Rinat Raifovich Galeev et al /J. Pharm. Sci. & Res. Vol. 10(4), 2018, 907-910

ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

The yield and quality of varieties of garden onion cultivated in a one-year cycle, depending on growth regulators

Rinat Raifovich Galeev, Sultan Khadjibikarovich Vyshegurov, Ivan Sergeevich Samarin, Varvara Sergeevna Demshina, Margarita Alekseevna Gumel

Federal State Budgetary Educational Institution of Higher Education "Novosibirsk State Agrarian University", 160 Dobroljubova st., 630039, Novosibirsk, Russian Federation

Abstract

The results of the scientific research in 2013-2016 performed in Western Siberia in the Novosibirsk Ob region on leached black soils are shown. The influence of growth regulators on the yield and quality of onion variety samples in a one-year cycle has been studied. The agronomic characters of garden onion variety samples of various ripeness groups have been assessed, and the best varieties and hybrids have been selected for cultivation in Western Siberia. The quality indicators of garden onion production have been determined for sowing seeds, and the experimental data have been statistically processed with setting the determination indices for studied factors.

Keywords: garden onion, variety, hybrid, growth regulators, leaf area, yield, product quality.

INTRODUCTION

Among vegetables, garden onion takes one of the leading places in the world in terms of sowing areas and gross harvesting of vegetable crops [1-3]. In Siberia, garden onion is the most beneficial vegetable crop in terms of economy. This determines its importance in vegetable growing in the region. The nutritional value of onion is determined by the presence of sugars and proteins in its composition. Onion contains significant amounts of calcium, potassium, phosphorus, iron, vitamin C up to 90 mg in leaves and up to 100 mg/100 g of wet substances in the bulbs [4-8]. The use of garden onion in Siberian vegetable production in the context of import substitution and ensuring food security will ensure improving food quality [9-13]. High-yielding heterotic hybrids of garden onion suitable for cultivation in a one-year cycle, and having early ripeness, good quality and good preservation during long-term storage are currently cultivated in Russia and abroad [14-16].

In Western Siberia, there has been a tendency to increasing production and consumption of vegetable crops, and particularly garden onion. However, the overall level of vegetable products consumption by the population remains inadequate, and amounts to 84% of the per capita consumption, as recommended by rational norm of 129 kg per year [17].

In the conditions of forest-steppe of the Ob region, efficiency of cultivating garden onion in a one-year cycle has not been studied enough, especially in using growth regulators for this crop.

METHODS

The meteorological conditions varied during the studies, which ensured objective assessment of the obtained data. In terms of the temperature and humidity, the most favorable conditions were in 2015 (the amount of precipitation during the vegetation period was 369 mm). In the experiments, the reference area of the plot was 20 m^2, the experiments were repeated four times, with placement being randomized.

Field experiments were laid according to the techniques of E. N. Mishustin and B. A. Dospekhov [18, 19]. Phenological phases of garden onion were noted according to the technique of state variety testing, biometric parameters - according to the technique of the Research Institute of Vegetable Growing. Leaf area was determined by the technique of N. F. Konyaev [20], photosynthetic potential - according to A. A. Nichiporovich [21]. Harvest was accounted for by the method of continuous harvesting. The experimental data were processed statistically according to B. A. Dospehov with the use of a PC and the Snedecor applications.

During the experiment, the following variety samples were studied: early maturing varieties Odintsovets, Bessonovskiy mestniy, Ermak, Strigunovskiy mestniy (Russia), Vares F_1, Candy F_1 (the Netherlands); midearly varieties Borodkovsky, Baterus (Russia), Barito F_1 (the Netherlands); midripening varieties Chalcedon, Velino, Zolotnichok, Rosario, Sturon (Russia) and Bennito F_1 (the Netherlands). Variety samples of garden onion were sown in the first decade of May with a single-row seeder with the interrow spacing 45 cm wide. In the experiments with growth regulators, seeds were soaked for 90 minutes in the growth regulator: 0.001% Argon, Albite 1 ml/kg of seeds Novosil 0.12 ml/kg, and Zircon 0.25 ml/kg. Harvesting was performed in the first week of September.

RESULTS

The experiments performed in 2013-2016 showed that sowing qualities of garden onion variety samples had laboratory germination rate of 87-94%, and field germination rate of 79-84%. The weight of 1,000 seeds ranged between 2.9 and 4.1 g, plants' stand density with the seeding rate of 1 million pieces/ha on the average was about 870 thousand plants/ha, preharvesting stand - 818 thousand plants/ha with plants' preservation rate before harvesting of 94%.

Phenological observations showed that mass germination of most varieties of garden onion variety samples was observed 11-17 days after sowing. Leaf drowning in the early ripening varieties was observed after 86-94 days, in midripening varieties - after 102-115 days.

In the group of early ripening garden onion variety samples, Candy variety samples F_1 and Ermak had the maximum leaf area. All midripening variety samples had larger maximum leaf area than variety Odintsovets (per 0.2-0.5 thousand. m^2/ha) at the standard rates of 14.2 thousand m^2/ha. Among midripening varieties, the reference (Chalcedon) exceeded the maximum leaf area of variety samples Sturon, Bennito F_1 and especially Zolotnichok. By the average leaf area, early ripening varieties of hybrid Candy F_1, midripening Barito F_1 and midripening varieties Zolotnichok and Sturon were the best. Similar situation was observed for the indicators of photosynthetic potential (FSP). In terms of photosynthesis net productivity, varieties Ermak and Candy F_1 (early ripening), Barito F_1 (medium early ripening) and Zolotnichok (midripening) stood out (Table 1). The study showed the effect of soaking garden onion seeds in growth regulators for 90 minutes. It has been found that in early ripening variety Odintsovets, growth regulator Novosil increased photosynthesis net productivity by 14%.

Table 1. Leaf area and photosynthetic productivity of garden onion (average over 2013-2016)

Variant	Leaf area, thous. m^2/ha		FSP, thous. m^2 d/ha	Net photosynthesis productivity, g/m^2 d
	maximum	average		
Variety study				
Early ripening:				
Odintsovets (st)	14.2	11.8	3,139	2.43
Bessonovsky mestniy	13.6	11.3	3,006	2.38
Yermak	14.3	11.7	3,112	2.74
Strigunovsky mestniy	13.8	11.0	2,926	2.40
Vares F_1	14.0	11.6	3,086	2.39
Candy F_1	14.4	12.0	3,192	2.74
Midripening:				
Borodkovsky	14.7	12.7	3,378	2.56
Baterus	14.4	12.5	3,325	2.48
Barito F_1	14.6	12.8	3,405	2.85
Midripening				
Chalcedon (st)	14.8	12.7	3,378	2.64
Velino	14.6	12.4	3,298	2.47
Zolotnichok	15.4	13.8	3,671	2.93
Rosario	14.5	12.8	3,405	2.81
Sturon	15.1	13.5	3,471	2.89
Bennito F_1	15.3	13.2	3,511	2.84
LSD_{05}	0.18	0.21	27.8	0.14
Soaking seeds in growth regulators for 90 min. variety Odintsovets (early ripening)				
Dry seeds (reference)	14.0	11.5	3,059	2.35
Water	14.3	11.7	3,122	2.37
Argon	14.6	11.9	3,165	2.54
Albite	14.5	11.8	3,139	2.43
Novosil	14.6	12.1	3,219	2.68
Zircon	14.2	11.6	3,085	2.40
variety Chalcedon (midripening)				
Dry seeds (reference)	14.4	12.5	3,325	2.53
Water	14.7	12.7	3,378	2.62
Argon	14.6	12.9	3,431	2.78
Albite	14.8	12.7	3,564	2.65
Novosil	15.4	13.4	3,484	2.94
Zircon	14.8	12.8	3,405	2.71
LSD_{05}	0.22	0.15	30.4	0.11

Midripening variety Chalcedon also showed an increase in the photosynthetic parameters by 9-16%, in particular against the background of using the Novosil growth regulator.

On the average over the experiments in 2013-2016, in terms of the total yield among early ripening varieties, hybrid Vares F_1 stood out (a 30% increase to the standard Odintsovets total yield, and 25% to commercial yield), and among midripening varieties - Barito F_1 (30% and 13%, respectively). Among midripening grades, hybrid Benito F_1 was the best (an increase to the standard total yield was 13%, and to commercial yield - 12%). It has been shown that the content of dry matter was higher in hybrids Vares F_1 (early ripening), and variety Zolotinka (midripening).

In terms of total sugar, hybrids Candy F_1, Strigunovsky mestniy (early ripening) and Bennito F_1 (midripening) should also be mentioned. In this crop, nitrates' concentration was 2.2-2.5 times below the MPC.

It has been statistically found that the total yield of garden onion by sowing seeds depended on the genotype by 39%, on the weather conditions by 27%, on interaction factors by 26%, and the commercial value - by 41, 26 and 23%, respectively (Table 2). The use of growth regulators for soaking seeds of garden onion in a one-year cycle contributed to increasing the total yield of garden onion in a one-year cycle for the early ripening variety Odintsovets from 21 (in the variant with Albite) to 56% (Novosil). In terms of commercial yield, variety Odintsovets had the maximum increase on the background of the variant with Novosil – 52%, and 47% - with the use of the Argon growth regulator. It has been found that the growth regulators of Novosil and Albin veraciously increased the dry matter content in early ripening variety Odintsovets. The highest amount of sugars was detected on the background of Argon and Novosil (the absolute increase to the reference was 0.4-0.5%). In the studies with midripening variety Chalcedon, the highest efficiency was also observed on the background of using the growth regulator Novosil: dry matter content, compared to the reference, increased by 0.6%, and the amount of sugars - by 0.7%, with the minimum content of nitrates (20 mg/kg). It has been shown that the use of growth regulators decreased the nitrate content in the bulbs 1.2-1.4 times.

In all variants of the experiment, the content of nitrates was 2.2-2.7 times lower than the MPC for garden onion.

Table 2. The yield and quality of garden onion in a one-year cycle (on the average over 2013-2016)

Variant	Yield						Content		
	overall			commercial					
	t/ha	deviation from the standard		t/ha	deviation from the standard		Dry substance, %	Total sugars, %	Nitrates mg/kg
		t/ha	%		t/ha	%			
Variety study									
Early ripening:									
Odintsovets (st)	28	-	-	24	-	-	13,5	9,2	31
Bessonovsky mestniy	24	-4	-14	19	-5	-21	12.3	8.8	34
Yermak	21	+3	+11	27	+3	+13	13.1	9.0	48
Strigunovsky mestniy	34	+6	+21	28	+4	+17	12.7	9.4	35
Vares F_1	35	+7	+30	30	+6	+25	13.4	9.1	42
Candy F_1	32	+4	+14	27	+3	+13	13.3	9.4	34
Midripening:									
Borodkovsky	26	-2	-7	22	-2	-8	13.0	8.5	29
Baterus	30	+2	+7	24	0	0	12.8	8.8	34
Barito F_1	35	+7	+30	27	+3	+13	13.1	9.1	28
Midripening									
Chalcedon (st)	38	-	-	34	-	-	13.2	9.4	23
Velino	27	-11	-28	23	-11	-32	13.3	9.8	28
Zolotnichok	36	-2	-5	27	-7	-21	13.5	9.9	30
Rosario	29	-9	-24	25	-9	-26	12.8	9.5	25
Sturon	41	+3	+8	36	+2	+6	13.1	10.0	20
Bennito F_1	43	+5	+13	38	+4	+12	13.0	10.3	25
Soaking seeds in growth regulators for 90 min. Odintsovets variety (early ripening)									
Dry seeds (reference)	23	-	-	19	-	-	12.3	8.7	37
Water	26	+3	+13	21	+2	+10	12.2	9.0	36
Argon	34	+11	+47	28	+9	+47	12.3	9.2	41
Albite	28	+5	+21	24	+5	+26	12.4	8.6	40
Novosil	36	+13	+56	29	+10	+52	12.6	9.1	32
Zircon	35	+12	+52	27	+8	+41	12.1	8.5	35
variety Chalcedon (midripening)									
Dry seeds (reference)	33	-	-	28	-	-	12.5	9.2	34
Water	39	+6	+18	34	+6	+21	12.8	9.6	29
Argon	45	+12	+36	38	+10	+36	13.1	9.4	23
Albite	38	+5	+15	33	+5	+17	12.6	9.3	28
Novosil	49	+16	+48	42	+14	+50	13.4	9.9	20
Zircon	43	+10	+30	38	+10	+36	12.8	9.7	27
LSD_{05}	-	-	-	-	-	-	0.18	0.14	3.21

Note 1. The results of dispersion analysis for studying varieties of two-factor experiment (15x3) for the total yield: LSD_{05} for particular differences – 2.38, for the main effects - 2.88, for pairwise interactions - 2.67. Main effects and interactions are the folloing: factor A (variety sample) – 38.8%, B (year) - 26.7, interaction between A and B - 25.9%. For commercial yield, these statistical parameters are 1.87, 2.26, 2.02, 40.8, 26.3 and 24.7%, respectively.

Note 2. The results of dispersion analysis in the experiment with growth regulators (4x6x3) for the total yield: LSD_{05} for particular differences – 1.63, for the main effects - 2.18, for pairwise interactions - 1.96. The main effects and interactions A (genotype) – 28.6%, B (growth regulator) - 35.4%, C (year) – 21.8, interaction between A and B - 4.8, A and C- 3.5, B and C – 1.2, among A, B, and C – 0.5. For commercial yield: 1.66, 2.24, 1.85, 24.6, 32.8, 25.6, 3.2, 4.8, 2.0, and 0.6, respectively.

DISCUSSION

The problem of improving the yield and quality of garden onion is of paramount importance. In the extensive conditions of Western Siberia, garden onion is highly profitable crop, especially when cultivated in a one-year cycle. Transition from high-cost technology of producing garden onion in two-year cycles using onion seedlings to one year cycle provides perspectives in increasing its yield and quality.

In this context, choosing new promising Russian- and Dutch-bred variety samples with a complex of agronomic characters, like high productivity, good product quality, relative resistance to diseases and certain pests, product preservation during long-term storage, is of special importance. Besides, in order to accelerate growth and development, to increase resistance to stress and adverse environmental factors, soaking seeds of garden onion in solutions of environmentally friendly growth regulators (Argon, Albite, Novosil and Zircon) is interesting.

CONCLUSION

In leached chernozems of the forest-steppe zone of Western Siberia (the Ob area near Novosibirsk), the following variety samples of garden onion were effectively grown in a one-year cycle with irrigation by sowing seeds: Vares F_1 and Candy F_1 (the Netherlands), and varieties Strigunovskiy local and Ermak (Russia). They ensured high parameters of the photosynthetic apparatus, yield of about 35 tonnes/ha in combination with good

quality of the product. In this crop, nitrates' concentration was 2.4 times below the MPC.

When seeds of garden onion varieties Odintsovets (early ripening) and Chalcedon (midripening) were soaked for 90 minutes, the total and commercial yields increased on the background of growth regulators: 0.001% Argon - by 36-47%, Albite at the rate of 1 ml/kg of seeds - by 15 - 21%, Novosil at the rate of 0.12 ml/kg – by 48-56%, and Zircon at the rate of 0.25 ml/kg - by 30-52%. Growth regulators increased the dry matter content and total sugars, and ensured good quality of the product at nitrates' concentration 2.5 times lower than the MPC for the studied crop.

It has been statistically found that the yield of garden onion depended on the genotype by 28.6%, on growth regulators - by 35.4%, on the conditions of the year - by 21.8%, and on interaction of the factors - by 10%.

REFERENCES

[1] Beshir, B., Nishikawa, Y., Cost-Benefit Analysis of Small-Scale Onion and Tomato Farming in Melkassa Area, *Tropical Agriculture and Development*. 2012, *56*, 143-150.

[2] Brewster, J.L., *Onions and other vegetable alliums*, CABI Publishing, Wallingford, 2008.

[3] Kulkarni, B.S., Patil, S.M., Ramchandra, V.A., Growth trends in the area, production, and export of onion from India-An economic analysis, *Internat. J. Com. &Bus. Manage*. 2012, *5*, 159-163.

[4] Berhanu, M.A., Berhanu, G.A., Constraints of onion (Allium cepa Var cepa L.) yield production and food preference to shallot (Allium cepa Var aggregatum) in the Case of Bibugn Woreda, Amhara Regional State, Ethiopia, *Food Science and Quality Management.* 2014, *32*, 41-45.

[5] Aklilu, S. Onion research and production in Ethiopia, *International Symposium on Edible Alliaceae*. 1997, *433*, 95-98.

[6] Belik, V. F., Sovetkina, V. S., *Ovoschnie kultury i tehnologiya ih vozdelivaniya* [Vegetable crops and the technology of their cultivation], Agropromizdat, Moscow, 1991, 378 p.

[7] Greenberg, E. G., Gubko, V. N., Vitchenko, E. F., *Ovoschnie kultury v Sibiri* [Vegetable crops in Siberia], Sib. Univ. publishing house, Novosibirsk, 2004, 347 p.

[8] Greenberg, E. G., Galeev, R. R., Kashnikova, V. I., et al. *Korneplody luk repchaty* [Root vegetables, garden onion], Novosibirsk Book publishing house, Novosibirsk, 1992, 157 p.

[9] Galeev, R. R. *Adaptivnie tehnologii proizvodstva ovoschei v Sibiri* [Adaptive technology of vegetable production in Siberia], Agro-Siberia, Novosibirsk, 2005, 276 p.

[10] Galeev, R. R., Zizina, Y. F., Effektivnost agrotehnicheskih priemov vozdelivaniya luka repchatogo v odnoletnei ku'ture v lesostepi Zapadnoi Sibiri [Efficiency of agrotechnical methods of cultivating garden onion in a one-year cycle in the forest-steppe of Western Siberia], *Vestnik of BSAA*. 2014, *2(35)*, 84-88.

[11] Zizina, Y. F., Galeev, R. R. Regulyatori rosta na odnoletnei kulture luka v Sibiri [Growth regulators for onions grown in a one-year cycle in Siberia], *Potatoes and vegetables*. 2014, *3*, 15-17.

[12] Abdisa, Y., Tekalign, T., Pant, L.M., Growth, bulb yield and quality of onion (Allium cepa L.) as influenced by nitrogen and phosphorus fertilization on vertisol I. growth attributes, biomass production, and bulb yield, *African J Agric Res*. 2011, *6*, 3252-3258.

[13] Kahsay, Y., Belay, F., Embaye, A., Enhancing onion production and productivity through the introduction of seed production techniques in the central zone of Tigray region, Ethiopia, *Academia J Agric Res*. 2016, *4*, 188-192.

[14] Manna, D., Growth, yield and bulb quality of onion (Allium cepa L.) in response to foliar application of boron and zinc, *SAARC J Agric.* 2014, *11*, 149-153.

[15] Bosch-Serra, A.D., Currah, L., Agronomy of Onions, in: Rabinowitch, H.D., Currah, L. (Ed.), *Allium crop science: recent advances*, CABI Publishing, 2002, pp. 187.

[16] Zizina, Y. F., Galeev, R. R. Formirovanie urozhainosti posevnogo luka repchatogo v lesostepi Novosibirskogo Priobya [Forming garden onion yield in the forest-steppe of the Ob area near Novosibirsk], *Achievements of AIC science and technology*. 2014, *5*, 22-24.

[17] Potapov, N. A., Galeev, R. R., Sozdan Soyuz sibirskih ovoschevodov [The Union of Siberian Vegetable Growers has been established], *Potatoes and vegetables*. 2009, *2*, 8.

[18] Mishustin, E. N., *Metodika provedeniya selskohozyaistvennogo opita* [The methodology of agricultural experiment], Selkhozizdat, Moscow, 1968, 276 p.

[19] Dospekhov, V. A. *Metodika polevogo opita* [Methods of field experiments], Agropromizdat, Moscow, 1985, 351 p.

[20] Konyaev, N. F. *Produktivnost rastenii i ploschad listyev* [Plant productivity and leaf area], East Siberian book publishing house, Irkutsk, 1970, 18 p.

[21] Nlchiporovich, A. A. *Fotosintez i urozhai* [Photosynthesis and the yield], Selkhozizdat, Moscow, 1957, 149 p.