Influence of the seeding rate of common oats on the weed infestation

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Abstract. The article examines the influence of the seeding rate of oats on the weed infestation of oat crops when growing it for green fodder. The aim of the research was to determine the seeding rate of oats when growing for green mass to reduce weed infestation of its crops in Central Yakutia. As a result of research for 2022-2024, the optimal seeding rate of oats in growing for green mass in Central Yakutia was set. It was noted that a reduced seeding rate (4.0mln pcs per 1ha) of oats significantly increases the number of weeds. And a seeding rate of 6.0 mln pcs/ha reduces the weed infestation of oats in growing it for green mass, ensuring a maximum productivity of green mass up to 118 hkg/ha or 11.8 t/ha.

1 Introduction

The influence of seeding rates of common oat (Avena sativa L.) on the level of weed infestation in the cultivation of this plant for green mass in the climate conditions of Central Yakutia is an important field of research. In the process of agricultural production, one of the key tasks is to optimize conditions for achieving heavy yields for the efficient use of resources and minimizing competition with weeds [1-6]. Seeding rates, regulating the density of planting, not only effect the growth and development of the crop, but also form the life area for adjacent plants [7-12]. In Central Yakutia, where the climate and soil conditions are specific, the study of these relationships is of special significance [7,13-21]. Each change in seeding rates can transform the dynamics of weed infestation, opening up new horizons for improving agronomic practices and sustainable agriculture. Determining the optimal sowing rate of oat seeds of the Rovesnik variety for the conditions of Central Yakutia is also determined by varietal agricultural technology. It is known that the larger the grains of the variety, the more accurately it is necessary to determine seed sowing rates for each agricultural zone. Therefore, a serious research of the impact of these rates on weed infestation is a key element in efforts to improve the productivity and quality of agricultural products.

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The purpose of these experiments was to determine the seeding rates of oats (Avena sativa L.) when grown for green mass in order to reduce weed infestation of its crops in the climate of Central Yakutia.

The objectives of the research were as follows:

1. To study the significance of oat seeding rates (Avena sativa L.) on the weed infestation of oat crops when growing it for green mass;

2. To elucidate the number of weed seeds in oat crops (Avena sativa L.) depending on different seeding rates.

3. To determine the types of weeds in the oat cenosis (Avena sativa L.).

2 Research methods

Records and observations were conducted using practical standard. Weed infestation of oat crops was determined using the methods of the State Commission for Variety Testing of Agricultural Crops.

Statistical data processing using the Excel software package, drafting of the map using the Agisoft Metashape program.

The record variety test plots were 25 m2. The placement of the variants was systematic. The seeding method was line. The oat variety Rovesnik was planted with a seeding rate of 4.5, 5.0 (C-control), 5.5 and 6.0mln pcs/ha. This step-by-step seeding rate of 500 thousand pieces per hectare for variants of the Rovesnik variety was determined due to its grain size (the weight of 1000 seeds of this variety is 44-51 g). Records and observations were conducted using practical standard. Weed infestation of oat crops was determined using the method of the State Commission for Variety Testing of Agricultural Crops (1989). To determine the weed infestation of soil with weed seeds, a 100g hitch was made from the total soil sample in 3 replicates and the soil was rinsed through a dockage screen with 0.5-1mm holes. The mass remained on the surface of the dockage screen was examined under a loupe, selecting and counting the number of weed seeds with a normal color and shape, without evidence of decomposition (Practical Guide SB RAAS, 1997).

3 Research results

The research for identifying the dependence of weed infestation of common oats (Avena sativa L.) on seeding rates were started in 2022 and continued until 2024.

The research data on weed infestation of common oats when grown for forage indicated that seeding rates effect on the weed infestation percentage. Thus, with an increase in the seeding rate of common oats from 4.5 to 6.0 mln pcs/ha, on average over three years, the number of common oat plants increased from 300.5 to 428.5 pcs/m2, the number of weeds decreased from 16.4 to 10.4 pcs/m2, respectively, the weed infestation level decreased from 5.2 $\pm$1.5% to 2.4 $\pm$0.6% (Table 1).

Table 1. Weed infestation of oat crops (Avena sativa) depending on seed application rate (2022-2024).

Seed application rate, mln pcs/ha	Component	Pcs/m^2			On average over the years, pcs/m^2	Average over the years, %
		2022	2023	2024		
4.5	Oats (Avena sativa)	286.3	364.5	250.8	300.5	94.8 ±2.6
	Weeds Incl.:	16.0	19.3	13.8	16.4	5.2 ±1.5
	couch grass (Elytrígia répens)	5.0	6.0	4.4	5.1	1.7±1.0
	field milk thistle (Sonchus arvensis)	3.0	4.2	2,0	3.1	1.0±0.9
	black bindweed (Fallópia convólvulus)	4.0	3.1	2.2	3.1	1.0±0.9
	Yakut artemisia (Artemisia jacutica).	4.0	3.0	2.2	3.1	1.0±0.9
	oatgrass (*Avena fatua),*	-	3.0	3.0	2.0	1.0±1.0
5.0 C	Oats (Avena sativa)	310.5	395.2	350.1	351.9	95.5 ±3.2
	Weeds Incl.:	15.7	18.4	15.5	16.5	4.5 ±1.8
	couch grass (Elytrígia répens)	4.5	5.0	4.2	4.6	1.3±0.9
	field milk thistle (Sonchus arvensis)	3.8	4.1	3.6	3.8	1.1±0.9
	black bindweed (Fallópia convólvulus)	4.1	4,0	3.0	3.7	1.0±1.0
	Yakut artemisia (Artemisia jacutica).	3.3	2.3	2.0	2.5	0.7±0.9
	oatgrass (*Avena fatua),*	-	3.0	2.7	1.9	0.5±1.0
5.5	Oats (Avena sativa)	350.7	365.2	384.6	366.8	96.5 ±1.2
	Weeds Incl.:	12.5	16.7	10.7	13.3	3.5 ±0.8
	couch grass (Elytrígia répens)	4.0	4.2	3.0	3.7	1.0±1.0
	field milk thistle (Sonchus arvensis)	3.1	4.0	2.5	3.2	0.9±0.9
	black bindweed (Fallópia convólvulus)	2.3	3.0	2.1	2.4	0.6±0.8
	Yakut artemisia (Artemisia jacutica).	3.1	3.0	1.1	2.4	0.6±0.8
	oatgrass (*Avena fatua),*	-	2.5	2.0	1.5	0.4+ 0.9
6.0	Oats (Avena sativa)	422.0	451.6	411.8	428.5	97.6 ±0.7
	Weeds Incl.:	8.4	12.3	10.5	10.4	2.4 ±0.6
	couch grass (Elytrígia répens)	3.1	3.5	2.8	3.1	0.7±1.0
	field milk thistle (Sonchus arvensis)	2.0	3.0	2.5	2.5	0.6±0.9
	black bindweed (Fallópia convólvulus)	1.5	2.2	2.1	1.9	0.4±0.9
	Yakut artemisia (Artemisia jacutica).	1.8	1.6	1.4	1.6	0.4±0.8
	oatgrass (*Avena fatua),*	-	2.0	1.7	1.2	0.3±1.0
LSD_{05}	Oats (Avena sativa)	1.9	2.5	1.9	2.9	2.1±0.02
LSD_{05}	Weeds	0.9	1.1	0.9	0.08	0.9± 0.01

While determining the types of weeds inhabiting the oat crops (Avena sativa), it was noted that the main weeds are couch grass *(Elytrígia repens),* field milk thistle *(Sonchus arvensis),* black bindweed *(Fallópia convólvulus), and Yakut* artemisia *(Artemisia jacutica). Since 2023, oatgrass (Avena fatua) has been identified in the common oat.*

Figure 1 shows weed seed counts before and after planting for the years 2022, 2023 and 2024.

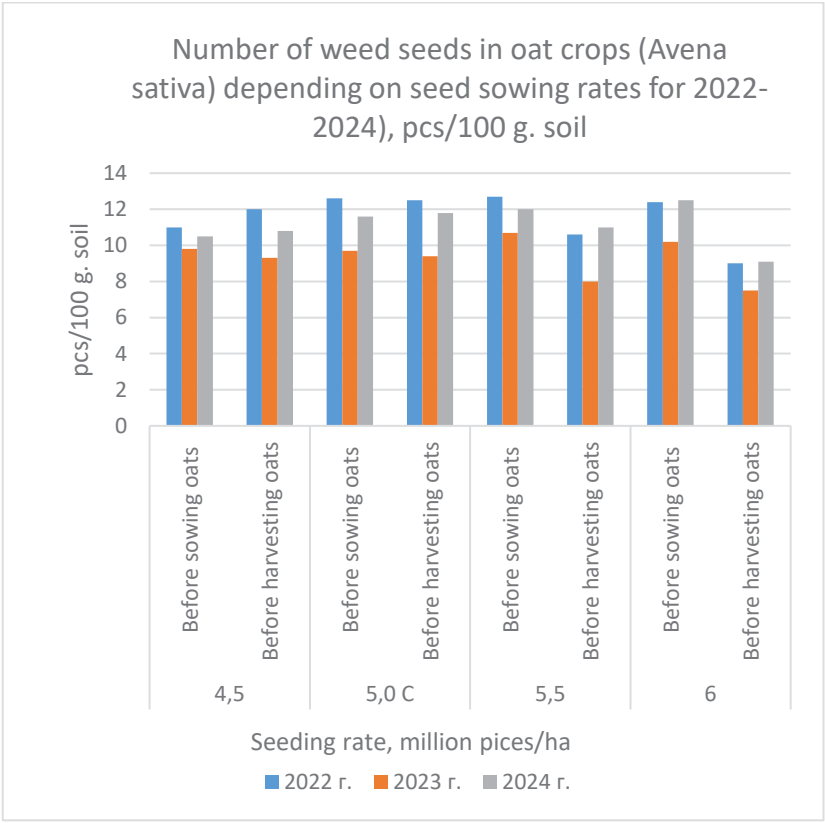

Fig. 1. Number of weed seeds in oat (Avena sativa) crops depending on seed sowing rates for 2022-2024, pcs/100 g. soil.

The graph (Figure 1) shows that at a seed sowing rate of 6 million pcs/ha, there is a decrease in the number of weed seeds during soil analysis for weed seed infestation in each year of research.

Calculation of the number of weed seeds in the soil in the spring before seeding and before harvesting of common oats (Table 2) allowed to establish that the number of weed seeds changes with an increase in the seeding rates of common oats from 5.5-6.0 ml. pcs/ha, respectively, by 1.9 and 3.2 pcs per 100 g of soil. It should be noted that the sowing rate of oat seeds, determined at 6.0 million pcs/ha, provided good protection against weeds. The replenishment of the soil with weed seeds is reduced due to a reduction in the weed infestation of crops from 5.2 to 2.4% on average over the years of the experiments.

Table 2. Number of weed seeds in common oats (Avena sativa) depending on seeding rates (2022-2024).

Seed application rate, mln pcs/ha	Component	Pcs/100g soil			On average over the years, pcs/m2	Deflection + -, pcs
		2022	2023	2024		
4.5	Before seeding oats	11.0	9.8	10.5	10.4	+0.3
	Before seeding oats	12.0	9.3	10.8	10.7	
5.0	Before seeding oats	12.6	9.7	11.6	11.3	-0.1
	Before seeding oats	12.5	9.4	11.8	11.2	
5.5	Before seeding oats	12.7	10.7	12.0	11.8	-1.9
	Before seeding oats	10.6	8.0	11.0	9.9	
6.0	Before seeding oats	12.4	10.2	12.5	11.7	- 3.2
	Before seeding oats	9.0	7.5	9.1	8.5	

The calculation of the forage yield of common oats (Avena sativa) showed that seeding rates effect on the formation of agrocenoses (Table 3). The highest yield of green mass was noted when seeding 6 mln pcs/ha (11.8 t/ha), where the excess of the control variant was 16.8%. The reduced yield of green mass (9.5 t/ha) on average over three years of research was formed by the option with a seeding rate of 4.5 million pieces/ha. On average, over the years of research, this option was lower than the control by 6% or 94% of the control. Option 3 with a seeding rate of 5.5 million pcs/ha provided an increase of up to 0.4 t/ha or +4% compared to the control option (Table 3).

Table 3. Yield of green mass of oats (Avena sativa) depending on seeding rates (2022-2024), t/ha.

Seed application rate, mln pcs/ha	Years			Average over the years, t/ha	Deflection from C, t/ha	% to C
	2022	2023	2024			
4.5	9.8	8.6	10.0	9.5	- 0,6	94.0
5.0 C	10.5	9.2	10.7	10.1	0	100
5.5	10.8	9.8	11.0	10.5	+0.4	104.0
6.0	12.1	10.6	12.8	11.8	+1.7	116.8

The step-by-step sowing rate of oat seeds of the Rovenik variety makes it possible to determine the optimal sowing rate of the Rovenik variety for growing it on green mass in the conditions of Central Yakutia.

The results of the researches presented in Figure 2 show that the maximum efficiency was observed in the 4th variant of the study of the seeding rate for the yield of green mass of oats. This variant annually provided the yield of green mass exceeding the control indicators by 1.15...1.2 times, which corresponds to an increase of 15...20%. This advantage was remained regardless of the meteorological conditions of the growth season over the three years of the experiment.

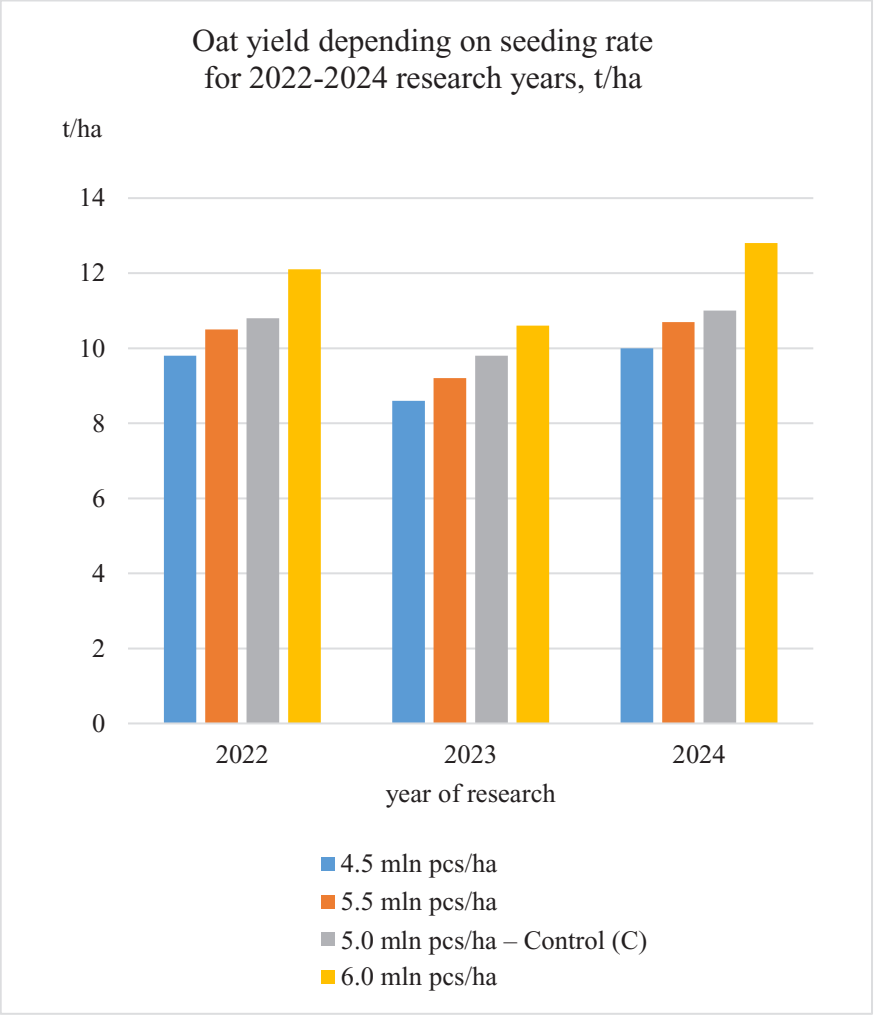

Fig. 2. Oat yield depending on seeding rate for 2022-2024 research years, t/ha.

4 Conclusions

1. Increasing the seeding rate of common oats seeds (Avena sativa) from 4.5 to 6.0 mln pcs/ha reduces the level of weed infestation from 5.2 + 1.5% to 2.4 + 0.6%;

2. To reduce the number of weed seeds in the soil by 1.9-3.2 pcs/100 g of soil, it is necessary to observe the following seeding rate of oats 6.0 mln pcs/ha, which ensures the highest yield of green mass (up to 11.8 t/ha).

3. The main weeds in the crops of common oats (Avena sativa) are couch grass (Elytrígia repens), field milk thistle (Sonchus arvensis), black bindweed (Fallópia convólvulus), *Yakut* artemisia (Artemisia jacutica), and oatgrass (Avena fatua).

4. In the permafrost zone on cryosolic wet meadow soils of Yakutia, when cultivating oats for forage in order to reduce weed infestation of crops and obtain high yields of green mass (up to 11.8 t/ha), it is recommended to use a seeding rate of 6 mln pcs/ha.

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