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Farklı Ekim Zamanlarının Aspir Bitkisinde Verim Ve Verim Karakterleri Üzerine Etkileri

Erkan BOYDAK[1], Muhammed Said YOLCU[2*], Filiz EKİN[1]

Öne Çıkanlar:
- Çeşit seçimi
- Ekim zamanı tespiti
- Tane verimi

Anahtar Kelimeler:
- Bingöl
- Aspir çeşitleri
- Ekim zamanı
- Verim
- Agronomi

ÖZET:

Bu araştırmanın amacı, belirli aspir (*Carthamus tinctorius* L.) çeşitlerinin tarımsal özelliklerine farklı ekim zamanlarının etkisini incelemektir. Çalışma, 2015 ve 2016 yıllarında Bingöl Üniversitesi Ziraat Fakültesi Deneme Tarlası'nda gerçekleştirilmiştir. Çalışma, üç tekrarlamalı ‘‘şansa bağlı bloklar deneme deseni’’ kullanılarak kurulmuştur. Çalışmada; dört farklı ekim zamanında üç farklı aspir çeşidi kullanılmıştır. Araştırmada bitki boyu, bitki başına dal sayısı, bitki başına tabla sayısı, tabla başına tohum sayısı, bin tohum ağırlığı, dekara verim, yağ oranı ve protein oranı dahil olmak üzere çeşitli tarımsal özellikler incelenmiştir. Bulgulara göre, Dinçer çeşidi hem ilk yılda 89.1 kg/da ile hem de ikinci yılda 75.50 kg/da ile dekara verim bakımından en iyi sonuçları göstermiştir. Ekim zamanına gelince, ilk yılın ilk ekim zamanının ve ikinci yılın üçüncü ekim zamanının diğer ekim zamanlarına göre dekara verim açısından daha iyi sonuçlar verdiği belirlenmiştir.

The Effect of Sowing Times on Yield and Yield Characteristics of Different Safflower Varieties

Highlights:
- Sowing dates determination
- Safflower varietes selection
- Seed yields

Keywords:
- Bingöl
- Safflower varietes
- Sowing dates
- Yield
- Agronomy

ABSTRACT:

The purpose of this research was to examine the impact of various sowing times on the agronomic traits of specific safflower (*Carthamus tinctorius* L.) varieties. The study was conducted at the Experimental Field of Bingol University Faculty of Agriculture in 2015 and 2016. The study was set up using a ‘‘randomized blocks trial design’’ with three replications. It involved the use of four different sowing times and three distinct safflower varieties. Several agronomic characteristics were analyzed in the research, including plant height, number of branches per plant, number of leaves per plant, seed count per leaf, thousand seed weight, yield per decar, oil content, and protein content. Based on the findings, the Dinçer variety exhibited the most favorable results concerning yield per decara in both years, achieving 89.1 kg/ha in the first year and 75.50 kg/ha in the second year. Regarding sowing time, it was determined that the first sowing time in the first year and the third sowing time in the second year yielded better results in terms of yield per decare compared to other sowing times.

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The first year of this study was prepared using the data from Filiz EKİN's Master's thesis.

INTRODUCTION

The global population increase is accompanied by an increasing demand for food worldwide. This situation requires prioritizing the increase in plant-based production in nutrition. Additionally, the growing deficit and dependency on oils necessitate the increase in oilseed production and diversity. According to the Food and Agriculture Organization (FAO), the total global oilseed production in 2020 was reported to be 610.1 million tons, showing a 3.8% increase compared to 2019 (FAO 2021). In our country, the production area allocated for oilseeds in 2020 was approximately 8.9 million hectares, and the production quantity was around 3.5 million tons. Furthermore, the production area allocated for safflower in the same year was about 151 thousand hectares, with a production quantity of around 21 thousand tons. However, it has been reported that there have been decreases in both the production area and quantity of safflower over the past six years (2015-2020) (Turkish Statistical Institute [TUIK] 2021).

Safflower, a member of the Asteraceae=Compositae (daisy) family, belongs to the Carthamus genus. There are 25 species of the Carthamus genus worldwide (Singh & Nimbkar, 2006). Although Carthamus tinctorius, the species of safflower, does not have a natural distribution area in Turkey, a total of 10 taxa (8 species and 2 subspecies) belonging to the Carthamus genus are found in the country. Safflower cultivation in our country focuses only on the Carthamus tinctorius species (Arslan et al., 2010). Safflower farming in Turkey is mainly carried out in the Central Anatolia, Aegean, and Mediterranean regions. However, safflower farming is less common in the Eastern and Southeastern Anatolia regions. The provinces with the highest seed yields in our country are Adana (200 kg/ha), Burdur (192 kg/ha), Çanakkale (185 kg/ha), Antalya (181 kg/ha), and Muş (180 kg/ha).

Safflower is an annual plant that can grow up to approximately 100 cm in height. It has broad leaves and flowers in colors such as yellow, orange, red, white, and cream. It can exist in both thornless and thorny forms. It is also known by other names such as false saffron, or dyer's saffron. Thorny forms of safflower have a higher oil content but lower flower quantity. The safflower plant is rich in oleic and linoleic fatty acids, ranging from 30% to 50% in its seeds. It is also suitable for cultivation in arid regions (Babaoğlu, 2005). The vegetative parts of safflower are consumed in dishes like curry, salads, and soups in India and Pakistan. The fresh or dried seedlings and seed husks are used as silage, feed, and fodder for animal nutrition. Harvested safflower plants are used as substrates for biogas production. In Latin America, Japan, and Western Europe, safflower is valued as a cut flower (Adamska & Biernacka, 2021; Cançelik, 2021; Gomashe et al., 2021).

The planting time significantly affects the germination, seedling growth processes, plant development, yield, and quality parameters of crops. If the correct planting time is not determined, the plant emergence can be irregular, and sometimes plants may fail to emerge at all. (Tekin at all. 2021). Early planting, as in other crops, can significantly increase the yield of safflower. Safflower is more tolerant to cold compared to other oilseed crops, so it can be planted in early spring or in the fall when the winter months are not extremely cold in temperate regions (Baydar and Erbaş, 2007). Early planting is particularly important under dry conditions (İnan, 2020).

Determining the correct planting time based on local conditions, climate, and the need of the crop is considered a key element for success in crop cultivation in terms of plant development, seed yield, quality, disease, and pest resistance. This study was conducted to explore the potential of safflower cultivation in irrigable lands in Bingöl Plain. The experiment was established with three different safflower varieties at four different planting times. The aim was to determine the most suitable variety and planting time from an agronomic perspective.

MATERIALS AND METHODS

In this study, Balcı, Dinçer, and Remzibey safflower varieties were obtained from the Geçit Kuşağı Agricultural Research Institute in Eskişehir as the materials. The study was conducted to assess the potential of Balcı, Dinçer, and Remzibey safflower varieties cultivation in irrigable lands in Bingöl Plain.

Bingöl province experiences a continental climate. The summer months are dry and hot, while the winter months are cold and harsh. In the spring months, although the temperature starts to rise, the mountainous areas surrounding the province can be cooler compared to the plain due to their higher elevation (Anonymous, 2011). The climate data for the experimental area is shown in Table 2.

In the autumn period, the experimental area was plowed, and in the spring period, shallow tillage was performed using a cultivator. Then, rotavators were used, followed by harrowing to prepare the field for planting. The research was conducted in the experimental field belonging to the Faculty of Agriculture at Bingöl University in the years 2015 (1st year) and 2016 (2nd year). The experiment was set up in a randomized blocks trial design with three replications. The plots were calculated to be 15 m², with a length of 5 m and a width of 3 m. Planting was done in four rows per plot, with a row spacing of 10 cm and an inter-row spacing of 20 cm. The planting process was carried out manually, with the seeds being sown at an average depth of 3-4 cm in the rows determined by markers. The Sowing time (ST) was arranged as the main plots, while the varieties were arranged as subplots. In 2015, the planting operations were conducted on May 8th (1st planting time), May 14th (2nd planting time), May 20th (3rd planting time), and May 25th (4th planting time). In 2016, the planting was carried out on May 6th (1st ST), May 12th (2nd ST), May 19th (3rd ST), and May 26th (4th ST).

The soil samples taken from different points within the test field at depths of 0-30 cm have been analyzed at Bingöl University Faculty of Agriculture, Soil Analysis Laboratory. The analysis results are provided in Table 1.

Table 1: Physical and chemical analysis results of the soil in the test field

Depth (cm)	Texture	pH	Salt (%)	Organic Matter (%)	P_2O_5 (kg/da)	K_2O (kg/da)	Lime (%)
0-30 cm	Loamy	6.57	0.031	1.905	7.91	24.51	0.36

According to the soil analysis results provided in Table 2, it can be observed that the soil in the test field has a pH value close to neutral, slightly acidic, without salinity problems, poor in organic matter, low in lime content, sufficient in phosphorus, and low in potassium levels.

In both experimental years, before sowing, a basal fertilizer consisting of 3 kg of pure nitrogen, 6 kg of phosphorus, and 1.5 kg of potassium in the form of NPK (15-15-15) compound fertilizer and DAP (18-46) fertilizer was uniformly applied to the test field manually. As a top dressing, 7 kg of pure ammonium nitrate (AN, %33) fertilizer per decare was used at the beginning of flowering. Hand weeding was carried out twice during the growing season. Irrigation was applied after each sowing to facilitate plant emergence. Other irrigations were applied using a drip irrigation system based on the water demand of the plants and air temperature. During harvest, the outer rows of each plot were left as border effects, and the middle two rows were used to collect data. Harvesting was done when the majority of plant leaves in the experiment were completely dried, the petals turned brown, and the heads could be manually threshed. The first-year harvest was conducted on September 1, 2015, and the second-year harvest was conducted on September 3, 2016.

Table 2: Average temperature (°C), total rainfall (mm), and relative humidity (%) values for Bingöl province where the experiment was conducted in 2015, 2016, and long-term

Months	Long Years	2015	2016	Long Years	2015	2016	Long Years	2015	2016
January	-2.5	1.8	-2.8	154.0	147.2	257.8	73.3	75.1	75.4
February	-0.9	1.9	2.5	137.7	119.8	95.3	72.2	74.4	73.3
March	4.9	5.5	7.0	124.1	155.3	131.0	64.2	66.9	60.2
April	10.9	10.7	14.0	103.8	66.7	46.8	61.2	60.1	43.4
May	16.2	16.4	16.3	66.8	21.2	66.2	55.8	53.9	57.4
June	22.6	22.6	22.3	18.4	8.1	34.4	42.5	38.4	43.5
July	27.0	27.4	26.9	7.3	0.1	7.0	36.7	28.1	43.2
August	26.8	27.1	28.1	5.4	0.6	0	36.8	30.8	28.8
September	21.3	23.6	20.1	16.4	0.4	29.1	42.2	30.0	40.3
October	14.2	14.4	15.2	70.3	18.9	4.4	58.9	68.6	43.0
November	6.5	14.4	6.4	91.8	46.2	53.7	64.7	56.4	48.0
December	0.2	1.3	-2.2	121.8	219.1	152.6	70.7	58.6	73.4
Total/Average	**12.3**	**13.9**	**12.8**	**917.8**	**803.6**	**878.3**	**56.6**	**53.4**	**48.8**

In the first year of the experiment, the following parameters were examined: plant height, number of tillers per plant, number of branches per plant, number of seeds per head, thousand grain weight, yield per decare, crude oil content, and crude oil yield. In the second year of the experiment, Due to the pandemic and economic inadequacy, fat and protein ratios for 2016 could not be analyzed. The findings obtained from the research were subjected to variance analysis using the "Split-Plot Design" according to the JUMP statistical package program. Significant differences among the values were determined through the LSD (0.05) test and grouped accordingly.

RESULTS AND DISCUSSION

The experiment revealed that the first sowing time resulted in the tallest plant heights during both the initial and subsequent years of the study. In the first year, the plants reached heights ranging from 38.81 to 34.69 cm, while in the second year, they also exhibited similar growth patterns. In both years, delays in sowing time resulted in decreases in plant height. Different varieties stood out in each year. Remzibey variety stood out in the first year, while Balcı variety stood out in the second year (Table 3, 4). This is because; The climatic differences that vary from year to year and the different performances of the varieties according to these differences. The inverse relationship between plant height and sowing time is associated with the duration of vegetation and the advancement of sowing time. The elongated vegetation period resulting from the advancement of sowing time leads to an increase in plant height. Studies conducted by Yılmazlar (2008), Coşge and Kaya (2008), Koç et al. (2009), Gök and Ekin (2019), which investigated the decreases in plant height due to delays in sowing time, support our findings. The differences in plant height observed between the two years are attributed to variances in climatic conditions. According to the results obtained in the initial year of the investigation, it became apparent that the second sowing time led to the highest number of branches per plant, with an average of 4.1 branches. Additionally, when considering the interaction between the ST × V factors, the Remzibey variety exhibited the highest number of branches per plant, reaching 4.5 branches specifically during the second sowing time. In the second year's data, among the different varieties studied, the Balcı variety displayed the highest number of branches per plant, achieving an average of 3.13 branches (as seen in Table 3 and 4). The results highlight the significant influence of sowing time on the vegetative growth process of plants, directly impacting the number of branches they develop. It is clear that the timing of sowing plays a crucial role in shaping the branching patterns and overall vegetative growth of the plants studied. After plants complete their vegetative growth and transition to the generative phase, climatic variables play an influential role. The hypothesis posits that by advancing the sowing time, there is a possibility of prolonging the vegetative phase and subsequently promoting a greater number of branches in the safflower plants. The results of studies conducted by Yılmazlar (2008), Atam (2010), Aydın (2012), Gök and Ekin (2019) support our findings.

The highest number of seeds per head in the 2015 year was obtained at the second sowing time with a value of 7.3 seeds per head. In the 2016 year, the Balcı variety had the highest value of 4.63 seeds per head (Table 3, 4). It is believed that plants that did not reach sufficient temperatures on May 8 tend to elongate their height instead of forming heads in order to provide more sunlight and warmth. When looking at the plant height values, the close values between the May 8 and May 14 sowing dates support our observation. The variations in plant height observed between years are believed to be due to climatic differences. Our findings are consistent with the research results of Nikabadi et al. (2008), Yılmazlar (2008), Koç et al. (2009), Atam (2010), and Gök and Ekin (2019).

Upon analyzing the data presented in Table 3 and 4, it becomes evident that there is a consistent reduction in the number of seeds per head as a consequence of delayed sowing time. The maximum number of seeds in the first year was observed when sowing took place at the earliest time, and in the second year, the peak was reached during the fourth sowing time, which falls within the same statistically significant group as the first sowing time.

In the initial year, the Remzibey variety displayed the highest number of seeds per head, recording 30.7 seeds per head. In the subsequent year, the Dinçer variety exhibited the highest count, with 16.13 seeds per head. This difference in seed numbers is believed to be influenced by genetic factors, as well as the shortened vegetation period caused by delayed sowing. This condition leads the plants to mature earlier and prioritize filling existing seeds rather than producing new ones.

Furthermore, variations in plant height between the years are attributed to dissimilarities in climatic conditions. The outcomes of this study align with earlier investigations conducted by Kıllı and Küçükler (2005), Yılmazlar (2008), Atam (2010), and Gök and Ekin (2019). All of these studies have consistently reported a reduction in the number of seeds per head as a consequence of delayed sowing time.

Table 3: Presents the mean values and LSD (0.05) groups for various agronomic characteristics, including Plant Height, Number of Branches per Plant, Number of Heads per Plant, Number of Seeds per head, 1000 Grain Weight, Yield per Decare, Oil Content, and Protein Content of Three Different Safflower Varieties planted at different sowing times during the year 2015

	Plant Height (cm)				Number of Branches per Plant (branch/plant)			
ST/V	***Balcı***	***Dinçer***	***Remzibey***	***Average***	***Balcı***	***Dinçer***	***Remzibey***	***Average***
1. ST	35.30	38.80	42.30	38.81 A	3.3 cd	3.3 cd	3.4 c	3.3 B
2. ST	36.56	38.60	40.73	38.63 A	4.0 ab	3.7 bc	4.5 a	4.1 A
3. ST	32.00	32.20	33.30	32.51 B	4.0 ab	3.3 cd	3.2 cd	3.5 B
4. ST	25.10	23.90	31.50	26.84 C	2.2 f	2.8 de	2.5 ef	2.5 C
Average	32.24 B	33.38 B	36.96 A		3.4	3.3	3.4	
LSD (0.05)	Sowing Times (2.45)	Variety (2.11)	Int. (ns)		Sowing Times (2.44)	Variety (ns)	Int. (2.12)	
	Number of Heads per Plant (piece/plant)				**Number of Heads per Plant (head/plant)**			
ST/V	***Balcı***	***Dinçer***	***Remzibey***	***Ort.***	***Balcı***	***Dinçer***	***Remzibey***	***Average***
1. ST	4.7	6.2	5.9	5.6 B	30.8	34.8	34.7	33.4 A
2. ST	7.4	7.5	7	7.3 A	33.3	30.4	34	32.6 A
3. ST	6.1	5.3	5.2	5.5 B	20.2	28.0	29.7	26.0 B
4. ST	4.2	4.2	4.9	4.4 C	24.0	22.7	24.4	23.7 B
Average	5.6	5.8	5.8		27.1 B	28.9 AB	30.7 A	
LSD (0.05)	Sowing Times (2.44)	Variety (ns)	Int. (ns)		Sowing Times (2.44)	Variety (2.11)	Int. (ns)	

Table 3: **(Continued)**

	1000 Seeds Weight (g)				Yield per Decare (kg/da)			
ST/V	***Balcı***	***Dinçer***	***Remzibey***	***Average***	***Balcı***	***Dinçer***	***Remzibey***	***Average***
1. ST	38.7	41.2	40.0	39.9 A	97.2	101.7	97.4	98.8 A
2. ST	37.8	38.8	36.9	37.8 AB	86.5	94.9	89.0	90.1 B
3. ST	36.7	37.5	36.9	37.0 AB	78.8	89.4	78.0	82.1 C
4. ST	34.2	33.8	34.6	34.2 C	73.3	70.4	74.7	72.8 D
Average	36.8	37.8	36.9		83.9 B	89.1 A	84.8 B	
LSD (0.05)	Sowing Times (2.44)	Variety (ns)	Int.(ns)		Sowing Times (6.11)	Variety (3.85)	Int. (ns)	
	Oil Ratio (%)				**Protein Ratio (%)**			
ST/V	***Balcı***	***Dinçer***	***Remzibey***	***Average***	***Balcı***	***Dinçer***	***Remzibey***	***Average***
1. ST	27.9	28.6	24.9	27.1 A	23.2	20.4	20.9	21.5 AB
2. ST	23.7	23.9	21.5	23.0 B	19.1	24.3	23.2	22.2 A
3. ST	20.4	21.6	17.7	19.9 C	20.0	19.7	18.9	19.5 BC
4. ST	22.8	20.4	17.5	20.2 C	20.2	20.5	19.8	20.2 C
Average	23.7 A	23.6 A	20.4 B		20.6	21.2	20.7	
LSD (0.05)	Sowing Times (2.4)	Variety (2.11)	Int. (ns)		Sowing Times (2.44)	Variety (ns)	Int. (ns)	

ns: non signifiance, ST: Sowing Times, V: Varietes, Int.: Interaction

In the first and second years of the experiment, the yield per decare was 89.1-75.50 kg/ha, respectively, and the Dinçer variety performed better than the other varieties in both years. In both years, the yield per hectare decreased with the delay in sowing dates, and the first sowing time yielded better results compared to other sowing times. The study found a decrease in seed yield as the sowing time was delayed. The variations in seed yield were mainly attributed to variety differences, but as the sowing dates progressed, drought stress began with increasing temperature and decreased rainfall. Due to insufficient time for plant development, the plants completed the growing season by producing seeds in a short period and limited quantity. The variations in plant height observed between years are believed to be due to climatic differences. The findings of Shahrokhnia and Sepaskhah (2017) and Gök and Ekin (2019), which indicate a decrease in seed yield with delayed sowing time, are in line with our study results.

Table 4: The average values and LSD (0.05) groups for Plant Height, Number of Branches per Plant, Number of Head per Plant, Number of Seeds per Head, 1000 Grain Weight, and Yield per Decare of Three Different Safflower Varieties planted at various sowing times in the year 2016 are presented in the table

	Plant Height (cm)				Number of Branches per Plant (branch/plant)			
ST/V	***Balcı***	***Dinçer***	***Remzibey***	***Average***	***Balcı***	***Dinçer***	***Remzibey***	***Average***
1. ST	34.80 a	35.00 a	34.27 a	34.69 A	3.37	2.90	2.63	2.97
2. ST	29.13 cd	32.47 ab	30.10 bcd	30.57 B	2.77	2.43	3.10	2.77
3. ST	29.13 cd	30.67 bc	28.90 cd	29.57 B	3.03	2.27	3.00	2.77
4. ST	29.10 cd	29.43bcd	27.07 d	28.53 B	3.33	2.70	3.10	3.04
Average	30.54	31.89	30.08		3.13 A	2.58 B	2.96 A	
LSD (0.05)	Sowing Times (3.85)	Variety (ns)	Int. (ns)		Sowing Time (ns)	Variety (0.32)	Int. (ns)	
	Number of Heads per Plant (head/plant)				**Number of Seeds per Head (seed/head)**			
ST/V	***Balcı***	***Dinçer***	***Remzibey***	***Average***	***Balcı***	***Dinçer***	***Remzibey***	***Average***
1. ST	4.90	4.27	4.47	4.54	16.83 abc	15.77 a-d	14.23 c-f	15.61 A
2. ST	3.97	3.60	4.37	3.98	10.97 g	15.93 a-d	12.27 fg	13.06 B
3. ST	4.40	3.20	5.00	4.20	13.50 d-g	17.27 ab	13.10 efg	14.62 A
4. ST	5.23	3.93	4.63	4.60	14.67 b-f	15.53 a-e	17.37 a	15.86 A
Average	4.63 A	3.75 B	4.62 A		13.99 B	16.13 A	14.24 B	
LSD (0.05)	Sowing Time (ns)	Variety (0.74)	Int. (ns)		Sowing Time (1.29)	Variety (1.31)	Int. (2.65)	
	1000 Seeds Weight (g)				**Yield per Decare (kg/da)**			
ST/V	***Balcı***	***Dinçer***	***Remzibey***	***Average***	***Balcı***	***Dinçer***	***Remzibey***	***Average***
1. ST	38.12	39.43	35.04	37.53	75.69	67.32	68.63	70.55
2. ST	36.63	38.21	32.53	35.79	65.67	79.13	66.38	70.40

Table 4: **(Continued)**

3. ST	38.09	37.23	32.40	35.91	62.41	90.28	81.28	77.99
4. ST	39.62	36.90	34.84	37.12	62.19	65.27	74.36	67.27
Average	38.11 A	37.94 A	33.70 B		66.49	75.50	72.67	
LSD (0.05)	Sowing Time (ns)		Variety (1.97)	Int. (ns)	Sowing Time (ns)		Variety (ns)	Int. (ns)

ns: non signifiance, ST: Sowing Times, V: Varietes, 1. ST: Sowing Time, Int.: Interaction

Upon analyzing both Table 3 and Table 4 with respect to 1000 Grain Weight, a noticeable trend emerges, indicating that the 1000 grain weight diminishes as the sowing time is delayed. Notably, the measurements of 1000 grain weight exhibit superior outcomes during the first sowing time in comparison to the subsequent sowing times. This phenomenon could be attributed to the longer vegetative period of the safflower plants sown early, providing them with more time to complete seed filling, thus resulting in a higher 1000 grain weight. Atam (2010), Hatipoğlu et al. (2012), and Gök and Ekin (2019) reported significant decreases in 1000 grain weight with delayed sowing time, supporting our findings.

According to the data presented in Table 3, there is a noticeable decrease in oil content as the sowing time is postponed. Remarkably, the first sowing time exhibited the highest oil content, measuring at 27.1%. This finding suggests that delaying the sowing time may have a negative impact on the oil content of safflower seeds, with the earliest sowing time resulting in the most favorable oil content. The Balcı variety has a higher oil content of 23.7% compared to other varieties. The differences in oil content observed among the safflower varieties could be attributed to their distinct responses to various climatic factors and inherent genetic variations. These variables can significantly influence the oil accumulation in the seeds, leading to variations in oil content among the different safflower varieties. The delay in sowing time can affect critical stages of plant growth, which can negatively impact oil formation. Late planting of oil crops can result in a decrease in the fruit or seed formation period and, consequently, a decrease in oil formation. Studies have reported a decrease in oil content due to delayed sowing time by Mirshekari et al. (2013), Gök and Ekin (2019), and Baseri et al. (2022).

Regarding protein content, it was determined that the second sowing time with 22.2% is the most suitable time. Varieties and interactions did not show any statistical effect on protein content. Climatic conditions and sowing time can affect the plant's growth rate, photosynthesis activity, and nutrient uptake, thereby influencing protein synthesis and content. Keleş and Öztürk (2012) reported that during the study, the first sowing time yielded the highest protein content, with a recorded value of 22.91 kg/ha. In contrast, the fifth sowing time resulted in the lowest protein yield, with only 11.30 kg/ha being obtained. These findings indicate that the timing of sowing significantly affects the protein yield of safflower, with earlier sowing times being more favorable for obtaining higher protein content. Aydın (2012) reported a range of 12.87-23.97 kg/ha for crude protein yield, and Gök and Ekin (2019) indicated changes in protein content due to delayed sowing time.

CONCLUSION

Based on the outcomes of the two-year research, it was determined that sowing during the first week of May (first sowing time) demonstrated greater suitability concerning the examined parameters when compared to the later sowing times. These results emphasize the significance of the optimal sowing period for achieving better agronomic characteristics in safflower cultivation. However, considering that spring sowings in March and April could yield different results depending on climatic conditions, they could contribute to safflower cultivation. When evaluated on a variety basis, different varieties stood out in terms of the examined parameters across the years. However, in terms of yield per decare, oil content, and protein content, the Dinçer variety showed better results compared to others. We believe that testing newly bred varieties under conditions similar to Bingöl and promoting safflower cultivation can contribute to closing the gap in oil production.

Conflict of Interest

This study does not present any potential conflicts of interest that could arise from its findings. The research is conducted with impartiality and transparency, ensuring that the results are solely based on the objective analysis of the data and not influenced by any conflicting interests.

Author's Contributions

The authors declare that they have contributed equally to the article.

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