



The Effect of KCl Fertilizer and Humic Acid to The Growth and Yields Of Spring Onion (*Allium fistulosum L.*)

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Abstract. The decrease in nutrients in the soil occurs due to leaching, which causes a reduction in the growth and quality of plant yields. Using KCl fertilizer and humic acid is one of the efforts to increase nutrients in the soil and plant growth and yield. This research was conducted in Seda Village, Mandirancan District, Kuningan Regency, from June to August 2024. The research method used was an experimental method with a complete randomized design (CRD), consisting of 16 treatments repeated 2 times. The observed variables consisted of the number of leaves, plant height, number of tillers, root volume, dry weight per cluster, relative growth rate, and fresh weight per cluster. This study showed that using KCl fertilizer at a dose of 1.2 g/plant and 0 g/plant humic acid gave good growth and yield in spring onion plants.

Keywords: Spring Onion, KCl, Humic Acid, Growth, Yield.

INTRODUCTION

The spring onion is one prospective vegetable that could grow aggressively and economically (*Allium fistulosum*, L.). Because they are packed with different nutrients, spring onions are one of the most popular vegetable varieties in the nation. Spring onions are high in vitamin C, low in vitamin B, and high in vitamin A. They are good for your health. Due to the increasing demand brought about by the high consumption of spring onions, more must be produced in terms of quality and quantity.

The high consumption of spring onion results in the need for increased production, so the production of spring onion must be increased both in terms of quality and quantity on an ongoing basis. One of the important plant cultivation techniques to increase optimal leek production is fertilization. Fertilizers add nutrients and soil fertility so that plants grow and develop optimally (Sunarjono, 2003 Putra, 2019).

One of the nutrients needed by plants is potassium. Potassium plays an important role in plant growth for various physiological functions, including carbohydrate metabolism,

enzyme activity, osmotic regulation, water use efficiency, nitrogen uptake, protein synthesis, and assimilate translocation. Potassium also has a role in increasing disease resistance and improving the quality of crop yields (Kenzie, 2001 on Rahma, I.S., and A. Zainal., A., 2019). Potassium strengthens the plant body to be sturdy along with the formation and enlargement of stem diameter. Potassium fertilizer can help the formation of proteins and carbohydrates and plays a role in strengthening the plant body so that leaves and fruits do not fall easily. Potassium is also a source of strength for plants in the face of drought and disease. Spring onions are among the plants that require high K and S nutrients compared to other plants (Sipayung, O., and Mariati, 2015).

Humic acid is a natural soil improver that is processed through the extraction of compacted humus at a high dose. As an organic fertilizer, humic acid can improve the physical, chemical, and biological properties of the soil, such as increasing the cation exchange capacity (CEC) of the soil so that the soil's ability to hold nutrients increases, making the soil looser and reducing soil acidity because it can improve the chemical and physical properties of the soil and absorb aluminum, which causes acidic soil by forming complex compounds that are difficult to decompose (Khoir et al., 2023).

There is not much information about the effect of KCl fertilizer and humic acid on the growth and yield of spring onions. This study aims to determine the effect of KCl fertilizer doses and humic acid on the growth and yield of spring onions.

LITERATURE

Potassium is classified as a mobile element in plants in cells, plant tissues, and xylem and phloem. The application of potassium fertilizer strengthens the plant body and makes it sturdy, along with the formation and enlargement of tuber diameter. Potassium is also a source of strength for plants in drought and disease. Potassium also spurs the translocation of carbohydrates from leaves to other plant organs, especially carbohydrate-storing plant organs (Aryati & Nirwanto, 2020).

Humic acids play an important role in influencing soil fertility and the chemical speciation of soils and waters. They are involved in complex reactions and can affect plant growth. Humic acids can improve soil fertility by improving the physical, chemical, and biological properties of the soil (Keiji et al., 2011; Afrianti et al., 2023).

The provision of humic acid will affect nutrient-deficient soil, in this case, humic acid plays an effective role in helping plants in the absorption of KCl fertilizer (Basha et al., 2020)

METHODS

The research was conducted on experimental land in Seda Village, Mandirancan District, Kuningan Regency. It is located at an altitude of 500 meters above sea level with a temperature of 23°C to 31°C. The experiment was conducted on polybags, with the experimental time starting in June to August 2024. The experimental design used was completely randomized, consisting of 16 combinations of KCl and humic acid fertilizer doses. Each treatment was repeated twice, so there were 32 experimental units. Each experimental unit consisted of 8 polybags, of which 3 were taken as destructive samples.

Observations were made when the plants were 14, 28, 42 DAP (Days After Planting), including the number of leaves, plant height, number of tillers, root volume, dry weight per clump, relative growth rate, and fresh weight per clump (at harvest). Observations on the number of leaves were counted manually per leaf. Plant height was measured using a ruler. The number of tillers was calculated manually by looking at the growing tillers. Root volume was measured using a measuring cup that was given water, and then the addition of water volume after inserting the roots was the root volume. The relative growth rate was calculated based on the plant's dry weight. Fresh weight was weighed using analytical scales.

DISCUSSION

Number of Leaves

Based on the results of the research conducted, it can be seen in Table 1 that the highest number of leaves at the age of 42 DAP was obtained in treatment D (1.2 g KCl fertilizer and 0 g humic acid). This illustrates that a large number of leaves were obtained at high doses of KCl fertilizer without the provision of humic acid. KCl fertilizer can increase the number of leaves because KCl fertilizer is an essential element for plant growth and development. This is in line with the opinion of Alfy and Handoyo (2022) that the proper application of KCl fertilizer can increase the number of leaves on plants; the more leaves, the higher the plant height.

Table 1 also shows that increasing humic acid at the same rate as KCl fertilizer did not increase the number of leaves. Humic acid improves soil structure. This is in line with Rustiati's (2014) opinion that providing humic acid is an innovative fertilizer formulation that increases the efficiency of fertilizer use and improves soil fertility.

Table 1. Number of Leaves Analysis Results

No.	Treatment	Number of Leaves (leaf)		
		14 DAP	28 DAP	42 DAP
1	A (0,3 g KCl + 0 Humic Acid)	2,50 a	6,00 a	8,95 a
2	B (0,6 g KCl + 0 g Humic Acid)	2,30 a	5,00 a	9,90 a
3	C (0,9 g KCl + 0 g Humic Acid)	2,30 a	5,10 a	10,60 b
4	D (1,2 g KCl + 0 g Humic Acid)	2,20 a	5,10 a	12,00 c
5	E (0,3 g KCl + 6 g Humic Acid)	1,90 a	5,20 a	9,10 a
6	F (0,6 g KCl + 6 g Humic Acid)	1,90 a	3,90 a	9,30 a
7	G (0,9 g KCl + 6 g Humic Acid)	2,00 a	4,60 a	10,20 b
8	H (1,2 g KCl + 6 g Humic Acid)	2,50 a	5,00 a	10,70 b
9	I (0,3 g KCl + 12 g Humic Acid)	1,80 a	3,90 a	10,00 a
10	J (0,6 g KCl + 12 g Humic Acid)	2,10 a	4,60 a	10,58 b
11	K (0,9 g KCl + 12 g Humic Acid)	1,90 a	4,60 a	9,15 a
12	L (1,2 g KCl + 12 g Humic Acid)	2,70 a	5,70 a	10,70 b
13	M (0,3 g KCl + 18 g Humic Acid)	2,00 a	4,80 a	10,30 b
14	N (0,6 g KCl + 18 g Humic Acid)	2,20 a	5,30 a	9,90 a
15	O (0,9 g KCl + 18 g Humic Acid)	1,90 a	4,90 a	9,30 a
16	P (1,2 g KCl + 18 g Humic Acid)	2,30 a	5,15 a	11,10 b

Descriptions: Numbers with the same lowercase letter in a column are not significantly different according to the Scott-Knott Group test at the 5% level.

Plant Height

Based on the study's results (Table 2), the plant height at 14 DAP has not shown any difference because it is still in its early growth. At the ages of 28 and 42 DAP, plant height showed a significant change. The highest value was obtained when the plants were 42 DAP in treatment D (1.2 g/plant KCl fertilizer and 0 g/plant humic acid).

The provision of different humic acids does not affect plant height growth. Providing sufficient KCl has a good effect on plant growth and development.

This is in line with the opinion of Delina et al. (2019), who believe that KCl fertilizer is very influential in growth, one of which is the height of the plant, with the right KCl application showing good results.

Number of Tillers

The results in Table 3 show an increase in the number of tillers from the age of 14 to the age of 28 HST and 42 HST. The treatment that gave the best value was treatment D (KCl 1.2 g/plant and humic acid 0 g/plant).

Table 2 Plant Height Analysis Results

No.	Treatment	Plant Height (cm)					
		14 DAP		28 DAP		42 DAP	
1	A (0,3 g KCl + 0 Humic Acid)	33,15	a	34,55	a	35,97	a
2	B (0,6 g KCl + 0 g Humic Acid)	31,80	a	38,55	b	41,68	b
3	C (0,9 g KCl + 0 g Humic Acid)	33,00	a	40,10	b	41,52	b
4	D (1,2 g KCl + 0 g Humic Acid)	34,40	a	43,05	b	46,12	c
5	E (0,3 g KCl + 6 g Humic Acid)	34,90	a	38,55	b	39,37	b
6	F (0,6 g KCl + 6 g Humic Acid)	33,45	a	37,35	b	39,33	b
7	G (0,9 g KCl + 6 g Humic Acid)	33,00	a	34,35	a	37,00	a
8	H (1,2 g KCl + 6 g Humic Acid)	30,15	a	34,20	a	37,84	a
9	I (0,3 g KCl + 12 g Humic Acid)	34,05	a	37,45	b	39,35	b
10	J (0,6 g KCl + 12 g Humic Acid)	29,60	a	31,70	a	33,30	a
11	K (0,9 g KCl + 12 g Humic Acid)	29,85	a	34,40	a	37,04	a
12	L (1,2 g KCl + 12 g Humic Acid)	30,45	a	35,10	a	37,97	a
13	M (0,3 g KCl + 18 g Humic Acid)	32,50	a	37,30	b	39,77	b
14	N (0,6 g KCl + 18 g Humic Acid)	33,50	a	38,90	b	40,00	b
15	O (0,9 g KCl + 18 g Humic Acid)	31,60	a	36,55	b	40,48	b
16	P (1,2 g KCl + 18 g Humic Acid)	29,00	a	32,18	a	35,07	a

Description : Numbers with the same lowercase letter in a column are not significantly different according to the Scott-Knott Group test at the 5% level.

Table 3. Analysis Result of Number of Saplings Per Clump

No.	Treatment	Number of tillers (fruit)					
		14 DAP		28 DAP		42 DAP	
1	A (0,3 g KCl + 0 Humic Acid)	0,50	a	1,00	a	1,70	a
2	B (0,6 g KCl + 0 g Humic Acid)	0,50	a	1,00	a	2,10	a
3	C (0,9 g KCl + 0 g Humic Acid)	0,20	a	0,90	a	2,60	b
4	D (1,2 g KCl + 0 g Humic Acid)	0,90	a	1,70	a	3,30	b
5	E (0,3 g KCl + 6 g Humic Acid)	0,20	a	1,00	a	1,80	a
6	F (0,6 g KCl + 6 g Humic Acid)	0,20	a	0,70	a	1,80	a
7	G (0,9 g KCl + 6 g Humic Acid)	0,60	a	1,10	a	2,30	a
8	H (1,2 g KCl + 6 g Humic Acid)	0,50	a	1,10	a	2,20	a
9	I (0,3 g KCl + 12 g Humic Acid)	0,30	a	0,80	a	2,50	b
10	J (0,6 g KCl + 12 g Humic Acid)	0,70	a	1,30	a	2,80	b
11	K (0,9 g KCl + 12 g Humic Acid)	0,40	a	0,80	a	1,58	a
12	L (1,2 g KCl + 12 g Humic Acid)	0,50	a	1,00	a	2,20	a
13	M (0,3 g KCl + 18 g Humic Acid)	0,30	a	0,90	a	2,30	a
14	N (0,6 g KCl + 18 g Humic Acid)	0,30	a	1,30	a	2,10	a
15	O (0,9 g KCl + 18 g Humic Acid)	0,30	a	0,90	a	2,00	a
16	P (1,2 g KCl + 18 g Humic Acid)	0,50	a	1,35	a	2,35	a

Description : Numbers with the same lowercase letter in a column are not significantly different according to the Scott-Knott Group test at the 5% level.

The element potassium has a vital role in photosynthesis, which is interrelated with the formation of the number of new tillers. This aligns with the opinion of Sitompul, G., S. et al. (2017) that the potassium content in KCl fertilizer can spur growth at the initial level and optimize photosynthesis. Increased photosynthate is distributed to the tissues to stimulate the formation of tillers in plants. This statement is in line with the opinion of Atikah (2023), which states that the single application of KCl fertilizer has a significant effect on the number of tillers.

Root Volume

At the age of 14 and 28 DAP, the average value of volume showed an increase that was not significantly different, and this was due to the growth of plants that were still in early growth and the absorption of nutrients that were not yet maximized. Root volume at the age of 42 DAP showed the highest value in treatment D (KCl 1.2 g/plant and humic acid 0 g/plant). This is because the presence of roots in an optimal environment and the availability of water and nutrients are sufficient, so root growth is not significant between treatments. The length of the roots is not too long because the need for water and nutrients is sufficient so that the roots that grow are only around the polybag.

Table 4. Root Volume Analysis Results

No.	Treatment	Root Volume (ml)		
		14 DAP	28 DAP	42 DAP
1	A (0,3 g KCl + 0 Humic Acid)	1,50 a	2,50 a	4,50 a
2	B (0,6 g KCl + 0 g Humic Acid)	1,25 a	3,00 a	6,00 a
3	C (0,9 g KCl + 0 g Humic Acid)	1,50 a	3,50 a	6,00 a
4	D (1,2 g KCl + 0 g Humic Acid)	1,50 a	3,00 a	8,00 b
5	E (0,3 g KCl + 6 g Humic Acid)	1,00 a	3,50 a	5,00 a
6	F (0,6 g KCl + 6 g Humic Acid)	1,00 a	3,00 a	5,50 a
7	G (0,9 g KCl + 6 g Humic Acid)	1,00 a	4,50 a	5,50 a
8	H (1,2 g KCl + 6 g Humic Acid)	2,00 a	4,50 a	6,00 a
9	I (0,3 g KCl + 12 g Humic Acid)	1,00 a	3,00 a	5,00 a
10	J (0,6 g KCl + 12 g Humic Acid)	1,50 a	3,00 a	5,50 a
11	K (0,9 g KCl + 12 g Humic Acid)	1,00 a	2,50 a	5,00 a
12	L (1,2 g KCl + 12 g Humic Acid)	1,00 a	3,50 a	6,00 a
13	M (0,3 g KCl + 18 g Humic Acid)	1,25 a	4,00 a	6,00 a
14	N (0,6 g KCl + 18 g Humic Acid)	1,50 a	5,50 a	6,50 a
15	O (0,9 g KCl + 18 g Humic Acid)	1,00 a	4,00 a	5,50 a
16	P (1,2 g KCl + 18 g Humic Acid)	1,00 a	2,50 a	5,00 a

Description : Numbers with the same lowercase letter in a column are not significantly different according to the Scott-Knott Group test at the 5% level.

KCl fertilizer is important in the roots because the K element is the main nutrient in stimulating root growth and development (Chantal et al., 2019). This statement can be associated with the opinion of Yulina, H., and Wiwik, A., (2021), which states that roots can grow and develop quickly in loose soil and have sufficient availability of water and nutrients. The research conducted is in accordance with this statement, where the right KCl dose of 1.2 g/plant gives very good results.

Plant Dry Weight Per Clump

The highest dry weight per clump at the ages of 14, 28, and 42 DAP was obtained in treatment D (KCl 1.2 g/plant and humic acid 0 g/plant). Nutrients absorbed by plant roots influence plant dry weight, so the better the nutrients obtained by plants, the better their development.

Table 5. Dry Weight Analysis Results

No.	Treatment	Dry Weight (g)		
		14 DAP	28 DAP	42 DAP
1	A (0,3 g KCl + 0 Humic Acid)	5,75 a	11,40 a	18,50 a
2	B (0,6 g KCl + 0 g Humic Acid)	8,55 a	13,55 a	25,40 a
3	C (0,9 g KCl + 0 g Humic Acid)	8,40 a	14,45 a	27,40 a
4	D (1,2 g KCl + 0 g Humic Acid)	14,50 b	30,90 b	46,20 b
5	E (0,3 g KCl + 6 g Humic Acid)	7,40 a	22,05 a	25,80 a
6	F (0,6 g KCl + 6 g Humic Acid)	8,35 a	17,95 a	24,75 a
7	G (0,9 g KCl + 6 g Humic Acid)	6,00 a	17,35 a	21,25 a
8	H (1,2 g KCl + 6 g Humic Acid)	7,35 a	16,65 a	20,15 a
9	I (0,3 g KCl + 12 g Humic Acid)	8,85 a	12,85 a	20,30 a
10	J (0,6 g KCl + 12 g Humic Acid)	6,70 a	12,85 a	21,15 a
11	K (0,9 g KCl + 12 g Humic Acid)	7,45 a	15,35 a	23,85 a
12	L (1,2 g KCl + 12 g Humic Acid)	8,40 a	17,75 a	26,10 a
13	M (0,3 g KCl + 18 g Humic Acid)	7,15 a	18,60 a	29,50 a
14	N (0,6 g KCl + 18 g Humic Acid)	10,25 a	19,85 a	30,25 a
15	O (0,9 g KCl + 18 g Humic Acid)	7,75 a	13,65 a	21,10 a
16	P (1,2 g KCl + 18 g Humic Acid)	8,25 a	15,70 a	20,90 a

Description : Numbers with the same lowercase letter in a column are not significantly different according to the Scott-Knott Group test at the 5% level.

Giving the appropriate dose is thought to meet the nutrients needed by leaf onions so that the photosynthesis process can take place optimally. The more effective photosynthesis, the more photosynthesis is produced by plants. The results of photosynthesis in the form of carbohydrates are then accumulated in plant parts. This is in line with the opinion of Agib et al. (2016) that the rapid vegetative growth of plants cannot be separated from the availability of nutrients that affect plant dry weight.

Relative Growth Rate

The relative growth rate from 14 to 28 HST showed no difference in the various doses of KCl and humic acid. This was in line with the observation of other growth component variables (root volume, number of leaves, and number of tillers). With the same root volume, it was assumed that the absorption of nutrients was relatively the same so the dry weight gain formed showed no difference. At the age of 42 HST, there were differences in relative growth rates, where the volume of roots, number of leaves, and number of tillers also showed differences. The growth of vegetative organs in plants, such as the number of leaves, plant height, and number of tillers, will affect the dry weight produced; the growth of vegetative organs becomes a reference for the growth rate of a plant (Anjarwati et al., 2017).

Table 7. Relative Growth Rate Analysis Results

No.	Treatment	Rate (g/day)	
		14 to 28 DAP	28 to 42 DAP
1	A (0,3 g KCl + 0 Humic Acid)	0,043 a	0,026 b
2	B (0,6 g KCl + 0 g Humic Acid)	0,035 a	0,044 b
3	C (0,9 g KCl + 0 g Humic Acid)	0,037 a	0,047 b
4	D (1,2 g KCl + 0 g Humic Acid)	0,054 a	0,029 b
5	E (0,3 g KCl + 6 g Humic Acid)	0,103 a	0,005 a
6	F (0,6 g KCl + 6 g Humic Acid)	0,057 a	0,023 a
7	G (0,9 g KCl + 6 g Humic Acid)	0,076 a	0,014 a
8	H (1,2 g KCl + 6 g Humic Acid)	0,059 a	0,013 a
9	I (0,3 g KCl + 12 g Humic Acid)	0,027 a	0,033 b
10	J (0,6 g KCl + 12 g Humic Acid)	0,038 a	0,044 b
11	K (0,9 g KCl + 12 g Humic Acid)	0,049 a	0,034 b
12	L (1,2 g KCl + 12 g Humic Acid)	0,054 a	0,027 b
13	M (0,3 g KCl + 18 g Humic Acid)	0,066 a	0,033 b
14	N (0,6 g KCl + 18 g Humic Acid)	0,057 a	0,027 b
15	O (0,9 g KCl + 18 g Humic Acid)	0,044 a	0,031 b
16	P (1,2 g KCl + 18 g Humic Acid)	0,043 a	0,022 a

Description : Numbers with the same lowercase letter in a column are not significantly different according to the Scott-Knott Group test at the 5% level.

Plant Fresh Weight Per Clump

The results showed that the highest fresh weight of plants per clump at each observation period was obtained in treatment D (KCl 1.2 g/plant and humic acid 0 g/plant). The highest average fresh weight of plants per clump at the age of 60 DAP (at harvest) was 98.00 g.

Potassium has a role as an activator of several enzymes in plant metabolism. Potassium plays a role in protein and carbohydrate synthesis and increases the translocation of

photosynthate to all parts of the plant. The higher the photosynthetic yield, the higher the fresh weight of the plant (Sumarni et al., 2012 on Manik, 2020)

The different doses of humic acid did not give a significant difference to the fresh weight of plants per clump. One of the functions of humic acid is to improve the physical properties of soil (such as improving soil structure), while in this study, the media was planted in polybags that have gone through the process of loosening. This is thought to be why humic acid did not make a significant difference to all observation parameters (Hasra et al., 2021).

Table 8 Analysis Results of Fresh Weight Per Clump

No.	Treatment	Fresh Weight (g)			
		14 DAP	28 DAP	42 DAP	60 DAP
1	A (0,3 g KCl + 0 Humic Acid)	8,20 a	12,85 a	27,25 a	66,00 a
2	B (0,6 g KCl + 0 g Humic Acid)	9,60 a	13,55 a	31,20 a	81,00 b
3	C (0,9 g KCl + 0 g Humic Acid)	9,35 a	14,45 a	40,15 b	82,00 b
4	D (1,2 g KCl + 0 g Humic Acid)	16,10 b	30,90 b	49,55 c	98,00 c
5	E (0,3 g KCl + 6 g Humic Acid)	6,35 a	21,05 a	28,35 a	59,00 a
6	F (0,6 g KCl + 6 g Humic Acid)	9,25 a	17,95 a	28,30 a	61,00 a
7	G (0,9 g KCl + 6 g Humic Acid)	6,55 a	17,35 a	23,00 a	61,00 a
8	H (1,2 g KCl + 6 g Humic Acid)	8,55 a	16,65 a	24,15 a	68,75 a
9	I (0,3 g KCl + 12 g Humic Acid)	10,00 a	12,85 a	32,55 a	62,00 a
10	J (0,6 g KCl + 12 g Humic Acid)	7,55 a	11,40 a	29,45 a	52,50 a
11	K (0,9 g KCl + 12 g Humic Acid)	8,30 a	15,35 a	26,55 a	47,00 a
12	L (1,2 g KCl + 12 g Humic Acid)	9,50 a	17,75 a	34,00 b	70,00 a
13	M (0,3 g KCl + 18 g Humic Acid)	8,00 a	18,60 a	37,75 b	62,00 a
14	N (0,6 g KCl + 18 g Humic Acid)	11,45 a	20,95 a	35,75 b	72,00 a
15	O (0,9 g KCl + 18 g Humic Acid)	8,60 a	13,65 a	25,70 a	83,00 b
16	P (1,2 g KCl + 18 g Humic Acid)	9,30 a	15,70 a	25,40 a	64,00 a

Description : Numbers with the same lowercase letter in a column are not significantly different according to the Scott-Knott Group test at the 5% level.

CONCLUSION

Different doses of KCl fertilizer and humic acid gave different effects on all observation variables, namely the number of leaves, plant height, number of tillers, root volume, dry weight per cluster, relative growth rate, and fresh weight per cluster. The highest fresh weight per clump was obtained at a dose of KCl 1.2 g/plant and Humic Acid 0 g/plant.

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