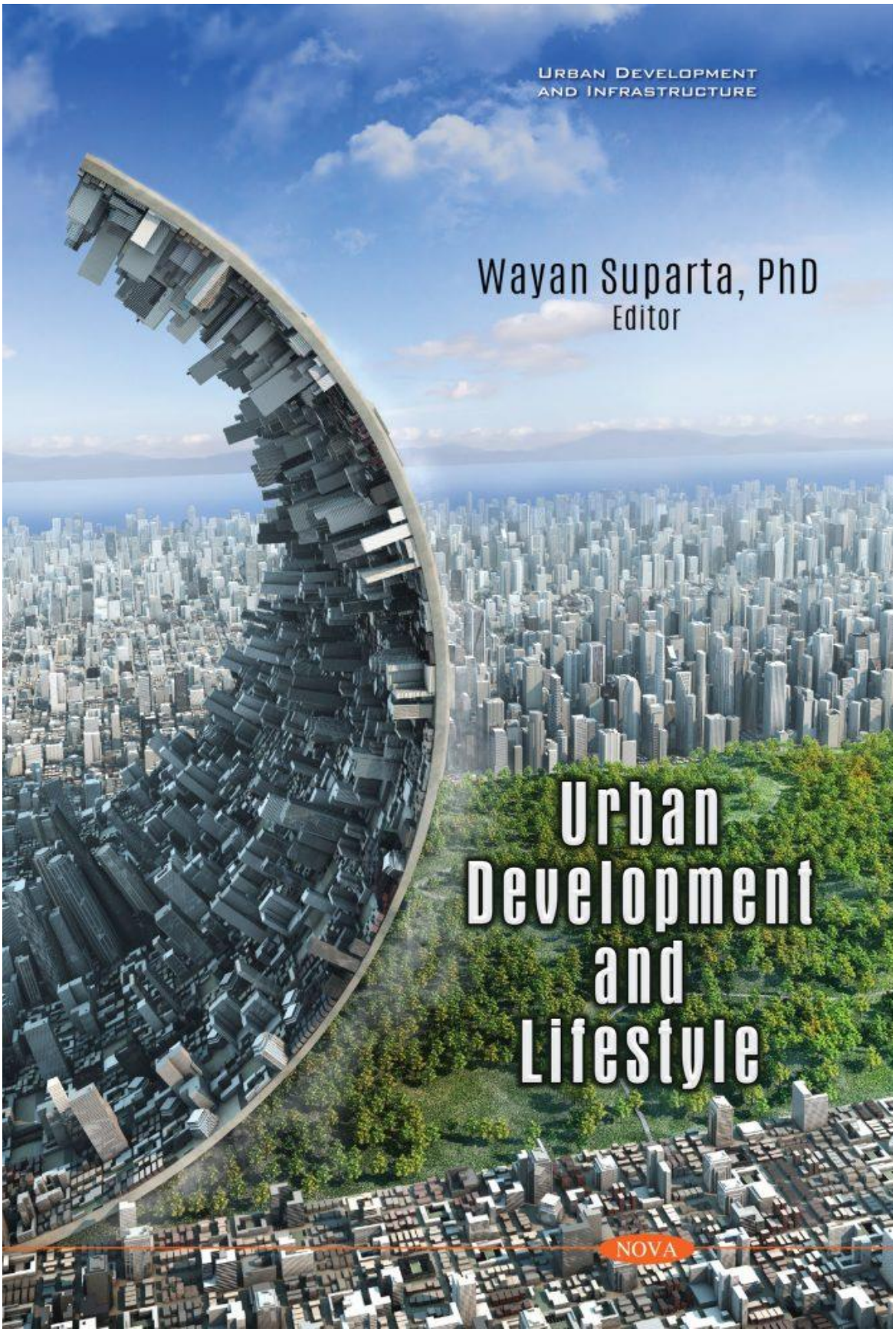
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Table of Contents

Table of Contents

Chapter26

POTENTIAL OF KIRINYUH (*CHROMOLAENA ODORATA*) AND COW MANURE TO INCREASE THE NITROGEN UPTAKE OF TOMATOES (*LYCOPERSICUM ESCULENTUM L.*) ON SANDY BEACH SOIL

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ABSTRACT

This research was conducted to determine the Nitrogen uptake of tomatoes (*Lycopersicum esculentum L*) on the sandy beach soil which was of kirinyuh (*Chromolaena odorata*) and cow manure application. The research method used was a complete randomized design consisting of two factors. The first factor is the giving of organic material consisting of 4 levels, i.e., without kirinyuh + cow manure (B0),30 tons/ha kirinyuh (B1), 30 tons/ha cow manure (B2) and 30 tons/ha mixture of cow manure and kirinyuh. The second factor is the application time of organic material consisting of 3 levels, i.e., at the time planting (T1), 20 days before planting (T2) and at 40 days before planting (T3). Each treatment was replicated three times. The results showed that cow manure and kirinyuh were able to increase the available Nitrogen of sandy beach soil and Nitrogen uptake of tomato. Then 30 tons/ha mixture of cow manure and kirinyuh applicated at 20 days before planting affects the hightest of Nitrogen uptake of tomatoes.

Keywords:kirinyuh, cow manure, nitrogen uptake, tomato

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INTRODUCTION

Nitrogen as one of the macro nutrients is needed by plants for growth. Nitrogen derived from fertilizers and free air can be absorbed by plants in the form of NH_4^+ and NO_3^- [1], The element is much needed by tomatoes in the vegetative phase to form proteins, chlorophyll, and other organic compounds [2]. Tomatoes are very responsive in the provision of N nutrients, therefore in the tropics these nutrients often show a real effect. When the N supply is sufficient, plant leaves grow large and expand the surface available for photosynthesis, accelerating the conversion of carbohydrates into proteins which are subsequently converted into protoplasms, functioning as vital substances of various enzymes that guide the entire process of plant metabolism [3].

Tomatoes (*Lycopersicum esculentum L*) are a horticultural commodity that is multipurpose and has the potential to be developed in Indonesia. Tomato production in Yogyakarta in 2015 reached 12.5 tons [4] and each year is increasing to keep pace with the increasingly high needs of the community. This plant can grow well in the highlands (more than 700 m above sea level), medium plains (200 m - 700 m above sea level), and lowlands (less than 200 m above sea level) [5]. Growing media that are suitable for tomatoes are clay or dusty clay textures, acrumbly structure containing a lot of organic matters and easily binding water, so that not many nutrients are leached. Tomatoes are horticultural plants that can grow in the lowlands and highlands and have the potential to be developed. Tomatoes require loose soil, acidity levels of 5-6, soil contains little sand, and contains a lot of humus, regular, and sufficient irrigation, and the addition of Nitrogen to support vegetative growth [6]. For optimum growth, tomatoes require N 200-230 kg/ha[7].

The sandy beach soil is one of the types of land that has the potential as a medium for growing tomatoes because of its wide spread in Indonesia and has not been widely used, but in its use, the sandy beach soil has obstacles in both physical and chemical properties. Sandy beach soil has soil properties such as sandy texture, single grain structure to crumbs, loose consistency when dried, a low moisture holding capacity, high water escape ability,and pH ranges from 6-7[8]. This soil also has low organic matter content, low cation exchange capacity. Total nutrient content is actually high but the available nutrient content is low, especially Nitrogen [9],[10].

The low availability of Nitrogen in sandy beach soil can a use stunted tomato growth. Tomatoes need large amounts of Nitrogen for optimal growth. In one season, tomatoes need Nitrogen given in the form of urea of 175 kg/ha [11]. If specifically calculated (45% N in urea), the Nitrogen given to tomatoes is 78.75 kg N/ha. If these needs are met by an artificial N fertilizer,it will require a large cost and, in the long run, will have a negative impact on the environment.

To overcome these obstacles, manipulation needs to be done, so that the sandy beach soil can be used as a medium for growing tomatoes. Manipulation that can be done is the addition of organic fertilizers in the form of cow manure and kirinyuh together,and set the aplication time of organic matter. The addition of organic fertilizers is expected to provide benefits for improving the quality of soil structure. With improved soil structure and good pore balance and spread, soil aggregates can provide a dense balance and pore space that is more beneficial for tomato growth.

Cow manure is a fertilizer that comes from cattle cages, in the form of solid manure mixed with food scraps and urine. All waste products from cows in fresh or composted form in a solid or liquid form have natural properties and do not damage the soil, and provide macro elements (nitrogen, phosphorus, potassium, calcium, and sulfur) and the micro elements (iron, zinc, boron, cobalt, and molybdenium). Cow manure is useful for improving physical, chemical, and iological soil properties, increasing water retention capacity, soil microbiological activity, cation exchange capacity value and adding nutrients [12].

Kirinyuh (*Chromolaena odorata*) is a potential weed to be used as a source of organic fertilizers because of high biomass production. The production of *Chromolaena odorata* biomass is 18.7 tons/ha in the fresh form and 3.7 kg/ha in the dried form, consisting of content of 103.4 kg/ha of N, 15.4 kg/ha of P, 80.9 kg/ha of K, and 63.9 kg/ha of Ca. Kirinyuh can be used as a source of green fertilizers, increase the content of N elements in the soil, and also reduce the use of synthetic fertilizers [13]. The result of the study by Nurhajati [14], it was found that Kirinyuh that grew alongside the road obtained fresh materials of 3 kg/ha. At the age of 6 months, *Chromolaena odorata* produces biomass of 11.2 tons/ha, and after 3 years of age is able to produce biomass of 277.7 tons/ha. Weed biomass has a high nutrient content (2.65% N, 0.53% P and 1.9% K) [15]. If pruned, then 3 (three) months, it will grow back and even can produce 4 tons/ha or the equivalent of 1.2 tons/ha of dry material containing artificial fertilizers (73 kg Urea, 97 kg SP-36 and 84 kg KCl) [16].

The release of Nitrogen from organic matter depends on the physical and chemical properties of the organic matter at the time of aplication and the community of the remodeled organisms. The content of N, lignin and polyphenols is the main factor that determines whether or not organic matter decomposes easily and releases N. The right application time of organic matter can help the availability of necessary N nutrients and will increase the Nitrogen uptake by plants [17].

This study aims to determine the potential of Kirinyuh weed and cow manure based on the right time of application to increase Nitrogen uptake of tomatoes on sandy beach soil.

METHODS

This research was conducted in Srigading Village, Sanden District, Bantul Regency, D. I.Yogyakarta. The analysis was carried out at the Laboratory of Plant Nutrition and Fertilizer Technology, Faculty of Agriculture, UPN "Veteran" Yogyakarta.

This research is a pot experiment, with a completely randomized two-factor design method. The first factor is giving of organic matter consisting of 4 levels, i.e., without kirinyuh and cow manure (B0), 30 tons/ha of kirinyuh or equivalent to 474 grams/pot (B1), 30 tons/ha of cow manure or equivalent to 474 grams/pot (B2) and30 tons/ha mixture of cow manure and kirinyuh or equivalent to 237 grams/pot. The second factor is the application time of organic matter consisting of 3 levels, i.e., at the time of planting (T1), 20 days before planting (T2), and 40 days before planting (T3). Each treatment was replicated 3 (three) times. Therefore, the number of trials is 36 pots

Table 1. Physical and Chemical Properties of Sandy Beach Soil

Soil Properties	Values	Rate [18]
C – Organic (%)	0,14	Very low
N – Total (%)	0,206	Very low
N – available (%)	0,013	Very low
P – available (ppm)	9,73	Low
K – available (me %)	0,237	Very low
pH H_2O	6,75	Neutral
CEC (me%)	5,9	Low
Fraction : Sand (%)	 90,96	 High
Silt (%)	5,84	Low
Clay (%)	3,2	Low
Texture class		Sand
Bulk density (g/cm^3)	1,63	
Particle density (g/cm^3)	2,73	

Table 2.Chemical Compositions of Kirinyuh and Cow Manure

Organic Matters	Composision		C/N
	C-organic (%)	N Content (%)	
Kirinyuh	31,00	2,56	12,10
Cow Manure	17,74	1,42	12,49

The sandy beach soil taken from the field was air dried and sieved through a 2 mm. This soil is put in a plastic pot, in which each pot is equivalent to 8 kg of absolute dried soil. The treatment is given by giving cow manure and kirinyuh based on the treatments, namely without giving cow manure and kirinyuh (control), giving 474 grams/pot or equal to 30 tons/ha, giving cow manure 474 grams/pot or equal to 30 tons/ha, and a mixture of cow and kirinyuh manure of 237 grams/pot (50%: 50% ratio). Application of cow and kirinyuh manure is given based on the treatment, namely at the time of planting, 20 days before planting, and 40 days before planting. After being mixed evenly between the soils, manure and kirinyuh are then given water until a field capacity condition is reached. Soil moisture is maintained in the condition of field capacity, namely by weighing the water. The amount of water is determined by weighing the experiment pots every day. The difference between the weight and contents at the time of weighing with the original weight constitutes the weight of water that must be added.

As a bioessay to determine the response of cultivated plants to soil conditions due to treatment, planting tomato seedlings is carried out on the soils in the treated pots. Planting is carried out on soil samples with an equivalent weight of 8.3 kg of soil in the field condition. Before planting, the tomato seedlings are made nurseries after the age of 20 days by taking several plants that grow well and are relatively uniform. Planting tomatoes is planted with 3

plants per pot. At the age of 7 days after planting thinning is done by leaving one of the best plants per pot. Plants maintained reach a maximum vegetative phase. After the maximum vegetative phase is reached, soil sampling is carried out to test the Nitrogen availability of sandy beach soil, plant tissue sampling for plant growth observation, nutrient test for plant tissue nitrogen, and plant tissue absorption, which is calculated using the following formula:

$$\text{N} - \text{uptake (g/pot)} = \text{N tissue content (\%) x Plant dry weight (g)} \quad (1)$$

To find out the effect of treatment on the parameters of the experiment,Analysis of Variance with significant of 5% was used, while to find out the comparison between treatments, Duncan's Multiple Range Test (DMRT) with significant of 5% was used [19].

RESULTS AND DISCUSSION

The results of the soil analysis at the study site (Table 1) showed that the beach sandy soil used in the study was dominated by 90.96% sand fraction (sand texture). With this texture, the surface area is small and has more macro pores, so the ability of the soil to bind water is relatively low. This soil has a macro pore space that is very easy for water and air movement, so the soil porosity is high. This soil also has good aeration because it has a bulk densityof 1.63 g/cm3 and a particle density of 2.73 g/cm3. Chemical fertility constraints include : very low organic C (0.14%), low CEC (5.9 me%) as well as other nutrients, namely total Nitrogen and very low N-available respectively 0.206 % and 0.013%, therefore, it is necessary to make efforts to improve the fertility of this sandy beach soil. From Table 2, it can be seen that the Kirinyuh contains very high nitrogen of 2.56%, very high C-Organic content of 31% and low C/N of 12.10. Cow manure also contains very high Nitrogen of 1.42%, high organic C content of 17.74% and low C/N of 12.49. From these data, both kirinyuh and cow manure have the potentials to improve the soil fertility of sandy beach soil.

Nutrient uptake is an indicator of soil response to fertilization. The response of nitrogen uptake of tomatoes to the aplication of cow manure and kirinyuh at various times of aplication can be seen from the parameters of N-available soil, plant growth and N-uptake observed at the maximum vegetative age (Table 3). From Table 3, the results of the analysis of variance of 5% significance level, it can be seen that the treatment of organic matter at various times of aplication significantly affects the N-available of sandy beach soil, plant dry weight, tissue N content and N-uptake of tomatoes. This condition indicates that the addition of cow manure and kirinyuh with the time of aplication is able to significantly increase these parameters. This is due to nutrient N produced by cow manure and kirinyuh by setting the time of aplication, which is able to meet nutrient requirements in the maximum vegetative phase of tomatoes.

From Table 3, it can be seen that the mixture of cow and kirinyuh (B3) manure treatments showed the highest N-Available result of 0.07% and was significantly different from the B0, B1, B2 treatments. The treatment of a mixture of cow manure and kirinyuh (B3) is the best treatment for increasing N-available sandy beach soil, where kirinyuh is able to play a role in improving the quality of cow manure as a source of organic matter, whereas cow manure acts as a decomposer to accelerate the process of over hauling organic matter by microorganisms, the rate of decomposition increases so that the process of organic N mineralization into $NH_4^+$and NO_3^- goes well, then the need for tomatoes for N-available can be fulfilled. Mean

while, without the use of cow manure and kirinyuh (B0), it actually reduces the N-availablesandy beach soils. This is due to the absence of cow manure which acts as a decomposer. Decomposer microorganisms found in cow manure are able to add microorganisms found in the soil. As a result of the absence of cow manure, the number of organic matter remover microorganisms is only small, the process of overhauling organic material becomes slow, and the number of the available N produced is little. The application of cow and kirinyuh manure at 20 days before planting (T2) is able to increase the highest available N and is significantly different from the simultaneous planting time (T1) because T2 is the best time for manure and kirinyuh to release the maximum N nutrients contained in cow manure and kirinyuh, while giving organic matter at 40 days before planting (T3) actually gives results that are not significantly different.

The increase in available N in the soil appears to respond to plant growth as indicated by the increase in plant dry weight (biomass) and plant tissue N-uptake (Table 3), which is in this case tomatoes uptake N from the soil in the available form (NO_3^- and NH_4^+) because of the addition of N from kirinyuh and cow manure (Table 2).This increase in nutrient uptake is due to an improved crop root system as evidenced by the increase in total dry weight of plants in Table 3. Such increase is due to the increased N availability of sandy beach soil. This is because photosynthates in plant tissues that are formed due to the application of a mixture of cow manure and kirinyuh given are widely used for cell division. This is consistent with the results of research [20] which states that an increase in total N-soil can increase the N availability of soil, which increases plants N uptake because N is absorbed by plants in the form of the available N (NO_3^- and NH_4^+) of soil. In fact, this is due to the addition of N from the cow manure and kirinyuh

Table 3. Effects of cow and kirinyuh manure at various times of application to N-available soil, plant dry weight, tissue N-content and N-uptake of tomatoes

Treatments	N-Available (%)	Dry weight (g)	Tissue N Content (%)	N-Uptake (g/plant)
Organic Matter				
B0	0.04 c	5.92 c	0.34 c	0.15 c
B1	0.06 b	5.98 bc	1.05 b	0.28 b
B2	0.06 b	6.11 ab	1.09 b	0.29 b
B3	0.07 a	6.27 a	1.38 a	0.51 a
Application Time				
T1	0.05 q	5.94 q	0.59 q	0.14 q
T2	0.07 p	6.15 p	1.13 p	0.44 p
T3	0.06 p	6.12 p	1.17 p	0.34 p
Interaction	(-)	(-)	(-)	(-)

Description: Average followed by the same letter in the same row or column showsthere is non significant on Duncan's Multiple Range Test at the level of 5%.

B0: without kirinyuh and animal manure

B1: 30 tons/ha kirinyuh

B2: 30 tons/ha cow manure

B3: 30 tons/ha mixture of kirinyuh and cow manure

T1: at the time as planting

T2: 20 days before planting

T3: 40 days before planting

From Table 3, the uptake of tomato plants to the maximum vegetative age shows that the mixed treatment of cow manure and kirinyuh (B3) application at 20 days before planting (T2) shows the highest N uptake of tomato plants and is significantly different from the treatment of B0, B1, B2. This is because the mixture of manure and kirinyuh is the best treatment that is able to meet the availability of nitrogen nutrients in the soil that plants need to uptake and use as food through the process of photosynthesis to produce photosynthates that are used for plant growth, namely the dry weight of plants. The higher the photosynthate produced, the higher the photosynthate transplanted so that the dry weight of the plants will increase (Table 3). Meanwhile, without giving cow manure and kirinyuh (B0) produces the lowest N uptake. This is due to the absence of cow manure which acts as a decomposer. Decomposer microorganisms contained in cow manure will resulting in the slowing process of the organic material overhauling, little availabe N produced, and the least N uptake proven to be the smallest dry weight of tomato plants (B0). The N is needed by plants in quite large. Nitrogen in plants functions in the process of plant growth, affects the action of chlorophyll, and increases protein levels in the body of the plants. Meanwhile, the need for nitrogen for tomato plants lasts throughout life. Nitrogen uptake is not the same at each phase of tomato growth, so this plant requires continuous availability of nitrogen at all stages of growth. Therefore, if there is no addition of N in the soil (B0), plant growth will be inhibited.

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CONCLUSION

The application of cow manure and kirinyuh (*Chromolaenaodorata*) can increase the available N of sandy beach soil, dry weight, N content and N-uptake of tomatoes. The 30 tons/ha mixture of cow manure and kirinyuh *(Chromolaena odorata*) that applicated at 20 days before planting affects the highest N-uptake of tomatoes.

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