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Full Length Research Paper

The effects of maxicrop leaf fertilizer on the yield and quality of soybean (*Glycine max* L. Merril)

Bünyamin Yildirim*, Neşe Okut, Didem Türközü, Ömer Terzioğlu and Murat Tunçtürk

Department of Field Crops, Faculty of Agriculture, Yüzüncü Yıl University 65080 Van Turkey.

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The aim of this study which was conducted in the summer of 2001 on the trial fields of Van YYU (Yüzüncü Yıl University) was to determine the effects of Maxicrop leaf fertilizer, applied on Beason soybean at various stages, on the yield and yield components. Maxicrop doses of 500, 1000 and 1500 g.ha^{-1} per hectare were applied at three different stages of the plant (seed stage, four-leaf stage and "beginning of blooming" stage). The highest plant height was achieved as 32.98 cm on average from 2000 g.ha^{-1} dose. No difference was recorded between the applications in terms of 1000 seed weight. The values of 1000 seed weight varied between 134.25 - 144.25 g on average. Application doses lead to an increase in seed yield. The highest seed yield value was achieved as 1265.7 kg. ha^{-1} from 2000 g.ha^{-1} dose while the lowest seed yield was achieved as 997.3 kg. ha^{-1} from the control dose.

Key words: Maxicrop, application time, application dose, yield.

INTRODUCTION

Since soybean, a member of leguminosae family, is rich in nutrients, it is regarded as a nutrient storage. Thanks to this characteristic, soybean is not only seen as an oil plant but also used for various purposes (Arslan et al., 1993). It is nourishment rich in nutrients with its 40 - 50% crude protein, nearly 20% oil and 5% mineral substance content (Doğan, 1986). It is richer than cows' milk, egg, moderate fatty beef, bean and lentil in terms of nutrients content and lecithin (İncekara, 1972). Every year, a huge or small amount of vegetable oil deficit occurs in Turkey (Arslan et al., 1993). Unfortunately, soybean which has been introduced in Turkey to reduce the deficit, but has not been able to be wholly expanded due to various reasons (Anonymous, 2003).

Bacterial inoculation was performed and 20 kg N/feddan of initial dose was applied on Calland soybean within the scope of field trials conducted by Abdel-Gawad et al. (1989a) between 1984-86 in Shalakan. In addition, leaf fertilizer was applied following the 10th and 20th days of the beginning of bean formation. Micronutrients included in the leaf fertilizer are 4% of Mg, 1% of Fe, 0.5% of Zn, 0.3% of B and 0.5% of Cu. Following the 10th day of bean formation, 0, 10, 20 and 30 kg N/feddan (0.42 da.) doses were applied again. Although leaf fertilizers had insignificant effect on the leaf area and leaf number per plant and on the leaf area index, it had an increasing effect on dry matter. As plants ripened, a decrease was observed in the nitrogen content in chlorophyll, karotinoid and leaf of the plants. On the other hand, leaf fertilizer had a retardant effect on the decrease of said characteristics, however, it was concluded that micro element application does not provide a significant advantage to this end. Hay yield and bean yield were recorded to be higher in plants on which leaf fertilizer was applied while no change was recorded in the oil content of the bean.

Again, in the trials made by Abdel-Gawad et al. (1989b) between 1984 - 86 on a clayey field in Shalakan, bacterial inoculation was performed and 20 kg N/feddan of initial dose was applied on Calland soybean. In addition, leaf fertilizer was applied following the 10th and 20th days of the beginning of bean formation. Moreover, 10 days after the beginning of bean formation, 0, 10, 20 and 30 kg N/feddan N was applied to the soil. The number of leafs, leaf blade index and the accumulation of dry matters in the tissues were the elements not affected by the late nitrogen application. On the contrary, a small increased was observed in chlorophyll and karotinoid amounts. A small and insignificant increase was observed in the protein content of the leaves and the seed; the number and weight of beans, 100 bean weights and the

*Corresponding author. E-mail: byildirim71@gmail.com.

yield.

In a two-year study conducted in Central Missouri, Chowdhury et al. (1985) examined two soybean cultivars in terms of the effects of leaf fertilization on the yield and seed composition. A leaf fertilization application was tried in the form of "80-80-24-4 (NPKS) kg/ha 40-4-12-2 (NPKS) kg/ha and Control". High level fertilizer application did not lead to a significant yield increase in Williams and Micthel soybean cultivars.

Woon and Porter (1986) state that the leaf fertilizer they applied in their study lead to a leaf-burn in both years and a decrease in the seed yield while only the leaf fertilization applied at 7 pm did not lead to any burn but did not increase seed yield as well. The aim of this study was to determine the effects of Maxicrop leaf fertilizer, applied on Beason soybean at various stages, on the yield and yield components.

MATERIALS AND METHODS

Beason Soybean was used in the study and the mineral content of Maxicrop which was applied on the soybean plant is as follows: Total N 1.2%, total P_2O_5 939 ppm, total K_2O 16.2%, Mn 4.5%, Na 3%, Fe 520 ppm, Mg 2050 ppm, Zn 15 ppm, Cu 2.8 ppm, B 43 ppm and Mo 13 ppm. This substance was applied in 500, 1000, 1500 and 2000 $g.ha^{-1}$ doses. The amount was sprayed with a pulvarizator with some water enough to wet all the material. Maxicrop was applied on the seed stage, 4-leaf-stage and the stage of "the beginning of blooming".

Study was conducted on YYÜ fields. The study was conducted on a Randomized Blocks as Split Plots Design. Main plots were allocated for times and the sub-plots were allocated for doses. Study results were analyzed according to SAS packet program and the differences between the averages were determined on the basis of Duncan's test.

RESULTS AND DISCUSSION

As can bee seen in variance analysis table, application times were found to be significant for the number of beans (Table 1). On the other hand, leaf fertilizer doses were found to be significant for plant height, initial bean height, the number of beans and bean yield.

Plant height

As can be seen in Table 2, the highest plant height is achieved as 32.98 cm on average from 2000 $g.ha^{-1}$ dose. The difference between 1000 and 1500 $g.ha^{-1}$ doses is statistically insignificant. When application times are compared, the highest plant height is achieved with the application at the seed stage.

1000 seed weight

No difference was observed between the applications in terms of 1000 seed weight. The values of 1000 seed weight varied between 134.25 and 144.25 g on average. In their study conducted in 1997, Yıldırım et al. detected the 1000 seed weight of the same soybean cultivar to be between 141.75 - 166.55 g. These figures are similar. In their study, Akçin et al. (1994) used four different soybean cultivars and 1000 bean weights were found to change between 133.26 and 179.37 g. 1000 seed weight values found in the study were similar with the values found by the researchers. Güllüoğlu and Arıoğlu (2004) stated that different growth regulators applied in their study had positive effects on 1000 bean weight and one of them was Maxicrop. Abdel-Gawad et al. (1989b) detected small increases in 1000 bean weight within the scope of the leaf fertilizer study they conducted. The applications in the current study did not have any statistical effect on 1000 bean weight. This difference may result from cultivar or ecological difference.

Seed yield

Akçin et al. reported that the plant hormone Alar 85, which they applied on four different soybean cultivars in the scope of this study, did not have statistical effect on bean yield. In their study conducted in 1997, Yıldırım et al. stated that increasing CCC doses were reflected in increases in yield. Average yield values obtained changed between 1025.7 and 1367.9 $kg.ha^{-1}$. Yield values obtained in this study were found to be between 933.3 and 1376.8 $kg.ha^{-1}$. Application doses lead to an increase in the yield.

Abdel-Gawad et al. (1989a) observed that growth regulator they applied in their study was effective on the bean yield and hay yield. Abdel-Gawad et al. (1989b) detected small yield increases in their study. Current results are consistent with these studies. Woon et al. stated that leaf burn and a decrease in seed yield were recorded in the applications performed in day time, within the scope of their study in 1986. However, they also stated that no yield decrease was recorded in the applications performed in the evening hours around 7 pm.

The effects of leaf fertilization on the yield and seed compositions of two soybean cultivates were examined by Chowdhury et al. (1985). Leaf fertilization was applied in the form of "80-80-24-4 (NPKS) kg/ha, 40-4-12-2 (NPKS) kg/ha and Control". High level fertilization application did not lead to a significant increase in the yield of Williams and Micthel cultivates. Wingeyer et al. (2005) stated in their study that leaf fertilization lead to leaf burns and solely symbiotic nitrogen fixation via normal methods was enough for nodule formation and high yield. Mallorino (2005) noted that leaf fertilization applications under production conditions may not be always economical since a yield increase of around 15% can be achieved. They observed that in case only liquid fertilizers composed of NPK are used, keeping N and P rates at low levels is safe to ensure minimization of leaf burn and yield decreases. Current results are partially similar with the results obtained in these studies.

Table 1. The results of variance analysis related with the effects of leaf fertilizer on the yield and yield components of soybean.

Variation source	Plant height	Number of beans	1000 seed weight	Seed yield	Crude oil ratio	Crude oil yield	Crude protein ratio	Crude protein yield
Repetition	-	-	**	-	-	-	-	-
Application times	-	*	-	-	-	-	-	-
Error 1	-	-	-	-	-	-	-	-
Doses	**	**	-	**	-	-	-	-
Time x dose x interaction	-	-	-	-	-	-	-	-
Error 2	-	-	-	-	-	-	-	-
General	-	-	-	-	-	-	-	-

*Significant at possibility level 0.05
**Significant at possibility level 0.01

Table 2. Results of Duncan test related with the effects of leaf fertilizer on the yield and yield components of soybean.

Yield and yield components	Doses (g ha^{-1})	Application times			Average*
		1	2	3	
Plant height (cm)	Control	30.70	28.93	29.10	29.58c
	1000	32.18	30.25	30.15	30.86b
	1500	32.93	30.43	29.70	31.02b
	2000	36.18	31.73	31.05	32.98a
	Average *	32.99a	30.33a	30.00a	
The number of Beans (ea)	Control	19.73	16.50	15.68	17.30b
	1000	20.60	19.30	18.50	19.47b
	1500	25.15	23.48	21.33	23.32a
	2000	28.63	24.80	22.68	25.37a
	Average *	23.53a	21.02b	19.54b	
1000 seed weight (g)	Control	136.50	139.50	138.25	138.08a
	1000	142.00	140.00	142.50	141.50a
	1500	137.00	137.75	139.50	138.08a
	2000	144.25	134.25	143.50	140.67a
	Average *	139.93a	137.88a	140.94a	
Seed yield (Kg.ha^{-1})	Control	1054.8	1003.8	933.3	997.3c
	1000	1178.5	1117.3	1012.0	1102.6b
	1500	1125.0	1222.5	1122.0	1156.5b
	2000	1376.8	1242.8	1177.5	1265.7a
	Average *	1183.8a	1146.6a	1061.2a	
Crude oil ratio (%)	Control	22.69	21.93	22.56	22.39a
	1000	19.87	22.69	20.39	20.98a
	1500	20.64	21.67	20.64	20.98a
	2000	21.41	20.74	21.28	21.15a
	Average *	21.15a	21.76a	21.22a	
Crude oil yield (Kg.ha^{-1})	Control	237.9	221.2	213.1	224.1b
	1000	234.4	252.8	206.8	231.3b
	1500	232.1	264.1	231.6	242.6ab
	2000	295.4	256.4	248.6	266.8a
	Average *	249.9a	248.6a	225.0a	

Table 2. Contd.

Crude protein ratio (%)	Control	28.18	27.01	26.26	27.15a
	1000	25.85	25.33	26.73	25.97a
	1500	26.84	25.68	28.75	27.09a
	2000	26.90	24.12	28.69	26.57a
	Average *	26.94a	25.54a	27.61a	
Crude protein yield Kg.ha^{-1}	Control	299.8	277.8	250.7	276.1b
	1000	303.8	283.6	272.0	286.5b
	1500	302.1	314.0	326.6	314.2ab
	2000	370.4	299.9	339.4	336.5a
	Average *	319.0a	293.8a	297.1a	

*No difference was observed at possibility level 0.05 between the averages represented with the same letter.

Crude oil ratio

Yıldırım et al. (1997) found the oil ratios to be between 19.50 and 20.83 in their study. Values detected in this study are partially similar and a bit higher than the values concerned. This situation may result from solar radiation differences between years. The number of sunny days is important particularly for the increase in oil ratio. Abdel-Gawad et al. (1989a) detected in their study that the leaf fertilizer they applied did not have any effect on the oil content. Applications in the study were also found to be ineffective on the oil ratio. Findings obtained are similar with the findings of these researchers.

Crude oil yield

According to Abdel-Gawad et al. (1989a), the oil content of beans did not change in the plants on which leaf fertilization was applied. Therefore, oil yield was not affected as well. In the current study, however, a statistically significant increase was recorded in oil yield only in 2000 (g ha^{-1}) application dose. In their study, Akçin et al. (1994) detected that different dose of plant hormone Alar-85 increased crude oil ratio. There is a similarity with this study.

Crude protein ratio

In their study, Yıldırım et al. (1997) found that CCC applications did not have any effect on crude protein ratios. Leaf fertilizer used in the current study did not also have any statistical effect on crude protein ratio. There is a similarity with this study. On the other hand Akçin et al. (1994) found that plant hormone Alar-85 had a positive effect on the crude protein ratio. The difference may result from the difference in the material used.

Crude protein yield

A statistically significant difference was detected between the fertilizer applications in terms of crude protein yield. As the leaf fertilizer dose increased, an increase was observed in crude protein yield. In their study, Yıldırım et al. (1997) found an increase in oil yield as CCC doses increased. The same soybean cultivate is used in the current study as well and there is a consistency in terms of crude protein yield.

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