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Soybean yield and quality as affected by spraying NPK fertilizers compound with amino acids and micronutrients

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Abstract : This study aimed to investigation the effects of foliar NPK fertilizers compound with micronutrients spraying at different levels and amino acids on soybean plants. The field experiment was conducted at Al Sharkia Governorate, Egypt in a private farm through a project of soil and water use Dept. of the National Research Center This experiment design with three replicates. Soybean seeds (Giza 21) were sown on the 15th of June, 2014. The NPK fertilizers contain macronutrients from N, P and K as (20- 20 -20) foliar application. The micronutrients were mixed from (Fe, Zn, Mn, Mg and B) and added every 15 days with irrigation at two levels 1.5 and 2.0 $Kgfed^{-1}$. The amino acids were applied at two levels as 1.5 and 2.0 g/l. The results are as follows: 1-The application of foliar NPK fertilizers with amino acids at 2.0g/l compound with mixed micronutrients as 2.0 Kgfed-1 increased the vegetative growth of soybean plants compared with control. 2- The best results of yield and its compound and concentrations of N, P and K were recorded with foliar NPK application compound with increasing the rate of amino acids and mixed micronutrients.
Key word : Soybean, foliar fertilization, NPK, Micronutrients, Amino acids.

Introduction

Soybean (*Glycine max* L.) is very important crop for human food as oil and it used for animal production like corn plant which seeds of soybean content high protein which is used for animals food. Soybean plants are large in protein compared with other foods such as animal meat, fish, eggs, and milk[24]. Soybean production needed to soil fertility as good or added more of nutrients as macro and micro nutrients. Especially, the application of fertilizers as nitrogen is very important element to increase the soybean production. The lower level of nitrogen fertilizers in the soil effects on yield and yield quality of soybean[39].

More studies indicate to increase the soybean production by use a new method as foliar application aimed to increase the nutrients available for plant. It is important method to decrease the loss of nutrients such as loss of nitrogen by leashing, fixation in soil and volatilization. The foliar application of nitrogen fertilizers increased nitrogen in the leaf, foliar applied nutrient can be more efficient than the soil applied [37]. Foliar fertilization of nitrogen with hard conditions in soil as drought and salinity increased the uptake of (Na, K, Ca, Mg P and N) in individual leaves [52]. The application of foliar NPK fertilizers increased the plant growth and yield which increased the translocation of macronutrients to the economic parts and finally increased the productivity of the crops [37]. The important of foliar application is increase the adsorption of nutrients with the liquid fertilizer. It was concluded that the foliar application increase the nutrients uptake by the leaves and the nutrients saved into the plant from loss compared with soil application or when applied the nutrients in soil [33].

[34] indicated that the foliar fertilization is very important method to improve the plant growth and increased the soybean yield from foliar applications of macro and micronutrients. [28] found that the application of NPK fertilizers as spray to leaves significantly increase the plant growth and yield of soybean plant.

Considerable nitrogen in soil can be loss by leaching, volatilization, denitrification and it can be immobilized by microbial activity as nitrification and nitrogen in soil can be fixed by clay mineral. The loss of nitrogen in soil decrease the amount of nitrogen available for plant uptake. The efficiency of this uptake can be defined by the ratio of fertilizer N in the crop to fertilizer N applied to the soil. With attention to best use guild lines, the efficiency of foliar N application may be optimized at nearly 95 to 100 per cent [14]. There results due to the direct link between foliar application and the activities of the enzymatic systems of the plant. The availability of nutrients such as nitrogen therefore by foliar feeding encourage enzymatic cycle to greater efficiency and quicker response to plant[14].

Amino acids effects on the plant growth and yield which active the enzymes systems in the plant and important the photosynthesis process[29]. The foliar application using amino acids improve the growth physiology that effect on build blocks of protein synthesis which amino acids play a vital role in plant metabolism as vitamin, nucleotide and hormone biosynthesis [44]. The spraying of amino acids at 0.25 ml/L significantly improved the vegetative growth such as plant height and dry weight of plant [26]. The application of amino acids as foliar is based on their requirement by plants in general and critical stages of growth in particular [11]. Plants can absorb amino acids by stomata and are commensurate with the environment temperature that controls the opening mechanism of the plant stomata[18].

The application of nutrition plays an important role in plant growth and it is generally include of macronutrients and micronutrients. The macronutrients as (N, P and K) is very important role of plant and any loss in these nutrients effect on plant growth, the plant need it with large amounts, but the micronutrients as (Zn, B, Co, Mn, Mo, Cu, Ni and Fe) the plant need it with least amounts and it very necessary for plant growth and development [4]. These results may be due to the micronutrients not only increase the yield but improve the quality of grain nutrients [7]. The application of micronutrients was moreover explain that micronutrients can increase the grain yield up to 50%, as well as increase macronutrients use efficiency[7].

Micronutrients are determine substances that are very necessary for plant growth however, they are used in minimize percent as compared to macronutrients, such as N, P and K the plant used it with large amounts [2]. [21] showed that the efficiency of micronutrients will be obtained with combination with macro elements. The foliar application was very effective and economic for soybean production. New research has obtained that a small amount of micronutrients such as Zn, Fe and Mn applied as foliar application increased significantly the yield of crops and quality [45] and [51].

The application of micronutrients as foliar increase the adsorption of macronutrients [40]**.** Also, the foliar application of macronutrients as nitrogen compound with micronutrients as boron fertilizers in soybean increased the plant growth and improved the quality of yield [19]. However, the foliar application with born fertilizer increased the protein reduction and percentage of oil content [19]. And the foliar application of zinc with macronutrients fertilizers in early stage from plant growth increased soybean seed yield [8]. Furthermore, the foliar application of micronutrients is very necessary of soybean production. More research have been obtained to increase soybean production and quality such as [35] reported that boron is one of the important nutrient it is effects on germination, fruit formation and transfer of photosynthetic components. The deficiency of B in plants caused bad growth and decrease the vegetative growth which leads to death of new leaves. [48] reported that the application of Fe and Zn effects on enzymatic systems as structural catalyst and interferes in proteins destruction in plant cells. Micronutrients increased the photosynthesis and translocation of assimilates to the seed. [20] showed that the young leaves chlorosis due to decrease of chlorophyll in the leaves, and plant metabolism will be caused by the lack of Fe and in condition of Fe deficiency stress, the absorption of Fe would be enhanced. When Fe is not available in soil, foliar application of this nutrient is very important it effect on nitrogenase activity and N_2 fixation by soybean plant. [46]showed that the foliar application of $ZnSO_4$ at flowering and seed stage increased the soybean yield components.

Finally, the foliar application of amino acids with micronutrients on soybean plants improved the plant growth and yield. Some new researchers showed that the spray of amino acids compound with micronutrients

that increasing the growth, yield and chemical composition of some economic plants [26]. The role of amino acids with micronutrients improving the adsorption of macronutrients which include in plant metabolism[10].

Keeping these points in mind, the objective of this study was to evaluation the foliar application of N, P and K fertilizers compound with amino acids and micronutrient to improve the yield and quality of soybean.

Materials and Methods

A field experiment was executed in Sharkia Governorate, Egypt, to effects the efficiency of foliar NPK application compound with amino acids and foliar micronutrients Fe, Zn, Mn and B on nutrient concentration and yield of soybean (*Glycine max* L.). Soybean seeds (Giza 21) were sown on the 15th of June, 2014. Samples of the commonly used commercial fertilizers were obtained from soluble fertilizers contain (20 - 20 - 20) from N, P and K and the micronutrients were sprayed as mixed micronutrients from Fe, Zn, Mn and B. Fe was applied as $FeSO_4$, Zn was applied as $ZnSO_4$, Mn was applied as Mn SO_4 and B was applied as Boric acids. Two levels were applied from micronutrients as (2.0 Kgfed^{-1} and 1.5 Kged^{-1}). The amino acids sprayed as two level (1.5 and 0.2 g/l). The commercial product used as a source of amino acids. The required quantity of foliar spray fertilizers was applied to the crop with irrigation. Total six irrigations were applied during the growth period of the crop. The control treatment was sprayed with ordinary water. Treatments were sprayed by hand sprayer resulting smoothly wet surface area. Six treatments were recorded as:

1. Control
2. Foliar NPK + amino acids 1.5 g/l
3. Foliar NPK + amino acids 2.0 g/l
4. Foliar NPK + mixed micronutrients 1.5 Kgfed^{-1}
5. Foliar NPK + mixed micronutrients 2.0 Kgfed^{-1}
6. Foliar NPK + amino acids 2.0g/l + mixed micronutrients 2.0 Kgfed^{-1}

Soybean harvest was performed manually. Ten plants randomly selected from each plot were used to record data seven quantitative traits (plant height, number of nodes per plant, number of pods per plant, number of grain per plant, grain yield per plant and 1000-seed weight). After harvesting grain yield was converted into tonfed^{-1}. Grain yield is calculated on a 13% moisture basis. Data were processed using analysis of variance (ANOVA) according to a linear model which included effects of cultivar and fertilizer treatments, and the interaction between them. Differences between traits means were assessed using Duncan's Multiple Range Test at $P \leq 0.05$ level.

Therefore, the main objective of this study depended on the efficiency of foliar fertilization with macronutrients compound with micronutrients at different levels with foliar amino acids as two levels on plant growth and quality of soybean plants.

Methods of analysis

Soil and plant samples were carried out to the laboratory in the National Research Center, oven dried, fine grounded, wet digested and prepared for chemical analysis. Mechanical analysis of the experimental soil was determined according to the international Pipette method and calcium carbonate content of the soil was determined volumetrically using Calcimeter as described by [43].

Soil pH was measured using a glass-electrode pH meter with a combined glass reference at soil: water 1:2.5 [12].

EC extract was determined by using the bridge [25].

Calcium carbonate was determined using a calcimeter and calculated as CaCO3 % as described by [42].

Organic matter content was analyzed according to the modified Walkley-Black method [25].

Carbonate and bicarbonate ions, were determined by titration with a standard solution of sulfuric acid using phenolphthalein as an indicator for CO3- and methyl-orange for HCO3- as described by [25].

Chloride ions were determined by titration with silver nitrate using potassium chromate as an indicator according to Mohr, s method [42].

Sulfates ions were determined by difference between total cations and total anions.

Extraction of exchangeable calcium and magnesium was done, and two cations were determined by titration with versinate along with extract of exchangeable sodium and potassium using 1 M ammonium acetate solution and two cations was determined flame photo metrically [25].

Total nitrogen in soil was determined using microKjeldahl method [25].

Total potassium in soil was determined by flame photometer according [25].

Total phosphorus in soil was determined colourmetrically using ascorbic acid method was measured according to [50].

The data obtained was subjected to analysis variance procedure using Duncan's Multiple Range Test was adopted for the means comparison among treatments showing significant difference. Effect of N and P fertilizer was partitioned into linear and quadratic components and regressions were calculated for effects significant at 0.05 level of probability [15].

The values obtained from spectroradiometer can be used to predict the N, P, K, Mg and Mn contents of orchard leaves in field. However, predictions of Ca, Fe, Zn and Cu contents are not adequate for use. The fore-optic may be used for determination of macronutrients, while plant probe may be useful for micronutrients determination [31].

A new, simple and selective spectrophotometric method was developed for the analysis amino acids which used in nitrification inhibitors this method obtained by [41].

Some physical and chemical characteristics of the studied soil and material fertilizers are presented in Tables (1).

Table (1): Some Physical and Chemical Analysis of Experiments Soil

Soil characteristics	Soil content
Mechanical analysis:	
Fine sand%	24.66
Coarse sand%	9.92
Silt%	12.80
Clay%	52.62
Textural	Clayey
Chemical analysis:	
Organic matter%	1.88
pH *	8.01
EC (dS m-1)**	0.15
CaCO3 g kg-1	0.22
Soluble ions (mmol-1)	
Ca++	0.46
Mg++	0.28
Na+	0.84
K+	0.08
CO-3	-
HCO--3	0.56
Cl-	0.40
SO-4	0.70
Available-N (g kg-1)	3.61
Available-P (g kg-1)	1.62
Available-K (g kg-1)	0.81

Results and Discussion

Plant Growth Parameters:

Vegetative Characters:

Results show that the effect of foliar NPK fertilization of soybean plants with amino acids at two levels compound with micronutrients as Fe, Zn, Mn and B at different concentrations on vegetative growth. Concerning the effect of foliar NPK with amino acids and micronutrients on soybean growth at vegetative stage, data in Table (2), obtained that the foliar NPK fertilization with amino acids was generally more effective than the control plants. Also, the application of amino acids as foliar application at 0.2 g/l increased the plant growth compared with amino acids at 1.5 g/l and control. These results may be due to the effect of foliar NPK fertilizers with amino acids on photosynthetic rates, plant stomatal conductance and transpiration. These results were in agreement with the results obtained by [44] on soybean who showed that the application of amino acids significantly improved plant growth. The vegetative growth as plant height (cm), number of pod per plant, number of nodes per plant, plant fresh weight and plant dry weight were increased with foliar NPK fertilizers with amino acids at 0.2 g/l these result may be due to the primary metabolites and the building blocks in the synthesis of proteins depend on amino acids. These results has positive effects on plant growth [22]. These results hold true for growth parameters in the yield (Table 2).

The highest values of the vegetative growth were obtained with foliar NPK fertilizers with mixed micronutrients at 2.0 $Kgfed^{-1}$. While the lowest values of this characteristics were occurred with foliar NPK fertilizer with micronutrients at 1.5 $Kgfed^{-1}$. These results may be due to the effect of foliar NPK fertilizers with micronutrients in plant physiology such as Fe plays a important role in several vital processes in plant such as photosynthesis consequently affecting plant growth and Zn is important for C fixed in the primary photosynthetic process [32]. Also, Zn increased photosynthetic efficiency which was reflected as simulative effect on vegetative growth plant and also zinc is a component of a variety of enzymes such as dehydrogenase, proteinase, peptidase and phosphohydrases (metabolism of carbohydrates, protein and phosphate) and Zn is known to stimulate plant resistance to dry and hot weather [36]. Zn is also well reduction known to be directly involved in biosynthesis of IAA hormone which induces cell division and cell elongation; Mn is involved in the evolution of O_2 in photosynthesis (Hill reaction). It is a component of several enzyme systems. It has also function in chloroplast as a part of electron-transfer (oxidation-reduction) reactions and electron transport system[47]. [8] showed that the foliar application with zinc at vegetative growth stage increased soybean seed yield. In addition, Mn is an important element to plant growth. It is a part of nitrate reductase, which is involved in reduction of NO_3 to NH_4 after its absorption by plants. Also, it is structural component of nitrogenase, which involved in nitrogen fixation of N_2 into the ammonium form in a symbiotic relationship with legumes [13] and [9]. Boron (B) is one of the important elements that have the main effects on germination, fruit formation and transfer of photosynthetic components [35].

Data in the same Table, illustrate that NPK foliar spraying treatments with micronutrients increased significantly the fresh weight and dry weight compared with control. The positive effect of Fe, Zn, Mn and B on fresh weight and dry weight could be attributed to that Fe, Zn, Mn and B have a vital roles in plants. These results are in conformity with those obtained by [5] and [1]. The foliar application of NPK with micronutrients at 2.0 $Kgfed^{-1}$ gave the highest values of fresh and dry weight. On the other hand, the lowest values of fresh and dry weight were found with control. These results may be due to the effect of these with micronutrients in plant physiology such as photosynthesis, enzyme systems, function in chloroplast and nitrogen fixation. These results are in conformity with those obtained by[13, 9,32,36].

As seems to appear from illustrated data in the same Table, the vegetative growth were significantly increased with foliar NPK fertilizer with amino acids as 2.0g/l compound with mixed micronutrients as 2.0$Kgfed^{-1}$. These results may be due to effect of amino acids on metabolites and building blocks in the synthesis of proteins [22] and the effect of micronutrients to increased the plant growth that its important role in plant physiology, photosynthesis, C fixed in the primary photosynthetic process, active of a variety of enzymes such as dehydrogenase, proteinase, peptidase and phosphohydrases (metabolism of carbohydrates, protein and phosphate). These results are in conformity with those obtained by [41,6,20].

Table (2): Effect of foliar NPK fertilizers with micronutrients and amino acids on vegetative growth of soybean plants.

Type of fertilizers	Plant	No. of pod	No. of nodes	fresh	dry weight (g)
Control	86.14	41	10	11.57	1.46
Foliar NPK + AS 1.5	95.46	44	12	13.29	2.79
Foliar NPK + AS 2.0	98.22	45	13	14.87	2.22
Foliar NPK + MM 1.5	104.51	52	13	17.25	3.46
Foliar NPK + MM 2.0	1121.31	53	14	18.49	3.51
Foliar NPK + AS 2.0 +	121.44	61	14	19.17	3.62
LSD at 0.05	2.15	1.24	0.21	1.55	0.11

Yield and its components:

Data in Table (3) obtained that the yield and its components as affected by foliar NPK fertilizer with amino acids and micronutrients. The maximum values of this characteristics were produced from foliar NPK application with amino acids. While, the minimum values of aforementioned attribute were obtained with control. The application of amino acids as spraying increasing the plant growth, yield and chemical composition of some economic plants. The application of amino acids is very important role in building blocks of proteins, metabolism, vitamin, and hormone biosynthesis [11]. Same results obtained by [10] who suggested that there are several potential benefits of providing nitrogen to cereals via the foliage as NPK fertilizer.

Data in the same table, obtained that the yield and its components were increased with application of NPK spraying with amino acids with level at 2.0 g/l compared with the level at 1.5 g/l. These results may be due to the effect of amino acids on plant metabolism [11]. These results may be also due to the effect of foliar application with NPK and amino acids on photosynthetic rates, stomatal conductance and transpiration. These results were in agreement with the results obtained b [27] who found that the foliar NPK application with amino acids increased the photosynthetic rates, stomatal conductance and transpiration.

Data showed that all spraying treatments of NPK fertilizers with micronutrients greatly improved the yield and its components of soybean plants compared with control. The application of micronutrients at 2.0 $Kgfed^{-1}$ were significantly improved the yield. In the same trend, grain yield was significantly increased with increasing foliar NPK with micronutrients concentrations from 1.5 up to 2.0$Kgfed^{-1}$. These results may be due to the effect of these micronutrients (Fe,Zn,Mn and B) in plant physiology such as photosynthesis consequently affecting plant growth, important for C fixed in the primary photosynthetic process [32]. Same results with [17] who found that yield and its components increased markedly by foliar spray of NPK with micronutrients compared with the untreated plants.

Results in the same Table, showed that spraying soybean plants with NPK spraying with micronutrients (Fe, Zn, Mn and B) at different concentrations 1.5$Kgfed^{-1}$ and 2.0$Kgfed^{-1}$ were increased the total yield with increasing concentrations from 1.5 up 2.0$Kgfed^{-1}$. The increase in total yield owed directly to the increase in vegetative growth. These increases might be ascribed to the favorable role of the used micronutrients and the positive effect of Fe, Zn, Mn, and B on dry weight could be attributed to that Fe, Zn, Mn and B have vital roles in plants as follows as Iron is very important which is an activator of enzymes [38]. Zinc is a component of many enzymes such as dehydrogenase, proteinase, peptidases and phosphohydrolase important for metabolism of carbohydrate, protein and phosphate [47]. Manganese involves in the evolution of O2 in photosynthesis. These results are in conformity with those obtained by [5]. Boron (B) is important to germination, fruit formation and transfer of photosynthetic components and the deficiency of B in plants cause bad growth which leads to death of new leaves[35].

It can be concluded that the best results of yield and its components were recorded with foliar NPK application compound with increasing the rate of amino acids and mixed micronutrients. Amino acids have act as chelating effect on micronutrients, when applied together with micronutrients, the absorption and transportation of micronutrients inside the plant is easier [16]. The application of amino acids as foliar spray is based on their requirement by plants in general and critical stages of growth in particular [11].

Table (3): Effect of foliar NPK fertilizers with micronutrients and amino acids on yield and its components of soybean plants.

Type of fertilizers	No of seeds per plant	No of grain per plant	Grain yield per plant (g)	1000-grain weight (g)	Grain yield (tonfed^{1-})
Control	12	78	16.42	143.12	1.24
Foliar NPK + AS 1.5	14	94	18.73	152.36	1.43
Foliar NPK + AS 2.0	14	95	19.41	155.61	1.44
Foliar NPK + MM 1.5	15	104	19.87	159.43	1.48
Foliar NPK + MM 2.0	15	108	20.14	161.11	1.50
Foliar NPK + AS 2.0 + MM 2.0	16	112	20.94	165.21	1.57
LSD at 0.05	0.12	0.54	1.46	1.59	0.11

Nutrient concentration:

Results showed that the application of foliar NPK fertilizer with amino acids and mixed micronutrients on nitrogen, phosphorus and potassium concentration (%). The results in Table (4) show that application of foliar NPK fertilizers with amino acids increased the nutrient concentration of soybean compared to control treatment. Same results by [43] who showed that the sparing macronutrients beside with amino acids decrease the denitrification of nitrogen and loss of nitrogen by leaching compared the nitrogen when applied in soil. [16] who found that the sparing of NPK with amino acids increased the concentration of phosphorus that its increased the absorption of phosphorus compared with the phosphorus in the soil which become fixed in soil and unavailable to plant. [27] who found that the application of NPK with amino acids sparing to leaves increased of potassium concentration and its uptake. The results indicate that the highest concentration of nitrogen with spraying NPK compound with amino acids but the lowest concentration of nitrogen at control. Also, the results show that the highest concentration of phosphorus and potassium absorbed with spraying NPK with amino acids treatment compared with treatment of control. These results were obtained by [16], [3]and [48].

Data in the same table, obtained that the concentration of nitrogen, phosphorus and potassium were increased with application of NPK spraying with amino acids with level at 2.0 g/l compared with the level at 1.5 g/l. These results may be due to the effect of amino acids on plant metabolism, vitamin, nucleotide and hormone [11]. Amino acids is activator of all metabolic and physiological of plant metabolism [10]. These results may be also due to the effect of foliar application with NPK and amino acids on photosynthetic rates, stomatal conductance and transpiration.

Results in the same Table, showed that spraying soybean plants with NPK with micronutrients (Fe, Zn, Mn and B) at different concentrations 1.5Kgfed^{-1}and 2.0Kgfed^{-1} were increased the concentrations of N, P and K 1.5 up 2.0 Kgfed^{-1}. The increase in N, P and K owed directly to the increase in vegetative growth. These increases might be ascribed to the favorable role of the used micronutrients and the positive effect of Fe, Zn, Mn, and B on dry weight could be attributed to that Fe, Zn, Mn and B have vital roles in plants as follows: Iron is activator of all enzymes in plant [38]. Zinc is a component of many enzymes such as dehydrogenase, proteinase, peptidases and phosphohydrolase important for metabolism of carbohydrate, protein and phosphate [48]. Manganese involves in the evolution of O_2 in photosynthesis. These results are in conformity with those obtained by [5]. Boron (B) is very important elements of germination and photosynthetic which improved the growth[35]. The results indicate that the highest concentration of nitrogen at 2.0 Kgfed^{-1}, but the lowest concentration of nitrogen at control. Also, the results show that the highest concentration of phosphorus and potassium absorbed at 2.0 Kgfed^{-1} treatments compared with treatment of control.

The maximum values of phosphorus concentration were obtained with sparing NPK fertilizer with micronutrients compared with control. These results obtained by[49] showed that the sparing of NPK with micronutrients increased the absorbed of many elements such as K, Ca, Mg and P, which may be attributed to decreased transpiration. Data in the same Table, obtained that the highest values of phosphorus concentration were observed with sparing fertilization NPK. And the highest values of P uptake were obtained with sparing NPK with micronutrients at 2.0 Kgfed^{-1}. Foliar application of macronutrients and micronutrients increased K

concentration and its uptake. Data in Table (4), observed that the maximum values of K concentrations were recorded with application of NPK with micronutrients. And the minimum values of K concentrations were obtained with control. These results are in agreement with the results obtained by [27] who found that the sparing fertilizers with NPK and micronutrients increased the K concentration which increased the absorbed of potassium.

Table (4): Effect of foliar NPK fertilizers with micronutrients and amino acids on nutrient concentration of soybean plants.

Type of fertilizers	Nitrogen %	Phosphorus %	Potassium %
Control	1.44	0.15	1.23
Foliar NPK + AS 1.5	2.41	0.29	1.46
Foliar NPK + AS 2.0	2.26	0.32	1.48
Foliar NPK + MM 1.5	2.57	0.36	1.52
Foliar NPK + MM 2.0	2.88	0.36	1.55
Foliar NPK + AS 2. + MM 2.0	2.96	0.38	1.56
LSD at 0.05	0.31	0.02	0.12

Conclusion

Recently the work related to plant nutrition reported nutrients on growth and yield of soybean has come to conclusion that foliar application of macro and micro nutrients with amino acids play an important role in the production of good crop and higher yield. The obtained results show that the vegetative growth, yield and quality of soybean plants were enhanced by foliar application of NPK with micronutrients. The treatment of amino acids with micronutrients gave better results of growth and yield characters of soybean plant.

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