

Improving techniques for cultivating potatoes of the Smolyanochka variety in elite seed production

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Abstract. In our experiments, 2 methods of harvesting tops were used relative to the control (without harvesting): mechanical (mowing) and chemical (desiccation Reglon Super) for 18; 12; 6 days before harvesting potatoes. On average, over 3 years, the yield of potatoes of the Smolyanochka variety ranged from 36.2 to 47.9 t/ha. The highest yield was obtained by mowing and desiccating the tops in 12 days - 47.3-47.9 t/ha and losses of 2.6; 2.2% respectively. Research has shown that mowing and desiccating the tops 12 days before harvesting ensured the yield of the average fraction of 50-48%, respectively, and the formation of healthier tubers. The strength of the peel contributed to the reduction of losses relative to the control during storage by 0.9-4.3% and the incidence of diseases by 0.5-5.0%. The article also shows the economic efficiency of the agricultural practices used. The profitability level of ware potatoes ranged from 69 to 150% and was greatest when the tops were mowed and desiccated 12 days before harvesting.

1 Introduction

In Russia, potatoes form the basis of the food market and have a significant impact on its formation and ensuring the country's food security [1, 5, 6].

The main methods of expanded production of the industry and its profitability are: increasing the share of sown areas in large agricultural enterprises and farms, relative to personal subsidiary plots; increasing productivity, the basis of which is innovative growing technologies using the adaptive and productive potential of new varieties and establishing a system of original and elite seed production [1, 2, 7].

In this regard, improving the elements of varietal technology, taking into account the maximum use of genetic, morphobiological characteristics and their parameters, in increasing the yield and yield of seed and marketable fractions is relevant.

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2 Materials and methods

Research on the study of varietal agricultural technology of the new potato variety Smolyanochka was carried out in 2020-2022. on the experimental field of the Smolensk State Agricultural Academy in the six-field crop rotation of the department of agronomy, land management and ecology, the predecessor is narrow-leaved lupine for green manure.

In the experiment, the productivity and quality of potato tubers of the Smolyanochka variety were studied depending on the timing and methods of processing potato tops before harvesting. Factor A – processing time (18, 12, 6 days before potato harvesting); factor B – processing methods (mowing; desiccation).

All experiments were carried out according to the experimental method of B.A. Dospheva. The placement of plots is randomized. The area of the experimental plot is 56 m², the registration plot is 51 m².

All observations, records and analyzes of field and laboratory studies were carried out according to generally accepted methods and GOSTs. Statistical processing of harvest data was carried out using the method of variance analysis, correlation and regression analyzes (B.A. Dospheva, 2014 and in the “STATISTICA” program). Technological maps were used to calculate the economic indicators of potato production.

The meteorological conditions of the growing seasons during the years of research differed from each other both in the amount of precipitation and the nature of its distribution, and in the air temperature during the growing season, which made it possible to give an objective assessment of the influence of the studied agricultural practices on the level of yield and quality of potatoes.

3 Results

Pre-harvest removal of tops by mowing or desiccation is one of the methods for increasing the yield of the seed fraction, the multiplication factor and the keeping quality of potato tubers.

In our experiments (2020-2022), 2 methods of harvesting tops were used relative to the control (without harvesting): mechanical (mowing) and chemical (desiccation Reglon Super) for 18; 12; 6 days before harvesting potatoes. The main objective of the experiment was the accelerated propagation of original potato tubers of the Smolyanochka variety by increasing the yield of the seed fraction.

On average, over 3 years, the yield of potatoes of the Smolyanochka variety ranged from 36.2 to 47.9 t/ha (Table 1). It was lowest in the variants with mowing and desiccation of the tops 18 days before harvesting and amounted to 38.0 - 36.2 t/ha, which is lower than the control by 1.9-3.7 t/ha and is associated primarily with physiologically incomplete ripening of tubers and the formation of their size. When mowing and desiccating the tops for 6 days, an increase in yield by 1.1-2.0 t/ha was observed, due to a reduction in losses by 7.1-6.8% relative to the control (10.4%) (Table 1).

The slight difference in yield between mowing and desiccation is associated in the first case with incomplete drying of the stems at a cutting height of 20 cm, in the second with incomplete withering of the tops, especially in wet years. The highest yield was obtained by mowing and desiccating potato tops of the Smolyanochka variety in 12 days - 47.3-47.9 t/ha and losses of 2.6; 2.2% respectively.

Removal of tops contributed to a reduction in mechanical damage by 1.3-1.7%, secondary picking - by 3.3-3.8%, and an increase in the separation of tubers by 0.2-1.9%.

Depending on the methods and timing of tops processing, the number of tubers per plant varied for the Smolyanochka variety from 11.3 to 12.8 pieces.

Table 1. Productivity and losses when harvesting potatoes of the Smolyanochka variety, depending on the methods and timing of tops removal, (average 2020-2022)

Options	Productivity, t/ha	Harvesting losses, %					Profitability of the seed fraction, %
		mechanical damage	not separated tubers, %	secondary selection	other, %	total losses, %	
Control	44.9	2.5	2.1	4.5	1.3	10.4	132
Mowing (18 days before harvesting)	38.0	1.0	0.4	0.9	0.4	3.7	120
Mowing (12 days before harvesting)	47.3	1.0	0.6	0.9	0.1	2.6	195
Mowing (6 days before harvesting)	46.9	1.2	0.8	1.0	0.3	3.3	122
Desiccation (18 days before harvesting)	36.2	0.8	0.2	0.7	0.5	2.2	120
Desiccation (12 days before harvesting)	47.9	1.0	0.4	0.6	0.2	2.2	209
Desiccation (6 days before cleaning)	46.0	1.2	0.9	1.2	0.3	3.6	212

On average, over 3 years of research, the number of small tubers in the control was 2.5 pcs./bush, which is less than when mowing and desiccating the tops in 18 days by 1.4-1.3 pcs./bush and more than in 12 days before harvesting by 0.2-0.1 pcs./bush, 6 days – by 0.1-0.3 pcs./bush, respectively.

Our research has established that the use of removing tops by mowing and desiccation made it possible to obtain a share of the middle fraction from 48.0 to 54.5%, which is 2.0-2.3 times higher than the control (Table 2).

Despite the high yield of the middle fraction (54.5-54.1%) during mowing and desiccation 18 days before harvesting, these tubers were affected by diseases by 7.2-7.4%, cracking of the peel, which led to losses during storage (Table 2 and Table 3).

Research has shown that mowing and desiccation of tops 12 days before harvesting ensured the yield of the average fraction of 50-48%, respectively, and the formation of healthier tubers (Table 3).

Morpho-biometric analysis showed that the mass of tubers by fraction, their share and clone mass corresponded to the tuber analysis and, in general, to the yield per hectare according to the options (Table 3).

The seed fraction of potatoes must include tubers with a diameter of at least 3 mm and weighing no more than 90 g.

The data in Table 3 show that on average, according to the experiment, the yield of the seed fraction ranged from 69 (in the control) to 74%. All options with tops removal exceeded the control by 1-4%.

The yield of the seed fraction, both in terms of the number of tubers relative to the medium and large fractions, and with their share, was the highest in the variants when mowing and desiccating the plantings 12 days before harvesting and amounted to 73-74%.

According to the yield of the seed fraction, its yield varied from 31.3 to 35.5 t/ha and was highest in the variants with mowing and desiccation of plantings 12 days before harvesting and amounted to 34.7-35.5 t/ha, respectively.

In the formation of the yield of the seed fraction, a significant role ($r = 0.807$) belonged to the tubers of the middle fraction.

Table 2. Influence of timing and methods of processing potato tops of the Smolyanochka variety on the fractional composition, average for 3 years

Indicators	Options						
	Control	Mowing			Desiccation		
		18 days before harvest	12 days before harvest	6 days before harvest	18 days before harvest	12 days before harvest	6 days before harvest
Number of tubers, pcs/bush:							
small	2.5	4.0	2.1	1.8	4.1	2.4	2.2
average	5.5	6.2	6.4	6.2	6.1	6.1	5.9
large	4.3	1.3	4.2	4.4	1.1	4.2	4.3
Total	12.3	11.5	12.8	12.4	11.3	12.7	12.4
Share of the middle fraction, %	23.6	54.5	50.0	49.2	54.1	48.0	47.6
Weight of tubers, g/bush							
small	52.9	74.1	50.0	55.2	72.2	55.2	50.6
average	388.1	342.2	408.7	402.4	336.4	422.1	388.6
large	535.1	409.8	520.4	533.7	378.3	522.8	554.1
Clone weight, g	976.1	826.1	989.1	991.3	786.9	1000.1	993.3
Productivity, t/ha	44.9	38.0	47.5	47.6	36.2	48.0	47.7

In our studies, weather conditions (from 17 to 32%), as well as the timing of tops processing (12-27%) and tops removal methods (5-7%) played a major role in the yield formation of the seed fraction of the Smolyanochka potato variety.

Thus, the highest yield of the seed fraction was in the conditions of 2021 and ranged from 77 to 80%, which is 9% higher than the dry year (2019) and 15% higher than the wet year (2020).

The main assessment of agricultural practices in potato seed plantings and the productivity of the seed fraction is the reproduction coefficient.

In our studies, according to the data in Table 3, the reproduction coefficient ranged from 6.1 to 9.1 units. and was the largest in the variant with desiccation 12 days before harvesting (9.1 units).

Table 3. Yield of seed and marketable fractions of potatoes of the Smolyanochka variety depending on the period and method of planting treatment, %

Indicators	Options						
	Control	Mowing			Desiccation		
		18 days before harvest	12 days before harvest	6 days before harvest	18 days before harvest	12 days before harvest	6 days before harvest
Seed fraction yield, %							
2019	68	72	72	69	69	73	69
2020	62	66	66	64	67	67	63
2021	77	82	82	78	81	83	78
average	69	73	73	70	72	74	70
Seed fraction yield, t/ha	30.9	27.7	34.7	31.9	26.1	35.5	31.3
Reproduction rate	7.4	6.6	9.0	8.3	6.1	9.1	8.3
Yield of commercial fraction, %							
2019	70	67	72	71	68	70	72
2020	73	67	79	73	64	78	79
2021	77	67	76	77	66	80	76
average	73	66	76	74	65	76	76

Thus, the most effective pre-harvest treatment of potatoes is mechanical removal (mowing) or desiccation (Reglon Super) of the tops 12 days before harvesting the tubers. These options had the highest indicators in terms of yield (47.3-47.9 t/ha), the number of tubers of the middle fraction (6.4-6.1 pcs./bush), the yield of the seed fraction (73-74%), its yield (37.4-35.5 t/ha), reproduction factor (8.6-8.8 units), marketable fraction (76%) and the smallest losses during harvesting (2.6-2.2%) and storage (9.0-8.3%).

Table 4. Peel thickness, storage losses and disease susceptibility of potato varieties Smolyanochka depending on the timing and methods of tops removal, average (2020-2022).

Indicators	Options						
	Control	Mowing			Desiccation		
		18 days before harvest	12 days before harvest	6 days before harvest	18 days before harvest	12 days before harvest	6 days before harvest
Peel thickness, microns	11.4	15.3	14.9	12.0	15.9	15.0	12.2
Storage losses for 7 months, %	11.7	10.8	9.3	11.1	9.6	7.4	10.7
Disease incidence, %	7.9	7.2	5.2	6.5	7.4	4.9	6.2
late blight	0.8	1.1	0.4	0.7	1.0	0.3	0.6
common scab	4.5	4.0	3.3	3.9	3.9	3.2	3.8
rhizoctonia	2.6	2.1	1.5	1.9	2.5	1.4	1.8

Storage losses and disease susceptibility are closely related to peel thickness (Table 5).

The highest peel thickness indicators for potatoes of the Smolyanochka variety were when harvesting the tops in 18, 12 days and amounted to 15.3-14.9 microns during mowing, and 15.9-15.0 microns during desiccation, which is 3.5 higher than the control - 4.5 μm respectively.

The strength of the peel contributed to the reduction of losses relative to the control during storage by 0.9-4.3% and the incidence of diseases by 0.5-5.0%.

Table 5. Economic indicators of potatoes of the Smolyanochka variety depending on the period and method of removal of the tops.

Indicators	Options						
	Control	Mowing			Desiccation		
		18 days before harvest	12 days before harvest	6 days before harvest	18 days before harvest	12 days before harvest	6 days before harvest
Productivity, t/ha seed fraction	30.9	26.9	32.7	31.9	25.3	33.5	31.3
general	44.9	41.0	45.5	45.6	40.2	46.0	45.7
Cost of gross production per 1 ha, thousand rubles	1689.9	1115.2	1237.6	1240.3	1093.4	1251.2	1243.0
Total costs, thousand rubles.	62323.7	62323.7	62323.7	62323.7	63823.7	63823.7	63823.7
Cost of production per 1 ha, thousand rubles	1623.2	1623.2	1623.2	1623.2	1638.2	1638.2	1638.2
Net income from 1 ha, thousand rubles	1016.3	787.3	1178.0	1181.4	769.3	1203.0	1076.1
Profitability level, % of total seed fraction	132	120	195	122	120	209	212
	88	76	130	131	69	150	130

In our studies, the level of profitability of ware potatoes ranged from 69 to 150% and was greatest when the tops were mowed and desiccated 12 days before harvesting - 130-

150%, respectively. This trend is also typical in the production of seed potatoes, where the level of profitability ranged from 120 to 212% and was greatest in the options when removing the tops in 12 days (195-209%) (Table 4).

Removing tops 18 days before harvesting potatoes by mowing or desiccation reduces profitability relative to control by 12-19%.

Mowing or desiccating tops 6 days before harvesting potatoes increases economic indicators in terms of profitability by 23-25% relative to control, but this is lower than options for removing tops 12 days before harvesting by 19-22%, respectively.

Thus, to increase the yield of the seed fraction, it is economically justified to use mowing and desiccation of the tops 6-12 days before harvesting potatoes. At the same time, the highest indicators of net income and level of profitability were obtained in the variants 12 days before harvesting (1178.0 thousand rubles, 195%; 1203.0 thousand rubles, 120%, respectively).

4 Conclusion

Removing tops increases equipment productivity and reduces tuber losses; regulates the physiological maturation of tubers and timing of harvesting; reduces the tendency to damage and improves the separation of tubers from the tops, their shelf life during storage; reduces damage to tubers by diseases.

There were no significant differences or advantages in the use of tops removal methods (mowing; desiccation). When growing ware potatoes, tops mowing and desiccation must be carried out no earlier than 6-12 days before harvesting. When choosing a method, it is necessary to take into account the climatic conditions of the year, the level of development of the economy, the availability of equipment, the direction of use, etc.

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