International Journal of Chemical Studies

PB Gunjal
PG. Student, Department of Agronomy, Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur, Maharashtra, India

AB Mohite
Associate Professor, Department of Agronomy, Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur, Maharashtra, India

JB Patil
Assistant Professor, Department of Agronomy, Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur, Maharashtra, India

VB Gedam
Assistant Professor, Department of Agronomy, Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur, Maharashtra, India

Effect of land configuration methods and sulphur levels on yield attributes, quality and yield of soybean (*Glycine max* L. Merrill)

PB Gunjal, AB Mohite, JB Patil and VB Gedam

DOI: https://doi.org/10.22271/chemi.2021.v9.i1j.11310

Abstract
The field experiment was conducted during kharif season of 2019-20 on medium black soil to study the effect of different land configuration methods and sulphur levels and their interaction at post graduate research farm, R.C.S.M. College of Agriculture, Kolhapur(MS). The treatment was conducted in split plot design with three replication and sixteen treatment comprising of four land configuration methods *viz.,* I_1- flat bed, I_2- BBF,I_3- ridge and furrow (2 feet), I_4- ridge and furrow (3 feet) and four sulphur levels *viz.,* S_1-00 kg ha^{-1}, S_2- 10 kg ha^{-1},S_3 - 20 kg ha^{-1}, S_4- 30 kg ha^{-1} in subplots. The yield and quality attributes like number of pods plant^{-1}, length of podsplant^{-1}, weight of pods plant^{-1}, number of seeds pods^{-1}, weight of seeds plant^{-1}, 100 seeds weight, oil and protein content as well as yield was also found maximum with the land configuration method ridge and furrow (3 feet) however it was comparable with the method BBF. As a result, the land configuration method ridge and furrow (3 feet) had the highest seed and stover yields as well as oil and the protein content were found maximum in the method ridge and furrow (3 feet). The yield and quality attributes were also highest and influenced significantly by application of 30 Kg S ha^{-1} but on par with 20 Kg S ha^{-1}. As a result the application of 30 Kg S ha^{-1} had the highest seed and stover yields. Also the oil and the protein content were found maximum in the treatment applied 30 Kg S ha^{-1} but comparable with 20 Kg S ha^{-1}.

Keywords: Land configuration methods, sulphur levels, yield, quality, soybean

Introduction

Soybean (*Glycine max* L. Merrill) is known as Chinese pea and Manchurian bean belongs to family leguminosae. Soybean crop is rich source of quality protein (40-42%), oil (18-20%) and other nutrients *viz.* calcium, magnesium and iron and glycine. It is a good source of isoflavones and therefore, it helps in preventing heart diseases, cancer and HIVs.Industrial uses of oil are in soap, paints, resins, and drying oil. A number of protein rich product, soya-milk, soya-paneer (tofu), soy-sauce, and soy-flour are produced from seeds. (Balasubramaniyan & Palaniappan, 2012) [3]. Soybean is an important oilseed crop in the world and gaining importance in India and is considered as golden bean. India has revolutised the rural economy and improved socio economic status of farmers in Madhya Pradesh, Maharashtra and Rajasthan since last five years as it plays major role in the global oilseed economy having 59% share of total oilseed production. Its contribution is around 35% of our oilseed production. Soybean has spread to different countries in the world and became an established component of world agriculture. Soybean has not only gained a vital importance in Indian Agriculture, but also plays a decisive role in oil economy of India. Soybean is known as wonder crop and it occupied a significant position in cropping systems of Western Maharashtra region. Hence its cultivation with various land configurations and sulphur levels plays important to improve its productivity and yield potential.Due to alteration of different land configuration the high and economical yield obtained because of these alteration provide the suitable microclimate for root growth and development, microorganism development, conserving soil moisture, increment in the uptake of plant nutrient and also provide support to plant stand in abnormal condition like high rainfall and high wind speed during the abnormal climatic conditions.Low productivity of soybean may be due to the nutritional deficiencies and also imbalanced fertilization. Ideal N: P: K ratio as 4:2:1 and accepted for macro level monitoring of consumption of plant nutrients for a country as a whole.

Corresponding Author:
JB Patil
Assistant Professor, Department of Agronomy, Agronomy Section, R.C.S.M. College of Agriculture, Kolhapur, Maharashtra, India

However, it is difficult to trace the genesis of this NPK ratio, whereas Indian soil ratio is 6.8:2.7:1. Sulphur plays an important role in improving the quality and marketability of produce. On an average, the improvement on oil content in major oilseeds due to sulphur application is 11.3 per cent in groundnut, 9.6 per cent in mustard, 9.2 per cent in soybean. In general, 15-50 percent increase in oil yield has been reported by Pasricha and Aulakh (1996) [15]. Sulphur also plays a crucial role in fat and protein metabolism.

Materials and Methods
The field experiment was conducted at Post Graduate Research Farm, R.C.S.M. College of Agriculture, and Kolhapur during *Kharif* 2019. The topography of experimental field was fairly uniform and leveled. The soil was vertisol (medium black) in nature and about one meter deep with good drainage. The soil of experimental field has pH 7.70, EC 0.30dSm^{-1}, organic carbon 0.18%, available N, P_2O_5, K_2O, S was 207.10,28.80, 287.10 and 16.84kg ha^{-1},respectively. The sixteen treatment combinations consist of four land configuration methods *viz.,* I_1- flat bed, I_2- broad bed furrow, I_3- ridges and furrow (2 feet), I_4- ridges and furrow (3 feet), and four sulphur levels *viz.,* S_1 (00 kg Sha^{-1}), S_2 (10 kg S ha^{-1}), S_3 (30 kg Sha^{-1}) and S_4 (40 kg S ha^{-1}) and these treatments were replicated three times in split plot design. Soybean was grown on different land configuration methods and sulphur applied as per treatments in the experimental field with recommended package of practices. Fertilizers were applied uniformly at the rate of50 kg N and 75kg P_2O_5 and 45 kg K_2O ha^{-1} by broadcasting method at the time of sowing and sulphur applied as per dose 15 days before the sowing of crop. The experimental data was statistically analyzed by using a standard method of "analysis of variance" as reported by Panse and Sukhatme (1967) [14].

Result and Discussion
Effect on yield parameters
Effect of land configurations
The different yield attributing characters as influenced by different treatment were presented in Table No 1. The significantly highest values under land configuration method *i.e.* 3 feet ridge and furrow of all growth characters *viz.* number of pods plant^{-1}, length of pods plant^{-1}, weight of pods plant^{-1}, number of seeds pod^{-1}, weight of seeds plant^{-1} and 100 seeds weight at harvest were recorded, however it was comparable with the land configuration method *i.e.* Broad Bed furrow. Both these land methods are significantly superior over other methods *viz.,* 2 feet ridge and furrow and flat bed. The results of field experiment showed better performance under ridges and furrow layouts than other layouts under study. (Thakur *et al.*, 2003; Ingle *et al.,*1999; Lakpale and Tripathi 2012; and Nangare 2015) [16, 10, 12, 13].

Effect of sulphur levels
The different yield attributing characters as influenced by different treatment were presented in Table No 1. Application of 30 kg S ha^{-1} recorded significantly the highest mean number of pods plant^{-1}, length of pods plant^{-1},weight of pods plant^{-1}, number of seeds pod^{-1}, weight of seeds plant^{-1} and 100 seeds weight as compared to rest of the sulphur levels, however comparable with 20 kg S ha^{-1} at the time of harvest. The mean number of pods plant^{-1}, weight of pods plant^{-1}, number of seeds pod^{-1}, weight of seeds plant^{-1} and 100 seeds weight increased with increasing levels of sulphur and reached maximum with 30 kg S ha^{-1}. The increasing rate of soil application of sulphur to S deficient soil must have increased the number of pods plant^{-1} (Devi *et al.,* 2012) [4].

Effect of interaction
The interaction effect between land configuration methods and sulphur methods were found to be non-significant in respect of different yield attributing characters.

Effect on yield
Effect of land configuration methods
The mean seed yield, stover yields and harvest index of as influenced by different treatments presented in Table No 2 reveled that among the land configuration methods the field layout *i.e.* 3 feet ridge and furrow produced maximum mean seed yield, stover yield and harvest index at the time of harvest and found significantly superior over the treatments 2 feet ridge and furrow and flat bed, however comparable with the land configuration method broad bed furrow at harvest. However Nangare (2015) [13] recorded increased seed yield, stover yields and harvest index in soybean under ridge and furrow planting over flatbed method of planting.

Effect of sulphur levels: The different yield attributing characters as influenced by different treatment were presented in Table No 2. Application of 30 kg S ha^{-1} recorded the highest mean seed yield, stover yields and harvest index as compared to rest of the sulphur levels, however but on par with sulphur fertilization @ 20 kg ha^{-1} after harvest and significantly superior over 10 kg S ha^{-1} and 00 kg ha^{-1}. Mean seed yield, stover yields and harvest index increased with increasing each levels of sulphur. The sulphur fertilization played a vital role in improving the three major aspects of yield determination i.e. formation of vegetative structure there by photosynthesis strong sink strength through development of reproductive structure and production of assimilates to fill economically important sink. Thus cumulative influence of S application maintained balance in source-sink relationship and ultimately resulted in increased seed yield. The results are in close conformity with the findings of Ganeshmurthy *et al.,* (1996) [5] and Hussain *et al.,* (2011) [9].

Table 1: Effect of land configuration methods and sulphur levels on yield parameters of soybean at harvest

Treatments	Number of pods plant^{-1}	Length of pods plant^{-1} (cm)	Weight of pods plant^{-1} (g)	Number of seeds pod^{-1}	Weight of seeds plant^{-1} (g)	100 seeds weight (g)
Main Plot: land configurations						
I_1- Flat Bed	54.75	2.31	25.02	2.30	16.16	11.94
I_2- Broad Bed Furrow	70.78	2.51	32.22	2.88	23.18	13.04
I_3- Ridge and Furrow (2 feet)	61.50	2.45	25.60	2.38	16.85	12.15
I_4- Ridge and Furrow (3 feet))	70.90	2.63	32.57	2.91	24.13	13.13
S. Em±	2.03	0.05	0.87	0.07	0.48	0.23
C. D. at 5%	7.02	0.18	3.00	0.25	1.66	0.81
C. V.%	10.9	7.28	10.40	9.5	8.28	6.44
Sub Plot: Sulphur levels						

S$_1$ - 00 Kg S ha^{-1}	59.96	2.18	26.42	2.42	17.55	11.88
S$_2$ - 10 Kg S ha^{-1}	62.47	2.45	26.84	2.53	19.35	12.16
S$_3$ - 20 Kg S ha^{-1}	66.42	2.55	29.28	2.73	21.31	13.03
S$_3$ - 30 Kg S ha^{-1}	69.07	2.73	32.15	2.78	22.37	13.19
S. EM±	1.87	0.06	0.86	0.08	0.47	0.25
C. D. at 5%	5.49	0.18	2.50	0.23	1.38	0.72
C. V.%	10.10	8.84	10.29	10.4	8.18	6.78
Interaction: I × S						
S. EM±	3.76	0.13	1.71	0.16	0.95	0.49
C. D. at 5%	NS	NS	NS	NS	NS	NS
General mean	64.48	2.47	28.85	2.62	20.08	12.56

Table 2: Effect of land configuration methods and sulphur levels on yield of soybean after harvest

Treatments	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest Index (%)
Main Plot: land configurations			
I$_1$- Flat Bed	21.05	31.59	39.80
I$_2$- Broad Bed Furrow	26.09	38.51	40.34
I$_3$- Ridge and Furrow (2 feet)	23.63	35.71	39.85
I$_4$- Ridge and Furrow (3 feet))	26.63	39.55	40.40
S. EM±	0.80	0.85	1.32
C. D. at 5%	2.78	2.94	NS
C. V.%	11.43	8.11	11.47
Sub Plot: Sulphur levels			
S$_1$ - 00 Kg S ha^{-1}	22.57	34.05	37.31
S$_2$ - 10 Kg S ha^{-1}	24.28	35.77	40.64
S$_3$ - 20 Kg S ha^{-1}	25.39	36.68	40.99
S$_3$ - 30 Kg S ha^{-1}	27.17	38.85	41.46
S. EM±	0.76	1.08	1.01
C. D. at 5%	2.24	3.14	2.95
C. V.%	10.91	10.26	8.73
Interaction: I × S			
S. EM±	1.53	2.15	2.02
C. D. at 5%	NS	NS	NS
General mean	24.35	36.34	40.10

Hosmath *et al.,* (2014) [8] reported that sulphur is an important nutrient for the higher yield of soybean crop. Arun Sharma (2011) [2] documented that when supply of sulphur is optimum, greater translocation of photosynthats occurs from leaves to seed.

Effect of interaction
The interaction effect between land configuration methods and sulphur methods were found to be non-significant in respect of different parameters of yield.

Effect on quality
Effect of land configuration methods
The mean oil content (18.67%), protein content (42.41%), oil yield (4.97kg ha^{-1}) and protein yield (11.33kg ha^{-1}) differed significantly due to different land configuration methods as influenced by different treatments presented in Table No 2. The land configuration method 3 feet ridge and furrow produced maximum mean oil content, protein content, oil yield and protein yield in seed after harvest and found significantly superior than the land configuration methods, 2 feet ridge and furrow and flat bed, however comparable with the land configuration method BBF.

Effect of sulphur levels
The highest application of 30 kg S ha^{-1} recorded significantly the highest mean oil content (18.27%), protein content (43.23%), oil yield (4.96 kg ha^{-1}) and protein yield (11.77 kg ha^{-1}) in seed as compared to 10 kg ha^{-1}and 00 kg ha^{-1} sulphur levels, however on par with the application of sulphur @ 20 kg S ha^{-1} after harvest. Mean oil content, protein content, oil yield and protein yield in seed increased with each increasing level of sulphur application. The high response of soybean was observed by the balanced application of N and S. These nutrients involved in the biosynthesis of proteins and many other important biomolecules, a balanced application of S and N enhanced their use efficiency in crop plants. Maximum oil yield was obtained in rapeseed mustard only, when S and N applications were balanced Ahmad *et al.,* (1998) [1]. As well as Gokhale *et al.,* (2005) [6] recorded highest oil content (37.26%) in soybean with application of 40 kg S ha^{-1}. Oil seed crops responses to liberal application of sulphur because it is involved in the synthesis of fatty acids and also increased protein quality through the synthesis of certain amino acids such as cystine, cysteine and methionine Havlin *et al.,* (1999) [7]. The increase in protein content of soybean with increasing level of S was also reported by Kumawat *et al.,* (2000) [11].

Effect of interaction
The interaction effect between land configuration methods and sulphur methods were found to be non-significant in respect of oil & protein content in seed.

Table 3: Effect of land configuration methods and sulphur levels on quality of soybean after harvest

Treatments	Oil content in seed (%)	Oil yield (kg ha^{-1})	Protein content in seed (%)	Protein yield (kg ha^{-1})
Main Plot: land configurations				
I$_1$- Flat Bed	16.69	3.53	38.15	8.04
I$_2$- Broad Bed Furrow	17.84	4.66	42.15	11.02
I$_3$- Ridge and Furrow (2 feet)	17.51	4.15	38.64	9.22
I$_4$- Ridge and Furrow (3 feet))	18.67	4.97	42.41	11.33
S. EM±	0.24	0.14	0.60	0.29
C. D. at 5%	0.84	0.49	2.09	0.99
C. V.%	4.74	11.33	5.18	10.03
Sub Plot: Sulphur levels				
S$_1$ - 00 Kg S ha^{-1}	16.97	3.51	37.06	7.63
S$_2$ - 10 Kg S ha^{-1}	17.36	4.23	39.74	9.68
S$_3$ - 20 Kg S ha^{-1}	18.11	4.62	41.31	10.53
S$_3$ - 30 Kg S ha^{-1}	18.27	4.96	43.23	11.77
S. EM±	0.24	0.15	0.65	0.35
C. D. at 5%	0.70	0.44	1.91	1.01
C. V.%	4.73	12.16	5.62	12.15
Interaction: I × S				
S. EM±	0.48	0.30	1.30	0.69
C. D. at 5%	NS	NS	NS	NS
General mean	17.68	4.33	40.34	9.90

Conclusion

1. Among the soybean land configuration method *viz.,* 3 feet ridge and furrow was suitable for Western Maharashtra region and would be recommended for better yield and quality.
2. The sulphur application @ 30 Kg ha^{-1} is beneficial for better yield and quality of soybean.

References:

1. Ahmad A, Abraham G, Gandotra N, Abrol YP, Abdin MZ. Interactive effect of nitrogen and sulphur on growth and yield of rapeseed-mustard (*Brassica juncea* L. Czern and Coss. and *Brassica campestris* L.). Journal of Agronomy and Crop Science 1988;181:193-199.
2. Arun Sharma.. Study the effect of sulphur and phosphorous with and without PSB inoculation on the yield attributes, yield and nutrient uptake of soybean. Journal of Progressive Agriculture 2011;**2**(2):41-43.
3. Balasubramaniyan P, Palaniappan SP. Principles and Practices of Agronomy 2012.
4. Devi KN. Response of soybean (*Glycine max* L. Merril) to sources and levels of phosphorus. Journal of Agriculture Science 2012;4:44-53.
5. Ganeshmurthy AN. Critical plant sulphur content and effect of sulphur application of grain and oil yield of rainfed soybean in Vertic Ustochrepts. Journal Indian Society of Soil Science 1996;44:290-294.
6. Gokhale DN, Kanade AG, Karanjikar PN, Patil VD. Effect of sources and levels of sulphur on seed yield, quality and sulphur uptake by soybean, (*Glycine max* L. Merrill) Journal of Oilseeds Res. 2005;22(1):192-193.
7. Havlin LJ, Beaton DJ, Tisjale LS, Nelson LW. Soil fertility and fertilizers. Prentice Hall of Indian 1999;6:319-346.
8. Hosmath JA, Babalad HB, Basavraj GT, Jahagirdar Shamrav, Patil RH, Agasimani SC. Sulphur nutrition in soybean (*Glycine max* L. Merril) in India. International Conference on Biological, Civil and Environmental Engineering (BCEE-2014) Dubai (UAE) 2014.
9. Hussain K, Islam M, Siddique MT, Hayat R, Mohsan S. Soybean growth and nitrogen fixation as affected by sulphur fertilization and inoculation under rainfed conditions in Pakistan. International Journal of Agriculture and Biology 2011;13(6):951-955.
10. Ingle MP, Malvi GC, Hadole SS, Padekar DG, Ingale AS. Effect of land configuration and nitrogen management on yield attributing character and yield of kharif soybean. Journal Soils and crops. 1999;9(1):34-36.
11. Kumawat SM, Dhakar LL, Maliwal PL. Effect of irrigation regimes and nitrogen on yield, oil content and nutrient uptake of soybean (Glycine max L. Merrill). Indian Journal of Agronomy 2000;45(2):361-366.
12. Lakpale R, Tripathi RS. Broad-bed furrow and ridge and furrow method of sowing under different seed rates of soybean (*Glycine max* L.) for high rainfall areas of Chhattisgarh plains. Soybean Research 2012;10:52-59.
13. Nangare MV. Performance of soybean varieties under different layouts. M.Sc. (Agri) Thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri (M.H.), India 2015.
14. Panse VG, Sukhatme PV. Statistical methods for agricultural research workers. ICAR publication, New Delhi 1967.
15. Pasricha NS, Aulakh MS. Sulphur: An emerging defiecient nutrient. In plant nutrient needs, supply, efficiency and policy issues. National Academy of Agricultural Science, New Delhi 1996,265-282.
16. Thakur NS, Raghuwanshi RS, Sharma RS. Performance of soybean genotypes under different row spacings and seed rates in medium black soils of Satpura plateau. Research on Crop 2003;4(3):313-316.