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Effect of Land Configurations and Intercropping on Plant Height and Biomass Accumulation of Redgram under Rainfed Ecosystem

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ABSTRACT

The field experiment was conducted during September, 2017 to March, 2018 in Agricultural Research Station, Virinjipuram, Tamil Nadu Agricultural University with different land configurations under rainfed ecosystem to understand the redgram growth and yield response. The experiment was laid out in split plot design with three main factors as land configurations L_1 - Compartmental bunding, L_2 - Broad Bed Furrow and L_3 - Ridges and furrow and seven sub factors as S_1- Redgram + Blackgram (4:5), S_2 - Redgram + Greengram (4:5), S_3 - Redgram + Cowpea (4:5), S_4 - Redgram + Groundnut (4:5), S_5 - Redgram + Sesame (4:5), S_6 - Redgram + Cotton (4:4) and S_7 - Redgram sole cropping and were replicated thrice. The higher redgram plant height (192 cm), leaf area index (3.24), dry matter production (1760 kg/ha) and redgram grain yield (668 kg/ha) was recorded with the (L_3) ridges and furrow method of sowing. Among the intercropping system, higher redgram plant height (179 cm) and dry matter production (1718 kg/ha) was recorded in redgram + blackgram intercropping system. The lowest redgram plant height, leaf area index, dry matter production and redgram grain yield was recorded in redgram + cotton (S_6) intercropping system.

Keywords

Land configuration, Intercropping, Compartmental Bunding, Ridges, furrow and broad bed furrow

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Introduction

Intercropping is one of the best agronomical options to minimize risk and it will be act as insurance against main crop failure in the vast rainfed tracts in the country (Sankaranarayanan *et al.*, 2010), it lead to farmers profit and subsistence oriented, energy-efficient and sustainable venture (Faroda *et al.*, 2007). The main concept of intercropping is to get increased total productivity per unit area and time, besides equitable and judicious utilization of land resources and farming inputs including labor. A careful selection of crops can reduce the mutual competition for moisture and nutrients to a considerable extent, i.e., by including fast growing early maturing crop with a slow growing, late maturing one. Redgram is a late maturing, tall growing and wide spaced crop with deep root system, which makes it suitable for intercropping. Besides, the growth of redgram is very slow in the early stage, during which time the more rapidly growing short duration and short statured crops like greengram and also taller crops like pearlmillet and sesamum can be conveniently intercropped to utilize the natural resources most efficiently in the early stages of pigeonpea.

Several studies already conducted with redgram based intercropping as one row or two rows of redgram with more number of intercrop rows, but, there is no systematic work on intercropping with increased number of redgram rows (>2) in replacement series and its effect on redgram plant height and biomass production in rainfed condition. Rainfed areas production completely depends on natural precipitation and the problem is low moisture in the root zone during the dry season (Hulihall and Patil, 2006), which leads to reduction of productivity by 35 to 40 percentage lesser than irrigated farming. To conserve the soil moisture, land configurations such as broad bed furrow, compartment bunding, set furrow cultivation and ridges and furrow etc, practices mainly aimed to conservation rain water and ensure uniform distribution of moisture in the inter-terraced area. Hence, the investigation was aimed to identify the land configuration to increase soil moisture conservation and understand the growth response of redgram with different intercropping systems.

Materials and Methods

The field experiment was conducted during September, 2017 to March, 2018 in Agricultural Research Station, Virinjipuram, Tamil Nadu Agricultural University at 12°5´ N and 79° E, to study the different redgram based intercropping system with varied land configurations under rainfed ecosystem to appraise the redgram growth and yield response with different intercrops. The soil of the experimental field is sandy clay loam with the pH of 7.8, bulk density of 1.58g/cm^{-3}, organic matter content of 1.335 g/kg, total N content of 285 kg/ha, total P content of 15.2 kg/ha and total K content of 276 kg/ha. Total rainfall during the crop period was 655.0 mm.

The experiment was laid out in Split Plot Design with three main factors of land configurations L_1 – Compartmental bunding, L_2 – Broad bed furrow and L_3 – Ridges and furrow and seven sub factors as S_1- Redgram + Blackgram (4:5), S_2 - Redgram + Greengram (4:5), S_3 -Redgram + Cowpea (4:5), S_4 - Redgram + Groundnut (4:5), S_5 - Redgram + Sesame (4:5), S_6 -Redgram + Cotton (4:4) and S_7 -redgram sole crop were replicated thrice. Test varieties were Co (Rg) 7, Co 6, Co 8, VBN 1, TMV 13, TMV 7 and Co 14 used for redgram, blackgram, greengram, cowpea, groundnut, sesame and cotton crops respectively. After main field preparation land configurations are were made manually with gross plot size of 8.6 m × 3.8 m (32.68 m^2) and net plot size of 7.8 m × .3.0 m (23.4 m^2). The compartmental bunding made by bunds around the plot to favour the infiltration of rain water without get off. In Broad bed furrow, beds were formed manually with the width of 150 cm bed and 30 cm furrow with 15 cm depth and height of 15 cm for both main and intercrops. Ridges & furrow were opened with the spacing of 45 cm for redgram and cotton and 30 cm for blackgram, greengram, cowpea, groundnut and sesame and sowing was done by dippling method. All the cultural practices for respective crops under rainfed condition were followed as per TNAU crop production guide**.** After crop establishment**,** five plants at random from each plot were selected and tagged for the purpose of recording morphological and yield parameters. Plant height was recorded from the ground level to the growing tip of the main shoot at harvest stage of crops. Plant samples for dry matter studies were collected at harvest stage. The collected samples were air dried and then oven dried at 65 ± 5^{0}C till it reached a constant weight. The total dry matter production (DMP) was expressed in kg/ha. The data were subjected to statistical scrutiny as per the procedure given by Gomez and Gomez (1984). Wherever, the treatment differences were found as significant (F test) critical differences were worked out at 5 per cent probability level and the values were furnished in the respective tables.

Results and Discussion

Effect of land configurations and intercropping on redgram plant height

Among the different land configurations, ridges and furrow (L_3) method of sowing recorded higher redgram plant height of 192 cm. This was on par with compartmental bunding (L_1) method of sowing. The lower redgram plant height was recorded in broad bed furrow sowing (158 cm) (Table 1). In different intercropping, redgram pure crop recorded maximum plant height of 183 cm. This was on par with redgram plant height grown with groundnut (S_4), greengram (S_2) and blackgram (S_1) intercropping. This was followed by intercropping of cowpea (S_3) and sesame (S_5) in redgram plant height. The lowest redgram plant height (156 cm) was recorded with cotton (S_6) intercropping (Table 1).

In interaction between land configuration and intercropping system, there was no significant difference in plant height of redgram.

Effect of land configurations and intercropping on redgram dry matter production

The ridges and furrow (L_3) method recorded higher dry matter production of 1760 kg/ha. This was on par with compartmental bunding (L_1) method of sowing (1590 kg/ha). Followed by the lower redgram dry matter production of 1376 kg/ha was recorded with broad bed furrow method of sowing (Table 2). Among, the inter cropping system, redgram pure crop recorded highest dry matter production of 2369 kg/ha. This was followed by higher redgram dry matter production of 1718 kg/ha was recorded with blackgram (S_1) intercropping. This was comparable with dry matter production of redgram raised in groundnut (S_4) and greengram (S_2) intercropping. This was followed by redgram dry matter production with cowpea (S_3) and sesame (S_5) intercropping and the lowest dry matter production of 958 kg/ha in redgram was recorded in cotton (S_6) intercropping system (Table 2). In interaction between land configuration and intercropping system, there was no significant difference in dry matter production of redgram.

Figure.1 Effect of land configurations and intercropping on redgram plant height and dry matter production

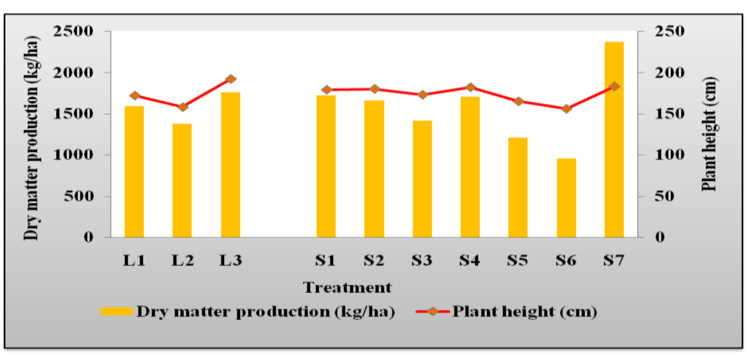

Table.1 Effect of land configurations and intercropping on redgram plant height

Treatments	Plant height (cm)			
Intercropping	Land configuration			
	L_1	L_2	L_3	Mean
S_1 – RG + BG (4:5)	177	163	197	179
S_2 – RG + GG (4:5)	178	165	199	180
S_3 – RG + CP (4:5	174	158	186	173
S_4 – RG + GN (4:5)	179	166	201	182
S_5 – RG + SM (4:5)	165	150	180	165
S_6 – RG + Cotton (4:4)	154	137	176	156
S_7 – RG (Sole crop)	180	166	202	183
Mean	172	158	192	
	L	S	L at S	S at L
SEd	7.8	4.5	10.6	7.8
CD (P = 0.05)	21.8	9.1	NS	NS

Land configurations		
L_1 – Compartmental bunding	L_2 – Broad bed and Furrow (BBF)	L_3 – Ridges and furrow

RG – Redgram; BG – Blackgram; GG – Greengram; CP – Cowpea; GN – Groundnut; SM - Sesame

Table.2 Effect of land configurations and intercropping on redgram dry matter production

Treatments	Dry matter production (kg/ha)			
Intercropping	Land configuration			
	L_1	L_2	L_3	Mean
S_1 – RG + BG (4:5)	1741	1509	1902	1718
S_2 – RG + GG (4:5)	1654	1441	1886	1661
S_3 – RG + CP (4:5	1377	1286	1585	1416
S_4 – RG + GN (4:5)	1790	1469	1852	1704
S_5 – RG + SM (4:5)	1197	1078	1339	1205
S_6 – RG + Cotton (4:4)	953	855	1066	958
S_7 – RG (Sole crop)	2419	1996	2693	2369
Mean	1590	1376	1760	
	L	S	L at S	S at L
SEd	78	51	113	89
CD (P = 0.05)	217	104	NS	NS

Land configurations		
L_1 – Compartmental bunding	L_2 – Broad bed and Furrow (BBF)	L_3 – Ridges and furrow

RG – Redgram; BG – Blackgram; GG – Greengram; CP – Cowpea; GN – Groundnut; SM - Sesame

Effect of land configurations and intercropping on redgram plant height

The plant height of redgram in ridges and furrow was increased by 10.4 percent higher than compartmental bunding method of sowing and 34.0 per cent higher than broad bed furrow method of sowing (Fig. 1). In the same way, higher plant height in ridges and furrow was reported by Deshmukh and Patel (2013) in pearl millet and Singh *et al.,* (2013) in sorghum crops. This was due to maintaining the favorable moisture condition for relatively longer duration in ridges and furrow method of sowing (Parihar *et al*., 2010; Singh *et al*., 2013) compared to compartmental bunding and broad bed furrow method of sowing.

The redgram plant height in groundnut intercropping was 4.7, 8.9 and 13.6 per cent higher than cowpea, sesame and cotton intercropping (Fig. 1). The redgram plant height (156 cm) in cotton (S_6) intercropping was reduced by 17.0 per cent compared to redgram sole crop. This results are conformity with the findings of Shivran and Ahlawat (2000), who reported that plant height in sole redgram and redgram intercropped with blackgram, did not differ significantly due to absence of competition between the crops and it favored to increased redgram plant height, on the other hand taller plants of sesame, finger millet (Srichandan and Mangaraj, 2015) and cotton (Junejo, 2006) might have depressed the growth of associated pigeonpea where the growth rate was usually lower during initial growth stages.

Effect of land configurations and intercropping on redgram dry matter production

In ridges and furrow method of sowing dry matter production of redgram increased by 9.6 percent higher than compartmental bunding method of sowing and 21.8 per cent higher than broad bed furrow method of sowing (Fig. 1). These results are in line with findings of Deshmukh and Patel (2013), Karimvand *et al*., (2013), Ambika *et al.,* (2017) and Bhople *et al.,* (2018) in cluster bean, sorghum, pearlmillet, cowpea, cotton and sunflower respectively. The ridges and furrow modification in surface configuration aided in conservation rain water and its availability for longer duration, mini barriers in run-off of water and increased moisture improved the availability of nutrients as well as nutrient uptake (Bhople *et al*., 2018). This in turn might have helped in the rapid cell division and multiplication and resulted in expansion of leaf area with increased chlorophyll content. As a result increased photosynthetic rate might have increased the supply of carbohydrates to the plants which in turn increased the vertical and lateral growth leading to higher dry matter accumulation (Saki Nejad, 2011).

The redgram dry matter production in blackgram intercropping was 17.5, 29.8 and 44.2 per cent higher than cowpea, sesame and cotton intercropping system with redgram (Fig. 1). The lower redgram dry matter production was recorded with cowpea (S_3) sesame (S_5) and cotton (S_6) intercropping (Table 2). Similar findings were reported by Soniya (2014) in redgram. This was due to the absence of competition between redgram and intercrops of blackgram, greengram and groundnut, which in turned to maximum dry matter production by enhanced plant height, number of branches and leaves, leaf area index and crop growth rate (Srichandan and Mangaraj, 2015).

From the results and discussion, it can be concluded that, among the different land configurations, ridges and furrow method of sowing (L_3) recorded higher redgram plant height and dry matter production. In various intercropping system, redgram intercropping with blackgram (S_1), groundnut (S_4) and greengram (S_2) produced higher plant height and dry matter production without affecting the growth of redgram.

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