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Original Research Article

Effect of Potash Application through Gliricidia Green Leaf Manuring on Yield and Nutrient Uptake by Soybean

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Keywords

Gliricidia green leaf manure, Potash, Nutrient uptake, Yield and soybean

A B S T R A C T

A field study was conducted to study the effect of potash application through gliricidia green leaf manuring on yield and nutrient uptake by soybean during *Kharif* 2016 at Research field of AICRP for Dryland Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. The soil of the experimental site was Vertisol which was moderately alkaline in reaction, low in available nitrogen, medium in available phosphorus and high in available potassium. The six treatments replicated four times in randomized block design comprised of control, 100% RDF (30:75:30 NPK kg ha^{-1}), 75% and 50% N and 100% P through chemical fertilizers and the combinations of 15 and 30 kg K ha^{-1} through gliricidia green leaf manure at 30 DAS and remaining recommended dose of potassium as basal dose through inorganic fertilizers. The results indicated that application of 100 % RDF (30:75:30 NPK kg ha^{-1}) resulted in higher nutrient uptake and soybean yield and was found to be on par with application of 75% N +100% P+15 kg K (inorganic) +15 kg K through gliricidia. Hence, it is concluded that conjunctive application of 75% N +100% P+15 kg K through chemical fertilizers +15 kg K through gliricidia green leaf manuring at 30 DAS resulted in higher nutrient uptake and yield of soybean grown in Vertisols under rainfed conditions.

Introduction

Soybean (*Glycine max.* L.) is one of the important oilseed as well as leguminous crop. It is originated in Eastern Asia/China and is second largest oilseed crop in India after groundnut. It is a miracle "Golden bean" of the 21st century mainly due to its high protein content-40%, oil-20%, carbohydrates-30%, fibre-0.5%, lecithin -0.5% and saponin -4%, and it is now making headway in Indian agriculture. In India, it is mainly grown as oilseed crop and is the cheapest and richest source of high quality protein. It supplies most of the nutritional constituents essential for human health. Soybean occupies an intermediate position between legumes and oilseeds. *Gliricidia sepium* belongs to leguminous family with subfamily Papilionoideae. It is a leguminous multipurpose tree and adopts very well in a wide range of soils. The leaves of gliricidia contain N (2.4%), P (0.1%) and K (1.8%). It adds plant nutrients and organic matter to the soil and increases crop productivity. The leaves decompose relatively fast, providing nitrogen and potassium. Gliricidia as green leaf manure plays important role in

increasing the fertility status of soils and helps in conserving soil through reduced soil erosion.

Materials and Methods

The experiment was carried out at Research field of AICRP for Dryland Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola(Maharashtra) which is situated in between 22^0 41' N latitude and $77^0$02' E longitude at an altitude of 307.4 m above mean sea level and has a subtropical climate.

The climate is characterized by three distinct seasons viz., summer becoming hot and dry from March to May, monsoon characterized as warm rainy from June to October and winter with dry mild cold from November to February. Most of the rainfall is received from south west monsoon.

The representative plant samples were collected from all the plots at harvest of soybean crop for nutrient content and uptake studies and subsequently grain and straw yield of soybean was also recorded.

Treatment details

T1 Control
T2 100% RDF (30:75:30 NPK kg ha^{-1})
T3 75% N +100% P+15 kg K(inorganic)+15 kg K through gliricidia
T4 75% N +100% P+30 kg K through gliricidia
T5 50% N +100% P+30 kg K through gliricidia
T6 100% K through gliricidia

Results and Discussion

The data on grain and straw yield of soybean (Table 1) was significantly influenced by various treatments.

Soybean yield

The significantly higher soybean grain yield (2042.2kg ha^{-1}) was recorded with the application of 100% RDF (30:75:30 NPK kg ha^{-1}) (T_2) and it was on par with the application of 75% N +100%P+15 kg K(inorganic)+15 kg K through gliricidia (T_3). It was also observed that 63.37% and 51.02% increase in grain yield of soybean was recorded in treatment T_2 and T_3 as compared to control respectively. The lowest soybean grain yield (1250.0 kg ha^{-1}) was recorded in treatment T_1 i.e. control. The significantly higher soybean straw yield (2253.1 kg ha^{-1}) was observed with the application of 100% RDF (30:75:30 NPK kg ha^{-1}) (T_2) and it was found to be on par with application of 75% N +100% P+15kg K(inorganic)+15 kg K through gliricidia (T_3).

It was also observed that 59.27% and 39.27 increase in straw yield of soybean was recorded in treatment T_2 and T_3 as compared to control respectively. The lowest soybean straw yield (1414.6 kg ha^{-1}) was recorded in treatment T_1 i.e. control.

Higher soybean yield with conjunctive application of gliricidia green leaf manure along with chemical fertilizers may be due to balanced supply of nutrients to the crops throughout the crop growth period. Green leaf manure undergo decomposition during which series of nutrient transformation takes place which helps in their higher availability to the crops and higher uptake of nutrients by the crop will result in higher yield.

The results are in conformity with the findings of Shirale and Khating (2009), Arbad and Ismail (2011), Singh and Kumar (2012), Sikka *et al.*, (2013), Aher *et al.*, (2015) and Shariff *et al.*, (2017).

Nutrient uptake by soybean

The data indicated that significantly higher N uptake (85.45 kg ha^{-1}) by soybean grain was observed with the application of 100% RDF (30:75:30 NPK kg ha^{-1}) (T_2) and it was found to be on par with application of 75% N +100% P+15kg K(inorganic)+15 kg K through gliricidia (T_3). The lowest N uptake by soybean grain (47.53 kg ha^{-1}) was observed in treatment T_1 i.e. control. The significantly higher N uptake (29.07 kg ha^{-1}) by soybean straw was observed with the application of 100% RDF(30:75:30 NPK kg ha^{-1}) (T_2) and it was also found to be on par with the application 75% N +100% P+15kg K(inorganic)+15 kg K through gliricidia (T_3).

The lowest N uptake (14.94 kg ha^{-1}) by straw was observed in treatment T_1 i.e. control. The significantly highest total N uptake (114.53 kg ha^{-1}) by soybean was observed with application of 100% RDF (30:75:30 NPK kg ha^{-1}) (T_2) and it was found to be on par with the treatment T_3 i.e.75% N +100% P+15kg K(inorganic)+15 kg K through gliricidia (T_3). The lowest total N uptake (62.47kg ha^{-1}) by soybean was observed in treatment T_1 i.e. control.

The uptake of N increased due to application of 100 % RDF (30:75:30 NPK kg ha^{-1}) and the integrated nutrient management which increased the concentration of N in grain and straw and thus results in higher uptake of nitrogen by the plant as compared to the organic fertilizers alone. The results are in conformity with the finding of Rao *et al.*, (2000), Channabasappa and Prabhakar (2003), Kumar *et al.,* (2006), Jeevan Rao and Rama Lakshmi (2009) and Sanjay Kumar *et al.,* (2015) (Table 2).

The data in respect of P uptake by soybean grain and straw and total P uptake by soybean were significantly influenced by various treatments and the data indicated that the significantly higher P uptake (13.97 kg ha^{-1}) by soybean grain was observed with the application of 100% RDF (30:75:30 NPK kg ha^{-1}) (T_2) and it was found to be on par with the application 75% N +100% P+15kg K(inorganic)+15 kg K through gliricidia (T_3). The lowest P uptake by soybean grain (6.49 kg ha^{-1}) was observed in treatment T_1 i.e. control.

The significantly higher P uptake (12.50 kg ha^{-1}) by soybean straw was observed with the application of 100 % RDF (30:75:30 NPK kg ha^{-1}) (T_2) and it was also found to be on par with the application 75% N +100% P+15kg K(inorganic)+15 kg K through gliricidia (T_3). The lowest P uptake by (5.75 kg ha^{-1}) straw was observed in treatment T_1 i.e. control.

The significantly higher total P uptake (26.47 kg ha^{-1}) by soybean was observed with the application of 100 % RDF (30:75:30 NPK kg ha^{-1}) (T_2) and it was found to be on par with the application 75% N +100% P+15kg K (inorganic) +15 kg K through gliricidia (T_3).

The lowest P uptake by soybean was observed in treatment T_1 i.e. control (12.24 kg ha^{-1}) (Table 3).

Significantly higher amount of P uptake by plant might be due to application of potash through gliricidia green leaf manuring which increases the availability of phosphorus in the soil. This includes production of organic acids through decomposition of organic matter and a consequent release of phosphate ions, production of hydrous oxides which reduces soil P fixation. Similar results were also reported by Talati (2004), Thakur and Sawarkar (2009) and Sikka *et al.,* (2013).

Table.1 Effect of gliricidia green leaf manuring on yield of soybean

Treatments		Soybean yield (kg ha^{-1})	
		Grain	Straw
T_1	Control	1250.0	1414.6
T_2	100 % RDF (30:75:30 NPK kg ha^{-1})	2042.2	2253.1
T_3	75% N +100%P+15 kg K(inorganic)+15 kg K through gliricidia	1887.8	1970.2
T_4	75% N +100%P+30 kg K through gliricidia	1666.7	1702.7
T_5	50% N +100%P+30 kg K through gliricidia	1409.5	1584.4
T_6	100% K through gliricidia	1337.4	1445.5
	SE (m) +	84.3	95.7
	CD at 5%	254.1	288.5

Table.2 Effect of gliricidia green leaf manuring on nitrogen uptake by soybean

Treatments		Nitrogen uptake (kg ha^{-1})		
		Grain	Straw	Total
T_1	Control	47.53	14.94	62.47
T_2	100 % RDF (30:75:30 NPK kg ha^{-1})	85.45	29.07	114.53
T_3	75% N +100%P+15 kg K(inorganic) +15 kg K through gliricidia	79.61	25.71	105.32
T_4	75% N +100%P+30 kg K through gliricidia	68.30	21.97	90.27
T_5	50% N +100%P+30 kg K through gliricidia	56.89	20.10	76.98
T_6	100% K through gliricidia	53.41	16.82	70.24
	SE (m) $\pm$	3.68	1.21	3.66
	CD at 5%	11.09	3.66	11.04

Table.3 Effect of gliricidia green leaf manuring on phosphorus uptake by soybean

Treatments		Phosphorus uptake (kg ha^{-1})		
		Grain	Straw	Total
T_1	Control	6.49	5.75	12.24
T_2	100 % RDF (30:75:30 NPK kg ha^{-1})	13.97	12.50	26.47
T_3	75% N +100%P+15 kg K(inorganic)+15 kg K through gliricidia	12.59	10.46	23.04
T_4	75% N +100%P+30 kg K through gliricidia	10.67	8.85	19.52
T_5	50% N +100%P+30 kg K through gliricidia	9.06	7.76	16.82
T_6	100% K through gliricidia	7.83	6.72	14.55
	SE (m) +	0.52	0.56	0.67
	CD at 5%	1.56	1.70	2.01

Table.4 Effect of gliricidia green leaf manuring on potassium uptake by soybean

Treatments		Potassium uptake (kg ha^{-1})		
		Grain	**Straw**	**Total**
T_1	Control	8.11	17.06	25.17
T_2	100 % RDF (30:75:30 NPK kg ha^{-1})	16.94	29.28	46.22
T_3	75% N +100%P+15 kg K(inorganic)+15 kg K through gliricidia	15.90	26.52	42.41
T_4	75% N +100%P+30 kg K through gliricidia	13.64	22.27	35.92
T_5	50% N +100%P+30 kg K through gliricidia	11.41	20.43	31.84
T_6	100% K through gliricidia	9.36	18.43	27.78
	SE (m) ±	0.63	1.23	1.28
	CD at 5%	1.89	3.72	3.86

The data indicated that the significantly higher K uptake (16.94 kg ha^{-1}) by soybean grain was observed with the application of 100% RDF (30:75:30 NPK kg ha^{-1}) (T_2) and it was found to be on par with the application 75% N +100% P+15kg K(inorganic)+15 kg K through gliricidia (T_3). The lowest K uptake (8.11 kg ha^{-1}) by soybean grain was observed in treatment T_1 i.e. control. The significantly higher K uptake (29.28 kg ha^{-1}) by soybean straw was observed with the application 100 % RDF (30:75:30 NPK kg ha^{-1}) (T_2) and it was also found to be on par with the application 75% N +100% P+15kg K(inorganic)+15 kg K through gliricidia (T_3). The lowest K uptake (17.06 kg ha^{-1}) by soybean straw was observed in treatment T_1 i.e. control (Table 4).

The significantly higher total K uptake (46.22 kg ha^{-1}) by soybean was observed in treatment T_2 i.e.100 % RDF (30:75:30 NPK kg ha^{-1}) and it was found to be on par with the application 75% N +100% P+15kg K(inorganic)+15 kg K through gliricidia (T_3). The lowest total K uptake (25.17 kg ha^{-1}) by soybean was observed in treatment T_1 i.e. control. Increased K uptake with the application of gliricidia green leaf manuring might be due to the fact that leaves of gliricidia contains larger amount of potassium and on decomposition, release of organic acids that solubilize native K and which may get available to the plant. Similar results were also recorded by Joshi and Rudradhya (1993), Annaduri *et al*., (1994), Deshmukh *et al*., (1994) and Kundu *et al*., (2009).

The results indicated that the use of gliricidia green leaf manuring at 30 DAS in conjunction with chemical fertilizers recorded higher soybean yield and nutrient uptake by soybean. Hence, it is concluded that the integrated application of 75% N +100% P+15 kg K through chemical fertilizer+15 kg K through gliricidia green leaf manuring at 30 DAS resulted in improvement in nutrient uptake and yield of soybean grown in Vertisols under rainfed conditions.

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