

Original Research Article

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Effect of Plant Residues on Growth and Seed Yield of Soybean

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ABSTRACT

Keywords

Seed yield, Haulm yield, Plant height, Plant residues, Soybean

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An experiment was conducted during Kharif 2012 and 2013 at Krishi Vigyana Kendra, Janwada, Bidar, University of Agricultural Sciences, Raichur, Karnataka, India. To assess the growth, yield and economics of soybean as influenced by the application of plant residues under rainfed situation of Northern Karnataka. Results revealed that, application of RDF (40:80:25 NPK kg/ha + 12 kg ZnSO₄/ha + 20 kg sulphur/ha) + plant residues at 3.0 tonnes/ha recorded significantly (p=0.05) higher haulm and seed yield (3007 and 2269 kg/ha, respectively) and which was on par with the application of RDF + plant residues at 2.25 tonnes/ha (2839 and 2136 kg/ha, respectively). Further, Application of RDF + plant residues at 0.75, 1.5 and 2.25 tonnes/ha were at par with each other with respect to haulm and seed yield. Whereas, significantly least haulm and seed yield were recorded in control treatment.

Introduction

Soybean (*Glycine max* (L.) Merrill) in India is cultivated over an area of 9.4 million ha with production of 9.6 million tons and is known as “Golden Bean” of 20th century. Though soybean is a legume crop, yet it is widely used as an oilseed. It is now occupying first place among all the oilseed crops in India followed by rapeseed mustard and groundnut, respectively. It grows in varied agro-climatic conditions. Due to its world- wide popularity, the international trade of soybean has spread globally. Soybean possesses a very high nutritional value and is the richest, cheapest and easiest source of the best quality proteins

(40 %) and oil (20 %) having a vast multiplicity of uses as food and industrial products (1).

Producers have expressed concerns about production practices where high levels of crop residue are present on the soil surface. These concerns include wetter soil and lower soil temperatures delaying planting and retarding plant development during early vegetative growth, and less uniform germination and emergence using planting equipment that cannot operate adequately in the residue. By the reproductive growth stage, however, vegetative growth of crops under no till management can catch up to the growth of

crops under tilled management (2). Another benefit of crop residue is that it reduces the energy of water droplets impacting the soil surface, thereby reducing the detachment of fine soil particles that tend to seal the surface and lead to crust formation. This sealing and crusting process can be enhanced by subsequent soil surface drying, and it reduces infiltration and promotes runoff because precipitation or irrigation rates may be greater than the rates at which the soil is able to absorb water. Residue may increase surface storage of rain or irrigation water. In addition, it slows the velocity of runoff water across the soil surface, allowing more time for infiltration (3).

Bidar District of Karnataka (India) is dominated by red lateritic and medium to deep black soils and these soils are poor in soil fertility due to deficiency of secondary and micronutrients. Soybean is one of the important oil seed crop and it is being grown in an area of 95,000 ha with a production of 33,250 thousand tonnes with an average productivity of 725 kg/ha. Since, the yields are low as compared to state average (950 Kg/ha). Intensive cropping, indiscriminate use of fertilizers and limited use of organic matter and plant residues are the reasons for limits soybean yield. However, very meager information is available on effect of plant residues on soybean yield. Hence a field experiment was conducted to investigate the effect of plant residues on soybean yield in Northern Karnataka.

Materials and Methods

Background of the study

An experiment was carried out during *Kharif* 2012 and 2013 at Krishi Vigyana Kendra (KVK), Janwada, Bidar, University of Agricultural Sciences, Raichur, Karnataka, India. The soil of the experimental field was

clay loam, slightly saline (pH 8.36), high in organic carbon (0.53 %), available nitrogen (268.0 kg N/ha), phosphorus (30.6 kg P₂O₅/ha) and potassium (423 kg K₂O/ha).

Treatments details

The experiment was comprises of six treatments *viz.*, T₁: Absolute Control, T₂: RDF (40:85:25 kg NPK + 12 kg ZnSO₄+20 kg Sulphur/ha), T₃: RDF + Plant residue at 0.75 tonnes/ha, T₄: RDF + Plant residue at 1.50 tonnes/ha, T₅: RDF + Plant residue at 2.25 tonnes/ha and T₆: RDF + Plant residue at 3.0 tonnes/ha.

Experimental details

The experiment was laid out in randomized complete block design with four replications. Soybean variety JS 335 was grown at a row spacing of 45 cm. Crop received recommended dose of nutrients @ 40:80:25: kg N: P₂O₅: K₂O per ha through urea, di-ammonium phosphate and muriate of potash, respectively. Sulphur and Zinc sulphate were applied as per treatment details through gypsum (18 % S) and Zinc sulphate, respectively. Soybean seed were inoculated with *Bradyrhizobium japonicum* culture @ 5 g per kg seed. The crop residues was applied as per the treatment after the germination of crop. The rainfall received during *kharif* 2012 and 2013 was 850 mm and 940 mm, respectively. Other crop management practices were performed as per recommended package of practices.

Data collection and economics

The observations on growth parameters/ attributes like plant height, branches per plant and pods per plant were taken on five randomly selected plants from each treatment at harvest. Observation on seed index was taken and expressed as g per 100 seed. After

harvest and threshing of crop, seed yield was recorded in net plot wise and converted to grain yield per hectare basis. The cost of inputs that were prevailing at the time of their use was considered for working out the economics of various treatments. Net return per hectare was calculated by deducting the cost of cultivation from gross returns per hectare, gross returns was calculated by using the total income obtained from grain and straw yield of rice and the benefit cost ratio was worked out as follows.

$$\text{Benefit cost ratio} = \frac{\text{Gross returns (₹/ha)}}{\text{Cost of cultivation (₹/ha)}}$$

Data analysis

MSTAT was used for statistical analysis of data and means were separated using critical difference (CD) at $p=0.05$. The data on weeds were transformed by square root transformation before being subjected to ANOVA (4).

Results and Discussion

Effect of plant residues on growth parameters of soybean

Results revealed that, Plant height and number of branches per plant showed a significant ($p=0.05$) variation with different rate of application of plant residues along with recommended dose of fertilizer application (Table 1). Application of RDF (40:80:25 NPK kg/ha + 12 kg ZnSO₄/ha+ 20 kg sulphur/ha) + plant residues at 3.0 tonnes/ha recorded significantly ($p=0.05$) taller plants (64.0 cm) and maximum branches (60.7) and which was onpar with the application of RDF + plant residues at 2.25 tonnes/ha (6.05 and 5.20, respectively). Further, Application of RDF + plant residues at 0.75, 1.5 and 2.25 tonnes/ha were at par

with each other with respect to plant height and number of branches per plant. This might be due to high accumulation of net photosynthates. The results obtained are consistent with findings reported by Meena *et al* (5). However, significantly ($p=0.05$) shorter plants and least number of branches were recorded in control.

Effect of plant residues on yield and yield parameters of soybean

Yield attributes like number of pods per plant, seed index, haulm and seed yield showed a significant variation for different rate of application of plant residues along with recommended dose of fertilizer application (Table 2). Results revealed that, 100 seed weight significantly did not differ with different rate of application of plant residues. Application of RDF (40:80:25 NPK kg/ha + 12 kg ZnSO₄/ha+ 20 kg sulphur/ha) + plant residues at 3.0 tonnes/ha recorded significantly ($p=0.05$) higher haulm and seed yield (3007 and 2269 kg/ha, respectively) and which was onpar with the application of RDF + plant residues at 2.25 tonnes/ha (2839 and 2136 kg/ha, respectively). Further, Application of RDF + plant residues at 0.75, 1.5 and 2.25 tonnes/ha were atpar with each other with respect to haulm and seed yield. This might be due to the favourable role of nutrients and moisture storage due to mulching with plant residues in nodulation and seed formation process. The results are in consistent with the findings of Saxena and Nainwal (6) who reported that seed and haulm yield increased significantly with incremental dose of sulphur and boron application. Application of crop residues on soil may conserve the soil moisture content and reduces the weed population. Therefore, the yield of soybean has been drastically increased. Plant residues acts as a mulching so that, it favours the plant growth.

Table.1 Effect of plant residues on growth parameters of soybean

Treatments	Plant height (cm)			Branches/plant			Pods/plant		
	2012	2013	Pooled	2012	2013	Pooled	2012	2013	Pooled
T1: Control	43.4	42.9	43.2	2.6	2.8	2.7	40	43	41.5
T2: RDF	54.3	55.2	54.8	3.9	3.6	3.75	59	62	60.5
T3: RDF + Plant residue at 0.75 tonnes/ha	55.9	57.6	56.7	4.1	4.3	4.2	60	65	62.5
T4: RDF + Plant residue at 1.50 tonnes/ha	57.4	59.7	58.6	4.6	4.9	4.75	71	73	72.0
T5: RDF + Plant residue at 2.25 tonnes/ha	59.9	61.6	60.7	5.3	5.1	5.20	79	80	79.5
T6: RDF + Plant residue at 3.0 tonnes/ha	63.2	64.8	64.0	6.1	6.0	6.05	83	84	83.5
C.D.(P=0.05)	6.72	8.84	7.78	0.85	0.88	0.86	7.73	9.32	8.52

RDF: 40:80:25 NPK kg/ha + 12 kg ZnSO₄+ 20 kg sulphur

Table.2 Effect of plant residues on yield and yield parameters of soybean

Treatments	100 Seed weight (g)			Haulm yield (kg/ha)			Seed yield (kg/ha)		
	2012	2013	Pooled	2012	2013	Pooled	2012	2013	Pooled
T1: Control	11.80	11.45	11.63	1138	1182	1160	925	961	943
T2: RDF	12.60	12.92	12.76	2383	2404	2393	1875	1893	1884
T3: RDF + Plant residue at 0.75 tonnes/ha	13.68	13.23	13.45	2513	2695	2604	1963	1990	1977
T4: RDF + Plant residue at 1.50 tonnes/ha	13.80	13.56	13.68	2633	2801	2717	2041	2102	2072
T5: RDF + Plant residue at 2.25 tonnes/ha	13.83	13.87	13.85	2783	2895	2839	2125	2148	2136
T6: RDF + Plant residue at 3.0 tonnes/ha	13.98	14.10	14.04	2959	3054	3007	2259	2279	2269
C.D.(P=0.05)	NS	NS	NS	333.9	387.4	361	281.8	264.5	273.1

RDF: 40:80:25 NPK kg/ha + 12 kg ZnSO₄+ 20 kg sulphur

Table.3 Economics of soybean as influenced by the application of plant residues (Mean of 2012 and 2013)

Treatment	Cost of cultivation (Rs.)	Gross Returns (Rs.)	Net Returns (Rs.)	B:C
T1: Control	26975	40362	13387	1.50
T2: RDF	32077	79506	47429	2.48
T3: RDF + Plant residue at 0.75 tonnes/ha	32565	83580	51015	2.56
T4: RDF + Plant residue at 1.50 tonnes/ha	33052	88284	55232	2.67
T5: RDF + Plant residue at 2.25 tonnes/ha	33540	90216	56676	2.69
T6: RDF + Plant residue at 3.0 tonnes/ha	34027	95718	61691	2.81
C.D. (P=0.05)	NA	NA	4256	0.11

RDF: 40:80:25 NPK kg/ha + 12 kg ZnSO₄+ 20 kg sulphur

Economics of soybean as influenced by the application of plant residues

Economic evaluation (Table 3) revealed that, the maximum net returns (₹ 61691/ha) and benefit cost ratio (2.81) were obtained with the application of RDF (40:80:25 NPK kg/ha + 12 kg ZnSO₄/ha+ 20 kg sulphur/ha) + plant residues at 3.0 tonnes/ha and which was closely followed by the application of RDF+ plant residues at 2.25 tonnes/ha (₹ 56676/ha and 2.69, respectively) compared to other treatments.

Further, least net returns and benefit cost ratio was observed in absolute control. These results are conformity with the findings of Singh, *et al* (7) stated that, the maximum net returns (₹20,115/ha) were obtained with 40 kg S per ha, which was significantly superior over control, but at par with 30 kg S per ha. Similarly, application of 2.0 kg B per ha recorded maximum net returns (19,591/ha), which was significantly superior to 0.5 kg B per ha and control, but was on par with 1 kg and 1.5 kg B per ha. The highest B: C ratio of 1.98 was recorded with the application of 30 kg S per ha.

It may be concluded that, application of RDF (40:80:25 NPK kg/ha + 12 kg ZnSO₄/ha+ 20 kg sulphur/ha) + plant residues at 3.0 tonnes/ha or 2.25 tonnes/ha may enhance the growth, seed yield of soybean and B:C ratio and this method proved most economical in Northern Karnataka.

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