AMERICAN JOURNAL OF BIODIVERSITY
https://biojournals.us/index.php/AJB
ISSN: 2997-3600

Article

Influence of Seeding Dates and Norms for Early-Priceing Windy Wheat Varieties on Wintering and Plant Density

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Citation: Muminova, O. Z & Egamov, I. U. Influence of Seeding Dates and Norms for Early-Priceing Windy Wheat Varieties on Wintering and Plant Density. American Journal Of Biodiversity 2026, 3(7), 13-18

Received: 10th Apr 2026
Revised: 27st May 2026
Accepted: 08th June 2026
Published: 25th July 2026

Abstract: According to the results of a field experiment conducted on early-maturing winter wheat varieties Ultra, Asr Chilgisi, and Grat under four sowing dates (September 20, October 5, October 20, and November 5) and two sowing rates (4.5 and 5.5 million viable seeds per hectare), it was found that the Asr Chilgisi variety yielded the best results when sown on the second date (October 5) at a sowing rate of 5.5 million viable seeds per hectare. Under this treatment, higher field germination, overwintering, and plant density were observed compared to other sowing dates and rates.

Keywords: winter wheat, Ultra, Asr Chilgisi, Grat, variety, early-maturing, seeds, sowing rate, sowing date, yield, centner.

Introduction

Taking into account the soil and climatic conditions of irrigated lands, scientific research is being conducted aimed at developing elements of agrotechnology for cultivating promising, high-yielding, and grain-quality varieties of soft winter wheat. Based on the research results, the most adapted varieties of winter soft wheat are selected for each region, optimal sowing dates and rates are determined, and scientifically grounded recommendations for fertilizer application are developed.

To obtain a high and high-quality harvest of winter wheat, it is recommended to sow 220–240 kg of seeds per hectare after October 20, which corresponds to 5.5–6.0 million germinating seeds per hectare [1].

When studying the mid-season winter wheat variety Pervitsa, it was established that the maximum yield (62.9 c/ha) was obtained at the first sowing date (September 15) and a sowing rate of 5 million germinating seeds per hectare. At later sowing dates and other sowing rates, the yield decreased by 5–7 c/ha, indicating the need for timely sowing of mid-season varieties [2].

For the late-ripening Zimnitsa variety, the optimal sowing date was the second decade of September (September 15). At a sowing rate of 5 million germinating seeds per hectare, the grain yield was 63.4 c/ha. In the remaining experimental variants, the yield decreased by 4–6 c/ha. For the Davr variety, the optimal sowing date is recognized as the first decade of October (October 1). With a sowing rate of 5 million germinating seeds per hectare, the yield reached 63.3 c/ha, while in other variants, the decrease was 3–4 c/ha [3].

It has been established that depending on soil and climatic conditions, the biological characteristics of the variety, sowing dates and rates, as well as the quantity and ratio of applied fertilizers, the growth and development of plants are improved, and the yield and grain quality of wheat increase [4].

In the conditions of the light sierozem soils of the Kashkadarya region, optimal conditions for obtaining uniform and full-fledged seed germination of winter soft wheat were ensured when sowing on October 20 at a sowing rate of 5 million seeds per hectare against a background of mineral fertilizer application of N210P147K105 kg/ha. Under these conditions, the "Bunyodkor" and "Gozgon" varieties ensured the highest field seed germination rates of 87.4% and 85.7%, respectively [5].

Materials and Methods

Field research was conducted at the Central Experimental Field of the Research Institute of Grain and Leguminous Crops. The objects of the study were early-maturing winter wheat varieties Ultra, Asr Chilgisi, and Grat. Experiments were conducted at four sowing dates (20.09, 05.10, 20.10, and 05.11) at two sowing rates of 4.5 and 5.5 million germinating seeds per hectare.

During the research, the following methodological guidelines were utilized: "Methods of Agrochemical Analyses of Soils and Plants" (Tashkent, 5th ed., 1977) for conducting agrochemical soil analyses; methodological recommendations of the All-Union Plant Research Institute (VIR, Moscow, 1977) for conducting phenological observations; "Methodology of State Variety Testing of Agricultural Crops" (Moscow, 1989).

Results

Research results showed that the sowing dates and rates of early-maturing winter wheat varieties significantly influenced seed field germination, plant overwintering, and the number of surviving plants by the end of the growing season.

Analysis of the influence of sowing rates showed that at a rate of 5.5 million germinating seeds per hectare, the number of plants at the beginning of the growing season was higher compared to the rate of 4.5 million seeds/ha for all studied varieties. For instance, in the Ultra variety, this indicator was 401.3–424.4 plants/m2 at a sowing rate of 4.5 million seeds/ha, and increased to 482.3–498.1 plants/m2 with an increase in the sowing rate to 5.5 million seeds/ha. A similar pattern was observed in the Asr Chilgisi and Grat varieties: the number of plants at the beginning of the growing season increased from 405.7–429.7 and 403.2–426.8 to 483.6–508.1 and 484.6–499.8 plants/m2, respectively.

The field germination of early-maturing varieties decreased as the sowing dates were delayed. At a sowing rate of 4.5 million germinating seeds per hectare, field germination was 94.3–95.4% in the variants sown on September 20, whereas it decreased to 89.1–90.1% when sown on November 5. A similar trend was observed with a sowing rate of 5.5 million seeds/ha, where field germination decreased from 90.5–92.3% to 87.6–88.1%. This is explained by the decrease in soil temperature during late sowing periods and the reduction of the period favorable for seed germination.

When analyzed by variety, it was established that regardless of the sowing rate, the highest indicators were obtained in the "Asr Chilgisi" variety. Specifically, with a sowing rate of 4.5 million germinating seeds per hectare and September 20 sowing, the number of plants at the beginning of the growing season was 429.7 plants/m2, which is 5.3 plants/m2 more than the Ultra variety and 2.9 plants/m2 more than the Grat variety. The field germination of this variety reached 95.4%, which also exceeded the indicators of the other studied varieties.

During the winter period, winter wheat plants go into a state of dormancy. The success of their overwintering depends on a complex of environmental factors, primarily the degree of plant preparation for the dormancy period and the level of their hardening before winter arrives.

In terms of the number of plants preserved after wintering, the Asr Chilgisi variety also held the leading position. When sowing at a rate of 4.5 million germinating seeds per hectare and on September 20, 366.4 plants/m2 were preserved after wintering, whereas for the Ultra variety, this figure was 355.4 plants/m2, and for the Grat variety, it was 359.7 plants/m2. Consequently, plant preservation after wintering was higher in the Asr Chilgisi variety by 11.0 plants/m2 compared to the Ultra variety and by 6.7 plants/m2 compared to the Grat variety.

Table 1. Influence of sowing dates and sowing rates on the plant density of early-maturing winter wheat varieties (2022).

No	**Varieties**	**Sowing dates**	**Number of plants at the beginning of the growing season, units/m2**	**Field germination of seeds, %**	**Number of plants after wintering, pcs./m2**	**Destroyed plants, units, %**	**Number of plants at the end of the growing season, units/m2**
			4.5 million units				
1	Ultra	September 20	424.4	94.3	355.4	69/16.2	349.2
2.		October 5th	421.1	93.5	333.5	87.6/20.8	331.7
3.		October 20th	415.4	92.2	324.8	90.8/21.8	320,2
4		November 5	401.3	89.1	309.2	92.1/22.9	304.8
5	Asr Chilgisi	September 20	429.7	95.4	366.4	63.3/14.7	362.3
6		October 5th	426.2	94.7	360.8	65.4/15,3	357.2
7		October 20th	418.4	92.9	338.2	80.2/19.1	335.6
8		November 5	405.7	90.1	323.6	82.1/20.2	320,4
9	Grate	September 20	426.8	94.8	359.7	67.1/15,7	356.3
10		October 5th	422.3	93.8	350.8	71.5/16.9	347.3
11		October 20th	412.6	91.6	326.4	86.2/21.9	323.1
12		November 5	403.2	89.6	314.7	88.5/20.2	316.8
			5.5 million units				
13	Ultra	September 20	498.1	90.5	416.3	81.8/16.4	412.8
14		October 5th	494.1	89.8	409.8	84.3/17.1	407.4
15		October 20th	486.4	88.4	403.8	82.6/17.4	401.6
16		November 5	482.3	87.6	391.4	90.9/18.8	389.4
17	Asr Chilgisi	September 20	508.1	92.3	428.7	70.9/15,6	424.6
18		October 5th	501.8	91.2	431.6	73.1/14.5	429.4
19		October 20th	491.3	89.3	409.6	81.7/16.6	406.7
20		November 5	483.6	87.9	397.4	86.2/17.8	394.2
21	Grate	September 20	499.8	90.8	421.7	78.1/15,6	417.8
22		October 5th	496.7	90.3	411.4	85.3/17.2	409.7
23		October 20th	487.4	88.6	400,8	86.6/17.7	397.4
24		November 5	484.6	88.1	393.1	91.5/18.9	390.5

A comparison of different sowing dates showed that in all studied varieties, the highest indicators of field germination, plant preservation after wintering, and plant density were obtained at earlier sowing dates.

According to the research results, it was established that for the Asr Chilgisi variety, at a sowing rate of 4.5 million germinating seeds per hectare, the number of plants preserved by the end of the growing season was 362.3 plants/m2 when sown on September 20, 357.2 plants/m2 when sown on October 5, 335.6 plants/m when sown on October 20, and 320.4 plants/m2 when sown on November 5. Compared to the September 20 sowing, the decrease was 5.1; 26.7 and 41.9 plants/m2**.**

A similar pattern was observed in the Ultra variety, where the number of plants decreased by the end of the growing season from 349.2 plants/m2 when sown on September 20 to 304.8 plants/m2 when sown on November 5. Thus, due to late sowing, losses amounted to 44.4 plants/m2**,** or 12.7%**.**

For the Grat variety, the difference between the specified sowing dates was 39.5 plants/m^2: the number of preserved plants decreased from 356.3 to 316.8 plants/m^2.

A similar trend was observed with a sowing rate of 5.5 million germinating seeds per hectare. For the "Asr Chilgisi" variety, in the variants sown on September 20 and October 5, 424.6 and 429.4 plants/m2 were preserved by the end of the growing season, respectively, whereas in the variants sown on October 20 and November 5, this figure was 406.7 and 394.2 plants/m2, respectively. At the same time, the October 5 sowing variant ensured the highest number of preserved plants among all studied variants.

Analysis of the proportion of dead plants showed that as the sowing dates shifted to a later period, plant losses during wintering increased. At a sowing rate of 4.5 million germinating seeds per hectare, the share of dead plants in the Ultra variety increased from 16.2% to 22.9%, in the Asr Chilgisi variety from 14.7% to 20.2%, and in the Grat variety from 15.7% to 22.0%. A similar trend was observed at a sowing rate of 5.5 million germinating seeds per hectare. The lowest plant mortality was observed in the Asr Chilgisi variety when sown on September 20, where this figure was 15.6%.

Discussion

The decline in field germination with delayed sowing observed in this experiment agrees with reports for wheat grown under comparable irrigated conditions elsewhere in Central Asia, where later planting lowers soil temperature and shortens the period available for seedling establishment [6]. Broader agronomic evidence from China and other semi-arid wheat-growing regions likewise links delayed sowing to weaker germination and slower stand establishment, driven by cooler seed-zone temperatures and reduced thermal-time accumulation before winter dormancy [7], [8].

The comparatively smaller relative losses recorded at the higher sowing rate (5.5 million seeds/ha) are consistent with findings that an increased seeding rate can partly offset the negative consequences of late sowing by compensating for reduced tillering and a shortened autumn growth period [9], [10]. As in the present study, however, this compensation proved only partial: even at the higher rate, the proportion of plants lost over winter still rose steadily as sowing was delayed, indicating that a higher seeding rate cannot fully substitute for weaker pre-winter hardening.

Findings from Uzbekistan's own irrigated gray-soil zones support this pattern: photosynthetic potential and dry-matter accumulation in winter wheat sown in the Zarafshan Valley from late September through mid-October, followed by a sharp decline for sowings after the third decade of October, closely resemble the germination and survival trends recorded here [11]. This regional convergence suggests that late September to early October remains the agronomically safest sowing window for early-maturing varieties across similar irrigated environments.

The overwintering losses observed in this study, which rose from roughly 15% to over 20% of the stand as sowing was delayed by six weeks, are broadly consistent with cold-tolerance research showing that a wheat plant's freezing threshold depends heavily on the degree of pre-winter hardening it has completed, which is itself a function of the length of the autumn growth period [12]. Delayed sowing shortens this hardening window and predisposes stands to greater winter injury regardless of variety, which likely explains why all three varieties in the present experiment showed a similar direction of response even though their absolute survival rates differed.

The clear advantage of Asr Chilgisi over Ultra and Grat parallels wider evidence that genotype-specific responses to sowing date and seeding rate are common in wheat, and that no single sowing regime performs equally well across all cultivars [13], [14]. This reinforces the practical value of variety-specific sowing recommendations rather than a single blanket sowing date for early-maturing winter wheat grown in similar agro-climatic zones.

Taken together, these findings align with an emerging view that pairing a sufficiently early sowing date with a moderately increased seeding rate offers the most reliable route to a dense, winterhardy stand, while seeding-rate increases show diminishing returns once sowing is delayed beyond the optimal window [9], [15]. Because the present results come from a single growing season (2022) at one experimental site, multi-year, multi-location trials would help confirm whether the September 20–October 5 window and the 5.5 million seeds/ha rate identified for Asr Chilgisi remain optimal under variable winter conditions.

Conclusion

Overall, the research results showed that with increasing sowing dates, seed field germination, plant preservation after wintering, and the number of plants preserved by the end of the growing season decreased. Among the studied varieties, the Asr Chilgisi variety was distinguished by the highest indicators of field germination, winter resistance, and plant preservation. The most favorable results were obtained during sowing on September 20 and October 5, especially with a sowing rate of 5.5 million germinating seeds per hectare.

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