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EFFECT OF SOWING DATES AND NORMS ON SEEDLING DENSITY AND GRAIN YIELD OF AUTUMN WHEAT VARIETIES

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Abstract. *This article describes the influence of different sowing dates and seeding rates on seedling density and grain yield of the «Svat» and «Tit» varieties of autumn triticale under the conditions of chestnut-meadow soils in the semi-desert zone of the Navoi region during the period 2022-2025.*

Key words: *chestnut-meadow soil, autumn triticale, varieties, sowing dates, seeding rates, growing season, field germination, germination, seedling density, grain yield.*

INTRODUCTION. Currently, triticale is cultivated in approximately 65 countries worldwide, with an annual sown area exceeding 5.0 million hectares, producing 14-16 million tons of gross yield and an average grain yield of 3.5-4.0 tons per hectare [8]. Triticale is cultivated on large areas in countries such as Poland, Germany, Belarus, Russia, and the United States, which collectively account for 87.8 percent of the world's triticale grain production [7]. Currently, triticale is recognized as high-quality feed for livestock, and strengthening a quality feed base for animals is crucial for fully meeting the world population's year-round demand for dairy and meat products. In this regard, it is of great importance to determine the optimal sowing dates and

norms for local and foreign varieties adapted to our local conditions in various natural climatic zones, develop corresponding agrotechnical measures, and provide scientifically based recommendations for production.

Based on this, from 2022 to 2025, we carried out studies in the semi-desert zone of the Navoi region on chestnut-meadow soils to determine the influence of varying sowing dates and seeding norms on seedling stand density and grain productivity of the foreign autumn triticale varieties «Svat» and «Tit».

RESEARCH METHODS AND METHODOLOGY

The experiment consisted of 18 variants arranged in a single-tier layout with 3 replications. The experimental field had a ridge width of 70 cm and a length of 50 m. Each plot area was 280 m², with a recorded (measured) area of 140 m². The total area of the experiments was 1.6 hectares. The experiment was conducted over 3 years in a short-rotation cropping system of 1:1 (cotton:cereal).

Table 1.

Experimental Scheme

№	Autumn Triticale Variety	Sowing dates	Seeding rates, million seeds/ha
1	Svat	15 September	4,0
2			5,0
3			6,0
4		1 October	4,0
5			5,0
6			6,0
7		15 October	4,0
8			5,0
9			6,0
10	Tit	15 September	4,0

11			5,0
12			6,0
13		1 October	4,0
14			5,0
15			6,0
16		15 October	4,0
17			5,0
18			6,0

The study examined seeds of the «Svat» and «Tit» autumn triticale varieties under three sowing dates (September 15, October 1, and October 15) and three seeding rates (4.0, 5.0, and 6.0 million seeds per hectare).

The experimental fields were selected and the variants were arranged in accordance with the methodological guide «Field Experiment Methodology» (2007). Phenological observations and assessments in autumn triticale plants were carried out following the «Methodology for State Variety Testing of Agricultural Crops» (Moscow, Kolos, 1964). The obtained results were subjected to mathematical-statistical analysis using B.A. Dospekhov's "Methodology of Field Experiment" (Moscow, 1985).

RESULTS AND DISCUSSION

It is widely recognized that seedling density is a critical yield-determining factor in cereal crops. However, sowing date plays a substantial role in achieving the desired plant stand.

Water, air, and temperature are fundamental factors for seed germination in cereal crops. Seeds initiate germination after absorbing approximately 50-70% of water by their own weight [2].

Seeds of autumn triticale start germinating at temperatures of 3-5 °C. Germination rate increases with rising temperature. The optimum temperature for germination is 20-22 °C [6].

Triticale germinates 2-3 days earlier compared to wheat. The optimum temperature for its germination ranges from 18 to 25 °C, while soil moisture in the 3-5 cm layer should exceed 80% [1].

Our studies carried out from 2022 to 2025 investigated the effect of sowing dates and seeding norms of triticale varieties on plant density during both the beginning and end of the vegetation period.

At the start of the vegetation period, seedling emergence rates were analyzed. For autumn triticale «Svat», sown at 4.0 million viable seeds per hectare, emerged seedling counts were 365.2, 362.8, and 359.2 plants/m² for the September 15, October 1, and October 15 sowing dates, respectively. At the 5.0 million seeds/ha rate, the corresponding densities were 452.5, 449.0, and 443.5 plants/m². At 6.0 million seeds/ha, densities were 538.2, 534.0, and 525.6 plants/m² for the same sowing dates.

Analysis of the plots sown with the autumn triticale variety «Tit» showed that seedling emergence density at the 4.0 million viable seeds per hectare rate was 370.4, 367.2, and 362.8 plants/m² for the respective sowing dates. At 5.0 million seeds/ha, densities were 457.5, 452.5, and 446.5 plants/m², while at 6.0 million seeds/ha, they were 542.4, 537.6, and 527.4 plants/m².

The data indicate that postponing the sowing date adversely impacts seedling emergence. Relative to the September 15 sowing, a seeding rate of 4.0 million viable seeds per hectare resulted in a reduction of 2.4 to 6.0 plants/m² for «Svat» and 3.2 to 7.6 plants/m² for «Tit». At 5.0 million seeds/ha, the decrease ranged from 3.5 to 9.0 plants/m² for «Svat» and 5.0 to 11.0 plants/m² for «Tit». At 6.0 million seeds/ha, the decline was 4.2 to 12.6 plants/m² for «Svat» and 4.8 to 15.0 plants/m² for «Tit».

Table 2.

Effect of sowing dates and norms on seedling stand density in autumn triticale cultivars

№	Autumn Triticale Variety	Sowing dates	Seeding rates, million seeds/ha	Seedling emergence count, plants/m2	Post-winter plant stand density, plants/m2	Plant density at the end of the growing season, plants/m²
1	Svat	15 September	4,0	365,2	325,0	323,6
2			5,0	452,5	395,9	391,4
3			6,0	538,2	463,9	456,9
4		1 October	4,0	362,8	327,2	328,3
5			5,0	449,0	397,8	396,0
6			6,0	534,0	467,3	458,7
7		15 October	4,0	359,2	328,7	326,2
8			5,0	443,5	401,8	392,5
9			6,0	525,6	468,3	453,6
10	Tit	15 September	4,0	370,4	327,8	326,0
11			5,0	457,5	397,1	393,0
12			6,0	542,4	463,8	457,8
13		1 October	4,0	367,2	335,3	331,6
14			5,0	452,5	408,2	399,1
15			6,0	537,6	475,8	461,3
16		15 October	4,0	362,8	325,4	325,8
17			5,0	446,5	393,4	392,9
18			6,0	527,4	457,3	450,9

Nevertheless, analysis of the actual final plant stand density across the treatment variants revealed noticeable differences compared to the initial density at the start of the growing season.

The results indicate that, although both varieties followed a similar trend in final plant density, for all seeding rates, the plots sown on October 1 consistently showed the most favorable outcomes.

Specifically, for the autumn triticale variety «Svat», when plant density was assessed in variant 4 sown on October 1 at a rate of 4.0 million viable seeds per hectare, an average of 328.3 plants/m² was recorded. The loss of emerged seedlings by the end of the growing season was 9.5%, with seedling survival at 90.5%. This density was observed to be higher by 2.2-4.8 plants/m² compared to variants 1 and 7 sown on September 15 and October 15, respectively, at the same seeding rate.

When variant 5, sown at 5.0 million viable seeds per hectare, was examined, it showed a higher density of 3.5-4.6 plants/m² compared to variants 2 and 8 sown on September 15 and October 15 at the same rate. For variant 6, sown at 6.0 million viable seeds per hectare, the density was higher by 1.8-5.1 plants/m² compared to variants 3 and 9 sown on September 15 and October 15, respectively.

Upon analyzing variants 13, 14, and 15 of the autumn triticale variety «Tit», sown on October 1 at rates of 4.0, 5.0, and 6.0 million viable seeds per hectare, the actual plant density at the end of the growing season was recorded as 331.6, 399.1, and 461.3 plants/m², respectively. This was found to be higher by 5.6-6.1-3.5 plants/m² compared to variants 10, 11, and 12 (sown on September 15 at corresponding rates), and by 5.8-6.2-10.3 plants/m² compared to variants 16, 17, and 18 (sown on October 15 at corresponding rates).

It can be observed that seedling loss in both varieties occurred not only during winter but continued from early spring until the end of the growing season. Examination of seedling mortality indicators across variants showed the lowest rates in plots of the «Svat» variety sown on October 15. Compared to plots sown on September 15, seedling loss was 1.4-2.2% lower, and survival

was 1.0-1.9% higher. Compared to plots sown on October 1, loss was 0.3-0.4% lower, and survival was 0.3-0.4% higher.

In the variants sown with the autumn triticale variety «Tit», the lowest loss of emerged seedlings by the end of the growing season was recorded in the plots sown on October 1. Compared to the plots sown on September 15, seedling loss was 1.4 to 2.3% lower, while seedling survival was 1.4 to 2.3% higher. Compared to the plots sown on October 15, seedling loss decreased by 0.2 to 0.5%, and survival increased by 0.2 to 0.5%.

To determine the influence of agrotechnical measures applied during the cultivation of autumn triticale varieties on grain yield, we conducted studies and calculations across the variants.

According to the results obtained, grain yield in the autumn triticale variety «Svat» sown on September 15 at rates of 4.0, 5.0, and 6.0 million viable seeds per hectare (variants 1-3) averaged 72.1, 70.5, and 62.4 quintals per hectare, respectively. In the plots sown on October 1 at the same seeding rates (variants 4-6), grain yield was 74.7, 76.8, and 78.5 q/ha. Analysis of the plots sown on October 15 (variants 7-9) showed yields of 69.4, 77.2, and 79.2 q/ha, respectively.

When analyzing the obtained grain yields across seeding rates, for the autumn triticale variety «Svat» sown at 4.0 million viable seeds per hectare, the highest yield was recorded in variant 4 (sown on October 1). Compared to variants 1 and 7 (sown on September 15 and October 15 at the same rate, respectively), an additional grain yield of 2.6 to 5.2 q/ha was obtained.

For plots sown at 5.0 million seeds per hectare, the highest grain yield was observed in variant 8 (sown on October 15). This was 0.4 to 6.7 q/ha higher than variants 2 and 5 (sown on September 15 and October 1 at the same rate, respectively).

Concerning plots sown at 6.0 million seeds per hectare, the best results were also identified in variant 9 (sown on October 15). This variant yielded 0.7

to 16.8 q/ha more than variants 3 and 6 (sown on September 15 and October 1 at the same rate, respectively).

Upon analyzing the variants sown with seeds of the autumn triticale variety «Tit», for the plots sown at 4.0 million viable seeds per hectare, the highest yield was observed in variant 13 (sown on October 1). It exceeded variants 10 and 16 (sown on September 15 and October 15, respectively, at the same rate) by 1.9 to 3.8 q/ha.

For plots sown at 5.0 million seeds per hectare, the maximum grain yield was recorded in variant 17 (sown on October 15), which was 2.4 to 6.5 q/ha higher than variants 11 and 14 (sown on September 15 and October 1, respectively).

Similarly, for plots sown at 6.0 million seeds per hectare, the best results were also noted in variant 18 (sown on October 15), producing an additional 1.9 to 14.9 q/ha compared to variants 12 and 15 (sown on September 15 and October 1, respectively).

Table 3.

Effect of planting dates and norms on grain productivity of autumn triticale cultivars, quintals/ha

№	Autumn Triticale Variety	Sowing dates	Seeding rates, million seeds/ha	Grain yield, q/ha			Average grain yield, q/ha
				2023	2024	2025	
1	Svat	15 September	4,0	71,9	73,3	71,0	72,1
2			5,0	69,8	71,6	70,0	70,5
3			6,0	61,9	63,7	61,6	62,4
4		1 October	4,0	73,7	75,8	74,5	74,7
5			5,0	76,7	78,5	75,3	76,8
6			6,0	78,4	80,3	76,7	78,5
7		15 October	4,0	69,0	71,5	67,8	69,4

8			5,0	76,9	78,7	76,0	77,2
9			6,0	79,0	80,8	77,8	79,2
10	Tit	15 September	4,0	69,4	70,6	68,9	69,6
11			5,0	68,4	70,8	67,6	68,9
12			6,0	61,6	64,1	60,7	62,1
13		1 October	4,0	71,2	72,9	70,4	71,5
14			5,0	72,8	74,7	71,6	73,0
15			6,0	75,0	76,9	73,5	75,1
16		15 October	4,0	67,5	69,3	66,4	67,7
17			5,0	75,7	76,4	74,3	75,5
18			6,0	77,1	78,2	75,9	77,1

The data indicate that consistent trends were repeated for both varieties. Higher grain yields were recorded on October 1 for plots sown at 4.0 million viable seeds per hectare, whereas for plots sown at 5.0 and 6.0 million seeds per hectare, the highest yields were observed in plots sown on October 15.

SUMMARY. Analysis of the plant stand density results shows that optimal performance for the «Svat» cultivar was achieved with the October 15 sowing date, whereas for «Tit», the best results were obtained with the October 1 sowing. The differential optimal sowing date between the two varieties can likely be attributed to their distinct biological traits and growth cycle durations.

While early sowing (September 15) of autumn triticale varieties promotes higher tillering, it also increases the proportion of non-productive tillers alongside productive ones. At this date, high seeding rates (5.0 and 6.0 million viable seeds/ha) cause excessive crowding, leading to a severe reduction in the nutrient area per plant and resulting in spike miniaturization, which critically compromises grain yield.

Late sowing (October 15) reduces the tillering capacity. Our studies demonstrated that establishing seeding norms in consideration of the sowing date exerts a positive influence on crop yield.

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