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Studies on Sowing Windows and Nitrogen Levels on Safflower in Non-Traditional Krishna Agro-Climatic Zone of Andhra Pradesh

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ABSTRACT

In the present investigation, an attempt was made to know the suitability of safflower in non-traditional areas of Krishna Agro Climatic Zone of South Coastal Andhra Pradesh. a field investigation was carried out at Regional Agricultural Research Station, Lam farm, Guntur, during *rabi* 2021-22 and 2022-23 with an objective to determine the effects of residue crop, sowing dates and nitrogen levels to determine the optimum time of sowing and to find optimum nitrogen and their interaction effect on safflower succeeding to kora. The study revealed that the sowing dates and nitrogen levels tried showed significance in their interaction but individual effects of sowing dates and nitrogen levels were non-significant. The safflower sown on 2nd FN of October with 125 % RDN recorded significantly higher seed yield which was on par with safflower sown on 1st FN of October with 100% RDN. The yield of safflower recorded in this experiment was 57 % below that of the productivity of safflower grown in traditional areas (843 kg ha^{-1}) indicating the various other factors to be considered other than present agronomic practices and traits for its' introduction to the Non-traditional area like Krishna Zone of Andhra Pradesh.

Keywords: *Dates of sowing, Per cent oil content, Nitrogen levels, Safflower and Vertisols*

Safflower (*Carthamus tinctorius* L.) is an important annual industrial crop. The stem, leaves, seeds and flowers are used for different purposes. In India and Pakistan, herbalists sell all parts of the crop for the treatment of various diseases and the flowers of the crop are used in the food, cosmetics, paint and pharmaceutical industries. It is an important oil seed crop that can be grown in arid regions due to its high tolerance to heat. Safflower seeds contain 13 to 46% oil, and approximately 90% of this oil is composed of unsaturated fatty acids *i.e.*, oleic and linoleic acids along with tocopherols, that have antioxidant effect and high vitamin E. The safflower oil is used in the diets of patients with cardiovascular disease, and bears great importance for its anti-cholesterol effect and suitable for biodiesel production. Carthamin, a substance obtained from the flowers of safflower, is an important natural raw material of dye and oil cake is a valuable animal feed (Anjum *et al*., 2017, Boli *et al*., 2020 and Marang *et al*., 2022). India is the largest producer (2 lakh tonnes) with the highest acreage (4.3 lakh ha). The average productivity is of 843 kg ha^{-1} (Directorate of Economics and statistics. Department of Agriculture and Co-operation Ministry of Agriculture. Government of India, 2019-2020).

As a hardy crop and suitability to drought situations, this crop is considered as an important crop to introduce in different parts of the country based on the climatic suitability. Keeping the prevailing environmental conditions, attempts have been made to introduce this crop to nontraditional areas like dry tracts of Krishna Zone of Andhra Pradesh under climate resilient agriculture. Safflower (*Carthamus tinctorius*) growth and productivity are influenced by many factors such as genotype, environment and agronomic practices to establish the crops' adoptability to this particular zone. Thus, an attempt was made in the present study to know effects of sowing time, cultivars suitability and levels of nutrients (N and P_2O_5 and K_2O) in the vertisols of Krishna zone.

MATERIAL AND METHODS

A field experiment was laid out with split plot design and replicated thrice at Regional Agricultural Research Station, Lam Farm, Guntur (Latitude: 16^0

18[1], Longitude: 80[0] 29[1], Altitude: 33 MSL). The climate was sub-tropical with mean annual rainfall of 950 mm. The soil of experimental field was clay loam in texture, slightly alkaline in reaction (pH 8.5), non-saline and medium in available N (312.5 kg ha^{-1}), high in P_2O_5 (185.4.1kg ha^{-1}) and high in K_2O (1016 kg ha^{-1}) and very low in organic carbon (0.20%). The micronutrients, Zn (0.7 ppm), Fe (4.5 ppm), Mn (9.5 ppm) and Cu (1.7 ppm) were available in critical limits at the experimental site. The study was carried for two successive *rabi* seasons under rainfed conditions during 2021-22 and 2022-23. No irrigation was given during the experiment. Korra variety, SiA322 (Garuda), was sown in the month of July and harvested in the month of September in the experimental site for the two consecutive seasons.

The experiment had three main and three sub-plots. Sowing dates (M_1- 1st FN of Oct, M_2- 2nd FN of Oct and M_3-1st FN of Nov) were considered as main plot treatments while, nitrogen levels *viz*., S_1-75 % RDN (30 kg N ha^{-1}), S_2-100 % RDN (40 kg N ha^{-1}), S_3-125 % RDN (50 kg N ha^{-1}) were taken as sub-plot treatments. The safflower variety, ISF-764, was used for the study and adopted recommended package of practices of ANGRAU for cultivation. The data on yield, yield attributes like plant height, number of branches plant^{-1}, number of heads plant^{-1} and 100 seed weight along with straw yield and oil yield were collected and analyzed statistically using Fishers method of analysis of variance. The significance of treatmental effects was tested with the help of F test at 5% level significance in order to compare the treatments.

RESULTS AND DISCUSSION

Sowing dates and nitrogen fertilizer are basic key input factors in deciding yield. The yield improvement and adoption to new environmental conditions needs optimum agronomic practices. The response of the crop is varied based on the agronomic practices, fertilizers, crop residues and sowing time in nontraditional area where they have to be established for getting higher yield. In the present study, an attempt was made to know the effect of kora residue and the different fertilizers levels along with sowing dates.

The experimental results indicated that the individual effects of sowing dates and nitrogen fertilization on safflower found to be non-significant on plant height, number of branches plant^{-1}, number of heads plan^{-1} and 100 seed weight but the interaction effect of sowing dates and nitrogen fertilization on seed and oil yield found to be significant. The safflower sown on 2nd fortnight of October with 125 % RDN recorded significantly higher seed and oil yield which was on par with safflower sown on 1st fortnight of October with 100% RDN (Tables1 and 2). These results are in conformation with the findings of Nathan *et al*. (2017), Ashok *et al*. (2020) and Sofy *et al*. (2020). This might be due to congenial weather conditions prevailed during the month of October and favours efficient utilization of all resources including nitrogen. Further, yield of safflower was increased successive increase in nitrogen levels from 100 to 125% N ha^{-1}. Similar results were also reported by Leghari *et al*. (2016), Nathan *et al*. (2017) and Sreekanth *et al*. (2021). However, the seed yield recorded under this experiment was very low (362.2 kg ha^{-1}) which was 57 % below the average productivity of the crop in traditional areas indicating the thorough study on various parameters before it is considered for commercial cultivation in this nontraditional dry tracts of Krishna agro-climatic Zone of south coastal Andhra Pradesh.

Thus, the study revealed that the no significant association of the yield traits with the treatments but the association was significant when the interaction of the treatments was considered. Further, the yields of the treatments were very less over the average yield of the crop in traditional areas indicating the consideration of various other factors before it is being introduced at commercial scale in Krishna Zone of Andhra Pradesh

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Table1. Yield and yield attributes of safflower as influenced by different sowing dates and fertilizer levels in non-traditionally growing areas

Treatments	Plant height (cm)	No of branches plant-1	No. of heads plan^{t-1}	100 seed weight (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Oil yield (kg ha^{-1})
Main plots (Date of Sowing)							
S_1-1st FN Oct	74.8	8.2	32.4	5.1	274	2203	74.1
S_2- 2nd FN Oct	69.6	8.8	37	6.2	277	2699	74.8
S_3-1st FN Nov	68	8.1	38.4	6.2	258	2266	69.6
SEM +/-	NS	0.41	5.67	0.38	48.3	397	13.02
CD (0.05)	13.2	NS	NS	NS	NS	NS	NS
CV (%)	17.1	10.5	13.4	8.2	17.9	15.2	13.9
Sub-plots (Nitrogen Levels)							
N_1-75% RDN	75	7.6	36.7	6.1	257	2266	69.6
N_2-100% RDN	72.8	9	34.3	5.9	271	2436	73.3
N_3-125% RDN	79.2	8.6	36.9	5.5	279	2466	75.6
SEM +/-	2.39	0.62	3.33	0.67	16.1	210.9	4.36
CD (0.05)	NS	NS	NS	NS	NS	NS	NS
CV (%)	6.9	15.7	19.6	14.4	12.7	18.7	12.7
Interaction							
SEM +/-	2.92	0.76	4.083	0.82	19.8	258.3	5.3
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**61.17**	**NS**	16.5
CV (%)	**6.7**	**15.7**	**19.7**		**12.7**	**18.7**	12.7

Table 2. Two way Interaction of sowing dates and nitrogen levels on seed & oil yield (kgha^{-1})

Interaction	**S_1-1st FN Oct**	**S_2- 2nd FN Oct**	**S_3-1st FN Nov**
Seed yield (kgha^{-1})			
N_1-75% RDN	279.8	214	279.8
N_2-100% RDN	312.7	255.1	246.9
N_3-125% RDN	230.4	**362.1**	246.9
SEM +/-	19.8		
CD (0.05)	61.17		
CV (%)	12.7		
Oil yield (kgha^{-1})			
N_1-75% RDN	75.6	57.8	75.6
N_2-100% RDN	84.4	68.9	66.7
N_3-125% RDN	62.2	97.8	66.6
SEM +/-	5.343		
CD (0.05)	16.5		
CV (%)	12.7		

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