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Effect of INM practices on nutrient uptake and seed yield in safflower

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ABSTRACT

A field experiment was conducted on 'effect of INM practices on nutrient uptake and seed yield in safflower" to study the effect of organic manures in combination with inorganic nitrogen fertilizer on uptake of major nutrients (N, P, K) and seed yield on safflower (Carthamus tinctorius L.) during rabi season 2009-10 at Students' farm of College of Agriculture, Rajendranagar, Acharya N. G. Ranga Agricultural University, Hyderabad. The treatments consisted of 25 % and 50 % recommended dose of nitrogen fertilizer substituted by each of farm yard manure, poultry manure and vermicompost in combination with 50 % and 75 % N through inorganic fertilizer along with control (no N) and 100 N (100 per cent N through inorganic fertilizer). In total, there were eight treatments which were laid out in a randomized block design and replicated thrice. Safflower variety NARI-6 was used for the study. Among the different combinations, application of 50 % N through inorganic fertilizer + 50 % N through vermicompost (T_7) resulted in higher uptakes of N, P and K by safflower at 30, 60 DAS and at harvest and seed yield (1239 kg ha^{-1}) were observed.

Key words: Safflower, Nitrogen, Phosphorus, Potassium, Seed yield

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INTRODUCTION

Safflower (*carthamus tinctorius* L.) is bestowed with a unique feature of salt as well as drought tolerance due to partially xerophytic nature, in addition to deep and extensive root system making efficient use of reserved soil moisture. It can safely be grown as a potential *rabi* crop in unirrigated areas. It contains about 30 % oil and mostly grown as mixed crop. Fertilizer is the major input through which the productivity can be increased by exploiting the varietal potential, since the cost of inputs of major nutrients through chemical fertilizers is increasing, the inherent fertility of soil has to be increased to make the soil more sustainable, and the use of organic manure in manurial schedules is suggested. Hence, integrated nutrient management is more emphasized, not only to boost the production but also to preserve the ecosystem. Integrated nutrient management (INM) envisaging the use of organic manures, crop residues and other organic wastes, biofertilizers and inorganic fertilizers. Soil organic matter plays a vital role in keeping the soil productivity high. The conjunctive use of organics with the nitrogen fertilizer increased the efficiency of nitrogen, improves the soil health and controls soil pollution. Farm yard manure, stubbles, plant residues, farm wastes, weeds, poultry manure, vermicompost etc. are the chief sources of nitrogen. However, the low availability of organics, prohibitive transport and labour cost limit their use. But in the overall interest of sustaining soil productivity, their use has to be encouraged resorting to integrated nutrient management.

Much work has been reported on integrated nutrient management in safflower but no systematic investigations have been carried out on nitrogen management involving vermicompost, farm yard manure and poultry manure along with inorganic fertilizers on the performance of safflower.

MATERIALS AND METHODS

A field experiment was carried out on sandy loam soil during *rabi* 2009-2010 at Students' Farm, College of Agriculture, Rajendranagar, Hyderabad. The treatments consisted of 25 % and 50 % recommended dose of nitrogen fertilizer (RDNF) substituted by each of farm yard manure, poultry manure and vermicompost in combination with 50 % and 75 % N through inorganic fertilizer along with control (no N) and 100 N (100 per cent N through inorganic fertilizer) laid out in a randomized block design and replicated thrice and all recommended practices were followed. Nitrogen content in plant sample was determined by microkjeldhal distillation method using Kelplus instrument [4]. Phosphorus content of the triacid extracts was determined by vanadomolybdo phosphoric acid yellow colour method on spectrophotometer at 420 nm [4]. Potassium content of the triacid extract was determined by flame photometer [7]. The crop was harvested when most of the leaves turned yellow. Harvested and threshed seed was cleaned and sun dried to a constant weight before recording final seed yield (kg ha^{-1}). Uptake of nutrients was calculated using nutrient concentrations and dry matter yield or seed yield as follows.

Nutrient uptake (kg ha^{-1}) = Nutrient content (%) X Dry weight of the plant (kg ha^{-1})/100

Statistical analysis of data was carried out as per the procedure given by Snedecor and Cochran [12].

Treatment Details:
T_1-Control (No N fertilizer)
T_2-100% RDN Through inorganic fertilizer (N)
T_3- 75% RDN Through inorganic fertilizer + 25% N through FYM
T_4- 75% RDN Through inorganic fertilizer +25% N through Vermi compost
T_5- 75% RDN Through inorganic fertilizer +25% N through Poultry manure
T_6- 50% RDN Through inorganic fertilizer +50% N through FYM
T_7- 50% RDN Through inorganic fertilizer +50% N through Vermi compost
T_8- 50% RDN Through inorganic fertilizer +50% N through Poultry manure

RESULTS AND DISCUSSION

Nitrogen uptake (kg ha^{-1})
The results revealed that the uptake of nitrogen increased with the advancement in age of the crop (Table 1). Among the treatments, treatment (T_7) which has received 50 % N through inorganic fertilizer + 50 % N through vermicompost recorded the highest nitrogen uptake at 30 DAS (11.74 kg ha^{-1}) followed by T_8 (11.37 kg ha-^{1}) and T_4 (10.76 kg ha^{-1}).

At 60 DAS the treatment T_7 obtained highest nitrogen uptake (40.37 kg ha^{-1}) followed by T_8 (38.33 kg ha^{-1}) and T_6 (37.14 kg ha^{-1}). Highest nitrogen uptake at harvest was recorded with T_7 (63.36 kg ha^{-1}) followed by T_8 (58.91 kg ha^{-1}) and T_6 (56.67 kg ha^{-1}). The treatment which has not received nitrogen fertilizer (T_1) has recorded the lowest nitrogen uptake at 30 DAS (5.59 kg ha^{-1}), 60 DAS (19.37 kg ha^{-1}) and at harvest stage (28.14 kg ha^{-1}).

The vermicompost combinations with fertilizer nitrogen performed better than their corresponding combinations of FYM and poultry manure. It might due to the steady and increased availability of nutrients from vermicompost, which might have resulted in increased uptake of nutrients by plants. The results were in accordance with the findings of [9] in green gram. However, the treatment T_7 (50 per cent nitrogen through vermicompost and 50 per cent nitrogen through inorganic fertilizer) appeared superior to T_2 (100 per cent nitrogen through inorganic fertilizer) which might be due to the supply of nutrients through out crop growth.

Table 1: Uptake of nitrogen (kg ha^{-1}) of safflower at various stages of crop growth as influenced by integrated nitrogen management

	Treatment	30 DAS	60 DAS	Harvest
T1	No N-(Control)	5.59	19.37	28.14
T2	N-(100 % through inorganic fertilizer)	9.78	32.67	47.10
T3	N-(75% through inorganic fertilizer + 25% through FYM)	9.75	35.02	49.15
T4	N-(75% through inorganic fertilizer + 25% through vermicompost)	10.76	36.39	54.55
T5	N-(75% through inorganic fertilizer + 25% through poultry manure)	10.28	35.19	51.14
T6	N-(50% through inorganic fertilizer + 50% through FYM)	10.68	37.14	56.67
T7	N-(50% through inorganic fertilizer + 50% through vermicompost)	11.74	40.37	63.36
T8	N-(50% through inorganic fertilizer + 50% through poultry manure)	11.37	38.33	58.91
	S.Ed.±	0.70	4.05	3.28
	CD (P = 0.05)	1.50	8.70	7.05

Recommended P& K were applied including T_1 through inorganic source in all the treatments

Phosphorus uptake (kg ha^{-1})

The data pertaining to phosphorus uptake at 30 DAS, 60 DAS and at harvest are presented in Table 2. The results showed that the manures in conjunction with inorganic fertilizer recorded higher values of uptake of phosphorus than control at 30, 60 DAS and at harvest. Among the treatments, the treatment T_7 registered the highest phosphorus uptake at 30 DAS (4.39 kg ha^{-1}) followed by T_8 (4.04 kg ha^{-1}) and T_6 (3.75 kg ha^{-1}). Treatment (T_2) which has received 100 % nitrogen through inorganic fertilizer had recorded 2.93 kg ha^{-1} phosphorus uptake at 30 DAS which was statistically lesser than all the treatments except control.

It was found that the highest phosphorus uptake at 60 DAS with T_7 (8.55 kg ha^{-1}) followed by T_8 (8.34 kg ha^{-1}) and T_6 (7.74 kg ha^{-1}). Uptake of phosphorus at harvest was recorded highest with T_7 (13.91 kg ha^{-1}) which was followed by T_8 (13.14 kg ha^{-1}) and T_6 (12.30 kg ha^{-1}). Control was recorded the lowest uptake of phosphorus at 30 DAS (1.70 kg ha^{-1}), 60 DAS (3.86 kg ha^{-1}) and at harvest (6.31 kg ha^{-1}), which has not received nitrogen fertilizer. Higher uptake of phosphorus in vermicompost treated plots might due to enhanced phosphatase activity, which contributed to increase the availability of phosphorus resulting in higher uptake of phosphorus.

Table 2: Uptake of phosphorus (kg ha^{-1}) of safflower at various stages of crop growth as influenced by integrated nitrogen management

	Treatments	30 DAS	60 DAS	Harvest
T_1	No N-(Control)	1.70	3.86	6.31
T_2	N-(100 % through inorganic fertilizer)	2.93	6.87	9.33
T_3	N-(75% through inorganic fertilizer + 25% through FYM)	3.09	7.14	9.82
T_4	N-(75% through inorganic fertilizer + 25% through vermicompost)	3.62	7.51	11.04
T_5	N-(75% through inorganic fertilizer + 25% through poultry manure)	3.23	6.99	10.34
T_6	N-(50% through inorganic fertilizer + 50% through FYM)	3.75	7.74	12.30
T_7	N-(50% through inorganic fertilizer + 50% through vermicompost)	4.39	8.55	13.91
T_8	N-(50% through inorganic fertilizer + 50% through poultry manure)	4.04	8.34	13.14
	S.Ed.±	0.28	1.00	0.94
	CD (P = 0.05)	0.60	2.16	2.02

Recommended P& K were applied including T_1 through inorganic source in all the treatments

Potassium uptake (kg ha^{-1})

The data pertaining to potassium uptake at 30, 60 DAS and at harvest are presented in Table 3. The uptake of potassium increased with the advancement of the age of the crop. Perusal of data at 30 DAS the treatment T_7, recorded highest potassium uptake was 4.68 kg ha^{-1}followed by T_8 (4.58 kg ha^{-1}) and T_6 (4.24 kg ha^{-1}). Among the T_3, T_4 and T_5 the treatment which received 75 % nitrogen through inorganic fertilizers + 25 % nitrogen through vermicompost (T_4) recorded 4.07 kg ha^{-1} potassium uptake at 30 DAS which was on par with each other, these treatments are significantly lesser than T_6, T_7 and T_8.

At 60 DAS the treatment T_7 (50 % nitrogen through inorganic fertilizers + 50 % nitrogen through vermicompost) recorded highest uptake of potassium was 11.36 kg ha^{-1} which was statistically on par with T_6 (10.05 kg ha^{-1}) and T_8 (10.28 kg ha^{-1}).

At harvest the uptake of potassium recorded highest with T_7 (42.40 kg ha^{-1}) which was statistically on par with T_4 (38.16

kg ha^{-1}), T_5 (36.96 kg ha^{-1}), T_6 (39.76 kg ha^{-1}) and T_8 (41.72 kg ha^{-1}). The treatment which has received 75 % nitrogen through inorganic fertilizers + 25 % nitrogen through FYM (T_3) recorded 35.81 kg ha^{-1} which was on par with T_2 (34.20 kg ha^{-1}) these treatments are statistically lesser than T_4, T_5, T_6, T_7 and T_8. Significantly the lowest uptake of potassium was observed with control at 30 DAS (1.98 kg ha^{-1}), 60 DAS (5.59 kg ha^{-1}) and at harvest (25.42 kg ha^{-1}), which has not received nitrogen fertilizer.

The variations in P and K uptake among different treatments might be attributed to their inherent capacity to supply nutrients for supporting crop growth. Similar results were reported by [3, 9, 5, 11, 8].

Table 3: Uptake of potassium (kg ha^{-1}) of safflower at various stages of crop growth as influenced by integrated nitrogen management

	Treatments	30 DAS	60 DAS	Harvest
T_1	No N-(Control)	1.98	5.59	25.42
T_2	N-(100 % through inorganic fertilizer)	3.25	7.70	34.20
T_3	N-(75% through inorganic fertilizer + 25% through FYM)	3.64	8.09	35.81
T_4	N-(75% through inorganic fertilizer + 25% through vermicompost)	4.07	8.57	38.16
T_5	N-(75% through inorganic fertilizer + 25% through poultry manure)	3.85	8.01	36.96
T_6	N-(50% through inorganic fertilizer + 50% through FYM)	4.24	10.05	39.76
T_7	N-(50% through inorganic fertilizer + 50% through vermicompost)	4.68	11.36	42.40
T_8	N-(50% through inorganic fertilizer + 50% through poultry manure)	4.58	10.28	41.72
	S.Ed.±	0.28	1.06	2.69
	CD (P = 0.05)	0.60	2.28	5.77

Recommended P& K were applied including T_1 through inorganic source in all the treatments

Seed yield (kg ha^{-1})

Among the treatments, T_7 (50 % N through inorganic fertilizer + 50 % N through vermicompost) recorded the highest seed yield (1239 kg ha^{-1}) followed by T_8 (1197 kg ha^{-1}) and T_6 (1154 kg ha^{-1}). Significantly the lowest seed yield was recorded with T_1 (610 kg ha^{-1}) which has not received nitrogen fertilizer (Table 4 and Fig.1). The combination of 50 % nitrogen through vermicompost and 50 % nitrogen through inorganic fertilizer resulted in better seed and stalk yield over inorganic fertilizer alone and over other treatmental combinations. This might be due to the immediate release of nitrogen through inorganic nitrogen and the latter by the mineralization of nitrogen through vermicompost resulting in steady supply of nutrients through out the crop growth period. The beneficial effects of vermicompost in conjunction with inorganic nitrogen fertilizers on yield parameters have also been reported by [2] in ground nut, [1] in sunflower, [10] in wheat, [9] in greengram and [6] in safflower.

Table 4: Seed yield (kg ha^{-1}) of safflower as influenced by integrated nutrient management

	Treatments	Seed yield (kg ha^{-1})
T_1	No N-(Control)	610
T_2	N-(100 % through inorganic fertilizer)	1020
T_3	N-(75% through inorganic fertilizer + 25% through FYM)	1059
T_4	N-(75% through inorganic fertilizer + 25% through vermicompost)	1122
T_5	N-(75% through inorganic fertilizer + 25% through poultry manure)	1077
T_6	N-(50% through inorganic fertilizer + 50% through FYM)	1154
T_7	N-(50% through inorganic fertilizer + 50% through vermicompost)	1239
T_8	N-(50% through inorganic fertilizer + 50% through poultry manure)	1197
	S.Ed.±	114
	CD (P = 0.05)	245

Recommended P& K were applied including T_1 through inorganic source in all the treatments

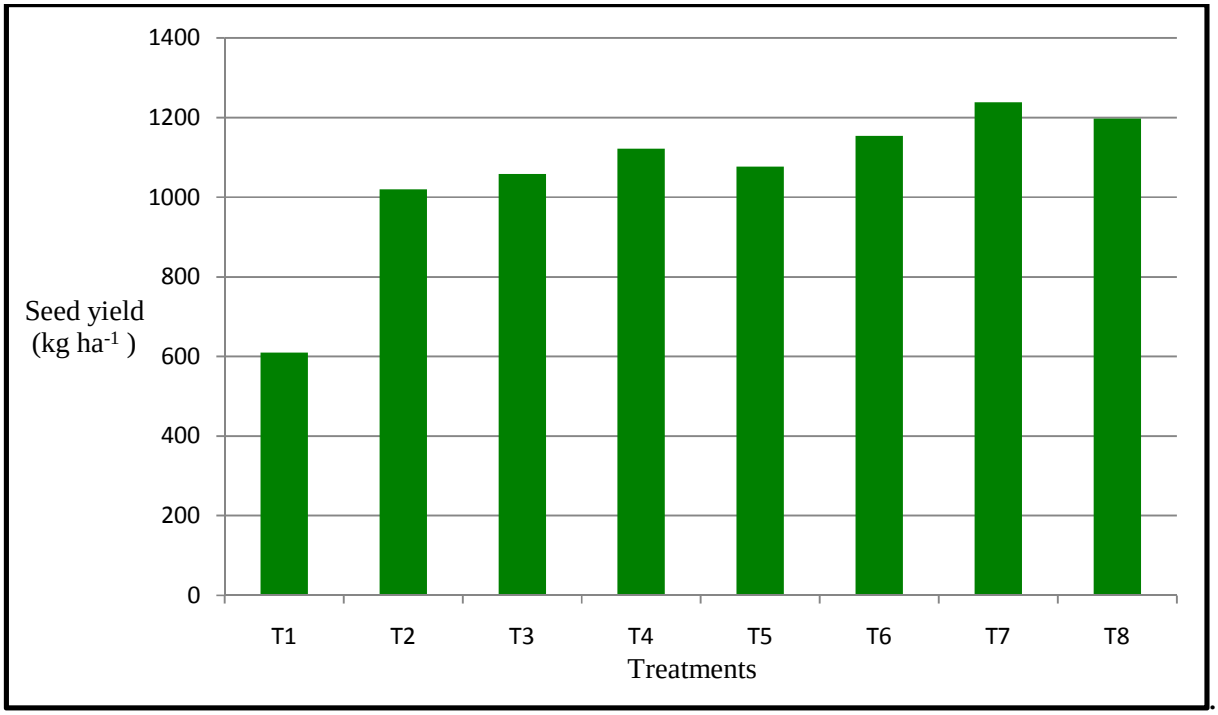

Fig. 1: Seed yield (kg ha^{-1}) of safflower as influenced by integrated nutrient management

CONCLUSION

Among the treatments, the treatment received 50 % N through inorganic fertilizer + 50 % N through vermicompost (T_7) recorded the highest seed yield and nutrient uptake (N, P, K) at 30, 60 DAS and at harvest stages of crop growth compared to the corresponding combinations. Vermicompost is known to contain all the essential plant nutrients and gives steady supply of these nutrients during entire crop period, leading to better growth and development of yield attributes.

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