

Change in the Agrophytocenosis of Hulless Barley Depending on the Elements of Cultivation Technology

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Abstract— The cultivation technology elements of hulless barley were studied at the experimental field of the Omsk State Agrarian University, including 3 chemicalization backgrounds: without chemicalization, with herbicides (Puma Super 7.5 + Sekator Turbo) and with herbicides + fertilizers (ammonium nitrate N60); 3 sowing dates: May 14th-18th, May 25th-28th, June 4th-6th; 3 seeding rates: 3.5, 4.5 and 5.5 million germinating grains per hectare. On backgrounds with no fertilizers, the field germination rate of the crop averaged 68.6% and 68.9%; it decreased to 68% at a fertilized background. Minimum germination rates were when sowing was on May 25th-28th; maximum – when sowing was on June 4th-6th. When there is an increase in the seeding rate, the field germination decreases. The ratio of weeds in the control variants averaged 25.4%, herbicides reduced the weed ratio to 3.9 – 8.2%; the effectiveness of herbicides at a fertilized background was lower. The weed ratio decreased from the early to later sowing dates and as the seeding rate increased. In plots without chemicalization, the weight of one weed plant was 1.80 g, in variants with herbicidal treatment – 1.91-1.92 g. It reached its maximum value on crops that were sowed at the third decade of May. The weight of one cultivated plant at a background without chemicalization was 3.89 g, at a background with herbicides – 4.44 g, at a background with fertilizers and herbicides – 5.03 g; an increase in the seeding rate led to a decrease in the weight. In control variants, an average of 42.9% of barley plants survived; 51.0% – with the use of herbicides; 49.0% – with fertilizers and herbicides. As the seeding rate increased, the viability was reduced. Thus, the optimal conditions for the development of barley plants in agrophytocenosis were formed at the background of the use of nitrogen fertilizer (N60) and spraying of crops with a mixture of herbicides Puma Super 7.5, oil-water dispersion and Sekator Turbo, oil dispersion.

Keywords—hulless barley, agrophytocenosis, weed ratio, field germination, viability, technology elements.

I. INTRODUCTION

When choosing the optimal technology for cultivating hulless barley, the attention must be primarily paid to sowing dates, seeding rates and the use of fertilizers and herbicides [1, 2, 3]. Moreover, all these issues should be considered with the specific zonal conditions. In this regard, the need to clarify a number of elements of the cultivation technology of hulless barley in the conditions of the southern forest-steppe of the Omsk region arose.

II. METHODS

The experiments on the study of elements of the cultivating technology for the hulless barley of the Omsk hulless 2 variety were carried out in years 2011-2014 on the experimental field of the Omsk State Agrarian University on meadow-chernozem medium-capacity small-humus medium-loam soil. Barley was placed in a crop rotation according to the scheme: pairs of pure-wheat-wheat-barley. 3 backgrounds of chemicalization were used: without chemicalization (O), with herbicides (H) and herbicides + fertilizers (H + F); 3 sowing dates: May 14th-18th, May 25th-28th, June 4th-6th; 3 seeding rates: 3.5, 4.5 and 5.5 million germinating grains per hectare. Ammonium nitrate (N60) was inserted with a seeder before sowing the first term. A tank mixture of herbicides (Puma Super 7.5, oil-water dispersion at a dose of 0.9 l / ha + Sekator Turbo, oil dispersion at a dose of 75 ml / ha) was used in the tillering stage of barley with a flow rate of 200 l / ha. The experiment was repeated three times; the plot area is 20 m². The counts and observations were carried out according to generally accepted methods.

III. RESULTS AND DISCUSSION

The influence of elements of cultivation technology on the formation of agrophytocenosis can be manifested from the moment of the formation of crop seedlings. Field germination of hulless barley without the use of fertilizers, on average for all terms and sowing rates, was 68.6% and 68.9% (Table 1). The low level of this indicator can be explained by the absence of lodicules on the seeds, which leads to possible damage to the embryos when in contact with the seeder and soil [4]. At the same time, a decrease in field germination rates is called one of the main reasons for the insufficient productivity of the hulless varieties of barley [5].

TABLE I. FIELD GERMINATION OF HULLESS BARLEY DEPENDING ON THE ELEMENTS OF CULTIVATION TECHNOLOGY (2011-2014), %

Chemicalization background	Sowing date			Seeding rate, million / ha			Chemicalization background average
	I	II	III	3.5	4.5	5.5	
O	68.8	66.2	71.8	71.8	68.8	66.2	68.9
H	68.4	66.6	70.9	71.2	68.6	66.0	68.6
H+F	67.3	66.1	70.5	71.3	67.5	65.2	68.0
Mean value	68.2	66.3	71.1	71.4	68.3	65.8	68.5

Field germination with a fertilized background was inferior to options without fertilizing by only 0.6-0.9%. At the same time, there are reports that the addition of N60 increases the density of barley, as in our experience, in the phase of 2-3 leaves of the culture [6].

Sowing dates had a greater influence on the field germination of barley. On average, for all backgrounds of chemicalization and seeding rates, the minimum indicators were obtained when sowing was on May 25th-28th – which is 66.3%, and the maximum when was sowing on June 4th-6th – 71.1%. Although in the Chelyabinsk region there was an increase in field germination at an earlier sowing period [3].

According to our observations, there is a clear tendency toward a decrease in field germination capacity of hullless barley as the seeding rate increases from 71.4% to 65.8%. A similar trend was noted earlier for chaffy barley in the Kurgan region [7].

As a result, the share of the seeding rate impact on the field germination rate of the crop was 57.3%, the sowing period – 41.0% and the chemicalization background – 1.7% (Fig. 1).

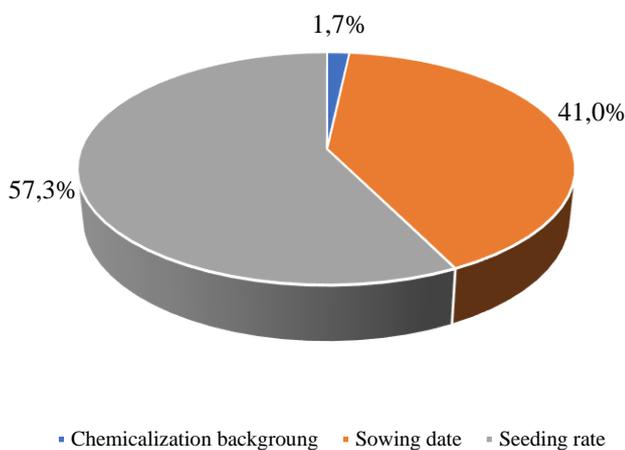


Fig. 1. Contribution of impact factors in field germination of hulls barley (2011-2014), %

Elements of technology affect the weed ratio of crops [8]. On average, for all sowing dates and seeding rates, the share of all weeds in barley agrophytocenosis in the control variants without the use of chemicals was 31.5% (Fig. 2). Which corresponds to a great degree of weed ratio. In this case, predominance was for young dicotyledonous species – 25.3%. A similar ratio remained on other versions of the experiment. When using a tank mixture of herbicides, a smaller degree of weed ratio was noted, the proportion of weeds was only 7.3. The effectiveness of the use of herbicides was lower at a background of nitrogen fertilizer. The weed ratio in this variant exceeded 10%, which is typical for an average degree of the ratio.

The barley sowing dates had a certain effect on the weed ratio, although the differences are not so contrasted. On average, for all chemicalization backgrounds and seeding rates, the share of all weeds was 18.1% at the first sowing period. When sowing in the third decade of May this indicator was 1.2% higher. A more noticeable reduction in weeds was noted in the crops on June 4-6 – 15.8%.

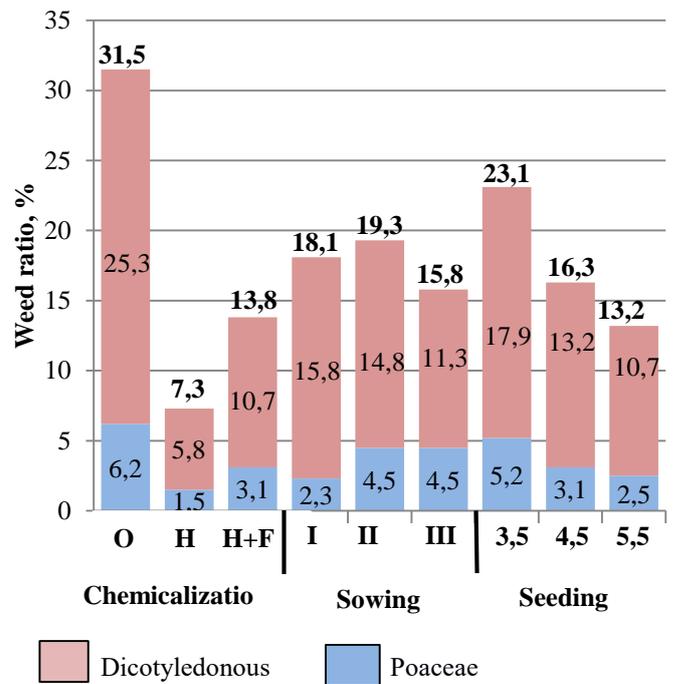


Fig. 2. The weed ratio in the agrophytocenosis of hullless barley (2011-2014), %

The seeding rates impact was more noticeable for the average of all chemicalization backgrounds and sowing dates. When sowing 3.5 million germinating grains per hectare, the proportion of weeds was 23.1%, and with an increase of 1 million / ha – it was at 16.3% and with a maximum sowing coefficient – 13.2%.

When assessing the effectiveness of sowing dates, a decrease in the proportion of weeds from early to later dates at all levels of chemicalization should be noted. The same trend was noted with increasing seeding rates.

As a result, the chemicalization background made the maximum contribution to the change in the weed ratio in agrophytocenosis – 84.6% (Fig. 3).

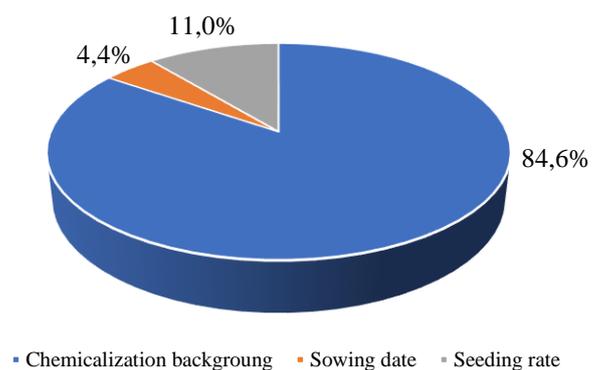


Fig. 3. Contribution of impact factors in the variability of the weed ratio in agrophytocenosis (2011-2014), %

Considering the formation of the weed component of agrophytocenosis, attention should be paid to the reaction of each weed plant to an element of the technology of barley cultivation. If on plots without the use of chemicals, the weight of one weed plant was 1.80 g, then after application of

the herbicides it was 1.91-1.92 g (Table 2). The contribution of the chemicalization background factor to this indicator was only 15.4%.

Assessing the impact of sowing dates on the individual development of weeds, it should be noted that when sowing in the second decade of May, the least comfortable conditions were created for the weeds. The mass of one plant was 1.76 g and this indicator reached its maximum value in the crops of the third decade of May. The contribution of the sowing period factor to the change in the weed mass index was 44.4%.

TABLE II. THE MASS OF ONE WEED PLANT (2011-2014), G

Chemicalization background	Sowing date			Seeding rate, million / ha			Chemicalization background average
	I	II	III	3.5	4.5	5.5	
O	1.53	2.07	1.80	1.84	1.72	1.84	1.80
H	1.77	2.03	1.94	1.61	1.87	2.26	1.91
H+F	1.99	1.84	1.92	1.88	1.99	1.87	1.92
Mean value	1.76	1.98	1.89	1.78	1.86	1.99	1.88

As the seeding rate increased, the number of weeds decreased, but the mass of each plant increased from 1.78 to 1.99 g. The impact of the seeding rate in the formation of the mass of one weed was 40.2%.

On average, according to our experience, they weight of each plant of hulless barley exceeded the weed plant by more than 2 times. The individual development of plants of hulless barley to a greater extent depended on the chemicalization background. The weight of one plant was 3.89 g on plots without the use of fertilizers and herbicides; with herbicides – 4.44 g; with the combined use of nitrogen fertilizers and herbicides – 5.03 g (Table 3).

TABLE III. VIABILITY OF HULLES BARLEY DEPENDING ON THE ELEMENTS OF CULTIVATION TECHNOLOGY (2011-2014), %

Chemicalization background	Sowing date			Seeding rate, million / ha			Chemicalization background average
	I	II	III	3.5	4.5	5.5	
O	3.58	3.68	4.42	3.99	3.97	3.72	3.89
H	4.65	3.91	4.75	4.63	4.50	4.19	4.44
H+F	5.67	3.99	5.42	5.42	5.02	4.64	5.03
Mean value	4.63	3.86	4.86	4.68	4.50	4.18	4.45

As the seeding rate increased from 3.5 to 5.5 million / ha, viability decreased from 53.0% to 42.5%. Least of all, the viability of barley plants responded to the sowing dates. In the first two terms, the difference is minimal – 0.4%. Only when sowing in the first decade of June, survival rate decreased to 45.9%. The share of the chemicalization background in the variability of the viability of plants of hulless barley was 37.7% (Fig. 4).

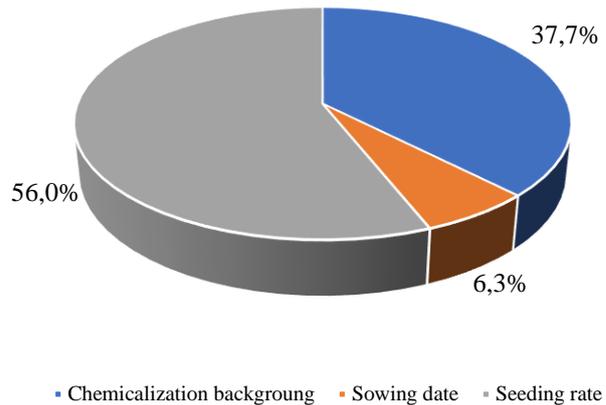


Fig. 4. Contribution of impact factors in the variability of viability of hulless barley (2011-2014), %

The largest contribution to this indicator was made by seeding rates – 56.0%. The impact of the sowing period was only 6.3%.

IV. CONCLUSION

The optimal conditions for the development of hulless barley plants in agrophytocenosis were formed at the background of nitrogen fertilizer (N60) application and spraying the crops with a tank mix of Puma Super 7.5, oil-water dispersion and Sekator Turbo, oil dispersion herbicides.

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