E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; 8(9): 648-651
Received: 26-07-2025
Accepted: 30-08-2025

B Hareesh
P.G. Research Scholar, Department of Agronomy, Agricultural college, Polasa, Jagtial, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

I Tirupathi
Assistant Professor, Department of Agronomy, Agricultural College, Polasa, Jagtial, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

O Sampath
Assistant Professor, Department of Agronomy, Agricultural Polytechnic, Jammikunta, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

R Sai kumar
Assistant Professor, Department of Soil science, Agricultural college, Sircilla, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

Corresponding Author:
B Hareesh
P.G. Research Scholar, Department of Agronomy, Agricultural college, Polasa, Jagtial, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

Identification of suitable safflower (*Carthamus tinctorius* L.) based intercropping systems with ideal row ratios for enhancing the system profitability

B Hareesh, I Tirupathi, O Sampath and R Sai kumar

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i9i.3832

Abstract
Intercropping is an efficient strategy for enhancing productivity, resource use efficiency and farm profitability in dryland cropping systems. A field experiment entitled Identification of Suitable Safflower (*Carthamus tinctorius* L.) Based Intercropping Systems with Ideal Row Ratios for Enhancing the system profitability was conducted during *rabi* 2024–25 at KVK, Bellampalli, in randomized block design with nine treatments and three replications. The soil was sandy clay loam, alkaline in reaction (pH 7.8), low in nitrogen, and medium in phosphorus and potassium. Significant differences were observed among treatments for growth and yield parameters. Sole safflower (T_1) produced the tallest plants (85 cm), maximum dry matter at harvest (70.50 g plant^{-1}) and superior yields (seed yield 1574 kg ha^{-1}, haulm yield 3226 kg ha^{-1}). Among intercropping systems, safflower + chickpea (2:4 ratio) (T_6) outperformed others, recording higher seed yield (1640 kg ha^{-1}) and stalk yield (4100 kg ha^{-1}) and was comparable to sole cropping. Conversely, safflower + mustard (1:3 ratio) (T_5) was least effective, with reduced growth and yield. The study clearly established that safflower + chickpea (2:4) is a promising intercropping system for improving crop productivity and sustaining profitability under dryland conditions.

Keywords: Safflower, intercropping, chickpea, mustard and seed yield

1. Introduction

Safflower (*Carthamus tinctorius* L.) is a significant oilseed crop cultivated during *rabi* season, with great potential for growth in India's arid regions. It belongs to the Asteraceae family and is also referred to as Kusum, Kusumbha or Kardi. Initially, safflower was grown for its dyes and cooking oil. Currently, its seeds are utilized as edible oil, bird feed and for medicinal purposes, particularly in the prevention of heart diseases. The seeds contain oil ranging from 28 to 32%, which is nutritionally similar to sunflower oil and has a high concentration of linoleic acid (78%) that is beneficial for lowering blood cholesterol levels (Naik *et al*., 2022) [1].

India stands as the largest safflower producer globally, yielding 2 lakh tonnes and having an extensive cultivation area of 4.3 lakh hectares; however, the average yield is only 465 kg per hectare (Times of Agriculture Today, 2022). In Telangana, safflower is cultivated on 18,159 acres, resulting in a production of 7,242 tonnes (Department of Agriculture and Farmers Welfare, 2023).

The key features that signify the value of safflower's colouring properties are the levels of the pigments carthamin and carthamidin present in the flowers. The pigments found in safflower include carthamin (3-6%), which is not soluble in water and carthamidin (24-30%), which dissolves in water (Machewad *et al*., 2012) [2]. The ease of harvesting safflower and its notable biological effects have made this plant a dual-purpose resource for both food and medicine in various regions around the globe (Asgarpanah and Kazemivash, 2013) [3].

Intercropping presents significant potential in contemporary agriculture, where compatible crops are cultivated together on the same land using high inputs. The primary benefit of intercropping is the boost in productivity achieved by maximizing the use of solar energy, thermal energy, water and nutrient resources in ecosystems with limited resources. Additionally, intercropping can preserve or improve soil quality, enhance biodiversity, manage weed growth, reduce the incidence of pests and diseases, decrease soil erosion and runoff and enhance farmers income.

The compatibility of crops is a crucial aspect of a successful intercropping system. The effectiveness of any intercropping arrangement relies on the careful selection of crop species that minimize competition for light, space, moisture and nutrients (Fukai & Trenbath, 1993) [4].

In an intercropping system, multiple crop species are frequently cultivated together in the same field for a specific duration, though these crops may not be planted or harvested at the same time. In reality, most intercropping systems consist of only two crops, since adding additional crops leads to increased labor expenses. Generally, intercropping is implemented with the goal of maximizing plant competition rather than focusing on competition aimed at achieving the highest crop yield.

The effectiveness of intercropping systems from improved temporal and spatial complementarity in resource utilization, which involves both the above-ground and below-ground components of the crops. Although two crops *viz.*, for soil nitrogen as it is essential for their growth, this competition encourages legumes to fix atmospheric nitrogen in conjunction with Rhizobium. Consequently, this leads to a complementary use of nitrogen by the crops, which is particularly critical in soils that are either deficient in inorganic nitrogen or excessively fertilized. Hence, the present study was designed to evaluate the Identification of Suitable Safflower (*Carthamus tinctorius* L.) Based Intercropping Systems with Ideal Row Ratios for Enhancing the system profitability. Identification of Suitable Safflower (*Carthamus tinctorius* L.) Based Intercropping Systems with Ideal Row Ratios for Enhancing the system profitability.

2. Materials and Method

A field experiment was conducted during *rabi* 2024–25 at KVK, Bellampalli, Mancherial district, Telangana, situated at 19.07°N latitude, 79.49°E longitude and 381.5 m MSL. The soil was sandy clay loam, neutral to alkaline in reaction (pH 7.8), low in available nitrogen, medium in phosphorus, and medium to high in potassium.

The experiment was laid out in a Randomized Block Design with nine treatments T_1: Sole safflower T_2: Safflower + Chick pea (1: 3 ratio) T_3: Safflower + Greengram (1: 3 ratio) T_4: Safflower + Blackgram (1: 3 ratio) T_5: Safflower + Mustard (1: 3 ratio) T_6: Safflower + Chick pea (2: 4 ratio) T_7: Safflower + Greengram (2: 4 ratio) T_8: Safflower + Blackgram (2: 4 ratio) T_9: Safflower + Mustard (2: 4 ratio)(Safflower variety ISF-764 was used as the main crop, while chickpea (NBEG-452), greengram (MGG-351), blackgram (MBG-1070), and mustard (Sitara Sringar) served as intercrops. Recommended fertilizer dose of 40:40:20 NPK kg ha^{-1} was applied to safflower, with proportionate application to intercrops.

Sowing was done on 14 November 2024 by dibbling method, maintaining 45 × 20 cm spacing for safflower and recommended spacings for intercrops. Standard cultural and plant protection practices were followed. Intercrops were harvested on maturity (Feb–Mar 2025) and safflower on 20 March 2025.

Observations on growth and yield attributes were recorded from five randomly selected plants per plot, and yield data were computed on a per hectare basis. Harvest index was calculated as the ratio of economic yield to biological yield. The data were analyzed using ANOVA for RBD **(**Panse and Sukhatme, 1985) [5], and treatment means were compared using the F-test at 5% level of significance.

Table 1. Physico-chemical properties of the experimental site.

S. No.	Particulars	Value	Method of analysis
A.	**Physical properties**		
1.	Mechanical analysis		Bouyoucos hydrometer (Piper,1966)
	Sand (%)	56.8	
	Silt (%)	16.3	
	Clay (%)	22.7	
	Textural class	Sandy Clay loam	
2.	Bulk density (Mg m^{-3})	1.6	Core sampler method, Blake and Hartge, (1986)
B.	Physico-chemical properties		
3.	Soil reaction (pH)	7.8	Combined electrode method (Jackson, 1973) [7]
4.	EC (dSm^{-1})	0.27	Conductivity Meter (Jackson, 1967) [8]
C.	**Chemical properties**		
5.	Organic carbon (%)	0.42	Walkley and Black modified method (Walkley and Black, 1934) [9]
6.	Available nitrogen (kg ha^{-1})	187.2	Alkaline permanganate method (Subbiah and Asija, 1956) [10]
7.	Available phosphorus (kg ha^{-1})	19.3	Olsen's extractant method (Olsen *et al*., 1954) [11]
8.	Available potassium (kg ha^{-1})	318.2	Flame photometer (Jackson, 1973) [7]

3. Results and Discussion

3. Growth parameters

The effect of safflower-based intercropping systems on growth parameters is presented in Table 2. Sole safflower recorded the maximum plant height (85 cm) and dry matter accumulation (70.5 g plant^{-1}) at harvest, whereas the minimum plant height (74 cm) and dry matter accumulation (58 g plant^{-1}) were observed under safflower + mustard (1:3) intercropping.

The higher growth parameter in sole safflower is attributed to the absence of interspecific competition for nutrients, water and light. In intercropped treatments, mild to moderate competition with companion crops led to slightly reduced growth, which became more pronounced as plants progressed to flowering and maturity stages. Overall, the trend indicates that intercropping affects safflower height more at later stages, whereas early vegetative growth remains largely unaffected. Similar trends observed by Kazemani and Sadegi (2013) and Mohammed *et al.* (2015).

3.2 Yield parameters

Yield attributes of safflower showed significant variation among the treatments (Table 3). The highest number of heads plant^{-1} (21) was recorded in T_6 – Safflower + Chickpea (2:4 ratio), which was statistically on par with T_1 – Sole safflower (20), while the lowest (16) was observed in T_5 – Safflower + Mustard (1:3 ratio). Similarly, T_1 – Sole safflower produced the maximum number of seeds head^{-1} (23), whereas the minimum (17) was obtained in T_7 – Safflower + Greengram (2:4 ratio). Test weight was also highest in T_1 – Sole safflower (36.2 g), closely followed by T_6 (36.1 g), and the lowest (32.9 g) was recorded in T_5 – Safflower + Mustard (1:3 ratio). The superiority of sole safflower and safflower + chickpea (2:4) for yield attributes suggests that safflower performs better either as a sole crop or with a compatible legume intercrop. Legume association, particularly with chickpea, might have improved soil fertility and reduced competition, thereby supporting higher seed setting and test weight. On the other hand, mustard intercropping exerted greater competition for resources, which negatively affected the growth and reproductive efficiency of safflower. Kumar *et al.* (2021) [13], who reported that intercropping safflower with less competitive legumes like chickpea can enhance or maintain yield components, while aggressive or fast-growing intercrops like mustard tend to reduce safflower performance due to increased interspecific competition.

Seed yield, haulm yield and harvest index of safflower varied significantly under different intercropping systems (Table 4). Sole safflower (T_1) recorded the highest seed yield (1574 kg ha^{-1}) and haulm yield (3226 kg ha^{-1}), whereas the lowest seed yield (287 kg ha^{-1}) and haulm yield (660 kg ha^{-1}) were obtained with safflower + mustard (1:3 ratio) (T_5). Similarly, harvest index was maximum in T_1 (32.7%) and minimum in T_5 (30.3%). These results align with the general understanding that intercropping, particularly with aggressive crops like mustard or under closer spacing, can reduce the vegetative growth of the main crop due to higher competition pressure. In contrast, less competitive legumes like chickpea and black gram, especially at wider ratios, maintain a more balanced environment for biomass accumulation in safflower. Comparable trends were noted by Dharmendra *et al*. (2018) [14] Karale *et al*. (2018) [15].

Table 2: Effect of different intercropping systems on plant height (cm) and dry matter accumulation (g plant^{-1})of safflower

Tr. No	Treatment Details	Plant height	Dry matter accumulation
T_1	Sole safflower	85	70.5
T_2	Safflower + Chick pea (1: 3 ratio)	79	67.2
T_3	Safflower + Green gram (1: 3 ratio)	74	63.1
T_4	Safflower + Black gram (1: 3 ratio)	78	66.0
T_5	Safflower + Mustard (1: 3 ratio)	74	58.4
T_6	Safflower + Chick pea (2: 4 ratio)	79	68.1
T_7	Safflower + Green gram (2: 4 ratio)	78	64.2
T_8	Safflower + Black gram (2: 4 ratio)	79	65.2
T_9	Safflower + Mustard (2: 4 ratio)	78	60.9
SEm		1.94	1.83
CD (p= 0.05)		5.9	5.5

Table 3: Effect of different intercropping systems on yield attributes of safflower

Tr. No	Treatment Details	Number of heads plant^{-1}	Number of seeds head^{-1}	Test weight (g)
T_1	Sole safflower	20	23	36.2
T_2	Safflower + Chick pea (1: 3 ratio)	20	22	35.7
T_3	Safflower + Green gram (1: 3 ratio)	19	20	34.1
T_4	Safflower + Black gram (1: 3 ratio)	20	21	34.7
T_5	Safflower + Mustard (1: 3 ratio)	16	18	32.9
T_6	Safflower + Chick pea (2: 4 ratio)	21	22	36.1
T_7	Safflower + Green gram (2: 4 ratio)	18	17	34.6
T_8	Safflower + Black gram (2: 4 ratio)	19	21	36.0
T_9	Safflower + Mustard (2: 4 ratio)	18	19	33.2
SEm±		0.10	0.84	0.09
CD (p= 0.05)		0.31	2.70	0.27

Table 4: Effect of different intercropping systems on yield of safflower

Tr. No	Treatment Details	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest index (%)
T_1	Sole safflower	1574	3226	32.7
T_2	Safflower + Chick pea (1: 3 ratio)	590	1233	32.3
T_3	Safflower + Green gram (1: 3 ratio)	481	1058	31.0
T_4	Safflower + Black gram (1: 3 ratio)	551	1157	32.2
T_5	Safflower + Mustard (1: 3 ratio)	287	660	30.3
T_6	Safflower + Chick pea (2: 4 ratio)	751	1577	32.2
T_7	Safflower + Green gram (2: 4 ratio)	564	1240	31.2
T_8	Safflower + Black gram (2: 4 ratio)	651	1354	32.4
T_9	Safflower + Mustard (2: 4 ratio)	496	1103	31.0
SEm±		34	132	0.09
CD (p= 0.05)		104	401	NS

4. Conclusion

Safflower-based intercropping significantly influenced growth and yield parameters. Sole safflower and safflower + chickpea (2:4 ratio) performed better in terms of plant height, dry matter, number of heads, seeds per head, test weight, seed yield, haulm yield, and harvest index. Intercropping with mustard, particularly at 1:3 ratio, reduced growth and yield due to higher competition for resources. The results suggest that intercropping safflower with compatible legumes like chickpea or black gram can sustain productivity, whereas aggressive crops like mustard may limit safflower performance. Overall, appropriate selection of companion crops and intercropping ratios is crucial for optimizing safflower growth and yield under intercropping systems.

References

1. Naik PC, Somanagouda G, Salakinkop SR. Effect of irrigation scheduling on growth, yield and economics of hybrid safflower. Biol Forum Int J. 2022;14(2a):414-9.
2. Machewad GM, Ghatge P, Chappalwar V, Jadhav B, Chappalwar A. Studies on extraction of safflower pigments and its utilization in ice cream. J Food Process Technol. 2012;3(8):172.
3. Asgarpanah J, Kazemivash N. Photochemistry, pharmacology and medicinal properties of *Carthamus tinctorius* L. Chin J Integr Med. 2013;19:153-9.
4. Fukai S, Trenbath BR. Processes determining intercrop productivity and yields of component crops. Field Crops Res. 1993;34(3-4):247-71.
5. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: ICAR; 1985. p.100-74.
6. Piper CS. Soil and plant analysis. New York: Interscience Institute; 1950.
7. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India Pvt Ltd; 1973. p.400-3.
8. Jackson ML. Soil chemical analysis – advanced course. 2nd ed. Madison: University of Wisconsin; 1967.
9. Walkley A, Black CA. Estimation of soil organic carbon by the chromic acid titration method. Soil Sci. 1934;37:28-9.
10. Subbaiah BV, Asija GL. A rapid procedure for determination of available nitrogen in soils. Curr Sci. 1956;25:259-60.
11. Olsen SR, Cole CU, Watnabe FS, Dean LA. Estimation of available phosphorus in soils by extraction with $NaHCO_3$. USDA Circ. 1954;939.
12. Kazemeini A, Sadeghi H. Reaction of the green bean-safflower intercropping patterns to different nitrogen fertilizer levels. Iran Agric Res. 2013;31(2):13-22.
13. Kumar D, Kumar M, Kumar S, Kumar R, Singh RK. Influence of bio-intensive complementary cropping systems on yields and quality parameters of mustard–chickpea intercropping under Indo-Gangetic plains. J Pharmacogn Phytochem. 2021;10(1):2271-5.
14. Dharmendra M, Chandra B, Shukla A, Singh VK, Pareek N. Effect of planting patterns and fertility levels in chickpea and linseed intercropping in Tarai region of Uttarakhand, India. Int J Curr Microbiol Appl Sci. 2018;7(8):1957-61.
15. Karale G, Biradar SA, Desai BK, Ajithkumar K, Rajanna. Growth and quality parameter of safflower as influenced by different row proportion in intercropping system of safflower (*Carthamus tinctorius* L.) and linseed (*Linum usitatissimum* L.) under rainfed condition. J Pharmacogn Phytochem. 2018;7(2):1549-54.
16. Department of Agriculture Cooperation and Farmer Welfare. 2023 [cited 2025 Sep 17]. Available from: https://agri.telangana.gov.in
17. Times of Agriculture Today. 2022 [cited 2025 Sep 17]. Available from: https://timesofagriculture.in