Int.J.Curr.Microbiol.App.Sci (2020) *9*(10): 440-451

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 10 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.910.054

Effect of Sources and Levels of Sulphur on Growth and Yield of *kharif* Soybean [*Glycine max* (L.) Merrill]

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Keywords

Soybean, Sulphur sources, Sulphur levels, Growth, Yield

Article Info

Accepted:
07 September 2020
Available Online:
10 October 2020

A B S T R A C T

A field experiment was conducted at Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh to assess the effect of sources and levels of sulphur on nutrient composition, yield and quality of *kharif* soybean [*Glycine max* (L.) Merrill] during the *kharif* season of 2018-2019. The results revealed that yield and yield attributes were significantly influenced by the different sources and levels of sulphur. The results of experiment indicated that plant height, no. of branches per plant, no. of pods per plant, seed and straw yield were observed maximum with application of cosavet fertis at 20 kg S ha^{-1} during both the years as well as in pooled results.

Introduction

Soybean [*Glycine max* (L.) Merrill] is an introduced and commercially exploited crop in India. Soybean [*Glycine max* (L.) Merrill] is considered as a miracle crop because of its dual qualities, *viz.*, high protein (40-42%) and oil content (20%) in seed. In India, soybean cultivation was started in 1977. It has high yield potential, wide adaptability, short duration and very high nutritional value having a vast multiplicity of uses as food and industrial products. Being a legume, it fixes a large amount of atmospheric nitrogen in soil. Therefore, soybean crop is known as “Golden Bean”, “Miracle Crop”, “Wonder Crop” and “Gold of Soil”. Soybean has a very high potential among grain legume crops for combating acute malnutrition. It is a good source of dietary fiber, calcium, magnesium, phosphate, thiamine, riboflavin, niacin, lecithin, potassium, sulphur, vitamins A, B & E and essential amino acids like lysine, leucine, methionine and threonine which are required for human body. Soybean protein is mainly rich in amino acids like vegetarians and it is also known as “poor man’s meat”.

Sulphur as secondary plant nutrient is becoming increasingly important in dryland agriculture as it is the “Master Nutrient” for all oilseed crops and pulses and is rightly being called the "Forth Major Plant Nutrient", along with nitrogen, phosphorus and potassium. Sulphur performs many important functions in the plant. It is best known for its role in the synthesis of proteins, oils and vitamins. It is a constituent of three amino acids viz., methionine, cysteine and cystine. Sulphur is also a constituent of S-glycosides (mustard oils), coenzyme A, vitamins, biotine and thiamine as also of iron-sulphur proteins called ferrodoxins. In that sulphur fertilizers are most critical for grain yield, oil and protein synthesis, and improvement of quality of soybean through enzymatic and metabolic efforts (Kumar *et al.,* 1981). It lowers the HCN content of certain crops, promotes nodulation in legumes and produces heavier grains of oilseeds (Tandon, 1987).

Materials and Methods

A field experiment entitled "Effect of sources and levels of Sulphur on nutrient composition, yield and quality of *kharif* soybean [*Glycine max* (L.) Merrill]." was carried out during *kharif* season of the year 2018 and 2019 at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Fig. 1). The experiment was conducted in C-7 Plot of Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh during *Kharif* season of 2018 and 2019. The soil was low in available nitrogen (225 and 230 kg ha^{-1} in 2018 and 2019, respectively), medium in available phosphorus (30.25 and 33.50 kg ha^{-1} in 2018 and 2019, respectively) and high in available potassium (280 and 288 kg ha^{-1} in 2018 and 2019, respectively), low in sulphur (8.94 and 9.80 mg kg^{-1} in 2018 and 2019, respectively).

Factorial Randomized Block Design with total thirteen treatments replicated thrice was employed in this study. The treatments were assigned to each replication by randomization process. The experiment comprising of total twelve treatment combination in which four sources of sulphur and three sources of sulphur. Absolute control was compared with these treatment combinations in RBD. The four sources *viz.,* S_1 – Gypsum (18-20% S), S_2 – Cosavet Fertis (80% S), S_3 – Elemental sulphur (100% S), S_4 – Bentonite (90% S) and three levels of sulphur *viz.,* L_1 – 10 kg S ha^{-1}, L_2 – 20 kg S ha^{-1} and L_3 – 30 kg S ha^{-1} with absolute control. Soybean variety Gujarat Junagadh Soybean -3 was used for sowing with seed rate of 60 kg ha^{-1} keeping inter row spacing of 45 cm on 21st July during 2018 and 25^{h} June 2019. The required quantity of N @ 30 kg ha^{-1} and P @ 60 kg ha^{-1} P_2O_5 were applied in the form of urea and DAP, respectively. All other recommended agronomic practices were followed during the period of crop growth. The crop was harvested at maturity on 10th October, 2018 and 5th November, 2019. The data on growth and yield parameters were recorded and the statistical analysis of data of the characters studied by the investigation through the procedure appropriate to the design of the experiment and significance of difference tested by the 'F' test (Panse and Sukhatme, 1985).

Results and Discussion

The results summarized in Table 1 indicated that different sources of sulphur produce significant effect on plant height. The maximum plant height (45.04, 47.37 and 46.20 cm) registered with application of cosavet fertis (S_2) during year 2018, 2019 and pooled, respectively which was statistically at par (43.28 and 45.61 cm) with elemental sulphur (S_3) during year 2018 and 2019 Gupta *et al.,* (2003). While, the application of sulphur @ 20 kg ha^{-1} (L_2) recorded the highest value of plant height (44.29, 46.62 and 45.46 cm) and it was at par (43.32, 45.65 and 44.48 cm) with application of sulphur @

30 kg ha^{-1} (L_3) during year 2018, 2019 and pooled, respectively. Similar results were also reported by Layek *et al.*, (2014).

Combined application of sulphur sources and levels produced significant effect on plant height (Table 2). The maximum (46.73, 49.06 and 47.90 cm) plant height was observed with application of cosavet fertis @ 20 kg S ha^{-1} (S_2L_2) over respective values of control (38.63, 40.80 and 39.71 cm) during year 2018, 2019 and pooled, respectively. It was remained at par with application of cosavet fertis @ 30 kg S ha^{-1} (S_2L_3) and elemental sulphur @ 20 kg S ha^{-1} (S_3L_2) during year 2018; and cosavet fertis @ 30 kg S ha^{-1} (S_2L_3) found at par during year 2019 and pooled results.

No. of branches per plant

The highest no. of branches plant^{-1} (5.78, 5.58 and 5.68) were recorded with application of cosavet fertis (S_2) in both years and pooled, respectively. It was remaining at par (5.39 and 5.19) with application of bentonite (S_4) during both years. These observations are also in agreement with that of Yatheesh *et al.*, (2013).

While, the no. of branches per plant significantly affected by different levels of sulphur (Table 3). The maximum no. of branches per plant (5.58, 5.38 and 5.48) was registered with the application of sulphur @ 20 kg ha^{-1} (L_2) in both years and pooled, respectively, which was statistically at par (5.33, 5.13 and 5.23) with application of sulphur @ 30 kg ha^{-1} (L_3) during both years and pooled result, respectively Singh *et al.*, (2017).

The application of sulphur @ 20 kg ha^{-1} in the form of cosavet fertis (S_2L_2) recorded the highest no. of branches per plant (6.10), it was remaining at par with application of sulphur @ 20 kg ha^{-1} as a source of gypsum at (S_1L_2), sulphur @ 30 kg ha^{-1} as cosavet fertis (S_2L_3) and sulphur @ 20 kg ha^{-1} as a source of bentonite (S_4L_2). The similar result also reported by Singh *et al.*, (2017).

The higher no. of branches per plant (6.20. 6.00 and 6.10) recorded with application of cosavet fertis @ 20 kg S ha^{-1} (S_2L_2) during year 2018, 2019 and pooled result, respectively over to control value (4.47, 4.40 and 4.43). It was statistically at par with application of gypsum @ 20 kg S ha^{-1} (S_1L_2), cosavet fertis @ 30 kg S ha^{-1} (S_2L_3) and bentonite @ 20 kg S ha^{-1} (S_4L_2) during year 2018 and 2019 and gypsum with 20 kg S ha^{-1} (S_1L_2) and cosavet fertis with 30 kg S ha^{-1} (S_2L_3) in pooled result (Table 4). The similar finding was also noted by Singh *et al.*, (2018).

No. of pods per plant

The application of cosavet fertis (S_2) produced the highest pods per plant (41.30, 43.29 and 42.29) during year 2018, 2019 and pooled result, respectively (Table 5). It was statistically at par with application of bentonite (S_4) with value of 40.73, 42.83 and 41.78 in both years and pooled result, respectively. It was also at par (41.73) with application of gypsum (S_1) during year 2019. These results are in close agreement with the findings of Vyas and Khandwe, (2013). The higher pods per plant (41.08, 43.09 and 42.08) were recorded under application of sulphur @ 20 kg ha^{-1} (L_2) in both years and pooled. It was remaining at par with application of sulphur @ 30 kg ha^{-1} (L_3) with values of 40.35, 42.45 and 41.40 in both years and pooled, respectively. The similar result was reported by Vaiyapuri *et al.*, (2010).

Table.1 Mean effect of sulphur sources and their levels on plant height (cm) of soybean

Treatments	Plant height (cm)		
	2018	2019	Pooled
Sulphur sources			
S_1 – Gypsum	41.22	43.96	42.59
S_2 – Cosavet Fertis	45.04	47.37	46.20
S_3 – Elemental sulphur	43.28	45.61	44.45
S_4 - Bentonite	42.22	44.55	43.38
S.Em±	0.73	0.63	0.48
C.D. at 5%	2.14	1.85	1.38
Sulphur levels (kg S/ha)			
L_1 – 10	41.21	43.84	42.53
L_2 – 20	44.29	46.62	45.46
L_3 – 30	43.32	45.65	44.48
S.Em±	0.63	0.55	0.42
C.D. at 5%	1.86	1.60	1.19

Table.2 Combined effect of sulphur sources and their levels on plant height (cm) of soybean

Treatments	Plant height (cm)		
	2018	2019	Pooled
T_1: Control	38.63	40.80	39.71
T_2: S_1L_1	41.35	43.68	42.52
T_3: S_1L_2	42.57	44.90	43.74
T_4: S_1L_3	39.75	43.28	41.52
T_5: S_2L_1	43.41	45.74	44.57
T_6: S_2L_2	46.73	49.06	47.90
T_7: S_2L_3	44.97	47.30	46.13
T_8: S_3L_1	43.88	46.21	45.05
T_9: S_3L_2	44.33	46.66	45.50
T_{10}: S_3L_3	41.63	43.96	42.80
T_{11}: S_4L_1	43.07	45.40	44.23
T_{12}: S_4L_2	43.52	45.85	44.69
T_{13}: S_4L_3	40.07	42.40	41.23
S x L Interaction			
S.Em±	1.27	1.09	0.84
C.D. at 5%	NS	NS	NS
Control v/s Rest			
S.Em±	0.97	0.81	0.63
C.D. at 5%	2.84	2.37	1.78
C.V. %	5.11	4.16	4.64
Y x T			
S.Em±	1.46		
C.D. at 5%	NS		

Table.3 Mean effect of sulphur sources and their levels on no. of branches per plant of soybean

Treatments	No. of branches plant^{-1}		
	2018	2019	Pooled
Sulphur sources			
S_1 – Gypsum	5.10	4.90	5.00
S_2 – Cosavet Fertis	5.78	5.58	5.68
S_3 – Elemental sulphur	4.93	4.73	4.83
S_4 - Bentonite	5.39	5.19	5.29
S.Em$\pm$	0.18	0.18	0.13
C.D. at 5%	0.53	0.53	0.37
Sulphur levels (kg S/ha)			
L_1 – 10	4.98	4.78	4.88
L_2 – 20	5.58	5.38	5.48
L_3 – 30	5.33	5.13	5.23
S.Em$\pm$	0.16	0.16	0.11
C.D. at 5%	0.46	0.46	0.32

Table.4 Combined effect of sulphur sources and their levels on no. of branches per plant of soybean

Treatments	No. of branches plant^{-1}		
	2018	2019	Pooled
T_1: Control	4.47	4.40	4.43
T_2: S_1L_1	4.60	4.40	4.50
T_3: S_1L_2	5.87	5.67	5.77
T_4: S_1L_3	4.83	4.63	4.73
T_5: S_2L_1	5.33	5.13	5.23
T_6: S_2L_2	6.20	6.00	6.10
T_7: S_2L_3	5.80	5.60	5.70
T_8: S_3L_1	4.97	4.77	4.87
T_9: S_3L_2	4.63	4.43	4.53
T_{10}: S_3L_3	5.20	5.00	5.10
T_{11}: S_4L_1	5.03	4.83	4.93
T_{12}: S_4L_2	5.63	5.43	5.53
T_{13}: S_4L_3	5.50	5.30	5.40
S x L Interaction			
S.Em$\pm$	0.32	0.32	0.22
C.D. at 5%	NS	NS	0.64
Control v/s Rest			
S.Em$\pm$	0.23	0.23	0.16
C.D. at 5%	0.67	0.68	0.46
C.V. %	10.30	10.70	10.50
Y x T			
S.Em$\pm$	0.31		
C.D. at 5%	NS		

Table.5 Mean effect of sulphur sources and their levels on no. of pods per plant of soybean

Treatments	No. of pods plant^{-1}		
	2018	2019	Pooled
Sulphur sources			
S_1 – Gypsum	39.63	41.73	40.68
S_2 – Cosavet Fertis	41.30	43.29	42.29
S_3 – Elemental sulphur	39.07	41.06	40.06
S_4 – Bentonite	40.73	42.83	41.78
S.Em$\pm$	0.57	0.56	0.40
C.D. at 5%	1.66	1.65	1.14
Sulphur levels (kg S/ha)			
L_1 – 10	39.12	41.14	40.13
L_2 – 20	41.08	43.09	42.08
L_3 – 30	40.35	42.45	41.40
S.Em$\pm$	0.49	0.49	0.35
C.D. at 5%	1.44	1.43	0.99

Table.6 Combined effect of sulphur sources and their levels on no. of pods per plant of soybean

Treatments	No. of pods plant^{-1}		
	2018	2019	Pooled
T_1: Control	34.73	36.83	35.78
T_2: S_1L_1	37.63	39.73	38.68
T_3: S_1L_2	40.87	42.97	41.92
T_4: S_1L_3	40.40	42.50	41.45
T_5: S_2L_1	40.20	41.97	41.08
T_6: S_2L_2	42.13	44.23	43.18
T_7: S_2L_3	41.57	43.67	42.62
T_8: S_3L_1	39.13	41.23	40.18
T_9: S_3L_2	39.90	41.67	40.78
T_{10}: S_3L_3	38.17	40.27	39.22
T_{11}: S_4L_1	39.53	41.63	40.58
T_{12}: S_4L_2	41.40	43.50	42.45
T_{13}: S_4L_3	41.27	43.37	42.32
S x L Interaction			
S.Em$\pm$	0.98	0.98	0.69
C.D. at 5%	NS	NS	NS
Control v/s Rest			
S.Em$\pm$	0.76	0.75	0.53
C.D. at 5%	2.21	2.20	1.50
C.V. %	4.23	4.01	4.12
Y x T			
S.Em$\pm$	1.01		
C.D. at 5%	NS		

Table.7 Mean effect of sulphur sources and their levels on seed yield (kg ha^{-1}) of soybean

Treatments	Seed yield (kg ha^{-1})		
	2018	2019	Pooled
Sulphur sources			
S_1 – Gypsum	2172	2205	2189
S_2 – Cosavet Fertis	2323	2411	2367
S_3 – Elemental sulphur	2112	2173	2143
S_4 - Bentonite	2200	2238	2219
S.Em±	49	52	36
C.D. at 5%	145	151	102
Sulphur levels (kg S/ha)			
L_1 – 10	2107	2159	2133
L_2 – 20	2267	2320	2294
L_3 – 30	2232	2291	2262
S.Em±	43	45	31
C.D. at 5%	125	131	88

Table.8 Combined effect of sulphur sources and their levels on seed yield (kg ha^{-1}) of soybean

Treatments	Seed yield (kg ha^{-1})		
	2018	2019	Pooled
T_1: Control	1928	1936	1932
T_2: S_1L_1	2031	2029	2030
T_3: S_1L_2	2363	2433	2398
T_4: S_1L_3	2124	2154	2139
T_5: S_2L_1	2208	2356	2282
T_6: S_2L_2	2383	2411	2397
T_7: S_2L_3	2377	2466	2421
T_8: S_3L_1	2154	2233	2194
T_9: S_3L_2	1980	1982	1981
T_{10}: S_3L_3	2204	2304	2254
T_{11}: S_4L_1	2033	2017	2025
T_{12}: S_4L_2	2343	2456	2400
T_{13}: S_4L_3	2224	2241	2232
S x L Interaction			
S.Em±	86	89	62
C.D. at 5%	NS	262	176
Control v/s Rest			
S.Em±	61	66	44
C.D. at 5%	178	192	126
C.V. %	9.90	9.02	9.73
Y x T			
S.Em±	85		
C.D. at 5%	NS		

Table.9 Mean effect of sulphur sources and their levels on straw yield (kg ha^{-1}) of soybean

Treatments	2018	2019	Pooled
Sulphur sources			
S_1 – Gypsum	2579	2711	2645
S_2 – Cosavet Fertis	2791	2934	2862
S_3 – Elemental sulphur	2533	2722	2627
S_4 - Bentonite	2482	2623	2553
S.Em±	53	48	36
C.D. at 5%	154	140	101
Sulphur levels (kg S/ha)			
L_1 – 10	2485	2660	2572
L_2 – 20	2693	2770	2731
L_3 – 30	2611	2813	2712
S.Em±	46	41	31
C.D. at 5%	134	121	88

Table.10 Combined effect of sulphur sources and their levels on straw yield (kg ha^{-1}) of soybean

Treatments	2018	2019	Pooled
T_1 Control	2190	2340	2265
T_2 S_1L_1	2470	2509	2489
T_3 S_1L_2	2665	2910	2788
T_4 S_1L_3	2601	2714	2658
T_5 S_2L_1	2574	2825	2700
T_6 S_2L_2	3040	2828	2934
T_7 S2L_3	2760	3147	2953
T_8 S_3L_1	2348	2620	2484
T_9 S_3L_2	2725	2878	2802
T_{10} S_3L_3	2525	2667	2596
T_{11} S_4L_1	2546	2684	2615
T_{12} S_4L_2	2341	2462	2401
T_{13} S_4L_3	2559	2724	2641
S x L Interaction			
S.Em±	91	83	62
C.D. at 5%	267	243	175
Control v/s Rest			
S.Em±	66	61	44
C.D. at 5%	194	177	126
C.V. %	9.12	9.25	8.97
Y x T			
S.Em±	87		
C.D. at 5%	NS		

Fig.1 General view of the soybean experimental plot

The no. of pods per plant was recorded maximum (42.13, 44.23 and 43.18) under application of cosavet fertis S @ 20 kg ha^{-1} (S_2L_2). It was statistically at par with application of gypsum at S @ 20 and 30 kg S ha^{-1} (S_1L_2 and S_1L_3), cosavet fertis @ 10 and 30 kg S ha^{-1} (S_2L_1 and S_2L_3) and bentonite @ 20 and 30 kg S ha^{-1} (S_4L_2 and S_4L_3) in year 2018. While, in year 2019, S_2L_2 was reaminig at par with application of gypsum at S @ 20 and 30 kg ha^{-1}(S_1L_2 and S_1L_3), cosavet fertis at S @ 30 kg ha^{-1} (S_2L_3) and bentonite at S @ 20 and 30 kg ha^{-1} (S_4L_2 and S_4L_3). The application of gypsum S @ 20 kg ha^{-1} (S_1L_2), cosavet fertis S @ 30 kg ha^{-1} (S_2L_3) and bentonite S @ 20 and 30 kg ha^{-1} (S_4L_2 and S_4L_3) were found at par in pooled result (Table 6).

Seed yield

The application of cosavet fertis (S_2) produced significantly highest seed yield (2323, 2411 and 2367 kg ha^{-1}) as compare to other sources during year 2018, 2019 and pooled result, respectively (Table 7). It was statistically at par (2200 kg ha^{-1}) with application of bentonite (S_4) during year 2018. The results confirmed to reports of Singh *et al.,* (2018). While, The significantly the highest seed yield was registered at 20 kg S ha^{-1} (L_2) (2267, 2320 and 2294) during both years and pooled result, respectively. It was found at par (2232, 2291 and 2262 kg ha^{-1}) with sulphur at 30 kg S ha^{-1} (L_3). The present findings are in close agreement with the results obtained by Mamatha *et al.,* (2018).

The interaction effect of sulphur sources and their levels on seed yield was found significant (Table 8). The maximum seed yield (2466 and 2421 kg ha^{-1}) was observed under application of cosavet fertis @ 30 kg S ha^{-1} (S_2L_3) recorded during year 2019 and pooled result, respectively. It was statistically (2466 kg ha^{-1}) at par under application of gypsum @ 20 kg S ha^{-1} (S_1L_2), cosavet fertis @ 10 and 20 kg S ha^{-1} (S_2L_1 and S_2L_2), elemental sulphur @ 10 and 30 kg S ha^{-1} (S_3L_1 and S_3L_3) and bentonite @ 20 and 30 kg S ha^{-1} (S_4L_2 and S_4L_3) during year 2019. While, application of gypsum with 20 kg S ha^{-1} (S_1L_2), cosavet fertis with 10 and 20 kg S ha^{-1} (S_2L_1 and S_2L_2), elemental sulphur with 30 kg S ha^{-1} (S_3L_3) and bentonite with 20 kg S ha^{-1} (S_4L_2) were found at par in pooled result. Similar, results were also obtained by Yatheesh *et al.,* (2013).

The combined application of sulphur sources and levels (Table 8) significantly influenced on seed yield of soybean as compare to control. The seed yield of soybean was significantly higher (2383 kg ha^{-1}) with application of sulphur @ 20 kg ha^{-1} as a source of cosavet fertis at (S_2L_2) during year 2018 and application of cosavet fertis @ 30 kg S ha^{-1} (S_2L_3) produced the highest value of seed yield (2466 and 2421 kg ha^{-1}) during year 2019 and pooled result as compare to control (1928, 1936 and 1932 kg ha^{-1}), respectively. It was remaining at par with application of gypsum @ 20 kg S ha^{-1} (S_1L_2), cosavet fertis @ 10 and 30 kg S ha^{-1} (S_2L_1 and S_2L_3) and bentonite @ 20 and 30 kg S ha^{-1} (S_4L_2 and S_4L_3) during year 2018. The application of gypsum @ 20 kg S ha^{-1} (S_1L_2), cosavet fertis @ 10 and 20 kg S ha^{-1} (S_2L_1 and S_2L_2), elemental sulphur @ 30 kg S ha^{-1} (S_3L_3) and bentonite @ 20 kg S ha^{-1} (S_4L_2) was found at par with application of cosavet fertis at 30 kg S ha^{-1} (S_2L_3) were found during year 2019 and application of gypsum @ 20 kg S ha^{-1} (S_1L_2), cosavet fertis @ 20 kg S ha^{-1} (S_2L_2) and bentonite @ 20 kg S ha^{-1} (S_4L_2) were remaining at par in pooled result.

Straw yield

A significant increased in straw yield was observed under different sources of sulphur application (Table 9). The significantly the highest straw yield (2791, 2934 and 2862 kg ha^{-1}) was registered at application of cosavet fertis (S_2) as compared to other sources of sulphur in both years and pooled, respectively. Similar results were reported by Yadav *et al.*, 2018. While, the application of sulphur at 20 kg S ha^{-1} (L_2) produced the highest straw yield (2693 and 2731 kg ha^{-1}) during year 2018 and pooled result, respectively. It was statistically at par (2611 and 2712 kg ha^{-1}) with application of sulphur at 30 kg ha^{-1} (L_3). While, the application of sulphur at 30 kg ha^{-1} (L_3) noted highest straw yield (2813 kg ha^{-1}) and was at par (2770 kg ha^{-1}) with application of sulphur at 20 kg ha^{-1} (L_2) during year 2019. The results were in close agreement with Hosmath *et al.*, (2014).

The interaction effect of application of sulphur sources and their levels on straw yield was found significant (Table 10). The application of cosavet fertis @ 20 kg ha^{-1} (S_2L_2) recorded maximum straw yield (3040 kg ha^{-1}) during year 2018 and application of cosavet fertis @ 30 kg ha^{-1} (S_2L_3) produced the highest straw yield (3147 and 2953 kg ha^{-1}) during year 2019 and pooled result, respectively. It was remain at par with application of gypsum with 20 kg S ha^{-1} (S_1L_2) during year 2019. The application of gypsum with 20 kg S ha^{-1} (S_1L_2), cosavet fertis with 20 kg S ha^{-1} (S_2L_2) and elemental sulphur with 20 kg S ha^{-1} (S_3L_2) were remain at par in pooled result. Similar result was also noted by Verma *et al.*, (2013).

The combined application of sulphur sources and levels (Table 10) significantly influenced on straw yield of soybean as compare to control. The significantly highest straw yield (3040 kg ha^{-1}) was registered with application of cosavet fertis @ 20 kg S ha^{-1} (S_2L_2) during year 2018 and application of cosavet fertis @ 30 kg S ha^{-1} (S_2L_3) produced the highest straw yield (3147 and 2953 kg ha^{-1}) during year 2019 and pooled result over that of control (2190, 2340 and 2265 kg ha^{-1}), respectively. It was found at par with application of cosavet fertis @ 20 kg S ha^{-1} (S_2L_2) in pooled result.

The favorable effect of sulphur fertilization on yield components and finally on yield might be due to balanced nutritional environment, efficient and greater partitioning of metabolites and adequate translocation of nutrients towards reproductive site.

The increase in seed yield may be due to stimulatory effect of applied sulphur on the synthesis of protein, which in turn might have accelerated photosynthesis and improved most of the yield contributing characters which resulted in significantly higher seed yield (Tulasi *et al.,* 2014). Increased in straw yield due to increased growth, which resulted in increased photosynthesis and assimilation rates, cell division, cell elongation and activation of enzymes which in turn increased straw yield (Poomurugesan and Poonkodi, 2008). Judicial supply of sulphur along with sources, contributes to better growth, thereby affectively increasing the yield per hectare.

Based on the results**,** it can be concluded that the application of sulphur in form of cosavet fertis at 20 kg ha^{-1} significantly improved the yield and yield attributes of soybean. It is found efficient for higher and qualitative yield production of soybean.

Acknowledgement

The authors are heartly thankful to Department of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh, India for providing instrumental facilities and necessary facilities during the course of investigation.

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How to cite this article:

Janaki Movalia and Savalia, S. G. 2020. Effect of Sources and Levels of Sulphur on Growth and Yield of *kharif S*oybean [*Glycine max* (L.) Merrill**]**. *Int.J.Curr.Microbiol.App.Sci.* 9(10): 440-451. doi: https://doi.org/10.20546/ijcmas.2020.910.054