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

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Abstract

The experiment was conducted during kharif season of the year 2016 at Experimental Farm of Agronomy section, College of Agriculture, Latur, to study the effect of foliar application of agrochemicals on growth, yield and economics of soybean. The application of thiourea spray @ 0.1 per cent at 30 and 45 DAS (T₄) was recorded higher plant height, number of functional leaves plant⁻¹, leaf area plant⁻¹, number of branches plant⁻¹ and dry matter accumulation plant⁻¹. The maximum pod yield plant⁻¹, seed yield plant⁻¹, number of seeds plant⁻¹ was obtained with the application of thiourea spray @ 0.1 per cent at 30 and 45 DAS (T₄). Maximum seed, straw and biological yield were obtained due to the application of thiourea spray @ 0.1 per cent at 30 and 45 DAS (T₄). The maximum gross and net monetary return with higher B: C ratio was obtained with the application of thiourea spray @ 0.1 per cent at 30 and 45 DAS (T₄). Application of thiourea spray @ 0.1 per cent at 30 and 45 DAS (T₄) was produced higher protein and oil yield. This treatment was followed by Thiourea spray @ 0.1 % at 30 DAS (T₃), KNO₃ spray @ 1 % at 30 and 45 DAS (T₈) and 19:19:19 spray @ 1 % at 30 and 45 DAS (T₁₀).

Keywords: Soybean, agrochemicals, foliar spray, growth parameter, economics.

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) ^[1]. 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) ^[11]. 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) ^[3]. 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) ^[7]. 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) ^[2] 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) ^[12]. 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.

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. The experimental field was levelled and well drained. The soil was clayey in texture, low in available nitrogen (108 kg ha⁻¹), low in available phosphorus (8.18 kg ha⁻¹), very high in available potassium (430 kg ha⁻¹) and slightly alkaline in reaction (7.45 pH). The experiment laid out in Randomized Block Design consisting ten foliar application of agrochemicals at different growth stages viz., Control (T₁), Water spray at 30 and 45 DAS (T₂), Thiourea

spray @ 0.1 % at 30 DAS (T₃), Thiourea spray @ 0.1 % at 30 and 45 DAS (T₄), Urea spray @ 2% at 30 DAS (T₅), Urea spray @ 2% at 30 and 45 DAS (T₆), KNO₃ spray @ 1 % at 30 DAS (T₇), KNO₃ spray @ 1 % at 30 and 45 DAS (T₈), 19:19:19 spray @ 1 % at 30 DAS (T₉) and 19:19:19 spray @ 1 % at 30 and 45 DAS (T₁₀) replicated thrice. Sowing was done on 21st June 2016. The seed of soybean variety MAUS- 71 was used for sowing. The soybean crop was harvested on 30th September 2016. The recommended dose of fertilizer was 30:60:30 NPK kg ha⁻¹.

Results and Discussion

Growth:

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

Treatments	Plant height (cm) at harvest	Number of leaves plant ⁻¹ at 60 DAS	Leaf area plant ⁻¹ (dm ²)	Total dry matter (g) plant ⁻¹ at harvest
T ₁ - Control	34.25	14.72	6.12	17.08
T ₂ - Water spray at 30 and 45 DAS	40.92	16.98	8.64	18.07
T ₃ -Thiourea spray @ 0.1 % at 30 DAS	42.63	19.62	9.36	22.02
T ₄ - Thiourea spray @ 0.1 % at 30 DAS and 45 DAS	46.34	20.61	11.35	23.55
T ₅ - Urea spray @ 2% at 30 DAS	41.07	17.08	8.59	20.62
T ₆ - Urea spray @ 2% at 30 DAS and 45 DAS	43.21	18.14	9.18	22.10
T ₇ - KNO ₃ spray @ 1 % at 30 DAS	40.48	17.36	9.70	22.81
T ₈ - KNO ₃ spray @ 1 % at 30 DAS and 45 DAS	44.27	20.31	10.47	23.14
T ₉ - 19:19:19 spray @ 1 % at 30 DAS	43.49	19.13	8.26	20.45
T ₁₀ -19:19:19 spray @ 1 % at 30 DAS and 45 DAS	43.08	19.86	10.87	23.09
S.E. ±	2.00	0.95	0.37	1.14
C.D.at 5 %	5.95	2.82	1.12	3.38

Foliar application of agrochemicals namely thiourea (0.1 %), urea (2 %), KNO₃ (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 (T₄) produced highest plant height (46.34 cm), Number of leaf plant⁻¹ (20.61), leaf area (11.35 dm²) and dry matter per plant⁻¹ (23.55 g). However plant height, leaf chlorophyll content, nodules, and their weight Followed by treatment KNO₃ spray @ 1 % at 30 DAS and 45 DAS (T₈). 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 (T₄) recorded maximum leaf area at 60 DAS (11.35 dm²) which was at par with the foliar application of 19:19:19

spray @ 1 % at 30 and 45 DAS (T₁₀) and KNO₃ spray @ 1 % at 30 and 45 DAS (T₈) and found Foliar application of Thiourea spray @ 0.1 % at 30 and 45 DAS (T₄) recorded maximum dry matter accumulation at harvest (23.55 g plant⁻¹). Which was at par with the foliar application of KNO₃ spray @ 1 % at 30 and 45 DAS (T₈) and 19:19:19 spray @ 1 % at 30 and 45 DAS (T₁₀) and found significantly over rest of the treatments it may be due to increase in plant height, number of functional leaves, leaf area plant⁻¹ by foliar application which are of vital part of the plant where the photosynthetic takes 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) [5].

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

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

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 (T₄) recorded higher gross (71234 Rs. ha⁻¹) and net (41715 Rs. ha⁻¹) returns and B:C ratio (2.41) per ha. followed by foliar Thiourea spray @ 0.1 % at 30 DAS (T₃) 19:19:19 spray @ 1 % at 30 and 45 DAS (T₁₀) and application of KNO₃ spray @ 1 % at 30 and 45 DAS (T₈).

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)^[4] and Singh (2013).

Conclusions

Economic analysis revealed that foliar application Thiourea spray @ 0.1 % at 30 and 45 DAS (T₄) recorded higher gross returns (71234 Rs. ha⁻¹), net returns (41715 Rs. ha⁻¹) and benefit cost ratio. The next best treatment was application of Thiourea spray @ 0.1 % at 30 DAS (T₃). Net return (39925 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 %), KNO₃ (1 %) and 19:19:19 (1 %) significantly influenced growth characters in soybean. Treatment (T₄) thiourea spray @ 0.1 % at 30 and 45 DAS recorded highest plant height (46.34 cm), leaf area (11.35 dm²) and higher dry matter production (19.17, 21.82 and 23.55 g plant⁻¹ at 75, 90 DAS and harvest, respectively) and lower value were recorded in control with no foliar spray.

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