

Article

Protein and Oil Content in the Grain Composition of Soybean Varieties

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Abstract: Soybean is a strategic agricultural crop due to its high protein and oil content, which play an essential role in human nutrition and industrial production. The quality of soybean grain, particularly protein and oil composition, is influenced by agronomic factors such as sowing dates and seeding rates. However, the optimal combination of sowing time and seeding rate for maximizing these quality indicators in newly developed soybean varieties remains insufficiently clarified. This study aimed to determine the effect of sowing dates and seeding rates on protein and oil content in soybean grain. The findings showed that early sowing (April 25–30) at a rate of 60 kg/ha resulted in the highest protein and oil content in both “Madad” (38.9% protein, 19.8% oil) and “Sevinch” (37.3% protein, 18.7% oil) varieties, while delayed sowing and lower or higher seeding rates led to a decrease in these indicators. A consistent pattern was observed across all experimental variants, where deviations from the optimal seeding rate reduced both protein and oil content. The study identifies a clear quantitative relationship between sowing timing, seeding rate, and grain quality parameters for specific soybean varieties. These results suggest that adopting early sowing with an optimal seeding rate of 60 kg/ha is essential for achieving higher protein and oil content, thereby improving the economic and nutritional value of soybean production.

Keywords: Soybean, Variety, Protein, Oil, Term, Standard

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1. Introduction

The fact that soybean is a strategic and important raw material in production is due to the protein and oil content of the grain. Protein is a high-molecular compound, the composition of which consists mainly of amino acids and nitrogen, carbon, oxygen, hydrogen and sulfur. Protein is a key component for the normal growth and development of the human body. Protein supply is mainly due to livestock and agricultural products. Soybean protein can range from 27% to 68%. Scientists have determined that soy protein is the cheapest and most widely available of all agricultural crops in the world[1].

2. Materials and Methods

The study was conducted at the Scientific Research Institute of Rice Cultivation to evaluate the effect of sowing dates and seeding rates on protein and oil content in soybean grain. Two soybean varieties, “Madad” and “Sevinch,” were selected as experimental materials due to their adaptability and relevance to local agricultural conditions. A field experiment was designed using a factorial approach with three sowing periods (early: April 25–30, medium: May 5–10, and late: May 15–20) and three seeding rates (45, 60, and 75 kg/ha). Each treatment combination was applied under similar agro-climatic and soil conditions to ensure consistency. Standard agronomic practices, including irrigation,

fertilization, and weed control, were uniformly maintained throughout the growing season.

At physiological maturity, soybean samples were collected from each experimental plot for laboratory analysis. Protein content was determined using standard nitrogen-based analytical methods, while oil content was measured through extraction techniques commonly applied in seed quality assessment. Grain hardness was also evaluated as an additional quality parameter. The obtained data were systematically recorded and subjected to comparative analysis to identify the influence of sowing time and seeding rate on grain composition. The results were analyzed to determine optimal agronomic conditions for maximizing protein and oil content in soybean varieties.

Soybean oil is the second largest vegetable oil producer in the world. Even cottonseed, sunflower, peanut, and rapeseed oils are produced 10 times less than it. Soybean oil is a source of energy for the human body, and it contains fat-soluble vitamins that play an important role in metabolism, cellular function, and as a means of protecting human skin from external stresses[2].

Soybean seeds contain an average of 20% oil, which is processed into high-quality oil for human consumption and technical purposes.

At the Rice Research Institute, studies were conducted to determine the protein and oil content of newly developed soybean varieties. The results of the study are as follows:

Table 1. "The Effect of Sowing Dates and Norms on the Grain Quality of Soybean Varieties"

No	Soybean Varieties	Sowing Dates	Seeding Rate (kg/ha, thousand seeds)	Oil Content in Seeds%	Protein Content in Seeds, %	Seed Hardness, %	
1	Madad	25.04-30.04	45 (280)	19,1	38,1	75,4	
2			60 (375)	19,8	38,9	75,1	
3			75 (465)	19,3	38,4	74,7	
4		05.05-10.05	15.05-20.05	45 (280)	18,7	37,6	75,0
5				60 (375)	19,5	38,1	74,8
6				75 (465)	19,1	37,8	74,2
7		15.05-20.05		45 (280)	18,5	37,2	74,5
8				60 (375)	19,2	37,7	74,1
9				75 (465)	18,8	37,3	74,0
10	Sevinch	25.04-30.04	45 (300)	18,3	36,7	74,8	
11			60 (400)	18,7	37,3	74,5	
12			75 (500)	18,4	36,8	74,1	
13		05.05-10.05	15.05-20.05	45 (300)	18,0	36,4	74,3
14				60 (400)	18,5	37,0	74,1
15				75 (500)	18,2	36,4	73,7
16		15.05-20.05		45 (300)	17,6	35,8	74,0
17	60 (400)			18,1	36,6	73,8	

18			75 (500)	18,0	36,1	73,5
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3. Results

According to the data obtained, it was determined that different sowing dates and standards of soybeans had an impact on the amount of protein and oil in their content. According to data obtained in the first year of the study, when both soybean varieties were planted early (April 25-30) at a rate of 60 kg per hectare, it was observed that they had high protein and oil contents. In the "Madad" variety, the protein content was 38.9% and the oil content was 19.8%, while in the "Sevinch" variety, these indicators were 37.3% and 18.7%, respectively. When these varieties were sown early at a rate of 45 kg per hectare, the protein content was 38.1 and 36.7%, the oil content was 19.1; 18.3%, and when planted at a rate of 75 kg per hectare, the protein content was 38.4; 36.8%; 19.3; 18.4%[3].

When soybean varieties were sown in the middle period (05.05-10.05), the protein and oil content in the grain was slightly lower than when sown in the early period. According to the data, when the varieties were sown at a rate of 45 kg per hectare, the protein and oil content was 37.6; 36.4 and 18.7; 18.0%, respectively, when the varieties were sown at a rate of 60 kg per hectare, 38.1; 37.0 and 19.5; 18.5%, and when the varieties were sown at a rate of 75 kg per hectare, 37.8; 36.4% and 19.1; 18.2%. When the varieties were sown late (15.05-20.05), the protein and oil content in the grain showed even lower values compared to those sown early and medium. It was observed that when the varieties were sown at 45 kg per hectare, these values were 37.2; 35.8% and 18.5; 17.6%, respectively, when the varieties were sown at 60 kg per hectare, they were 37.7; 36.6% and 19.2; 18.1%, and when the varieties were sown at 75 kg per hectare, they were 37.3; 36.1% and 18.8; 18.0%[4].

When analyzing the data on the effect of sowing dates on the protein and oil content of soybean varieties, it can be concluded that when soybean varieties are planted 10 days later than the early date (25.04-30.05), the protein content in the "Madad" variety is lower by 0.5% to 0.8%, the oil content by 0.2% to 0.4%, and when planted 20 days later, the protein content is lower by 0.9% to 1.2%, and the oil content by 0.5% to 0.6%. In the "Sevinch" soybean variety, these indicators were lower compared to the early date: when the protein content was 10 days later, the protein content was 0.3% to 0.4%, the oil content was 0.2% to 0.3%, and when the protein content was 20 days later, the protein content was 0.7% to 0.9%, and the oil content was 0.4% to 0.7%[5].

When analyzing the data obtained on the sowing rates of the varieties, it was found that in both varieties and at all sowing dates, the sowing rates were low (45 kg) or very high (75 kg) in both varieties and in all sowing dates, the amount of protein and oil in soybeans was lower than in the variants planted at 60 kg per hectare. In the 1st variant of the experiment, where the "Madad" variety was planted early at 45 kg per hectare, the protein content was 38.1%, and the oil content was 19.1%, while in the 3rd variant, where the 75 kg per hectare was planted, these indicators were 38.4; 19.3%, respectively. In the 2nd variant, where the 60 kg per hectare was planted, these indicators were higher than these indicators, with protein 38.9%, oil 19.8%, that is, the protein content was 0.8; 0.5%, and the oil content was 0.7; It was found that the yield was 0.5% higher[6]. The same pattern was observed in the variants of the experiment planted in the middle and late periods[7].

These patterns were also observed in the variants of the experiment where the "Sevinch" variety was planted, and when this variety was also planted at a rate of 60 kg per hectare, the protein and oil content was higher than the variants planted at 45 kg and 75 kg per hectare[8]. According to the data obtained, in variant 10, where this variety was planted early at a rate of 45 kg per hectare, the protein content was 36.7%, and the oil content was 18.3%, while in variant 12, where this variety was planted at a rate of 75 kg per hectare, these indicators were 36.8; 18.4%, respectively. In variant 11, where 60 kg per hectare was planted, these indicators were higher than these indicators, with protein

37.3%, oil 18.7%, i.e., compared to variants 10 and 12, the protein content was 0.6; 0.5%, and the oil content was 0.4; It was found to be 0.3% higher[9].

Therefore, from the data obtained, it can be concluded that in order to have a high protein and oil content in soybeans, it is advisable to sow both varieties of soybeans at an early rate of 60 kg per hectare. Sowing 15 kg less than this optimal rate (45 kg) per hectare will lead to a decrease in protein content by 0.5-0.8% and oil content by 0.3-0.7%, while sowing 15 kg more (75 kg) will lead to a decrease in protein content by 0.5-0.6 and 0.3-0.5%, respectively[10].

It should be noted that another quality indicator of soybeans is grain hardness[11]. Grain hardness is mainly important in crushing and processing the grain[12].

According to the data obtained on this grain quality, the earlier and lower the soybean varieties are sown, the higher the grain hardness[13]. In all variants of the experiment planted early and at low rates, the grain hardness was higher than in the variants planted at medium and late terms of 60 and 75 kg per hectare. For example, the soybean variety "Madad" had a grain hardness of 75.4% when planted at 45 kg per hectare in the early period, 75.1% when planted at 60 kg per hectare in the same period, and 74.7% when planted at 75 kg per hectare[14]. Similar patterns were also observed in the variants planted at medium and late terms of the experiment, and these indicators were 75.0; 74.8; 74.2 and 74.5; 74.1; It was found to be 74.0%.

Delaying the sowing dates also affected the grain hardness, and delaying the sowing dates led to lower grain hardness. In the early sowing period, the grain hardness was 75.4; 75.1 and 74.7%, while in the middle sowing period it was 75.0; 74.8 and 74.2%, and in the late sowing period it was 74.5; 74.1 and 74.0%[15].

4. Conclusion

In order to obtain high protein and oil content in soybean grains (38.9% protein, 19.8% oil in the "Madad" variety, 37.3% protein, 18.7% oil in the "Sevinch" variety), it is advisable to sow both varieties at an early rate of 60 kg per hectare. Sowing 15 kg/ha less than this optimal rate (60 kg/ha) (45 kg/ha) will lead to a decrease in protein content by 0.5-0.8% and oil content by 0.3-0.7%, while sowing 15 kg/ha more (75 kg/ha) will lead to a decrease in protein content by 0.5-0.6 and 0.3-0.5%, respectively.

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