural year is estimated to be in the range of 45–95%, depending on environmental and climatic conditions [3, 5, 8, 10]. Harm due to diseases of agricultural plants is associated with both a decrease in yield and a deterioration in the quality of agricultural products [6]. In the next 10–20 years, problems associated with weeds, with fungi parasitizing on the roots of spring wheat, will worsen, will be even more insurmountable with the intensification of agriculture [13, 14]. It was noted that agronomic techniques affect the quality of grain, especially spring wheat [4, 11, 12]. Among the common diseases of spring wheat root rot is known, causing significant damage to grain yield.
The aim of the work is to study the phytosanitary condition of agrocenoses depending on the method of tillage. The objectives of this study were to assess the impact of soil treatment methods on the density and overall species composition of weeds in the arid zone; quantitative accounting of plants affected by root rot, depending on the method of tillage.

2. Materials and methods

Studies were conducted in Russia in the Orenburg region. The total rainfall in the Orenburg region for the agricultural year 2017-18 (from September to August) was 242.1 mm. The plot of the landscape location refers to alluvial on plakorah watershed surfaces with a slight slope of 1 - 2° (Table 1). The soils of the Orenburg region are characterized by a non-flushing regime, mostly alkaline chernozem, often with increased carbonate content [15].

| Area and place of study                  | Coordinates          | Soil treatment |
|-----------------------------------------|----------------------|----------------|
| Orenburg region Orenburg district       | 51° 7' 22" 55° 17' 30" | 1. deep loosening |
| Training and Experimental Field OSAU    | 115.6                | 2. minor loosening |

3. The study of the structure of the modified lead-tin-base bronze

Dump tillage (plowing) contributes to soil fertility and the creation of favorable growing conditions for plants, but the main negative point is soil erosion. In contrast to conventional tillage, resource-saving technologies include: zero tillage and minimal tillage (small tillage), which will avoid serious impacts on the soil. All agricultural practices affect weeds in different ways. Our experiments are aimed at studying the floristic composition of weed-field vegetation and quantitative pest accounting at the experimental site of the Orenburg district of the Orenburg region. Table 2 shows the number of species of field weed plants encountered in various soil tillage methods. There were 10 species of plants in the study area belonging to 7 families. Table 2 shows the main biological features of each type of weed (Bayer weed plant code).

When dumping the soil of spring wheat in the Orenburg region, there were 5 species of plants from 5 families dominated by Amaranthus retroflexus L., the threshold of harm was not exceeded. At the same time, juvenile monocotyledonous weeds made up - 20%, juvenile dicotyledons - 60%, perennial dicotyledons - 20%, of which xeromeophytes make up - 40%, mesophytes - 60%. Xerophytic flora of weed vegetation occurred during the application of fine loosening of the soil. The species composition has changed, the dominant Panicum miliaceum L. exceeding the FPV (phenocceptive threshold of damage) by 36 times. At Atripleh hastata L FPV exceeded 1.6 times. When using small-scale loosening, 10 species of weed-field plants from 7 families were counted. The share of juvenile monocotyledonous weeds accounts for 30%, perennial monocotyledons 10%, juvenile dicotyledons 40%, perennial dicotyledons 20%. During the period of crop rotation, the ratio of annual plants to the total number of weed species remained at the level of 70%. Life forms are represented by xeromesophytes - 40%, mesophytes - 40%, meso-xerophytes 20%.
Table 2. Species of weed plants in the studied areas of the Orenburg district of the Orenburg region of the OSAU training and economic field with various methods of tillage

| Kinds of plants        | Families          | Weed code | Ways of working the soil |
|------------------------|-------------------|-----------|--------------------------|
|                        |                   |           |                          |
| *Amaranthus retroflexus* | *Amaranthaceae*   | AMAPE     | +                        |
| *Panicum miliaceum*    | *Poaceae*         | PANDI     | +                        |
| *Atriplex hastata*     | *Chenopodiaceae*  | ATXHA     | +                        |
| *Persicaria arenastrum*| *Polygonaceae*    | POLAV     | +                        |
| *Convolvulus arvensis* | *Convolvulaceae*  | CONAR     | +                        |
| *Euphorbia waldstéini* | *Euphorbiaceae*   | EPHPE     | -                        |
| *Setaria viridis*      | *Poaceae*         | SETVI     | -                        |
| *Malva neglecta*       | *Malvaceae*       | MALNE     | -                        |
| *Elytrigia repens*     | *Poaceae*         | ARBTH     | -                        |
| *Poa trivialis*        | *Poaceae*         | ARBTH     | -                        |

Figure 1. Bar chart. The number of weed plants on the experimental field of OSAU: (a) - waste treatment of the soil; (b) minimum tillage.

Figure 1. (a), (b) Displays the density of weeds in various soil treatments. When tilling spring wheat with fine loosening, the density and diversity of species is much greater than as a result of tillage with deep loosening. On the histogram 1 (b) we see the quantitative excess of the FPV Panicum miliaceum L. Atripleh hastata L. at the experimental site as a result of a gentle way of tillage.

As a result of our research, results were obtained like the experiments conducted by Froud-Williams et al. [5], who analyzed the impact of resuso-saving technologies on the weeds of grain crops. The
authors emphasized that species with a slight projection cover began to occupy a leading position (for example, Bromus spp.). While other species characteristic of arable land practically disappeared.

As a result of the experiments with two methods of soil treatment, we can talk about the following changes in the species composition of weed field vegetation:
in experiments with small loosening, an increase in plant species is observed by a factor of 2, and the quantity (density) of Panicum miliaceum L. weeds has increased 23 times. Atriplex hastata L. additionally, 2 families of Euphorbiaceae, Malvaceae with 2 plant species appeared, the Poaceae family was enlarged into 3 species, i.e. xerophytic flora is observed (xeromesophytes accounted for - 40%, meso-xerophytes with 20% mesophytes - 40%) (see table 2). The total biomass of weeds of the experimental field of the Orenburg region with dumping tillage was 2.06 g; with minimal tillage, the biomass of weeds was 12.81 g. Roasea family [16].

Thus, the use of resource-saving technologies in the cultivation of agricultural crops is accompanied by a significant change in the weed biocenosis and an increase in the weediness of weeds.

It was noted that agronomic techniques affect the quality of grain, especially spring wheat. Back in 2001, scientists suggested a high prevalence of root rot in fields with minimal or zero tillage [4, 9, 11]. Among the common diseases of spring wheat root rot is known, causing significant damage to grain yield. On stationary plots, we observed the manifestation of the species of root Fusarium rot prevailing in the zone. To determine the degree of infestation of plants with root rot, special scales were used that characterize the intensity of the disease (Fig. 2). In the case of deep tillage (plowing), 44% of spring wheat was affected by fusarium rot from 1 to 9%, about 2% of spring wheat plants were affected by 10–29%.

In the experience of tillage (fine loosening), 40% of plants affected by fusarium rot were noted by 1-9%, about 10% of spring wheat roots were affected by 10-29%, and the remaining 50% of the roots of plants were not affected by the pathogen. Our research confirms the views of Mahoney AK, Babiker EM (2006) [7], they suggested that the incidence of root rot of cultivated plants depends on agricultural practices, namely on the method of tillage.

4. Conclusion
In the studied areas there is a characteristic set of sustainable weed-field vegetation, which is able to quickly penetrate into the agrocenosis. On experiments with small loosening, an increase in plant species is observed by a factor of 2, the amount (density) of weeds Panicum miliaceum L., Atriplex hastata L. increased 23 times. As a result of minimal tillage, species diversity increases, i.e. additionally, 2 families of Euphorbiaceae, Malvaceae with 2 plant species appeared, the Poaceae family was enlarged into 3
species, i.e. xerophytic flora is observed (xeromesophytes accounted for - 40%, meso-xerophytes 20% by mesophytes - 40%). In the experiments with dumping tillage, mesophytes prevailed up to 60%.

The phytosanitary condition of cultivated plants showed that 46% of plants affected by Fusarium rot were observed in the experiment with deep tillage (plowing) of spring wheat, and 50% of the plants affected by the pathogen were counted in the soil tillage.

The use of resource-saving technologies in the cultivation of crops, accompanied by a significant change in the weed biocenosis and increased weediness, because the current composition of weeds is a result of prolonged natural selection against the background of intensive processing using a plow.

Acknowledgments
The studies were performed in accordance with the plan of research works Federal Research Centre of Biological Systems and Agrotechnologies of the Russian Academy of Sciences No. 0761-2019-0003.

References
[1] Albrecht H 2005 Weed Research Development of arable seed banks during the 6 years after weed research 45(5) 339–50
[2] Appleby A P and Muller F 2000 Carpy Weed control Agrochemicals New York Willy VCH 687–709
[3] Korotkova A M, Sizova E A, Lebedev S V and Zyazin N N 2015 Influence of NPs Ni° on the induction of oxidative damage in Triticum vulgare Oriental J. of Chem. 31 137–45
[4] Korotkova A M, Lebedev S V, Kayumov F G and Sizova E A 2017 The influence metal nanoparticles (Fe, Cu, Ni) and their oxides (Fe₃O₄, CuO, NiO) Agricultural Biology 52(1) 172–82
[5] Levakhin G., Duskaev G. and Dusaeva H., 2015. Assessment of Chemical Composition of Grain Crops Depending on Vegetative Stage for Feeding. Asian Journal ofCrop Science, 7: 207-213.
[6] Kuyper T W 2017 Agronomy for Sustainable Development Sustainable intensification in agriculture: the richer shade of green A review 37–39
[7] Mahoney A B, Babiker E M, Paulitz T C, See D, Okubara P A and Hulbert S H 2016 Phytopathology 106(10) 1170–6
[8] Moody K 1991 Weed management in rice Handbook of pest management in agriculture ed D Pimentel (Florida: CRC Press. Boca Raton) pp 301–28
[9] Neve P L and Barney J N 2018 Reviewing research priorities in ecology, evolution and management: a horizon scan Mar. Weed Res. 58(4) 250–8
[10] Korotkova A, Lebedev S and Gavrich I 2017 The study of mechanisms of biological activity of copper oxide nanoparticle CuO in the test for seedling roots of Triticum vulgare Environ Sci. Pollut Res. 24(11) 10220–33
[11] Paulitz T C 2006 Low input no-till cereal production Eur. J. Plant Pathol 115 271–81
[12] Pimentel D, McNair S, Janecka J et al 2001 Economic and environmental threats, animal andmicrobe invasions Agriculture, Ecosystems / Environment 84 1–20
[13] Lebedev S, Gavrish I, Galaktionova L, Korotkova A 2019 Assessment of the toxicity of silicon nanooxide in relation to various components of the agroecosystem under the conditions of the model experiment Environmental geochemistry and health, 41(2) 769-782
[14] Varanasi A, Prasad P V V and Jugulam M 2016 ed. D L Sparks 107–46
[15] Klimentyev AI, Lozhkin I V and Trubin A P 2006 Geoeological assessment of the soil cover ofurbanized territories (on the example of the city of Orenburg) (Ekaterinburg: Ural Branch of the Russian Academy of Sciences) 254 p
[16] Titlyanova A A and Afanasyeva N A 1993 Successions and the biological cycle (Novosibirsk: Siberian Publishing School of Science) 157 p