

EVALUATION OF SAFFLOWER (*Carthamus tinctorius* L.) CULTIVARS UNDER DIFFERENT SOWING DATES ON YIELD AND YIELD ATTRIBUTES IN NON TRADITIONAL AREA OF NORTHERN TELANGANA ZONE (NTZ)

ABSTRACT

The field experiment entitled “Evaluation of safflower (*Carthamus tinctorius* L.) cultivars under different sowing dates on yield and yield attributes in [a non-traditional non-traditional](#) area of Northern Telangana Zone (NTZ)”, an experiment was conducted at Regional Agricultural Research Station, Polasa, Jagtial during *Rabi*, 2022. The experiment was laid out in factorial randomized block design with ten treatment combinations by replicating thrice. The treatments [includes include](#) two factors *i.e.*, factor -1 having two genotypes G₁: ISF-764, G₂: TSF-1, and factor -2 having five sowing dates D₁: 15th October, D₂: 30th October, D₃: 15th November, D₄: 30th November, D₅: 15th December. Among the genotypes of safflower, TSF-1 recorded higher seed yield (1243 kg ha⁻¹) and yield attributing characters *viz.*: number of heads plant⁻¹ (26.34), number of seeds head⁻¹ (32.34), seed weight plant⁻¹ (42.01 g), seed index (3.71 g). Stover yield (5386 kg ha⁻¹) and biological yield (6629 kg ha⁻¹) over ISF-764. The result showed that among the different sowings of safflower 30th October sowing ~~was~~ recorded significantly higher Yield and Yield attributing characters *viz.*: number of heads plant⁻¹ (31.24), number of seeds head⁻¹ (35.16), seed weight plant⁻¹ (47.84 g), seed index (3.77 g), seed yield (1412 kg ha⁻¹), Stover yield (6415 kg ha⁻¹) and biological yield (7827 kg ha⁻¹) as compared to 15th November and 30th November, 15th December sowing date respectively and it is on par with safflower crop sown on 15th October. From the study, it can be concluded that the genotype TSF-1 sown on [the](#) 15th and 30th [of](#) October performed best among all other treatment combinations.

[Key words](#) ~~Keywords~~: Safflower, Genotype, Sowing date, Yield, and Yield Attributes.

INTRODUCTION

Oilseeds are the second major agricultural commodity after cereals in India. Safflower (*Carthamus tinctorius* L.) is one of the important edible [oilseed oilseed crop crops](#). The crop is mainly grown in Maharashtra, Karnataka and parts of Andhra Pradesh, Madhya Pradesh, Orissa, Bihar, etc., in the country. The major [safflower growing safflower growing](#) states are Maharashtra and Karnataka, which contribute more than 90% of India's production. India is the

largest producer of safflower (2.0 lakh tonnes) in the world with [the](#) highest acreage (4.3 lakh hectares) but with ~~an~~ average productivity of 465 kg ha⁻¹ (Times of Agriculture ~~today~~ [Today](#) 2022). In Telangana safflower is growing in an area of 7590 acres with 2732 MT of production.

Appropriate cultivar serves as a pivot around which all other parameters of agriculture are adjusted ~~in order to~~ achieve the highest yield of [the](#) crop. Finding a suitable cultivar is the first and most crucial aspect affecting the crop's average yield. The capacity to respond to various agronomical elements that are complementary to yield, assuming all other inputs are sufficiently supplied, is the result of the interaction of genetic factors governing growth and yield potential. The right cultivar must ~~be choose~~ [be chosen](#) for the area because the climatic conditions of one place may not apply to another. Cultivar selection is a key management component in any cropping system even more critical in sowing date for crop production (Soleymani *et al.*, 2011). All the varieties may not be suitable for timely as well as late sowing. The yield and quality properties of safflower are largely determined by ecological factors and cultivation techniques. It was reported that the sowing date and cultivars of safflower vary depending on ecological conditions (Daltalab *et al.*, 2013).

It is equally important to choose the right sowing date. Utilizing advantageous climatic conditions to their fullest and protecting plants during their growth phases from ~~unfavorable~~ [unfavorable](#) environmental influences are both essential for enhancing crop output. Since temperature and day length have a greater impact on the length of development stages, the sowing date can be ~~choose~~ [chosen](#) to provide ~~for~~ the best temperature and day length for the various stages of plant growth. It is also essential to choose the right planting date by having appropriate knowledge of ecological and environmental growing elements (Khajehpour 1998). Crop planting depends on rainfall and soil moisture availability in dryland environments. Early sowing makes better use of the moisture in the soil. The crop displayed early vigor, growth, and development, which led to greater yield. The yield fall rate varies from 4 to 80 kg day⁻¹ ha⁻¹ as a result of delayed seeding. Because pests and diseases are more common, germination is poor due to low temperatures, plant stand is weak, and there is severe terminal drought, delayed sowing reduces yield.

MATERIALS AND METHODS

The field experiment entitled “Evaluation of safflower (*Carthamus tinctorius* L.) cultivars under different sowing dates on yield and yield attributes in ~~non-traditional~~ [nontraditional](#) area of Northern Telangana Zone (NTZ)”, an experiment was conducted at RARS, Polasa, Jagtial during *Rabi*, 2022. The experiment was laid out in factorial randomized block design with ten treatment combinations by replicating thrice. The treatments includes two *i.e.*, factor-1 having

two genotypes G₁: ISF-764, G₂: TSF-1 and factor -2 having five sowing dates D₁: 15th October, D₂: 30th October, D₃: 15th November, D₄: 30th November, D₅: 15th December. The soil of the experimental field was a sandy clay loams in texture, soil pH (8.04), EC (0.21 dsm⁻¹), low in organic carbon (0.43 %), low in available nitrogen (179.20 kg ha⁻¹) and available phosphorus (13.80 kg ha⁻¹) but high in available potash (310 kg ha⁻¹). For ensuring good germination, healthy and good quality seeds were used with 20 kg ha⁻¹ with a planting geometry of 45 x 20 cm. The recommended dose of fertilizer (40 N + 25 P₂O₅kg/ha) was applied in safflower. Full A full dose of P₂O₅ and half dose of N were applied at the time of sowing in the furrow below the seed. Remaining The remaining half dose of N was applied at the stage of the crop at 35-40 DAS. Soil moisture was not sufficient for crop growth so three uniform irrigation was given to the crop at rosette stage, flowering stage and seed development stage. The data was analyzed by the method of "Analysis of Variance" as described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Number of heads plant⁻¹

Number Several heads plant⁻¹ is an important yield contributing character to judge the seed yield of safflower crop. Data presented in Table 1, revealed that maximum heads plant⁻¹ (26.34) was recorded by genotype TSF-1 and minimum heads was recorded by genotype ISF-764 (24.06).

The sowing date showed a significant variation on number of heads plant⁻¹. The maximum heads plant⁻¹ (31.24) was recorded with 30th October sown crop, as compared to 15th November and 30th November, 15th December sowing date respectively and it is on par with safflower crop sown on 15th October. The minimum number of heads (19.50) plant⁻¹ was noticed with 15th December sown crop. Similar result was found by Emami *et al.*, (2011). The data revealed that combinations of safflower genotypes and different sowing dates did not differ significantly for number of heads plant⁻¹ (Table 1).

Number of seeds head⁻¹

The data revealed in Table 1, the effect of genotypes on Number of seeds head⁻¹ was noticed significant. Significantly more number of seeds head⁻¹ was produced by genotype TSF-1 (32.34) than ISF-764 (27.06).

The data presented in Table 1, noticed that effect of sowing dates on number of seeds head⁻¹ was found to be significant. The highest number of seeds (35.16) head⁻¹ was recorded with 30th October (D₂) sown crop, as compared to 15th November and 30th November, 15th December sowing date respectively and it is on par with safflower crop sown on 15th October. The minimum number of seeds (23.16) head⁻¹ was noticed with 15th December sown crop.

The number of seeds head⁻¹ in different treatment combinations were subjected to statistically analyzed, which revealed that there was no significant difference between combination of safflower genotypes and different sowing date (Table 1). These findings confirm those of Daltalab *et al.*, (2013).

Seed weight plant⁻¹(g)

The data noted in Table 1, revealed that the effect of genotypes on seed weight plant⁻¹ was found significant. Genotype TSF-1 (G₂) produced more (42.01 g) seed weight plant⁻¹. Genotype ISF-764 (G₁) produced less (37.48 g) seed weight plant⁻¹.

The data presented in Table 1, showed that seed weight plant⁻¹ was affected significantly with different sowing dates. Maximum seed weight plant⁻¹ (47.84 g) was observed in the 30th October (D₂) sown crop, as compared to 15th November and 30th November, 15th December sowing date respectively and it is on par with safflower crop sown on 15th October. Minimum seed weight plant⁻¹ (32.04 g) was found at 15th December (D₅) sown crop. Odivi *et al.*, (2013) reported that delay in sowing resulted generally decrease in the yield attributes.

Seed Index (g)

Effect of genotypes on safflower test weight did not show any significant difference. TSF-1 genotype having highest (3.71 g) test weight compared to genotype ISF-764 (3.67 g). The data Table 1, showed that the test weight was not affected significantly by the different sowing dates. However maximum test weight (3.77 g) was obtained under the 30th October (D₂) date of sowing and minimum test weight (3.42 g) was obtained under the 15th December (D₅) sown crop. Similar results were reported by Ali Reza Badri *et al.*, (2011).

Seed yield (kg ha⁻¹)

The data noted in Table 2, revealed that the effect of genotypes on seed yield was found to be significant. The highest seed yield (1243 kg ha⁻¹) recorded with genotype TSF-1, which was significantly higher over ISF-764 (1104 kg ha⁻¹) genotype. The data presented in Table 2, indicated that dates of sowing brought about significant variation in seed yield. The maximum seed yield (1412 kg ha⁻¹) was noticed under 30th October (D₂) sown crop, which was on par with 15th October (1330 kg ha⁻¹) sown (D₁) crop. The lowest seed yield (887 kg ha⁻¹) was obtained with 15th December (D₅) sown crop.

This increase in yield might be due to more yield attributes viz.; number of heads plant⁻¹, number of seeds head⁻¹, seed weight plant⁻¹ (g), and seed index. The results are in close association with findings of Emami *et al.*, (2011). Among interaction of dates of sowing and cultivars of

safflower, the data was not found evident. The findings are in close conformity with Sheykhrou *et al.*, (2012).

Stover yield (kg ha⁻¹)

The data noted in Table 2, revealed that the effect of genotypes on Stover yield was found to be significant. The highest Stover yield (5386 kg ha⁻¹) was recorded with genotype TSF-1, which was significantly higher over ISF-764 (4715 kg ha⁻¹) genotype due to taller plant. Results revealed that, Stover yield decreased consistently with delay in sowing. The data presented in Table 2, indicated that dates of sowing brought about significant variation in Stover yield. The highest Stover yield (6415 kg ha⁻¹) was recorded under 30th October (D₂) sown crop, which was on par with 15th October (6038 kg ha⁻¹) sown (D₁) crop. The lowest Stover yield (3358 kg ha⁻¹) was obtained with 15th December (D₅) sown crop.

The positive effect of date of sowing on Stover yield may be due to the pronounced growth during early stages of crop. It resulted that higher plant height and dry matter accumulation and ultimately tended in realization of higher straw yields. Interaction of sowing dates and cultivars of safflower was not found significant in case of Stover yield. This may be due to taller plant. Similar result was found by Sheykhrou *et al.*, (2012).

Biological yield (kg ha⁻¹)

Table 2, indicated the genotype TSF-1 registered significantly higher biological yield (6629 kg ha⁻¹) over ISF-764 during the investigation. The highest biological yield (7827 kg ha⁻¹) was obtained under 30th October sown crop which was superior over 15th November and 30th November, 15th December sown crop. Heidari *et al.*, (2004) reported that postponing the sowing date in addition to temperature increase in developmental stages of germination to flowering which shortening this period cause to yield component production period encounter with high temperature and reduced the total plant dry weight although number of heads per plant, seeds index and seed yield more affected by it in comparison to biomass yield.

Table. 1 Yield attributes of safflower as influenced by genotypes and sowing dates

Treatments	No of heads plant ⁻¹	No of seeds head ⁻¹	Seed weight plant ⁻¹ (g)	Seed Index (g)
Factor- 1: Genotypes				

G ₁ : ISF - 764	26.34	27.06	37.48	3.67
G ₂ : TSF - 1	24.06	32.34	42.01	3.71
S.Em ±	0.43	0.57	0.83	0.13
CD (P = 0.05)	1.30	1.51	2.50	NS
Factor- 2: Sowing dates				
D ₁ : 15 th October	29.67	33.67	45.03	3.63
D ₂ : 30 th October	31.24	35.16	47.84	3.77
D ₃ : 15 th November	24.50	30.00	38.65	3.65
D ₄ : 30 th November	21.50	26.50	35.20	3.73
D ₅ : 15 th December	19.50	23.16	32.04	3.42
S.Em ±	0.68	0.80	1.31	0.20
CD (P = 0.05)	2.05	2.40	3.95	NS
Interaction (G x S)				
S.Em ±	0.97	1.13	1.87	0.30
CD (P = 0.05)	NS	NS	NS	NS

Table. 2 Seed yield (Kg ha⁻¹), Stover yield (Kg ha⁻¹), Biological yield (Kg ha⁻¹) and of safflower asinfluenced by genotypes and sowing dates

Treatments	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Biological yield (Kg ha ⁻¹)
Factor- 1: Genotypes			

G ₁ : ISF - 764	1104	4715	5819
G ₂ : TSF - 1	1243	5386	6629
S.Em ±	17.79	80.46	93.52
CD (P = 0.05)	53.26	240.91	287.71
Factor- 2: Sowing dates			
D ₁ : 15th October	1330	6038	7368
D ₂ : 30 th October	1412	6415	7827
D ₃ : 15 th November	1222	5549	6771
D ₄ : 30 th November	1017	3893	4910
D ₅ : 15 th December	887	3358	4245
S.Em ±	28.12	127.22	148.43
CD (P = 0.05)	84.22	380.92	264.13
Interaction (G x S)			
S.Em ±	39.78	179.91	219.70
CD (P = 0.05)	NS	NS	NS

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The performance of different safflower cultivars can significantly vary with changes in sowing dates, as temperature and photoperiod conditions vary across the growing season. This study aims to understand how various cultivars respond to the specific climate and soil conditions of the Northern Telangana Zone. By analyzing the yield and yield attributes (such as oil content, plant height, number of branches, and seed size) under different sowing dates, researchers can identify the most suitable cultivar-sowing date combinations for maximizing productivity in this region.

Agro-environmental factors play a critical role in determining crop performance and overall agricultural sustainability. The study will likely consider factors such as temperature (Casana and Olivares, 2020; Guevara et al. 2013), precipitation (Hernandez et al. 2017; Parra et al. 2012), soil moisture (Hernandez et al. 2018; Olivares et al. 2018; Hernandez et al. 2020), soil type (Olivares and Hernandez, 2019), and agro-climatic indices specific to the Northern Telangana Zone. These factors can directly influence crop phenology, water use efficiency (Olivares, 2018; Zingaretti and Olivares, 2019), nutrient uptake, and disease incidence, ultimately affecting safflower yield and its attributes.

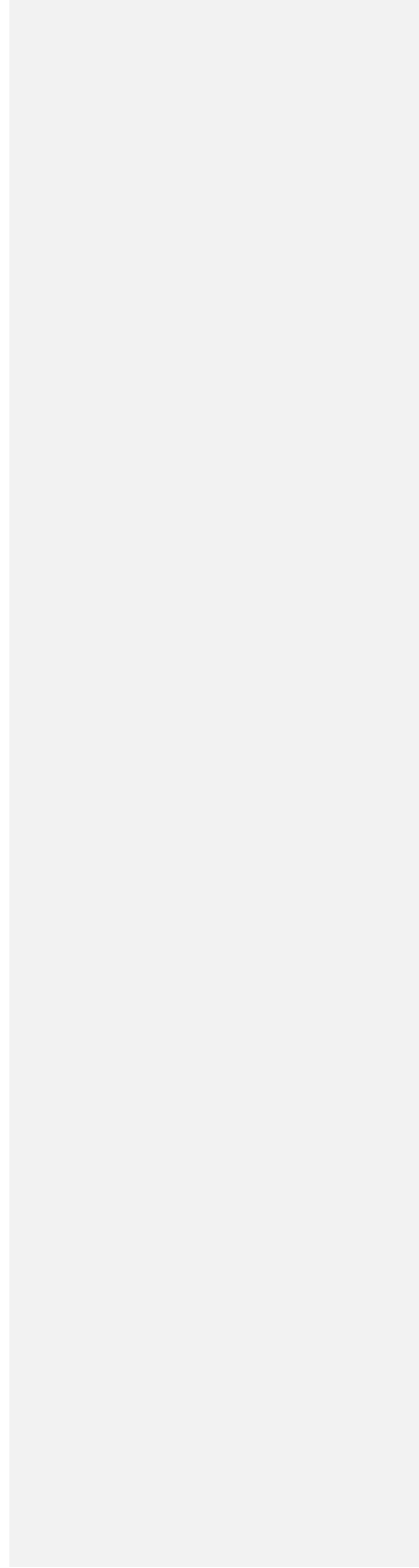
To draw insights and implications from the findings, researchers may compare the results with agroecological zoning studies conducted on tropical crops in Latin America. Latin America is known for its diverse climates and soils (Viloria et al. 2023; Lobo et al. 2023), and similar studies might have been carried out on crops like soybean, maize, or banana (Campos, 2014; Olivares-Campos, 2023). By comparing the responses of safflower cultivars in Northern Telangana Zone with those of tropical crops in different agroecological regions of Latin America, researchers can identify commonalities and potential transferable knowledge to optimize safflower production in similar tropical environments.

One of the main challenges in conducting such an evaluation is the variability of weather conditions across seasons and years. Weather fluctuations can significantly impact crop performance and introduce confounding variables in the study. To mitigate these challenges, the research may consider multi-year studies and robust statistical analysis (Olivares et al. 2022).

Furthermore, understanding the potential limitations of each safflower cultivar and its adaptability to specific agro-environmental factors is crucial for sustainable crop management (Olivares and Hernandez, 2019; Pitti et al. 2021). Identifying traits that confer resilience to adverse conditions and high productivity will be valuable for breeding programs and agricultural extension services in the region (Montenegro et al. 2021; Olivares et al. 2020).

The evaluation of safflower cultivars under different sowing dates in the non-traditional area of Northern Telangana Zone is essential for optimizing production and ensuring food security in the region. By assessing the influence of agro-environmental factors on yield and yield attributes, the study can provide valuable insights into sustainable safflower cultivation practices. Drawing parallels with agroecological zoning studies in Latin America can offer valuable perspectives and foster knowledge exchange among regions facing similar agricultural challenges and opportunities (Zingaretti et al. 2016; Olivares et al. 2017).

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CONCLUSION

The above results conclude that the combination of genotype TSF-1 sown on 15th and 30th October recorded higher yield and yield parameters like number of heads plant⁻¹, number of seeds head⁻¹, seed weight plant⁻¹, seed index and seed yield, stover yield, biological yield. From the study it can be concluded that combination of genotype TSF-1 sown on 15th and 30th October performed best among all other treatment combinations. It is more suitable for Northern Telangana Zone (NTZ).

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