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The effect of NPK fertilizer dose and type on the growth and production of scallions (*Allium fistulosum l.*)

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Abstract

This study aimed to determine the effect of the right and optimal dose and type of NPK fertilizer on the growth and production of leek plants. The purpose is to determine the optimum dose of NPK fertilizer, the kinds of NPK fertilizer that can increase, and the interaction between the dose and type of NPK fertilizer. This research was conducted in Kalibening District, Central Java. It is used in the field of agriculture or specifically in the discipline of agrotechnology. This research aims to determine the optimum dose of NPK fertilizer, the types of NPK fertilizer that can increase, and the interaction between the dose and type of NPK fertilizer. This research used the Randomised Group Design (RAK) method. NPK dosage consisted of 4 levels, and NPK variety consisted of 3 levels. Data were processed using Microsoft Excel with an analysis of variance. The best NPK fertilizer dose was 3.5/plant (140kg/ha) (K1). The optimum type of NPK fertiliser is NPK 16: 16: 16 (M1). There is a significantly different interaction between the variable stem diameter (mm) at a dose of 7g/plant (300kg/ha) and NPK 15:09:20+TE fertilizer (K2M2).

Keywords

Scallions, Fertilizer, Dosage, Growth, Production

Introduction

Scallions (*Allium fistulosum L*) are one of the vegetables often consumed by the public [1]. Scallions are seasonal vegetable plants with grass-like leaves. The part that is often consumed by the public is the young leaves. The leaf base of this plant forms a pseudo stem and is clumpy in nature [1]. The production of spring onions in Central Java in 2018 was 1,212,998 tons, with a harvest area of 12,364 ha. In 2019, it was 1,321,408 tons with a harvest area of 12,679 ha [2]. In 2020, it was 1,221,414 tons with a harvest area of 12,373 ha. Thus, the production of spring onions in Central Java in 2018-2019 experienced a moderate increase, and in 2019-2020, it decreased.

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Scallions can grow optimally if the soil structure supports them by providing nutrients that plants need. The effects of erosion, evaporation, and deliberate exploitation of the soil result in reduced nutrients needed by scallions [3]. Various factors, such as climate and plant maintenance, undoubtedly influence the production of spring onions. One of the factors in maintaining spring onions is fertilization. Fertilization is one way that can be done to meet the availability of soil nutrients needed by spring onions. Spring onions require fertilizers that contain a lot of N to maximize leaf growth [3]. N element availability in the soil can be added by using an inorganic fertilizer. One of the inorganic fertilizers is NPK Grower fertilizer. NPK Grower fertilizer contains 15% N, 9% P, 20%, and several other micronutrients needed by plants in vegetative and generative plant growth [1]. NPK fertilizer can help plant growth so that it can develop optimally. Each nutrient element, namely nitrogen (N), phosphate (P), and potassium (K) in NPK fertilizer, has a different role in helping plant growth. Based on research by Benni (2023) on the dosage of fertilization of spring onions using NPK fertilizer, the results showed that a 200 kg/ha fertilization dosage provided better growth. Using organic fertilizers combined with inorganic fertilizers is a soil management strategy that can increase soil productivity [4].

The objectives of the research that has been conducted are to determine the optimum dose of NPK fertilizer that can increase the growth and production of spring onion plants, to determine the types of NPK fertilizer that can increase the growth and production of spring onion plants, and to determine the interaction between the dose and type of NPK fertilizer on the growth and production of spring onion plants.

Method

The research was conducted in a private garden in Sikumpul Village, Kalibening District, Banjarnegara Regency, located 1,049 meters above sea level from June 2024 to September 2024. The design used in this study was a Complete Randomized Block Design (RAK)—factorial experiment consisting of 2 factors (Figure 1). The first factor is the dose of NPK fertilizer consisting of 4 levels: K0 = 0g/plant, K1 = 3.5g/plant, K2 = 7g/plant, K3 = 10.5g/plant. The second factor is the type of NPK fertilizer consisting of 3 levels: M1 = NPK 16:16:16, M2 = NPK 15:09:20+TE, and M3 = NPK 9:25:25.

Two factors that are tried will obtain 12 treatment combinations. Each treatment is repeated three times so that there are (3 x 4) x 3 = 36 experimental units; 3 sample plants determine each experimental plot. The combination of treatment factors is the NPK fertilizer dose and the NPK fertilizer type.

The observed variables were plant height (cm), number of leaves (leaflets), number of tillers per clump (leaflet), weight of tillers per clump (g), number of leaves per tiller (leaflet), weight of stump (g), dry weight of stump (g), length of longest root (cm), weight of root (g) and stem diameter (cm).

The F test analyzed the data obtained at α level of 5%. If there is a significant difference in the factors tested, the data analysis is continued with the BNT (Smallest Real Difference) test.

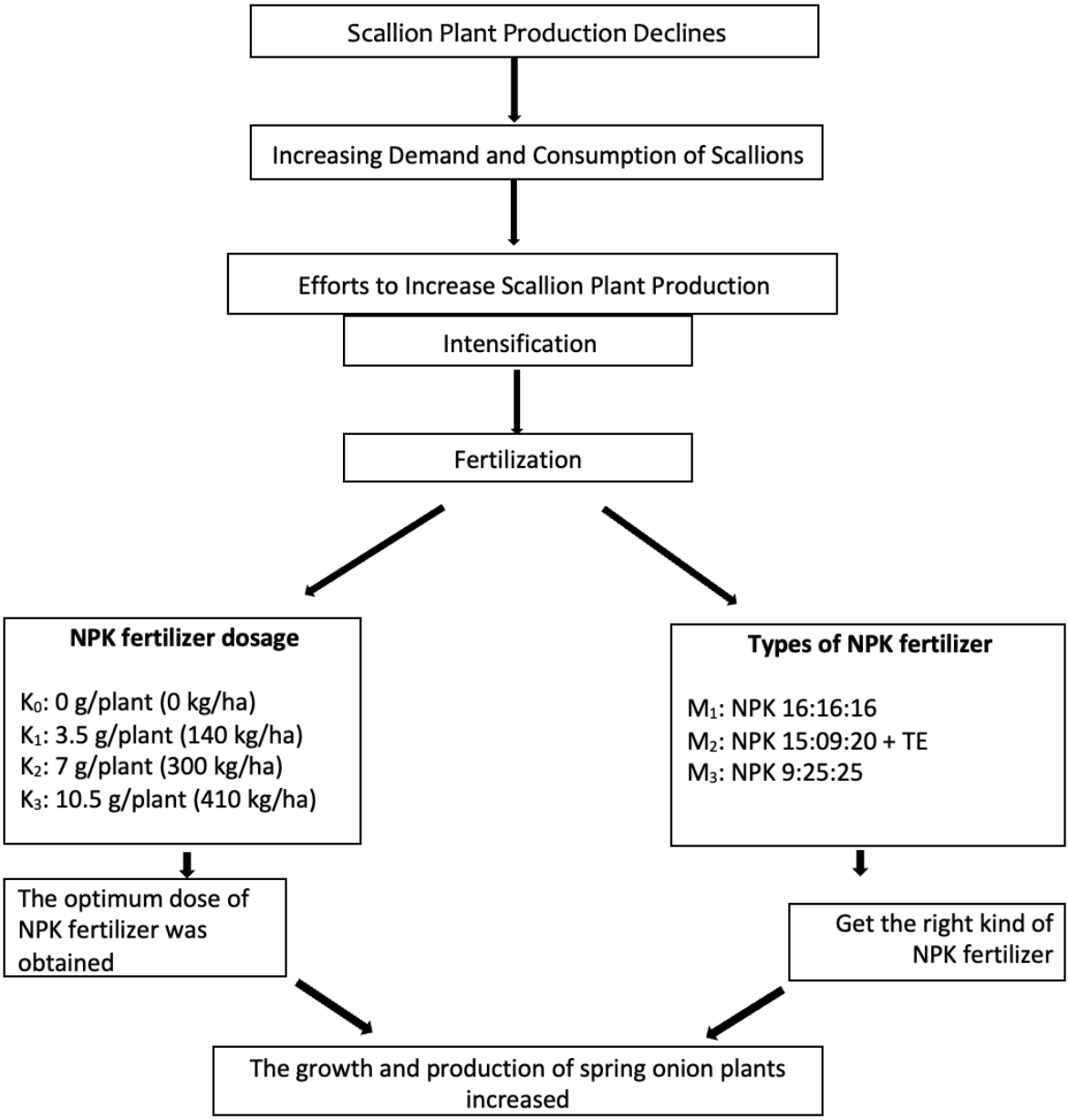

Figure 1. Complete Randomized Block Design (RAK)

Results

The matrix of the analysis of research data on NPK fertilizer doses and types of NPK fertilizers on the growth and production of spring onions can be seen in Table 1. The average figures and statistical analysis of research data on the effect of NPK fertilizer doses and types of NPK fertilizers can be seen in Table 2. The average number of interactions between the effect of NPK fertilizer doses and types of NPK fertilizers on the growth and production of spring onions can be seen in Table 3.

Table 1. Matrix of Research Results on the Effect of Fertilizer Dosage and Type of NPK Fertilizer on the Growth and Production of Scallions (*Allium fistulosum L*).

No.	Observed variables	Factors tried		
		Dose NPK	Type NPK	Interaction
1	Plant Height (cm)	tn	tn	tn
2	Number of leaves (blades)	tn	*	tn
3	Number of Clump Offspring (fruit)	tn	tn	tn
4	Weight of Seedlings Per Cluster (g)	tn	tn	tn
5	Number of Per Tiller Leaves (g)	tn	*	tn
6	Storage Weight (g)	tn	*	tn
7	Dry Weight of Stove (g)	q*	tn	tn
8	Longest Root Length (cm)	tn	tn	tn
9	Root Weight (g)	tn	**	tn
10	Stem Diameter	tn	tn	*

Information: ** = Very Real Difference, * = Significantly Different, tn = Different Not Real, q = Quadratic

Table 2. Average figures and statistical analysis of research data on the Effect of Dosage and Type of NPK Fertilizer on the Growth and Production of Scallion Plants (Allium fistulosum L).

Treatment	Number of leaves (blades)	Number of leaves Per Tiller (blades)	Stem Weight (g)	Stem Dry Weight (g)	Root Weight (g)
NPK Fertilizer Dosage					
K0 = No grant	27.14	21.15	87.44	62.88^{bc}	8.44
K1 = 3.5 g/plant (140kg/ha)	27.59	21.59	94.85	74.92^{a}	7.70
K2 = 7 g/plant (300kg/ha)	26.14	20.37	90.44	68.03^{ab}	8.19
K3 = 10.5 g/plant (410kg/ha)	23.77	17.78	76.59	56.25^{c}	6.89
F count	2.17^{tn}	2.29^{tn}	2.92^{tn}	3.91*	1.70^{tn}
F table 5%	3.38	3.3	13.33	11.71	1.53
F table 1%	4.6	4.48	18.12	15.92	2.09
BNT 5% Test	-	-	-	11.71	-
KK (%)	13.24	16.7	15.61	18.28	20.15
Types of NPK Fertilizer					
M1 = NPK 16 : 16 : 16	28.25^{a}	22.25^{a}	93.94^{a}	70.55	9.2a
M2 = NPK15:09:20 + TE	25.97^{ab}	20.13^{ab}	89.55^{ab}	67.25	7.5b
M3 = NPK 9 : 25 : 25	24.27^{ab}	18.27^{b}	78.5^{b}	58.77	6.6b
F Count	3.96*	4.15*	4.08*	3.08^{tn}	8.19**
F table 5%	2.93	2.85	11.54	10.14	1.33
F table 1%	3.98	3.88	15.69	13.78	1.81
BNT 5% Test	3.38	-	13.33	-	1.53
KK (%)	13.24	16.7	15.61	18.28	20.15

Description: The numbers in the column and treatments followed by the same letter show no significant difference based on the BNT test at the 5% level. **=very significant difference *=not significant difference and tn=not significant difference.

Table 3. Average interaction figures between the effect of NPK fertilizer dose and type of NPK fertilizer on the growth and production of spring onions. (*Allium fistulosum L*).

Treatment	Stem Diameter (cm)
K0M1	11.66^{ab}
K0M2	10.2^{abcd}
K0M3	11.68^{ab}
K1M1	10.26^{abcd}
K1M2	10.37^{abcd}
K1M3	10.06^{bcd}
K2M1	9.96^{bcd}
K2M2	12.00^{a}

Treatment	Stem Diameter (cm)
K2M3	9.06[d]
K3M1	10.98 [abc]
K3M2	9.61[cd]
K3M3	10.10[bcd]
F Count	2.71*
F Table 5%	1.85
F table 1%	2.51
BNT 5%	1.85
KK (%)	10.41

Description: The numbers in the column and treatments followed by the same letter show no significant difference based on the BNT test at the 5% level. **=very significant difference *=not significant difference and tn=not significant difference.

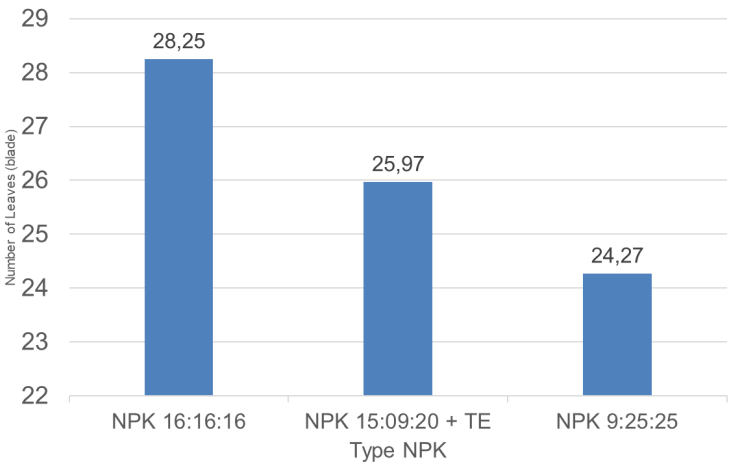

Figure 2. The effect of different types of NPK fertilizer on the number of leaves

Figure 2 shows the effect of different types of NPK fertilizer on the number of leaves on the tiller. Figure 3 shows the effect of different types of NPK fertilizer on the number of leaves on the tiller. Figure 4 shows the effect of different types of NPK fertilizer on total root weight. Figure 5. The effect of different types of NPK fertilizer on total root weight. Then, Figure 6 shows the effect of NPK dosage on the growth and yield of leek plants on the variable of dry weight of stalk.

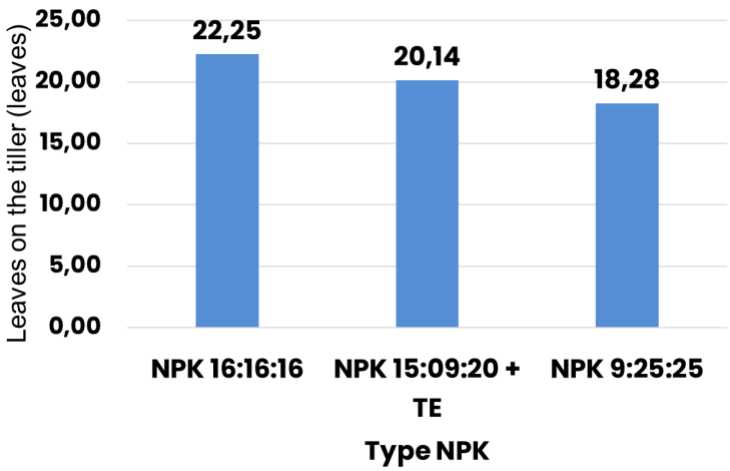

Figure 3. The effect of different types of NPK fertilizer on the leaves on the tiller

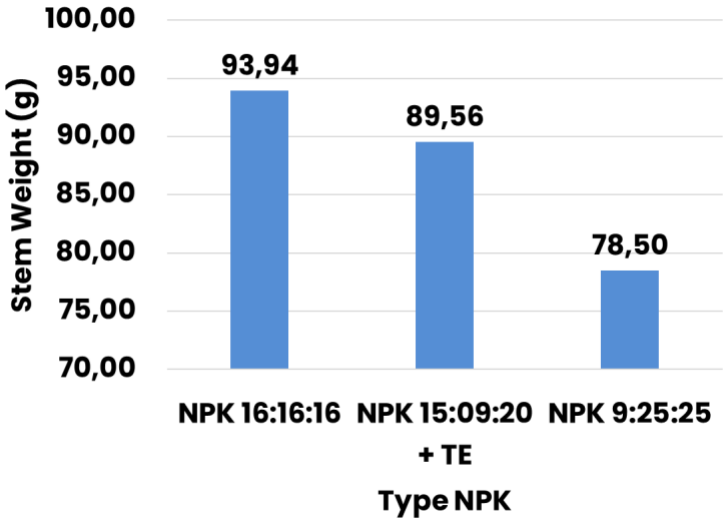

Figure 4. The effect of different types of NPK fertilizer on total root weight

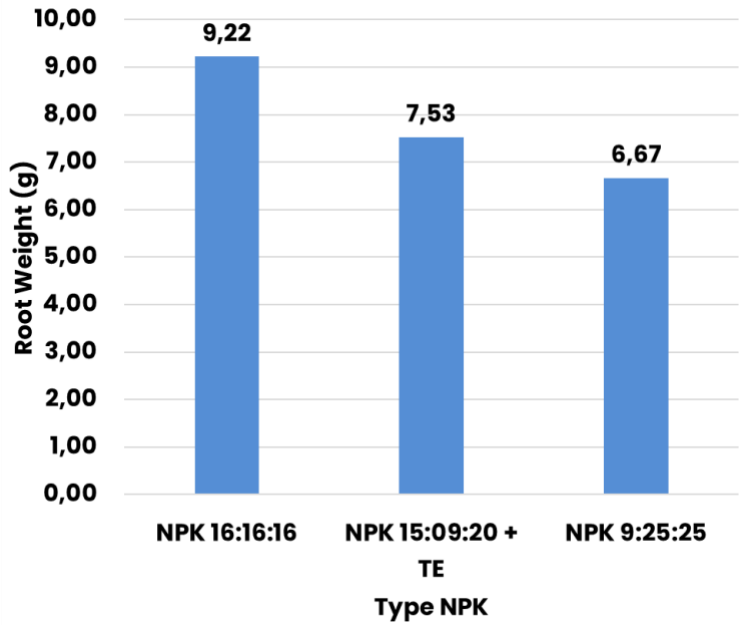

Figure 5. The effect of different types of NPK fertilizer on total root weight

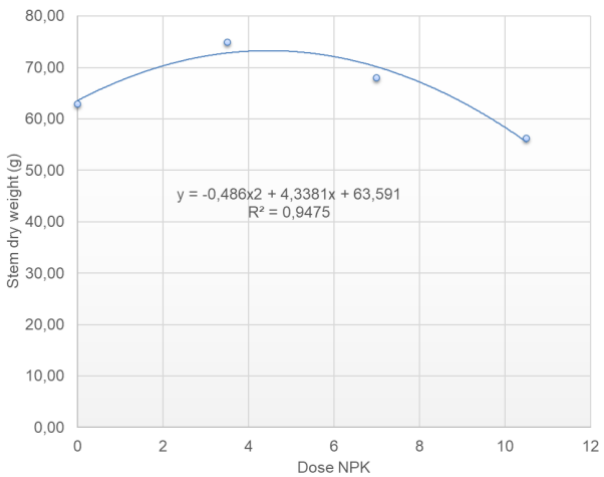

Figure 6. The effect of NPK dosage on the growth and yield of leek plants on the variable of dry weight of stalk (g)

Discussion

NPK fertilizer dosage

The study results showed that the dose had a significantly different effect on the dry weight variable of the stubble. The highest dry weight of the stubble was achieved at a dose of 3.5 g/plant (K2), which was 74.92 grams. In general, the NPK fertilization treatment with a dose of 140 kg/ha had a better effect on increasing the growth and yield of spring onions. This can be seen from the growth and yield components, which were better than the 300 kg/ha and 420 kg/ha dose treatments. In general, the NPK fertilization treatment with a dose of 200 kg/ha had a better effect on increasing the growth and yield of shallots, as can be seen from the growth and yield components, which were better than the NPK fertilizer treatment with a dose of 250 kg/ha and 300 kg/ha. This condition is due to the optimum dose treatment and can increase the nutrients needed for the growth of spring onions. Soil conditions that can affect plant weight are the soil's nutrient and nutrient content [5]. Nutrient content in the soil, such as Nitrogen and Magnesium, are essential nutrients in the formation of plant weight in plant tissue [6]. Indrawan (2020) also stated that adding fertilizer can actually increase plant weight [1]. Auliana stated that the more optimal the amount of liquid organic fertilizer, the greater the availability of nutrients. However, not all nutrients can be absorbed and utilized by plants. Some of the released nutrients are volatilized, lost by water, and eaten by soil macro and microbiology, so even at the highest dose, the nutrients absorbed are not much so that production can decrease [7]. Providing organic fertilizer can increase soil chemical fertility and improve the physical and biological properties of the soil [8].

The results of the study of NPK fertilizer doses on the variables of plant height, number of leaves, number of tillers per clump, weight of tillers per clump, number of offspring leaves, weight of the stump, length of the longest root, weight of the root, and diameter of the stem were not significantly different. This condition is because the planting medium used contains nutrients that can still be sufficient for spring onion plants; therefore, each treatment does not affect the growth of spring onion plants; in line with the literature of Putra (2022), the nutrient content of fertilizers can be lost due to several factors, including evaporation, absorption, decomposition and storage [9]. The evaporation and absorption processes can cause the loss of N and K nutrient content by an average of half of the original, while P is about a third. Storage in the open for a long time will increase the loss of N elements, losses in the form of ammonia (evaporation), and nitrate compounds, which are also washed away by rainwater. This washing also applies to K and P elements.

Types of NPK fertilizer

The study of various types of NPK fertilizers showed that the variables of plant height, number of tillers per clump, the weight of tillers per clump, dry weight of the stump, length of the longest root, and stem diameter were not significantly different. This

condition is caused by the content of nutrients and water in the planting medium still being fulfilled, so the plants have not absorbed the nutrient content in the various types of NPK fertilizers in each treatment. Following Jannah, a suitable growing medium must provide water, air, and nutrients in a balanced condition to ensure perfect root development and better plant growth [8]. Sufficient nutrition supported by good planting media can encourage optimal plant growth and production.

The results of the study showed that the types of NPK fertilizers on the variables of the number of leaves, the number of offspring leaves, and the weight of the stover were significantly different. This condition is caused by several factors, including insufficient light intensity because plants need light for photosynthesis in vegetative and generative growth. Light intensity is the amount of light received by plants. Light intensity is an important component that directly affects the results of plant photosynthesis. In photosynthesis, light energy is needed to form carbohydrates from inorganic materials in the form of CO_2 and H_2O. The greater the amount of light energy available, the greater the amount.

The study results showed that the treatment of various NPK fertilizers on the root weight variable was very different. This is due to several environmental and genetic factors. The availability of nutrients also influences the growth and yield of a plant because these nutrients are a source of enzyme activity and plant metabolism [10]. It is also supported by the reasonably abundant levels of organic matter from the planting medium, supplying organic matter into the soil. Organic matter is one of the important elements in the soil that plays a role in balancing soil fertility, increasing cation exchange capacity, and providing good binding power for the soil to absorb nutrients so that they can be utilized by plants optimally. The provision of NPK is a fertilizer that contains macro and micronutrients, namely N, P, and K, which are complete to ensure the uniform distribution of all nutrients so that plant growth and yields are maximized, especially for root weight [11]. Applying NPK Mutiara fertilizer (16-16-16) with the correct dose can improve the soil's physical, chemical, and biological properties. The soil provides soil space for air and water, improves soil structure, and becomes looser. To support the development of plant roots. In this way, plants quickly absorb nutrients, allowing the Scallion plant to grow well and produce high production yields. According to Nurrohman, the N element contained in fertilizer is a component of organic matter in seeds, such as amino acids, proteins, coenzymes, chlorophyll, and a number of other components in seeds, so the application of fertilizers containing N to plants will increase plant growth [12]. NPK Mutiara fertilization (16-16-16) provides the best and most balanced N, P, and K nutrients compared to NPK (15:09:20 + TE) and NPK (9-25-25) so that one application of this fertilizer will provide a balance of macronutrients for plants. The content of N, P, and K elements is 16% each, and the dose given is sufficient for growth. This assumption is reinforced by Annisa, who stated that adding compound NPK fertilizer to plants can increase plant height, number of leaves, and root weight [13].

The effect of interaction of dosage and type of NPK fertilizer

The results of the interaction study of the dose and type of NPK fertilizer did not have a significant effect on the variables of Plant Height (cm), Number of Leaves (strands), Number of Seedlings per Clump (fruit), Weight of Seedlings per Clump (g), Number of Perennial Leaves (g), Slab Weight (g), Dry Slab Weight (g), Longest Root Length (cm), Root Weight (g). These variables do not have significant interactions between the effects of concentration and types of nutrients working separately on the growth and production of soybean plants. This condition is reinforced by the opinion of Anisa (2019) that if there is a different interaction effect that is not significant, it is concluded that the treatment factors act independently of each other [13].

The results of the interaction study of dose and type of NPK fertilizer on the variable of stem diameter were significantly different. This condition shows that the highest stem diameter was achieved at a dose of 7 g/plant and the type of NPK fertilizer 15:09:20 + TE, which is 12 mm. interaction can occur when the treatment of dose and type of nutrition affects the growth and production of spring onion plants. Two factors are said to interact if the effect of a treatment factor changes when the level of other treatments changes [13]. The genetic properties in plants are factors that play a significant role in determining the flowering phase and can affect the morphological characteristics of plants. Good plant morphological characteristics will provide suitable yield components [12].

Conclusion

1. Significantly different results on the dry weight of the stover and showed insignificantly different results on the variables Plant Height (cm), Number of Leaves (strands), Number of Offshoots per Clump (fruit), Weight of Offshoots per Clump (g), Number of Hybrid Leaves (g), Weight of Stalks (g), Length of the longest root (cm), Weight of roots (g), diameter of stem (mm). The best NPK fertilizer dose that can increase spring onion plants' growth and yield is the NPK fertilizer dose treatment of 3.5g/plant (K2).
2. The treatment of NPK fertilizer types showed significantly different root weight results. It showed significantly different results on the number of leaves, number of offspring leaves, and weight of the stump. It showed insignificant different results on the variables of plant height, number of tillers per clump, weight of tillers per clump, dry weight of the stump, most extended root length, and stem diameter. The optimum type of NPK fertilizer that can increase the growth and yield of spring onion plants is NPK 16: 16: 16 (M1).
3. There is no significant interaction between the dose and type of NPK fertilizer on the variables of Plant Height (cm), Number of Leaves (strands), Number of Offshoots per Clump (fruit), Weight of Offshoots per Clump (g), Number of Perennial Leaves (g), Slab Weight (g), Slab Dry Weight (g), Longest Root Length (cm), Root Weight (g).

There is a significant interaction between the variable Stem Diameter (mm) at a dose of 7g/plant and the type of NPK fertilizer 15:09:20+TE (K2M2).

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References

[1] I. A. Anni, E. Saptiningsih, and S. Haryanti, "Pengaruh Naungan Terhadap Pertumbuhan Dan Produksi Tanaman Bawang Dain (Allium fistulosum L.) Di Bandungan, Jawa Tengah," *J. Akad. Biol.*, vol. 2, no. 3, pp. 31–40, 2013, [Online]. Available: https://ejournal3.undip.ac.id/index.php/biologi/article/view/19151

[2] S. Laude and Y. Tambing, "pertumbuhan dan hasil bawang daun (allium fistulosum l.) pada berbagai dosis pupuk kandang ayam The Growth and Yield of Spring Onion (Allium Fistulosum L.) At Various Application of Chicken Manure Doses," *J. Agrol.*, vol. 17, no. 2, pp. 144–148, 2010.

[3] D. Indrawan, E. Efendi, and S. S. Ningsih, "Respon Dosis Pupuk Burung Puyuh Dan Npk Grower Terhadap Pertumbuhan Dan Produksi Tanaman Bawang Daun (Allium," pp. 72–83, 2011.

[4] S. Benni, D. Hervani, and H. Wt, "Pemberian Pupuk Kotoran Ayam Dan Pupuk NPK Terhadap Pertumbuhan Dan Hasil Tanaman Bawang Daun," vol. 1, no. 2, pp. 86–91, 2023.

[5] Rohimah H.S Lestari and Palobo Fransiskus, "PENGARUH DOSIS PUPUK NPK TERHADAP PERTUMBUHAN DAN HASIL BAWANG MERAH, KABUPATEN JAYAPURA, PAPUA (Effect Of NPK Fertilizer Dosage On Growth And Yield Of Shallot, District Jayapura, Papua) Rohimah H.S. Lestari dan Fransiskus Palobo," *Ziraa'Ah*, vol. 44, pp. 164–170, 2019.

[6] Suntoro, "Pengaruh Penambahan Bahan Organik, Dolomit Dan KCL Terhadap Kadar Klorofil Dampaknya Pada Hasil Kacang Tanah (Arachis hypogeae L.)," *J. Bio Smart*, vol. 4(2):, pp. 36-40., 2002.

[7] ichsan, "A Komoditas Unggulan Sektor Perkebunan. Universitas Lambung Mangkurat," 2024.

[8] Jannah, "J Total bakteri asam laktat, pH, keasaman, citarasa dan kesukaan yogurt drink dengan penambahan ekstrak buah belimbing. J. Aplikasi Teknologi.".

[9] E. Agus, Cahyono, Ardian, and F. Silvina, "Pengaruh Pemberian Beberapa Dosis Pupuk Npk Terhadap Pertumbuhan Berbagai Sumber Tunas Tanaman Nanas (Ananas Comosus (L) Merr) Yang Ditanam Antara Tanaman Sawit Belum Menghasilkan Di Lahan Gambut," *Jom Faperta Vol. 1 No.* 2, vol. 85, no. 1, pp. 2071–2079, 2014.

[10] B. Mpapa, "Analisis Kesuburan Tanah Tempat Tumbuh Pohon Jati (Tectona Grandis L.) Pada Ketinggian Yang Berbeda," *J. Agrista Unsyiah*, vol. 20, no. 3, pp. 135–139, 2016.

[11] A. S. Pranata, "Meningkatkan Hasil Panen dengan Pupuk Organik," *Agro Media Pustaka*, 2010.

[12] H. Anisa *et al.*, "Pengaruh Konsentrasi dan Interval Pemberian PGPR (Plant Growth Promoting Rhizobacteria) Terhadap Pertumbuhan dan Produksi Bunga Kol (Brassica oleraceae var. botrytis L.)," *Biofarm J. Ilm. Pertan.*, vol. 5, no. 2, pp. 130–139, 2019, doi: 10.30598/biopendixvol5issue2year2019.

[13] E. NUrrohman, S. Zubaidah, and H. Kurwantoro, "Pengembangan Modul Pembelajaran Budidaya Tanaman Kedelai Dengan Pendekatan Kontekstual Untuk Siswa SMK Pertanian," *J. Pendidik.*, vol. 2, no. 5, pp. 1003–1007, 2017, doi: 10.26877/imajiner.v1i5.4473.