International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 3596-3599

Received: 19-03-2018
Accepted: 22-04-2018

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Effect of land configurations and intercropping on nutrient uptake 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, and Tamil Nadu Agricultural University with different land configurations under rainfed ecosystem to understand the nutrient uptake of redgram. 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 nutrient uptake was recorded with the (L_3) ridges and furrow method of sowing and redgram + blackgram intercropping system.

Keywords: Land configuration, intercropping, compartmental bunding, ridges and furrow, broad Bed Furrow and nutrient uptake

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) [3], it lead to farmers profit and subsistence oriented, energy-efficient and sustainable venture (Faroda *et al.*, 2007) [1]. 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 Nutrient uptake in rainfed condition. Understanding the nutrient uptake pattern of redgram under intercropping system in rainfed condition is more important to use optimum quantity of fertilizers to succeed the maxim production. 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 Nutrient uptake 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**.** The nitrogen, phosphorus and potassium content of plant sample estimated by Microkjeldahl method, Triple acid digestion with colorimetric estimation and Triple acid digestion with flame photometric method respectively. The uptake of nutrients was calculated by multiplying the nutrient content and dry matter production and expressed in kg/ha. The data were subjected to statistical scrutiny as per the procedure given by Gomez and Gomez (1984) [2]. 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.

Table 1: Effect of land configurations and intercropping on nitrogen uptake of redgram

Treatments	Nitrogen (cm)			
Intercropping	Land configuration			
	L_1	L_2	L_3	Mean
S_1 – RG + BG (4:5)	91.2	83.8	101.6	92.2
S_2 – RG + GG (4:5)	92.0	84.4	102.4	92.9
S_3 – RG + CP (4:5	89.8	81.6	95.7	89.0
S_4 – RG + GN (4:5)	92.3	85.8	103.6	93.9
S_5 – RG + SM (4:5)	84.8	77.3	92.7	84.9
S_6 – RG + Cotton (4:4)	79.2	70.4	90.8	80.1
S_7 – RG (Sole crop)	137.7	127.0	153.8	139.5
Mean	172	158	192	
	L	S	L at S	S at L
SEd	3.81	2.72	5.79	4.71
CD (P = 0.05)	10.57	5.52	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 potassium uptake of redgram

Treatments	Potassium (kg/ha)			
Intercropping	Land configuration			
	L_1	L_2	L_3	Mean
S_1 – RG + BG (4:5)	41.40	38.05	46.12	41.9
S_2 – RG + GG (4:5)	41.73	38.30	46.47	42.2
S_3 – RG + CP (4:5	40.76	37.03	43.42	40.4
S_4 – RG + GN (4:5)	41.87	38.94	46.99	42.6
S_5 – RG + SM (4:5)	38.50	35.06	42.08	38.5
S_6 – RG + Cotton (4:4)	35.92	31.94	41.22	36.4
S_7 – RG (Sole crop)	62.50	57.65	69.80	63.3
Mean	43.24	39.57	48.01	
	L	S	L at S	S at L
SEd	1.73	1.23	2.63	2.14
CD (P = 0.05)	4.80	2.50	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		

Results and Discussion

Effect of land configurations on nitrogen, Phosphorus and potassium uptake of redgram

Among the different land configurations, ridges and furrow (L_3) method was recorded highest nitrogen uptake of 105.8 kg/ha by redgram. This was on par with higher nitrogen uptake recorded in compartmental bunding (L_1) method of sowing and it was comparable with lower nitrogen uptake of redgram (87.2 kg/ha) was recorded with broad bed furrow method of sowing (Table. 1).

In phosphorus uptake, ridges and furrow (L_3) method recorded highest uptake of 5.5 kg/ha by redgram. This was followed by compartmental bunding (L_1) method of sowing (4.9 kg/ha). The lowest phosphorus uptake of redgram (4.5 kg/ha) was recorded with broad bed furrow method of sowing (Table. 2).

In potassium, sowing in ridges and furrow (L_3) method recorded highest potassium uptake of 48.01 kg/ha by redgram. This was followed by compartmental bunding (L_1) method of sowing (43.24 kg/ha). The lowest potassium uptake of redgram (39.57 kg/ha) was recorded with broad bed furrow method of sowing (Table. 3).

The maximum nitrogen, phosphorus and potassium uptake of redgram was recorded in ridges and furrow method of sowing (Fig. 1). Similar finding was reported by Kiran *et al*. (2008) [6], Singh *et al*. (2013) [7] and Kanwar *et al*. (2017) [8]. This might be due to the fact that increased soil moisture content enhanced the deeper penetration of roots and better soil environment due to better aeration, microbial activity and good drainage might have received optimum moisture and nutrients for its growth causing more nutrient recovery through grain and stover under ridge and furrow method of sowing, which resulted into higher uptake of N, P and K nutrients by crop (Vishnu *et al*., 2017) [9]. This was due to the higher soil moisture availability in ridges and furrow favored to optimum soil moisture and nutrient utilization and increased growth and development and production compare to

compartmental bunding and broad bed furrow method of sowing.

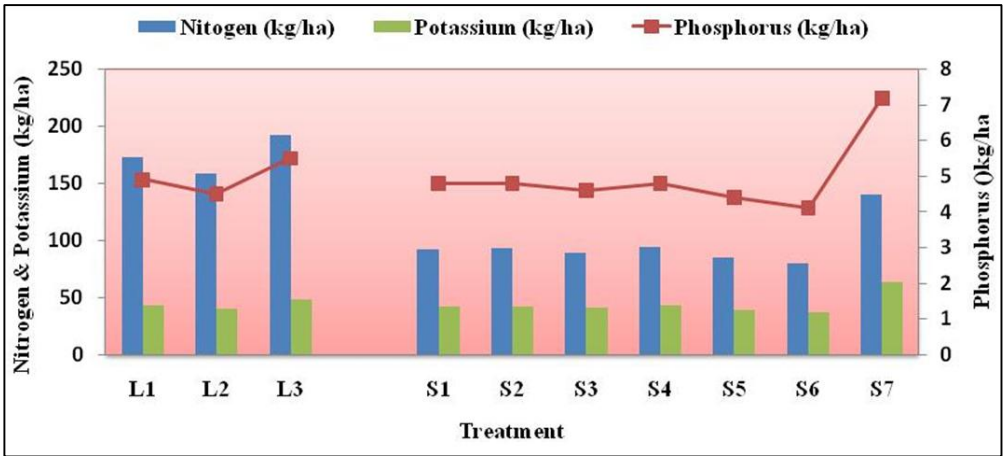

Fig 1: Effect of land configurations and intercropping on nitrogen, phosphorus and potassium uptake of redgram

Among the different intercropping system, redgram pure crop recorded highest nitrogen uptake of 139.5 kg/ha. Next to this higher redgram nitrogen uptake of 93.9 kg/ha was recorded in groundnut (S_4) intercropping. This was on par with nitrogen uptake of redgram raised in greengram (S_3) blackgram (S_1) and cowpea (S_3) intercropping. These were on par with nitrogen uptake of redgram grown in sesame (S_5) intercropping and lower nitrogen uptake (80.1 kg/ha) was recorded in redgram grown with cotton (S_6) intercropping system (Table. 1).

Similarly, redgram pure crop recorded highest phosphorus uptake of 7.2 kg/ha. Next to this higher phosphorus uptake of 4.8 kg/ha in redgram was recorded in blackgram (S_1) intercropping. This was on par with Phosphorus uptake of redgram raised groundnut (S_4) and greengram (S_3) intercropping. This was followed by Phosphorus uptake of redgram grown with cowpea (S_3) and sesame (S_5) intercropping and these were comparable with phosphorus uptake (4.1 kg/ha) was recorded in redgram grown with cotton (S_6) intercropping system (Table. 2).

Again the redgram pure crop recorded highest potassium uptake of 63.3 kg/ha. Next to this higher redgram potassium uptake of 42.6 kg/ha was recorded in groundnut (S_4) intercropping. This was on par with potassium uptake of redgram raised in blackgram (S_1) and greengram (S_2) intercropping. This was followed by potassium uptake of redgram grown with cowpea (S_3) and sesame (S_5) intercropping. The lowest potassium uptake (36.4 kg/ha) was recorded in redgram grown with cotton (S_6) intercropping system (Table. 3).

At all locations redgram pure crop recorded highest nitrogen, phosphorus and potassium uptake due to high plant population than intercropping systems. Among the intercropping systems, redgram intercropped with groundnut (S_4), blackgram (S_1) and greengram (S_2) was recorded higher nitrogen, phosphorus and potassium uptake at across the locations (Fig. 1). This might be the reason of maximum plant height, growth rate, dry matter production and grain yield of redgram by complementary effect (Shivran and Ahlawat, 2000) of intercrops lead to higher nutrient uptake. In cowpea, sesame and cotton intercropping reduced the redgram nitrogen, phosphorus and potassium uptake due to the reduced crop growth, dry matter production and grain yield competitive effect by smothering effect which might reduce the redgram growth and development by reduced utilization of soil moisture and nutrients (Srichandan and Mangaraj, 2015).

Conclusion

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 nitrogen, phosphorus and potassium uptake. In various intercropping system, redgram intercropping with blackgram (S_1), groundnut (S_4) and greengram (S_2) increased nitrogen, phosphorus and potassium uptake without affecting the growth of redgram.

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