

Article

Effectiveness Of Mulching In Increasing Potato Yield

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Abstract: This study evaluated the effectiveness of different mulching methods in the cultivation of the potato cultivars DT-7, Z and Ganying 9 introduced from China. The research was carried out in 2024–2026 at the Scientific Experimental Station of Tashkent State Agrarian University. The effects of polyethylene film and decomposed manure mulch on potato growth, development and yield were investigated; an unmulched treatment served as the control. Field emergence rate, the timing of the main phenological phases, plant biometric characteristics, the number and mass of tubers, and total and marketable yield were determined.

Keywords: potato, Chinese cultivars, DT-7, Z, Ganying 9, mulching, polyethylene film, decomposed manure, field emergence rate, phenological observations, biometric characteristics, total yield, marketable yield.

Introduction

Potato is currently grown worldwide on 17.1 million ha, with an average yield of 22.86 t/ha and a gross output of 390.4 million t. The leading producers are China (94.8 million t), India (57.1 million t), Ukraine (21.1 million t), the USA (19.1 million t), Russia (18.4 million t), Germany (12.7 million t), Bangladesh (10.46 million t), France (9.2 million t) and Pakistan (8.4 million t). In Uzbekistan, potato is grown on 220.0 thousand ha, with a gross yield of 3.7 million t and an average yield of 16.8 t/ha.[1][2][3]

The country pays particular attention to ensuring the sustainable food security of the population, fully meeting domestic demand for potatoes, increasing the production of ware and seed potatoes, and developing the domestic seed-production system. Resolution of the President of the Republic of Uzbekistan No. PP-269 of 8 September 2025, “On additional measures to increase potato production and further develop potato seed production in the Republic”, sets the tasks of creating virus- and bacteria-free potato planting material and increasing the output of high-generation seed potatoes. Accordingly, the priority tasks include reducing imports of seed potatoes, strengthening the domestic seed base and lowering production costs by broadening the cultivar assortment, producing superelite and elite seed potatoes, developing advanced resource-saving cultivation technologies, and widely introducing innovative solutions and scientific achievements.[4][5][6]

Methods

The research was conducted in 2024–2026 at the Scientific Experimental Station of Tashkent State Agrarian University. The potato cultivars DT-7, Z and Ganying 9, introduced from China, were grown and studied under two mulching methods: mulching with polyethylene film and mulching with decomposed manure. An unmulched treatment was used as the control. The plots were 20 m long with four rows and 400 plants per plot; the feeding area was 28 m²; the experiment had four replications.[7][8]

Results

In all years of the study, all cultivars were planted in open ground in early spring, in the third ten-day period of February and the first ten-day period of March. Phenological observations and measurements were carried out on the Chinese-introduced cultivars (Table 1). After planting, the seed tubers were covered with film or manure, and the effects of these mulching methods on plant growth and development were compared.[9] The phenological observations recorded tuber emergence, field emergence rate, and the timing of budding, flowering and haulm yellowing. In DT-7, the field emergence rate ranged from 96.9 to 98.4% across treatments: 96.9% in the unmulched control, 97.1% under manure mulch, and the highest, 98.4%, under polyethylene film mulch.[10][11]

In cultivar Z, the field emergence rate ranged from 97.0 to 98.3%: 97.0% in the unmulched control, 97.8% under manure mulch, and the highest, 98.3%, under polyethylene film mulch.[12]

In cultivar Ganying 9, the field emergence rate ranged from 97.2 to 98.6%: 97.2% in the unmulched control, 97.6% under manure mulch, and the highest, 98.6%, under polyethylene film mulch.[13]

Thus, both mulching methods had a positive effect on the field emergence rate of the Chinese-introduced cultivars. The largest increase over the control was obtained with polyethylene film: 1.5 percentage points in DT-7, 1.3 in Z and 1.4 in Ganying 9.

The time from planting to emergence in DT-7 was 21 days in the control, 17 days under film mulch and 19 days under manure mulch. In Z it was 21 days in the control, 18 days under film and 19 days under manure. In Ganying 9 it was 21 days in the control, 17 days under film and 18 days under manure. Consequently, under polyethylene film mulch emergence occurred earlier than in the control by 4 days in DT-7, 3 days in Z and 4 days in Ganying 9.

The period from emergence to budding in DT-7 was 34 days in the control, 28 days under film mulch and 30 days under manure mulch. In Z it was 33, 27 and 31 days, respectively, and in Ganying 9 it was 32, 28 and 31 days. In all the Chinese-introduced cultivars, budding under polyethylene film mulch occurred earliest, 4–6 days earlier than in the control.

The interval from budding to flowering was 5–6 days across cultivars and treatments, with no substantial variation.

The period from flowering to haulm yellowing differed only slightly among cultivars and treatments. In DT-7 it was the same in the control and the manure treatment (35 days) and 1 day longer under film mulch (36 days). In Z it was 35 days in the control and 36 days in both mulched treatments. In Ganying 9 it was 37 days in the control, 2 days shorter under manure mulch (35 days) and 1 day longer than the control under film mulch (38 days).

Table 1

Effect of mulching methods on the phenological parameters of potato cultivars introduced from China, days (2024–2026)

o.	Treatment	Field emergence rate, %	Planting – emergence	Emergence – budding	Budding – flowering	Flowering – haulm yellowing	Emergence – haulm yellowing
DT-7							
	Unmulched (control)	96.9	21	34	6	35	75
	Polyethylene film mulch	98.4	17	28	5	36	69

o.	Treatment	Field emergence rate, %	Planting – emergence	Emergence – budding	Budding – flowering	Flowering – haulm yellowing	Emergence – haulm yellowing
	Decomposed manure mulch	97.1	19	30	5	35	70
Z							
	Unmulched (control)	97.0	21	33	6	35	74
	Polyethylene film mulch	98.3	18	27	5	36	68
	Decomposed manure mulch	97.8	19	31	5	36	72
Ganying 9							
	Unmulched (control)	97.2	21	32	5	37	74
	Polyethylene film mulch	98.6	17	28	5	38	71
	Decomposed manure mulch	97.6	18	31	6	35	72

The mulching methods also affected the duration of the growing season, i.e. the period from emergence to haulm yellowing and cessation of growth, which ranged from 68 to 75 days across cultivars and treatments. In DT-7 it was 75 days in the control; under manure mulch it was 5 days shorter (70 days), and under polyethylene film mulch 6 days shorter (69 days). In Z it was 74 days in the control, 72 days under manure mulch (2 days shorter) and 68 days under film mulch (6 days shorter). In Ganying 9 the growing season ended after 74 days in the control, 72 days under manure mulch (2 days shorter) and 71 days under film mulch (3 days shorter).

Thus, the phenological observations showed that, of the mulching methods tested on the Chinese-introduced cultivars, polyethylene film mulch was the most effective in accelerating emergence, growth and development.[14]

Table 2

Effect of mulching methods on the biometric parameters of potato cultivars introduced from China (2024–2026)

from China (2011–2016)

o.	Treatment	Per plant				
		stem height, cm	number of leaves, pcs	leaf area, m²	haulm mass, g	root mass, g
DT-7						
	Unmulched (control)	74.0	181.3	0.68	305.8	28.5
	Polyethylene film mulch	78.5	186.4	0.76	309.4	32.1
	Decomposed manure mulch	75.2	184.7	0.73	307.1	29.3
Z						
	Unmulched (control)	88.8	189.3	0.69	323.5	31.1
	Polyethylene film mulch	93.2	196.5	0.73	329.1	35.9
	Decomposed manure mulch	91.7	192.7	0.71	326.4	32.1

o.	Treatment	Per plant				
		stem height, cm	number of leaves, pcs	leaf area, m²	haulm mass, g	root mass, g
Ganying 9						
	Unmulched (control)	78.2	202.1	0.71	320.1	29.8
	Polyethylene film mulch	84.8	212.7	0.82	334.4	36.7
	Decomposed manure mulch	82.3	206.4	0.76	327.9	31.5

The effect of the mulching methods on the biometric parameters of the Chinese-introduced potato cultivars was also determined (Table 2): stem height, number of leaves, leaf area, haulm mass and mass of roots in the 0–30 cm soil layer. Measurements were made on 10 plants in each plot.

The stem height of DT-7 ranged from 74.0 to 78.5 cm across treatments. The control was the shortest (74.0 cm); all mulched treatments exceeded it: 75.2 cm under manure mulch (1.2 cm taller) and 78.5 cm under polyethylene film mulch (4.5 cm taller).

In Z, the stem height in the control was 88.8 cm. Both mulched treatments exceeded it: 91.7 cm under manure mulch (2.9 cm taller) and 93.2 cm under film mulch (4.4 cm taller).

In Ganying 9, the stem height in the control was 78.2 cm. Both mulched treatments exceeded it: 82.3 cm under manure mulch (4.1 cm taller) and 84.8 cm under film mulch (6.6 cm taller).

The number of leaves and the leaf area also differed among cultivars and treatments. In DT-7, the control had 181.3 leaves and a leaf area of 0.68 m² per plant; under film mulch these values were 186.4 and 0.76 m², and under manure mulch 184.7 and 0.73 m². The highest values were obtained under film mulch, which exceeded the control by 5.1 leaves and 0.08 m² of leaf area.

In Z, the control had 189.3 leaves and a leaf area of 0.69 m²; under film mulch the values were 196.5 and 0.73 m², and under manure mulch 192.7 and 0.71 m². The highest values were again obtained under film mulch, which exceeded the control by 7.2 leaves and 0.04 m².

In Ganying 9, the control had 202.1 leaves and a leaf area of 0.71 m²; under film mulch the values were 212.7 and 0.82 m², and under manure mulch 206.4 and 0.76 m². In this cultivar too, the highest values were obtained under film mulch, which exceeded the control by 10.6 leaves and 0.11 m².

In the experiment, mulching had a positive effect on haulm mass and on the development and mass of the root system.

The haulm mass of DT-7 was 305.8 g in the control, 309.4 g under film mulch (3.6 g more than the control) and 307.1 g under manure mulch (1.3 g more).

The haulm mass of Z was 323.5 g in the control, 329.1 g under film mulch (5.6 g more than the control) and 326.4 g under manure mulch (2.9 g more).

The haulm mass of Ganying 9 was 320.1 g in the control, 334.4 g under film mulch (14.3 g more than the control) and 327.9 g under manure mulch (7.8 g more).

To determine root mass, the roots were dug up and weighed, and the mean value was calculated. In DT-7, root mass was 28.5 g in the control, 32.1 g under film mulch and 29.3 g under manure mulch; the largest gain over the control, 3.6 g, was obtained under film mulch.[15]

In Z, root mass was 31.1 g in the control, 35.9 g under film mulch and 32.1 g under manure mulch; the largest gain over the control, 4.8 g, was obtained under film mulch.

In Ganying 9, root mass was 29.8 g in the control, 36.7 g under film mulch and 31.5 g under manure mulch; the largest gain over the control, 6.9 g, was obtained under film mulch.

Overall, with respect to the effect of the mulching methods on the biometric parameters of the Chinese-introduced cultivars (stem height, number of leaves and leaf area, haulm mass and root mass), polyethylene film mulch gave the highest values.

The productivity parameters of the Chinese-introduced potato cultivars were also determined (Table 3): the number, mass and yield of tubers per plant, total and marketable yield, marketable share, and marketable yield relative to the control.

In DT-7, the number of tubers per plant was 7.8 in the control, 8.2 under film mulch and 8.0

under manure mulch; the largest gain over the control, 0.4 tubers, was obtained under film mulch.

Table 3

Effect of mulching methods on the productivity of potato cultivars introduced from China (2024–2026)

o.	Treatment	Per plant			Total yield, t/ha	Marketable yield, t/ha	Marketable share, %	Marketable yield relative to control, %
		number of tubers, pcs	tuber mass , g	tuber yield , g				
DT-7								
	Unmulched (control)	7.8	68.1	531	37.9	29.2	77.0	100
	Polyethylene film mulch	8.2	71.3	585	41.8	32.1	76.8	110
	Decomposed manure mulch	8.0	70.2	562	40.2	31.0	77.0	105
Z								
	Unmulched (control)	5.4	65.1	351	25.1	19.1	76.0	100
	Polyethylene film mulch	5.8	67.4	391	27.9	21.2	75.8	111
	Decomposed manure mulch	5.6	66.0	370	26.4	20.0	76.0	105
Ganying 9								
	Unmulched (control)	8.2	70.6	579	41.4	33.2	80.2	100
	Polyethylene film mulch	9.1	70.2	639	45.6	37.2	81.6	112
	Decomposed manure mulch	8.7	71.3	620	44.3	35.2	79.5	106

In Z, the number of tubers per plant was 5.4 in the control, 5.8 under film mulch and 5.6 under manure mulch; the largest gain over the control, 0.4 tubers, was obtained under film mulch.

In Ganying 9, the number of tubers per plant was 8.2 in the control, 9.1 under film mulch and 8.7 under manure mulch; the largest gain over the control, 0.9 tubers, was obtained under film mulch.

The mean tuber mass in DT-7 was 68.1 g in the unmulched control, 71.3 g under film mulch and 70.2 g under manure mulch; the largest gain over the control, 3.2 g, was obtained under film mulch.

In Z, the mean tuber mass was 65.1 g in the unmulched control, 67.4 g under film mulch and 66.0 g under manure mulch; the largest gain over the control, 2.3 g, was obtained under film mulch.

In Ganying 9, the mean tuber mass was 70.6 g in the control, 70.2 g under film mulch and 71.3 g under manure mulch; the largest gain over the control, 0.7 g, was obtained under manure mulch.

The tuber yield per plant ranged from 351 to 639 g across cultivars and treatments: 531–585 g in DT-7, 351–391 g in Z and 579–639 g in Ganying 9. Cultivar Z had the lowest tuber yield per plant. In all cultivars, the highest value among the mulch types was obtained under polyethylene film mulch.

Total yield was also determined. In DT-7 it was 37.9 t/ha in the control, 41.8 t/ha under film mulch and 40.2 t/ha under manure mulch; film mulch gave the largest gain over the control, 3.9 t/ha.

In Z, total yield was 25.1 t/ha in the control, 27.9 t/ha under film mulch and 26.4 t/ha under manure mulch; film mulch gave the largest gain over the control, 2.8 t/ha.

In Ganying 9, total yield was 41.4 t/ha in the control, 45.6 t/ha under film mulch and 44.3 t/ha under manure mulch; film mulch gave the largest gain over the control, 4.2 t/ha.

Marketable yield was separated from total yield. In DT-7 it was 29.2 t/ha in the control, 32.1 t/ha under film mulch and 31.0 t/ha under manure mulch; film mulch gave the largest gain over the control, 2.9 t/ha (10%).

In Z, marketable yield was 19.1 t/ha in the control, 21.2 t/ha under film mulch and 20.0 t/ha under manure mulch; film mulch gave the largest gain over the control, 2.1 t/ha (11%).

In Ganying 9, marketable yield was 33.2 t/ha in the control, 37.2 t/ha under film mulch and 35.2 t/ha under manure mulch; film mulch gave the largest gain over the control, 4.0 t/ha (12%).

The marketable share of the yield ranged from 75.8 to 81.6% across cultivars and treatments; the Chinese-introduced cultivar Ganying 9 again had the highest values.

Thus, mulching the Chinese-introduced potato cultivars with polyethylene film was the most effective method, increasing marketable yield over the control by 10% in DT-7, 11% in Z and 12% in Ganying 9.

Conclusions.

Mulching with polyethylene film increased the field emergence rate and accelerated tuber emergence by 4 days in DT-7, 3 days in Z and 4 days in Ganying 9.

According to the phenological observations, mulching the Chinese-introduced potato cultivars with polyethylene film was the most effective method for plant growth and development.

Mulching the Chinese-introduced potato cultivars with polyethylene film was the most effective method, increasing marketable yield over the control by 10% in DT-7, 11% in Z and 12% in Ganying 9.

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