

Conference Paper

Increase of Onion Productivity by Regulation of Growing Technology Elements

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Abstract

This article describes the impact of growth regulators used as foliar dressing on the high-quality commercial production of Mars and Candy F₁ hybrid onion bulbs grown in the Rostov Region. The highest yield of finished product per 1 thousand m² of leaf area and 1 thousand units of photosynthetic potential (PSP) was observed when the Candy and Mars hybrids were treated with Novosil (3.9-4.1 t and 45.0-47.0 kg, respectively), which also produced the highest rates of net photosynthesis productivity: 8.5-8.7 g / m² per day. The effect of the agent on growth processes was slightly more effective in the Candy hybrid. It was established that the use of Novosil and Immunocytophytes foliar dressing in growing technology makes it possible to obtain the Mars and Candy hybrids at the level of 49.0-50.1 t / ha, reduce the consumption of additional irrigation water per unit of production and improve the quality of commercial onion bulbs and their storage for a long winter period. The increase in storage resulting from the use of Novosil occurred due to the decrease in the natural loss and mass of the sprouted bulbs.

Keywords: onion, hybrid, yield, stimulant fertilizer, storage, quality.

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1. Introduction

The bulb onion market in 2017 was characterized by a reduction in the supply of domestic goods, due to the low production volume in 2016, as well as the fact that the crop had short shelf life and was also affected by various fungal diseases. The reduction in yields also affected open-field vegetable growing as a whole. In addition, the rise in prices for goods affected the onion market. In the Southern District, prices rose by 30-50%. In Rostov-on-Don in the small wholesale segment the average prices for onions amounted to 10.5 rubles / kg September 2017, which was 12.5% lower than in August and 38.2% lower than in July [1].

In our country, more than 100 types of vegetable plants from 23 botanical families are cultivated, which differ significantly in biological characteristics, temperature, water,

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air modes of cultivation, soil fertility requirements and reactions to the use of macro- and micronutrients. During nutrient bottlenecks, there are signs of starvation of vegetable plants. It is very important to notice these signs in time and apply appropriate dressing. The delay of the introduction of the missing elements leads to the decrease in yield and quality of vegetables. Russian and foreign companies currently produce the extensive range of various mineral, organic, organomineral, trace elements, amino acid, microbiological, peat, humic fertilizers and subsoils and the number of proposed synthetic and natural growth regulators is already approaching the thousand. It is quite difficult for inexperienced growers to understand what is useful in this amount of the proposed variety [2].

The soil and climatic conditions of the South of Russia and the Rostov Region, in particular, allow cultivating onions in summer crop and obtain high yields of excellent quality [3]. However, even the average yield of 41 t / ha is not the limit for onions. Based on the data of Avdeenko S.S., Bondarev I.I. [4], in the conditions of the Rostov region, using a complex of factors (irrigation, fertilizer and green manure in a complex action), yields up to 60 t / ha can be obtained.

Onions became the most common vegetable crop in the Rostov region. The main volumes of production are exported to the center and the Northern regions [4]. Onions are considered to be the most valuable food and are more important in human life. First, it has nutritional value because it is rich in carbohydrates and nitrogenous substances. According to the Institute of Nutrition of Russian Academy of Medical Sciences, the rate of onion consumption per capita per year should be at least 8.2 kg, including 2.2 kg of bulb onion [5].

Unfortunately, in the current situation it is possible to confidently state that the recommended rate of onion consumption is not respected for a number of reasons. One of the main reasons for this situation is the still insufficient level of crop productivity in the region, and since the region provides the need for onions, mainly due to its own resources, agricultural science needs to look for ways to increase the yield and improve the quality of bulb onion, including storage.

The works of Chinese and Indian scientists are devoted to the assessment of the impact of the use of bioregulators, irrigation and organic fertilizers, and the peculiarities of their effect on the productivity and quality of onions [6-7].

According to the opinion of the authors [8], the main promising ways to develop the production of onion in the conditions of the Veselovsky district of the Rostov Region may include the following: introducing a new varietal composition into production; wider use for of new agrochemicals with improved quality for growing onions (for example, for

weed control; for preparing seeds for sowing, the use of fertilizers and growth stimulants with immunomodulating properties, etc.); the expansion of the modern machine-tractor fleet for universal use (including irrigation); ensuring long-term storage of the products obtained without exporting from the manufacturer and the possibility of its processing. In this regard, the relevance of research in this area is undoubtedly high.

2. Methods and Equipment

2.1. Methods

The main purpose of the work is to study growth stimulants on hybrids of onion in summer crop on irrigation, which can really increase the yield and improve its quality in relation to the Rostov region.

Variants of experiment: Water - control; Immunocytophyte - the first treatment in the phase of 4-5 leaves, the second - after 30-40 days, 20 g / ha. The flow rate of the working fluid is 300 l / ha; Novosil - the first treatment in the phase of 4 leaves, the second - after 15 days, 20 ml / ha. The flow rate of the working fluid is 300 l / ha; Buton - the first spraying in the phase of mass growth of leaves, the second - after 4-6 days, 20 g / ha. The flow rate of the working fluid is 400 l / ha.

Candy F₁ and Mars F₁ hybrids were used in the experiment. The study was conducted according to the Methodology of experimental work in vegetable growing and melon growing (M., 1992) [9]. The accounting plot area was 20 m²; the placement of experience options was a systematic longline, in 4-fold repetition. Phenological observations were carried out, calculating the duration of the interphase periods. The synchronicity of seedlings, the dynamics of growth processes, yield and quality of the resulting products were also noted.

Onions were experimentally grown on the fields of Krasny Oktyabr CJSC of the Veselovsky District in 2016-2018 according to the technology of summer crop adopted in the region which implied sowing seeds into the soil in late March - the first decade of April under irrigation according to the scheme 55 + 15 cm. During the growing season 8 sprinkling irrigation was carried out with a norm of 300 m³ / ha. The predecessor was cucumber.

CJSC Red October is located in the Veselovsky district of the Rostov Region. According to natural-economic division, this husbandry is included in the Central irrigated zone, subzone "B" [10]. The soil cover is represented by ordinary micellar-carbonate chernozems and meadow soils. The climate is arid with moderately hot summers and

moderately cold winters. 420-500 mm of precipitation falls during a year and 190-250 mm falls and for a period with a temperature above 10 degrees. Hydrothermal index is 0.65-0.75, the average annual temperature is 8.6-9.3 degrees. The sum of temperatures for the active growing season is 3200-3400 degrees.

3. Results

The growth stimulators used in the experiment influenced the phenological phases of onion vegetation. Thus, in Candy F₁ hybrid, the period from the appearance of mass seedlings to the green onion lodging was the shortest (78-79 days) when the plants were treated with Novosil and Immunocytophytes with a control period of 81 days. Our studies showed that Buton preparation did not reduce, but, on the contrary, increased the transition to green onion lodging by 6-7 days compared to Novosil and Immunocytophyte and by 4 days in comparison with the control sample. According to Mars F₁ hybrid, we noted a similar trend. By green onion lodging phase, the action of stimulants continued to affect the rate of passage of the phenological phases of the crop. Thus, hybrids in our experience responded to the use of Novosil and Immunocytophyte by shortening the period from green onion lodging to harvesting compared to the control sample for 5-7 days. The result of the positive effect of the preparations was a reduction in the total growing season by 11-14 days in comparison with the control sample, which can give a significant advantage during harvesting. It means that harvesting will take place in a more favorable weather period. The use of Buton preparation increases the duration of the growing season of hybrids in the experiment by 12-15 days.

The duration of the phenological phases with the use of growth stimulants was reflected in the growth processes of onion hybrids (Table 1).

The area of leaves of Candy hybrid in the experiment ranged from 9.3 thousand m² / ha (minimum indicator) when it was treated with Novosil to 14.6 thousand m² / ha (maximum indicator) when treating vegetative plants with Immunocytophyte stimulator. According to the Mars hybrid, the emerging trend in the formation of minimum indicators of leaf area during treatment with Novosil and maximum indicators during treatment with Immunocytophyte remained. Our studies allowed determining that the highest yield of finished products per 1 thousand m² of leaf area and 1 thousand units of PSP were observed when processing plants Candy hybrid and Mars hybrid with Novosil agent: 3.9-4.1 tons and 45.0-47.0 kg, respectively. Under the influence of this stimulant, the highest indicators of the net productivity of photosynthesis were also noted: 8.5-8.7 g /

TABLE 1: Influence of growth regulators on the growth processes of onions (in average for 2016-2018) (Candy F₁ / Mars F₁)

| Variant | Leaf area, thousand m ² /ha | | Photosynthetic potential (PSP), thousand m ² day/ha | Crop yield | | Net photosynthesis productivity, g / m ² per day |
|-----------------|--|-----------|--|---|--|---|
| | maximal | average | | per 1 thousand m ² of leaf area, t | for 1 thousand units of photosynthetic potential (PSP), kg | |
| Water – control | 14.3/13.8 | 11.1/10.8 | 973.3/953.1 | 3.0/2.8 | 33.8/31.8 | 7.4/7.2 |
| Immunocytophyte | 14.6/14.2 | 10.8/10.6 | 930.0/910.0 | 3.5/3.3 | 40.7/38.7 | 7.3/7.1 |
| Novosil | 13.4/13.2 | 9.3/9.0 | 796.5/776.0 | 4.1/3.9 | 47.0/45.0 | 8.7/8.5 |
| Buton | 10.8/10.3 | 9.5/9.2 | 836.0/815.0 | 3.3/3.1 | 37.2/37.0 | 5.9/5.7 |

m² per day. The effect of the agent on growth processes on Candy hybrid was slightly more effective.

If we consider the total yield, we can see that the weather conditions in 2018 made it possible to obtain higher yield indicators than in 2017 and 2016 although they were quite significantly different from the average annual conditions. This fact affected both Candy hybrid and Mars hybrid (Table 2).

According to Candy hybrid, in 2016 the maximum yield was observed for Novosil agent, and in 2017 and 2018. - for Immunocytophyte, and as a result, the average yield for 3 years of observation with a maximum rate of 50.1 t / ha was obtained in this variant. However, all the stimulants studied in the experiment showed the increase compared to the control sample from 2.9 (Buton) to 7.2 t / ha. These increases were significant (NRS 0.99-1.99 t / ha). The excess of productivity compared to control sample by 16.8% allows speaking about a more efficient use of additional moisture by onion plants obtained with irrigation water. Thus, in the control sample, the water consumption per 1 ton of production amounted to 55.94 m³ and in the best case, it decreased by 8.04 (Immunocytophyte agent), in the variants with Novosil and Buton - by 3.54-7.36 m³ compared to the control sample.

According to the data on Mars hybrid, in 2016 and 2018, the maximum yield was observed in Novosil agent, and in 2017 in Immunocytophyte, and as a result, the maximum average yield for 3 years of observation (49.2 t / ha) was obtained in Novosil variant, unlike Candy hybrid, which had a maximum yield (50.1 t / ha) with application of Immunocytophyte. However, the difference in yield for the variants using Novosil and Immunocytophyte was not significant: 0.2 t / ha. All stimulants studied in the experiment

showed the increase compared to the control sample from 2.3 (Buton) to 6.3 t / ha, and these increases were significant (NSP₀₅ 0.86-1.24 t / ha). The increase by 14.7% increase in productivity compared to control sample indicates a more efficient use of hybrid Mars onions of additional moisture obtained with irrigation water. Thus, the water consumption per 1 ton of products in the best variants decreased by 6.96-7.16 m³ / t (Immunocytophyte and Novosil) and 2.84 m³ / t (Buton preparation) compared to the control sample (55.94 m³ / t).

TABLE 2: Yield of onion, depending on the processing of growth regulators

| Variety | Total yield by years, t / ha | | | In average, t/ha | Dressing ± according to agent | |
|---|------------------------------|-------------|-------------|------------------|-------------------------------|-------------|
| | 2016 | 2017 | 2018 | | t/ha | % |
| Candy Hybrid F ₁ | | | | | | |
| Water – control | 38,8 | 44,1 | 45,8 | 42,9 | - | - |
| Immunocytophyte | 45,4 | 49,6 | 55,4 | 50,1 | 7,2 | 16,8 |
| Novosil | 46,1 | 48,7 | 53,4 | 49,4 | 6,5 | 15,2 |
| Buton | 45,0 | 45,2 | 47,2 | 45,8 | 2,9 | 6,8 |
| Average for Candy Hybrid F ₁ | 43,83 | 46,90 | 50,45 | 47,05 | 5,53 | 12,93 |
| Increase to control, t/ha / % | 5,03/12,96 | 2,80/6,35 | 4,65/10,15 | 4,15/9,67 | | |
| NSP ₀₅ t/ha / % | 0,99/2,25 | 1,99/4,24 | 1,36/2,69 | | | |
| Mars Hybrid F ₁ | | | | | | |
| Water – control | 40,1 | 44,0 | 44,6 | 42,9 | - | - |
| Immunocytophyte | 45,7 | 49,7 | 51,6 | 49,0 | 6,1 | 14,2 |
| Novosil | 46,4 | 48,5 | 52,6 | 49,2 | 6,3 | 14,7 |
| Buton | 44,7 | 44,2 | 46,7 | 45,2 | 2,3 | 5,4 |
| Average for Mars Hybrid F ₁ | 44,23 | 46,60 | 48,88 | 46,58 | 4,90 | 11,43 |
| Increase to control, t/ha / % | 4,13/10,30 | 2,60/5,91 | 4,28/9,60 | 3,68/8,58 | | |
| NSP ₀₅ t/ha / % | 0,86/1,94 | 1,18/2,54 | 1,24/2,54 | | | |
| In average by the year of research and hybrids | 44,03 | 46,75 | 49,66 | 46,81 | | |
| The increase in the best variant to the average, t / ha / % | 2,37/5,11 | 2,95/5,94 | 5,74/11,56 | 3,29/7,03 | | |

According to the biochemical composition, the maximum values were revealed during the use of Novosil growth regulator. In dry matter, the 24%, increase in Candy F₁ hybrid was found, in Mars F₁ hybrid the increase was 21.6%, for the total sugar content the increase was 2.1% (Candy F₁ hybrid) and 1.8% (Mars F₁ hybrid).

4. Discussion

In average for 2016-2017 the shelf life of onions of Candy F₁ during winter storage period by increased by 16.7% for samples treated with Novosil growth regulator, compared to the control sample, where water was sprayed, while the sprouted bulbs in this variant had a minimum amount of 10.7%. According to Candy F₁ hybrid, the positive effect of Novosil on shelf life was also observed: in the experiment it was higher compared to the control sample by 9.2%. During the use of Novosil stimulator, it was found that the increase in shelf life occurs due to the decrease in the natural loss and mass of sprouted bulbs.

5. Conclusion

Thus, the use of the technology foliar feeding of Novosil and Immunocytophyte allows obtaining harvests at the level of 49.0-50.1 t / ha for Mars and Candy hybrids, reducing the consumption of additional irrigation water per unit of production and improving the quality of bulb onions and their storage during long winter periods.

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Conflict of Interest

The authors have no conflict of interest to declare.

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