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## Effect of foliar application of agrochemicals on growth, yield and quality of soybean (*Glycine max* (L.) Merrill)

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**Abstract**

The experiment was conducted during *kharif* season of the year 2016- 17 at Experimental Farm, Agronomy Section, College of Agriculture, Latur. To study the effect of foliar application of agrochemicals on growth, yield and economics of soybean. Among the different treatment the application of thiourea spray @ 0.1 % at 30 and 45 DAS (T4) was recorded higher plant height (46.34 cm), leaf area plant<sup>-1</sup> 11.35 dm<sup>2</sup>, and dry matter accumulation plant<sup>-1</sup> 23.55 g plant<sup>-1</sup> with higher B: C ratio. This was closely followed by thiourea spray @ 0.1 % at 30 DAS (T3), KNO<sub>3</sub> spray @ 1 % at 30 and 45 DAS (T8) and 19:19:19 spray @ 1 % at 30 and 45 DAS (T10) and control (T1) were recorded lower value.

**Keywords:** Soybean, agrochemicals, foliar spray, growth, yield, quality

**Introduction**

Soybean (*Glycine max* L.) is leguminous crop and belongs to family Leguminosae with sub family papilionaceae also known as Chinese pea, Golden pea and Manchurian bean. Soybean is reported to have originated in Eastern Asian countries while the cultivated soybean originated in china during 2800 BC. It is an excellent health food and contains about 40 per cent quality protein, 23 per cent carbohydrates and 20 per cent cholesterol free oil. Soybean protein is rich in valuable amino acid, lysine (5%) which is deficient in most of the cereals. It also contains 60 per cent polyunsaturated fatty acids (52.8 % linolenic acid + 7.2 % linoleic acid). It has high calorific value releasing 432 calories from 100 gm edible protein as compared to 350 calories from cereals of same quantity. Soybean is the cheapest source of proteins and hence it is called "Poor man's meat". Soybean holds a very important position in the Indian agriculture and economy and it has a worth of over Rs 5000 crores and with a production around 10.43 million ton. (Anonymous, 2015)<sup>[1]</sup>. India is fifth-largest producer of soybean in the world and has been adding area under soybean sowing since 2000.

Foliar application of agrochemicals is more beneficial than soil application and requires lesser quantity of agrochemicals through spraying. Undoubtedly, higher yield of soybean and quality of its oil is associated with foliar spraying of agrochemicals (Vahedi, 2011)<sup>[12]</sup>. Moreover, soil pollution would be a major problem by agrochemicals soil application. Plant leaves uptake nutrients better by foliar spraying is created than soil application. (Bozorgi *et al.*, 2011)<sup>[3]</sup>. Foliar spraying of agrochemicals is very helpful when the roots cannot provide necessary nutrients or unable to uptake of nutrients for plant (Kinaci and Gulmezoglu, 2007)<sup>[8]</sup>. Under drought condition or lesser the avail of soil moisture under such situation it has been found that foliar application of agrochemicals is more influential as compared to soil application. It was suggested that agrochemicals could be applied successfully to compensate shortage of those elements (Arif *et al.*, 2006)<sup>[2]</sup> and foliar spraying could be effective 6 to 20 times as compared to soil application. Resistance to different stresses will be increased by foliar application of agrochemicals (Ghasemian *et al.*, 2010). Also, effectiveness of foliar spraying is higher and the cost of foliar application is lower as compared to soil application (Yassen *et al.*, 2010)<sup>[13]</sup>. Surmount on problems such as drought condition or less available of soil moisture in semi arid region and for easy requirement of nutrients through spraying of different agrochemicals for break yield barriers of soybean crop.

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## Material and Methods

The experiment was conducted during *kharif* season of the year 2016- 17 at Experimental Farm, Agronomy Section, College of Agriculture, Latur. This study area is situated between 18°05' to 18°75' North latitude and between 76°25' to 77°25' East longitude. This experiment was laid out in Randomized Block Design with three replication and ten treatments. In treatment consist Control (T<sub>1</sub>) Water spray at 30 and 45 DAS (T<sub>2</sub>), Thiourea spray @ 0.1 % at 30 DAS (T<sub>3</sub>), Thiourea spray @ 0.1 % at 30 and 45 DAS (T<sub>4</sub>), Urea spray @ 2% at 30 DAS (T<sub>5</sub>), Urea spray @ 2% at 30 and 45 DAS

(T<sub>6</sub>), KNO<sub>3</sub> spray @ 1 % at 30 DAS (T<sub>7</sub>), KNO<sub>3</sub> spray @ 1 % at 30 and 45 DAS (T<sub>8</sub>), 19:19:19 spray @ 1 % at 30 DAS (T<sub>9</sub>) and 19:19:19 spray @ 1 % at 30 and 45 DAS (T<sub>10</sub>). The soil of the experimental site was clayey in texture. The soil was low in available nitrogen (108 kg ha<sup>-1</sup>) and phosphorus (8.18 kg ha<sup>-1</sup>), very high in available potassium (430 kg ha<sup>-1</sup>) content and slightly alkaline in reaction having pH of 7.45. Soybean cultivar MAUS 71 was used with spacing 45 cm between rows and 5 cm within row. The crop was raised as per the recommended package of practices and provides plant protection measures.

**Table 1:** Growth attributes of soybean as influenced by different treatments

Treatments	Plant height (cm)	Number of leaves plant <sup>-1</sup> at 60 DAS	Leaf area plant <sup>-1</sup> (dm <sup>2</sup> )	Total dry matter (g) plant <sup>-1</sup> at harvest	Protein Content (%)	Protein yield (kg ha <sup>-1</sup> )	Oil content (%)	Oil yield (kg ha <sup>-1</sup> )
T <sub>1</sub> - Control	34.25	14.72	6.12	17.08	38.14	723	19.74	374
T <sub>2</sub> - Water spray at 30 and 45 DAS	40.92	16.98	8.64	18.07	39.52	859	19.83	431
T <sub>3</sub> -Thiourea spray @ 0.1 % at 30 DAS	42.63	19.62	9.36	22.02	39.74	987	19.83	499
T <sub>4</sub> - Thiourea spray @ 0.1 % at 30 DAS and 45 DAS	46.34	20.61	11.35	23.55	40.59	1042	20.09	509
T <sub>5</sub> - Urea spray @ 2% at 30 DAS	41.07	17.08	8.59	20.62	38.57	874	19.77	447
T <sub>6</sub> - Urea spray @ 2% at 30 DAS and 45 DAS	43.21	18.14	9.18	22.10	39.65	926	19.86	463
T <sub>7</sub> - KNO <sub>3</sub> spray @ 1 % at 30 DAS	40.48	17.36	9.70	22.81	39.41	914	19.97	463
T <sub>8</sub> - KNO <sub>3</sub> spray @ 1 % at 30 DAS and 45 DAS	44.27	20.31	10.47	23.14	39.84	995	19.84	496
T <sub>9</sub> - 19:19:19 spray @ 1 % at 30 DAS	43.49	19.13	8.26	20.45	38.41	906	19.75	466
T <sub>10</sub> -19:19:19 spray @ 1 % at 30 DAS and 45 DAS	43.08	19.86	10.87	23.09	40.26	1003	19.91	496
S.E. ±	2.00	0.95	0.37	1.14	0.53	47	1.09	24
C.D.at 5 %	5.95	2.82	1.12	3.38	NS	139	NS	70

## Results and Discussion

Foliar application of agrochemicals namely thiourea (0.1 %), urea (2 %), KNO<sub>3</sub> (1 %) and 19:19:19 (1%) significantly influenced on different growth parameters on soybean. The treatment with application of Thiourea spray @ 0.1 % at 30 and 45 DAS (T<sub>4</sub>) produced highest plant height (46.34 cm), Number of leaf plant<sup>-1</sup> (20.61), leaf area (11.35 dm<sup>2</sup>) and dry matter per plant<sup>-1</sup> (23.55 g). However plant height, leaf chlorophyll content, nodules, and their weight. Followed by treatment KNO<sub>3</sub> spray @ 1 % at 30 DAS and 45 DAS (T<sub>8</sub>). The increase in growth attributes may be due to better uptake and translocation of plant nutrient to growing plant. Foliar application of Thiourea spray @ 0.1 % at 30 and 45 DAS (T<sub>4</sub>)

recorded maximum leaf area at 60 DAS (11.35 dm<sup>2</sup>) which was at par with the foliar application of 19:19:19 spray @ 1 % at 30 and 45 DAS (T<sub>10</sub>) and KNO<sub>3</sub> spray @ 1 % at 30 and 45 DAS (T<sub>8</sub>) and found Foliar application of Thiourea spray @ 0.1 % at 30 and 45 DAS (T<sub>4</sub>) recorded maximum dry matter accumulation at harvest (23.55 g plant<sup>-1</sup>). Which was at par with the foliar application of KNO<sub>3</sub> spray @ 1 % at 30 and 45 DAS (T<sub>8</sub>) and 19:19:19 spray @ 1 % at 30 and 45 DAS (T<sub>10</sub>) and found significantly over rest of the treatments it may be due to increase in plant height, number of functional leaves, leaf area plant<sup>-1</sup> by foliar application which are of vital part of the were the photosynthetic takes

**Table 2:** Effect of foliar application of agrochemicals on economics of soybean

Treatments	Seed yield (kg ha <sup>-1</sup> )	Cost of cultivation (Rs. ha <sup>-1</sup> )	Gross returns (Rs. ha <sup>-1</sup> )	Net returns (Rs. ha <sup>-1</sup> )	B:C ratio
T <sub>1</sub> - Control	1895	28493	52596	24103	1.85
T <sub>2</sub> - Water spray at 30 and 45 DAS	2174	29493	60329	30836	2.05
T <sub>3</sub> -Thiourea spray @ 0.1 % at 30 DAS	2484	29006	68931	39925	2.38
T <sub>4</sub> - Thiourea spray @ 0.1 % at 30 DAS and 45 DAS	2567	29519	71234	41715	2.41
T <sub>5</sub> - Urea spray @ 2% at 30 DAS	2265	29071	62863	33792	2.16
T <sub>6</sub> - Urea spray @ 2% at 30 DAS and 45 DAS	2336	29649	64824	35175	2.19
T <sub>7</sub> - KNO <sub>3</sub> spray @ 1 % at 30 DAS	2321	30253	64399	34146	2.13
T <sub>8</sub> - KNO <sub>3</sub> spray @ 1 % at 30 DAS and 45 DAS	2498	32013	69310	37297	2.17
T <sub>9</sub> - 19:19:19 spray @ 1 % at 30 DAS	2360	29563	65481	35918	2.21
T <sub>10</sub> -19:19:19 spray @ 1 % at 30 DAS and 45 DAS	2492	30633	69144	38511	2.26
S.E. ±	119	--	3296	3296	--
C.D.at 5 %	353	--	9793	9793	--

Place and thereby build up more photosynthesis, which reflected ultimately on dry matter accumulation, similar kind of results were reported by Govindan and Thirumurugan (2000). However, the higher oil content (20.09 %) was obtained with the application of Thiourea spray @ 0.1 % at 30 and 45 DAS (T<sub>4</sub>) followed by KNO<sub>3</sub> spray @ 1 % at 30 DAS (T<sub>7</sub>), 19:19:19 spray @ 1 % at 30 and 45 DAS (T<sub>10</sub>) and

Thiourea spray @ 0.1 % at 30 DAS (T<sub>3</sub>). Without application of agrochemicals (T<sub>1</sub>) was recorded lowest oil content that was (19.74 %). Similar result was found with oil yield, highest oil yield was measured with application of (T<sub>4</sub>)- Thiourea spray @ 0.1 % at 30 DAS and 45 DAS (509 kg ha<sup>-1</sup>) and lower oil (374 kg ha<sup>-1</sup>) yield noticed with (T<sub>1</sub>) control.

The effect of agrochemicals applications on mean protein content (%) was found to be non-significant, whereas, mean protein yield ( $\text{kg ha}^{-1}$ ) was found to be statistically significant Thiourea spray @ 0.1 % at 30 and 45 DAS (T<sub>4</sub>) recorded higher mean protein content and mean protein yield (40.59 %,  $1041 \text{ kg ha}^{-1}$ ) respectively. The higher protein yield was obtained due to application of thiourea spray @ 0.1 % at 30 and 45 DAS (T<sub>4</sub>) is the result of protein extracted from the higher seed yield similar results were reported by Dadhich *et al* (2015). Protein yield found at par with (T<sub>8</sub>) KNO<sub>3</sub> spray @ 1 % at 30 DAS and 45 DAS and (T<sub>10</sub>) -19:19:19 spray @ 1 % at 30 DAS and 45 DAS.

### Economics

Foliar application of different agrochemicals in soybean increased the gross and net returns over control. Spraying of Thiourea spray @ 0.1 % at 30 and 45 DAS (T<sub>4</sub>) recorded higher gross ( $71234 \text{ Rs. ha}^{-1}$ ) and net ( $41715 \text{ Rs. ha}^{-1}$ ) returns and B: C ratio (2.41) per ha. Followed by foliar Thiourea spray @ 0.1 % at 30 DAS (T<sub>3</sub>) 19:19:19 spray @ 1 % at 30 and 45 DAS (T<sub>10</sub>) and application of KNO<sub>3</sub> spray @ 1 % at 30 and 45 DAS (T<sub>8</sub>).

This might be due to higher economic yield obtained as a result of better utilization of agrochemicals through foliage. These results are in conformity with the finding of Chaurasia *et al* (2005)<sup>[4]</sup> and Singh (2013).

### Conclusions

Economic analysis revealed that foliar application Thiourea spray @ 0.1 % at 30 and 45 DAS (T<sub>4</sub>) recorded higher gross returns ( $71234 \text{ Rs. ha}^{-1}$ ), net returns ( $41715 \text{ Rs. ha}^{-1}$ ) and benefit cost ratio. The next best treatment was application of Thiourea spray @ 0.1 % at 30 DAS (T<sub>3</sub>). Net return ( $39925 \text{ Rs. ha}^{-1}$ ) and B: C ratio (2.38) was found to be superior over control.

Foliar application of agrochemicals namely thiourea (0.1 %), urea (2 %), KNO<sub>3</sub> (1 %) and 19:19:19 (1 %) significantly influenced growth characters in soybean. Treatment (T<sub>4</sub>) thiourea spray @ 0.1 % at 30 and 45 DAS recorded highest plant height (46.34 cm), leaf area ( $11.35 \text{ dm}^2$ ) and higher dry matter production ( $19.17, 21.82$  and  $23.55 \text{ g plant}^{-1}$  at 75, 90 DAS and harvest, respectively). Quality parameter such as oil content, oil yield Protein content and protein yield was found significant with treatment (T<sub>4</sub>) thiourea spray @ 0.1 % at 30 and 45 DAS and lower value were recorded in control with no foliar spray.

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