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YIELD MAXIMIZATION WITH NUTRIENT MANAGEMENT AND NURSERY PRACTICES ON TRANSPLANTED RED GRAM (*Cajanus cajan* (L) MILLSP.)

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Abstract

Field experiment was carried out at a farmer field in Velanjeri village of Thiruvallur District, Tamil Nadu during, to study the influence of different nursery techniques and nutrient management practices on transplanted red gram. The experiment was laid out in split plot design and replicated thrice. The different nursery techniques *viz,* polythene bag (M_1), pro-tray (M_2) and leaf cup (M_3) were assigned to main plot. Seven nutrient management practices *viz,* control (S_1), 100 per cent recommended dose of fertilizer (S_2), 100 per cent RDF + 2 per cent DAP foliar spray (S_3), 100 per cent RDF + 0.25 per cent humic acid foliar spray (S_4), 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} (S_5), 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 2 per cent DAP foliar spray (S_6), 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 0.25 per cent humic acid foliar spray (S_7) were assigned to sub plot. Red gram variety Co (Rg) 7 was used. Growth components *viz*., plant height, LAI, DMP, CGR and number of branches plant^{-1} and yield components *viz.,* number of pods plant^{-1}, number of seeds pod^{-1}, seed and stalk yield were recorded. Among the main treatments, polythene bag nursery (M_1) recorded higher values of growth parameters, yield components and yield and in the sub treatments, application of 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 0.25 per cent humic acid foliar spray (S_7) recorded higher values of growth parameters, yield components and yield of red gram.

Key words: Nursery practices, nutrient management, polythene bag, protray, leaf cup, red gram.

Introduction

Red gram (*Pigeon pea*) is an important pulse crop in India. It is also known as Arhar and Tur. Red gram is mainly cultivated and consumed in developing countries of the world. India occupies 90 per cent of the world red gram area and accounts for 80 per cent of the world production. However, India leads in red gram production and acreage, its productivity is 733.4 kg ha^{-1} which is lower than the global productivity of 829.9 kg ha^{-1} (FAOSTAT, 2016). In Tamil nadu, red gram is cultivated in 37,769 ha with the production of 20,400 tonnes with a productivity of 540 kg ha^{-1} which is lower than the national productivity (Anil Kumar *et al.,* 2012).

Red gram is recognized as a valuable source of protein which has diversified uses as food, fodder and fuel (Ramanjit Kaur *et al.,* 2015). Yield of red gram is greatly influenced by a number of agronomic practices but timely sowing of seeds with onset of monsoon is most important aspect which decides the final seed yield. In order to ensure timely sowing due to late onset of monsoon, transplanting of red gram seedlings will be one of the technique to overcome delayed sowing and also increased average yield (Jamadar *et al.,* 2014). Among several constraints, improper nutrient management is a very important aspect. Red gram requires higher amount of phosphorus for optimum production. Most of the phosphatic fertilizers are being imported and their application in adequate amount is restricted and these are insoluble in nature (Meena *et al.,* 2012).

Phosphobacteria plays an important role in improving the chemical and physical nature of the soil, adding organic matter to the soil, solubilizing the insoluble

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phosphates, increasing the availability and utilization of vital nutrients, secreting growth accelerating substances and reducing the input cost with accelerated total crop production. Foliar spray techniques helps the nutrients to reach the site of food synthesis directly, leading to no wastage and quick supply of food materials and thereby reduce the requirement of fertilizers (Dass and Jana, 2015).

Humic substances have a very strong influence on the growth of plant roots. When humic acids are applied on the soil, enhancement of plant growth initiation and increased root growth was observed (Pettit, 2004). Application of humic substances along with inorganic fertilizers and/or organic manures plays a greater role in plant bio-chemical, physical activities and soil fertility consequently resulting in better growth and yield of crops. Based on the above aspects, the present study was formulated on red gram.

Materials and methods

Field experiment was carried out at a farmer field in Velanjeri village of Thiruvallur District, Tamil Nadu. The experimental field is geographically situated at 13^0 11' N latitude and 79^0 38' E longitude at an altitude of 76 m above mean sea level. The mean annual rainfall is 1152.8 mm, which is distributed during North-East monsoon (604.1mm), South – West monsoon (449.5 mm), summer (65.7 mm) and winter (33.5 mm). The mean maximum and minimum temperature are 37.9^0C and 18.5^0C with a mean of 28.2^0C. The soil of the experimental field was sandy loam in texture with low in available N, high in available P and high in available K. Red gram variety Co (Rg) 7 was used as the test variety for the study.

The experiment was laid out in split plot design and replicated thrice. The different nursery techniques *viz,* polythene bag (M_1), pro-tray (M_2) and leaf cup (M_3) were assigned to main plot. Seven nutrient management practices *viz,* control (S_1), 100 per cent recommended dose of fertilizer (S_2), 100 per cent RDF + 2 per cent DAP foliar spray (S_3), 100 per cent RDF + 0.25 per cent humic acid foliar spray (S_4), 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} (S_5), 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 2 per cent DAP foliar spray (S_6), 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 0.25 per cent humic acid foliar spray (S_7) were assigned to sub plot.

Biometric observations in growth parameters like plant height, LAI, DMP, CGR and number of branches $plant^{-1}$ and yield components *viz.,* number of pods $plant^{-1}$, number of seeds pod^{-1}, seed and stalk yield were recorded. The experimental data were statistically analysed as per the procedure to find out the treatment difference. The critical difference was worked out at five per cent probability level for significant results.

Results and discussion

Growth components

Nursery management practices recorded significant variations in growth parameters of redgram (table. 1). Among the different nursery techniques in the main plot, polythene bag nursery (M_1) recorded higher values of plant height (153.71 cm), LAI at flowering stage (2.83), dry matter production (4788.6 kg ha^{-1}), crop growth rate (4.75 g m^{-2} day^{-1}) at 60 – 90 DAS and number of branches $plant^{-1}$ (20.09). Protray and leaf cup recorded lesser growth characters of red gram due to low volume of soil than polythene bag. Polythene bag seedlings have better root growth and capacity to withstand transplanting shock and require less time for establishing as compared to portray and leaf cup. Similar report was recorded by Jamadar *et al.* (2014).

Table 1: Growth parameters of red gram as influenced by nursery practices and nutrient management and in red gram

Treatments	Plant height at harvest (cm)	LAI at flowering stage	DMP at harvest (kg ha^{-1})	CGR At 60-90 DAS (g m^{-2} day^{-1})	No. of branches $plant^{-1}$
Main plot					
M1	153.71	2.83	4788.6	4.96	20.09
M2	147.27	2.70	4587.9	4.75	19.25
M3	150.20	2.76	4679.3	4.84	19.64
S.Ed	1.02	0.02	32.21	0.02	0.11
CD (p=0.05)	2.85	0.06	89.42	0.08	0.32
Subplot					
S_1	113.00	2.08	3520.6	3.64	14.77
S_2	137.28	2.53	4276.6	4.43	16.98
S_3	150.88	2.78	4700.5	4.87	19.72
S_4	155.22	2.86	4835.0	5.01	20.29
S_5	138.84	2.55	4325.2	4.48	18.15
S_6	171.90	3.16	5355.2	5.55	22.47
S_7	185.64	3.42	5783.1	5.99	24.27
S.Ed	2.78	0.11	87.65	0.06	0.50
CD (p=0.05)	5.64	0.23	189.68	0.14	1.03

Main plot: M_1 - polythene bag, M_2 - pro-tray, M_3 - leaf cup nursery
Subplot: , S_1 - control, S_2 - 100 percent recommended dose of fertilizer, S_3 - 100 per cent RDF + 2 per cent DAP foliar spray,), S_4 - 100 per cent RDF + 0.25 per cent humic acid foliar spray, S_5 - 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1}, S_6 - 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 2 per cent DAP foliar spray, S_7 - 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 0.25 per cent humic acid foliar spray

Table 2: Yield parameters of red gram as influenced by nursery practices and nutrient management and in red gram

Treatments	No. of pods plant^{-1}	No. of seeds pod^{-1}	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})
Main plot				
M1	130.06	4.53	1182.5	3422.7
M2	124.60	3.62	1132.8	3289.0
M3	127.09	3.77	1155.4	3349.9
S.Ed	0.84	0.02	7.31	21.09
CD (p=0.05)	2.34	0.06	20.30	58.42
Subplot				
S_1	95.62	2.77	869.3	2561.8
S_2	116.16	3.37	1056.0	3078.6
S_3	127.67	3.70	1160.0	3374.4
S_4	131.34	3.81	1194.0	3455.6
S_5	117.48	3.41	1068.0	3109.6
S_6	145.45	4.22	1322.3	3803.6
S_7	157.08	4.56	1428.0	4093.5
S.Ed	2.54	0.08	14.99	45.45
CD (p=0.05)	5.16	0.18	30.42	92.13

Main plot: M_1 - polythene bag, M_2 - pro-tray, M_3 - leaf cup nursery

Subplot: S_1 - control, S_2 - 100 percent recommended dose of fertilizer, S_3 - 100 per cent RDF + 2 per cent DAP foliar spray,), S_4 - 100 per cent RDF + 0.25 per cent humic acid foliar spray, S_5 - 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} S_6 - 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 2 per cent DAP foliar spray, S_7 - 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 0.25 per cent humic acid foliar spray

Among the different nutrient management practices in the subplot, application of 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 0.25 per cent humic acid foliar spray (S7) was significantly superior over the other treatments and recorded higher plant height (185.64 cm), LAI at flowering stage (3.42), dry matter production (5783.1 kg ha^{-1}), crop growth rate of 5.99 g m^{-2} day^{-1} during 60-90 DAS and number of branches plant^{-1} (24.27). Inoculation with phosphobacteria might have resulted in higher phosphorus availability and consequent increase in growth and dry matter production and also mediated by biological process. Humic acid contains lower molecular fraction easily reach the plasma of plant cells, determining a positive effect on plant growth and enhance the uptake of nutrients. These results are in accordance with the findings of Lingaraju *et al.* (2016). Increase in number of branches may be due to more extensive root system and better translocation of macro and micro nutrients. This is in agreement with the findings of Rajesh *et al.* (2015).

Yield attributes and Yield

Nursery management practices registered significant variations in yield parameters and yield (table. 2). Among the different nursery techniques in the main plot, polythene bag nursery (M_1) recorded higher number of pods plant^{-1} (130.06), number of seeds pod^{-1} (4.53), seed yield (1182.5 kg ha^{-1}) and stalk yield (3422.7 kg ha^{-1}). Polythene bag raised seedlings influenced better yield components and yield due to increased root growth and supplying nutrients to plants at reproductive stage led to increase the pod setting and reduce the flower drop of red gram. The present results are in line with the findings of Praharaj *et al*. (2015).

The nutrient management practices also produced significant variation in the number of pods plant^{-1}, number of seeds pod^{-1}, seed yield and stalk yield. Among the nutrient management practices in the subplot, application of 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1}+0.25 per cent humic acid foliar spray (S_7) registered higher number of pods plant^{-1} (157.08), number of seeds pod^{-1} (4.56), higher seed yield (1428 kg ha^{-1}) and stalk yield (4093.5 kg ha^{-1}). Recommended dose of fertilizer along with bioinoculants and humic acid foliar spray influenced biomass yield due to stimulation in the metabolism of macro and micronutrients, activation of enzyme changes in the membrane permeability and protein synthesis. These findings are in line with the findings of Mohanraj *et al*. (2016)

Conclusion

Based on the result of the experiment it was concluded that the nursery practice with polythene bag and application of 100 per cent RDF + phosphobacteria soil application @ 2 kg ha^{-1} + 0.25 per cent humic acid foliar spray were found to be most efficient and economic method for increasing the seed yield of red gram.

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