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EFFECT OF DIFFERENT PLANTING DATES ON THE GROWTH AND PRODUCTIVITY OF SUNFLOWER VARIETIES

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ABSTRACT

The local production of oilseeds in Pakistan contributes 0.507 million tons out of a total of 3.255 million tons, while 2.748 million tons are imported. Pakistan focuses on major oilseed crops such as sunflower, canola, rapeseed, mustard, and cotton. The study aims to investigate the impact of planting dates on the growth and seed yield of sunflower, recognizing its multifaceted importance in promoting digestion, cardiovascular health, and cognitive function. The trial was carried out during the spring season of 2020 at the Experimental Farm of the Department of Agronomy, Sindh Agriculture University, Tandojam. Sunflower varieties, namely HO-1 and Suncrop 555, were studied. The findings indicated that sowing sunflower crops on February 15th led to the highest values in various growth and yield parameters, including plant height (177.67 cm), flowering days (97.50), maturity days (109.17), stem girth (29.83 cm), seeds per head (1007.7), seed weight (88.50g), head diameter (17.83 cm), seed index (700.83g), seed yield (483.50 kgha^{-1}), and oil content (38.00%). The planting date of February 15th demonstrated optimal crop development and yield characteristics. Furthermore, the variety "Suncrop 555" exhibited significantly higher crop yield compared to the "HO-1" variety.

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INTRODUCTION

The sunflower (*Helianthus annus* L.) is an important crop cultivated worldwide for food and oil purposes. In Pakistan, the major oilseed crops are sunflower, canola, rapeseed, mustard and cotton. The total availability of edible oils during 2019-20 remained at 3.255 million tons of which local production contributed 0.507 million tons and the import share of edible oil/oilseeds was 2.748 million tons (Adhikary et al., 2016). Sunflower seeds are either eaten directly or processed for cooking oil and other purposes. Sunflowers are primarily grown for oil purposes. Vitamins, minerals and nutrients such as iron, magnesium, selenium, zinc, and potassium are rich in sunflower seeds. Sunflower seeds stimulate digestion, the functioning of the cardiovascular system and the capacity of the brain (Anisuzzaman et al., 2018).

The sunflower reacts to differing sowing times differently but delayed sowing affects both seed yield and seed quality adversely. Therefore, it is very important to determine the cultivation of the sunflower variety for a specific area, depending on prevailing ecological conditions and cultivation practices, particularly the sowing period (Ahmed et al., 2015). Since sowing time is a key factor in influencing sunflower seed yield as well as oil content, it is of primary importance to find an optimal sunflower sowing date. Too early or late sunflower seeding may have adverse effects on crop output (Anjum et al., 2012). When the sunflower is sown later than the prescribed dates, lower seed emergence contributes to reduced growth of seedlings and crop yields. Under conditions where the growth of the sunflower at the rosette stage is not optimal before the onset of extreme winter, the seedlings may not survive under frost conditions (Bhatti et al., 2018).

The delayed sunflower sowing resulted in poor crop production to seed yield and oil content in studies (Bughio et al., 2019). Past studies on similar elements have shown that delayed sowing has decreased yields in most crops (Bagheripour et al., 2017 & Erdogan et al., 2017). Even if the cultivars are grown in the same ecological environment, seeding dates may display differences. Since sunflower cultivars have distinctive features and yield potential of their own (Ismail, 2019), they have significant variations in yield and quality characteristics. Therefore, the selection of cultivars and sowing dates broadly influence sunflower development.

MATERIALS AND METHODS

The study was conducted at 'Student Farm' SAU Tandojam during the year 2019-20. The experiment design was a randomized complete block design (RCBD) with factorial arrangements having three replications. The net plot size of 15 m^2. Four planting dates 15th Feb, 25th Feb, 06th March and 16th March among two sunflower cultivars i.e. HO-I and Suncropp-555. The crop was sown using the hand drilling method. All the cultural and agronomic practices and other intercultural operations were done when required. The data was analyzed in Statistix-8.1, a specialized software for statistical analysis. The difference of variations among the data from the plots was analyzed using ANOVA, and the treatment means significance was calculated by LSD test, wherever it was found to be necessary.

RESULTS AND DISCUSSION

Plant height (cm)

The maximum plant height of 177.67 cm was recorded when the sunflower crop was sown on 15th February, followed by the crop sown on 25th February and 6th March resulting in the average height of the plant (156.50 and 132.67 cm), respectively. However, the minimum plant height (112.33 cm) was observed in the sown crop (16th March). In the case of varieties, the height of the plant was higher (167.42 cm) in the "HO-I" variety than in the "Suncrop555" variety having 122.17 cm. The interactive effect of the 15th February × variety "HO-1" resulted in the taller height of the plant (215.67 cm), and the dwarf height of the plant (103.33 cm) was obtained in the interaction of 16th March × variety "Suncrop555". According to DMRT (Ducan's Mean Range Test), there were significant ($P<0.05$) differences in the height of plants among planting dates and cultivars (Table 1).

Days to flowering

The minimum days to flowering of 97.65 was recorded when the sunflower crop was sown on 16th March, followed by the crop sown on 6th March and 25th February resulting in average days to flowering of 99.78 and 100.83, respectively. However, the minimum days to flowering (102.50) were observed in the sown crop (15th February). In the case of varieties, the days to flowering were lower (97.76) in the "Suncrop555" variety than in the "HO-I" variety having 102.78 days to flowering. The interactive effect of the 15th February × variety "HO-I" produced the maximum days to flowering (105.00), and the lowest days to flowering (95.16) were obtained in the interaction of the 16th March × variety "Suncrop555". According to DMRT (Ducan's Mean Range Test), there were significant ($P<0.05$) differences in flowering days among planting dates and cultivars (Table 1).

Days to maturity

The minimum days to maturity of 105.17 was recorded when the sunflower crop was sown on 16th March, followed by the crop sown on 6th March and 25th February resulting in average days to maturity of 106.50 and 108.00, respectively. However, the minimum days to maturity (109.17) were observed in the sown crop (15th February). In the case of varieties, the days to maturity were lower (109.00) in the "Suncrop555" variety than in the "HO-I" variety having 117.11 days to maturity. The

interactive effect of the 15th February × variety "HO-I" produced maximum days to maturity (119.67), and the lowest days to maturity (103.00) were obtained in the interaction of the 16th March × variety "Suncrop555". According to DMRT (Ducan's Mean Range Test), there were significant (P<0.05) differences in maturity days among planting dates and cultivars (Table 1).

Table 1. Different Planting Dates, Growth and Productivity of Different Varieties of Sunflower.

Planting dates	Varieties	Plant height (cm)	Days to flowering	Days to maturity	Stem girth (cm)	Head diameter (cm)	Seeds head^{-1}	Seed weight head^{-1}(g)	Seed index(g)	Seed yield (kg ha^{1})	Oil content (%)
15 Feb	HO-I	215.68	104.01	118.68	24.67	15.01	884.8	87.34	598.01	397.64	40.01
25 Feb		186.34	103.68	117.34	24.01	12.34	732.1	63.01	474.34	280.51	39.44
06 March		146.34	102.34	115.25	22.67	9.34	675.1	41.34	217.34	234.81	38.77
16 March		121.34	100.14	113.20	22.01	7.34	403.4	34.34	98.34	199.71	37.15
15 Feb	Suncrop555	139.68	100.01	114.68	33.01	18.67	1128.8	87.67	799.68	565.38	36.01
25 Feb		126.68	98.68	110.15	31.67	15.67	974.1	71.67	618.68	453.31	35.37
06 March		119.01	97.25	108.23	30.67	13.34	817.1	49.01	442.68	326.81	34.80
16 March		103.34	95.17	103.01	29.67	10.34	635.1	24.34	298.34	232.41	34.17

Stem girth (cm)

The maximum stem girth of 29.83 cm was recorded when the sunflower crop was sown on 15th February, followed by the crop sown on 25th February and 6th March resulting in an average stem girth of 28.83 cm and 27.66 cm, respectively. However, the minimum stem girth (26.83 cm) was observed in the sown crop (16th March). In the case of varieties, the stem girth was higher (32.25 cm) in the "Suncrop555" variety than in the "HO-I" variety having a 24.33 cm stem girth. The interactive effect of the 15th February × variety "Suncrop555" produced the maximum stem girth (34.00 cm), and the lowest stem girth (23.00 cm) was obtained in the interaction of the 16th March × variety "HO-I". According to DMRT (Ducan's Mean Range Test), there were significant (P<0.05) differences in stem girth among planting dates and cultivars (Table 1).

Head diameter (cm)

The maximum diameter of the head of 17.83 cm was recorded when the sunflower crop was sown on 15th February, followed by the crop sown on 25th February and 6th March resulting in an average diameter of the head of 15.00 cm and 12.33 cm, respectively. However, the minimum diameter of the head (9.83 cm) was observed in the sown crop (16th March). In the case of varieties, the diameter of the head was higher (15.50 cm) in the "Suncrop555" variety than the "HO-I" variety having 12.00 cm. The interactive effect of the 15th February × variety "Suncrop555" produced the maximum diameter of the head (19.66 cm), and the lowest diameter of the head (8.33 cm) was obtained in the interaction of the 16th March × variety "HO-I". According to DMRT (Ducan's Mean Range Test), there were significant (P<0.05) differences in the diameter of the head among planting dates and cultivars (Table 1).

Seeds head^{-1}

The maximum seed head^{-1} of 1007.7 was recorded when the sunflower crop was sown on 15th February, followed by the crop sown on 25th February and 6th March resulting in an average seed head^{-1} of 854.0 and 746.5, respectively. However, the minimum seed head^{-1} (520.2) was observed in the sown crop (16th March). In the case of varieties, the seeds head^{-1} was higher (889.42) in the "Suncrop555" variety than the "HO-I" variety having 674.75 seeds head^{-1}. The interactive effect of the 15th February × variety "Suncrop555" produced maximum seeds head^{-1} (1129.7), and the lowest seeds head^{-1} (404.3) were obtained in the interaction of the 16th March × variety "HO-I". According to DMRT (Ducan's Mean Range Test), there were significant (P<0.05)

differences in seed head^{-1} among planting dates and cultivars (Table 1).

Seed weight head^{-1} (g)

The maximum seed weight head^{-1} of 88.50 g was recorded when the sunflower crop was sown on 15th February, followed by crop sown on 25th February and 6th March that resulted in an average seed weight head^{-1} of 68.33 g and 46.16 g, respectively. However, the minimum seed weight head^{-1} (30.33 g) was observed in the sown crop (16th March). In the case of varieties, the seed weight head^{-1} was higher (59.16 g) in the "Suncrop555" variety than the "HO-I" variety having 57.50 g seed weight head^{-1}. The interactive effect of the 15th February × variety "Suncrop555" produced maximum seed weight head^{-1} (88.66 g), and the lowest seed weight head^{-1} (25.33 g) was obtained in the interaction of 16th March × variety "Suncrop555". According to DMRT (Ducan's Mean Range Test), there were significant (P<0.05) differences in seed weight head^{-1} among planting dates and cultivars (Table 1).

Seed index (g)

The maximum seed index of 700.83 g was recorded when the sunflower crop was sown on 15th February, followed by the crop sown on 25th February and 6th March resulting in an average seed index of 548.50 g and 332.00 g, respectively. However, the minimum seed index (200.33 g) was observed in the sown crop (16th March). In the case of varieties, the seed index was higher (541.83 g) in the "Suncrop555" variety than in the "HO-I" variety having a 349.00 g seed index. The interactive effect of the 15th February × variety "Suncrop555" produced the maximum seed index (801.67 g), and the lowest seed index (100.33 g) was obtained in the interaction of the 16th March × variety "HO-I". According to DMRT (Ducan's Mean Range Test), there were significant (P<0.05) differences in seed index among planting dates and cultivars (Table 1).

Seed yield (kg ha^{-1})

The maximum seed yield of 483.50 kg ha^{-1} was recorded when the sunflower crop was sown on 15th February, followed by crop sown on 25th February and 6th March that resulted in average seed yield of 368.90 kg ha^{-1} and 282.80 kg ha^{-1}, respectively. However, the minimum seed yield (218.05 kg ha^{-1}) was observed in the sown crop (16th March). In the case of varieties, the seed yield was higher (396.47 kg ha^{-1}) in the "Suncrop555" variety than in the "HO-I" variety having 280.16 kg ha^{-1} seed yield. The interactive effect of the 15th February × variety "Suncrop555" produced the maximum seed yield (567.37 kg ha^{-1}), and the lowest seed yield (201.70 kg ha^{-1}) was obtained in the interaction of the 16th March × variety "HO-I". According to DMRT (Ducan's Mean Range Test), there were significant (P<0.05) differences in seed yield among planting dates and cultivars (Table 1).

Oil content (percent)

The maximum oil content of 38.00percent was recorded when the sunflower crop was sown on 15th February, followed by the crop sown on 25th February and 6th March that resulted in average oil content of 37.39percent and 36.77percent, respectively. However, the minimum oil content (35.65%) was observed in the sown crop (16th March). In the case of varieties, the oil content was higher (38.8%) in the "HO-1" variety than in the "Suncrop555" variety having 35.08% oil content. The interactive effect of the 15th February × variety "HO-1" produced maximum oil content (40.00%), and the lowest oil content (34.16%) was obtained in the interaction of the 16th March × variety "Suncrop555". According to DMRT (Ducan's Mean Range Test) there was a significant (P<0.05) difference in oil content among planting dates and cultivars (Table 1).

DISCUSSION

In this study, the planting date of 15th Feb. produced optimum crop growth and yield characters. The variety "Suncrop555" resulted in significantly higher crop yield as compared to the variety "HO-I". However, the oil content percentage was detected higher in the sunflower variety "HO-1". These results were further supported by Ismail (2019) compared two hybrids (i.e. Suraj and Roshan) that were sown at the National Agricultural Research Centre, Islamabad, in 2009, on different dates to check their performance. The soil is mostly clayey keeping organic material but showing low availability of phosphorus and micronutrients. Data on different parameters, i.e. number of seeds/head and weight of seed per head (g) were collected. The hybrids (Soraj and Roshan) sown early (mid-July) showed outstanding performance by producing a seed weight per head19.60 and 23.4 g as compared to the hybrids (Soraj and Roshan) sown late (end of August) having seed weight per head of 11 and 12.1 g. (Nasim *et al.,* 2012) revealed

that the highest plant height (151.18 cm), 1000-seed weight (51.72g), crude oil content (46.18percent), seed yield (2.55 t ha-1) and oil yield (1.18 t ha^{-1}) were obtained on the second sowing date (20th of April) while the highest ratio of dehulled/hulled seed weight (70.04percent) and head diameter (20.49 cm) was obtained on the first sowing date (10th of April) in 2012. (Ozer *et al.,* 2018) studied the grade factor in 3 levels (Record = V1, Zaria =V2, Golshid =V3) and the planting date factor was studied in four levels (July 15 =D1, July 30 =D2, August 14 = D3, August 29 = D4). The obtained results showed that the effect of grade and planting date on the diameter of circular flower of *Helianthus annuus*, thousand seed weight and seed yield was meaningful, but the mutual effect of planting date and grade on above mentioned cases was not meaningful. The highest yield of seed and oil was 3523 and 1713 kg h-1. (Vermorel et al., 2017) concluded that crop growth and yield were significantly improved by the 1st April planting date in comparison to the 15th and 30th May planting dates. (Yazdifar et al., 2018) showed that all the characteristics of crops are influenced significantly by planting dates. Numerically high values of height of the plant, the diameter of the head, seed weight/head, 1000 seed weight and yield were observed when the crop was planted on Nov. 20th than the rest of the planting dates. However, lower values of height of the plant, the diameter of the head, seed weight/head, 1000 seed weight and yield were observed when the crop was planted on Dec. 20th. They concluded that sunflower crops would be sown on Nov 20th to obtain optimum crop yield.

CONCLUSION

It was concluded that the planting date of 15th Feb. produced optimum crop growth and yield characters. The variety “Suncrop555” resulted in significantly higher crop yield as compared to variety “HO-I” and detected higher oil content percentage. Farmers could have sunflowers cultivated on 15th February because plant growth and yield are higher as compared to other dates of cultivation of sunflowers. The drill method could be used for sunflower cultivation its more efficient for production.

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