Influenceof organic nutrientmanagement on growth andphysiological parameters of redgram (*Cajanus cajan*L.)

ABSTRACT

To determine the "Effect of organic nutrient management in growth and yield of redgram (*Cajanus cajan* L.). Executed during rabi season 2022 - 2023 at North farm, Karunya Institute of Technology and Sciences, Coimbatore.T_1 (100% N equivalent based FYM @ 5 t ha^{-1}), T_2 (100% N equivalent based vermicompost @ 0.8 t ha^{-1}), T_3 (100% N equivalent based goat manure @ 0.8 t ha^{-1}), T_4 (50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1}), T_5 (50% N equivalent based FYM @ 2.5 t ha-1 + 50% N equivalent based goat manure @ 0.416 t ha^{-1}), T_6 (50% N equivalent based vermicompost @ 0.416 t ha^{-1} + 50% N equivalent based goat manure @ 0.416 t ha^{-1}), T_7 (75% N equivalent based FYM @ 3.15 t ha^{-1} + 25% N equivalent based vermicompost @ 0.208 t ha^{-1}), T_8 (75% N equivalent based vermicompost @ 0.625 t ha^{-1} + 25% N equivalent based goat manure @ 0.208 t ha^{-1}), T_9 (75% N equivalent based FYM @ 3.15 t ha^{-1} + 25% N equivalent based goat manure @ 0.208 t ha^{-1}), T_{10} (100% RDF+ FYM @ 12.5 t ha^{-1}), (T_{11}) Control. The maximum plant height, number of root $plant^{-1}$, dry matter production, LAI, CGR, RGR, NAR were found higher in 50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1}(T_4)and 100% RDF + FYM @ 12.5 t ha^{-1} (T_{10})and which was followed by 100 % N equivalent based FYM @ 5 t ha^{-1} (T_1) compared to (T_{11}) control. From the result recorded it is concluded the 50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1} increases the crop growth and yield of redgram.

Keywords: FYM, growth, nutrient supply,organic manures,vermicompost.

1. INTRODUCTION

Redgram (*Cajanus cajan. L*), a leguminous plant also called as "arhar" or "tur," which is cultivated in a wide range of agroclimatic areas especially in tropical and subtropical countries. In India, redgram is cultivated in marginal lands under rainfed conditions with poor resources. Redgram contains essential amino-acids like methionine and lysine. Redgram possesses nitrogen-fixing bacterium called rhizobium, which releases growth-promoting chemicals including indole acetic acid (IAA), gibberellins and cytokinin, that aids in growing root biomass. Redgram also improves soil conditions by fixing atmospheric nitrogen. Redgram are a nutritious food for people because they are high in proteins, amino acids, iron, magnesium, phosphorus, as well as vitamins like riboflavin, folacin, and niacin. A variety of redgram products are available including dried seeds, immature seeds and pods that are eaten as green vegetables, and leaves and stems that are used as fodder.

In India, the area under cultivation of redgram is 47.17 lakh ha with the total production and productivity of 41.37 lakh tonnes and 877 kg ha^{-1} (Anonymous., 2020) [1]. The redgram production of the country is about 96%, which is contributed by the following states Maharashtra, Karnataka, Madhya Pradesh, Uttar Pradesh, Gujarat, Telangana, Jharkhand, Odisha and Andhra Pradesh. The cultivation scenario of redgram in Tamil Nadu is about the area of 0.47 lakh ha^{-1} with the total production and productivity of 0.50 lakh tonnes and 1049 kg ha^{-1} (Anonymous., 2020) [1].

There are some factors like non-availability of quality seeds of improved and short duration varieties, growing of pulses under marginal and sub marginal soils with less inputs under rainfed conditions, moisture stress, pest and disease infestations, non-scientific post harvest practices and storage conditions are the major cause for the minimized yields of pulses in India. Hence, there is a chance to improve the pulses productivity by increasing the soil fertility and its productivity through improving soil organic carbon, soil moisture storage capacity and adopting organic nutrient and pest management practices (Yadav *et al*., 2019) [2]. The crop productivity under organic production system of the crops can be increased by optimization of nutrients at different crop stages (Naik *et al*., 2014) [3].

The green revolution increased the use of fertilizers to the next level, which in turn causes high risk on environmental impact and increase the demand of food production. To overcome the demand organic agriculture plays an important role with organic amendments that can retain soil moisture, increases soil infiltration and improves crop growth and yield. The usage of organic manure has sparked the interest due the negative impact on chemical fertilizers. Organic farming is a growing alternative agricultural practice for maintaining economically sustainable crop production with less environmental impact. It uses organic soil amendments as nutrient inputs. Since, organic manures are the storehouse of all essential nutrients besides providing substrate for other bio-inoculants (Choudhary and Suri, 2018) [4]. Under these organic sources and their management have shown good results not only in sustaining the productivity but also proved effective in maintaining soil health and enhancing nutrient use efficiency (Kumar *et al*., 2014) [5]. In organic farming the availability of appropriate organic nutrient sources is a challenge therefore, there should be a promotion for the use of organic inputs in the farm itself which can be achieved using various nutrient sources that provides different nutrient release pattern and efficiency. With this consideration the experiment was carried out to study the effect of different organic manures and optimum condition of organic manures in redgram.

2. MATERIALS AND METHOD

The field experiment was conducted during *rabi* season 2023 - 2024 at North farm, Karunya Institute of Technology and Sciences, Coimbatore. The soil of the experimental field was silt clay loam in texture, pH (8.42), EC(0.52 ds m^{-1}), level of organic carbon (1.78 %), available N (305.2 kg ha^{-1}), available P (167.9 kg ha^{-1}), available K (42.56 kg ha^{-1}). The experimental was laid out in randomized complete block design with three replication and 11 treatments which includes, T_1 (100% N equivalent based FYM @ 5 t ha^{-1}), T_2 (100% N equivalent based vermicompost @ 0.8 t ha^{-1}), T_3 (100% N equivalent based goat manure @ 0.8 t ha^{-1}), T_4 (50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1}), T_5 (50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based goat manure @0.416 t ha^{-1}), T_6 (50% N equivalent based vermicompost @ 0.416 t ha^{-1} + 50% N equivalent based goat manure @ 0.416 t ha^{-1}), T_7 (75% N equivalent based FYM @ 3.15 t ha^{-1} + 25% N equivalent based vermicompost @ 0.208 t ha^{-1}), T_8 (75% N equivalent based vermicompost @ 0.625 t ha^{-1} + 25% N equivalent based goat manure @ 0.208 t ha^{-1}), T_9 (75% N equivalent based FYM @ 3.15 t ha^{-1} + 25% N equivalent based goat manure @ 0.208 t ha^{-1}), T_{10} (100% RDF+ FYM @ 12.5 t ha^{-1}), T_{11} (Control).Redgram APK1 variety with short duration of 90-105 days was used as the test variety that was sown with the spacing of 45 cm x 20 cm. Organic manure was applied to the field as per the treatment schedule. The data obtained in the study was analyzed using AGRES at 5% level of significance suggested by Gomez and Gomez [6].

3. RESULTS AND DISCUSSION

3.1 Plant height

The analysis of data revealed (table 1) that pattern of plant height at 30 DAS, the effect of organic nutrient management on plant height were non significant. Among the treatments, 50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1} (T_4) recorded higher plant height at 60 DAS and at harvest (90.41 cm, 128.41 cmrespectively) and which was on par with 100% RDF + FYM 12.5 t ha^{-1} (T_{10})(87.53 cm, 127.96 cm respectively). It was followed by 100% n equivalent based vermicompost @ 0.8 t ha^{-1} (T_2), whereas significantly lower plant height was recorded with control (T_{11}) (48.65 cm, 85.66 cm respectively. The increase in the plant height is due to the application of FYM and vermicompost helped the plants to attain the maximum height to the slow release of essential nutrient for the growth and development of plant. Similar findings were observed by Patil *et al.* (2012) [7] and Singh *et al.* (2022) [8].

3.2. Root nodules plant^{-1}

With the application of different organic manure at 60 DAS, number root nodules plant^{-1}recorded was non significant (table1). Among the different organic manures 50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1} (T_4) (20.90, 10.90 respectively) and 100 % RDF + FYM @ 12.5 t ha^{-1} (T_{10}) (20.10, 10.43 respectively) recorded higher root nodules plant^{-1}at 90 DAS followed by 100% N equivalent based vermicompost@0.8 t ha^{-1} (T_2). Lower number of root nodules plant was observed in control (T_{11}) (15.01, 5.01 respectively). Root development helps in better root nodulation with application of FYM and vermicompost. The greater photosynthesis production of metabolism and enzymatic activities due to FYM and vermicompost application has influenced the nodulation due to the availability of phosphorus through organic sources helped in higher root growth which increases nodulation. This result was confirmed by Singh *et al.* (2017) [9], Ullasa *et al.* (2018) [10].

3.3. Dry matter production

Dry matter production on 30 DAS, 60 DAS and at harvest was given in (table 2) and fig 1. The dry matter production on 30 DAS higher dry matter production was recorded in 50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1} (T_4) (460kg ha^{-1}, 3053kg ha^{-1}, 3591kg ha^{-1}) and 100% RDF + FYM 12.5 t ha^{-1} (T_{10}) (448 kg ha^{-1}, 3000 kg ha^{-1}, 3501 kg ha^{-1}) and it was followed by 100% N equivalent based vermicompost @ 0.8 t ha^{-1} (T_2) which is lower when compared to control (T_{11}) (283 kg ha^{-1}, 1406 kg ha^{-1}, 1501 kg ha^{-1}).The application of vermicompost stimulated growth due to higher microbial activity and soil reaction; additionally, a large portion of nitrogen in vermicompost's organic fraction and fermented solutions of FYM contain various salts rich in micronutrients in a form that is available to plants, which is likely to be the reason for the higher dry matter production. Hence the availability of these nutrients to the plants helps in higher dry matter production. The findings from this study were supported by Verma *et al.* (2014) [11], Shrimal and khan (2017) [12].

3.4. Leaf area index

The impact of organic manures on leaf area index at 60 DAS and at harvest (table 2). The higher LAI was observed with the application of 50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1} (T_4) (3.50, 2.86 respectively) and 100% RDF + FYM 12.5 t ha^{-1} (T_{10}) (3.24, 2.71 respectively). It was Followedby100% N equivalent based vermicompost @ 0.8 t ha^{-1} (T_2). Comparatively lower LAI on was found in control (T_{11})recorded (2, 2.09 respectively). Major activities including light interception, evapotranspiration and photosynthesis are directly associated with leaf area index. Leaf surfaces are the primary source of energy of mass exchange. Among the different organic manure, the higher LAI was found with 50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1} (T_4) and which was found to be statistically on par with 100% RDF + FYM 12.5 t ha^{-1} (T_{10}) and which was followed by 100 % N equivalent based vermicompost @ 0.8 t ha^{-1} (T_2) at both 30 DAS, 60DAS and at harvest. The similar report was confirmed with the results reported by Yadav *et al*. (2019) [2].

3.5. Crop growth rate

Application of various organic manures (table 3) higher CGR was found that 50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 (T_4) at 30 DAS – 60 DAS and 60 DAS – at harvest (7.78 $g^{-1}m^{-2}day^{-1}$, 2.45 $g^{-1}m^{2}day^{-1}$ respectively) and which was at par 100% RDF + FYM 12.5 t ha^{-1} (T_{10}) (7.66 $g^{-1}m^{-2}day^{-1}$, 2.25 $g^{-1}m^{-2}day^{-1}$ respectively). Followed by 100% N equivalent based vermicompost @ 0.8 t ha^{-1} (T_2) comparatively lower CGR was recorded in control (T_{11}) (3.37 $g^{-1}m^{-2}day^{-1}$, 0.43 $g^{-1}m^{-2}day^{-1}$). Followed by 100% N equivalent based vermicompost @ 0.8 t ha^{-1} (T_2)

comparatively lower CGR was recorded in control (T_{11}) (3.37 $g^{-1}m^{-2}day^{-1}$, 0.43 $g^{-1}m^{-2}day^{-1}$).Maximum CGR was recorded with the application of vermicompost can be attributed to the direct relationship between CGR and LAI and the amount of solar energy received. The findings were confirmed with the result of Zalaghi*et al.* (2019) [14].

3.6. Relative growth rate

Influence of differentorganic manures at 30 -60 DAS and 60 DAS- At harvest was shown in (table 3), the higher RGR was found with the application of 50% N equivalent based FYM + 50% N equivalent basedvermicompost (T_4) (70.7$g^{-1}g^{-1}day^{-1}$ and 6.28 $g^{-1}g^{-1}day^{-1}$) and that was identical with 100% RDF + FYM 12.5 t ha^{-1} (T_{10}) (70 $g^{-1}g^{-1}day^{-1}$, 5.56 $g^{-1}g^{-1}day^{-1}$ respectively) and the following treatment was 100% N equivalent basedvermicompost @ 0.8 t ha^{-1}. Substantially lower RGR was recorded in control (T_{11}) (53.5 $g^{-1}g^{-1}day^{-1}$ and 1.55 $g^{-1}g^{-1}day^{-1}$). The greater amount of carbon from the organic manures supplied to promote development of shoot and roots. It promotes the efficient utilization of sunlight and nutrients enabling the additional biomass accumulation. The positive influence of farm yard manure and vermicompost on nutrient availability and soil health had resulted in higher RGR were attained through organic manure Kumar *et al.* (2023) [15].

3.7. Net assimilation rate

The implication of different organic manures on NAR between 30-60 DAS and 60-At harvest in redgram was recorded (table 3). The higher NAR was found in 50% N equivalent based FYM + 50% N equivalent based vermicompost (T_4) (18.09 $g^{-1}m^{-2}day^{-1}$, 5.16 $g^{-1}m^{-2}day^{-1}$) that was on par with 100% RDF + FYM 12.5 t ha^{-1} (T_{10}) (17.63 $g^{-1}m^{-2}day^{-1}$, 5.09 $g^{-1}m^{-2}day^{-1}$)followed by 100% N equivalent basedvermicompost @ 0.8 t ha^{-1} (T_2). Comparatively control (T_{11}) has a lower NAR recorded (3.21 $g^{-1}m^{-2}day^{-1}$, 3.13 $g^{-1}m^{-2}day^{-1}$). This is based on the inverse relationship between LAI and NAR in increasing LAI leads to decreasing NAR. The reason can be considered as the age and size of the plant increases with increase in the competition of food. The similar results were observed by Zalaghi*et al.* (2019) [14].

	Plant height (cm)	Number of root nodules plant^{-1}

Table1. Effect of organic nutrient management on plant height and number root nodules in redgram

	Treatments	DMP (kg ha^{-1})			LAI		
		30 DAS	60 DAS	At Harvest	60 DAS	90 DAS	At Harvest
T_1	100% N equivalent based FYM @ 5 t ha^{-1}	24.01	72.39	108.07	28.11	17.20	7.20
T_2	100% N equivalent based vermicompost @ 0.8 t ha^{-1}	24.40	75.60	109.21	28.35	17.50	7.50
T_3	100% N equivalent based goat manure @ 0.8 t ha^{-1}	22.79	61.59	86.60	26.91	15.10	5.10
T_4	50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1}	25.12	90.41	128.41	30.92	20.90	10.90
T_5	50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based goat manure @ 0.416 t ha^{-1}	23.34	62.42	87.75	26.84	15.20	5.20
T_6	50% N equivalent based vermicompost @ 0.416 t ha^{-1} + 50% N equivalent based goat manure @ 0.416 t ha^{-1}	23.30	64.23	98.07	27.08	16.20	6.20
T_7	75% N equivalent based FYM @ 3.15 t ha^{-1} + 25% N equivalent based vermicompost @ 0.208 t ha^{-1}	24.86	74.63	109.30	28.29	17.30	7.30
T_8	75% N equivalent based vermicompost @ 0.625 t ha^{-1} + 25% N equivalent based goat manure @ 0.208 t ha^{-1}	23.50	65.06	100.07	27.09	16.40	6.40
T_9	75% N equivalent based FYM @ 3.15 t ha^{-1}+ 25% N equivalent based goat manure@ 0.208 t ha^{-1}	23.67	63.13	93.13	26.95	15.40	5.40
T_{10}	100% RDF+ FYM @ 12.5 t ha^{-1}	25.08	87.53	127.96	29.88	20.10	10.43
T_{11}	Control	22.67	48.65	85.66	25.97	15.01	5.01
Mean		23.88	69.60	103.11	27.85	16.94	6.97
SE(d)		1.59	5.92	8.92	2.75	1.70	0.63
CD (p= 0.05)		NS	12.31	18.61	NS	3.54	1.32

Table 2. Effect of organic nutrient management on dry matter production and leaf area index in redgram

	Treatments	30 DAS	60 DAS	At Harvest	30 DAS	60 DAS	At Harvest
T_1	100% N equivalent based FYM @ 5 t ha^{-1}	429	2031	2438	0.12	2.70	2.23
T_2	100% N equivalent based vermicompost @ 0.8 t ha^{-1}	442	2258	2670	0.12	2.78	2.54
T_3	100% N equivalent based goat manure @ 0.8 t ha^{-1}	311	1430	1584	0.11	2.10	2.14
T_4	50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1}	461	3054	3592	0.13	3.50	2.86
T_5	50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based goat manure @ 0.416 t ha^{-1}	359	1556	1710	0.11	2.20	2.24
T_6	50% N equivalent based vermicompost @ 0.416 t ha^{-1} + 50% N equivalent based goat manure @ 0.416 t ha^{-1}	370	1862	2053	0.11	2.30	2.28
T_7	75% N equivalent based FYM @ 3.15 t ha^{-1} + 25% N equivalent based vermicompost @ 0.208 t ha^{-1}	435	2131	2541	0.12	2.67	2.48
T_8	75% N equivalent based vermicompost @ 0.625 t ha^{-1} + 25% N equivalent based goat manure @ 0.208 t ha^{-1}	399	1977	2177	0.11	2.50	2.31
T_9	75% N equivalent based FYM @ 3.15 t ha^{-1}+ 25% N equivalent based goat manure@ 0.208 t ha^{-1}	362	1696	1860	0.11	2.30	2.27
T_{10}	100% RDF+ FYM @ 12.5 t ha^{-1}	449	3001	3501	0.13	3.24	2.71
T_{11}	Control	283	1407	1501	0.10	2.00	2.09
Mean		391	2037	2330	0.12	2.57	2.38
SE(d)		39	157	197	0.01	0.23	0.21
CD (p= 0.05)		82	327	410	NS	0.49	0.44

		CGR ($g^{1}m^{2}day^{-1}$)		**RGR ($g^{-1}g^{-1}day^{-1}$)**		**NAR ($g^{-1}g^{-1}day^{-1}$)**	
	Treatments	**30-60 DAS**	**60- At Harvest**	**30-60 DAS**	**60- At Harvest**	**30-60 DAS**	**60- At Harvest**
T_1	100% N equivalent based FYM @ 5 t ha^{-1}	4.80	1.83	51.8	4.06	9.94	2.14

T_2	100% N equivalent based vermicompost @ 0.8 t ha^{-1}	5.45	1.85	54.4	4.72	15.99	5.40
T_3	100% N equivalent based goat manure @ 0.8 t ha^{-1}	3.36	0.69	50.9	2.27	1.61	1.58
T_4	50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1}	7.78	2.45	70.7	6.28	18.09	5.16
T_5	50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based goat manure @ 0.416 t ha^{-1}	3.59	0.69	48.9	2.10	3.94	1.05
T_6	50% N equivalent based vermicompost @ 0.416 t ha^{-1} + 50% N equivalent based goat manure @ 0.416 t ha^{-1}	4.48	0.86	53.9	2.17	6.69	1.05
T_7	75% N equivalent based FYM @ 3.15 t ha^{-1} + 25% N equivalent based vermicompost @ 0.208 t ha^{-1}	5.09	1.85	53.0	4.19	12.39	2.41
T_8	75% N equivalent based vermicompost @ 0.625 t ha^{-1} + 25% N equivalent based goat manure @ 0.208 t ha^{-1}	4.73	0.90	53.3	2.14	6.99	1.19
T_9	75% N equivalent based FYM @ 3.15 t ha^{-1}+ 25% N equivalent based goat manure@ 0.208 t ha^{-1}	4.00	0.74	51.5	2.05	2.85	1.70
T_{10}	100% RDF+ FYM @ 12.5 t ha^{-1}	7.66	2.25	70.0	5.56	17.63	5.09
T_{11}	Control	3.37	0.43	53.4	1.55	3.21	3.13
Mean		4.94	1.32	55.5	3.37	9.03	2.72
SE(d)		0.53	0.14	4.7	0.36	1.16	0.29
CD (p= 0.05)		1.10	0.29	9.9	0.75	2.41	0.61

Table3. Effect of organic nutrient management on crop growth rate, relative growth rate and net assimilation rate in redgram

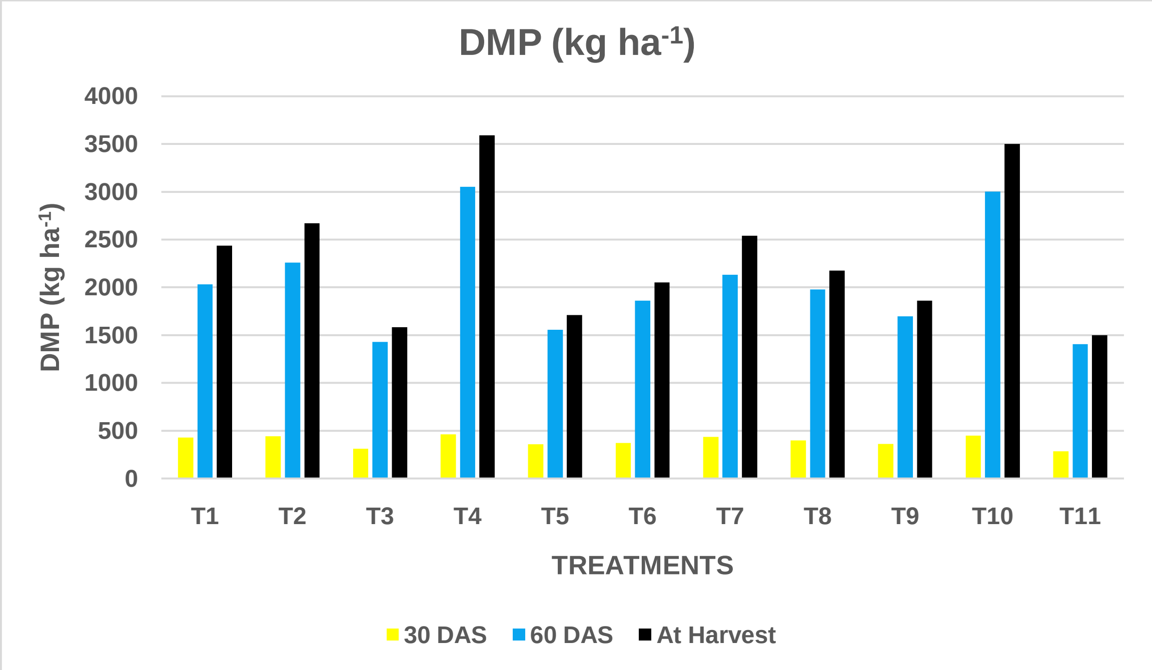

Fig 1. Effect of organic nutrient management on dry matter production in redgram

4. CONCLUSION

Based on the findings, it has been found that organic nutrient management with 50% N equivalent based FYM @ 2.5 t ha^{-1} + 50% N equivalent based vermicompost @ 0.416 t ha^{-1}. Redgram increased productivity and profitability are attributed to higher plant height, number of root nodules $plant^{-1}$, dry matter production, LAI, CGR, RGR and NAR. Farmers can develop an efficient organic nutrient management strategy for redgram in the designated area with the support of the experimental trail on organic nutrient management tactics in the field, which identifies the most prevalent results.

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