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

www.agronomyjournals.com
2024; 7(3): 506-508
Received: 06-01-2024
Accepted: 11-02-2024

SA Shinde
Junior Agronomist, AICRP on Safflower, VNMKV, Parbhani, Maharashtra, India

PO Bhutda
Assistant Professor, SRS, VNMKV, Parbhani, Maharashtra, India

SP Kausalye
Officer Incharge, UPRS, VNMKV, Parbhani, Maharashtra, India

SB Ghuge
Officer Incharge, AICRP on Safflower, VNMKV, Parbhani, Maharashtra, India

Corresponding Author:
SA Shinde
Junior Agronomist, AICRP on Safflower, VNMKV, Parbhani, Maharashtra, India

STCR Based site specific nutrient management in soybean-safflower cropping system

SA Shinde, PO Bhutda, SP Kausalye and SB Ghuge

DOI: https://doi.org/10.33545/2618060X.2024.v7.i3g.461

Abstract
Experiment was conducted at research farm of AICRP on safflower research project, VNMKV, Parbhani during *kharif* and *rabi* seasons 2022-23, to study the impact of site specific nutrient management through soil test crop response on yield and economics of soybean-safflower cropping system. Experiment was conducted in split plot design with three replications. The main plot treatment consist of sowing of soybean normal duration variety and short duration variety in *kharif* season followed by sowing of safflower in *rabi* season with four subplot treatment of STCR equation based fertilizer application. The result revealed that seed yield of safflower after normal duration (1156 kg/ha) and short duration soybean variety (1257kg/ha) was significantly influenced due to early time span of short duration soybean variety. Application of 100% STCR based fertilizer application recorded highest seed yield (1585 kg/ha) which was Followed by 75% STCR based fertilizer application (1303 kg/ha). Similarly in system gross returns, system net returns and system B:C ratio also significantly higher with application of 100% STCR Based fertilizer application treatment.

Keywords: STCR, SSNM, Safflower, RDF

Introduction
Safflower is a major *rabi* oilseed crop of Maharashtra mainly cultivated on residual moisture condition. The area under safflower crop in the Maharashtra is 0.22 lakh ha which accounts for 42% of the total area in the country with a production of 0.15 lakh tones, which accounts for 36% of the India's safflower production. The average productivity of state was 691 kg/ha in 2019-20 (Anonymous, 2020) [1]. The majority of area under safflower cultivation is in marathwada region. The average productivity of the Maharashtra is very low. Therefore need to develope suitable technology to improve productivity of safflower. Cropping system is an important component of farming system. It denotes the cropping patterns used on a farm and their interaction with farm resources, other farm enterprises and available technology which determine their make up. Thus it represents the yearly sequence and spatial arrangement of crops and fallows in an area.

Cropping system is planned on the basis of soil type, climate and water resources, taking into account farmers requirements for the maximum production. Most of the dry land areas in India are mono-cropped, however, cropping intensity may be increased by adopting the suitable inter copping and double cropping systems with improved management practices. Similarly waste lands and uncultivated fallows can be well utilized by adopting different alternate land use system according to land use capability classification. Safflower crop, like other crops, requires balanced nutrition, including secondary/micro nutrients and adequate moisture to realize higher seed and oil yield. Despite the fact that safflower is a drought tolerant crop Bitarafan *et al.*, (2011) [3] this crop often experiences moisture stress due to dry and hot weather prevalent during post rainy season. Further, non-application of balanced nutrition based on the site-specific soil nutrient status is also another reason for lower safflower yields. Hence there was a need to test if site-specific soil nutrient management (SSNM) techniques in safflower crop to help to improve the yield. Thus, the aim of present study to quantify the safflower based cropping system productivity with site-specific soil nutrient management (SSNM) techniques.

Materials and Methods

The experiment was conducted on medium black soil at AICRP on Safflower farm, VNMKV, Parbhani (MS) during *kharif* and *rabi* season of the year 2022-23. The experimental soil was medium deep black, low in available nitrogen, medium in available phosphorus and high in available potassium. Fertilizers were applied to the crop based on target yield and fertility status. Initial value of available nitrogen (130.46 kg ha $^{-1}$), phosphorus (9.14 kg ha $^{-1}$) and potassium (666.74 kg ha $^{-1}$) were considered to calculate the fertilizer requirement for targeted yields of safflower. The experiment was laid out in Split plot design with two main plot treatments Cropping system T_1: Soybean (ND) MAUS-612, T_2: Soybean (SD) JS-93-05 and four subplot treatments STCR equation based fertilizer application F_0: No fertilizer (00 NPK kg/ha), F_1: STCR equation based 50% NPK (39:37:00 NPK kg/ ha), F_2: STCR equation based 75% NPK (59:55:00 NPK kg/ ha), F_3: STCR equation based 100% NPK (78:74:00 NPK kg/ ha), This treatments combination replicated three times. The fertilizer used were urea and Diammonium phosphate. Yield and yield attributes were recorded. The targeted yield developed for the safflower crop under AICRP on STCR scheme were used for the calculation of fertilizer N, P_2O_5 and K_2O by considering the targeted yield of 15 q ha^{-1} was done by the equation listed below.

F.N =9.11 x T – 0.45 x S.N;

F.P2O5: 6.27 x T – 2.19 x S.P;

F.K2O: 9.27 x T- 0.38 x S.K

Result and Discussion

Effect of Cropping Pattern

Seed yield and system economics were significantly influenced by the cropping system. The seed yield of Safflower after short duration soybean (Var. JS 9305) was 1257 kg/ha and that after harvest of normal duration soybean (Var. MAUS-612) was 1156 kg/ha. The effect of short and normal duration soybean on safflower was significant on safflower seed yield except biological yield, system gross returns, system net returns and system B: C ratio.

Effect of STCR Based Fertilizer Application

Application of 100% STCR based fertilizer application recorded highest seed yield (1585 kg/ha) which was Followed by 75% STCR based fertilizer application (1303 kg/ha) the higher seed yield may be attributed to higher total dry matter accumulation which in turn might be due to the availability of balanced and higher nutrition *viz.* available nitrogen, phosphorus, potassium and zinc and their uptake and translocation to the reproductive parts and their cumulative effect on improvement in yield attributing characters. Similar results were obtained by Mishra and Vyas (2015) [4], Subramanivan *et al.,* (2001) [5], Biradar *et al.,* (2006) [2], Similarly system gross returns, system net returns and system B: C ratio was highest with Application of 100% STCR based fertilizer application due to highest seed yield.

Interaction Effect of Cropping Pattern X STCR based fertilizer application

The Interaction Effect of Cropping Pattern X STCR based fertilizer application was found to be non significant.

Table 1: Seed yield and economics of soybean-safflower cropping system as influced by cropping system and Site specific nutrient management

Treatments	Seed yield (kg/ha)		Biological yield (Kg/ha)		System Gross returns (Rs/ha)	System Net returns (Rs/ha)	System B:C ratio	Safflower Equivalent yield (kg/ha)
	Soybean	Safflower	Soybean	Safflower				
Cropping system								
T_1: Soybean (ND) MAUS-612	2072	1156	5915	3187	154410	72946	3.99	2733
T_2: Soybean (SD) JS-93-05	2019	1257	5957	3273	157850	76386	4,00	2794
S.Em±		10		14	758	758	0.02	13.54
C.D (p=0.05)		64		NS	NS	NS	NS	NS
STCR equation based fertilizer application								
F_0: No fertilizer		891		2537	133742	54475	3.35	2367
F_1: STCR equation based 50% NPK		1046		2905	146233	65013	3.59	2588
F_2: STCR equation based 75% NPK		1303		3445	164022	81826	4.03	2903
F_3: STCR equation based 100% NPK		1585		4031	180523	97350	4.44	3195
S.Em±		44		72	2855	2855	0.08	50
C.D (p=0.05)		138		221	8798	8798	0.25	155
T x F Interaction								
S.Em±		63		101	4037	4037	0.11	71
C.D (p=0.05)		NS		NS	NS	NS	NS	NS
C.V (%)		9.11		5.46	4.48	9.37	5,15	4.48
GM		1206		3229	156130	74666	3.85	2763

Conclusion

From the above enumeration, it may be concluded that Seed yield and system economics were significantly influenced by the cropping system and STCR equation based fertilizer application. The effect of short and normal duration soybean on safflower was significant on safflower seed yield Application of 100% STCR based fertilizer application recorded highest seed yield which was Followed by 75% STCR based fertilizer application.

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