THE EFFECT OF SEED SOWING RATES AND FERTILIZATION LEVELS ON GRAIN QUALITY INDICATORS OF CHICKPEA VARIETIES

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Abstract

This study presents information on the effects of seed sowing rates and nitrogen fertilization on the grain quality indicators of chickpea varieties. The research focuses on the locally developed chickpea varieties "Obod" and "Polvon". The findings contribute to understanding how agronomic practices influence grain quality in these cultivars.

Keywords: chickpea, variety, sowing rate, fertilizer, mineral fertilizer, protein, carbohydrate, productivity, grain, fat.

ВЛИЯНИЕ НОРМ ВЫСЕВА СЕМЯН И УРОВНЯ УДОБРЕНИЯ НА ПОКАЗАТЕЛИ КАЧЕСТВА ЗЕРНА СОРТОВ НУТА

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Аннотация:

В данном исследовании представлена информация о влиянии норм высева семян и азотного удобрения на показатели качества зерна различных сортов нута. Исследование сосредоточено на местных сортах нута «Обод» и «Полвон». Полученные результаты способствуют пониманию того, как агротехнические приемы влияют на качество зерна этих культур.

Ключевые слова: нут, сорт, норма высева, удобрение, минеральное удобрение, белок, углевод, урожайность, зерно, жир.

Introduction

Chickpea seeds contain up to 20.0–32.5% crude protein, 8% fat, and 47–60% starch. The carbohydrate content in chickpeas is considered to be several times higher than that in soybean meal. In terms of the essential amino acids methionine and tryptophan, chickpeas surpass other leguminous plants. Chickpea grains contain a large amount of mineral salts and rank first among all leguminous crops in selenium content. Advantages of chickpeas over other leguminous crops include less damage from pests, higher positioning of the lower pods above the ground, resistance to lodging, and pods that do not split or shatter when ripe. They are adapted for harvesting with conventional grain harvesting machines [1].

One of the important indicators determining the quality of chickpeas is the amount of protein in the grain. The protein content, whether high or low, is influenced by the biological characteristics of the variety, cultivation methods, and climatic conditions. The main indicators of grain quality include the grain's shape, its size, and the quality and quantity of protein. Often, an increase in yield leads to a decrease in the protein content of the grain [2].

According to the classification of protein content in chickpea grains, they are characterized as follows: 14–18% is considered very low, 20.1–24% is average, 24% to 28% is high, and over 28% is very high [3].

Research Materials and Methods

Field experiments were conducted at the experimental field of the Southern Agriculture Research Institute. The experiment consisted of 24 variants, arranged in a single tier with three replications. Chickpea varieties "Obod" and "Polvon," which are registered in the State Register, were sown. The chickpea varieties were planted at three different planting densities—333,333 plants/ha, 166,666 plants/ha, and 111,111 plants/ha—using three spacing systems (60×5-1 cm, 60×10-1 cm, 60×15-1 cm). During the growing period, mineral fertilizers were applied 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. Phenological observations, biometric measurements, and calculations during the growth period of the chickpea varieties were carried out according to the commonly accepted methods: "Dala tazhribalarini utkazish uslublari" (2017), "Metodika Gosudarstvennogo sortoispytaniya sel'skokhozyajstvennykh kul'tur" (1989), B.A. Dospekhov's “Metodika polevogo opyta” (1985)[3], and “Metody agrokhimicheskikh, agrofizicheskikh i mikrobiologicheskikh issledovanij v polivnykh khlopkovykh rajonakh” (Soviet Research Institute of Cotton, 1963) [4]. The net productivity of photosynthesis was determined using the methods of A.A. Nichiporovich ("O putyah povysheniya produktivnosti fotosinteza rastenij v posevakh. In the book Fotosintez i voprosa produktivnosti rastenij (1963)).

Research Results

In the variants where the “Obod” variety was sown at a density of 333,333 seeds per hectare (using a 60×5×1 cm planting scheme), the protein content in the grain was 19.1% in the variant with a fertilizer ratio of $N_0P_{90}K_{60}$, 22.1% with $N_{30}P_{90}K_{60}$, 22.8% with $N_{45}P_{90}K_{60}$, and 21.6% with $N_{60}P_{90}K_{60}$. It was determined that, compared to the control variant, the protein content was higher by 3.0% in the $N_{30}P_{90}K_{60}$ variant, 3.7% in the $N_{45}P_{90}K_{60}$ variant, and 2.5% in the $N_{60}P_{90}K_{60}$ variant.

The fat content in the grain was 3.9% in the variant sown with the fertilizer ratio $N_0P_{90}K_{60}$, 4.5% with $N_{30}P_{90}K_{60}$, 4.6% with $N_{45}P_{90}K_{60}$, and 4.4% with $N_{60}P_{90}K_{60}$. It was determined that, compared to the control variant, the fat content increased by 0.6% in the $N_{30}P_{90}K_{60}$ variant, 0.7% in the $N_{45}P_{90}K_{60}$ variant, and 0.5% in the $N_{60}P_{90}K_{60}$ variant.

The carbohydrate content was 31.1% in the variant sown with $N_0P_{90}K_{60}$, 35.9% with $N_{30}P_{90}K_{60}$, 37.1% with $N_{45}P_{90}K_{60}$, and 35.1% with $N_{60}P_{90}K_{60}$. Compared to the control variant, the carbohydrate content increased by 4.8% in the $N_{30}P_{90}K_{60}$ variant, 6.0% in the $N_{45}P_{90}K_{60}$ variant, and 4.0% in the $N_{60}P_{90}K_{60}$ variant, as demonstrated in the experiments.

It was observed that the fiber content in the grain reached 9.8% in the variant sown with $N_0P_{90}K_{60}$ kg/ha. In the variant sown with $N_{30}P_{90}K_{60}$ kg/ha, the fiber content was 11.3%, which is 1.5% higher than the control variant. The variant sown with $N_{45}P_{90}K_{60}$ kg/ha also showed a fiber content of 11.3%, representing a 1.9% increase compared to the control. In the variant sown with $N_{60}P_{90}K_{60}$ kg/ha, the fiber content reached 11.1%, which is 1.3% higher than the control variant.

In the variants where the chickpea variety was sown at a density of 111,111 seeds per hectare (using a 60×15×1 cm planting scheme), the protein content in the grain was 25.9% with a fertilizer ratio of $N_0P_{90}K_{60}$, 27.5% with $N_{30}P_{90}K_{60}$ kg/ha, 29.8% with $N_{45}P_{90}K_{60}$ kg/ha, and 28.1% with $N_{60}P_{90}K_{60}$ kg/ha. Compared to the control variant, the protein content increased by 1.6% in the $N_{30}P_{90}K_{60}$ variant, 3.9% in the $N_{45}P_{90}K_{60}$ variant, and 2.2% in the $N_{60}P_{90}K_{60}$ variant. Regarding the fat content in the grain, the measurements were 5.3% with $N_0P_{90}K_{60}$ kg/ha, 5.6% with $N_{30}P_{90}K_{60}$ kg/ha, 6.1% with $N_{45}P_{90}K_{60}$ kg/ha, and 5.7% with $N_{60}P_{90}K_{60}$ kg/ha. Compared to the control variant, the fat content was higher by 0.3% in the $N_{30}P_{90}K_{60}$ variant, 0.8% in the $N_{45}P_{90}K_{60}$ variant, and 0.4% in the $N_{60}P_{90}K_{60}$ variant.

The carbohydrate content was observed to be 42.2% in the variant sown with $N_0P_{90}K_{60}$ kg/ha, 44.7% in the variant sown with $N_{30}P_{90}K_{60}$ kg/ha, 48.5% in the variant sown with $N_{45}P_{90}K_{60}$ kg/ha, and 45.8% in the variant sown with $N_{60}P_{90}K_{60}$ kg/ha. Compared to the control variant, the carbohydrate content was higher by 2.5% in the $N_{30}P_{90}K_{60}$ kg/ha variant, 6.3% in the $N_{45}P_{90}K_{60}$ kg/ha variant, and 3.6% in the $N_{60}P_{90}K_{60}$ kg/ha variant.

In the experiments, it was observed that the fiber content in the grain was 13.3% in the variant sown with $N_0P_{90}K_{60}$ kg/ha. In the $N_{30}P_{90}K_{60}$ kg/ha variant, the fiber content reached 14.1%, which is 0.8% higher than the control variant. The $N_{45}P_{90}K_{60}$ kg/ha variant showed a fiber content of 15.3%, representing a 2.0% increase compared to the control, while the $N_{60}P_{90}K_{60}$ kg/ha variant had a fiber content of 14.4%, which is 1.1% higher than the control variant.

Experimental findings demonstrated that the protein content in the grains of the "Obod" variety is more strongly influenced by changes in sowing rates than by the levels of nitrogen fertilization. Specifically, an increase in nitrogen fertilizer application led to an increase in protein content by 1.6–3.9%, whereas a reduction in sowing rates resulted in a more substantial increase in protein content by 3.6–7.0%.

Thus, it was determined that the protein content in the grain is not solely dependent on nitrogen fertilizers; phosphorus and potassium fertilizers also contribute to its formation.

Table-1 Effect of seeding rates and fertilization rates on grain quality indicators of pea varieties (Karshi, 2021)

№	Varieties of chickpea	Seed planting schemes	Annual rates of mineral fertilizers, kg/ha	Protein	Oil	Carbohydrates	Fiber
1	Obod	60x5x1	St. $N_0P_{90}K_{60}$	19,1	3,9	31,1	9,8
2			$N_{30}P_{90}K_{60}$	22,1	4,5	35,9	11,3
3			$N_{45}P_{90}K_{60}$	22,8	4,6	37,1	11,7
4			$N_{60}P_{90}K_{60}$	21,6	4,4	35,1	11,1
5		60x10x1	St. $N_0P_{90}K_{60}$	23,7	4,8	38,6	12,2
6			$N_{30}P_{90}K_{60}$	25,7	5,3	41,9	13,2
7			$N_{45}P_{90}K_{60}$	26,6	5,4	43,2	13,6
8			$N_{60}P_{90}K_{60}$	25,2	5,1	41,0	12,9
9		60x15x1	St. $N_0P_{90}K_{60}$	25,9	5,3	42,2	13,3
10			$N_{30}P_{90}K_{60}$	27,5	5,6	44,7	14,1
11			$N_{45}P_{90}K_{60}$	29,8	6,1	48,5	15,3
12			$N_{60}P_{90}K_{60}$	28,1	5,7	45,8	14,4
13	Polvon	60x5x1	St. $N_0P_{90}K_{60}$	19,4	4,0	31,6	9,6
14			$N_{30}P_{90}K_{60}$	21,4	4,4	34,8	11,0
15			$N_{45}P_{90}K_{60}$	21,3	4,3	34,6	10,9
16			$N_{60}P_{90}K_{60}$	19,6	4,0	31,9	10,1
17		60x10x1	St. $N_0P_{90}K_{60}$	22,0	4,5	35,8	11,3
18			$N_{30}P_{90}K_{60}$	25,4	5,2	41,3	13,0
19			$N_{45}P_{90}K_{60}$	25,8	5,3	42,0	13,2
20			$N_{60}P_{90}K_{60}$	24,4	5,0	39,7	12,5
21		60x15x1	St. $N_0P_{90}K_{60}$	25,4	5,2	41,3	13,0
22			$N_{30}P_{90}K_{60}$	26,6	5,4	43,4	13,7
23			$N_{45}P_{90}K_{60}$	28,0	5,7	45,6	14,4
24			$N_{60}P_{90}K_{60}$	26,4	5,4	43,0	13,5

Similarly, in the variants where the "Polvon" variety was sown at a density of 333,333 seeds per hectare (using a 60×5×1 cm planting scheme), the protein content in the grain was 19.1% with a fertilizer ratio of $N_0P_{90}K_{60}$ kg/ha, 21.4% with $N_{30}P_{90}K_{60}$ kg/ha, 21.3% with $N_{45}P_{90}K_{60}$ kg/ha, and 19.6% with $N_{60}P_{90}K_{60}$ kg/ha. Compared to the control variant, the protein content was higher by 2.3% in the $N_{30}P_{90}K_{60}$ kg/ha variant, 2.2% in the $N_{45}P_{90}K_{60}$ kg/ha variant, and 0.5% in the $N_{60}P_{90}K_{60}$ kg/ha variant.

It was determined that the fat content in the grain was 4.0% in the variant sown with $N_0P_{90}K_{60}$, 4.4% in the variant sown with $N_{30}P_{90}K_{60}$, 4.3% in the variant sown with $N_{45}P_{90}K_{60}$, and 4.0% in the variant sown with $N_{60}P_{90}K_{60}$. Compared to the control variant, the fat content was higher by 0.4% in the $N_{30}P_{90}K_{60}$ variant and by 0.3% in the $N_{45}P_{90}K_{60}$ variant.

The carbohydrate content was observed to be 31.6% in the variant sown with $N_0P_{90}K_{60}$, 34.8% in the variant sown with $N_{30}P_{90}K_{60}$, 34.6% in the variant sown with $N_{45}P_{90}K_{60}$, and 31.9% in the variant sown with $N_{60}P_{90}K_{60}$. The experiments demonstrated that, compared to the control variant, the carbohydrate content increased by 3.2% in the $N_{30}P_{90}K_{60}$ variant, by 3.0% in the $N_{45}P_{90}K_{60}$ variant, and by 0.3% in the $N_{60}P_{90}K_{60}$ variant.

It was observed that the fiber content in the grain reached 9.6% in the variant sown with $N_0P_{90}K_{60}$ kg/ha. In the variant sown with $N_{30}P_{90}K_{60}$ kg/ha, the fiber content was 11.0%, which is 1.4% higher than the control variant. The variant sown with $N_{45}P_{90}K_{60}$ kg/ha showed a fiber content of 10.9%, representing a 1.3% increase compared to the control, while the variant sown with $N_{60}P_{90}K_{60}$ kg/ha had a fiber content of 10.1%, which is 0.5% higher than the control variant.

In the variants where the variety was sown at a density of 166,666 seeds per hectare (using a 60×10×1 cm planting scheme), the protein content in the grain was 22.0% with a fertilizer ratio of $N_0P_{90}K_{60}$, 25.4% with $N_{30}P_{90}K_{60}$ kg/ha, 25.8% with $N_{45}P_{90}K_{60}$ kg/ha, and 24.4% with $N_{60}P_{90}K_{60}$ kg/ha. Compared to the control variant, the protein content was higher by 3.4% in the $N_{30}P_{90}K_{60}$ kg/ha variant, 3.8% in the $N_{45}P_{90}K_{60}$ kg/ha variant, and 2.4% in the $N_{60}P_{90}K_{60}$ kg/ha variant.

Regarding the fat content in the grain, it was 4.5% in the variant sown with $N_0P_{90}K_{60}$ kg/ha, 5.2% with $N_{30}P_{90}K_{60}$ kg/ha, 5.3% with $N_{45}P_{90}K_{60}$ kg/ha, and 5.0% with $N_{60}P_{90}K_{60}$ kg/ha. Compared to the control variant, the fat content was higher by 0.7% in the $N_{30}P_{90}K_{60}$ kg/ha variant, 0.8% in the $N_{45}P_{90}K_{60}$ kg/ha variant, and 0.5% in the $N_{60}P_{90}K_{60}$ kg/ha variant.

The carbohydrate content was observed to be 35.8% in the variant sown with $N_0P_{90}K_{60}$ kg/ha, 41.3% in the variant sown with $N_{30}P_{90}K_{60}$ kg/ha, 42.0% in the variant sown with $N_{45}P_{90}K_{60}$ kg/ha, and 39.7% in the variant sown with $N_{60}P_{90}K_{60}$ kg/ha. Compared to the control variant, the carbohydrate content increased by 5.5% in the $N_{30}P_{90}K_{60}$ kg/ha variant, 6.2% in the $N_{45}P_{90}K_{60}$ kg/ha variant, and 3.9% in the $N_{60}P_{90}K_{60}$ kg/ha variant.

Regarding the fiber content in the grain, it was 11.3% in the variant sown with $N_0P_{90}K_{60}$ kg/ha, 13.2% in the variant sown with $N_{30}P_{90}K_{60}$ kg/ha (which is 1.7% higher than the control variant), 13.2% in the variant sown with $N_{45}P_{90}K_{60}$ kg/ha (1.9% higher than the control variant), and 12.5% in the variant sown with $N_{60}P_{90}K_{60}$ kg/ha (1.2% higher than the control variant).

Conclusion. The "Obod" variety demonstrated slightly higher levels of protein, fat, and carbohydrate content in the grain compared to the "Polvon" variety across the various treatment variants. This difference is attributed to the "Obod" variety being developed under the specific soil and climatic conditions of the study area. In the "Polvon" variety, an increase in the amount of nitrogen fertilization resulted in an increase in protein content by 0.2–3.8%, while a reduction in sowing rates led to an increase in protein content by 2.6–6.8%, as observed in the experiments.

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