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 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 two factors *i.e.,* factor - 1 having two genotypes G_1: ISF-764, G_2: TSF-1 and factor -2 having five sowing dates D_1: 15th October, D_2: 30th October, D_3: 15th November, D_4: 30th November, D_5 : 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 15th and 30th October performed best among all other treatment combinations.

Key words : 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 crop. 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 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 highest acreage (4.3 lakh hectares) but with an average productivity of 465 kgha^{-1} (Times of Agriculture 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 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 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 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 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 dry land 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 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 G_1: ISF-764, G_2: TSF-1 and factor -2 having five sowing dates D_1: 15th October, D_2: 30th October, D_3: 15th November, D_4: 30th November, D_5 : 15th December. The soil of

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 planting geometry of 45 x 20 cm. The recommended dose of fertilizer (40 N + 25 P_2O_5 kg/ha) was applied in safflower. Full dose of P_2O_5 and half dose of N were applied at the time of sowing in the furrow below the seed. Remaining half dose of N was applied at stage of 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 at 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 of heads $plant^{-1}$ is 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 30^{th} October sown crop, as compared to 15^{th} November and 30th November, 15^{th} December sowing date respectively and it is on par with safflower crop sown on 15^{th} October. The minimum number of heads (19.50) $plant^{-1}$ was noticed with 15^{th} 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 30^{th} October (D_2) sown crop, as compared to 15^{th} November and 30th November, 15^{th} December sowing date respectively and it is on par with safflower crop sown on 15^{th} October. The minimum number of seeds (23.16) $head^{-1}$ was noticed with 15^{th} December sown crop.

Th 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(G_2) produced more (42.01 g) seed weight plant $^{-1}$. Genotype ISF-764 (G_1) 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 (D_2) 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 (D_5) 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 (D_2) date of sowing and minimum test weight (3.42 g) was obtained under the 15th December (D_5) 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 (D_2) sown crop, which was on par with 15th October (1330 kg ha^{-1}) sown (D_1) crop. The lowest seed yield (887 kg ha^{-1}) was obtained with 15th December (D_5) 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 Sheykhlou *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 (D_2) sown crop, which was on par with 15th October (6038 kg ha^{-1}) sown (D_1) crop. The lowest Stover yield (3358 kg ha^{-1}) was obtained with 15th December (D_5) 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 due to taller plant. Similar result was found by Sheykhlou *et al.,* (2012).

Biological yield (kg ha-1)

Table 2, indicated the genotype TSF-1registered 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 : 15th October	**29.67**	**33.67**	**45.03**	**3.63**
D_2 : 30th October	**31.24**	**35.16**	**47.84**	**3.77**
D_3 : 15th November	**24.50**	**30.00**	**38.65**	**3.65**
D_4 : 30th November	**21.50**	**26.50**	**35.20**	**3.73**
D_5 : 15th 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 as influenced 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 : 30th October	**1412**	**6415**	**7827**
D_3 : 15th November	**1222**	**5549**	**6771**
D_4 : 30th November	**1017**	**3893**	**4910**
D_5 : 15th 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**

CONCLUSION

The above results conclude that 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).

References

Ali, R. B., Amir, H. S. R., Saeed, S. Z and Zahra, B. 2011. Sowing Date Effect on Spring Safflower Cultivars. *International Journal of Science and Advanced Technology*. 1(9):139.

Daltalab, B., Kazemi, A. H and Khalilvand, B. E. 2013.The Effect of Sowing Date on Yield, Yield Components and Oil Content of Three Spring Safflower Cultivars under Full Irrigation in Tabriz. *International Journal of Farming and Allied Sciences*.2(3): 66-69.

Deokar, A.B., Patil, N.D., Manke, B.S and Monde, M.S. 1984. Response of safflower varieties to different dates of sowing. *Journal of Maharashtra Agricultural University*. 9: 67-69.

Emami, T., Naseri, R., Falahi, H and Kazemi, E. 2011. Response of yield, yield component and oil content of safflower to planting date and plant spacing on row in rainfed conditions of Western Iran. *Eurasian Journal of Agriculture and Environment Science*. 10(6): 947-953.

Girase, P.D., Wani, A.G and Deokar, A.B. 1980. Response of safflower varieties to plant densities and nitrogen levels. *Journal of Maharashtra Agricultural University*. 6(1): 1-4.

Heidari, Z., P. 2004. The effect of temperature and day length on safflower generative and reproductive growth. M.Sc.Thesis. *Industrial University of Isfahan.*

Kaihan, A., Mojtaba, J.K and Asad, R. 2010. Effect of sowing date and planting density on growth and yield of safflower cultivars as second crop. *Advances in Environmental Biology*. 5(9): 2756-2760.

Mohan, K., Chinmad V.P and Ravi, K.R.L. 2005. Characterization of safflower genotype for growth parameters and yield. *Karnataka Journal of Agricultural Science.* 18(3): 638-643.

Odivi, A. G., Hadi, H., Bahare, B and Mohsen, S. 2013. Effect of sowing date on yield and its components, oil and protein concentration and some agronomical traits of safflower. *Technical Journal Engineering and Applied Sciences*. 3(14): 1405-1410.

Panse, V. G and Sukhatme, P. V. 1985. Statistical methods for Agricultural workers. (3rd Edition). ICAR, New Delhi.

Sheykhlou, N., Seyed, A. V., Jahanfar, D. M. 2012. Study of new dry land safflower cultivars.yield under different planting seasons in Zanjan area. *International Journal of Agricultural and Crop Sciences*. 4(20): 1546-1550.

Soleymani, A., Emami, S. A., Shahrajabian, M. H. and Naranjani, L. 2011. Evaluation of suitable planting dates and autumn safflowercultivars under climatic condition of Isfahan, *Iran. Research Crops*. 12(1):155-162.