COTTON SCIENCE

Volume-4
Issue-1

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Cotton Science International scientific journal

Founder and Publisher **Zhōnghuá Mínguó**

Published science may 2021 year. Issued Quarterly.

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THE IMPACT OF SEED PLANTING RATES AND FERTILIZATION QUANTITIES ON THE FORMATION OF DRY MASS IN CHICKPEA VARIETIES.

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Abstract. This study investigates the effects of seed planting rates and nitrogen fertilization on the accumulation of dry mass in the local chickpea varieties "Obod" and "Polvon." The research aimed to determine how different planting schemes and nitrogen quantities impact the growth and yield of these varieties. The findings revealed that the highest dry mass per hectare was achieved in the variant planted according to the 60x5x1 scheme with 60 kg of nitrogen fertilization. Furthermore, the accumulation of dry mass per individual plant was maximized in the variant planted according to the 60x15x1 scheme, also with 60 kg of nitrogen. These results highlight the importance of optimizing planting and fertilization practices to enhance the productivity of chickpea crops.

Keywords: chickpea, variety, planting rate, fertilizer, mineral fertilizer, dry mass, seedling, flowering, ripening.

Introduction. During the vegetation period of chickpea plants, research has been conducted by scientists such as N.H. Samarah, N. Hoddod and A.H. Alqudah in irrigated and rainfed conditions around the Mediterranean region concerning the accumulation of dry mass. It has been observed that the plants grown in rainfed conditions have a higher dry mass and lower moisture content compared to those grown under irrigation. This indicates that the reproductive growth period of the chickpea is shorter and matures more quickly under drought conditions. It has been established that non-irrigated cultivation leads to a yield reduction of 49-54% compared to irrigated cultivation. Moreover, a positive correlation between yield and the duration of the reproductive growth period has been proven [1].

The results of the research conducted in Azerbaijan indicate that shifting the planting date from early spring to winter in continental climate zones significantly enhances the yield of chickpeas [2]. When conducting structural analyses of the plants, it was found that when chickpeas are sown in the autumn, the height of the plants, the dry mass, and the number of pods and seeds per plant are comparatively higher (by 20-25%) [3].

Research Materials and Methodology. Field experiments were conducted in the experimental field of the Southern Agricultural Scientific Research Institute. The experiment consisted of 24 variants, arranged in a single layer with 3 repetitions. The chickpea varieties included in the State Register, "Obod" and "Polvon" were planted. The chickpea varieties were planted in three different systems (60x5-1; 60x10-1; 60x15-1) with three different seedling densities (333,333 plants/ha, 166,666 plants/ha, 111,111 plants/ha) and were fed with mineral fertilizers at rates of $N_0P_{90}K_{60}$, $N_{30}P_{90}K_{60}$, $N_{45}P_{90}K_{60}$ and $N_{60}P_{90}K_{60}$ kg/ha during the growing period.

During the growing period of the chickpea varieties, phenological observations, biometric measurements, and calculations were conducted using the generally accepted guidelines from "Dala tazhribalarini utkazish uslublari" (2017), "Metodika Gosudarstvennogo sortoispytaniya sel'skokhozyajstvennykh kul'tur" (1989), B.A.Dospekhov's “Metodika polevogo opyta” (1985), and "Metody agrokhimicheskikh, agrofizicheskikh i mikrobiologicheskikh issledovanij v polivnykh khlopkovykh rajonakh" (Soviet Research Institute of Cotton, 1963). The dry mass was determined using the method of A.A. Nichiporovich (O putyah povysheniya produktivnosti fotosinteza rastenij v posevakh. In the book Fotosintez i voprosa produktivnosti rastenij (1963)), where two repetitions (1, 3) were identified during the phases of branching, pod formation, flowering, and legume formation in plants.

Research results. Based on the results obtained from our research conducted under the climatic conditions of Kashkadarya region, it was demonstrated that the leaf area of the studied varieties was relatively similar to each other. Specifically, in the variant where 333,333 seeds of the "Obod" variety were planted per hectare (in a 60x5x1 scheme), during the branching phase, the yields were as follows: 5.08 centners/ha for the $N_0P_{90}K_{60}$ variant, 5.36 centners/ha for the $N_{30}P_{90}K_{60}$ variant, 5.72 centners/ha for the $N_{45}P_{90}K_{60}$ variant, and 6.43 centners/ha for the $N_{60}P_{90}K_{60}$ variant.

In the pod formation phase, the yields were: 8.90 centners/ha for the $N_0P_{90}K_{60}$ variant, 9.80 centners/ha for the $N_{30}P_{90}K_{60}$ variant, 10.90 centners/ha for the $N_{45}P_{90}K_{60}$ variant, and 11.10 centners/ha for the $N_{60}P_{90}K_{60}$ variant.

During the flowering phase, the yields were: 18.90 centners/ha for the $N_0P_{90}K_{60}$ variant, 19.50 centners/ha for the $N_{30}P_{90}K_{60}$ variant, 20.40 centners/ha for the $N_{45}P_{90}K_{60}$ variant, and 24.60 centners/ha for the $N_{60}P_{90}K_{60}$ variant.

In the podding phase, the yields were: 25.00 centners/ha for the $N_0P_{90}K_{60}$ variant, 26.70 centners/ha for the $N_{30}P_{90}K_{60}$ variant, 28.10 centners/ha for the $N_{45}P_{90}K_{60}$ variant, and 30.20 centners/ha for the $N_{60}P_{90}K_{60}$ variant.

Finally, in the ripening phase, the yields were: 37.10 centners/ha for the $N_0P_{90}K_{60}$ variant, 39.30 centners/ha for the $N_{30}P_{90}K_{60}$ variant, 40.50 centners/ha for the $N_{45}P_{90}K_{60}$ variant, and 45.20 centners/ha for the $N_{60}P_{90}K_{60}$ variant.

Table 1. Effect of seeding rates and fertilization rates on dry mass formation in pea cultivars

№	Name of variety	Planting scheme	The rate of planting seeds per hectare		Fertilization rate is kg/ha	Dry mass m2/ha									
			thousand units/ha	Kg/ha		Shooting c/ha	Branching 1 bush/gr	Branching c/ha	Branching 1 bush/gr	Flowering c/ha	Flowering bush/gr	Poding c/ha	Poding 1 bush/gr	Maturing c/ha	Maturing 1 bush/gr
1	Obod	60x5x1	333333	116	Control Fon (N_0 P_{90} K_{60})	5.08	2.03	8.90	3.56	18.90	7.57	25.00	10.01	37.12	14.87
2					Fon +N_{30}	5.36	2.06	9.80	3.76	19.48	7.47	26.70	10.24	39.26	15.06
3					Fon +N_{45}	5.72	2.17	10.90	4.14	20.40	7.74	28.11	10.67	40.48	15.36
4					Fon +N_{60}	6.43	2.36	11.10	4.07	24.62	9.03	30.17	11.07	45.24	16.60
5		60x10x1	166666	58	Control Fon (N_0 P_{90} K_{60})	3.28	2.56	7.10	5.53	17.10	13.33	23.20	18.08	35.32	27.53
6					Fon +N_{30}	3.26	2.45	7.80	5.86	17.38	13.05	24.70	18.54	37.16	27.90
7					Fon +N_{45}	3.32	2.45	8.70	6.41	18.00	13.26	25.91	19.09	38.08	28.05
8					Fon +N_{60}	4.03	2.90	8.80	6.33	22.22	15.98	27.87	20.04	42.84	30.81
9		60x15x1	111111	39	Control Fon (N_0 P_{90} K_{60})	2.68	3.08	6.30	7.25	16.50	18.99	22.40	25.78	34.72	39.96
10					Fon +N_{30}	2.76	3.11	7.00	7.89	16.88	19.04	23.90	26.95	36.66	41.34
11					Fon +N_{45}	3.12	3.46	7.90	8.77	17.80	19.77	25.11	27.88	37.88	42.07
12					Fon +N_{60}	3.73	3.98	8.00	8.54	21.92	23.40	27.07	28.89	42.54	45.41
13	Polvon	60x5x1	333333	133	Control Fon (N_0 P_{90} K_{60})	5.48	2.19	9.18	3.67	19.26	7.70	26.14	10.45	39.24	15.69
14					Fon +N_{30}	5.94	2.28	9.54	3.67	20.14	7.74	27.94	10.74	41.36	15.90
15					Fon +N_{45}	6.04	2.27	10.01	3.76	20.85	7.83	28.72	10.79	43.17	16.22
16					Fon +N_{60}	6.83	2.54	10.95	4.07	25.10	9.32	29.36	10.90	46.40	17.23
17		60x10x1	166666	67	Control Fon (N_0 P_{90} K_{60})	3.68	2.89	7.38	5.79	17.46	13.69	24.34	19.09	37.44	29.36
18					Fon +N_{30}	3.94	3.00	7.44	5.66	18.14	13.80	25.84	19.66	39.36	29.95
19					Fon +N_{45}	3.84	2.86	7.61	5.66	18.65	13.87	26.32	19.57	40.97	30.47
20					Fon +N_{60}	4.53	3.32	8.55	6.28	22.80	16.73	26.96	19.79	44.10	32.37
21		60x15x1	111111	45	Control Fon (N_0 P_{90} K_{60})	2.88	3.35	6.78	7.89	16.66	19.39	23.74	27.63	36.64	42.65
22					Fon +N_{30}	3.14	3.51	6.94	7.76	17.34	19.40	25.34	28.35	38.56	43.13
23					Fon +N_{45}	3.04	3.36	7.41	8.18	17.85	19.71	26.12	28.83	40.17	44.35
24					Fon +N_{60}	3.73	4.03	8.25	8.91	22.00	23.77	26.66	28.81	43.30	46.79

In the branching phase. the yield per single plant was determined as follows: 2.03 grams for the $N_0P_{90}K_{60}$ variant. 2.06 grams for the $N_{30}P_{90}K_{60}$ variant. 2.17 grams for the $N_{45}P_{90}K_{60}$ variant. and 2.36 grams for the $N_{60}P_{90}K_{60}$ variant.

During the pod formation phase. the yield per single plant was 3.56 grams for the $N_0P_{90}K_{60}$ variant. 3.76 grams for the $N_{30}P_{90}K_{60}$ variant. 4.14 grams for the $N_{45}P_{90}K_{60}$ variant. and 4.07 grams for the $N_{60}P_{90}K_{60}$ variant.

In the flowering phase. the yield per single plant was recorded as 7.57 grams for the $N_0P_{90}K_{60}$ variant. 7.47 grams for the $N_{30}P_{90}K_{60}$variant. 7.74 grams for the $N_{45}P_{90}K_{60}$ variant. and 9.03 grams for the $N_{60}P_{90}K_{60}$ variant.

During the podding phase. the yield per single plant was 10.0 grams for the $N_0P_{90}K_{60}$ variant. 10.20 grams for the $N_{30}P_{90}K_{60}$ variant. 10.70 grams for the $N_{45}P_{90}K_{60}$ variant. and 11.10 grams for the $N_{60}P_{90}K_{60}$ variant.

Finally. in the ripening phase. the yield per single plant was found to be 14.90 grams for the $N_0P_{90}K_{60}$ variant. 15.10 grams for the $N_{30}P_{90}K_{60}$ variant. 15.40 grams for the $N_{45}P_{90}K_{60}$ variant. and 16.60 grams for the $N_{60}P_{90}K_{60}$ variant.

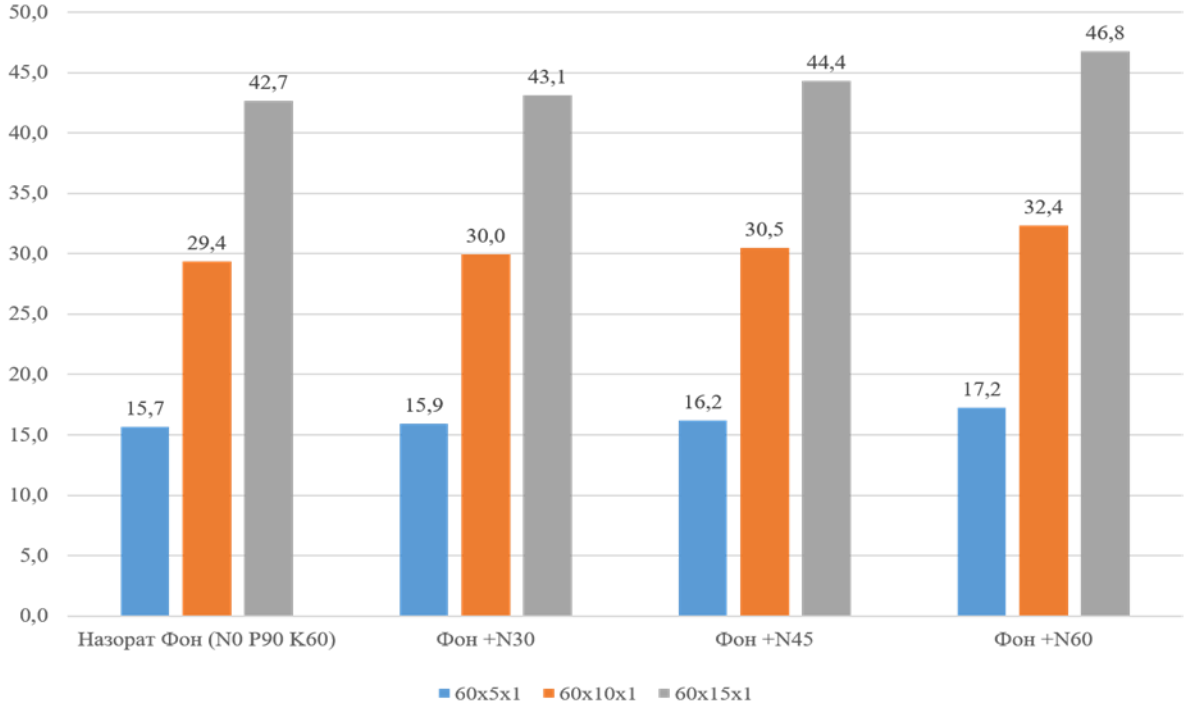

Figure 1. The impact of planting standards for the "Obod" variety and the application rates of mineral fertilizers on the dry mass accumulation of a single plant (ripening phase).

In the variant where 111.111 seeds of the "Obod" variety were planted per hectare (in a 60x15x1 scheme). the following yields were recorded during the branching phase: 2.68 centners/ha for the $N_0P_{90}K_{60}$ variant. 2.76 centners/ha for the $N_{30}P_{90}K_{60}$ variant. 3.12 centners/ha for the $N_{45}P_{90}K_{60}$ variant. and 3.73 centners/ha for the $N_{60}P_{90}K_{60}$ variant.

In the pod formation phase. the yields per hectare were: 6.30 centners/ha for the $N_0P_{90}K_{60}$ variant. 7.0 centners/ha for the $N_{30}P_{90}K_{60}$ variant. 7.90 centners/ha for the $N_{45}P_{90}K_{60}$ variant. and 8.0 centners/ha for the $N_{60}P_{90}K_{60}$ variant.

During the flowering phase. the yields were: 16.50 centners/ha for the $N_0P_{90}K_{60}$ variant. 16.90 centners/ha for the $N_{30}P_{90}K_{60}$ variant. 17.80 centners/ha for the $N_{45}P_{90}K_{60}$ variant. and 21.90 centners/ha for the $N_{60}P_{90}K_{60}$ variant.

In the podding phase. the yields per hectare were: 22.40 centners/ha for the $N_0P_{90}K_{60}$ variant. 23.90 centners/ha for the $N_{30}P_{90}K_{60}$ variant. 25.10 centners/ha for the $N_{45}P_{90}K_{60}$ variant. and 27.10 centners/ha for the $N_{60}P_{90}K_{60}$ variant.

Finally. during the ripening phase. the yields were: 34.70 centners/ha for the $N_0P_{90}K_{60}$ variant. 36.70 centners/ha for the $N_{30}P_{90}K_{60}$ variant. 37.90 centners/ha for the $N_{45}P_{90}K_{60}$ variant. and 42.50 centners/ha for the $N_{60}P_{90}K_{60}$ variant. indicating the accumulation of dry mass.

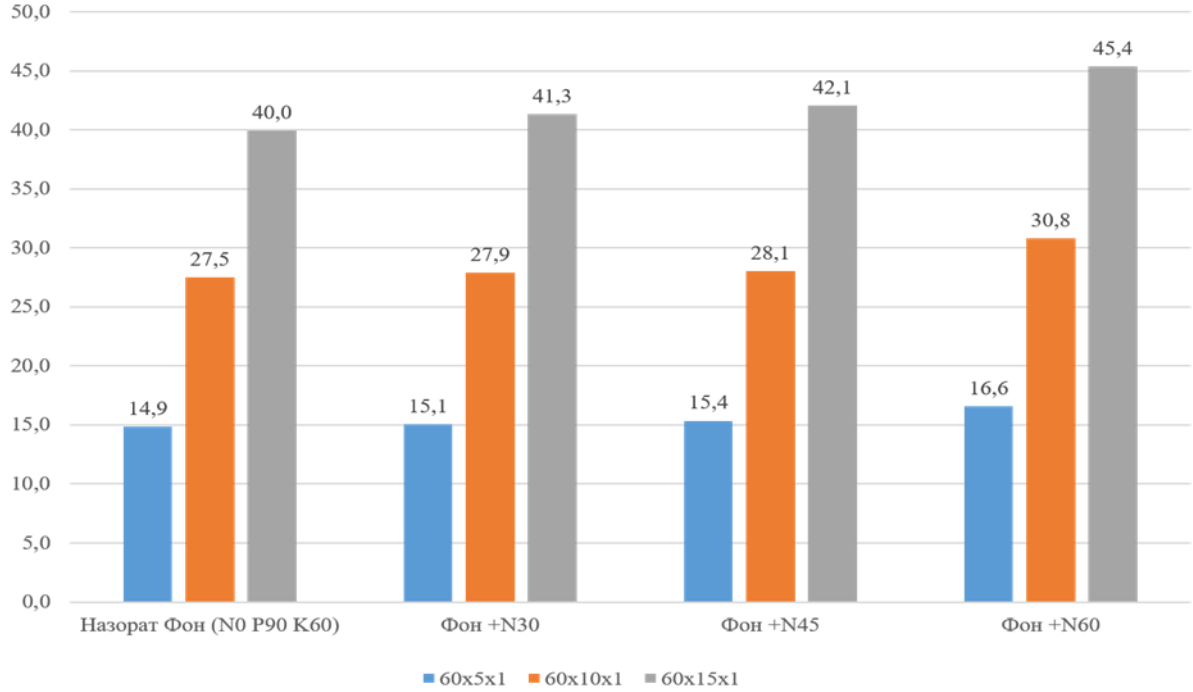

Figure 2. The impact of planting standards for the "Polvon" variety and the application rates of mineral fertilizers on the dry mass accumulation of a single plant (ripening phase).

In the branching phase. the yield per single plant was found to be: 3.08 grams for the $N_0P_{90}K_{60}$ variant. 3.11 grams for the $N_{30}P_{90}K_{60}$ variant. 3.46 grams for the $N_{45}P_{90}K_{60}$ variant. and 3.98 grams for the $N_{60}P_{90}K_{60}$ variant.

During the pod formation phase. the yields were: 7.25 grams for the $N_0P_{90}K_{60}$ variant. 7.89 grams for the $N_{30}P_{90}K_{60}$ variant. 8.77 grams for the $N_{45}P_{90}K_{60}$ variant. and 8.54 grams for the $N_{60}P_{90}K_{60}$ variant.

In the flowering phase. the yields per single plant were: 19.0 grams for the $N_0P_{90}K_{60}$ variant. 19.0 grams for the $N_{30}P_{90}K_{60}$ variant. 19.80 grams for the $N_{45}P_{90}K_{60}$ variant. and 23.40 grams for the $N_{60}P_{90}K_{60}$ variant.

During the podding phase. the yields were: 25.80 grams for the $N_0P_{90}K_{60}$ variant. 27.0 grams for the $N_{30}P_{90}K_{60}$ variant. 27.90 grams for the $N_{45}P_{90}K_{60}$ variant. and 28.90 grams for the $N_{60}P_{90}K_{60}$ variant.

Finally. in the ripening phase. the yield per single plant was recorded as: 40.0 grams for the $N_0P_{90}K_{60}$ variant. 41.30 grams for the $N_{30}P_{90}K_{60}$ variant. 42.10 grams for the $N_{45}P_{90}K_{60}$ variant. and 45.40 grams for the $N_{60}P_{90}K_{60}$ variant. indicating the accumulation of dry mass.

In the variant where 333.333 seeds of the "Polvon" variety were planted per hectare (in a 60x5x1 scheme). the following yields were recorded during the branching phase:

- 5.48 centners/ha for the $N_0P_{90}K_{60}$ variant.
- 5.94 centners/ha for the $N_{30}P_{90}K_{60}$ variant (0.46 centners/ha higher than the control variant).
- 6.04 centners/ha for the $N_{45}P_{90}K_{60}$ variant (0.56 centners/ha higher than the control variant).
- 6.83 centners/ha for the $N_{60}P_{90}K_{60}$ variant (1.35 centners/ha higher than the control variant).

During the pod formation phase. the yields per hectare were:

- 9.18 centners/ha for the $N_0P_{90}K_{60}$ variant.
- 9.54 centners/ha for the $N_{30}P_{90}K_{60}$ variant (0.36 centners/ha higher than the control variant).
- 10.01 centners/ha for the $N_{45}P_{90}K_{60}$ variant (0.83 centners/ha higher than the control variant).
- 10.95 centners/ha for the $N_{60}P_{90}K_{60}$ variant (1.77 centners/ha higher than the control variant). indicating the accumulation of dry mass.

The formation of reproductive organs was observed to significantly increase the amount of dry mass. Specifically. during the flowering phase. the yields per hectare were recorded as follows:

- 19.26 centners/ha for the $N_0P_{90}K_{60}$ variant.
- 20.14 centners/ha for the $N_{30}P_{90}K_{60}$ variant (0.88 centners/ha higher than the control variant).
- 20.85 centners/ha for the $N_{45}P_{90}K_{60}$ variant (1.59 centners/ha higher than the control variant).
- 25.10 centners/ha for the $N_{60}P_{90}K_{60}$ variant (5.84 centners/ha higher than the control variant).

In the podding phase. the yields per hectare were:

- 26.14 centners/ha for the $N_0P_{90}K_{60}$variant.
- 27.94 centners/ha for the $N_{30}P_{90}K_{60}$ variant (1.8 centners/ha higher than the control variant).
- 28.72 centners/ha for the $N_{45}P_{90}K_{60}$ variant (2.58 centners/ha higher than the control variant).
- 29.36 centners/ha for the $N_{60}P_{90}K_{60}$ variant (3.22 centners/ha higher than the control variant).

Finally. in the ripening phase. the yields were recorded as:

- 39.24 centners/ha for the $N_0P_{90}K_{60}$ variant.
- 41.36 centners/ha for the $N_{30}P_{90}K_{60}$ variant (2.12 centners/ha higher than the control variant).
- 43.17 centners/ha for the $N_{45}P_{90}K_{60}$ variant (3.93 centners/ha higher than the control variant).
- 46.40 centners/ha for the $N_{60}P_{90}K_{60}$ variant (7.16 centners/ha higher than the control variant). indicating the accumulation of dry mass.

Conclusion. The amount of dry mass is dependent on the leaf area of the plant. and it was determined that with the increase or decrease of leaf area. the dry mass accumulated per hectare and per individual plant varied based on the planting rates and fertilization quantities. In both varieties. an increase in the amount of nitrogen fertilization led to a rise in the dry mass. while a decrease in planting rates resulted in a reduction of dry mass per hectare; however. an increase in the dry mass of individual plants was observed. The obtained results can be explained by the correlational relationship between changes in planting rates and the expansion or contraction of the nutritional area for each individual plant.

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