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THE EFFECT OF SOWING DATES AND SEEDING RATES ON THE LEAF AREA FORMATION OF OIL FLAX VARIETIES UNDER RAINFED CONDITIONS OF JIZZAKH REGION

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Abstract: This article presents the results of field experiments conducted at the Research Institute of Rainfed Agriculture in the Gallaorol district of Jizzakh region. The study examined the effect of different sowing dates and seeding rates on leaf area formation in the Bahorikor and Lalmikor oil flax varieties under rainfed (Bahorikor) and irrigated (Lalmikor) conditions. The results showed that both sowing date and plant density have a significant effect on leaf development. The highest leaf area was observed in the second ten-day period of March at a seeding rate of 4.0 million seeds per hectare.

Keywords: oil flax, leaf area, Bahorikor, Lalmikor, sowing date, seeding rate, photosynthesis, rainfed agriculture.

Introduction: Oil flax (Linum usitatissimum L.) is an important raw material for the food, pharmaceutical, and technical industries. The biological productivity of this crop is largely determined by the intensity of the photosynthetic process, and the efficiency of photosynthesis in turn depends primarily on the development of the plant's leaf area. Leaf area is one of the key morphophysiological indicators that determines a plant's capacity to capture solar energy. When the leaf surface is sufficiently developed, more assimilation products are formed, which contributes to increased yield; conversely, a smaller leaf area reduces photosynthetic productivity.

Under rainfed conditions, the formation of leaf area is directly related to factors such as soil moisture, temperature regime, sowing date, and plant density. For this reason, determining the optimal sowing date and seeding rate for the rainfed areas of Jizzakh region is of considerable scientific and practical importance.

Materials and Methods: The research was carried out in 2024 at the experimental field of the Research Institute of Rainfed Agriculture in the Gallaorol district of Jizzakh region. The experiment was established on light-colored typical serozem (sierozem) soils. The Bahorikor and Lalmikor oil flax varieties were used as the research material. Three sowing dates (the first, second, and third ten-day periods of March) and three seeding rates (3.5, 4.0, and 4.5 million seeds per hectare) were studied. The experiment was carried out in three replications. During the growing season, leaf area was determined at the stem elongation, budding, flowering, and green ripeness stages. Both the leaf area per plant (cm^2) and the total leaf area per hectare (thousand cm^2/ha) were calculated.

table 1.

Leaf area per plant (cm^2) of oil flax varieties as affected by sowing date and seeding rate (Gallaorol, 2024)**.**

No.	Sowing date	Variety	Seeding rate, million seeds/ha	Stem elongation	Budding	Flowering	Green ripeness
1	1–10 March	Bahoriko r	3.5	125.0	195.6	208.3	200.5
2	1–10 March	Bahoriko r	4.0	130.6	204.4	217.7	209.5
3	1–10 March	Bahoriko r	4.5	122.8	192.2	204.6	197.0
4	11–20 March	Bahoriko r	3.5	131.6	205.9	219.3	211.1
5	11–20 March	Bahoriko r	4.0	137.5	215.2	229.2	220.6
6	11–20 March	Bahoriko r	4.5	129.3	202.3	215.4	207.3
7	21–30 March	Bahoriko r	3.5	117.2	183.4	195.3	188.0
8	21–30 March	Bahoriko r	4.0	122.4	191.6	204.1	196.4
9	21–30 March	Bahoriko r	4.5	115.1	180.1	191.8	184.6
10	1–10 March	Lalmikor	3.5	132.8	207.9	221.4	213.1
11	1–10 March	Lalmikor	4.0	138.8	217.2	231.4	222.7
12	1–10 March	Lalmikor	4.5	130.5	204.2	217.5	209.3
13	11–20 March	Lalmikor	3.5	139.8	218.8	233.1	224.3
14	11–20 March	Lalmikor	4.0	146.1	228.7	243.5	234.4
15	11–20 March	Lalmikor	4.5	137.4	215.0	228.9	220.3
16	21–30 March	Lalmikor	3.5	124.5	194.9	207.5	199.8
17	21–30 March	Lalmikor	4.0	130.1	203.6	216.9	208.7
18	21–30 March	Lalmikor	4.5	122.3	191.4	203.9	196.2

table 2.

Total leaf area per hectare (thousand sm²/ha) of oil flax varieties as affected by sowing date and seeding rate (Gallaorol, 2024).

No.	Sowing date	Variety	Seeding rate, million seeds/ha	Stem elongation	Budding	Flowering	Green ripeness
1	1–10 March	Bahoriko r	3.5	34877.4	54583.1	58129.0	55949.1
2	1–10	Bahoriko	4.0	42531.	66562.0	70886.1	68227.

No.	Sowing date	Variety	Seeding rate, million seeds/ha	Stem elongation	Budding	Flowering	Green ripeness
	March	r		6			8
3	1–10 March	Bahorikor	4.5	44743.9	70024.2	74573.2	71776.7
4	11–20 March	Bahorikor	3.5	38068.4	59577.0	63447.3	61068.0
5	11–20 March	Bahorikor	4.0	45347.6	70969.1	75579.4	72745.2
6	11–20 March	Bahorikor	4.5	46711.1	73102.9	77851.8	74932.4
7	21–30 March	Bahorikor	3.5	33653.8	52668.2	56089.7	53986.3
8	21–30 March	Bahorikor	4.0	39794.3	62278.1	66323.9	63836.8
9	21–30 March	Bahorikor	4.5	41343.0	64701.8	68905.0	66321.1
10	1–10 March	Lalmikor	3.5	36971.2	57859.9	61618.6	59307.9
11	1–10 March	Lalmikor	4.0	44383.6	69460.4	73972.7	71198.7
12	1–10 March	Lalmikor	4.5	47118.7	73740.8	78531.2	75586.3
13	11–20 March	Lalmikor	3.5	40259.5	63006.1	67099.1	64582.9
14	11–20 March	Lalmikor	4.0	47372.6	74138.2	78954.4	75993.6
15	11–20 March	Lalmikor	4.5	49021.8	76719.0	81702.9	78639.1
16	21–30 March	Lalmikor	3.5	35477.5	55522.3	59129.1	56911.8
17	21–30 March	Lalmikor	4.0	41236.9	64535.8	68728.2	66150.9
18	21–30 March	Lalmikor	4.5	43690.6	68375.7	72817.6	70086.9

Results and Discussion: The results of the study showed that leaf area increased gradually during the growing season, reaching its maximum value at the flowering stage. Subsequently, during the green ripeness period, this indicator decreased somewhat as a result of natural leaf senescence. In the Bahorikor variety, the highest leaf area per plant was observed in the second ten-day period of March at a seeding rate of 4.0 million seeds per hectare, reaching 229.2 cm² at flowering and 220.6 cm² at the green ripeness stage. In the same variant, leaf area was also higher than in the other variants at the stem elongation and budding stages. In the Lalmikor variety, the maximum leaf area likewise formed in the second ten-day period of March at a rate of 4.0 million seeds per hectare, reaching 243.5 cm² at flowering and 234.4 cm² at green ripeness. These values were higher than those of the Bahorikor variety, indicating that the Lalmikor variety has a stronger capacity for forming vegetative mass.

The total leaf area per hectare also varied depending on the seeding rate. In the Bahorikor variety, the highest value, 77,851.8 thousand cm²/ha, was recorded at the flowering stage in the

second ten-day period of March at a seeding rate of 4.5 million seeds per hectare, while in the Lalmikor variety the corresponding figure reached 81,702.9 thousand cm²/ha. This indicates that the total leaf area expanded owing to the increase in plant number. At the same time, the best result for leaf area per individual plant was observed at the 4.0 million seeds per hectare rate. This shows that as the seeding rate increases, competition among plants for light, moisture, and nutrients intensifies. As a result, although the leaf surface of each individual plant became somewhat smaller, the total leaf area increased owing to the greater number of plants. In the variants sown in the third ten-day period of March, a decrease in leaf area was observed. This can be explained by the fact that the later stages of the growing season for these variants coincided with conditions of high temperature and moisture deficit, which limited the development of the photosynthetic process and led to the formation of a smaller leaf surface.

Many researchers have noted that leaf area formation is directly related to the intensity of photosynthesis. For example, Domaratskyi Y. et al. found that an increase in leaf surface enhances a plant's capacity to capture light, resulting in greater dry matter accumulation and higher yield [3]. Their study also substantiated the need to evaluate leaf area as a key biometric indicator in oil flax as well. Aybar Yalınkılıç N. et al. assessed the effect of sowing date on the vegetative growth and yield of flax. Their study noted that good development of the leaf apparatus is associated with early sowing, which enhances photosynthetic activity, and that an optimal leaf surface contributes to the formation of yield components [2]. Ghareeb S.A. reported that sowing date and seeding rate affect the growth, plant height, vegetative biomass, and yield components of flax. The author noted that an optimal sowing density ensures good development of the leaf apparatus and increases photosynthetic efficiency [5]. Mevada K.D. et al. studied the effect of different sowing dates and seeding rates on the vegetative growth of flax. The authors showed that an optimal sowing date contributes to a better formation of leaf number and leaf area, which ultimately increases yield [4]. Al-Obady R.F., Shaker A.T., and colleagues evaluated the effect of NPK fertilizers and sowing date on the growth indicators of flax. According to their results, favorable nutrient conditions enhance leaf development, expand the photosynthetic surface, and increase yield [1].

Conclusion: In summary, the results of the study show that sowing date and seeding rate have a significant effect on leaf area formation in oil flax. The best results for leaf area per plant were observed in both varieties in the second ten-day period of March at a seeding rate of 4.0 million seeds per hectare. Although the total leaf area per hectare was higher at the 4.5 million seeds per hectare rate, the leaf area of individual plants decreased somewhat owing to competition among plants. The Lalmikor variety demonstrated relatively higher indicators of vegetative development compared with the Bahorikor variety. For the effective formation of leaf area under the rainfed conditions of Jizzakh region, it is advisable to sow oil flax in the second ten-day period of March at a rate of 4.0 million seeds per hectare.

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