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NUTRIENT UPTAKE, POST-HARVEST SOIL AVAILABLE NUTRIENT STATUS AND YIELD AS INFLUENCED BY VARIETIES AND PLANT GEOMETRIES OF REDGRAM

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ABSTRACT

A field experiment was conducted at wetland farm, S. V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India during *rabi* season of 2023-24 to study the seed yield, post harvest soil available nutrient status and nutrient uptake of ultra short duration redgram varieties under different plant geometries. The field experiment was laid out in a split pot design with three replications. The treatments consists of four varieties *viz.,* ICPV 21333, ICPV 21444, ICPV 21777 and ICPV 21888 as main plots and three plant geometries *viz.,* 30 cm × 10 cm, 45 cm × 10 cm and 60 cm × 10 cm as sub plots. ICPV 21333 recorded significantly higher seed yield and nutrient uptake where as, ICPV 21444 registered higher post harvest soil available nutrient status among the varieties tested. Plant geometry of 60 cm × 10 cm resulted in higher post harvest soil available nutrient status and 45 cm × 10 cm resulted in higher seed yield where as, plant geometry of 30 cm × 10 cm recorded higher nutrient uptake.

KEYWORDS: Nutrient uptake, Plant geometries, Redgram, seed yield and Ultra short duration varieties.

INTRODUCTION

Redgram (*Cajanus cajan L.*) also known as pigeonpea or arhar or tur is the second most important pulse crop after chickpea in India. It is a good source of protein (20-22 per cent), vitamins (thiamine, riboflavin, niacin and choline) and minerals such as iron, iodine, calcium, phosphorus, sulphur and potassium. In addition to its primary use as a dal, it's immature green seeds and pods are consumed as vegetable (Yadav *et al*., 2021). In India, redgram is cultivated in an area of 47.24 lakh hectares with a production of 43.16 lakh tonnes and a productivity of 914 kg ha^{-1}. Whereas, in Andhra Pradesh, it is grown under rainfed conditions in an area of 2.31 lakh hectares, with an annual production of 8.38 lakh tonnes and a productivity of 363 kg ha^{-1} during 2020-21 (*www.indiastat.com*, 2020-21). Under changing climate scenario, ultra short duration genotypes of redgram contribute to a greater harvest index. The advent of these ultra-short duration redgram varieties that matures in 100-110 days makes it possible to explore redgram cultivation during the off-season and non-traditional niches, with the goal of increasing the national pulse production pool. Ultra short duration varieties also display photo insensitivity, synchronous maturity, hardiness and adaptability to diverse cropping systems (Saxena *et al.,* 2019). However, there is a need to find out the suitable ultra-short duration redgram cultivar that fit in diverse cropping systems for enhanced productivity.

Choice of a suitable geometry for a particular genotype is one of the important factors among the different agronomic practices limiting the yield of redgram. Adaptation of proper planting geometry to a particular genotype will go a long way in making efficient use of limited growth resources and thus to stabilize yield. Ultra short duration varieties of redgram having determinate and indeterminate growth habits respond very well to crop geometry. Therefore, there is a need to identify the suitable crop geometry for ultra short duration redgram varieties for higher productivity.

MATERIAL AND METHODS

The present investigation was carried out at wetland farm, S.V. Agricultural College, Tirupati of Acharya N.G. Ranga Agricultural University which is geographically situated at 13.5°N latitude and 79.5°E longitude with an altitude of 182.9 m above mean sea level in the Southern Agro-Climatic Zone of Andhra Pradesh. The present experiment was laid out in a split-plot design and replicated thrice. The treatments include four varieties *viz.*, ICPV 21333 (V_1), ICPV 21444 (V_2), ICPV 21777 (V_3) and ICPV 21888 (V_4) as main plots and three plant geometries *viz.,* 30 cm × 10 cm, 45 cm × 10 cm and 60 cm × 10 cm as sub plots. Recommended dose of fertilizers (20:50:0 kg N, P_2O_5 and K_2O ha^{-1}), were applied as basal in the form of urea and single super phosphate.

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The experimental field was sandy clay loam in texture with low organic carbon (0.46%). The soil is neutral in reaction (pH 7.8), low in available N (215.9 kg ha^{-1}), medium in available phosphorus (31.2 kg ha^{-1}) and potassium (243.1 kg ha^{-1}). A total rainfall of 378.6 mm was received in 15 rainy days during the crop growing period. All the other recommended practices were adopted as per the recommendations.

RESULTS AND DISCUSSION

Data pertaining to the yield, N, P and K uptake by redgram and post-harvest available soil nutrient status at harvest as influenced by varieties and plant geometries is discussed in different sections.

Effect of varieties on yield, N, P and K uptake and post-harvest soil available nutrient status of redgram

The highest seed yield of redgram was recorded in ICPV 21333 (V_1). The next best variety was ICPV 21888 (V_4) which was significantly superior to that of ICPV 21777 (V_3) (Table 1.). Significantly lower seed yield was recorded in ICPV 21444 (V_2) (Table 1.). The differences in yield among the varieties could be attributed to their genetic potential to utilize and translocate photosynthates from source to sink. The superiority of the redgram variety ICPV 21333 (V_1) in terms of growth, yield attributes *i.e.,* number of pod bearing branches $plant^{-1}$, number of pods $plant^{-1}$ and number of seeds pod^{-1} have positively impacted on seed yield of redgram. Similar results were reported by Rajani *et al*. (2018), Deepika (2020), Shruthi (2020), Deva *et al*. (2021) Kumar *et al*. (2021) and Devi *et al.* (2022).

With regard to the varieties tested, significantly higher nutrient (nitrogen, phosphorus and potassium) uptake at harvest by redgram was recorded with the variety ICPV 21333 (V_1). This might be due to the elevated growth stature coupled with higher dry matter accumulation. Similar findings were reported by Devi

Table 1. Seed yield and nutrient uptake by redgram at harvest as influenced by varieties and plant geometries

Treatments	Seed yield (kg ha^{-1})	Nitrogen uptake (kg ha^{-1})	Phosphorus uptake (kg ha^{-1})	Potassium uptake (kg ha^{-1})
Main plots - Varieties (V)				
V1 : ICPV 21333	1079	85	20.0	79
V2 : ICPV 21444	760	61	14.4	56
V3 : ICPV 21777	853	68	16.0	63
V4 : ICPV 21888	969	74	17.6	69
SEm±	23.1	1.6	0.36	1.5
CD (P = 0.05)	80	6	1.3	5
Sub-plots - Plant Geometries (G)				
G1 : 30 cm × 10 cm	931	81	19.1	75
G2 : 45 cm × 10 cm	1031	73	17.3	68
G3 : 60 cm × 10 cm	784	62	14.7	58
SEm±	17.8	1.2	0.29	1.1
CD (P = 0.05)	53	4	0.9	3
Varieties (V) × Plant Geometries (G)				
G at V				
SEm±	35.6	2.31	0.57	2.15
CD (P = 0.05)	NS	NS	NS	NS
V at G				
SEm±	53.6	3.69	0.85	3.42
CD (P = 0.05)	NS	NS	NS	NS

Table 2. Post-harvest soil available N, P_2O_5 and K_2O as influenced by varieties and plant geometries in redgram

Treatments	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})
Main plots - Varieties (V)			
V1 : ICPV 21333	144	23.3	206
V2 : ICPV 21444	181	29.4	259
V3 : ICPV 21777	170	27.5	243
V4 : ICPV 21888	156	25.2	223
SEm±	3.0	0.49	4.2
CD (P = 0.05)	11	1.7	14
Sub-plots - Plant Geometries (G)			
G1 : 30 cm × 10 cm	151	24.5	216
G2 : 45 cm × 10 cm	161	26.0	230
G3 : 60 cm × 10 cm	176	28.6	252
SEm±	2.8	0.44	3.9
CD (P = 0.05)	8	1.3	12
Varieties (V) × Plant Geometries (G)			
G at V			
SEm±	5.49	0.89	7.78
CD (P = 0.05)	NS	NS	NS
V at G			
SEm±	7.60	1.23	10.61
CD (P = 0.05)	NS	NS	NS

(2022). The next best redgram variety was ICPV 21888 (V_4) which was significantly superior to that of ICPV 21777 (V_3) except for the nitrogen uptake where they were on par with each other. Significantly lower nutrient uptake by with ICPV 21444 (V_2).

Higher post-harvest soil available nitrogen, phosphorus and potassium were recorded with ICPV 21444 (V_2) followed by ICPV 21777 (V_3) and ICPV 21888 (V_4) in the order of descent with significant difference between each other except for the post harvest soil available nitrogen which was on par with that of ICPV 21777 (V_3). The variety ICPV 21333 (V_1) registered significantly lower soil available nitrogen, phosphorous and potassium. Higher growth parameters *viz.,* plant height, leaf area, maximum dry matter production and better root system with the redgram variety ICPV 21333 (V_1) might have led to better uptake of nutrients and increased nutrient use efficiency, which in turn reflected on lower soil nutrient status after harvest. These results are in conformity with that of Deva *et al*. (2021) and Devi (2022).

Efffect of plant geometries on yield, N, P and K uptake and post-harvest soil available nutrient status of redgram

Redgram with the plant geometry of 45 cm × 10 cm (G_2) resulted in significantly higher seed yield compared to 30 cm × 10 cm (G_1). Yield reduction at higher plant density is due to less number of pods plant^{-1} in the indeterminate plants (Reddy and Reddy, 2010). Higher seed yield with 45 cm × 10 cm (G_2) might be due to optimum plant population with better availability of growth resources to individual plants and their maximum utilization throughout the growth period compared to that of other plant geometries tried 30 cm × 10 cm (G_1) and 60 cm × 10 cm (G_3). This might have resulted in higher stature of yield attributes and hence the seed yield of redgram. These findings are in conformity with the observations of Abhishek *et al.* (2023), Ammaiyappan *et al.* (2021) and Sujathamma *et al*., (2022). Significantly lower seed yield of redgram was recorded with the plant geometry of 60 cm × 10 cm (G_3).

Among the plant geometries tested, 30 cm × 10 cm (G_1) resulted in significantly higher nutrient uptake. The next treatment was 45 cm × 10 cm (G_2) which was significantly superior to that of 60 cm × 10 cm (G_3). Higher nutrient uptake at 30 cm × 10 cm (G_1) geometry might be due to higher plant population unit area^{-1} coupled with removal of higher amount of nutrients from the soil. These results were in accordance with the findings of Sangeetha *et al*. (2011) and Venkanna *et al*. (2013). Higher post harvest soil available nitrogen, phosphorus and potassium were recorded with redgram at a plant geometry of 60 cm × 10 cm (G_3) which was significantly superior to the rest of the plant geometries tested. This might be due to maintenance of lesser plant population unit area^{-1} which have reduced the uptake of nutrients and increased the post harvest soil available nitrogen, phosphorus and potassium. The next best spacing that recorded higher post harvest soil nutrient status was 45 cm × 10 cm (G_2). Redgram with the plant geometry of 30 cm × 10 cm (G_1) recorded significantly lower post harvest soil available nitrogen, phosphorus and potassium. These results are in accordance with the findings of Prathibha (2017) and Dathamma (2023).

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