



NPK Fertilizer Dosage Treatment On the Growth and Yield of Red Spinach (*Amaranthus Tricolor L.*)

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ABSTRACT

The purpose of this study was to determine the extent of the effect of the use of fertilizer doses NPK compound on the growth and yield of red spinach (*Amaranthus tricolor L.*), This research method used a Randomized Block Design (RAK) consisting of six (6) treatments with three (3) replications and two (2) sample plants. The treatment was given, namely the dose of NPK Compound Fertilizer which consisted of six (6) doses, A = No NPK Compound Fertilizer (Control), B = NPK Compound Fertilizer 100 kg/Ha (0.05 gr/tan = 0.5 gr/ 10 tons/polybag), C = NPK Compound Fertilizer 200 kg/Ha (0.10 gr/tan = 1.0 gr/10 tons/polybag), D = NPK Compound Fertilizer 300 kg/Ha (0.15 gr/tan = 1.5 gr/10 tons/polybag), E = NPK Compound Fertilizer 400 kg/Ha (0.20 gr/tan = 2.0 gr/10 tons/polybag) and F = NPK Compound Fertilizer 500 kg/Ha (0.25 gr/tan = 2.5 gr/10 tons/polybag), for analysis and assisted by using Excel. Research Results There was a significant effect on the observed variables of plant height, number of leaves and wet weight of red spinach plants due to the treatment of using various doses of NPK compound fertilizers and effective (appropriate) doses or optimum doses of NPK compound fertilizers during growth and yield of red spinach plants. The dose of NPK compound fertilizer treatment was 300 kg/Ha (0.15 gram/plant), while the maximum dose was indicated by the treatment dose of NPK compound fertilizer 500 kg/Ha (0.25 gram/plant), because statistically both treatments of compound fertilizer dose The NPK was not significantly different.

Keywords : Red Spinach, NPK, Fertilizer, Organic, Fertilizer Dosage.

1. INTRODUCTION

Spinach is usually consumed as a green vegetable and contains many vitamins and minerals. In Indonesia, there are three types of spinach, including *Amaranthus tricolor* (a plucked spinach that is widely grown and cultivated by farmers, the red stem is called red spinach and the whitish green stem is called green spinach.), *Amaranthus dubius* (is a pickled spinach, the growth is upright, broadleaf, dark green/reddish color), *Amaranthus croenthus* (a type of spinach that can be grown as pull spinach as well as pickled spinach, this type of spinach grows upright, large leaves, grayish green). Spinach plants are generally bred through seeds and are widely cultivated both on soils in the highlands and lowlands (Nugroho, 2011).

In Indonesia, spinach consumption has increased from year to year, but this need has not been maximally fulfilled by many spinach farmers. and true (dilla Khabilah et al., 2022).

According to (Lathifah & Susilawati, 2019) stated that spinach (*Amaranthus tricolor*) is one of the important vegetables in the food needs of the population, because it provides nutrition in





the form of fiber, vitamins, protein and others needed by the human body. Besides that, spinach is also used as other businesses in the form of dyes, ornamental plants, laxatives, and so on. In line with the increasing population growth and the development of businesses that use spinach as raw materials, the demand for spinach is increasing. To meet these needs in 2008, Indonesia imported around 57,801 kg, while the potential level of spinach yields could reach 20–50 tons per hectare (Lathifah & Susilawati, 2019). Thus the yield of spinach in Indonesia can still be increased. Efforts to increase spinach productivity include fertilizing, both organic and inorganic fertilizers (Hadisuwito, 2012).

As with other plants, spinach will not give maximum results, if the necessary nutrients are not available enough. To achieve the available nutrients in the soil, fertilization can be done, namely by using organic fertilizers and or inorganic fertilizers, so that it is expected to increase crop yields. According to (Supartha et al., 2012), cultivation technology that needs to be considered in an effort to increase crop production is the use of fertilizers in the right type, dose, method and time.

The correct cultivation of spinach plants includes stages including certified seeds, good soil management, planting and maintenance methods and correct and appropriate harvests. Soil that can be used for planting spinach is soil that has sufficient nutrients for growth so that spinach plants can grow and produce maximally as expected (Khusni et al., 2018). Soil that is lacking in nutrients can be overcome by fertilization. Fertilization can be done by paying attention to the type of fertilizer used. The types of fertilizers that can be used are inorganic fertilizers and organic fertilizers (Manurung et al., 2020).

Inorganic fertilizers are fertilizers that come from factories made with a mixture of chemicals with high nutrient levels, while organic fertilizers are fertilizers that come from weathering organic materials in the form of plant residues, human and animal fossils, animal waste and organic rocks. (Pebrianti et al., 2015).

According to (Supartha et al., 2012), inorganic fertilizers are able to increase soil productivity in a short time, but will cause damage to the soil structure (soil becomes hard) and reduce the productivity of the resulting plants while the soil given organic fertilizer has a good soil structure and The content of soil organic matter is sufficient, so that the ability of the soil to bind water is greater. application nitrogen can increase plant growth, increase protein synthesis, chlorophyll formation which causes greener leaf color and increase root shoot ratio. Therefore, optimal nitrogen application can increase the rate of plant growth (Parman, 2007).





One of the important factors in plant cultivation that supports the success of plant life is the problem of fertilization. A common problem in fertilization is the low efficiency of nutrient uptake by plants. The efficiency of N and K fertilization is low, ranging from 30-40%. The efficiency of P fertilization by plants is also low, ranging from 15-20% (Adnan et al., 2015).

Plants are not enough just to rely on nutrients from the soil alone. Therefore, plants need to be given additional nutrients from the outside, namely in the form of fertilizers (Hariyadi et al., 2018). Efforts to increase the efficiency of fertilizer use can be pursued through the principles of the right type, right dose, right method, timely application and balanced according to plant needs (Hariyadi & Ali, 2020). To be able to grow and produce optimally, plants need essential nutrients in addition to solar radiation, water and CO₂. Essential nutrients are nutrients that play an important role as a source of nutrients for plants. The availability of each of these elements in the soil differs between plants (Nisak et al., 2017).

Increasing the production of vegetables, especially mustard greens, spinach and other vegetables, can be done by fertilizing (Sari et al., 2020).

. Fertilization through the soil can be done with artificial fertilizers and natural fertilizers. Fertilization can also be applied according to its type, including single fertilizer, compound fertilizer, macro element fertilizer and micro element fertilizer. The lack of knowledge of farmers regarding the amount and type of nutrients needed by plants is also a problem that results in the low increase in production per unit area (Prasetya, 2014).

Compound fertilizer is a mixed fertilizer which generally contains more than one kind of plant nutrients (macro and micro), especially N, P and K nutrients (Roesmarkan and Yuwono, 2002). The advantages of NPK compound fertilizers, namely with one application of fertilizer, can include several elements needed by plants, so that they are more efficient in their use when compared to single fertilizers (Ali, 2015). It is hoped that NPK fertilizer will be a solution and alternative to increase vegetable crop yields. The use of NPK fertilizer can increase the nutrient content in the soil and provide ease of application in the field.

2. RESEARCH METHOD

This study used a Randomized Block Design (RAK) consisting of six (6) treatments with three (3) replications and two (2) sample plants. Placement of treatment in experimental plots was carried out randomly, with the treatment given, Dosage of NPK Compound Fertilizer consisting of six (6) doses, treatment, A = No NPK Fertilizer (Control), B = 50 kg/Ha NPK Fertilizer (0.05 gr/tan = 0.5 gr/10 tons/polybag), C = 100 kg/ha NPK fertilizer (0.10 gr/tan = 1.0 gr/10





tons/polybag), D= 150 kg/ha NPK fertilizer (0.15 gr/tan = 1.5 gr/10 tons/polybag), E= 200 kg/ha NPK fertilizer (0.20 gr/tan = 2.0 gr/10 tons/polybag) and F = NPK fertilizer 250 kg/Ha (0.25 gr/tan = 2.5 gr/10 tons/polybag). Types of variables or parameters of growth and yield of red spinach plants observed in the study, Height, Number of Leaves, and Wet Weight of Plants, while the tool to calculate the results of data analysis was using or assisted by the Excel program.

3. RESULTS AND DISCUSSION

Plant Height The

results of the analysis of variance showed that the treatment using a dose of NPK compound fertilizer had a very significant effect on the observation of plant height during the growth of red spinach, both at the age of 10 days, 20 days and 30 days after planting seeds. It can be assumed that the given NPK compound fertilizer is able to meet the nutrient needs of red spinach plants during their growth.

The usual dose of fertilization for mustard, kale and spinach is 100 kg per hectare of urea, 100 kg per hectare of SP-36 and 50 kg per hectare of KCL. By giving the right dose of fertilizer, it is hoped that it can meet the nutrient needs of mustard, spinach and kale plants, so that the growth of these plants can be optimal.

Table 1. Average Plant Height of Red Spinach Due to the Use of Various

Fertilizer Different	Doses at		
	NPK	of	Compound
Observation	Ages a	19.83 a	31.73 a
NPK Compound Fertilizer 100 kg/Ha	15.50 b	27.07 b	39.00 b
NPK Compound Fertilizer 200 kg/Ha	16.07 b	30.00 b	41.67 b
NPK Compound Fertilizer 300 kg/Ha	20.00 c	36.50 c	49.33 c
NPK Compound Fertilizer 400 kg/Ha	21.33 c	38.50 c	51.97 c
NPK Compound Fertilizer 500 kg/Ha	22.50 c	40.07 c	53.00 c
BNT 5%	2.83	4.35	5.33

Note: The numbers accompanied by the same letter in the same column are not significantly different in the 5% BNT Test





. In Table 1. shows that with increasing use of fertilizer doses NPK compounds will be followed by an increase in plant height during the growth of red spinach plants. The highest red spinach plants tended to be achieved by using a dose of NPK compound fertilizer of 500 kg/Ha (49.33 cm), although statistically it was not significantly different from the treatment using a dose of NPK compound fertilizer of 400 kg/Ha (51.97 cm) and a dose of fertilizer. 300 kg/Ha (39.90) of NPK compounds, while the shortest red spinach plants from 10 days to 30 days tended to be treated without NPK compound fertilizers (31.73 cm) and were statistically significantly different from treatments using other doses of NPK compound fertilizers. . It is presumed that with increasing doses of NPK compound fertilizers up to the optimum dose the response of red spinach plants is also optimum, so that if the dose is increased again, the increase in growth is not significant (not significant).

Vegetables such as spinach, mustard greens and kale are quite easy to cultivate and are responsive to environmental changes and fertilizer application. Spinach, mustard and kale plants require adequate intake of N, P and K nutrients to support their growth (Prasetya, 2014).

This is in accordance with the results of research (Ningkeula, 2019) which showed that the application of NPK compound fertilizer at a dose of 300 grams per plot or 300 kg per hectare (4 grams per plant) was able to increase the yield of mustard (*Brassica Juncea L.*) and spinach plants. red (*Amaranthus tricolor L.*) was the highest and as the best result, the plant weight was 8.22 kg per plot equivalent to 6.85 tons per hectare.

Number of Leaves

The results of the analysis of variance showed that the treatment using doses of NPK compound fertilizer had a very significant effect on the observation of the number of leaves during the growth of red spinach plants, both at the age of 10 days, 20 days and 30 days after planting the seeds. Table 2.

Table 2. Average of NPK Compound Fertilizer

Doses at	Number Spinach		
	the	Plants	Various
Different	Observation	Ages	21.00 a
NPK Compound Fertilizer 100 kg/Ha	9.33 b	18.00 b	29.33 b
NPK Compound Fertilizer 200 kg/Ha	10.67 bc	23.67 c	32.33 b





NPK Compound Fertilizer 300 kg/Ha	12 ,33 cd	27.67 d	37.00 c
NPK Compound Fertilizer 400 kg/Ha	13.00 d	28.00 d	38.33 c
NPK Compound Fertilizer 500 kg/Ha	13.67 d	29.33 d	39.67 c
BNT 5%	1.67	3.33	4.00

Information: The numbers accompanied by the same letter in the same column are not significantly different in the 5% BNT Test

In Table 2. The dose of NPK compound fertilizer was followed by an increase in the number of leaves during the growth of the red spinach plant. The smallest number of leaves was indicated by the treatment without NPK fertilizer (21.00 leaves) and statistically significantly different from the treatment using other doses of NPK fertilizer. The highest number of leaves was achieved by treatment with a dose of NPK compound fertilizer of 500 kg/Ha (39.67 strands), although statistically it was not significantly different from the treatment using a dose of NPK compound fertilizer 400 kg/Ha (38.33 strands), as well as the treatment using a dose of compound fertilizer. NPK 300 kg/Ha (37.00 strands), so it is suspected that the dose of NPK compound fertilizer has reached the optimum or as required by red spinach plants, namely the dose of NPK compound fertilizer is 300 kg/ha.

Compound fertilizers are mixed fertilizers that generally contain more than one type of plant nutrients (macro and micro), especially N, P and K nutrients (Ningkeula, 2019). The advantage of NPK compound fertilizer is that with one application of fertilizer, it can cover several elements needed by plants, making it more efficient in its use when compared to single fertilizers.

Wet Weight of Red Spinach Plants The

results of the analysis of variance showed that the treatment of using NPK compound fertilizer doses had a very significant effect on the wet weight of red spinach plants at harvest at 30 days after planting. Table 3. It can be assumed that the NPK compound fertilizer given, able to meet the nutrient needs of red spinach plants during its growth and its use is more practical and profitable.

According to Husnaeni & Setiawati, 2018 that the application of compound inorganic fertilizers into the soil can increase the availability of nutrients that are fast and available to plants, in addition to other advantages of using compound fertilizers, namely saving time, labor and transportation costs.





Table 3. Average Wet Weight of Red Spinach Plants Due to the Use of Various Doses of NPK Compound Fertilizer

Treatment of Fertilizer	Average Wet Weight of Red Spinach Plants (grams)
Without NPK Compound Fertilizer	19.33 a
NPK Compound Fertilizer 100 kg/ Ha	28.00 b
NPK Compound Fertilizer 200 kg/Ha	30.67 b
NPK Compound Fertilizer 300 kg/Ha	38.00 c
NPK Compound Fertilizer 400 kg/Ha	39.33 c
NPK Compound Fertilizer 500 kg/Ha	40.67 c
BNT 5%	5.31

Information: The numbers accompanied by the same letter in the same column are not significantly different in the 5% BNT Test

. In Table 3. it shows that with increasing doses of NPK compound fertilizers, there tends to be an increase in the wet weight of spinach plants. red. The wet weight of the smallest red spinach plants tended to be indicated by the treatment without NPK compound fertilizer (19.33 grams) and statistically significantly different from the treatment using other doses of NPK compound fertilizer. The highest wet weight of red spinach plants tended to be achieved by using a dose of NPK compound fertilizer of 500 kg/Ha (40.67 grams), although statistically it was not significantly different from the treatment using a dose of NPK compound fertilizer of 400 kg/Ha (39.33 grams) and use of NPK compound fertilizer dose of 300 kg/Ha (38.00 grams). It is suspected that the dose of NPK compound fertilizer has reached the optimum or as required by red spinach plants, namely the dose of NPK compound fertilizer is 300 kg/ha.

The function of nitrogen (N) for vegetable crops is as a constituent of protein for plant shoot growth and fertilizing vegetative growth, making it suitable for leaf vegetable plants, such as mustard greens, spinach, kale and so on. The function of phosphorus (P) as one of the constituent elements of protein, is needed for the formation of flowers, fruits and seeds, stimulates root growth to become elongated and grow strong, so that plants will be drought resistant. Lack of phosphorus (P) will cause plants to grow stunted, flowering and seed formation are inhibited, and plants become weak so they easily collapse. The element potassium (K) plays a role in metabolic processes such as photosynthesis and respiration which are important in plant growth.





Phosphorus (P) is one of the main obstacles in acidic soils such as inceptisols. Phosphorus (P) is an immovable property and its efficiency is approximately 20%, so that the phosphorus that is not absorbed by plants will remain in the soil as a residue to become phosphorus reserves or be bound by organic matter. Organic phosphorus in the soil is about 5-50% of total soil phosphorus, which varies around 15-80% in most soils (Aziz, 2013).

Furthermore (Firdausi & Muslihatin, 2016) argues that the application of compound inorganic fertilizers into the soil can increase the availability of nutrients quickly and available to plants, in addition to other advantages of using compound fertilizers, namely saving time, labor and transportation costs. That in order to obtain high yields of mustard plants, 50 kg of N fertilizer per hectare is required or equivalent to 100 kg of urea per hectare, in addition to TSP and KCL. Research that has been carried out previously.

4. CONCLUSION

There was a significant effect on the observed variables of plant height, number of leaves and wet weight of red spinach plants due to the treatment of using various doses of NPK compound fertilizer and the effective dose (appropriate) or optimum dose in the use of NPK compound fertilizer during growth and yield of spinach plants. Red plants tend to be achieved by treatment with a dose of 300 kg of NPK compound fertilizer per hectare (0.15 grams per plant), although the highest growth and yield (maximum dose) is always indicated by the treatment with a dose of 500 kg of NPK compound fertilizer per hectare (0.25 grams per plant), statistically between the two treatments the dose of urea fertilizer was not significantly different.

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