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Response of Different Levels of Sulphur and Plant Growth Regulator on Growth and Yield of Soybean (*Glycine max* (L.) Merill)

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Abstract: *A field experiment on Soybean (Glycine max (L.) Merill) was conducted at farm, Department of Agronomy, College of Agriculture, Latur. The experimental fields soil was clayey in texture, low in nitrogen, medium in phosphorus and alkaline in reaction. The experiment was laid out in a factorial randomized block design with twelve treatments. Each experimental unit was repeated four times. Sowing was done on 2st July, 2012 by dibbling the seeds at spacing 45 cm × 5 cm. The recommended cultural practices and plant protection measures were taken. The recommended dose of fertilizer (30:60:30 kg NPK ha^{-1}) was applied at the time of sowing through Urea, DAP and MOP. Results revealed that the application of sulphur 40 kg ha^{-1} recorded significantly higher growth and seed yield followed by application of 30 kg S ha^{-1}, 20 kg S ha^{-1} and 0 kg S ha^{-1}. Where as the application of kinetin 40 ppm recorded significantly growth contributing characters and seed yield followed by NAA 40 ppm and salicylic acid 50 ppm.*

Keywords: *Sulphur , growth regulator, growth and seed yield.*

INTRODUCTION

Soybean (*Glycine max* (L.) Merill) belongs to family Papilionaceae is one of the most important protein and oilseed crops throughout the world. Soybean is also known as the "Golden bean" or "Miracle crop" because of its multiple uses. Soybean seed contains 18-20 per cent oil, 40 per cent protein, 30 per cent carbohydrates, 4 per cent saponins and 5 per Soybean being a high protein and energy crop has high nutrient requirements and its productivity is often limited by the low availability of essential nutrients or imbalanced nutrition forming one of the important constraints to soybean productivity in India.

Sulphur is very important nutrient for optimum production of high-yielding soybeans. Sulphur is a component of several amino acids, the building blocks of proteins. This element is therefore, very important with respect to quality. It is essential for the formation of nodules on the roots of legumes. Soybean growing on soil that are low or deficient in sulphur are poorly nodulated and therefore nitrogen fixation is depressed. It is also involved in the formation of oils.

Plant growth regulators are organic compounds which in small amount modify a given physiological plant process. They are extensively used to manipulate flower formation and fruit set in different crops. Salicylic acid is a common plant-produced phenolic compound, which function's as a plant growth regulators. Exogenous application of salicylic acid may influence a range of diverse process in plant's including stomatal closure, ion uptake and transport, ethylene synthesis and seed yield (Khan and Balakrishnan, 2003).

Plant growth regulators so far have emerged as "magic chemicals" that could increase agricultural production at an unprecedented rate and help in removing and circumventing many of the barriers imposed by genetics and environment. Plant growth regulators when added in small amounts; modify the natural growth regulatory system right from seed germination to senescence in several crop plants. The yield of soybean can be enhanced through physiological growth manipulation by way of foliar application of growth regulators like NAA. The synthetic auxin naphthalene acetic acid (NAA) promote rooting in soybean hypocotyls. Whereas,

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aqueous solutions of salicylic acid, applied as a spray to the shoots of soybean significantly increased the growth of shoots and roots as measured after seven days of treatment.

MATERIALS AND METHODS

The experiment was conducted during *kharif* season of 2012. Department of Agronomy Farm, College of Agriculture, Latur. The soil of the experimental site was deep, black in colour with good drainage. The soil of experimental plots was clayey in texture. The chemical composition of experimental plots indicated that the soil was low in available nitrogen (193.55 kg ha^{-1}), medium in available phosphorus (15.82 kg ha^{-1}), very high in available potassium (333.78 kg ha^{-1}) content and alkaline in reaction having pH 8.17. The present experiment was laid out by using factorial randomised block design with three replications. The treatments were consisting of four levels of sulphur fertilizer i.e S_1-control (0 kg), S_2-20kg of sulphur, S_3-30 kg of sulphur, S_4-40kg of sulphur and three types of growth regulators *i.e.* R_1-Kinetin spray40 ppm, R_2-NAA 40 ppm and R_3-Salicylic Acid 50 ppm constituting twelve treatments.

RESULT AND DISCUSSION

Growth Studies

Effect of levels of sulphur

The effect of different levels of sulphur fertilizer on plant height was found to be significant and the higher plant height was recorded by the application of sulphur 40 kg ha^{-1} (35.89 cm) as compared to other levels of fertilizers. The increase in growth attributes may be due to better uptake and translocation of plant nutrients to growing plants, but it was found to be at par with application of sulphur 30 kg ha^{-1}. Similar kind of observations were recorded by Farhad *et al.,* (2010). The application of sulphur 40 kg ha^{-1} recorded higher mean number of functional leaves (26.18) and it was at par with the application of sulphur 30 kg ha^{-1} (24.45, 13.66 dm^2) at every stage of the crop growth. Thus might be due to more available of sulphur to plant which resulted in vigorous growth, resulted in higher number of leaves and leaf area. Trivedi *et al.,* (2011) also reported similar results.The application of sulphur 40 kg ha^{-1} recorded the higher dry matter accumulation at 75 DAS (29.83 g) along with application of sulphur 30 kg ha^{-1} (26.77 g). Least dry matter $plant^{-1}$ was recorded by application of 0 kg ha^{-1}(20.73) at all the crop growth stages. It may be due to better utilization of available resources at higher level of sulphur which resulted in more photosynthesis and hence more dry matter was produced. Similar kind of results were reported by Hussain *et al.,* (2011).

Table 1
Growth attributes of soybean as influenced by different treatments

Treatment	Height at harvest	No. of leaves at 75 DAS	Dry matter at harvest
Sulphur levels (S)			
S_1= 0 kg S ha^{-1}	28.20	15.06	18.33
S_2 = 20 kg S ha^{-1}	30.13	17.80	20.11
S_3 = 30 kg S ha^{-1}	34.92	24.05	24.67
S_4 = 40 kg S ha^{-1}	35.89	25.75	27.11
S.E.+	1.35	1.01	3.57
C.D. at 5 %	3.97	2.95	1.19
Growth regulator levels (R)			
R_1 = Kinet in 40 ppm	34.93	23.57	23.58
R_2 = NAA40 ppm	32.81	20.49	22.33
R_3 = Salicylic acid 50 ppm	29.12	17.94	21.75
S.E.+	1.17	0.87	3.90
C.D. at 5 %	3.43	2.56	1.03
Interaction (S × R)			
S.E.+	2.34	1.75	6.21
C.D. at 5 %	NS	NS	NS
G.M.	32.28	20.66	22.56

Effect of Plant Growth Regulator

The application of kinetin 40 ppm produced more vegetative growth in early period of crop growth. It was observed from the data that the height was found to be increased progressively at every stage of crop growth. The effect of plant growth regulators on plant height was found to be significant and the maximum plant height and number of leaves were recorded by the application of kinetin 40 ppm as compared to other plant growth regulators. Total dry matter accumulation per plant was found to be increased continuously with advancement in age of the crop till 75 DAS and later on it slightly decreases at maturity. The rate of increase in dry matter accumulation was slow up to 30 days and faster between 31-75 DAS and there after decreases to harvest stage. The application of kinetin 40 ppm recorded the higher dry matter accumulation (26.85 g) than application of NAA 40 ppm (24.86) and salicylic acid 50 ppm (23.63) at 75 DAS.

Yield Studies

Effect of levels of sulphur

The application of sulphur 40 kg ha^{-1} recorded higher mean seed yield (30.20 q ha^{-1}) and it was at par with the application of sulphur 30 kg ha^{-1} (28.36 q ha^{-1}). This might because of the cumulative effect in increasing growth contributing characters which have been clearly exhibited on the final produce i.e. seed and straw yield ha^{-1}. Similar trend was observed in case of straw and biological yield.

Table 2
Seed yield, Straw yield and Biological yield as influenced by different treatments

Treatment	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})
Sulphur levels (S)			
S_1= 0 kg S ha^{-1}	21.62	26.42	48.04
S_2 = 20 kg S ha^{-1}	23.64	26.65	50.30
S_3 = 30 kg S ha^{-1}	28.36	30.35	58.72
S_4 = 40 kg S ha^{-1}	30.20	35.93	66.13
S.E.+	0.83	0.90	1.41
C.D. at 5 %	2.44	2.66	4.13
Growth regulator levels (R)			
R_1= Kinetin 40 ppm	27.94	31.60	59.55
R_2 = NAA 40 ppm	25.04	29.22	54.26
R_3 = Salicylic acid 50 ppm	24.89	28.69	53.58
S.E.+	0.72	0.78	1.22
C.D. at 5 %	2.11	2.30	3.58
Interaction (S × R)			
S.E.+	1.44	1.75	2.44
C.D. at 5 %	NS	NS	NS
G.M.	25.95	29.84	55.80

Effect of Plant Growth Regulator

Data on mean seed yield q ha^{-1}, straw yield q ha^{-1} and biological yield q ha^{-1} as influenced by different levels of plant growth regulators was found to be significant. The application of kinetin 40 ppm recorded significantly higher mean seed yield (27.94 q ha^{-1}),mean straw yield (31.60 q ha^{-1})and mean biological yield (59.55 q ha^{-1}). Straw yield q ha^{-1} as influenced by different levels of plant growth regulators was found to be significant. The application of kinetin 40 ppm recorded significantly higher mean straw yield q ha^{-1} (31.60 q ha^{-1}) followed by the application of NAA 40 ppm (29.22 q ha^{-1}) and salicylic acid 50 ppm (28.69 q ha^{-1}). Kinetin helps in reducing chlorophyll degradation, due to which it retain more chlorophyll to plant which helps in increasing yield. Similar trend was observed in respect of biological yield.

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