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POTENTIAL FOR USING SUNN HEMP (*CROTALARIA JUNCEA*) AS A SOURCE OF GREEN MANURE AND SOIL ORGANIC MATTER

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Abstract

Green manures, often known as cover crops, are plants which are grown to improve the soil structure and nutrient content and organic matter of the soil. Sunn hemp (*Crotalaria juncea*) could be a valuable green manure or cover crop as source of soil organic matter for farmers as crops producers because of its rapid growth and large nitrogen fixing ability. The time at which a green manure crop should be buried is the most important in deriving the full benefit from the green manure. The aim of this observation were to determine how old the sunn hemp has the highest contain of nitrogen, phosphorus, potassium and organic matter. After all, it has high quality to be used as green manure and soil organic matter.

This research was conducted in two stages, field and laboratory observation. Field observation was conducted at Siman district, Ponorogo city, divided into cultivation, planting and pruning. While the laboratory experiments includes observation of nutrient contents of Nitrogen, Phosphorus, Potassium, organic matter and C/N ratio of sunn hemp, was done at Soil Laboratory, Brawijaya University, Malang, to determined nutrient contain of sunn hemp, was done at 15, 30, 45, 60 and 75 DAP (days after planting). The results of this experiment showed that sunn hemp has variant nutrient content during each observations. Furthermore, *C. juncea* at the age of 15, 30, 45, 60 and 75 DAP all can be used by producers and farmers as green manure and valuable source of soil organic matter, based on SNI No. 19-7030-2004.

Key words: *Green manure, Crotalaria juncea, organic matter*

Introduction

Soil nutrients are essential for crop production. All plants require nutrients to grow and development. Consequently, a significant portion of these nutrients are removed and exported during harvested process. To maintain crop production, requires some nutrients that are removed to be replaced with synthetic fertilizer. However, some problems come up when application of chemical synthetic fertilizer are out of control, without deliberate application of organic matter to maintain the stability of soil fertility. The lack of organic matter content on soil compotion leading to soil fertility degradation. Degradation of soil fertility

affecting soil capability to store water, soil nutrient, also affecting the value of soil pH, furthermore, it will create unsuitable ecology plant growth and development.

Application of organic matter into soil will improve the quality of soil fertility. Organic matter have an important role to maintain soil healthy and fertility. Application of organic matter also lead to increased the quality of soil, especially on biology and will encourage the improvement of soil fertility, both physical and chemical soil fertility, furthermore, improving plant growth and productivity. On the other hand, periodical application of organic matter is essential to recovery the loss of humus, which is necessary for keeping the soil healthy an suitable condition by enhancing the supply of nitrogen also promoting the growth of microorganisms. Green manure could best serve this purpose with number of agronomic and environmental advantages (Kaul, et. al., 2015).

Green manure is a type of organic matter derived from plants or parts of died plants, which are immersed into the soil to adding organic matter and nutrients, especially provide nitrogen and another nutrients. Sunn hemp (*Crotalaria juncea*) has high potential to be used as green manure, because sunn hemp be able to produce biomass rapidly. Sunn hemp is a leguminous cover crop which highly adapted to tropical or subtropical and generates much biomass (7 t/ha of air-dried organic matter at 2 months of growth), and produces 150 to 165 kg/ha of N under favorable conditions (Wang et al., 2011). sunn hemp also capable of biologically fixing atmospheric N into an organic form of nitrogen. Several studies have shown that sunn hemp can contain approximately 50 lbs of N/ ton of aboveground biomass; Several studies revealed that 2- to 3-month old sunn hemp has a relatively low C:N ratio (18.9:1) with Nitrogen (N), Phospor (P), kalium (K) in a ratio approximately 3:1:2 (Marshall, 2002). On the other hand, ²Under favorable soil conditions, sunn hemp could be an adequate fertilizer to meet most of the N, P, K nutrient requirements for many vegetable crops. Since most of the N and other macronutrients are found in leaves and flower heads, use of sunn hemp as a mulch or green manure would be most beneficial at the early- to mid-flowering stages (Marshall, 2002).

Maximum nitrogen production of sunn hemp occurs on before flowering phase (~40-50 days from sowing in hot weather). Average nitrogen concentration is ~5% when young, but falls back to about 1.75% at flowering. Several study around the world reported that sunn hemp have produced >150kgN/ha from 10t/ha biomass, so it is a very valuable input of nitrogen to the soil, as well as organic matter. In short, it is important to observe the time at which sunn hemp should beburied to derived the full benefit from sunn hemp as green manure.

From this background, The aim of this observation were to determine how old the sunn hemp has the highest contain of nitrogen, phosphorus, potassium and organic matter. After all, it has high quality to be used as green manure and soil organic matter.

Material and methods

This research was conducted in two stages, field and laboratory observation. Field observation was conducted at Siman district, Ponorogo city, divided into soil tillage, planting and pruning. Sunn hemp was sown in parallel lines in the double rows space. Sunn hemp’s pruning was done at 15, 30, 45, 60 and 75 DAP (days after planting) to analisys plant tissue of sunn hemp was done at soil chemistry laboratory, Brawijaya University. Furthermore, the objective of laboratory experiments was to observation of nutrient contents of Nitrogen (N), Phosphorus (P), Potassium (K), organic matter and C/N ratio of sunn hemp. nutrient concentration of sunn hemp was evaluated from each plot. Subsamples were taken from all of the part of sunn hemp. Analyzed. Total N was determined by the macro-Kjeldahl procedure, whereas total K was determined by atomic emission. Phosphorus was measured inthe same extracts by colorimetry following the molybdate ascorbic acid method.

Result and Discussion

Table 1. Nutrient Content of Sunn hemp in Different Age

Age of Sunn hemp	C Organik	N Total	C/N	Organic Matter	P		K
					HNO ₃ +	HClO ₄	
15 DAP	20,61	2,66	8	36,01	0,21	1,85	
30 DAP	27,69	3,35	8	47,91	0,44	1,51	
45 DAP	33,83	3,15	10	58,52	0,20	2,13	
60 DAP	33,62	2,54	11	58,16	0,45	1,16	
75 DAP	33,55	3,46	13	58,05	0,50	2,05	

From the data above, obviously explain that nutrient content of N, P, K, organic matter, and C / N ratio varied in different age of sunn hemp. The amount of C-organic content and organic matter, the highest number was found in sunn hemp at age 45 hst, with 33.83% and 58.52%, respectively. While at 30 dap, sunn hemp has produce the highest

nitrogen content by 3.35%. One of the main criteria of green manure as organic fertilizer is has high nitrogen (N) content. Palm et al. (2001) classified that organic fertilizer should containing N at least 2.5%. Observation at 15-75 hst, it is found that sunn hemp has N content more than 2.5%, and the highest content of nitrogen was at 75 DAP, and the lowest nitrogen content was at 60 DAP. As legume cover crop, sunn hemp can fix atmospheric nitrogen that is available over time to succeeding crops as it decomposes. The results showed that sunn hemp had different nutrient content in each age of observation. there are several factors that can affect the results of observation of nutrient content : a) Planting time related with optimal weather for sunn hemp's growth b) Plant age; related with life stage of sunn hemp, c) Mechanism of plant growth and development d) Soil fertility and nutrient status in the soil (Evans, 1979) With high fertilizer prices and sustainability concerns with synthetic soil amendments, the potential use of sunn hemp to provide nitrogen to crops such as cotton, corn, and rice has prompted research to determine N availability from a sunn hemp cover crop. Nitrogen production with sunn hemp varies depending on many factors; however, reported N values in sunn hemp range between 110 and 160 kg ha⁻¹. In most investigations, sunn hemp nitrogen content equals or exceeds N content of traditional winter legume cover crops (Reeves 1994). Sunn hemp has a lot of nitrogen content because has symbiotic system with Rhizobium bacteria to fix N from the air. Nitrogen fixation is a biochemical process that has an important role in converting atmospheric nitrogen (free nitrogen) in which can be used for the plant. The bacterial genes that can fix free nitrogen in the air are Azotobacter, Clostridium, and Rhodospirillum. In addition, also known bacterial genus that can bind free nitrogen, but can only live if symbiosis with plants from the Leguminosae tribe, the genus

Rhizobium (Nasikah, 2007). Rhizobium enters the legume root through the hair of the roots or directly to the point of emergence of lateral roots. Root hair is the first part of the plant that responds to Rhizobium infection. Inside the root nodule there is not only one kind of strain from Rhizobium, maybe two or more strains live together in a root nodule. However, some genera of Rhizobium are found only in certain host (specific) plants (Dewi, 2007).

From the observation of C/N ratios at various ages, showed that sunn hemp can be used as a source of green manure with C/N ratio ranging from 8 to 13. Category of SNI No. 19-7030-2004 shows that composition of organic matter should have ratio of C/N ratio is 10-13. C/N functions to increase fertility in the soil. The addition of organic material with high C/N ratio causes the soil to rapidly change the C/N balance, because soil microorganisms will digest that residual crops. C/N also serves to balance the availability of nitrogen that can be utilized by plants. If organic matter given to the soil has a high C/N ratio, soil and plant microorganisms will compete to utilize nitrogen and plants always lose (Sutanto, 2002). Several reports said that ¹⁰ Nitrogen (C/N) ratio of compost is an important factor that determines whether the soil fertility has improved or deteriorated. ¹ if the ratio is below this range, N losses from the pile might be excessive; if the C/N ratio is too high, the relative decomposition slows down when the nitrogen is used up and some organisms are non active.

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