



Full Length Research

Integrated Nutrient Management (INM) of *Kharif Sorghum* (*Sorghum bicolor* L. Moench) and *Rabi Chickpea* (*Cicer arietinum* L.) as a Low-Cost Production Cropping System.

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ABSTRACT

The present study was conducted under field condition during kharif sorghum and rabi chickpea cropping system at ARI Main Farm, Rajendranagar, Hyderabad, India. The experiment was laid out in split plot design with three main treatments and three sub-treatments, replicated thrice. There were 9 treatments which included application of three different organic manures as a main treatments viz., Farm Yard Manure (FYM), Vermicompost (VC) and Neem Seed Cake (NSC) and their combinations with 0%, 50% and 100% RDF as sub plot treatments. Manures were applied at recommended doses (5 t ha⁻¹ for FYM and 2.5 t ha⁻¹ for VC and NSC). The data was recorded for two years and two seasons (kharif and rabi) to evaluate the economics of the integrated nutrient management as low cost production cropping system. Among the different integrated nutrient management, the highest net returns and cost benefit ratio during both years 2012 and 2013 of experiments were registered by VC+100 % RDF ₹ 92270, 101161 net returns and 2.68, 2.39 cost benefit ratio, FYM +100 % RDF reported the second net returns and cost benefit ratio after VC+100 % RDF, which are ₹ 64257, 89126 net returns, 1.41 and 1.94 cost benefit ratio. The results also showed that VC + 50 % RDF recorded the third role among the integrated nutrient management treatments 81280, 88740 net returns, 2.43, 2.14 as cost benefit ratio frequently, while NSC either sole or integrated with RDF resulted in the least net returns and cost benefit ratios.

Key words: B:C ratio, kharif sorghum, rabi chickpea, cropping system, Rajendranagar.

INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench) is one of the main staple crops for the world's poorest and most food-insecure people. The crop is genetically suited to hot and dry agro ecologies where it is difficult to grow other food grains. Sorghum is truly a dual-purpose crop; where both grain and stover are highly valued outputs in large parts of the developing world (Ahmed et al., 2007). It belongs to the family *Gramineae*, including both wild and cultivated species, it is

commonly known as *jowar* in India and is an important staple food for millions of people in semiarid tropics of Asia and Africa. India contributes to 19% of the total world area (44.53 million hectares) under sorghum with 11.44% of the total world production (62.49 million tonnes) during 2006-07. Sorghum is mainly cultivated for food, feed, fodder, and more recently for bio-fuel and sugar production. It is being considered as the second largest grain crop till the green revolution in India and

Table 1. Effect of integrated nutrient management on gross returns, cost of cultivation and benefit cost ratio of *kharif* sorghum-*rabi* chickpea cropping system first season

Treatments	First season			
	Gross returns (₹ ha ⁻¹)	Cost of cultivation (₹)	Net returns (₹ ha ⁻¹)	B:C ratio
FYM+0 %	89351	44260	45091	1.02
FYM+50 %	97964	45140	52824	1.17
FYM+100 %	110277	46020	64257	1.41
VC+0 %	93712	32635	61077	1.87
VC+50 %	114795	33515	81280	2.43
VC+100 %	126665	34395	92270	2.68
NSC+0 %	94629	59260	35369	0.61
NSC+50 %	114130	60140	53990	0.90
NSC+100 %	121892	61020	60872	1.00

presently occupies third place among the food in terms of acreage and production (Anonymous, 2010).

Therefore, the present study was undertaken with a view to find out the influence of integrated nutrient management (INM) on growth and yield of *kharif* sorghum and *rabi* chickpea and their economic importance as low cost production cropping system.

MATERIALS AND METHODS

The field experiment was conducted in black clay loam soil in *kharif* (rainy) and *rabi* seasons at the Main Farm of Agricultural Research Institute (ARI), Rajendranagar, Hyderabad. The farm is geographically situated at an altitude of 542.6 m above Mean Sea Level (MSL) at 18.5° North latitude and 77.5° East longitude. Experimental site was clay loam in texture, slightly alkaline in reaction (pH), low in organic carbon (O.C) as well as low available nitrogen, medium in the available phosphorus and high in available potassium. The experiment was laid out in split plot design with three main treatments and three sub-treatments, replicated thrice. There were 9 treatments which included application of three different manures as a main treatment *viz.*, Farm Yard Manure (FYM) Vermicompost, (VC) and Neem Seed Cake (NSC) and their combinations with 0%, 50% and 100% RDF as sub plot treatments. Manures were applied as the recommended doses @ 5 t ha⁻¹ for FYM and 2.5 t ha⁻¹ for VC and NSC.

Benefit-cost ratio

This criterion indicates the rate of return per rupee invested in *kharif* (rainy) sorghum and *rabi* chickpea cropping system of two seasons. It was worked out by dividing the sum of discounted net cash flow by the establishment cost at 9 per cent rate of interest (Reddy and Ram 2010).

$$\text{B: C ratio} = \frac{\text{Worth of Gross returns}}{\text{Worth of Cost}} \quad \text{or} \quad \frac{\text{Net returns}}{\text{Cost of production}}$$

RESULTS AND DISCUSSION

In this chapter, the attempts were made to present the important findings of the two years field and laboratory experiments. Discussion on the implications of these results and possible reasons behind them has been attempted with the support of available scientific research findings to derive valid conclusions.

Effect of integrated nutrient management on benefit cost ratio of *kharif* sorghum and *rabi* chickpea for the two seasons

Economic profitability is the prime force which drives any scientific technology from research field to the actual area of concern *i.e.*, farmers field. Hence, the scientific practice that is ecologically promising vis-à-vis economically appealing would be practically sustainable in long term (Sudhanshu, 2013). In the present investigation integrated nutrient management fetched marginal increase in the net returns and cost benefit ratios compared to application of sole organic manure.

Results pertaining to the economics of direct and residual effects of integrated nutrient management treatments in *kharif* sorghum *rabi* chickpea cropping system is presented in Tables 1 and 2. Among the different integrated nutrient management, the highest net returns and cost benefit ratio during both first and second seasons of experiments were registered by VC+100 % RDF ₹ 92270, 101161 net returns and 2.68, 2.39 cost benefit ratio which might be due to the significant increase in yield in *kharif* sorghum (grain and straw yield) and *rabi* chickpea (seed and haulm). FYM +100 % RDF reported the second net returns and cost benefit ratio after VC+100 % RDF, which are ₹ 64257, 89126 net returns, 1.40 and 1.94 cost benefit ratio which might be due to the low cost of cultivation by FYM compared to VC as it was well known that the price of FYM is less than VC and also could be due to the significant increase in yield in both crops during the two years. These results are consistent with the results reported by Kushwaha et al. (2007). On the other hand, Mishra et al. (2010) reported

Table 2. Effect of integrated nutrient management on gross returns, cost of cultivation and benefit cost ratio of *kharif* sorghum-*rabi* chickpea cropping system second season

Treatments	Second season			
	Gross returns (₹ ha ⁻¹)	Cost of cultivation (₹)	Net returns (₹ ha ⁻¹)	B:C ratio
FYM+0 %	102829	44260	58570	1.32
FYM+50 %	113558	45140	68418	1.52
FYM+100 %	122312	46020	89126	1.94
VC+0 %	107759	40510	75124	1.85
VC+50 %	122255	41390	88740	2.14
VC+100 %	135557	42270	101161	2.39
NSC+0 %	107330	59260	48070	0.81
NSC+50 %	120317	60140	60177	1.00
NSC+100 %	128345	61020	67325	1.10

0 % = Zero RDF, 50 % = 50 % RDF and 100 % = 100 % RDF, VC = Vermicompost, NSC = Neem Seed cake and FYM = Farm Yard Manure, ₹ = Rupee

- Sale price of sorghum grain (15 ₹ kg⁻¹)
- Sale price of sorghum stover (1 ₹ kg⁻¹)
- Sale price of Bengal gram seed (15 ₹ kg⁻¹)
- Sale price of Bengal gram haulm (1 ₹ kg⁻¹)

lower B: C ratio with 75 % RDF through inorganic + FYM @ 5 t ha⁻¹ in *kharif* sorghum.

The results also showed that VC + 50 % RDF recorded the third role among the integrated nutrient management treatments 81280, 88740 net returns, 2.43, 2.14 as cost benefit ratio frequently, while NSC either sole or integrated with RDF resulted in the least net returns and cost benefit ratios. This also may be due to the highest cost of cultivation, hence the highest price of the organic manure was observed in the neem seed cakes which is 11 RS kg⁻¹ which is around five times compared to FYM price 2.5 ₹ kg⁻¹ and three times compared to VC price 3.5 ₹ kg⁻¹, which resulted in increasing of cost of cultivation specially in *kharif* sorghum.

Both net returns and cost benefit ratio increased by increasing rate of fertilizer as integrated with any organic source in the experiment and the results of the second season showed better than in first season, which could be attributed to the residual effect of the organic manure which will be well decomposed in the second season compared with the first season, and also may be due to the effect of *rabi* chickpea as it was nitrogen fixing crop. Similarly, Thind et al. (2002) also found that the residual effect of organic manures on succeeding wheat yield was higher than the other treated plots.

Among the different manures the lesser effect on yield and net return observed from NSC and their combinations because of high cost. Keeping these facts in view, it was clear that the B: C ratio was less due to the high cost of manures. Even though combination of vermicompost and farm yard manure has a good B: C ratio but however, application of neem seed cake and their combinations had also contributed to give less B: C ratio. This may be due to less nutrient contents in NSC and also might be due to the high cost while, VC and FYM had good results on B: C ratio and improved the soil properties which resulted on the yield. So, farmers may adopt these practices for realizing higher income and to maintain soil

quality as it serves as better option for them than other combinations.

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