

UDC 631.5:635.21

INFLUENCE OF PLANTING SCHEME ON THE YIELD AND QUALITY OF POTATO PRODUCTS IN THE HOT CLIMATE OF UZBEKISTAN**Abdurakhimov Mingzhigit Kattabekovich,**

Doctor of Agricultural Sciences, Professor. Samarkand State University named after Sharof Rashidov.

E-mail: abduraximov59@inbox.ru**Makhmudova Yulduz Sharopovna,**

Supporting doctoral student. Samarkand State University named after Sharof Rashidov.

E-mail: yulduzmahmudova372@gmail.com**Ortikov Tulkin Kuchkarovich,**

candidate of biological sciences, professor. Samarkand State University named after Sharof Rashidov.

E-mail: ortikovt@mail.ru

Abstract: This article examines the relationship between high potato yields in the hot climate of Uzbekistan and regional natural and climatic conditions, including precipitation, temperature, and relative humidity. These parameters are influenced by potato planting patterns.

Experiments revealed that choosing the right planting pattern influences potato yield and product quality. Row spacing had a positive impact on the length of the growing season, biometric indicators, and yield. In the narrow-row (70 cm) plantings, soil temperatures were on average 2-3 °C lower than in the wide-row (90 cm) plantings, due to the higher plant density and complete soil coverage. This situation resulted in higher yields in the narrow-row (70 cm) plantings. The highest yield in the experiment was recorded with the 70x20 cm planting pattern, reaching 30.7 tons. Row spacing had a positive impact on potato biometrics and productivity. However, in the variants with narrow row spacing (70 cm), the yield was higher due to the larger number of tubers.

Key words: Arizona potato variety, planting patterns, temperature, biometric parameters, yield, tuber quality.

Introduction. The global environmental crisis and the resulting global climate change are creating challenges for potato farming. As a result, potato yields are declining due to abnormally high temperatures and the scorching summer sun. Furthermore, a lack of natural soil moisture and sudden temperature fluctuations also cause stress in plants. These factors depend on the potato planting pattern.

The selection of potato planting patterns is an important aspect of agronomic research, substantiating the development of varietal agricultural technology for a specific soil and climate zone or region [Satunkin IV 2018, Vasil'ev AA, Gorbunov AK, 2021, Galeev RR, 2014, Galeev RR 2012]. Yield, as a valuable economic indicator of any variety, determines its resistance to unfavorable environmental conditions (drought, heat, winter hardiness, soil salinity), diseases, and pests. [Ostonakulov T.E., Ismoilov A.I., Amirov Kh.S. 2024].

When the row spacing is widened, the air humidity decreases in the plant mass, reducing the likelihood of moisture concentration on the leaves and stems of potatoes, which is unfavorable for the process of introduction of the pathogen into plant tissue, the intensity of subsequent sporulation and, ultimately, the development of late blight [Uromova I.P., Kuposova N.N., Kozlov A.V., 2015., Uromova I.P., Shtyrlina O.V., Vasyukova E.A., Loginova T.A. 2018].

Weather observations indicate that climate change is occurring. Global and local climate change is characterized by heavy rainfall and drought, which causes temperature and humidity stress in

plants, ridge erosion, and difficulties during the autumn harvest due to soil overwatering [Starovoytov V.I., Starovoytova O.A., 2015]. Given the unpredictable development of climatic conditions during the most critical period of crop formation, it is necessary to consider in advance the possibility of modifying potato cultivation technologies [Fedotova L.S., Kravchenko A.V., Timoshina N.A., Knyazeva E.V., 2011].

The aim of our study was to investigate the impact of different planting patterns on potato yield and quality in the central zone of the Republic of Uzbekistan under climate change.

Research materials and methods. The following observations, calculations, and methods were used in the field experiment: phenological monitoring, biometric measurements, seed germination in the field, actual plant density; plant yield and productivity, tuber growth dynamics, haulm-to-tuber ratio, and average tuber weight according to the All-Russian Research Institute of Potato Growing methodology (1967, 1989).

Study results and discussion. It is known that high ambient temperatures reduce the rate of photosynthesis in potato plants. As a result, plant growth is poor, and yields are reduced. Therefore, changes in air and soil temperature will need to be continually monitored.

According to the Samarkand Meteorological Station, the highest air temperature in March 2022, when potatoes were planted, occurred on March 4th and reached 24 °C. The lowest temperature, 20 °C, was observed on March 19th, which is normal for potato germination and seedling growth. In the experiment, the period of intensive tuber growth and potato harvesting coincided with May. During this period, the average daily air temperature was 26-30 °C. The hottest days were May 25th and 26th, when the temperature reached 35°C. By the end of June, the temperature rose to 41 °C. During this period, the potatoes ripened, and soil moisture and temperature were maintained at a moderate level through irrigation (Table 1).

The lowest daytime air temperature in March 2023 was recorded on March 9 and amounted to 15 °C, and the highest was 27 °C on March 10. The lowest temperature recorded in April of this year was 13 °C (April 18), and the highest was 33 °C (April 13-14). In May, during the period of intensive potato tuber formation, the lowest temperature was 17 °C (May 6), and the highest was 33 °C (May 31). In June, the highest air temperature was 38 °C (June 16-17) (Table 2).

In March 2024, the weather was relatively cool and rainy. On March 1–2, temperatures ranged from –1°C to +10°C. A rise in temperature was recorded on March 20, reaching 27°C. In May, during the potato harvest accumulation period, the lowest temperature was 19°C (May 10), and the highest was 35°C (May 14) (Table 3). Long-term observations show that the optimal time for planting early potatoes is March 1–5.

The optimal daytime air temperature for intensive tuber accumulation and growth is known to be 25–26°C. In 2022, the average daily air temperature from planting to emergence was 8°C, from emergence to budding 19.8°C, from budding to flowering 21.9°C, and from flowering to harvest 22.2°C. Maximum yield accumulation occurs from flowering to yellowing of the tops. During this period, the average daily temperature was 22.2°C, ensuring normal yield accumulation.

Table 1 Meteorological data for the growing season 2022 .

Meteorological indicators	Decades, average month	Months				Average amount for the growing season	
		March	April	May	June		
Temperature, °C	1st decade	9.5	19.4	21.9	25.0	18.9	
	2nd decade	8.0	19.8	20.5	25.9	18.5	
	3rd decade	7.9	20.4	19.8	28.1	19.0	
	Average month	8.4	19.8	20.7	26.3	18.8	
Relative humidity, %	air	1st decade	70	48	63	42	55.7
	2nd decade	89	59	61	43	63.0	

	3rd decade	74	61	57	41	58.2
	Average month	77	56	60	42	58.7
Atmospheric precipitation, mm	1st decade	28.6	0.0	35.2	-	63.8
	2nd decade	103.4	41.1	2.7	6.7	153.9
	3rd decade	16.6	5.9	42.5	-	65.0
	Average amount	148.6	47.0	80.4	6.7	282.7

Table 2 Meteorological data for the growing season 2023 .

Meteorological indicators	Decades, average month	Months				Average amount for the growing season	
		March	April	May	June		
Temperature, °C	1st decade	15.6	15.3	18.6	27.8	19.3	
	2nd decade	14.1	16.0	22.3	29.9	20.5	
	3rd decade	16.0	20.3	23.8	26.4	21.6	
	Average month	15.0	17.2	21.6	28.0	20.4	
Relative humidity, %	air	1st decade	48	63	44	31	47.2
		2nd decade	65	49	49	31	48.5
		3rd decade	56	59	36	34	46.2
		Average month	56	57	43	32	47.0
Atmospheric precipitation, mm	1st decade	-	18.0	4.9	-	22.9	
	2nd decade	10.9	1.0	16.2	-	28.1	
	3rd decade	-	-	-	-	-	
	Average amount	10.9	19.0	21.0		50.9	

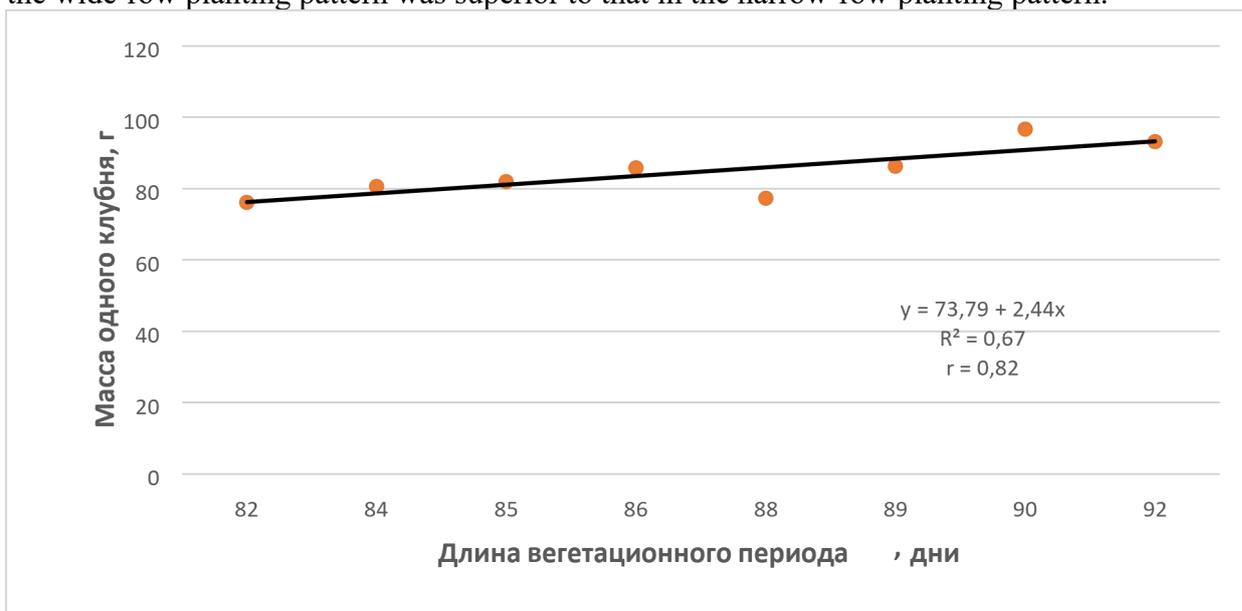
Table 3 Meteorological data for the growing season 2024 .

Meteorological indicators	Decades, average month	Months				Average amount for the growing season	
		March	April	May	June		
Temperature, °C	1st decade	4.7	14.5	19.4	25.3	15.9	
	2nd decade	9.6	15.9	19.6	27.8	18.2	
	3rd decade	13.0	18.0	20.6	29.0	20.1	
	Average month	9.1	16.1	20.0	27.3	18.3	
Relative humidity, %	air	1st decade	79	57	64	39	59.7
		2nd decade	67	74	67	38	54.7
		3rd decade	66	54	51	39	52.5
		Average month	70.7	61.7	60.6	38.7	57.9
Atmospheric precipitation, mm	1st decade	20.1	3.6	27.9	60.7	58.3	
	2nd decade	39.5	35.6	33.6	1.0	109.7	

3rd decade	41.3	0.0	2.8	0.0	44.1
Average amount	100.9	39.2	64.8	7.7	212.6

Potato yield is known to be determined by plant productivity. It has been found that yield per plant varies depending on the feeding area, that is, the planting pattern. For example, in the control variant (planting pattern 70x25 cm), the yield per bush was 640.0 g, the number of tubers was 7.8, and the average weight of one tuber was 82 g. In other experimental variants, where potatoes were planted in narrow rows (70 cm), these parameters differed from the control. Thus, the highest yield was observed with the 70x30 cm pattern: the yield per bush was 678.02 g, the number of tubers was 7.9, and the average tuber weight was 85.8 g (Table 4). With the 70x20 cm scheme, the productivity of one plant was 605.0 g, the number of tubers was 7.5 pcs., the average tuber weight was 80.6 g. With the 70x15 cm scheme, due to the smaller distance between bushes, the yield per plant was lower - 556.0 g; a smaller number of tubers (7.3 pcs.) and a lower average tuber weight (76.1 g) were also recorded.

Planting potatoes in wide rows (90 cm) had a significant impact on yield. For example, with a 90 x 25 cm planting pattern, the yield per plant was higher—690 g—compared to a 70 x 25 cm planting pattern. Higher yields were also recorded with 90 x 30 cm planting patterns compared to 70 x 20 cm, 70 x 30 cm, and 90 x 20 cm. Furthermore, the average weight of a single tuber in the wide-row planting pattern was superior to that in the narrow-row planting pattern.



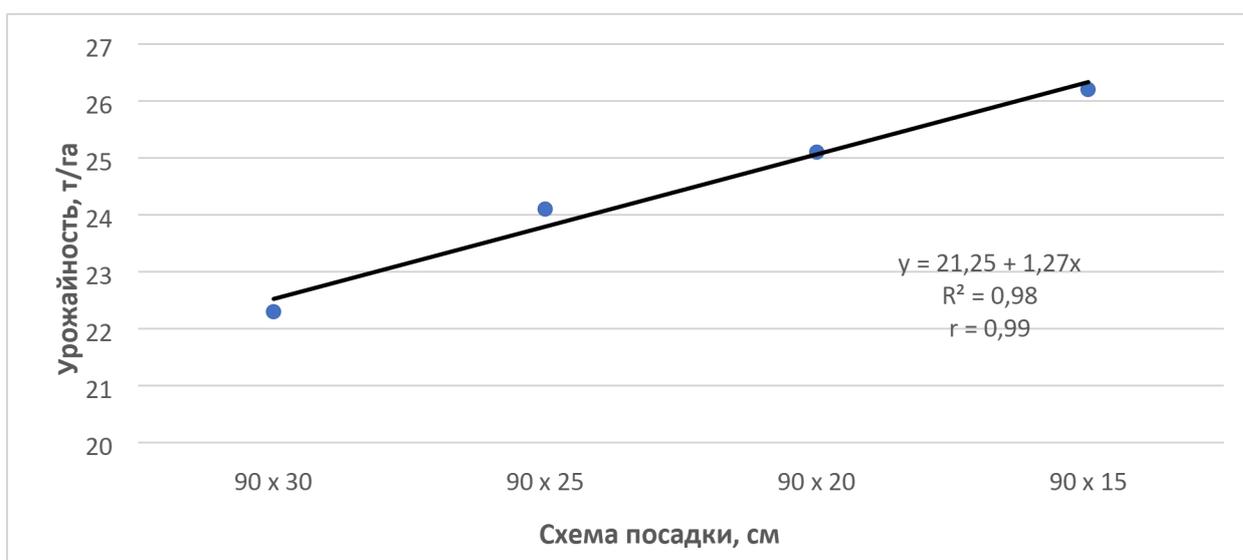
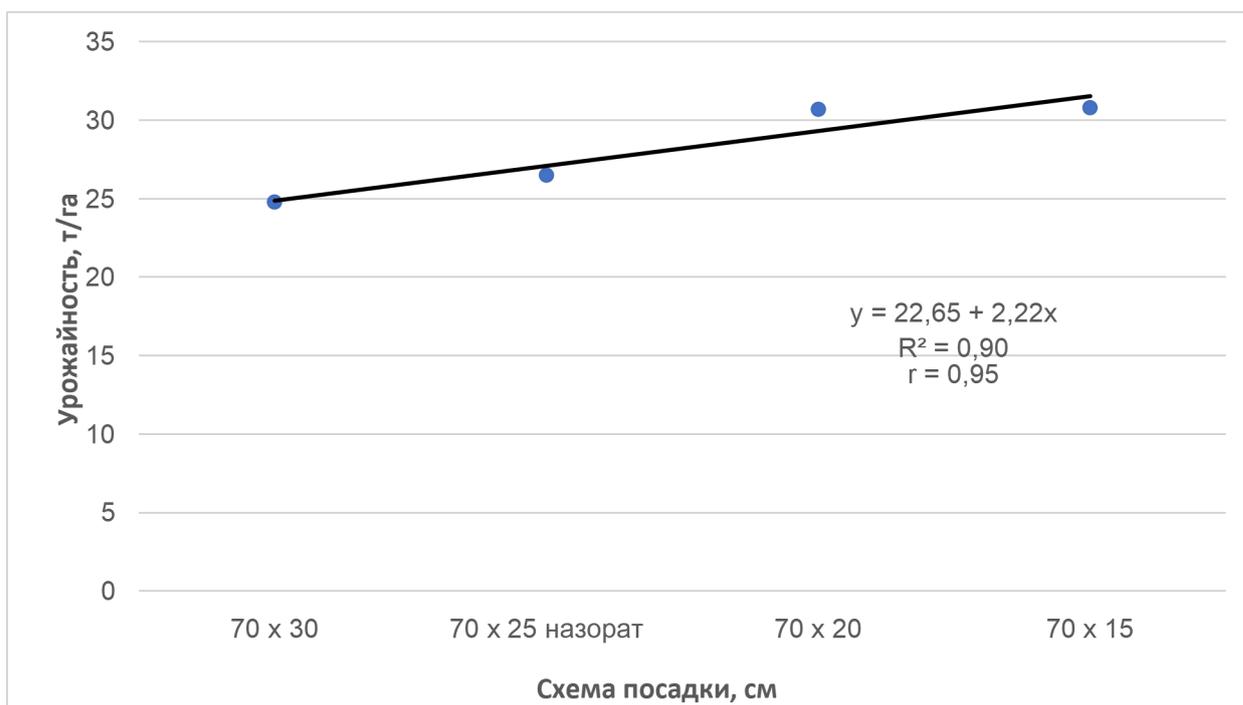
The correlation coefficient between the duration of the growing season, i.e. from the emergence of potato seedlings to the moment the tops turn yellow, and the average tuber weight is $r=0.82$, which means a high positive correlation between the two factors studied.

Table 4. Effect of row spacing on potato productivity indicators.

Options	Planting diagram, cm	Productivity per bush, g	Number of tubers on one bush, pcs.	Average tuber weight, g	Number of real plants, thousand/piece*ha
1	70 x 25 controls	640.0	7.8	82.0	55.4
2	70 x 30	678.0	7.9	85.8	46.1

3	70 x 20	605.0	7.5	80.6	69.2
4	70 x 15	556.0	7.3	76.1	92.3
5	90 x 30	745.0	7.7	96.7	43.1
6	90 x 25	690.0	7.4	93.2	35.9
7	90 x 20	630.0	7.3	86.3	53.8
8	90 x 15	580.0	7.5	77.3	71.8

In the narrow-row planting variants, the large number of potato plants resulted in higher yields compared to the wide-row planting variants. Narrow-row planting yielded 24.8–30.7 tons per hectare. The highest yield was obtained in the 70x20 cm variant—30.7 tons per hectare, 4.2 tons more than the control (70x25 cm), which yielded 26.5 tons per hectare.



With wide-row planting (90 cm), plant productivity was high, and tubers were comparatively large (86–96 g on average), but the overall yield per unit area was low. With the 90 x 25 cm planting pattern, yield was 22.3 t/ha, which is 4.2 t/ha less than the control (Table 5).

The correlation coefficient between potato planting pattern and yield is $r=0.95-0.99$, which indicates a high positive relationship between these factors.

Table 5. Effect of row spacing on potato yield

Options	Planting diagram, cm	Yield by year, t/ha			Yield, t/ha	Deviation from standard	
		2022	2023	2024		t/ha	%
1	70 x 25 nazorat	28.0	24.3	27.2	26.5		100
2	70 x 30	26.0	22.6	25.9	24.8	-1.7	92.98
3	70 x 20	32.0	29.2	31.0	30.7	+4.2	115.84
4	70 x 15	33.0	29.3	30.0	30.5	+4.0	115.0
5	90 x 30	24.0	20.6	22.3	22.3	-4.2	84.2
6	90 x 25	26.0	22.4	23.9	24.1	-2.4	90.9
7	90 x 20	27.0	23.8	24.6	25.1	-1.4	94.7
8	90 x 15	28.0	24.7	25.8	26.1	-0.4	98.5
	S x (%)	3.16	3.06	3.24			
	NSR 05 (t/ha)	2.61	2.22	2.51			

Conclusions . Planting potatoes with narrow (70 cm) and wide (90 cm) row spacings affected the length of the growing season. In the studied variants, the period from germination to yellowing of the tops was 82–92 days. Moreover, in the variants with wide row spacings, the growing season was longer compared to the variants with narrow row spacings. This is due to the fact that with wide row spacings, the plant feeding area was larger, which ensured better plant development and more active physiological processes. Row spacing positively impacted the biometric indicators and productivity of potatoes. However, in the variants with narrow row spacings (70 cm), due to the greater number of tubers, the yield was higher.

REFERENCES

1. Satunkin IV News of the Orenburg State Agrarian University, 2018, No. 3 (71), pp. 87–89, EDN: USULXC. (In Russ.)
2. Vasil'ev AA, Gorbunov AK, Agrarnyy nauchnyy zhurnal, 2021, No. 2, pp. 9–13, DOI: 10.28983/asj.y 2021i2pp9-13, EDN: OMERPC. (In Russ.),
3. Galeev RR, Shul'ga MS, Vestnik NGAU (Novosibirsk State Agrarian University), 2014, No. 1 (30), pp. 12–18, EDN: RYPTRR. (In Russ.)
4. Galeev R. R. Vestnik Buryat state village of high-quality farming academy im . V.R. Filippova, 2012, No. 4 (29), pp. 94–99, EDN: PJDXP. (In Russ.)
5. Ostonakulov TE Ismoyilov AI Amirov XS The photosynthetic activity, yield and adaptability coefficient of potato varieties during early culture in film greenhouses. J. Actual problems of modern science. - Magnitogorsk. No. 2, 2024. - P. 99-102.
6. Butov AV Mandrova AA Potato ecological quality in the biologization of high intensity technologies of its cultivation and irrigation. ISSN 2074-9414 Food Processing: Techniques and Technology. 2018. Vol. 48.No. 2. pp. 170-177.
7. Uromova I.P., Shtyrlina O.V., Vasyukova E.A., Loginova T.A. Influence of row spacing on the yield of healthy potatoes . Journal. Advances in Modern Natural Science. - 2018. - No. 7 - P. 65-70

8. Makhmudova Yu. Sh., Abdurakhimov M.K. Dependence of potato cultivation on environmental factors. Bulletin of Agrarian Science of Uzbekistan, No. 4 (10), 2023, pp. 64-66.
9. Uromova I.P., Kuposova N.N., Kozlov A.V. Influence of row spacing on potato yield and quality // Modern problems of science and education. 2015. No. 2-3.