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Research Article

Effect of Varied Levels of Sulphur and Sources of Organics on Growth, Yield Parameters and Economics of Soybean (*Glycine max* L.) in Alfisols of Karnataka

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ABSTRACT

A field experiment was conducted during kharif sesson 2016 at Palanahalli village , Magadi taluk, Ramanagara distinct to study the "Effect of varied levels of sulphur and sources of organics on growth, yield and economics of soybean in Alfisols of Karnataka". The experiment was laid out in RCBD with seventeen treatments and replicated thrice. The results revealed that application of 100 % RDF + poultry manure at 6 t ha^{-1} + sulphur at 40 kg ha^{-1} through gypsum recorded significantly higher growth and yield parameters like plant height (73.67 cm), number of leaves per plant (16.22), number of branches (10.30), dry matter content (32.33g plant^{-1}), test weight (13.88 gm) and yield parameters like Number of pods plant^{-1} (123.33), Pod yield plant^{-1} (63.17g), pod yield (30.30q ha^{-1}), seed yield (26.90 q ha^{-1}) and haulm yield (44.15 q ha^{-1}). However, higher Benefit:Cost (B:C) ratio was also observed in application of 100 % RDF + poultry manure at 6 t ha^{-1} + sulphur at 40 kg ha^{-1} through gypsum (3.41) and lower B:C ratio recorded in treatment receiving recommended dose of fertilizer (RDF) and farm yard manure (FYM) application.

Key words: *Sulphur, Organic, Soybean, Growth, Yield, Alfisols, and B:C ratio*

INTRODUCTION

The soybean [*Glycine max* (L.)] is a species of legume native of East Asia, widely grown for its edible bean which has numerous uses. Fat-free (defatted) soybean meal is a significant and cheap source of protein for animal feeds and many prepackaged meals. It has been recognized as one of the most important food crops of world next to wheat, rice and maize. Soybean is a major oil seed crop of the world, grown in an area of 118.01 million hectares with production of 315.06 million tonnes and productivity of 2.67 t ha^{-1} [1]. In the world, it is being cultivated mainly in USA, Brazil, China, Argentina and India.

Soybean was first introduced to India during 1880 and its cultivation in India has gained momentum.

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In recent years, it has become an important oil seed crop of our country, occupying the third place next to groundnut and rapeseed, mustard in area and production. In India it is grown over an area of 10.02 million hectares with production of 11.64 million tonnes and productivity of 1062 kg ha^{-1} [1]. Predominant soybean growing states in India are Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh, Karnataka and Gujarat. In Karnataka soybean occupies an area of 0.29 million hectare with production of 0.24 million tonnes and productivity of 868 kg ha^{-1} [1]. In Karnataka Belagavi, Bidar, Dharwad, Haveri and parts of Bagalkot are the major soybean growing districts of Karnataka.

Sulphur is one of the essential elements needed by plants. It plays an important role in crop production. In plant nutrient sulphur is required by the plants in amounts similar to phosphorus and is important in protein formation and other functions. Functionally, sulphur significantly influences yield and quality of crops, improves odour and flavour, and imparts resistance to cold hence it is generally considered as a "quality nutrient".

In recent years crop deficiencies of sulphur have been reported with increasing frequency in many parts of the country and considerable yield increases with sulphur application have also been observed with crops such as legumes, forages, groundnut, mustard, soybean, maize, wheat *etc*.

Use of organic manures in agriculture adds much needed organics and mineral matter to the soil. The organic matter addition to soil improves the physical, chemical and biological properties and also improves soil fertility and productivity. Therefore, the use of both the organic manures and chemical fertilizers in appropriate proportion assumes special significance as complementary and supplementary to each other in crop production.

MATERIAL AND METHODS

The field experiment was conducted in the farmer's field at Pallanhalli village, Magadi taluk, Ramanagara district during the *kharif* season 2016. To study the "Effect of varied levels of sulphur and sources of organics on growth, yield parameters and economics of soybean in *Alfisols* of Karnataka". The soil of the experimental site was sandy loam in texture which was nutral (7.38), with low salt content (0.39 dSm^{-1}) and low organic carbon content (8.51 g ka^{-1}).The available nitrogen (240.50kg ha^{-1}) was low, available phosphorus (28.23kg ha^{-1}) was low, available potassium content (165.34kg ha^{-1}) was medium ans low available sulphur (8.17 mg kg^{-1}). The experiment was laid out in a Randomized Complete Block Design with seventeen treatments replicated thrice. The treatment combination include, T_1: Control (RDF + FYM) T_2: 50 % RDF + poultry manure @ 3 t ha^{-1} + 20 kg ha^{-1} sulphur through gypsum, T_3: 50 % RDF + poultry manure @ 3 t ha^{-1} + 40 kg ha^{-1} sulphur through gypsum, T_4: 50 % RDF + poultry manure @ 6 t ha^{-1} + 20 kg ha^{-1} sulphur through gypsum, T_5: 50 % RDF + poultry manure @ 6 t ha^{-1} + 40 kg ha^{-1} sulphur through gypsum, T_6: 100 % RDF + poultry manure @ 3 t ha^{-1} + 20 kg ha^{-1} sulphur through gypsum, T_7: 100 % RDF + poultry manure @ 3 t ha^{-1} + 40 kg ha^{-1} sulphur through gypsum, T_8: 100 % RDF + poultry manure @ 6 t ha^{-1} + 20 kg ha^{-1} sulphur through gypsum, T_9: 100 % RDF + poultry manure @ 6 t ha^{-1} + 40 kg ha^{-1} sulphur through gypsum, T_{10}: 50 % RDF + vermicompost @ 3 t ha^{-1} + 20 kg ha^{-1} sulphur through gypsum, T_{11}: 50 % RDF + vermicompost @ 3 t ha^{-1} + 40 kg ha^{-1} sulphur through gypsum, T_{12}: 50 % RDF + vermicompost @ 6 t ha^{-1} + 20 kg ha^{-1} sulphur through gypsum, T_{13}: 50 % RDF + vermicompost @ 6 t ha^{-1} + 40 kg ha^{-1} sulphur through gypsum, T_{14}: 100 % RDF + vermicompost @ 3 t ha^{-1} + 20 kg ha^{-1} sulphur through gypsum , T_{15}: 100 % RDF + vermicompost @ 3 t ha^{-1} + 40 kg ha^{-1} sulphur through gypsum, T_{16}: 100 % RDF + vermicompost @ 6 t ha^{-1} + 20 kg ha^{-1} sulphur through gypsum, T_{17}: 100 % RDF + vermicompost @ 6 t ha^{-1} + 40 kg ha^{-1} sulphur through gypsum.

The experiment consisted of 2 levels of sulphur 20 and 40 kg ha^{-1} through gypsum, 2 levels of poultry manure and vermicompost at 3 and 6 t ha^{-1} (on dry basis). Recommended dose of fertilizer for soybean crop is 25: 60: 25 kg N, P_2O_5, K_2O and 50 per cent of recommended dose (12.5:60:12.5 kg N, P_2O_5 and K_2O ha^{-1}) which were applied according to the treatment details. Nitrogen in the form of urea and DAP, P_2O_5 in the form of DAP, K_2O in the form of Muriate of potash (MOP**)** and sulphur in the form of gypsum were applied at the time of sowing. Farm yard manure, Poultry manure, Vermicompost were applied two weeks before sowing as per the treatments. MAUS 2 a high yielding variety of soybean was used as the test crop in this experiment. The experimental field was ploughed with tractor-drawn plough twice and finally with cultivator followed by rotovator to get fine tilth. Later the stubbles were removed and the field was uniformly leveled and layout was implemented for *kharif* soybean. Seeds were sown on 28 July, 2016. Weeding, gap filling, thinning, irrigation and pesticide application were done as and when necessary. The plants selected for growth studies were also utilized for recording the growth parameters such as plant height, dry matter accumulation and yield components such as number of pods per plant, number of seeds for pod and seed yield per plant. Grain yield and haulm yield altogether were considered as biological yield. The crop was harvested each plot wise and the yields were expressed in q ha^{-1}.

The cost of inputs that were prevailing at the time of their use was considered for working out the economics of various treatment combinations. A net return ha^{-1} was calculated by deducting the cost of cultivation from gross income per hectare. Benefit cost ratio was calculated by using the following formula.

$$\text{Benefit cost ratio (B:C ratio)} = \frac{\text{Gross returns (Rs.)}}{\text{Cost of cultivation (Rs.)}}$$

These data's *viz*., growth and yield parameters, grain yield and haulm yield were statistically analyzed by adopting standard procedures outlined by Gomez and Gomez[5].

Harvest index is the ratio of the economic (grain) yield to the total biological yield as suggested by Donald[3]. It was obtained as follows.

$$\text{Harvest index} = \frac{\text{Grain yield (kg ha}^{-1}\text{)}}{\text{(Pod yield + Stalk yield) kg ha}^{-1}}$$

RESULTS AND DISCUSSION

Effect on Growth parameters:

The data on the growth and yield parameters of soybean revealed that the application of varied levels of sulphur and sources of organics with recommended dose of fertilizer (NPK) as per different treatments had shown significant influence on the plant height, number of leaves, number of branches and total dry matter production at harvest of crop growth are presented in Table 1.

Significantly higher growth parameters such as plant height (73.67cm), number of leaves per plant (16.22), number of branches per plant (10.30) and dry matter content per plant (32.33 g) were recorded in T_9 treatment which received 100 % RDF + PM at 6 t ha^{-1} + sulphur at 40 kg ha^{-1} through gypsum when compared to other treatments. However, it was on par with treatment receiving 100 % RDF + poultry manure at 6 t ha^{-1} + sulphur at 20 kg ha^{-1} through gypsum. . However, lowest growth parameter was recorded in the (T_1) control (RDF + FYM). This might be due application of 40 kg S ha^{-1} and 6 t ha^{-1} poultry manure might have helped in vigorous root growth. Because sulphur plays a key role in

formation of chlorophyll resulting in higher photosynthesis which leads to increase in plant height, more number of leaves and more number of branches. Similar results were observed by Gupta *et al*.[6]. They showed that the effects of poultry manure (PM, 0 and 5 t ha^{-1}) and sulphur fertilizer (0, 20, 40 and 60 kg ha^{-1}) on the growth and yield of soybean cultivars JS-335 and NRC-12 are positive. Higher dry matter production could be due to release of sulphate (SO_4-S) ions immediately in to soil solution resulting in better absorption of sulphur nutrient which has resulted in vigorous growth and production of higher dry matter accumulation by plant. Similar results were reported by Prasad *et al*.[10], and Ramamoorthy *et al*.[11], in soybean.

Effect on yield parameters

The data on the yield parameters of soybean revealed that the application of varied levels of sulphur and sources of organics with recommended dose of fertilizer (NPK) as per different treatments had shown significant influence on the Number of pods per plant, Pod yield per plant, Seed yield per plant and Test weight at harvest of crop growth are presented in Table 2.

Significantly higher number of pod per plant (123.33), pod yield per plant (63.17 g) and seed yield per plant (53.11 g) was recorded where 100 % RDF + PM at 6 t ha^{-1} + sulphur at 40 kg ha^{-1} through gypsum (T_9) was applied. However, it was on par with treatments T_8 where 100 % RDF + PM at 3 t ha^{-1} + sulphur at 40 kg ha^{-1} through gypsum (59.88 g). However, lower Number of pods per plant, Pod yield per plant, Seed yield per plant and Test weight was recorded in (T_1) control (RDF + FYM) compared to all other treatments. This might be due to application of 40 kg of sulphur in combination of poultry manure higher yield components that are directly responsible for seed yield appeared to determined by physiological characters both during vegetative and reproductive phase of the crop growth. The results of this investigation agree with the findings of Tomar *et al*.[14].

Effect on pod yield, seed yield and haulm yield:

There was a significant difference in the pod, seed and haulm yields of soybean (q ha^{-1}) due to application of varied levels of sulphur and sources organics, the results were shown in the Table 3.

Application of 100 % RDF + PM at 6 t ha^{-1} + sulphur 40 kg ha^{-1} through gypsum (T_9) proved significantly superior and produced highest Pod yield (30.30 q ha^{-1})**,** seed yield (26.90 q ha^{-1}) and haulm yield (44.15 q ha^{-1}) as compared to other treatments. But it was on par with treatment T_8 received 100 % RDF + PM at 6 t ha^{-1} + sulphur at 40 kg ha^{-1} through gypsum. However, lowest seed and haulm yield (13.64 q ha^{-1} and 21.22 q ha^{-1} respectively) was obtained in the (T_1) control (RDF + FYM) treatment. This higher pod, grain and haulm yields in these treatments might be due to application of organic manures in combination with inorganic fertilizers to the soil, resulted in increased availability of nutrients considerably improvement in yield parameters were observed. These findings are in accordance with the results of Babalad[2] who observed increased yield and yield attribute in soybean due to application of organic manure and inorganic fertilizers. Similar results were reported by Sharma and Dixit[12]. The difference in the seed yield was largely because of variations in yield components such as number of pods $plant^{-1}$, seed yield $plant^{-1}$ and test weight. It might be due to higher yield components that are directly responsible for seed yield appeared to be determined by physiological characters both during vegetative and reproductive phases of the crop growth. The results of this investigation agree with the findings of Tomar *et al*.[14].

Economics of soybean crop:

The data on cost of cultivation, gross returns and net returns as influenced by different sources and levels of boron and sulphur are presented in Table 4.

Application of (T_{17}) 100 % RDF + VC at 6 t ha^{-1} + sulphur at 40 kg ha^{-1} through gypsum was recorded the maximum cost of cultivation (Rs. 31613 ha^{-1}) and minimum cost of cultivation was recorded in (T_2) control (Rs. 23357 ha^{-1}). Higher gross returns (Rs. 97500 ha^{-1}), net returns (Rs.68887 ha^{-1}) and B:C ratio(3.41) were recorded in (T_9) 100 % RDF + PM at 6 t ha^{-1} + sulphur at 40 kg ha^{-1} through gypsum followed by (T_8) 100 % RDF + PM at 6 t ha^{-1} + sulphur at 20 kg ha^{-1} through gypsum (Rs.3.24 ha^{-1}). Lowest gross net return and B:C ratio was observed in (T_1) control treatment. Higher gross and net returns might be due to lower cost of cultivation including the cost of these fertilizers in this treatment and B:C ratio (3.41) was also found maximum with these treatments. This might be due to increase in economic yield of soybean under these nutrient management practices coupled with lower cost of cultivation. Increase in monetary returns due to organic manures (poultry manure) and its combination with inorganic fertilizers was also reported by Joshi and Billore[7] and Patel and Patel[8] and also this might be due to more availability of sulphur through gypsum which has increased the seed yield, stalk yield and quality of safflower. These results are in accordance with the findings of Sharma *et al.*[13], Verma *et al*.[15], and Patel *et al.*[9].

Table 1: Growth parameters of soybean at harvest as influenced by combined application of varied levels of sulphur and sources of organics

Treatments	Plant height (cm)	Number of branches $plant^{-1}$	Number of leaves $plant^{-1}$	Total dry matter $plant^{-1}$ (g)
	At 90 DAS			
T_1 - Control (RDF + Rec. FYM)	46.15	3.65	4.99	11.77
T_2 - 50 % RDF + PM @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	60.88	5.30	8.90	23.22
T_3 - 50 % RDF + PM @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	61.91	5.66	9.26	23.81
T_4 - 50 % RDF + PM @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	63.18	6.46	7.55	25.29
T_5 - 50 % RDF + PM @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	64.26	6.78	10.67	25.92
T_6 - 100 % RDF + PM @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	68.11	8.37	12.15	28.40
T_7 - 100 % RDF + PM @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	69.22	8.70	12.52	29.33
T_8 - 100 % RDF + PM @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	71.11	9.05	14.33	30.58
T_9 - 100 % RDF + PM @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	73.67	10.30	16.22	32.33
T_{10}- 50 % RDF + VC @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	54.15	4.07	7.27	20.42
T_{11}- 50 % RDF + VC @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	55.44	4.25	7.74	20.92
T_1 - 50 % RDF + VC @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	57.26	4.63	8.22	22.22
T_{13}- 50 % RDF + VC @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	58.55	4.92	8.54	22.85
T_{14}- 100 % RDF + VC @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	62.04	6.25	9.52	24.18
T_{15}- 100 % RDF + VC @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	63.00	6.33	9.91	24.85
T_{16}- 100 % RDF + VC @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	66.38	7.63	10.85	26.67
T_{17}- 100 % RDF + VC @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	68.48	7.81	11.59	27.07
Sem ±	**0.82**	**0.82**	**0.64**	**0.53**
CD@ 5 %	**2.37**	**2.36**	**1.83**	**1.53**

Table 2: Yield attributes of soybean at harvest as influenced by combined application of varied levels of sulphur and sources of organics

Treatments	Number of pods plant^{-1}	Test weight (g)	Pod yield plant^{-1} (g)	Seed yield plant^{-1} (g)
T_1 - Control (RDF + Rec. FYM)	73.67	8.41	31.36	28.00
T_2 - 50 % RDF + PM @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	87.71	10.52	48.89	39.41
T_3 - 50 % RDF + PM @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	89.17	10.85	49.66	40.63
T_4 - 50 % RDF + PM @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	95.44	11.75	52.11	43.81
T_5 - 50 % RDF + PM @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	97.67	11.92	53.19	44.58
T_6 - 100 % RDF + PM @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	106.33	12.26	56.74	47.96
T_7 - 100 % RDF + PM @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	108.67	12.98	58.59	49.70
T_8 - 100 % RDF + PM @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	114.33	13.10	59.88	50.71
T_9 - 100 % RDF + PM @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	123.33	13.88	63.17	53.11
T_{10}- 50 % RDF + VC @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	81.04	9.72	43.21	34.41
T_{11}- 50 % RDF + VC @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	82.07	10.03	44.79	35.96
T_1 - 50 % RDF + VC @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	83.96	10.51	46.99	37.55
T_{13}- 50 % RDF + VC @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	85.11	10.77	47.92	38.79
T_{14}- 100 % RDF + VC @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	91.67	11.29	50.40	41.65
T_{15}- 100 % RDF + VC @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	93.70	11.52	51.59	42.16
T_{16}: 100 % RDF + VC @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	98.00	12.10	53.44	44.03
T_{17}- 100 % RDF + VC @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	101.67	12.25	54.59	45.08
Sem ±	**3.55**	**0.64**	**1.37**	**0.70**
CD@ 5 %	**10.21**	**1.83**	**3.94**	**2.01**

Table 3: Pod, seed and haulm yields of soybean at harvest as influenced by combined application of varied levels of sulphur and sources of organics

Treatments	Pod yield (q ha^{-1})	Seed yield (q ha^{-1})	Haulm yield (q ha^{-1})
T_1 - Control (RDF + Rec. FYM)	14.67	13.64	21.22
T_2 - 50 % RDF + PM @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	19.89	19.01	32.15
T_3 - 50 % RDF + PM @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	22.23	19.38	32.67
T_4 - 50 % RDF + PM @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	22.87	20.42	34.08
T_5 - 50 % RDF + PM @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	23.17	20.80	34.82
T_6 - 100 % RDF + PM @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	25.75	23.07	38.08
T_7 - 100 % RDF + PM @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	26.65	23.44	39.19
T_8 - 100 % RDF + PM @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	27.85	24.47	41.20
T_9 - 100 % RDF + PM @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	30.30	26.90	44.15
T_{10}- 50 % RDF + VC @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	18.05	16.79	28.17
T_{11}- 50 % RDF + VC @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	18.33	17.03	29.01
T_{12} - 50 % RDF + VC @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	19.29	17.73	30.33
T_{13}- 50 % RDF + VC @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	19.81	18.11	30.85
T_{14}- 100 % RDF + VC @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	22.33	20.07	33.05
T_{15}- 100 % RDF + VC @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	22.83	20.41	33.67
T_{16}- 100 % RDF + VC @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	24.67	22.81	35.75
T_{17}- 100 % RDF + VC @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	25.73	23.05	36.15
Sem ±	**1.41**	**0.89**	**1.22**
CD @ 5 %	**4.06**	**2.56**	**3.59**

Table 4: Economics of soybean as influenced by varied levels of sulphur and sources of organics application

Treatments	Cost of cultivation (Rs- ha^{-1})	Gross returns (Rs- ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
T_1 - Control (RDF + Rec. FYM)	26713	53196	26483	1.99
T_2 - 50 % RDF + PM @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	23357	70200	46844	3.01
T_3 - 50 % RDF + PM @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	23557	70629	47073	3.00
T_4 - 50 % RDF + PM @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	26357	79638	53282	3.02
T_5 – 50 % RDF + PM @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	26557	80574	54018	3.03
T_6 - 100 % RDF + PM @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	25413	77532	52119	3.05
T_7 - 100 % RDF + PM @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	25613	78000	52387	3.05
T_8 - 100 % RDF + PM @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	28413	92000	63587	3.24
T_9 - 100 % RDF + PM @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	28613	97500	68887	3.41
T_{10} - 50 % RDF + VC @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	24857	54132	29276	2.18
T_{11} - 50 % RDF + VC @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	25057	54600	29544	2.18
T_{12} - 50 % RDF + VC @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	29357	66729	37373	2.27
T_{13} - 50 % RDF + VC @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	29557	67158	37602	2.27
T_{14} - 100 % RDF + VC @ 3 t ha^{-1} + 20 kg ha^{-1} S by gypsum	26913	69732	42819	2.59
T_{15} - 100 % RDF + VC @ 3 t ha^{-1} + 40 kg ha^{-1} S by gypsum	27113	70200	43087	2.59
T_{16} - 100 % RDF + VC @ 6 t ha^{-1} + 20 kg ha^{-1} S by gypsum	31413	88959	57546	2.83
T_{17} - 100 % RDF + VC @ 6 t ha^{-1} + 40 kg ha^{-1} S by gypsum	31613	89895	58282	2.84

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