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Response to Availability of N Regosol and its Uptake by Tomatoes on Giving Gamal (*Gliricidia sepium*) at Different Times

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Abstract

The low availability of Nitrogen nutrients for tomato plants results in disruption of plant growth processes including inhibition of root extension, causing N nutrient uptake to decrease. This study aims to determine the effect of the time of application of Gamal fertilizer (Gliricidia sepium) on the availability of N Regosol and its uptake by tomatoes (Solanum Lycopersicum L). This research is a pot experiment using a completely randomized design method (CRD) with 9 treatments, namely without Gamal and without Inoculant at the same time as planting (G0), Giving Gamal at the same time as planting (G1), Giving Gamal 10 days before planting (G2), Giving Gamal 20 days before planting (G3) and Giving Gamal 30 days before planting (G4). Giving gamal + inoculant at the same time as planting (G5), giving Gamal + inoculant 10 days before planting (G6), Giving Gamal + inoculant 20 days before planting (G7), and giving Gamal + inoculant 30 days before planting (G8). Each treatment was repeated 3 times, so the number of pots was 27. The results were analyzed using a variance at the 5% level, if there was a significant effect, then tested further with the Duncan Multiple Range Test at the 5% level. The results showed that giving Gamal (Gliricidia sepium) at different times affected increasing the available N Regosol and N uptake of tomatoes. The time of giving Gamal + inoculant 10 days before planting significantly gave the best response to the availability of N Regosol and N nutrient uptake of tomato plants.

Keywords: Gamal, Nitrogen, Regosol, Tomato, time of application

I. INTRODUCTION

N (nitrogen) is a primary macronutrient needed in large quantities for the optimum growth of tomatoes. Regosol has the potential as a growing medium for tomatoes because it is still very broad and has not been widely used, this soil has constraints both from physical and chemical properties, especially in the low availability of N., as well as manipulating the timing of its application, it is hoped that Gamal can overcome Regosol constraints, namely increasing the availability of N Regosol and its uptake by tomatoes.

II. LITERATURE REVIEW

Nitrogen is one of the primary macronutrients that is needed by plants in large quantities to increase their growth. Nitrogen comes from fertilizers and free air can be absorbed by plants in the form of

NH4 + and NO3-, these elements are needed by plants in the vegetative phase to form protein, chlorophyll, and other organic compounds.
Tomato is a plant that is very responsive to the provision of N. This plant requires loose soil, acidity between 5-6, the soil contains little sand, and contains a lot of humus, regular and sufficient irrigation, and the addition of N elements to support vegetative growth.

Regosol, which is widely distributed in Indonesia, has the potential to be developed as a medium for growing tomatoes. This soil has a sandy texture, single grain structure to crumbs, loose consistency when dry, has low moisture resistance and high water escape power so that the ability to provide essential nutrients is reduced and elements that are easily dissolved, especially nitrogen will be easily lost and not available to them. plant. Regosol generally has low levels of organic matter, low cation exchange capacity, high levels of elements in total but low levels of available elements, especially N (Darmawijaya, 1990). The low availability of N in Regosol can result in inhibition of tomato growth. In general, tomatoes require nitrogen as much as 78.75 kg N / ha or the equivalent of 175 kg N / ha Urea for optimal growth. If this need must be met by artificial N fertilizers, it will cost a lot and in the long run harm the environment.

Gamal (*Gliricidia sepium*) or kerosene is a herbaceous plant belonging to legumes and is a type of multi-purpose legume, often used as a living fence or shade. The use of Gamal can provide benefits for improving the quality of the soil structure. This condition causes soil aggregate to provide a dense balance and pore space which is more favorable for tomato growth. Gamal also has a high ability to bind N2-air with the help of N-fixing bacteria, causing N levels in plants to be relatively high, reaching 3.15% (Yusuf, 2006). The low C / N ratio causes Gamal to have the potential to be used as organic fertilizer which can be directly applied to the soil, this means that the availability of nitrogen nutrients can be available quickly after giving Gamal (Nuraida & Muhtar, 2000)

The release of N from organic matter depends on the physical and chemical properties of the organic matter, the timing of application, and the community of decomposing organisms. The content of N, lignin, and polyphenols are the main factor that determines whether or not organic matter decomposes and releases N. The correct timing of organic fertilizers can help the availability of N nutrients needed and will increase the uptake of N by plants (Handayanto et al. 1999).

The addition of inoculants can accelerate the decomposition of organic matter. The role of inoculants together with green manure in the soil will increase the number of decomposers so that green manure is broken down even faster. Inoculants are also able to increase the nutritional status of plant organic fertilizers and maintain the stability of N availability. To find out when is the right time to give gamal so that it can increase the availability of N Regosol and its uptake by tomatoes optimally, it is necessary to research the Response of N Regosol Availability and Its Uptake by Tomatoes in Giving Gamal (*Gliricidia sepium*) at different times.

III. RESEARCH METHODOLOGY

The research was conducted in Jurusawah Hamlet, Menoreh Village, Salaman District, Magelang Regency, Central Java Province. Soil and plant tissue analysis was carried out in the Plant Nutrition and Fertilizer Technology Laboratory of the Agrotechnology Study Program, Faculty of Agriculture, UPN Veteran Yogyakarta.
This research is a pot experiment using a completely randomized design method (CRD) with 9 treatments, namely without giving Gamal and without inoculants at the same time as planting (G0). Giving Gamal at the same time as planting (G1), 10 days before planting (G2), 20 days before

planting (G3), and 30 days before planting (G4). Giving gamal + inoculant at the same time as planting (G5), 10 days before planting (G6), 20 days before planting (G7), and 30 days before planting (G8). Each treatment was repeated 3 times, so there were 27 pots. Regosol material from Jurusawah Salaman, Magelang is like field conditions (moisture content is known) taken randomly as many as 12 sample points with a depth of 0-20 cm then the soil is composited and dried.

Table 1. Physical and Chemical Properties of Regosol Soil

Type of Analysis	Result	Valued based on PPT 2009
1. N-Total (%)	0,1501	low
2.N-vailable(%)	0,0138	very low
3. KPK (me%)	13,5742	low
4. Textur		sandy loam
sand(%)	44,96	
clay(%)	7,84	
Dust(%)	47,2	
5. C - Organic (%)	0,9916	low
6. pH H_2O	6.75	Neutral

Tabel 2.Chemical composition of Gamal (*Gliricidia sepium*)

	Analysis type	Result of analysis	Valued based on PPT 2009
1.	N (%)	3,1930	Very high
2.	C–Organik (%)	11,2	Very high
3.	C/N	3,507	low

Tabel 3. Inokulan Bio Helth composition

1.	mushroom	1,2. 10^8 CFU/g	Very high
2.	Bacteria	0,85. 10^8 CFU/g	Very high

Soil that has been drained and then sieved so that it passes the 2 mm filter, this soil is put in as many as 27 pots, each pot is equivalent to 6 kg of absolute dry soil. Organic fertilizer material derived from the leaves of Gamal (*Gliricidia sepium*) is cut approximately 1 cm then aerated and applied to the soil according to the treatment, then given water so that the field capacity conditions are achieved. Planting is carried out on soil samples with a weight equivalent to 6 kg of absolute dry soil, in order to determine the response of cultivated plants to soil conditions due to treatment. After the maximum vegetative phase is reached, soil samples are taken to test the availability of Nitrogen Regosol, take plant tissue samples to observe plant growth, test plant tissue nitrogen nutrient levels and plant tissue uptake are calculated using the following formula:

N uptake (g / pot) = tissue N content (%) x Plant dry weight (g)

To determine the effect of treatment on research parameters using variance (Analysis of variance), while to determine the comparison between treatments used Duncan's Multiple Range Test (DMRT) with a significant difference of 5%.

IV. FINDING AND DISCUSSION

The results of soil analysis in the research location (table 1) Regosol used for this study have a sandy clay texture with a total N-content in the soil of 0.1501% which is included in the moderate criteria (PPT 2004), while the available N content is 0.0138%. very low criteria (PPT, 2004). N is available in the soil in the form of NO3- and NH4 + which is found in soil solutions and in exchange complexes which are very unstable, highly volatile, and washable so that the analysis of N in soil and its valuation is mostly carried out in the form of N-Total. The KPK Regosol of 13.5742 is categorized as low, while the result of the C-Organic analysis is 0.9916, which is low and an H2O pH of 6.75 is categorized as neutral. The low KPK on this soil requires the addition of fertilizers to improve the soil. In this case, the use of Gamal leaves is expected to be able to increase Regosol fertility both in soil physical properties and soil chemical properties.

From table 2 it can be seen that Gamal leaves have a very high N content of 3.1930% and a very high C-Organic content of 11.2%. From these data, it shows that Gamal has the potential as a soil repairer for Regosol, besides that the Biohealth Inoculant (table 3) which contains very high fungi and bacteria can be a good decomposer. Nutrient uptake is an indicator of soil response to fertilization. The response of N nutrient uptake to giving Gamal at various times of administration can be seen from the parameters of N-available soil, plant growth, and N nutrient uptake observed at the maximum vegetative age (Table 4). From table 4, it can be seen that Gamal treatment at various times of administration has a significant effect on increasing the available N Regosol, plant dry weight, N content of tomato plant tissue, and N nutrient uptake. This condition indicates that the addition of Gamal with the timing of application can significantly increase these parameters. This is due to the N nutrient resulting from Gamal mineralization with the timing of application able to meet the nutrient requirements in the maximum vegetative phase of tomatoes.

Table 4. Effect of gamal application time on available N, dry weight, tomato plant N content and N nutrient uptake

Treatment	N-available soil	Plant dry weigh (gr)	N value Tomat (%)	Nutriton uptake N (gr/plant)
G0	0,0060 a	4.68 a	0.31 a	1.47 a
G1	0.0143 ab	20.86 bc	1.07 bc	22.41 bc
G2	0.0310 e	22.00 c	1.70 d	37.1 d
G3	0.0259 cd	18.86 bc	1.37 cd	25.72 c
G4	0.0155 ab	21.10 c	0.76 ab	22.83 bc
G5	0.0255 cd	19.40 bc	1.35 cd	26.14 c
G6	0.0338 f	23.02 c	1.82 d	42.09 d
G7	0.0268 de	19.66 bc	1.48 cd	28.14 c
G8	0.0155 bc	16.74 b	1.07 bc	17.85 b

Note: Numbers followed by the same letter in the same column show that they are not significantly different.

G0 = Without giving Gamal, without giving inoculants
G1 = Giving gamal without inoculants at the same time as planting
G2 = Giving gamal without inoculants, 10 days before planting
G3 = Giving gamal without inoculant 20 days before planting
G4 = Giving gamal without inoculant 30 days before planting
G5 = Giving Gamal with inoculants at the same time as planting
G6 = Giving Gamal with inoculant 10 days before planting
G7 = Giving Gamal with inoculants 20 days before planting
G8 = Giving Gamal with inoculant 30 days before planting

Table 4 shows that the time of giving Gamal has a very significant effect on N-Available Regosol. This shows that the timing of the Gamal application can significantly increase the value of N-Available Regosol compared to without giving Gamal (G0). This condition is due to the effect of the release of N-Available in the Gamal. From table 4 it is found that all treatments both G1, G2, G3, G4, G5, G6, G7, and G8 show a significant increase in N-available compared to G0 (control). The highest N-available was achieved at giving Gamal + inoculant 10 days before planting (G6) of 0.0388% or an increase of 463.33% compared to control (G0). G2 with G6, G3 with G7, G4 with G8.

Giving Gamal and inoculant 10 days before planting (G6) was able to increase the N available Regosol the highest compared to other treatments. Gamal is able to act as a source of organic material. The results of the gamal overhaul can improve the soil structure of Regosol, causing a better balance and distribution of the pores, which is beneficial for tomato growth. The added inoculant acts as a decomposer to accelerate the process of reforming organic matter by microorganisms, the rate of decomposition increases so that the mineralization process of organic N into NH4 + and NO3- runs well, so the need for tomatoes for available N can be met. Pujiyanto (1994) also found that the availability of Gamal leaf nutrients, especially nitrogen after composting for 1-2 weeks, is sufficient to meet the needs of plants and the metabolic needs of decomposers in breaking down parts of Gamal leaves that have not been completely weathered. The increase in available N in the soil appears to respond to plant growth as indicated by an increase in plant dry weight (biomass) and plant tissue N uptake (table 4), in this case, tomatoes absorb N from the soil in the available form (NO3- and NH4 +) because of the addition of N from the Gamal (table 2).

From table 4 it can be seen that the treatment of Gamal and Gamal + inoculant was able to increase the value of N-Regosol, in the treatment of G2 with G6 there was no significant difference, G3, G5, G7 had no significant differences, G1, G4 and G8 also had no significant difference, however, all treatments were significantly different from G0 (control).

Meanwhile, the highest absorption was achieved by giving Gamal + inoculant 10 days before planting (G6) of 42.09 or an increase of 2782.8% compared to the control. From table 4 and Figure 2, the tomato plant uptake to the maximum vegetative age shows that the application of Gamal and inoculant 10 days before planting (G6) was able to provide the highest N uptake of tomato plants and was significantly different from other treatments. This is because giving Gamal and inoculants 10 days before planting is the best time to meet the availability of nitrogen nutrients in the soil that plants need to be absorbed and used as food through the photosynthesis process to produce

photosynthate which is used for plant growth, namely plant dry weight. The higher the photosynthate produced, the higher the translocated photosynthate so that the dry weight of the plant will increase (Table 4). Meanwhile, without giving Gamal and inoculant (G0) the lowest N uptake. This is due to the absence of organic materials and inoculants that act as decomposers. Decomposer microorganisms found in inoculants will increase the microorganisms present in the soil. Due to the absence of Gamal and inoculants, the number of microorganisms to decompose organic matter is only a few, the process of changing organic matter is slow, the available N is produced is low, resulting in the least N uptake proved to be the smallest dry weight of tomato plants (G0) by plants in very large numbers. Nitrogen in plants functions in the process of plant growth affects the work of chlorophyll and increases protein levels in the plant body (Hakim et al. 1986). Meanwhile, the nitrogen requirement for tomato plants lasts throughout life. The amount of nitrogen uptake is not the same at each stage of tomato growth, so the plant requires nitrogen availability continuously at all growth stages. Therefore, if there is no addition of N in the soil (G0), plant growth will be hampered.

With the comparison between treatments, it can be seen that giving Gamal and inoculant 10 days before planting (G6) can give the highest N-available Regosol N uptake of tomato plants. From table 4 it can be seen that during the 0 days N-available soil is still low because the nutrients from the gamal cannot be fully dissolved so that the N in the soil is not yet available, 10 days later (in the application of Gamal 10 days before planting) the gamal can be dissolved maximally and is able to increase the availability of N nutrients in the soil, while after 10 days the available N-element in the soil decreases, this is due to several things, among others, the N nutrient available in the soil is used by microorganisms, carried by water and the mineralization process occurs so that the nutrients available before will decrease in number.

V. CONCLUSION AND FURTHER RESEARCH

Giving Gamal (*Gliricidia sepium*) at different times had the effect of increasing the available N Regosol and N uptake of tomatoes. The time of giving Gamal + inoculant 10 days before planting significantly gave the best response to the availability of N Regosol and N nutrient uptake of tomato plants.

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