Influence of seed onion planting time on productivity and quality of bulb onion varieties

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Abstract. Vegetable crops play an important role in human nutrition. They contain the necessary organic acids, mineral salts, vitamins and other useful substances. The most popular among vegetables in the conditions of the Udmurt Republic are white cabbage, carrots and table beets, cucumbers, squash, tomatoes and various types of onions. Among onion crops, leeks and shallots are grown in small quantities; among perennial onions - welsh onions, chives and tree onions. The most common among the population is common onion grown mainly for bulbs, in small quantities - for greens. The study of the planting timing of onion varieties' seeds is relevant. The studies' results of the influence of the seed onion planting time on the yield and product quality of common onion varieties in the open ground of the Udmurt Republic are presented. Spicy varieties Stuttgarter Riesen and Shetana were selected for the study. Along with the early spring planting date adopted in Udmurtia, the fall seed onion planting was also studied (September 20, September 30, October 10, October 20). Phenological observations revealed that common onion plants of the standard variety Stuttgarter Riesen entered the leaf lodging and harvesting phases on average three days earlier than the studied variety Shetana. In terms of yield, Stuttgarter Riesen onion surpassed Shetana by 6.8 t/ha (28%) and had a higher content of dry matter, water-soluble sugars and ascorbic acid in the bulbs. Autumn planting dates led to a decrease in all the studied parameters of bulb onion.

1. Introduction
Bulb onions are a valuable vegetable crop and play an important role in human nutrition. A person needs to consume 7-10 kg of this vegetable per year. The nutritional value of onions is that it contains sugars, proteins, salts of calcium, potassium, phosphorus, iron, zinc, aluminum, copper and others, as well as vitamins A, B1, B2, B6, PP, C up to 90 mg/100 g in leaves, up to 10 mg/100 g in bulbs. Onions contain amino acids, which are essential for the human body, and are used as a medical remedy. As it is known, common onion contains a large amount of phytoncides. Both bulbs and green leaves are used for food.

The sown area for onion in Russia is about 62 thousand hectares. In the Udmurt Republic, this crop occupies about 490 hectares, the gross harvest is 17,944.2 thousand cwt and 101.4 thousand cwt, respectively.

To obtain high yields, it becomes necessary to improve the technologies of cultivating agricultural crops including onions. A great range of varieties and hybrids of onions are presented on the seed market and this list is updated every year. One of the important conditions for increasing yields and improving the quality of bulb onions is the correct choice of varieties [1–6]. Much attention in the scientific
 literature is paid to the timing of seed onion sowing and planting [7–8], preparation of the planting bulb [9–10], the choice of the duration of crop maintenance [11–12]. Common onions can be grown as annual crop by sowing seeds and through seedlings, biennial and three-year crop. The time choice of sowing, planting and crop duration depends on the climatic conditions of the area, including the soil temperature during sowing and planting [13]. The choice of fertilizers [14–16], plant density [17], and other issues [18–20] are of great importance in increasing onion yield.

In the Udmurt Republic, common onion is grown mainly through seed onion when planted in early spring.

Late fall planting of seed onion is used rarely due to the unfavorable conditions of the autumn-winter-spring period. The establishment of a stable snow cover and its height is of great importance when planting onions in late fall. According to long-term average data in the conditions of the Udmurt Republic, a stable snow cover is observed from November 8-18, but in some years it can establish at the end of December. But the method deserves attention, as it allows to reduce tension during spring work, plants grow faster in spring, ripen earlier. Practically no such studies have been carried out in the republic.

The purpose of the research: to determine the optimal planting time for common seed onion, which ensures high yields and product quality.

Tasks:
1. Determine the influence of the variety and planting time on the yield of onion.
2. Assess the quality of obtained products.

2. Materials and methods
A two-factor small-plot field experiment was laid to study the timing of planting seed onion in 2018–2019 on soddy podzolic medium loamy soil in the conditions of the Udmurt Republic. For factor A, the following onion varieties were selected: Stuttgarter Riesen (St) and Shetana; for factor B, the planting date of seed onion was taken: September 20, September 30, October 10, October 20, early spring planting date was chosen for control. The placement of experimental options was carried out by the method of randomized repetitions, 4-fold repetition. The method of establishing and conducting research was generally accepted for a given culture.

For planting, seed onion with a diameter of 1.5-2.2 cm was used; planting was carried out to a depth of 3-4 cm with two-line ribbons according to the scheme: 50 + 20 x 8-10 cm.

The onset of phenological development phases was noted after leaves' regrowth.

Harvesting of bulb onions was carried out manually on a plot basis with recalculation to 1 m². Then the bulbs were ripened and the total yield was calculated. Commercial bulbs were selected for a qualitative analysis.

Research methods. Experimental research: experiments, observations, descriptions, measurements, comparative analysis, generalization.

3. Research results
Phenological planting observations of common onion revealed that the leaves' regrowth during the fall planting of seed onion in both varieties began on April 26, in the early spring (May 1) - on May 8. On average, Shetana onion plants were behind in the beginning of the feather lodging and harvesting phases for three days from the standard Stuttgarter Riesen variety.

Both factors influenced the yield of bulb onions (Figure 1).
Figure 1. Yield of onion varieties depending on the planting time, average for 2018–2019.

The yield of both varieties was at the level of the average for Russia. It varied from 21.4 to 32.0 t/ha. On average for varieties, this indicator was significantly lower for Shetana onion and amounted to 24.2 t/ha, which was less than the standard by 6.8 t/ha at LSD05 for factor A of 0.3 t/ha.

On average, autumn planting dates led to a significant decrease in this indicator by 1.1 - 4.5 t/ha at LSD05 at 0.4 t/ha. Moreover, there was a tendency for a decrease in yield at later planting dates. This pattern was observed for both varieties. When planting on October 20, the lowest yield of onions was obtained and amounted to: Stuttgarter Riesen - 28.7 t/ha, Shetana - 21.4 t/ha, which was less than the control by 4.2 and 4.9 t/ha, respectively, at LSD05 of particular differences 0.6 t/ha.

In the studies carried out, the yield of onions depended on the bulb mass (table 1). The largest bulb mass was obtained from the Stuttgarter Riesen variety when planted in early spring. The factors studied had a negative impact on the bulb weight. So, on average, an onion weighing 51.1 g was obtained from Shetana, which was 13.1 g less than the standard with LSD05 according to factor A 1.3 g.

With the fall planting period, a decrease in this indicator by 6.6–14.0 g was noted with LSD05 according to factor B 2.1 g. There was a clear pattern of reducing the bulb weight when planting at a later date in both varieties. The smallest bulb mass - 42.7 g - was obtained from Shetana variety when planted on October 20.

Table 1. Bulb weight of onion varieties depending on planting time, average for 2018–2019.

| Planting time (B) | Variety (A) | Stuttgarter Riesen (c) | Shetana | Factor A deviation | Average for factor B |
|------------------|-------------|-----------------------|---------|-------------------|---------------------|
|                  |             | . dev. | . dev. |                  | . dev.             |
| Early spring (c) | 71.7        | – | 60.1 | – | -11.6 | 65.9 | – |
| September 20     | 63.6        | -8.1 | 55.0 | -5.1 | -8.6 | 59.3 | -6.6 |
| September 30     | 62.5        | -9.2 | 52.2 | -7.6 | -10.3 | 57.5 | -8.4 |
| October 10       | 61.9        | -9.8 | 45.5 | -14.6 | -16.4 | 53.7 | -12.2 |
| October 20       | 61.2        | -10.5 | 42.7 | -17.4 | -18.3 | 51.9 | -14.0 |
| Average A        | 64.2        | – | 51.1 | – | -13.1 | – | – |
The choice of variety and planting dates play an important role in the quality of the resulting product. After harvesting and processing, the content of dry matter, ascorbic acid, water-soluble sugars and nitrates' accumulation were determined in the onion bulbs.

In the studies carried out, the studied factors had a significant effect on the dry matter content in the bulbs (table 2).

**Table 2.** The content of dry matter in the bulbs of common onion varieties depending on the planting time, average for 2018–2019.

| Planting time (B)       | Variety (A) | Factor A deviation | Average for factor B |
|-------------------------|-------------|--------------------|---------------------|
|                         | Stuttgarter Riesen (c) | % dev. | Shetana | % dev. | % dev. | % dev. |
| Early spring (c)        | 14.5 –      | 11.4 –             | -3.1                | 13.0 – |
| September 20            | 14.7 0.2    | 11.9 0.5           | -2.8                | 13.3 0.3 |
| September 30            | 14.7 0.2    | 11.8 0.4           | -2.9                | 13.3 0.3 |
| October 10              | 14.5 0.0    | 11.5 0.1           | -3.0                | 13.0 0.0 |
| October 20              | 14.3 -0.2   | 11.3 -0.1          | -3.0                | 12.8 -0.2 |
| Average A               | 14.5 –      | 11.6 –             | -2.9                | – –    |
| LSD$_{05}$              | of particular differences | of main effects |
|                         | A 0.2       | B 0.1              |                     |

On average for 2018-2019 in the bulb onion of the standard variety Stuttgarter Riesen, 2.9% of dry matter accumulated significantly higher than in the studied variety Shetana. For Shetana onions, a significant decrease in this indicator was observed for all planting dates. On average, the deviation from the standard was 2.9% with LSD$_{05}$ according to factor A of 0.1%. Planting time has had an ambiguous effect on the dry matter content in the bulbs. When planting on September 20 and 30, a significant increase in dry matter was noted by 0.3%, and when planting on October 20, a significant decrease by 0.2% was observed with LSD$_{05}$ by factor B of 0.2%.

The dry matter content in the bulbs of the standard variety Stuttgarter Riesen varied depending on the sowing time from 14.3 to 14.7%, the largest amount was obtained when planting on September 20 and 30, the difference from the control was 0.2% with LSD$_{05}$ of particular differences 0.2%. Planting at the latest date (October 20) led to a decrease in this indicator by 0.2%. In Shetana onion bulbs, a significant increase in dry matter was noted when planting on September 20 and 30, the difference with the control was 0.5 and 0.4%, respectively, with LSD$_{05}$ of particular differences of 0.2%.

The studied onion varieties differed significantly in the content of water-soluble sugars in the bulbs (Table 3).

**Table 3.** The content of water-soluble sugars in the bulbs of common onion varieties depending on the planting time, average for 2018–2019.

| Planting time (B) | Variety (A) | Factor A deviation | Average for factor B |
|-------------------|-------------|--------------------|---------------------|
|                   | Stuttgarter Riesen (c) | % dev. | Shetana | % dev. | % dev. |
| Early spring (c)  | 14.5 –      | 11.9 –             | -2.6                | 13.2 – |
On average, the Stuttgarter Riesen onion showed a significant increase in the content of water-soluble sugars by 3.2\% with LSD\textsubscript{05} according to factor A of 0.3\%. The amount of sugars in the Stuttgarter Riesen bulbs varied within 14.2-14.5\% and did not depend on the planting time. The autumn planting dates for Shetana onions led to a decrease in this indicator by 0.7–1.8\%, with LSD\textsubscript{05} of particular differences 0.7\%.

On average, with the fall planting dates on September 30 and October 20, a significant decrease in vitamin C in the bulbs (table 4). The content of ascorbic acid in bulb onions in Shetana variety showed a significant decrease by 0.7 mg/100 g in comparison with the control LSD\textsubscript{05} A of 0.1 mg/100 g. No significant differences were observed in terms of planting time, average for 2018–2019.

The content of nitrites in the bulbs varied by options from 35.0 to 37.0 μg/kg and did not exceed the MPC (Table 5). The studied factors did not have a significant effect on this indicator.

| Planting time (B) | Variety (A) | Factor A deviation | Average for factor B |
|------------------|-------------|--------------------|---------------------|
|                  | Stuttgarter Riesen (c) | mg/100 g | dev. | Shetana | mg/100 g | dev. |
| Early spring (c) | 6.4 | - | 5.8 | - | -0.6 | 6.1 | - |
| September 20     | 6.4 | 0.0 | 5.8 | 0.0 | -0.6 | 6.1 | 0.0 |
| September 30     | 6.4 | 0.0 | 5.7 | -0.1 | -0.7 | 6.0 | -0.1 |
| October 10       | 6.4 | 0.0 | 5.7 | -0.1 | -0.7 | 6.0 | -0.1 |
| October 20       | 6.3 | -0.1 | 5.7 | -0.1 | -0.6 | 6.0 | -0.1 |
| Average A        | 6.4 | - | 5.7 | - | -0.7 | - | - |

LSD\textsubscript{05} of particular differences of main effects

| | A | B |
|---|---|---|
| 0.2 | 0.1 | F\textsubscript{a} < F\textsubscript{05} |

| Planting time (B) | Variety (A) | Factor A deviation | Average for factor B |
|------------------|-------------|--------------------|---------------------|
|                  | Stuttgarter Riesen (c) | mg/kg | dev. | Shetana | mg/kg | dev. |
| Early spring (c) | 36.0 | - | 36.5 | - | 0.5 | 36.2 | - |
| September 20     | 36.5 | 0.5 | 35.3 | -1.2 | -1.2 | 35.9 | -0.3 |
| Date       | September 30 | October 10  | October 20  | Average A | LSD_{0.05} |
|------------|--------------|-------------|-------------|-----------|------------|
|            | 36.3         | 35.0        | 35.5        | 35.9      | of particular differences |
|            | 0.3          | -1.0        | -0.5        | –         | A          |
|            | 36.5         | 36.3        | 37.0        | 36.3      | B          |
|            | 0.0          | -0.2        | 0.5         | 0.4       | F_{a}<F_{0.05} |
|            | 0.2          | 1.3         | 1.5         | –         | F_{a}<F_{0.05} |
|            | 36.4         | 35.6        | 36.2        | 0.0       | F_{a}<F_{0.05} |

4. Conclusion

Thus, according to the results of the studies, the following conclusion can be drawn: the highest yield of common onion was obtained during the early spring planting period, Stuttgarter Riesen variety provided high productivity.

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