

# Higher NPK nutrients absorption due to the use of humic acid affects the growth and yield of baby corn applied with mungbean extract

*by Fachirah Ulfa*

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## Higher NPK nutrients absorption due to the use of humic acid affects the growth and yield of baby corn applied with mungbean extract

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**Abstract.** This study aims to determine the growth and production of baby corn plants due to application of humic acid and mungbean sprouts extract. The study was conducted at the Teaching Farm of the Faculty of Agriculture, Hasanuddin University, Makassar from March to May 2018. This study used a factorial two-factor design that was arranged based on a randomized block design. The first factor was the application of humic acid consisted of control, 20, and 25 kg ha<sup>-1</sup>. While the second factor was the mungbean sprout extract concentration consisted of control, 5, 15, and 25 ppm. Each treatment was repeated 3 times, resulted in 36 experimental units. The results show that humic acid treatment can increase NPK uptake by corn plants and improve soil chemical properties. However, the two treatments had no significant effect on the growth and production of the baby corn plants. Application of 25 kg ha<sup>-1</sup> humic acid and 25 ppm mungbean sprouts extract showed the best results on the parameters of the plant height (107.28 cm) and the highest number of leaves (15.56 leaves). Highest production per hectare was obtained both from the application of 20 kg ha<sup>-1</sup> humic acid and 5 ppm of mungbean sprouts extract, and application of 25 kg ha<sup>-1</sup> humic acid and with 15 ppm of mungbean sprout extract.

### 1. Introduction

Corn (*Zea mays*) is one of the important cereals besides rice and wheat. One of the basic needs of the community, especially in Indonesia is corn. Besides being used as carbohydrates for humans, it can also be used as animal feed and industrial raw materials. In addition to consumption as a staple food, corn can also be consumed at earlier stage of the ear development as vegetables in many dishes. This very young corn ears are often referred to as baby corn.

The demand for baby corn products in Indonesia is quite high, but cannot be fulfilled by the export of this community by the corn companies. The quantity, quality and continuity of Indonesia's baby corn production do not meet international market demand standards. Often the market demand cannot be met due to non-continuous production and quality that has not been guaranteed. For domestic consumers, the supply of baby corn does not seem to be too problematic because not all require for very high quality so that whatever demand can still be fulfilled. As for exporters and canneries who always demand the highest quality and sometimes ask for large quantities, the supply of baby corn is a problem because farmers and suppliers cannot meet the demands on quality and quantities basis.



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Nutrients are essential substances for plants that affect plant growth and physiological development. Nutrients are also called essential elements because each nutrient must exist in the largest amount for plants [1]. Lack of one of the nutrients will cause disruption to the growth and physiological development of the plant. This is due to the fact that each element has its own function in the process of plant metabolism, so that if one function is not fulfilled, all plant metabolic processes will be disrupted [2].

One effort to increase the absorption of nutrients is by applying humic acid. Humic acid can affect plant growth directly and indirectly. The indirect effect of humic acid on plant growth are through improved soil properties, hence increase nutrient uptake by plants which in turn improve plant growth and production. While the direct effect of the substance is through improved metabolic processes in plants, such as increased root respiration, improved protein synthesis and nucleic acid, and increased photosynthesis rate [3].

Chen and Aviad [4] studied the use of humic acid stimulate plant growth. The application of humic acid affects the height, fresh weight, dry weight, shoots and roots, the number of lateral roots, root initiation, seedling growth, nutrient absorption and flowering. According to Tan [5], nitrogen levels in humic acid range from 2% to 5%. Thus, addition of humic acid to the soil can increase N-total and C-organic in the soil. The application of humic acid also increases P-available in the soil. The carboxyl and phenolic groups in humic acid have the property of being able to bind Al, Fe and Ca ions from a soil solution, forming complex compounds that are difficult to dissolve. Thus, humic acid can play role to reduce the free Al, Fe and Ca ions in the soil solution and make more phosphate available to the plants.

Previous studies showed that application of 20 kg per hectare of humic acid together with NPK fertilizer with a dose of 100% recommended dose provided the highest nitrogen availability during flowering and harvesting periods of 0.1% and 0.089% (soil depth 0-20 cm) while at a depth of 21-40 cm at 0.078 % and 0.070%. Humic acid has the ability as a ligand that can bind nitrogen to form complexes that can temporarily store nutrients in the soil and release it when plants need it. Vaughan and Ord [6] report that humic acid can inhibit urease activity which can reduce the release of nitrogen through evaporation so that the availability of nitrogen in the soil increases.

The efficiency of N, P and K fertilization on agricultural land can be increased by adding the humic acid to the soil. A study of Hermanto et al. [7] showed that in the control plot, efficiency of N, P, and K fertilization was below 50% compared to the plot applied with humic acid. This indicates that the nutrients (N, P and K) are absorbed by plants were lesser than those that are not absorbed. The macro nutrients that are not absorbed by plants may be carried by water or evaporated. The application of humic acid in the soil was proven to increase fertilizer efficiency with the highest value obtained in the administration of humic acid 20 kg per hectare and even higher fertilizer efficiency was achieved at lower fertilizer doses [7].

Plant growth is also regulated by a growth control system through the work of plant growth regulator compounds. Plant growth regulator commonly used today is a synthetic growth regulator which is relatively expensive and sometimes has scarce availability. To overcome this need, it is necessary to look for growth regulators that can be obtained easily, cheap but have the same or more ability than synthetic growth regulators to improve plant growth. The compound should also be extracted from plant bioactive compounds as plant growth regulators. One of it is from mungbean sprouts [8].

The results of research conducted by Mahanani [9] showed that the administration of mungbean sprout extract with a concentration of 40% on potato plants of the granola variety showed better growth and best results compared to other natural growth regulators or without growth regulators. The mungbean sprout extract is also very influential on the growth of orchid plants [10]. The mungbean sprouts are a type of vegetable that is commonly consumed, easily obtained, economical and does not produce compounds that have toxic effects. Mungbean sprout extract has a concentration of auxin growth regulator of 1.68 ppm, gibberellins 39.94 ppm, and cytokinin 96.26 ppm [8]. Based on the description above, it becomes the rationale for conducting research on the growth and production of baby corn plants on the application of humic acid and green bean sprout extract.

## 2. Methodol<sup>20</sup>

The research was carried out in the Teaching Farm, Faculty of Agric<sup>30</sup>re, Hasanuddin University Makassar, South Sulawesi (05°07'39" South latitude and <sup>13</sup>9°28'58" East longitude) at an altitude of 8 - 48 m above sea le<sup>21</sup> (asl) from March to May 2018. Analysis of N, P, and K content of plants was carried out at the Laboratory of A<sup>6</sup>mal Food Chemistry, Department of Nutrition and Animal Feed, Faculty of Animal Husbandry and analysis of soil nutrient content was carried out at the Laboratory of Chemistry and Soil Fertility, Department of Soil Science, Faculty of Agriculture, Hasanuddin University.

<sup>6</sup>he research was carried out in the form of a two-factor factorial experiment arranged on the basis of a randomized block design. The <sup>4</sup>irst factor was the application of humic acid consisted of 3 levels, namely: Control, 20, and 25 kg ha<sup>-1</sup>. The second factor was the application of mungbean sprout extract consisted of 4 levels, namely control, 5, 15, and 25 ppm per plant. Each treatment combination was repeated 3 times so that 36 unit experiments were obtained.

Mungbean sprout extract was carried out according to Ulfa [8]. Prior to planting, plots was applied with chicken manure one week before planting. Application of humic acid was conducted by spreading it on the soil surface<sup>23</sup> then mixed it evenly. A basic fertilizers were given consisted of Urea, SP36 and KCl at doses of 150 kg ha<sup>-1</sup>, 200 kg ha<sup>-1</sup>, and 50 kg ha<sup>-1</sup>, respectively. The application of the mungbean sprout extract was conducted by spraying on the baby corn plant starting at 2 weeks after planting according to the treatment and continued once a week.

Harvest of the ear of baby corn were carried out manually at 1-2 days after silking, where the ear is still very young. Harvesting must be done immediately so that it is not too large and hard. The frequency of harvest was done once every 2-3 days and the final harvest time is around 2-4 weeks after the first harvest.

<sup>20</sup>The observed components were plant height, number of leaves, ear length and diameter, and productivity. Plant N, P, and K content observations were made after harvest by analysing the N content in the main stems or leaf bones of the sample plants, P content in leaf bones near the ear of sample plants, and Plant K content in strand<sup>33</sup> leaf bones near the ear in sample plants [11]. Data collected were analysed statistically using two-way analysis of variance according to the design<sup>13</sup>ed. If there is a significant effect of treatments ( $p < 0.05$ ) then a further analysis was conducted using the Least Significance Difference (LSD) test at the 5% level.

## <sup>5</sup>3. Results

### 3.1. Effect of humic acid on soil chemical properties

Application of humic acid improved the chemical properties of the soil (table 1).

<sup>8</sup>**Table 1.** Effect of the application of humic acid on the soil chemical properties of soil at the research site

Soil Chemical Properties	Hum <sup>8</sup> ic Acid Dosage		
	Control	20 kg ha <sup>-1</sup>	25 kg ha <sup>-1</sup>
pH	5.3	5.5	5.7
C (%)	2.05	2.36	2.44
N (%) (Kjeldahl)	0.16	0.21	0.21
<sup>11</sup> ppm)	8.6	10.2	10.5
K (cmol(+)/kg soil)	0.22	0.36	0.41
Ca (cmol(+)/kg soil)	2.96	5.24	5.33
Mg (cmol(+)/kg soil)	1.63	2.14	1.85
Na (cmol(+)/kg soil)	0.19	0.21	0.14
CEC (cmol(+)/kg soil)	15.63	16.32	16.33
Base Saturatation (%)	32	49	47

Table 1 shows that adding humic acid to the soil increase some chemical properties of the soil such as C-organic, macro and micro nutrients except for Mg, and improve cation exchanges capacity and base saturation of the soil. This indicate that humic acid can improve soil fertility by altering the chemical properties of soil. Improvement especially in the nutrient content of the soil and the availability of the elements to be absorbed by the plants.

### 3.2. Plant N, P, and K absorption

The results of the N, P and K nutrient content analysis in semi-corn plant tissue in response to the application of humic acid are shown in table 2.

**Table 2.** Nitrogen (N), Phosphate (P), and Potassium (K) content of the baby corn on different doses of humic acid

Humic acid plot	Composition (%)		
	N	P	K
Control	0.64	0.039	0.902
20 kg ha <sup>-1</sup>	0.81	0.057	0.900
25 kg ha <sup>-1</sup>	1.24	0.110	0.890

The results in table 2 show that the application of humic acid improved absorption of Nitrogen (N) and Phosphorous (P) by the plants. Absorption of these elements by the plants in the plots applied with humic acid were higher than control plot. N and P content in the plants increased with the dose of humic acid added to the soil. This can also mean that the nutritious values of the biomass residue were higher in the plants applied with the organic matter.

**12.** *Effect of humic acid and mungbean sprouts extract on the growth and production of baby corn*  
 Analysis of variance results reveal that the treatment of humic acid at mungbean sprout extract and the interaction of both treatment did not have a significant effect on the growth and production parameters of baby corn. Nevertheless, the parameter values increased with the dose of humic acid (table 3 and 4). Highest plant height was obtained in the dose of 20 kg ha<sup>-1</sup> of humic acid, other parameters such as number of leaves, ear length and diameter showed the best result in the use of 25 kg ha<sup>-1</sup> humic acid. Highest production per hectare also found in the humic acid treatment compared to control.

**Table 3.** Average of plant height, number of leaves, ear length and diameter of baby corn on different dosages of humic acid and concentration of mungbean sprouts extract.

Observed parameters	Dosage of Humic Acid		
	Control	20 kg ha <sup>-1</sup>	25 kg ha <sup>-1</sup>
Plant Height (cm)	84.50	<b>94.48</b>	90.76
Number of Leaves (Leaves)	9.47	9.91	<b>11.40</b>
Ear Length (cm)	12.45	13.21	<b>13.60</b>
Ear Diameter (mm)	19.14	18.73	<b>19.51</b>

**Table 4.** Productivity of baby corn (ton ha<sup>-1</sup>) on different dosages of humic acid and concentration of mungbean sprouts extract.

Mungbean sprouts	Humic acid dosage			Average
	Control	20 kg ha <sup>-1</sup>	25 kg ha <sup>-1</sup>	
Control	1.74	2.07	1.83	1.88
5 ppm	2.28	<b>2.29</b>	1.85	2.14
15 ppm	1.75	2.04	<b>2.29</b>	2.03
25 ppm	1.83	1.99	1.85	1.89
Average	1.90	2.10	1.96	

#### 4. Discussion

The results of variance showed that humic acid treatment did not significantly affect all observed growth and production parameters. This can be caused because for the purposes of baby corn, corn plants are harvested earlier and do not provide an opportunity to benefit from the use of humic acid. One of the factors that influence the administration of humic acid and green bean sprout extract did not significantly affect all parameters due to the high rainfall intensity so that washing occurred before the treatment was absorbed by the plant roots. The factor influencing the effectiveness of fertilization is the weather factor, because if it rains it will reduce the effectiveness of nutrient absorption [12].

However, from the growth and production data obtained, there is a tendency that the use of 20 kg per hectare of humic acid gives a better parameter value in terms of plant height. The use of humic acid in higher doses of 25 kg per hectare shows a better response in terms of number of leaves, cob length and ear diameter. This shows that the application of humic acid in baby corn plants increases the growth and production of baby corn plants. The more benefit of humic acid for plants is that it is able to bind iron, oxides and hydroxides and release them slowly to plants when needed, thus physically, chemically, and biologically, the soil will return to fertility with abundant organic and mineral materials.

From the results of this analysis it can be seen that the nutrients (NPK) absorbed by plants have increased. This is in line with Jones [13] that the application of 20 kg ha<sup>-1</sup> humic acid along with 100% NPK fertilizer gives the highest available P at flowering 0.138% (soil depth 0-20 cm) and 0.109% (20-40 cm) while at harvest time of 0.100% (soil depth 0-20 cm) and 0.096% (21-40 cm). Application of P fertilizer to the soil will increase the amount of P available, and the amount will be higher if the application of P fertilizer is followed by administration of humic acid. Without humic acid, P fertilizer application is less efficient because of the adsorption or fixation of P by Al and Fe ions, Al and Fe hydroxides and clay minerals.

Humic acid treatment, green bean sprout extract and its interaction did not significantly affect this according to the results of soil physical analysis in table 1, it appears that the land in the study site before planting had a pH (5.3), and after planting the pH changed slightly, the content (NPK) absorbed by plants experiences an increase before planting and after administration of humic acid, because humic acid can bind nutrients to the soil and can be absorbed by plants so plant growth also increases and administration of humic acid can improve soil properties, so nutrient uptake by plants increases, so plant growth also increases. This is in accordance with the opinion of Wahono [2] that the lack of one of the nutrients will cause disruption to the growth and physiological development of the plant. This is due to the fact that each element has its own function in the process of plant metabolism, so that if one function is not fulfilled, all plant metabolic processes will be disrupted. According to Nardi et al. [14] improvements in metabolic processes in planting, such as increased root respiration, protein synthesis, nucleic acids [3], and an increase in the rate of photosynthesis.

In addition to humic acid, the productivity of baby corn to some extent is also influenced by the administration of mung bean extract. The regulating substance contained in this extract helps growth which ultimately affects plant productivity. Growth regulators play a role in supporting plant growth by stimulating budding. Plant growth regulators are non-nutrient plant organic compounds which in low concentrations can affect physiological processes especially those related to plant growth, differentiation and development processes [15].

It is known that the content of several growth hormones such as auxin, cytokinin and gibberellins provide a good influence on plant growth response. Based on the analysis conducted by Ulfa [8] that green bean sprout extract has the auxin hormone 1.68 ppm, gibberelin 39.94 ppm, and cytokinin 96.26 ppm. The same is stated by Su et al. [16] that the proper interaction between auxin and cytokinin will have a good influence on cell division and control cell differentiation. Apart from the hormones that are owned, green beans in the form of sprouts have more vitamin content than the shape of the seeds. Compared in seeds, vitamin B levels increase by 2.5 - 3 times greater whereas vitamin C which is practically very little in dried grains in the form of sprouts increased to 20 mg / 100 g of mungbeans.

## 5. Conclusions

Humic acid treatment can increase NPK uptake **16** corn plants and improve soil chemical properties. However **5**, the two treatments had no significant effect on the growth and production of the baby corn plants. Application of 25 kg ha<sup>-1</sup> humic acid and 25 ppm mungbean sprouts extract showed the best results on the parameters of the **29** plant height (107.28 cm) and the highest number of leaves (15.56 leaves). Highest production per hectare was obtained **5** both from the application of 20 kg ha<sup>-1</sup> humic acid and 5 ppm of mungbean sprouts extract, and application of 25 kg ha<sup>-1</sup> humic acid and with 15 ppm of mungbean sprout extract.

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