Response of Pigeonpea to Zinc Sulphate and Potassium under rainfed Conditions in Western Mandals of Chittoor District

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ABSTRACT

On-Farm Trials on Yield enhancement in redgram through basal application of Potassium and Zinc sulphate were conducted in sandy loam soils under rainfed condition in western mandals of Chittoor district in Andhra Pradesh during 2017-18 to 2019-20 in 5 farmers fields in 2.0 ha during each year. Treatments comprised of basal application of Nitrogen @ 20 kg/ha, Phosphorus @ 50kg/ha, Potash @ 60 kg/ha and Zinc sulphate @ 25 kg/ha were applied to Redgram. In check plot FYM @ 20 q/ac was applied. Yield attributes viz. number of pods/plant (223), 100 seed weight (11.1 g), yield (4.2 q/ha) and B: C ratio (1.1) were significantly higher in case of treatment plot compared to check plot with number of pods/plant (194.3), 100 seed weight (9.2 g), yield (3.3 q/ha) and B: C ratio (1.0).

Keywords: Redgram, Pigeonpea, Potassium, Zinc sulphate, yield and Economics

Introduction

Pigeonpea (Cajanus cajan L.) is one of the important protein rich pulses in the tropics and subtropics and is the second most important pulse crops of India after chickpea (Sahaja et al., 2019). Globally, arhar is grown in an area of 56.16 lakh hectares with a production of 44.25 lakh tonnes and productivity of 788.1 kg/ha (FAO STAT, 2019). India ranks first in redgram production globally with 38.8 lakh tonnes cultivated under 48.24 lakh hectares with productivity of 804 kg/hectare in 2020-21 (agricoop.nic.in). In India, Redgram takes second position in total pulse production

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after Bengalgram. Andhra Pradesh produced1.16 lakh tonnes in an area of 2.33 lakh hectares with 496 kg/hectare productivity in 2020-21. (http://indiastat.com). In Chittoor district of Andhra Pradesh, Redgram was grown in an area of 7501 ha during 2020-21 (O/o JDA, Chittoor). Pigeonpea is rich source of proteins. Heavy incidence of Pests and diseases during flowering and pod formation leads to reduction in productivity. Availability of Potassium and Zinc to crop will improve yields of Redgram along with nitrogen and phosphorus as these are essential nutrients for redgram. The function of potassium in plant metabolism is different from that of other major nutrients. The later become part of the plant structure, whereas potassium largely remains as an ion in the cells and sap and helps to control the water intake and metabolism of the plant. Some of the specific effects of potassium are to increase root growth and improve drought resistance. (Ranade, 2011). Zinc is one of the seventh plant micronutrients, involved in many enzymatic activities of the plant. It functions generally as a metal activator of enzymes. It is reported that, zinc improves crop productivity almost as much as major nutrients. Besides increasing crop yield, it increases the crude protein content, amino acids, energy value and total lipid in chickpea, soybean, black gram etc (Chalak et al.,2018). Soils in Chittoor district are in general deficit in micro nutrients. Moreover redgram is being cultivated in sandy loams recording low yields. Research results at RARS, Tirupati showed that application of zinc sulphate and potassium as basal dose will increase yield of Redgram by about 23%.

Materials and Methods

On-Farm Trials on Yield enhancement in redgram through basal application of Potassium and Zinc sulphate were conducted in sandy loam soils under rainfed condition in western mandals of Chittoor district during 2017-18 to 2019-20 in 5 farmers fields in 2.0 ha during each year. Sowings were done with seed drill with spacing of 180 cm between rows and intercropped with redgram. In TO1 Nitrogen @ 20 kg/ha, Phosphorus @ 50kg/ha, Potash @ 60 kg/ha and Zinc sulphate @ 25 kg/ha were applied to Redgram. In TO2, (Farmers practice) FYM @ 20 q/ac was applied. No irrigations were given as it is grown under rainfed conditions. Five plants were selected in each field and data was recorded on number of pods/plant, number of seeds/pod and 100 seed weight which were statistically analyzed. Yield was recorded in 5 sq.m in five locations after threshing of the produce.

Economics was calculated as shown below:

Cost of cultivation (Rs. ha^{-1})

Cost of cultivation (₹ ha^{-1}) was calculated considering the prevailing charges of agricultural operations and market price of inputs involved.

Gross returns (Rs. ha^{-1})

Gross returns were obtained by converting the harvest into monetary terms at the prevailing market rate during the course of studies.

Gross return (₹ ha^{-1}) = (Seed yield x price)

Net returns (Rs.ha^{-1})

Net returns were obtained by deducting cost of cultivation from gross return.

Net returns (₹ ha^{-1}) = Gross return (₹ ha^{-1}) - Cost of cultivation (₹ ha^{-1})

Cost: Benefit ratio

The benefit: cost ratio was calculated by dividing gross returns by cost of cultivation.

$$\text{Cost: benefit ratio} = \frac{\text{Gross returns (₹ ha}^{-1}\text{)}}{\text{Cost of cultivation (₹ ha}^{-1}\text{)}}$$

Table 1: Technological Options

Technology Option	Particulars	Source of technology
TO1	Basal application of Zinc sulphate (25 kg/ha) + MOP (60 kg/ha) + Nitrogen (20 kg/ha), Phosphorus (50 kg/ha)	RARS, Tirupati
TO2 (Farmers practice)	Basal application of FYM @ 20 q/ac	-

Results and Discussions

Table 2: Yield Attributes of Treatment and Check Plots of Redgram

Year	No. of pods/plant		No. of seeds/pod		100 seed weight (g)	
	TO1	TO2	TO1	TO2	TO1	TO2
2017-18	254	213	4.0	4.0	11.3	9.5
2018-19	205	190	4.0	4.0	11.1	9.2
2019-20	210	180	4.0	4.0	11.0	9.0
Mean	223.0	194.3	4.0	4.0	11.1	9.2

Yield Attributes: On an average no. of pods/plant in treatment and check plots were 223 and 194.3, respectively. 100 seed weight of treatment and check plots were 47.8 and 38.8, respectively (Table 2). The highest 100 seed weight was due to application of potassium and zinc sulphate. Similar results were also reported by Chalak et al., (2018). It has been concluded that there is significant difference between treatment and check plot with regard to number of pods/plant and 100 seed weight (Table 4)

Table 3: Yield and Economics of Treatment and Check Plots of Redgram

Year	Yield (q ha^{-1})		% increase in yield over check	Gross returns (Rs ha^{-1})		Net returns (Rs ha^{-1})		B: C ratio	
	TO1	TO2		TO1	TO2	TO1	TO2	TO1	TO2
2017-18	5.0	3.75	33	20000	15000	1000	-1000	1.05	0.94
2018-19	3.7	3.15	17.5	20350	17325	1850	825	1.10	1.05
2019-20	3.9	2.95	8.5	21450	16225	2950	-275	1.16	0.98
Mean	4.2	3.3	19.7	20600.0	16183	1933	-150.0	1.1	1.0

*Yields are low as farmers are growing local varieties which are very low yielders and also proper management practices are not followed.

Table 4: Summary of t-test in comparing no. of pods/plant, 100 seed weight, yield and net returns in treatment and farmers practice for three years

	Treatments	N	Mean	Std.Deviation	t-value	p-value
No. of pods/ plant	TO1	5	223.0	0.38	2.36*	0.003
	TO2	5	194.3	0.25	2.36*	0.003
100 seed weight	TO1	5	11.1	0.12	2.31*	0.004
	TO2	5	9.2	0.10	2.31*	0.004
Yield	TO1	5	4.2	0.16	2.31*	0.002
	TO2	5	3.3	0.16	2.31*	0.002
Net returns	TO1	5	1933	1.6	2.36*	0.004
	TO2	5	-150	1.0	2.36*	0.004

*Significant at 5% level

Yield and Economics

Perusal of the data presented in the table 3 and 4 and fig.1and 2 revealed that in demo plot, yield and net returns were found to be significantly higher than in control (farmers practice) during all the years (2017-18 to 2019-20). In treatment plot mean yield of 4.2 q/ha was recorded. Whereas, in control plot 3.3 q/ha yield was recorded. Net returns of treatment and check plot were 1933 and -150 Rs/ha, respectively. Mean B: C ratio of treatment and check plots were 1.1 and 1.0, respectively (Table 3). The higher yield resulted due to more number of pods per plant and 100 seed weight as it is one of the important yields attributing character. The seed yield of pigeon pea further increased with the soil application of zinc sulphate. The positive effect of K on crop yield might also be due to its requirement in carbohydrate synthesis and translocation of photosynthesis and also may be due to improved yield attributing characters, shoot growth and nodulation (Chalak et al., 2018). Similar results are in compliance with the findings of Jat et al. (2013), Mukundgowda et al. (2015), Patil and Dhonde (2009), and Ali et al. (2007), Buriro et al. (2015).

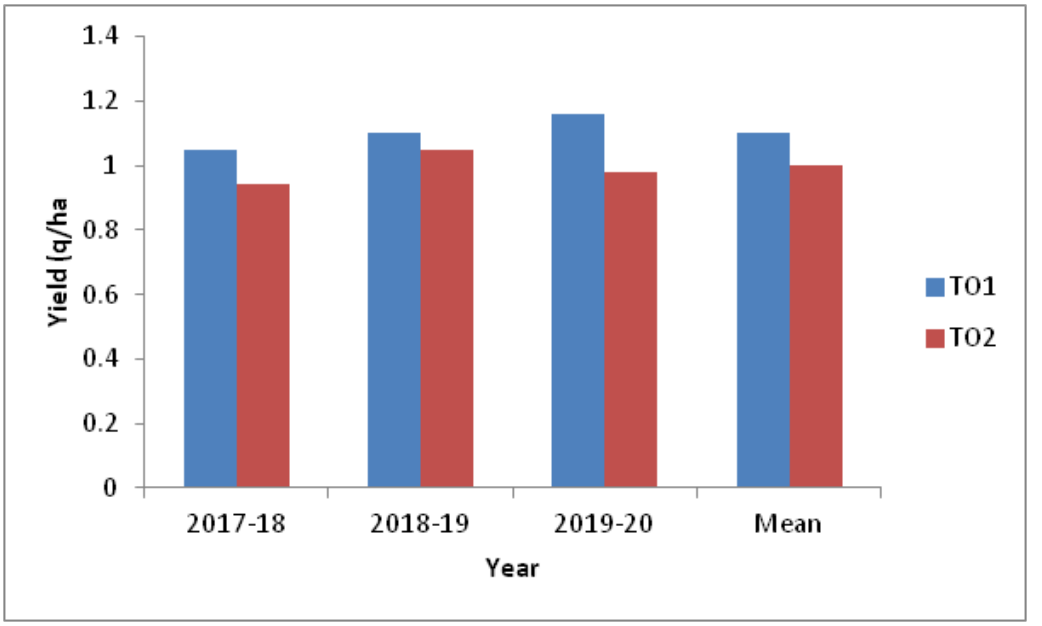

Fig 1. Comparison of Treatment and Check plots in terms of yield

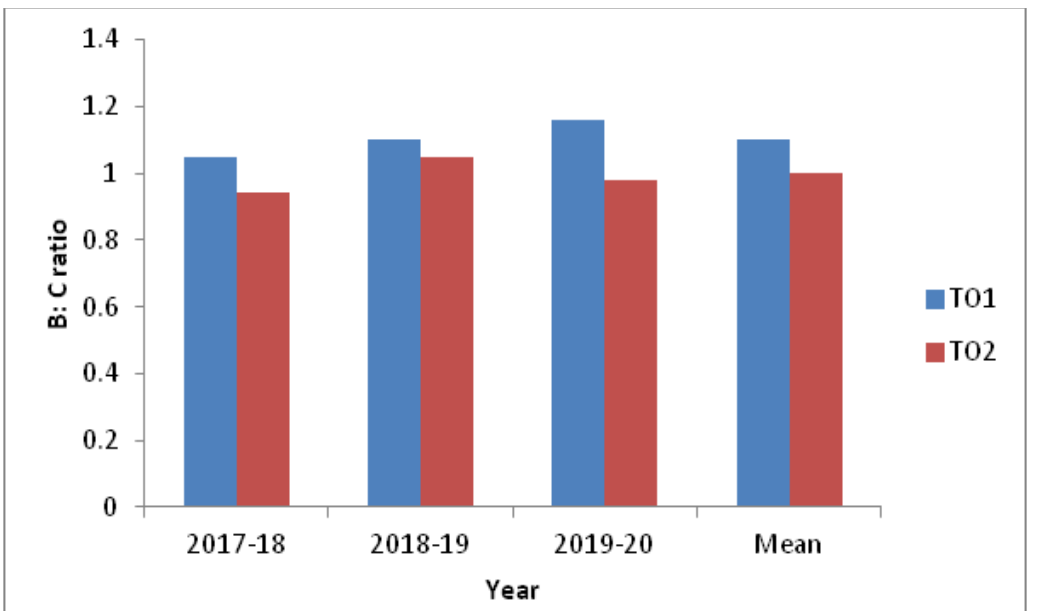

Fig 2. Comparison of Treatment and Check plots in terms of B: C ratio

Conclusion

Basal application of Nitrogen Phosphorus, Potash supplying fertilizers and zinc sulphate proved best in terms of increasing pods/plant, test weight and giving higher yields compared to check plot where only FYM was applied. It was due to fulfilling of nutrient requirement to the crop. Hence application of required fertilizers is beneficial in giving higher yields and net returns.

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