International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 8, Issue 51, 2016, pp.-2273-2277.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

EFFECT OF ORGANIC MANURES, FERTILIZERS AND BIO-FERTILIZERS ON GROWTH AND YIELD OF SOYBEAN (*Glycine max*)

MACHHAR R. G.[1], SADHU A. C.[2], PATEL S. K.[3]*, KACHA H. L.[4] AND MOTAKA G.N.[5]

[1,3&4]Krishi Vigyan Kendra, Dahod, Anand Agricultural University, Hadgood Road, Hadgood, Anand, 388110, Gujarat
[2]Department of Agronomy, Anand Agricultural University, Hadgood Road, Hadgood, Anand, 388110, Gujarat.
[5]B. A. College of Agriculture, Anand Agricultural University, Hadgood Road, Hadgood, Anand, 388110, Gujarat
*Corresponding Author: Email-sunjaypatel01@yahoo.com

Received: May 30, 2016; Revised: August 07, 2016; Accepted: August 08, 2016; Published: October 27, 2016

Abstract- Field experiment was conducted at Krishi Vigyan Kendra, Anand Agricultural University, Dahod during *kharif* 2011 and 2012 to study the "Effect of organic manures, fertilizers and bio-fertilizers on growth and yield of soybean (Glycine max)". The experimental field had an even topography with a gentle slope having good drainage and sandy loam in texture. Sixteen treatment combinations in *kharif* soybean comprised of four treatments of organic manures and four treatments of fertilizers/bio-fertilizers were tested in a Factorial Randomize Block Design (FRBD) with four replications. The various growth and yield attributing characters of soybean were significantly higher under the treatment of FYM @ 10.0 t ha^{-1} and the lowest under control (RD) i.e. no organic manure treatment. No significant response of organic manure, fertilizers and bio-fertilizers treatments was observed on plant population at 20 DAS and at harvest during both the years of study and also in pooled results. The highest seed yield (2283, 2338 and 2311 kg ha^{-1} during the years 2011, 2012 and pooled data, respectively) and highest stover yield (3479, 3866 and 3673 kg ha^{-1} during 2011, 2012 and in pooled, respectively) of soybean was recorded with treatment M_3 (10.0 t FYM) over rest of the treatments. Similarly, the highest seed yield (2224 kg ha^{-1}) and stover yield (3637 kg ha^{-1}) were recorded under the treatment B_3 (20 kg S ha^{-1} + 10 kg Zn ha^{-1} + Bio- fertilizer) than other treatments.

Keywords- Organic manure, Fertilizer, Bio-fertilizer, Soybean yield, Soybean stover

Citation: Machhar R. G., et al., (2016) Effect of Organic Manures, Fertilizers and Bio-Fertilizers on Growth and Yield of Soybean (*Glycine max*). International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 8, Issue 51, pp.-2273-2277.

Academic Editor / Reviewer: Pathak Jagannath, Dwivedi B.S., Dr R. K. Mathukia

Introduction

Soybean (*Glycine max*) is one of the most important oilseed crops in the world having eastern Asian origin and belongs to the family *fabaceae*. Soybean has now been established as an economically important leguminous crop, known for its high valued protein, oil, food, feed and industrial application. It enriched the soil by fixing nitrogen in symbiosis with bacteria. In the International World Trade Markets, soybean is ranked number one among the major oil crops. In India, the consumption of oil has been increasing steadily as a result of rise in population and living standard of the people [5, 22].

Soybean accounts for about 50 per cent of oilseeds production and 30 per cent of the total supply of all the vegetable oils in the world. It is a unique two-in-one crop, having both high quality protein (43 per cent) and oil (20 per cent) content. The protein form of soybean is equivalent in quality to that of meat, milk products and eggs. The soybean produces 2-3 times higher good quality protein on per hectare basis and cholesterol free oil than other pulses [15]. The soybean protein is rich in lysine (about 5 per cent), which is deficient in most of the cereals. Out of the total soybean produced, about 85 per cent is utilized for oil extraction, 10 per cent for seed purpose and 5 per cent as a food. Soybean designated as 'miracle bean' has established potential as an industrially vital and viable oilseed crop in many areas of India. Soybean plays a vital role in agricultural economy of India. However, the soybean production is declining in India due to inadequate use of fertilizers. Apart from nitrogen and phosphorus, some of the secondary and micronutrients element are important for increasing the grain yield of soybean. There is an increasing interest in the use of organic manures as a source of nutrient supply to crop production for sustainable soil productivity, ecological stability and to minimize the requirement for chemical fertilizers. Indian soils are poor in organic carbon due to its tropical climate. With the increasing soil degradation and cost of chemical fertilizers, there is a need to integrate them with organic sources, which are good for soil health besides supplying nutrients for longer period. Amongst the different sources of organic manures, FYM, vermicompost and castor cake are easily available in the market. Irrespective of the other crops oilseed crops, sulphur is now rightly called as the fourth essential plant nutrient after N, P and K. Presently, its importance is recognized due to its wide spread deficiency in the soils. The deficiency of sulphur in the soils and crops is mainly due to intensive cultivation with high yielding varieties, use of S- free fertilizers, scarce use of organic manures and increase in irrigation facility. The beneficial role of sulphur in increasing crop production, particularly in the oilseeds and pulse crops has been reported by several researchers. About 37 per cent soils of the Gujarat are found sulphur deficient. The soils of middle Gujarat are light in texture and mostly in medium and deficient range in S availability; which resulted in reduction in yield and quality of the soybean crop [17].

MaterialsandMethods

The field experiment was conducted during the kharif season of 2011 and 2012 at Krishi Vigyan Kendra, Anand Agriculture University, Muvaliya Farm, Dahod. The soil had clay-loam in texture having 0.27% organic carbon, available N 521.3 kg ha-1, available P2O5 38.5 kg ha-1, available K2O 455.6, available S 8.24 mg kg-1 and available Zn 0.92 kg ha-1. The experiment was laid out in Factorial

Randomized Block Design (FRBD) with 4 replications. Sixteen treatment combinations in *kharif* soybean comprised of four treatments of organic manures i.e. M0 (RD), M1 (Castor cake @ 1.0 t ha-1), M2 (Vermicompost @ 2.5 t ha-1) and M3 (FYM @ 10.0 t ha-1) and four treatments of fertilizers/bio-fertilizer i.e. B0: Control, B1: 20 kg S ha-1, B2: 20 kg S ha-1+ 10 kg Zn ha-1, B3: 20 kg S ha-1 + 10 kg Zn ha-1 + Bio-fertilizers. Soybean crop was shown on 15 and 13 July in 2011 and 2012, respectively, maintaining the spacing of 45 cm between two rows. Recommended dose of fertilizer (45: 60:00 NPK kg ha-1 Basal) was applied before sowing of 'NRC-37' soybean.

Data on different aspects of soybean crop were subjected to statistical analysis by SPSS software. The values of calculated "F" was worked out and compared with the value of table "F" at 5 per cent level of significance. The value of S. Em. ± and co-efficient of variation (C.V. %) was also calculated

Results and Discussions

The plant population recorded at 20 DAS and at harvest was not influenced significantly due to fertilizers and bio-fertilizer treatments during individual years as well as on the pooled basis.

The results presented in [Table-1] indicated that the plant height of soybean in both the years as well as on pooled basis was significantly affected by application of different organic manures at 60 DAS and at harvest; however it was not significant at 30 DAS during both the years as well as in pooled results. Significantly higher values of plant height (64.59 and 71.48 cm) were observed at 60 DAS and at harvest, respectively with the treatment FYM (10.0 t ha-1), but remained statistically at par with the treatment Vermicompost @ 2.5 t ha-1 and Castor cake @ 1.0 t ha-1 in the year 2011-12, whereas in the year 2012-13, the plant height was 66.43 cm and 73.66 cm at 60 DAS and at harvest, respectively in the same order. The control treatment (RD) produced shortest plants height at 60 DAS (56.24 and 57.21 cm) and at harvest (64.35 and 67.52 cm) than all the organic manures treatments in the years 2011-12 and 2012-13, respectively. The increase in plant height, number of branches plant-1, days to 50 per cent flowering, days to maturity and number of root nodules plant-1 with FYM was probably due to cytokine synthesis and rapid conversion of synthesized carbohydrates into protein, consequent to increase in the number and size of growing cells, resulting ultimately into more number of branches. Secondly, it might be due to addition significant increase in organic matter content in the soil with the application of organic manure which improved the favourable effect on modifying the soil environment to hold more water and nutrients, better aeration and enhanced microbial activities. These results are in agreement with those reported by [23, 26,19].

An appraisal of the data presented in [Table-1] revealed that the difference in plant height at 30 DAS was non-significant due to different treatments of fertilizers and bio-fertilizer however, numerically higher values of plant height (29.26 cm) was observed with treatment B3. Likewise, significantly higher plant height of soybean was recorded at 60 DAS and at harvest, respectively with the treatment B3, but was at par with other treatments during the years 2011, 2012 and in pooled data.

Interaction effect with respect to plant height recorded at 30, 60 DAS and at harvest was found non-significant during both the years (2011 and 2012) and in the pooled analysis. It appears from the results presented in [Table-2] that the differences in number of branches plant-1 due to organic manures were significant during both the experimental years and in the pooled data. Application of FYM @ 10.0 t ha-1 produced significantly higher number of branches plant-1 (4.46 and 4.73) than control, but was at par with treatments of Vermicompost @ 2.5 t ha-1 and Castor cake @1.0 t ha-1 in both the year (2011 and 2012) and in pooled data. It might be due to better availability of phosphorus to the plants as bacterial culture aids in dissolution of unavailable phosphorus in the soil. The results are in conformity with the findings of [30, 12, 18,15].

Table-1 *Plant height of soybean at 30, 60 DAS and at harvest as influenced by various treatments*

Treatments	Plant height (cm)								
	30 DAS			60 DAS			At harvest		
	2011	2012	Pooled	2011	2012	Pooled	2011	2012	Pooled
Organic manures (M)									
M_0: Control (RD)	28.27	28.36	28.02	56.24	57.21	56.72	64.35	67.52	65.93
M_1: Castor cake @ 1.0 t ha^{-1}	28.88	29.02	28.90	57.62	59.92	58.77	66.95	70.34	68.64
M_2: Vermicompost @ 2.5 t ha^{-1}	28.92	30.08	29.52	61.76	64.76	63.26	69.97	71.61	70.79
M_3: FYM @ 10.0 t ha^{-1}	29.75	30.13	30.07	64.59	66.43	65.51	71.48	73.66	72.57
S.Em. ±	0.53	0.51	0.34	1.05	1.11	1.53	1.38	1.25	1.86
C. D. at 5 %	NS	NS	NS	3.01	3.17	4.31	3.92	3.56	5.23
Fertilizers and bio-fertilizer (B)									
B_0 : Control	28.24	28.55	28.50	57.59	59.32	58.46	66.08	67.28	66.68
B_1 : 20 kg S ha^{-1}	29.06	29.44	29.06	60.02	62.38	61.20	68.16	71.04	69.60
B_2 : 20 kg S ha^{-1} + 10 kg Zn ha^{-1}	29.18	29.69	29.33	60.76	62.75	61.75	68.47	72.27	70.37
B_3 : 20 kg S ha^{-1} + 10 kg Zn ha^{-1} + Bio- fertilizer	29.34	29.92	29.62	61.83	63.87	62.85	70.04	72.53	71.28
S.Em. ±	0.53	0.51	0.34	1.05	1.11	0.77	1.38	1.25	0.93
C. D. at 5 %	NS	NS	NS	3.01	3.17	2.15	3.92	3.56	2.61
Interaction M × B	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	7.27	7.00	6.65	7.03	7.17	7.10	8.08	7.07	8.90

The number of root nodules plant-1 was increased significantly at 40 DAS during both the years as well as in combined analysis due to organic manure treatments [Table-2]. Application of FYM @ 10.0 t ha-1 (M3) significantly enhanced the number of root nodules plant-1 in both the years and in pooled data. The corresponding values for M1 and M2 were 46.31 and 47.38 as well as 52.13 and 54.50 during the years 2011 and 2012, respectively. The lowest values of 39.94 and 41.06 were observed in control treatment (M0) during the years 2011 and 2012, respectively. The treatment B3 produced significantly higher number of root nodules plant-1 (51.19 and 54.38 during the years 2011 and 2012, respectively). The same values for B1 and B2 were 47.38 and 48.69 during the year 2011, whereas in the year 2012, it was 50.38 and 51.69, respectively. The lowest number of root nodules plant-1 (45.50 and 45.94) was recorded under control treatment during the years 2011 and 2012, respectively. The increase under the treatment B3 was to the tune of 12.51, 18.37 and 15.44 per cent over B0 (control) in the years 2011, 2012 and in pooled data results respectively. These results are in close agreement with those reported by [28, 6, 24, ,25].

It was observed from the data [Table-3] that fertilizers and bio-fertilizer significantly increased the number of days to 50 per cent flowering on pooled basis, whereas, it was found not significant during both the years. The maximum number of days to 50 per cent flowering was observed in B3 treatment. The increase under the

treatment B3 was to the tune of 4.25 per cent over B0 on pooled basis.

Interaction effect of organic manures and fertilizers/bio-fertilizer with respect to number of root nodules plant-1 recorded at 40 days after sowing was non-significant during the years 2011, 2012 and in pooled analysis.

It was observed from the [Table-3] that organic manures significantly increased days to 50 per cent flowering in both the years and also in their combined analysis. Among the organic manure treatments, treatment M3 recorded significantly the highest number of days to 50 % flowering (51.7, 48.2 and 49.9, respectively) during the years 2011, 2012 and in the pooled analysis than M2, however it was found at par with treatments M1 and M0 during both the years as well as in pooled analysis. The minimum days to 50 per cent flowering was recorded under treatment M0 (control) in 2011, 2012 and in combined analysis. The maximum days to 50 per cent flowering (49.1 days) was recorded under the treatment B3 as compared to rest of the treatments in pooled results, but was remained at par with B1 and B2 treatments. The minimum number of days to 50 per cent flowering (48.8, 45.5 and 47.1, respectively) was recorded by treatment B0 during the years 2011, 2012 and in pooled data.

Table-2 *Number of branches plant^{-1} and number of root nodules plant^{-1}of soybean as influenced by various treatments*

Treatments	No. of branches plant^{-1}			No. of root nodules plant^{-1}		
	2011	2012	Pooled	2011	2012	Pooled
Organic manures (M)						
M_0: Control (RD)	3.54	3.62	3.58	39.94	41.06	40.50
M_1: Castor cake @ 1.0 t ha^{-1}	3.79	3.82	3.81	46.31	47.38	46.84
M_2: Vermicompost @ 2.5 t ha^{-1}	4.12	4.44	4.28	52.13	54.50	53.31
M_3: FYM @ 10.0 t ha^{-1}	4.46	4.73	4.60	54.38	59.44	56.91
S.Em. ±	0.10	0.12	0.11	0.97	1.25	0.78
C. D. at 5 %	0.29	0.34	0.32	2.76	3.57	2.21
Fertilizers and bio-fertilizer (B)						
B_0 : Control	3.55	3.82	3.69	45.50	45.94	45.72
B_1 : 20 kg S ha^{-1}	3.77	4.03	3.90	47.38	50.38	48.88
B_2 : 20 kg S ha^{-1} + 10 kg Zn ha^{-1}	4.18	4.29	4.24	48.69	51.69	50.19
B_3 : 20 kg S ha^{-1} + 10 kg Zn ha^{-1} + Bio- fertilizer	4.40	4.47	4.44	51.19	54.38	52.78
S.Em. ±	0.10	0.12	0.11	0.97	1.25	0.78
C. D. at 5 %	0.29	0.34	0.32	2.76	3.57	2.21
Interaction M × B	NS	NS	NS	NS	NS	NS
C.V. %	10.21	11.34	10.78	8.05	9.90	6.28

Table -3 *Number of days to 50 per cent flowering and days to maturity of soybean as influenced by various treatments*

Treatments	Number of days to 50 per cent flowering			Days to maturity		
	2011	2012	Pooled	2011	2012	Pooled
Organic manures (M)						
M_0: Control (RD)	48.5	43.9	46.2	102.6	103.2	102.9
M_1: Castor cake @ 1.0 t ha^{-1}	50.0	45.5	47.8	103.8	104.7	104.2
M_2: Vermicompost @ 2.5 t ha^{-1}	50.3	48.1	49.2	104.4	105.3	104.8
M_3: FYM @ 10.0 t ha^{-1}	51.7	48.2	49.9	105.9	106.8	106.3
S.Em. ±	0.68	0.67	0.58	1.07	0.91	0.79
C. D. at 5 %	1.95	1.90	1.44	NS	NS	2.27
Fertilizers and bio-fertilizer (B)						
B_0 : Control	48.8	45.5	47.1	102.5	104.6	103.6
B_1 : 20 kg S ha^{-1}	49.8	46.2	47.9	104.6	104.9	104.8
B_2 : 20 kg S ha^{-1} + 10 kg Zn ha^{-1}	51.1	46.7	48.9	104.4	105.0	104.7
B_3 : 20 kg S ha^{-1} + 10 kg Zn ha^{-1} + Bio-fertilizer	50.9	47.3	49.1	105.1	105.4	105.2
S.Em. ±	0.68	0.67	0.58	1.07	0.91	0.79
C. D. at 5 %	NS	NS	1.44	NS	NS	2.27
Interaction M × B	NS	NS	NS	NS	NS	NS
C.V. %	5.45	5.73	4.20	4.11	3.48	3.05

It was observed from the data [Table-3] that organic manures did not significantly increase the number of days to maturity in both the years, but in combined analysis, number of days to maturity was significantly affected due to organic manure treatments. Treatment M3 recorded the highest days to maturity (106.3 days) in the pooled analysis, however it was found at par with treatments M2, M1 and M0 in the pooled analysis. It is evident from the data [Table-3] that fertilizers and bio-fertilizer application not significantly influenced the numbers of days to maturity during both the years as well as in the pooled analysis. The maximum days to maturity (105.1 days) was recorded under the treatment B3 as compared to rest of the treatments in pooled results. The minimum number of days to maturity of 102.5, 104.6 and 103.6 was recorded by treatment B0 during the years 2011, 2012 and in pooled data, respectively.

Interaction effect of organic manures and fertilizers/bio-fertilizer with respect to days to 50 per cent flowering and number of days to maturity was found non-significant during the years 2011, 2012 and in pooled data.

Result pertaining to the pod length presented in [Table-4] indicates that significantly higher average pod length (3.66, 3.90 and 3.79 cm in the years 2011, 2012 and in pooled analysis, respectively) was recorded in treatment of FYM @ 10.0 t ha-1, which was found to be at par with Vermicompost @ 2.5 t ha-1 and Castor cake @1.0 t ha-1. Control treatment (RD) recorded the lowest pod length (2.67 and 2.92cm in the years 2011 and 2012, respectively). Significantly maximum pod length of 3.50 cm and 3.88 cm was recorded with treatment B3 during the years 2011 and 2012, respectively showing it's superiority over rest of the treatments i.e. B2 and B1. Increased pod length under the treatments M3, M2 and M1 was to the tune of 35.84, 30.47 and 16.49 per cent over M0, respectively on pooled basis. The increase in pod length was might be ascribed to the fact that after proper decomposition and mineralization of applied organic manures. Slow release of nutrients during the entire crop growth period resulted in to better plant growth. The present findings are in close agreement with those reported by [23, 27, 8,2].

The number of seeds pod-1 was significantly influenced by different organic manures during both the years as well as in combined analysis [Table-4]. Application of FYM @ 10.0 t ha-1 (M3) recorded significantly more number of seeds per pod (3.13, 3.36 and 3.24 in the year 2011, 2012 pooled analysis, respectively) than rest of the treatments. Treatment M3 increased number of seeds pod-1 to the extent of 31.51, 28.57 and 29.60 per cent over control treatment in the years 2011, 2012 and pooled analysis, respectively. Significantly higher values of number of seeds pod-1 (2.99 in the year 2011, 3.19 in the year 2012 and 3.09 in the pooled result) were recorded under treatment B3 than treatment B0, but it was remained statistically at par with the treatments B2 and B1 in the same year. Application of organic manures increased the number of seeds pod-1 with enhancement in the uptake of nutrients at flowering and improvement in the size of the sink to receive the source i.e. increased seeds pod-1. These results corporate with those of [4, 13, 26]. The increase yield attributes under PSB treatment may be due to favourable effect of phosphate solubilizing bacteria on root growth and increased root activity thereby overall increased in absorption of applied nutrients which indirectly helps in increased in the growth of the root and ultimately effect on increased in yield attributes. Similar results were obtained by [6]. Secondly, the benefit of bio-fertilizers might be ascribed to N addition through biological N fixation by Rhizobium, activation of amino acids for synthesis of carbohydrates and P solubilization by PSB treatment. Co-inoculation of bio-fertilizer produced heavier seeds, which might be accorded to the better translocation of photosynthetic [9]. Number of seeds pod-1 was found non-significant due to interaction effect of organic manures and fertilizers/ bio-fertilizer during both the years (2011 and 2012) as well as in pooled analysis [Table-4].

Table-4 *Number of seeds pod-1 and pod length (cm) as influenced by various treatments*

Treatments	Pod length (cm)			No. of seeds pod-1		
	2011	2012	Pooled	2011	2012	Pooled
Organic manures (M)						
M_0: Control (RD)	2.67	2.94	2.79	2.38	2.62	2.50
M_1: Castor cake @ 1.0 t ha-1	2.92	3.58	3.25	2.62	2.77	2.70
M_2: Vermicompost @ 2.5 t ha-1	3.50	3.79	3.64	3.06	3.16	3.11
M_3: FYM @ 10.0 t ha-1	3.66	3.90	3.79	3.13	3.36	3.24
S.Em. ±	0.09	0.10	0.07	0.08	0.08	0.07
C. D. at 5 %	0.25	0.27	0.20	0.23	0.23	0.19
Fertilizers and bio-fertilizer (B)						
B_0 : Control	2.92	2.96	2.94	2.34	2.65	2.50
B_1 : 20 kg S ha-1	3.11	3.58	3.35	2.88	3.00	2.94
B_2 : 20 kg S ha-1 + 10 kg Zn ha-1	3.24	3.75	3.49	2.98	3.07	3.03
B_3 : 20 kg S ha-1 + 10 kg Zn ha-1 + Bio-fertilizer	3.50	3.88	3.69	2.99	3.19	3.09
S.Em. ±	0.97	1.25	0.78	0.08	0.08	0.07
C. D. at 5 %	2.76	3.57	2.21	0.23	0.23	0.19
Interaction M × B	NS	NS	NS	NS	NS	NS
C.V. %	8.05	9.90	6.28	11.48	10.99	9.33

The result presented in [Table-5] showed that application of FYM @ 10.0 t ha-1 recorded significantly higher seed yield (2283, 2338 and 2311 kg ha-1 during the years 2011, 2012 and pooled data, respectively) and this treatment was found to be at par with treatments of Vermicompost @ 2.5 t ha-1 and Castor cake @ 1.0 t ha-1. The lowest values of seed yield (1720 kg ha-1 in years 2011, 1573 kg ha-1 in year 2012 and 1647 kg ha-1 pooled data) were recorded with M0. The marked decrease in seed yield under M0 treatment was may be due to inadequate supply of nutrients, poor root proliferation which resulted in poor growth and yield attributes. Above findings are in accordance with those reported by [1], who observed that the yield of soybean was increased with increase in the FYM application rates upto 10.0 t ha-1. [4, 20, 19, 3] and [16] under different soil and climatic conditions also reported the similar results.

Table- 5 *Seed and stover yield (kg ha-1)of soybean as influenced by various treatments*

Treatments	Seed yield (kg ha-1)			Stover yield (kg ha-1)		
	2011	2012	Pooled	2011	2012	Pooled
Organic manures (M)						
M_0: Control (RD)	1720	1573	1647	3079	3540	3310
M_1: Castor cake @ 1.0 t ha-1	1868	1732	1800	3129	3551	3340
M_2: Vermicompost @ 2.5 t ha-1	2155	2185	2170	3225	3762	3494
M_3: FYM @ 10.0 t ha-1	2283	2338	2311	3479	3866	3673
S.Em. ±	56	57	41	91	88	53
C. D. at 5 %	160	164	116	258	250	151
Fertilizers and bio-fertilizer (B)						
B_0 : Control	1772	1601	1687	2918	3482	3200
B_1 : 20 kg S ha-1	1901	1955	1928	3225	3691	3458
B_2 : 20 kg S ha-1 + 10 kg Zn ha-1	2122	2056	2089	3337	3703	3520
B_3 : 20 kg S ha-1 + 10 kg Zn ha-1 + Bio-fertilizer	2231	2217	2224	3432	3842	3637
S.Em. ±	56	57	41	91	88	53
C. D. at 5 %	160	164	116	258	250	151
Interaction M × B	NS	NS	NS	NS	NS	NS
C.V.%	11.23	11.78	8.19	11.23	9.55	6.14

The seed yield was significantly affected during both the years as well as in pooled data [Table-5]. A perusal of data revealed that treatment B3 recorded significantly the highest seed yield of 2231, 2217 and 2224 kg ha-1 during 2011, 2012 and in pooled data, respectively. Treatment B3 was found significantly superior than treatments B0 and B1 in both the years and in pooled analysis. The control treatment (B0) resulted in significantly the lowest seed yield of soybean (1772, 1601 and 1687 kg ha-1 in 2011, 2012 and in pooled data, respectively). Data presented in [Table-5] indicated that seed yield of soybean was unaffected

due to interaction effect between organic manures and fertilizers/bio-fertilizer. The increase in seed yield with application of sulphur @ 20 kg ha-1 along with 10 kg Zn ha-1 and seed inoculation of Rhizobium + PSB (B3) might be due to better yield attributes like pod length and number of seeds pod-1.

Among the different organic treatments, application of FYM @ 10.0 t ha-1 (M3) was turned out to be superior over rest of the treatments during both the years as well as in pooled data. The per cent increase recorded with treatment M3 in 2011, 2012 and in pooled data over treatment M0 (control) was 9.21, 13.00 and 10.97 per cent, over M1 was 8.87, 11.19 and 9.97 per cent and over M2 was 2.76, 7.88 and 5.12 per cent, respectively. Significantly the lowest stover yield was recorded under treatment M0. These results supported the observations made by [1, 26, 8] and [19]. The different fertilizers and bio-fertilizer treatments, the treatment B3 was turned out to be superior over rest of the treatments during both the years as well as in pooled data. The maximum stover yield of soybean was recorded with treatment B3 (3432, 3842 and 3637 kg ha-1) over rest of the treatments viz.; B0 (2918, 3482 and 3200), B1 (3225, 3691 and 3458 kg ha-1) and B2 (3337, 3703 and 3520 kg ha-1) during 2011, 2012 and in pooled data, respectively. The lowest value of stover yield was recorded with control treatment (B0). Interaction effect between organic manure and fertilizers/bio-fertilizer with respect to stover yield was found non-significant. Similar results were observed by [14, 11, 6, 12, 10, 21] and [29].

Conclusions

It may be concluded that organic manures FYM@10 t ha-1 and fertilizers/bio-fertilizers @ [20 kg S ha-1 + 10 kg Zn ha-1 + bio-fertilizer (rhizobium + PSB)] gave higher plant height, number of branches plant-1, number of root nodules plant-1, number of days to 50 per cent flowering, days to maturity, pod length, number of seed pod-1 ultimately produced highest seed and stover yield.

Conflict of Interest: None declared

References

[1] Bachhav P.R. and Sable R.A. (1996) *J. Maharashtra Agric. Univ.,* 21(2), 244-247.

[2] Bachhav S.D., Patel S.H. and Suryawanshi P.K. (2012) *International. J. Forestry and Crop Improve*., 3 (2), 140-143.

[3] Bandyopadhyay K.K., Ghosh P.K., Chaudhary R.S., Hati K. M., Mandal K. G and Mishra J.A. (2004) *Indian J. Agric. Sci.,* 74 (2), 55-63.

[4] Bisht J.K. and Chandel A.S. (1996) *Ann. Agric. Res.,* 17, 360-65.

[5] Chung G. and Singh R.J. (2008) *Plant Sci*., 27, 295-341.

[6] Dubey B.C., Siddiqui SA., Shukla N. P and Hasija S. K. (1995) *Advance Agricultural Res.in India*., 4, 29-35.

[7] Dubey S.K. (1997) *J. Indian Soci. Soil Sci*., 45, 506-509.

[8] Ghosh P. K., Bandyopadhyay K. K. and Singh A. B. (2005) *J. Oilseeds Res*., 22 (2), 289-292.

[9] Gupta V, Sharma R. S. and Vishwakarma H. S. (2006) *Indian J. Agro*n., 51 (3), 160-164.

[10] Ijgude M.B. and Kadam J.R. (2008) *An Asian J. Soil Sci.,* 3 (1), 194-196.

[11] Jat J.R. and Mehra R.K. (2007) *J. Indian soc. of soil sci.,* 55 (2),190-195.

[12] Joshi O. P. (2003) *Soybean Res*., 1, 29-42.

[13] Kathiresan G., Manickam G. and Gnanamurthy P. (1999) *J. Oilseed Res*., 16 (2), 249-259.

[14] Krishna K.G., Rao K.L., Kumar A.R and Sreelatha D.(1995) J. *Maharashtra Agric. Uni.,* 20 (2), 246-248.

[15] Kumar S., Singh R.K and Solanki N.S. (2004) *Indian J. Agron*., 49(4), 237-240.

[16] Laharia G. S., Patil Darshana, U. and Damre P.R. (2013) *Crop Res.,* 45(1, 2 & 3), 155-159.

[17] Machhar R.G., Sadhu A.C., Patel S.K. and Patel V.J. (2015) *Green Farming,* 6(5), 1042-1045.

[18] Menaria B.L. and Singh P. (2004) *Legume Res.,* 27(3), 231-232.

[19] Narayana L., Gurumurthy K.T. and Prakasha H. C. (2009) *J. Agric. Sci*., 22 (2), 435-437.

[20] Navale K.B., Gaikwad C. B. and Tamboli B.D. (2000) *J. Maharastra Agric. Univ.,* 25 (1),105-107.

[21] Pable D. and Patil D.B. (2011) *International. J. Agric. Sci.,* 7 (1), 129-132.

[22] Patel S.K., Patel U.M., Trivedi M.M., Machhar R.G., Kacha H.L. (2014) *Spring* 3(4), 6-10

[23] Pattanashetti V. A., Agasimani C. A. and Babalad H. B. (2002) *J.Oilseeds Res*., 19 (1),113-114.

[24] Sharma K.N. and Namdeo K.N. (1999b) *Crop Res*., 17(2),164-169.

[25] Shittu O.S. and Ogunwale J.A. (2013) *Agricultural Journal*., 8 (2), 78-82.

[26] Talati P.K. (2004) Effect of inorganic and organic sources of nitrogen on summer soybean (*Glyscin max*. (L.) Merrill) under south Gujarat condition. Unpublished M.Sc. (Argi.) thesis submitted to G.A.U., S.K.Nagar.

[27] Thanuna than, K., Arulmurugan K., Kuppuswamy G and Ravichandran (2002) *Madras Agric. J*., 89, 613-616.

[28] Tiwari K.P., Namdeo K.N., Lal J.P.(1993) *J. Oilseeds Res*., 10(2), 6-9.

[29] Uike Y., Kulhare P.S., Sharma G.D., Thakur R.K., and Yadav B. (2013) *Indian J. Agron.,* 58(3), 437-439.

[30] Vara J.A., Modhwadia M.M., Patel B.S., Patel J.C. and Khanpara V.D. (1994) *Indian J. Agron*., 39 (4), 678.