

# Biomass Production and Nutrient from *Crotalaria Juncea* L as Green Manure in defferent Planting Distance and Age of Harvest

*by* Muhammad Jayadi

---

**Submission date:** 01-Aug-2021 09:45AM (UTC+0700)

**Submission ID:** 1626329920

**File name:** een-Manure-In-Different-Planting-Distance-And-Age-Of-Harvest.pdf (400.69K)

**Word count:** 5413

**Character count:** 27759

# Biomass Production AND Nutrient FROM Crotalaria JUNCEA L. AS Green Manure IN Different Planting Distance AND Age OF Harvest

Basri Baba, Elkawakib Syam'un, Muhammad Riadi, Muhammad Jayadi

**Abstract:** The purpose of research is to determine the biomass production and nutrient content of *Crotalaria juncea* L. as green manure used different planting distance and age of harvest. The study was conducted in Bontouse village, Tanasitolo Wajo district, South Sulawesi, Indonesia from December 2017 to July 2018. The study used a factorial two-factor in Randomized Block Design. The first factor is planting distance (J) with three levels:  $J_1 = 5 \text{ cm} \times 20 \text{ cm}$ ;  $J_2 = 10 \text{ cm} \times 20 \text{ cm}$  and  $J_3 = 15 \text{ cm} \times 20 \text{ cm}$ . The second factor is the age of harvest *C. juncea* (U) with four levels:  $U_1 = 15 \text{ days}$ ;  $U_2 = 30 \text{ days}$ ;  $U_3 = 45 \text{ days}$  and  $U_4 = 60 \text{ days}$ . Each treatment unit was made plot measuring  $200 \text{ cm} \times 200 \text{ cm}$ , each treatment unit was repeated three times. The results was showed that the average biomass production of *C. juncea* was around  $3.638.21 \text{ g/m}^2$  or  $36.382.08 \text{ kg ha}^{-1}$  on planting distance  $J_1 = 5 \text{ cm} \times 20 \text{ cm}$ , significantly different from  $J_2 = 10 \text{ cm} \times 20 \text{ cm}$  and  $J_3 = 15 \text{ cm} \times 20 \text{ cm}$ . The age of harvest *C. juncea*  $U_4 = 60 \text{ days}$  has average of the heaviest biomass about  $6.680.28 \text{ g/m}^2$  or  $66.802.78 \text{ kg ha}^{-1}$  and significantly different from the treatment of  $U_1 = 15 \text{ days}$ ,  $U_2 = 30 \text{ days}$  and  $U_3 = 45 \text{ days}$ . Production and nutrient content of *C. juncea* on the use of planting distance  $J_1 = 5 \text{ cm} \times 20 \text{ cm}$  produced the highest nitrogen about  $1.570.06 \text{ kg/ha}^{-1}$ , the highest phosphorus production of  $80.05 \text{ kg ha}^{-1}$  and the highest potassium production of  $1,398.58 \text{ kg/ha}^{-1}$ . Age of harvest  $U_4 = 60 \text{ days}$  produces the highest average nitrogen production about  $2954.84 \text{ kg/ha}^{-1}$ , the highest average production of phosphorus  $151.51 \text{ kg/ha}^{-1}$  and the highest average production of potassium is  $2044.61 \text{ kg/ha}^{-1}$ .

**Index Terms:** *Crotalaria juncea*, biomass, green manure, nutrient, planting distance

## 1 INTRODUCTION

Green manure as important alternative increasing soil quality and plant nutrition (White and Brown, 2010). The material of green manure come from cover crop or waste of harvest. Cover crops meaning crops grown to cover the land to protect the soil from erosion, loss plant nutrients through leaching and runoff. The another reason is cover crops useful for weed suppression, carbon sequestration, and integrated pest management. Cover crops protect water quality by reducing losses of nutrients, pesticides, or sediment from agricultural fields. Soil erosion leads to reductions in soil quality and productivity (Yadav et al., 2000; Dabney et al., 2001). Utilization of green manure increasing the content of organic matter and soil nutrients. This condition such as physical, chemical and biological properties of the soil to be more suitable for plant growth. Commonly plant material was used as source of green manure. Green manure used in the soil in two from: fresh material or after decomposition process. Some plants often used as a cover crop of green manure such as: quick stick (*Gliricidia sepium*), white leadtree (*Leucaena leucocephala*), *Sesbania rostrata*, *Crotalaria* spp., and *Mucuna pruriens* (Odhiambo, 2010; Yuliana et al., 2013; Sumarni, 2014; Pereira et al., 2016). *Crotalaria* spp. family Leguminosae or Fabaceae as potential plant as green manure.

The plant produces many of biomass, containing higher water and nitrogen inside cell tissue. Approximately 90 species of *Crotalaria* spp. spread in the world wide except Antarctic. The one of famous species as the source of green manure is *Crotalaria juncea* L. (Abawi and Widmer, 2000; Bhardwaj et al., 2005). *C. juncea* contain higher nitrogen approximately 3.27%, lowest lignin and polyphenol approximately 7.42% and 0.78%, respectively. *C. juncea* has properties that easily decomposed into organic matter, as cover crop, produces minerals contain humus will improve soil structure and be able to nourish the soil (Balkcom and Reeves, 2005; Ambrosano et al., 2013; Cherr et al., 2016; Subaedah et al., 2016). The findings of research from Marla et al. (2008); Djajadi (2011); Curto et al., (2015); Patel and Dhillon (2017) reported that in addition to providing fertility to the soil, *C. juncea* useful plant that rapidly reduces the population of pathogenic nematode on plant such as *Meloidogyne incognita* infect cultivated plants i.e. tomato. Commonly in decomposition process, tissue of youngest plants decomposed quickest. There are contain more water and soft textures (Baitsaid et al., 2018). *C. juncea* growth is very fast. In short time can produce more biomass used as green manure. The biomass playing role adding organic matter to the soil (Sutejo, 2002 and Schomberg et al., 2007). Sainju and Sing (2001) and Subaedah et al. (2004) suggested that the application of forage plants or green manure as organic material increasing total nitrogen content of soils up to 60%, increase ability cation exchange capacity to 24%, and enhance C-organic soil to 25% compared out the treatment of organic matter in plantation. Paul et al., (2001); Ruffo et al., (2004); Sumarni (2014); Syahri et al., (2016); Adekiya et al. (2019) reported the results of their research that green manure derived from *C. juncea* improve soil quality including: physical properties in the form of aggregate stability, chemistry (organic matter, nitrogen, phosphorus and cation exchange capacity) and soil biology (inhibit development of soil borne pathogens). Sharma et al. (2017) reported that green manure from *C. juncea* contain more organic and decomposer materials such as *Trichoderma*

• Basri Baba is currently pursuing Doctoral Degree Program of Agricultural Science in Faculty of Agriculture, Hasanuddin University Makassar 90245 Indonesia. E-mail: [ixydell@gmail.com](mailto:ixydell@gmail.com)

• Elkawakib Syam'un is currently Lecturer at Department of Agronomy, Faculty of Agriculture, Hasanuddin University, Makassar 90245 Indonesia.

• Muhammad Riadi is currently Lecturer at Department of Agronomy, Faculty of Agriculture, Hasanuddin University, Makassar 90245 Indonesia.

• Muhammad Jayadi is currently Lecturer at Department of Soil Science, Faculty of Agriculture, Hasanuddin University, Makassar 90245 Indonesia.

sp. They has an important role as biocontrol agents for pathogenic microbes in the [12]. According to Odhiambo and Bomke (2001); de Oliveira et al., (2007) and Ossom et al., (2010) reported that *C. juncea* improve the productivity of cultivated plants on dry land because able reserve water used by plants such as taro and sweet potato. In research without *C. juncea* application resulted lowest production. *C. juncea* as leguminous playing an important role as green manure as soil organic material in fresh form and processed products such as compost and liquid organic fertilizer. Compost made from *C. juncea* can be used as an alternative to anorganic fertilizer. In the future application of anorganic fertil [11] can be reduced or eliminated (Odhiambo, 2010, Murungu et al., 2011, Sukartono et al., 2011 and Ziblim et al., 2013). *C. juncea* in the fresh form carried out by planting in monoculture and intercropping. Monoculture system by planting one month after harvesting the crops then immersed in the soil during soil cultivation. *C. juncea* in the form of processed products such as compost must be propagated monoculture using seeds. *C. juncea* in fresh and processed products can not be known precisely the results of biomass and content of the nutrients. Based the reason above, the purpose of research is to determine the biomass production and nutrient content of *C. juncea* as green manure at different planting distance and age of harvest.

## 2 METHODOLOGY

### 2.1 Site of Research

The research activities was conducted in Bontouse village, Tanasitolo Wajo district, South Sulawesi, Indonesia from December 2017 to July 2018. The materials and equipment used such as : *C. juncea* seeds, label, raffia ropes, nylon ropes, cultivator, scales, scissors, plastic bag and stationery. The study was arranged using a Factorial two-factor in Randomized Block Design. The first factor as planting distance (J) used three levels :  $J_1 = 5 \text{ cm} \times 20 \text{ cm}$ ,  $J_2 = 10 \text{ cm} \times 20 \text{ cm}$  and  $J_3 = 15 \text{ cm} \times 20 \text{ cm}$ ; the second factor is the age of harvest green manure (U) used four levels:  $U_1 = 15$  days,  $U_2 = 30$  days,  $U_3 = 45$  days and  $U_4 = 60$  days. The combination of treatments given are:  $J_1U_1 = 5 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 15 DAP}$  (Day After Planting);  $J_1U_2 = 5 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 30 DAP}$ ;  $J_1U_3 = 5 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 45 DAP}$ ;  $J_1U_4 = 5 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 60 DAP}$ ;  $J_2U_1 = 10 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 15 DAP}$ ;  $J_2U_2 = 10 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 30 DAP}$ ;  $J_2U_3 = 10 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 45 DAP}$ ;  $J_2U_4 = 10 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 60 DAP}$ ;  $J_3U_1 = 15 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 15 DAP}$ ;  $J_3U_2 = 15 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 30 DAP}$ ;  $J_3U_3 = 15 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 45 DAP}$ ;  $J_3U_4 = 15 \text{ cm} \times 20 \text{ cm} + \text{age of harvest 60 DAP}$ .

### 2.2 Preparation and Management of *C. juncea*

The land was processed by applying cattle manure and divided into three replications. In each replication, the plot measurement 200 cm x 200 cm were made for each treatment unit. Each replication consists of 12 plots and total 36 plots. *C. juncea* planting is grow with planting distance according to the treatment. Maintenance of *C. juncea* is carried out until harvest with replanting, weeding and irrigation. *C. juncea* harvest is carried out according to the treatment by pulling the plant including all parts of the plant (roots, stems, and leaves) will be used in the research activities.

### 2.3 The Observation of *C. juncea*

Parameters was observed in the activity are: weight of *C. juncea* biomass and nutrient content. Biomass weight is obtained based on harvest time according to the treatment. *C. juncea* harvest was chopped, then weighed to obtain weight of *C. juncea* biomass. To find out the nutrient content of *C. juncea*, chopped from the roots, stems and leaves are taken as 250 g. The sample bring to the Laboratory of Soil, Plant, Fertilizer and Water, South Sulawesi Agricultural Research and Development Agency. This a best place analyzed macro nutrient content of *C. juncea* such as : nitrogen, phosphorus and potassium.

### 2.4 Data Analysis

All of the data were tabulated and analyzed of variance (ANOVA) followed by Least Significant Difference with  $\alpha = 5\%$ .

## 3 RESULT AND DISCUSSION

### 3.1 Biomass Production of *C. juncea*

The results of observations of *C. juncea* biomass production are presented in Table 1 below:

Table 1. The Average Biomassa of *C. juncea*

Planting Distance (cm)	Mean	Age (Day)			Average	LSD <sub>0.05</sub>
		15 (U <sub>1</sub> )	30 (U <sub>2</sub> )	45 (U <sub>3</sub> )		
5 × 20 (J <sub>1</sub> )	g/m <sup>2</sup>	470.42	2296.17	4299.25	7487.99	3639.21*
	g/m <sup>2</sup>	(1581.87)	(9104.87)	(17197.00)	(29948.00)	(14552.83)
	kg/ha	(4704.17)	(22961.87)	(42992.50)	(74879.99)	(36392.83)
10 × 20 (J <sub>2</sub> )	g/m <sup>2</sup>	233.83	1105.75	4011.50	6490.08	2960.17*
	g/m <sup>2</sup>	(835.33)	(4423.00)	(14044.00)	(20900.33)	(11800.87)
	kg/ha	(2338.33)	(11057.50)	(40110.00)	(64900.83)	(29601.87)
15 × 20 (J <sub>3</sub> )	g/m <sup>2</sup>	346.83	1261.00	3168.00	5063.76	2686.96*
	g/m <sup>2</sup>	(887.33)	(5124.00)	(12672.00)	(24856.00)	(12759.68)
	kg/ha	(2488.33)	(12610.00)	(31680.00)	(50637.60)	(26869.96)
Average	g/m <sup>2</sup>	(1268.11)	(6243.89)	(15304.33)	(26721.11)	
	kg/ha	(12681.11)	(62438.92)	(153043.33)	(267211.11)	
LSD <sub>0.05</sub>		603.2117				

\*Numbers in the same column followed by same letters are not significantly different (LSD  $\alpha=0.05$ ).

The use of different planting distance and age of harvest *C. juncea* has a significant effect, while their interaction does not significantly affect the weight of *C. juncea* biomass. The results of *C. juncea* biomass production in Table 1 was showed the treatment planting distance  $J_1 = 5 \text{ cm} \times 20 \text{ cm}$  resulted the heaviest average of *C. juncea* biomass (3.638.21 g/m<sup>2</sup> or 14.552.83 g/4 m<sup>2</sup> or 36,382.08 kg/ha) and significantly different from planting distance  $J_2 = 10 \text{ cm} \times 20 \text{ cm}$  and  $J_3 = 15 \text{ cm} \times 20 \text{ cm}$ . Treatment of plant age  $U_4 = 60$  days harvest the heaviest average of plant biomass (6.680.28 g/m<sup>2</sup> or 26.721.11 g/4 m<sup>2</sup> or 66.802.78 kg/ha) and significantly different from the age of  $U_1 = 15$  days,  $U_2 = 30$  days and  $U_3 = 45$  days. The results of further test analysis was showed that the highest *C. juncea* biomass achievement was obtained at planting distance  $J_1 = 5 \text{ cm} \times 20 \text{ cm}$ . The planting distance is the tightest of the various crop treatment. In general, planting distance affect plant populations with denser spacing means that the plant population will increase. According to Feichtinger et al. (2004) and Daudu et al. (2016) suggested that increasing plant populations in normal condition, without competition between plants, it is expected that production per unit area will also be higher. It will cause increasing in plant biomass. [12]ased Good Agriculture Practices in the field, Mosjidis et al. (2007) and Tripathi et al. (2013) reported that [15]ving seed of *C. juncea* at the planting distance  $30 \times 10 \text{ cm}$  at 30 days after sowing is effective increasing the seed yield of *C. juncea*. According to Habte et al. (2013), Mendonca and Schiavinato (2005) described that biomass is defined as the total amount of living material based the time at certain area. Magdalena et al. (2013) state that biomass includes

constituting the majority of living organisms that contain a lot of liquid. Hansch and Mendel (2009) and Pereira et al. (2016) suggested that measurement of total plant biomass is a good parameter can be used as an indicator of plant growth. Based on the fact that estimated plant biomass is relatively easy to measure and is an integration of almost all events experienced by plants before.

### 3.2 Nutrient Production of *C. juncea*

#### 3.2.1 Nitrogen Content

Nitrogen production from *C. juncea* at different planting distance and plant age is very significant, while the interaction of both does not significantly affect the nitrogen production of *C. juncea*. Table 2 was showed the average nitrogen production of *C. juncea*.

**Table 2.** The Average of Nitrogen Production from *C. juncea* ( $\text{kg ha}^{-1}$ )

Planting Distance (cm)	Age (Day)				Average	LSD <sub>0.05</sub>
	15 (U <sub>1</sub> )	30 (U <sub>2</sub> )	45 (U <sub>3</sub> )	60 (U <sub>4</sub> )		
5 × 20 (J <sub>1</sub> )	220.25	965.75	1814.41	3279.53	1570.06 <sup>a</sup>	187.417
10 × 20 (J <sub>2</sub> )	138.85	433.29	1579.57	2879.09	1257.70 <sup>a</sup>	
15 × 20 (J <sub>3</sub> )	116.12	547.94	1255.63	2705.60	1156.32 <sup>a</sup>	
Average	158.41 <sup>a</sup>	648.99 <sup>a</sup>	1549.87 <sup>a</sup>	2954.84 <sup>a</sup>		
LSD <sub>0.05</sub>	216.4104					

Numbers in the same column followed by same letters are not significantly different (LSD  $\alpha=0.05$ ).

Table 2 was showed that treatment planting distance J<sub>1</sub> = 5 cm × 20 cm produces the highest average of nitrogen approximately 1,570.06  $\text{kg ha}^{-1}$  and significantly different from planting distance J<sub>2</sub> = 10 cm × 20 cm and J<sub>3</sub> = 15 cm × 20 cm. Treatment of plant age at U<sub>4</sub> = 60 days produced the highest average nitrogen about 2954.84  $\text{kg ha}^{-1}$  and significantly different from the treatment of plant age U<sub>1</sub> = 15 days, U<sub>2</sub> = 30 days and U<sub>3</sub> = 45 days. Odhiambo (2010) and Han et al. (2011) findings was showed soil with threated of *C. juncea* having the highest amount of mineral nitrogen after 16 weeks of incubation. The amount of mineral nitrogen ranged from 121 to 170  $\text{mg kg}^{-1}$  are higher than other legumes such as *Mucuna pruriens*. The cumulative amounts of nitrogen from the legume residues mineralized recovered as mineral nitrogen in soil after 16 weeks of incubation ranged from 21 - 41% (92 - 121  $\text{mg kg}^{-1}$ ). Mineralization rate from *C. juncea* relative constant, k value was significantly correlated to the residue nitrogen content, nitrogen net mineralized, C/N ratio and lignin/N ratio. Results from this study indicated that *C. juncea* contribute significant amounts of nitrogen for uptake by plants, with release nitrogen at a faster rate. High clay content in soil slowed down nitrogen mineralization. Decomposition and nutrient release from leguminous biomass were monitored by sampling at 30, 60, 90, 120, 150 and 180 days after installing litter bags. In general, *Crotalaria spectabilis* and *Canavalia ensiformes* showed higher decomposition and nutrient release rates and they are the most promising for the dry region and poor soil nutrition (Thonissen et al., 2000 and Pereira et al., 2016).

#### 3.2.2 Phosphorus Content

Phosphorus (P) is essential mineral for all living organisms in nature. Plants must have phosphorus for normal growth and maturity. Phosphorus plays a role in photosynthesis, respiration, energy storage and transfer, cell division, cell enlargement and several other processes in plants. Phosphorus is one of the major plant nutrients in the soil. It is

a constituent of plant cells, essential for cell division and development of the growing tip of the plant. For this reason it is vital for seedlings and young plants (Jeranyama et al., 2010 and Mabuza et al., 2016). Han et al. (2011) reported that nutrient release such as from leaf litter in an apple orchard system can contribute a significant portion of the nutrient requirement for apple production. Beside litter, cover crops such as *C. juncea* has potential as green manure improving soil health. Accounting for this nutrient contribution in the annual fertilizer management is important to avoid excess application, optimize net returns, and maintain sustainable production systems. Production of phosphorus derived from *C. juncea* in different planting distance treatments significantly affected the treatment of plant age, while the interaction of the both does not significantly affect the phosphorus production of *C. juncea*. Table 3 was showed the average phosphorus production of *C. juncea*.

**Table 3.** The Average of Phosphorus Production from *C. juncea* ( $\text{kg ha}^{-1}$ )

Planting Distance (cm)	Age (Day)				Average	LSD <sub>0.05</sub>
	15 (U <sub>1</sub> )	30 (U <sub>2</sub> )	45 (U <sub>3</sub> )	60 (U <sub>4</sub> )		
5 × 20 (J <sub>1</sub> )	13.78	56.69	83.05	166.67	80.05 <sup>a</sup>	10.751
10 × 20 (J <sub>2</sub> )	9.13	24.18	98.71	149.59	70.40 <sup>ab</sup>	
15 × 20 (J <sub>3</sub> )	7.37	38.75	73.74	138.27	64.53 <sup>b</sup>	
Average	10.09 <sup>a</sup>	39.87 <sup>a</sup>	85.17 <sup>a</sup>	151.51 <sup>a</sup>		
LSD <sub>0.05</sub>	12.4141					

Numbers in the same column followed by same letters are not significantly different (LSD  $\alpha=0.05$ ).

Table 3 was showed that planting distance J<sub>1</sub> = 5 cm × 20 cm produce the highest average of phosphorus production (80.05  $\text{kg ha}^{-1}$ ) but was not significantly different from J<sub>2</sub> = 10 cm × 20 cm. There are significantly different from J<sub>3</sub> = 15 cm × 20 cm (J<sub>3</sub>). Treatment of plant age U<sub>4</sub> = 60 days produces the highest average production of phosphorus (151.51  $\text{kg ha}^{-1}$ ) and significantly different from plant age U<sub>1</sub> = 15 days, U<sub>2</sub> = 30 days and U<sub>3</sub> = 45 days. Murungu et al., (2011) reported that *C. juncea* stems had 65% dry weight remaining after 132 days while just over 10% of *Mucuna sp.* and *C. juncea* leaves remained. There was no mineral contribution to maize growth by cover crops. However, in incubation studies, *Mucuna sp.* mineralized 60  $\text{mg nitrogen kg}^{-1}$  and 3.2  $\text{mg phosphorus kg}^{-1}$  and *C. juncea* mineralized 45  $\text{mg nitrogen kg}^{-1}$  and 3.5  $\text{mg phosphorus kg}^{-1}$ . This suggested that weeds and/or leaching may have impacted negatively to nutrient flow from decaying cover crops species to maize during the long winter fallow period. Kahiluoto et al. (2012) and Subaedah et al. (2014) reported that field studies have indicated that plant-available phosphorus supply is the main determinant of the performance of arbuscular mycorrhiza of crops. Presence arbuscular mycorrhiza as supply of phosphorus help plant maintaining and increasing their development. Ziblim et al. (2013) reported that *Mucuna pruriens* recorded higher mean levels of percentage nitrogen, phosphorus, percentage organic carbon and soil pH except in potassium where the mean added level was higher than *Crotalaria juncea*. There was no significant difference in the soil amendment potentials of *M. pruriens* and *C. juncea*. *M. pruriens* is recommended to be used as a fallow crop since it has an added advantage of serving as a cover crop to control soil erosion.

#### 3.2.3 Potassium Content

Commonly NPK fertilizer contain Nitrogen, Phosphorus and potassium ( $K_2O$ ). Although similar symbol with phosphorus, potassium has many different roles in plants. For example, in photosynthesis on plant, potassium regulates the opening and closing of stomata, and therefore regulates  $CO_2$  uptake. Potassium triggers activation of enzymes and is essential for production of Adenosine Triphosphate (ATP) (Han et al., 2011). C. juncea production potassium at different planting distance and plant age is very significant, while the interaction of both does not significantly affect the production of C. juncea. Table 4 was showed treatment planting distance  $J_1 = 5 \text{ cm} \times 20 \text{ cm}$  produced the highest average of potassium production ( $1398.58 \text{ kg ha}^{-1}$ ) and significantly different from  $J_2 = 10 \text{ cm} \times 20 \text{ cm}$  and  $J_3 = 15 \text{ cm} \times 20 \text{ cm}$ .

**Table 4.** The Average of Potassium Production from C. juncea ( $\text{kg ha}^{-1}$ ).

Planting Distance (cm)	Age (Day)				Average	LSD <sub>0.05</sub>
	15 (U <sub>1</sub> )	30 (U <sub>2</sub> )	45 (U <sub>3</sub> )	60 (U <sub>4</sub> )		
5 × 20 (J <sub>1</sub> )	307.01	930.72	1920.42	2436.18	1398.58*	160.588
10 × 20 (J <sub>2</sub> )	194.54	424.46	1898.59	1798.66	1079.06*	
15 × 20 (J <sub>3</sub> )	154.82	569.76	1492.80	1898.98	1029.09*	
Average	218.79*	641.65*	1770.60*	2044.61*		

LSD<sub>0.05</sub> 185.4308  
Numbers in the same column followed by same letters are not significantly different (LSD  $\alpha=0.05$ ).

The treatment of plant age at  $U_4 = 60$  days resulted in the highest average production of potassium ( $2044.61 \text{ kg ha}^{-1}$ ) and significantly different from  $U_1 = 15$  days,  $U_2 = 30$  days and  $U_3 = 45$  days. The analysis at Table 4 was showed that C. juncea treated at planting distance  $J_1 = 5 \text{ cm} \times 20 \text{ cm}$ , the plants produced highest nitrogen production ( $1.570.06 \text{ kg ha}^{-1}$ ); highest phosphorus production ( $80.05 \text{ kg ha}^{-1}$ ) and highest potassium production ( $1.398.58 \text{ kg ha}^{-1}$ ). Treatment plant age  $U_4 = 60$  days produced highest nitrogen ( $2,954.84 \text{ kg ha}^{-1}$ ), highest phosphorus ( $151.51 \text{ kg ha}^{-1}$ ), and highest potassium production ( $2,044.61 \text{ kg ha}^{-1}$ ). In the age of 60 days is the optimal age formation of these elements inside C. juncea plant tissue. Mosjidis et al. (2007) state that C. juncea is one of the Leguminosae plants has nodules on roots contain rhizobium bacteria catch free nitrogen in the atmosphere. According to Yadav et al. (2000) state that the conversion of free nitrogen from atmosphere to ammonia is mediated by the enzyme nitrogenase. The amount of nitrogen that is converted to ammonia is highly dependent on the physical, chemical and biological conditions of the soil. It was showed at the age of 60 days, the complete a series of metabolic processes including number content of nitrogen, phosphorus, potassium, C-organic and C / N has reached optimal levels in C. juncea. The use of green manure from leguminous can improve number of nutrients into the soil through decomposition and nutrient release from biomass. The findings of research showed *Crotalaria spectabilis* and *Canavalia ensiformis* has a higher decomposition and nutrient release rates. For greater persistence of residue in the soil, C. juncea is more recommended (Pereira et al., 2016).

## CONCLUSION

The conclusion of the research is :

1. Average of the heaviest biomass production of C. juncea about  $3.638.21 \text{ g/m}^2$  or  $36.382.08 \text{ kg ha}^{-1}$  at planting distance  $J_1 = 5 \text{ cm} \times 20 \text{ cm}$  and significantly different from planting distance  $J_2 = 10 \text{ cm} \times 20 \text{ cm}$  and  $J_3 = 15 \text{ cm} \times 20 \text{ cm}$ .

2. The age of harvest C. juncea at  $U_4 = 60$  days obtained an average of the heaviest biomass of  $6.680.28 \text{ g/m}^2$  or  $66.802.78 \text{ kg ha}^{-1}$  and significantly different from the age of harvest  $U_1 = 15$  days,  $U_2 = 30$  days and  $U_3 = 45$  days.
3. Production and nutrient content of C. juncea on the use of planting distance  $J_1 = 5 \text{ cm} \times 20 \text{ cm}$  produces the highest nitrogen production ( $1.570.06 \text{ kg ha}^{-1}$ ), the highest phosphorus production ( $80.05 \text{ kg ha}^{-1}$ ) and the highest production of potassium ( $1.398.58 \text{ kg ha}^{-1}$ ).
4. Treatment age harvest  $U_4 = 60$  days produces the highest average nitrogen production ( $2954.84 \text{ kg ha}^{-1}$ ), highest average phosphorus production ( $151.51 \text{ kg ha}^{-1}$ ) and the highest average potassium production ( $2044.61 \text{ kg ha}^{-1}$ ).

## REFERENCES

- [1] Abawi, G. S., and Widmer, T.L. (2000). Impact of soil health management practices on soil borne pathogens, nematodes and root diseases of vegetable crops. *Applied Soil Ecology*, 15: 37-47.
- [2] Adekiya, A. O., Agbede, T. M., Aboyeji, C. M., Dunsin, O., and Ugbe, J. O. (2019). Green manures and NPK fertilizer effects on soil properties, growth, yield, mineral and vitamin C composition of okra (*Abelmoschus esculentus* (L.) Moench). *Journal of the Saudi Society of Agricultural Sciences*, 18(2) April 2019: 218 – 223.
- [3] Ambrosano, E. J., Cantarella, H., Ambrosano, G. M. B., Dias, F. L. F., Rossi, F., Trivelin, P. C. O., and Muraoka, T., 2013. The role of green manure nitrogen use by corn and sugarcane crops in Brazil. *Agricultural Sciences*, 4(12A): 89 – 108.
- [4] Baitsaid, A., Schaffer, B., Vargas, A. I., Li, Y., and Liu, G., 2018. Effect of plant age on in-soil decomposition and nitrogen content of sunn hemp tissue. *Journal Communication in Soil Science and Plant Analysis*, 49(21): 2680 – 2688.
- [5] Balkcom, K. S., and Reeves, D. W., 2005. Sunn hemp a. utilized as a legume cover crop for corn production. *Agron. J.*, 97: 26 – 31.
- [6] Bhardwaj, H. L., Webber, C. L., and Sakamoto, G. S., 2005. Cultivation of kenaf and sunn hemp in the mid-Atlantic United States. *Ind. Crops. Prod.*, 12: 151 - 155.
- [7] Cherr, C. M., Scholberg, J. M. S., and McSorley, R., 2006. Green manure approaches to crop production: a synthesis. *Agron. J.*, 98: 302-319.
- [8] Curto, G., Dallavalle, E., Santi, R., Casadei, N., D'Avino, L., and Lazzeri, L., 2015. The potential of *Crotalaria juncea* L. as a summer manure crop in comparison to Brassicaceae catch crops for management of *Meloidogyne incognita* in the Mediterranean area. *European Journal of Plant Pathology*, 142(4) August 2015 : 829-841.
- [9] Dabney, S. M., Delgado, J. A., and Reeves, D. W., 2001. Using winter cover crops to improve soil and water quality. *Commun. Soil Sci. Plant Anal.* 32: 1221-1250.
- [10] Daudu, C. K., Uyovbisere, E., Amapu, Y. I., and Onyibe, J. a. E., 2006. Qualitative and quantitative

- evaluation of four organic materials as nutrient resources for maize in the Nigerian Savanna. *Journal of Agronomy*, 5: 220 - 227.
- [11] de Oliveira, F. L., Guerra, J. G. M., de LD Riberio, R., de  
 a. Almeida, D. L., da Silva, E. E., Urquiaga, S., and Espindola, J. A. A., 2007. The use of sunn hemp as green manure intercropped with taro. *Hortic. Bras.*, 25(4) October – December 2007: 562 – 566.
- [12] Djajadi, 2011. *Crotalaria juncea* L.: fiber crops for green  
 a. manure and biological control for nematode. *Prespektif Review Penelitian Tanaman Industri*, 10(2).
- [13] Feichtinger, F., Erhart E., and Harti, W., 2004. Net nitrogen (N) mineralization related to soil organic matter (SOM) pools. *Plant Soil Environ.*, 50: 273 – 276.
- [14] Habte, M., Gebrekidan, H., and Haile, W. (2013). *Composition and nutrition release of selected green manure species at different stages of growth on alisols at Areka, Southern Ethiopia. International Journal of Natural Sciences Research*, 1(5): 30 – 42.
- [15] Han, M. Y., Zhang, L. X., Fan, C. H., Liu, L. H., Zhang, S., Li, B. Z., and Alva, A. K. (2011). Release of nitrogen, phosphorus and potassium during the decomposition of apple (*Malus domestica*) leaf litter under different fertilization regimes in Loess Plateau, China. *Soil Science and Plant Nutrition*, 57: 549 - 557
- [16] Hansch, R., and Mendel, R. R. (2009). Physiological functions of mineral micronutrients (Cu, Zn, Mn, Fe, Ni, Mo, B, Cl). *Current Opinion in Plant Biology*, 12(3) June 2009: 259 – 266.
- [17] Hartwig, N. L., and Ammon, H. U. (2002). Cover crops and living mulches. *Weed Sci.* 50: 688-699.
- [18] Jeranyama, J., Hesterman, O. B., Waddington, S. R., and Harwood, R. R. (2000). Relay-intercropping of sunnhemp and cowpea in smallholder maize system in Zimbabwe. *Agron. J.*, 92: 239 – 244.
- [19] Jhilmuoto, H., Ketoja, E., and Vestberg, M. (2012). *Plant-available P supply is not the main factor determining the benefit from arbuscular mycorrhiza to crop P nutrition and growth in contrasting cropping systems. Plant and Soil*, 350(1-2) January 2012: 85 – 98.
- [20] Mabuza, M. P., Edje, O. T., and Shongwe, G. N. (2016). Effect of inorganic fertilizers and sunnhemp (*Crotalaria juncea* L.) as green manure crop on maize (*Zea mays* L.) growth, seed yield and labour cost. *American Journal of Agriculture and Forestry*, 4(3) May 2016: 56 – 63.
- [21] Magdalena, F., Sudiarsi and Sumarni, T. (2013). Application of manure and *Crotalaria juncea* L. to reduce anorganic fertilizer on maize (*Zea mays* L.). *Jurnal Produksi Tanaman*, 1(2) Mei 2013: 61 – 71.
- [22] Marla, S.R., Huettel, R. N., and Mosjidis, J. (2008). Evaluation of *Crotalaria juncea* populations as hosts and antagonistic crops to manage *Meloidogyne incognita* and *Rotylenchulus reniformis*. *Nematropica*, 38: 155-162.
- [23] Mendonca, E. H. M., and Schiavinato, M. A. (2005). Growth of *Crotalaria juncea* L. supplied with mineral nitrogen. *Braz. Arch. Biol. Technol.*, 48(2) March 2005: 181- 185.
- [24] Mosjidis, J. A. (2007). Breeding of annual and perennial legumes and their utilization as forage and cover crops. *Field Veg. Crop Res. (Zbornik Radova)*, 44: 7-11.
- [25] Murungu, F. S., Chiduzza, C., Muchaonyerwa, P and Mkeni, P. N. (2011). Decomposition, Nitrogen and phosphorus mineralization from residues of summer grown cover crops and suitability for a smallholder farming system in South Africa. *Communications in Soil Science and Plant Analysis*, 42: 2461 – 2472.
- [26] Mthambo, J. J. O., and Bomke, A. A. (2001). Grass and legume cover crop effects on dry matter and nitrogen accumulation. *Agron. J.* 93: 299 - 307.
- [27] Mthambo, J. J. O. (2010). Decomposition and nitrogen release by green manure legume residues in different soil types. *African Journal of Agricultural Research*, 5(1) January 2010: 090 – 096.
- [28] Ossom, E. M., Rhykerd, R. I., and Rhykerd, C. L. (2010). Ecological properties under sunnhemp (*Crotalaria juncea* L.) green manuring of sweetpotato (*Ipomoea batatas* (L.) Lam.) in Swaziland. *American-Eurasian J. Agric. & Environ. Sci.* 9(4): 364-375.
- [29] Patel, S., and Dhillon, N. K. (2017). Evaluation of sunnhemp (*Crotalaria juncea*) as green manure/amendment and its biomass content on root knot nematode (*Meloidogyne incognita*) in successive crop brinjal. *Journal of Entomology and Zoology Studies*, 5(6): 716 -720.
- [30] Paul, K. I., Black, A. S., and Conyers, M. K. (2001). Effect of plant residue return on the development of surface soil pH gradients. *Biology and Fertility of Soil*, 33: 75 – 82.
- [31] Pereira, N. S., Soares, I., and de Miranda, F. R. (2016). Decomposition and nutrition release of leguminous green manure species in the Jaguaribe-Apodi region, Ceara, Brazil. *Ciencia Rural, Santa Maria*, 46(6) June 2016: 970 - 975.
- [32] Ruffo, M.L., Bullock, D. G., and Bollero, G. A. (2004). Soybean yield as affected by biomass and nitrogen uptake of cereal rye in winter cover crop rotations. *Agron. J.* 96: 800-805.
- [33] Sainju, U.M., and Singh, B. P. (2001). Tillage, cover crop,  
 a. and kill-planting date effects on corn yield and soil nitrogen. *Agron. J.* 93: 878-886.
- [34] Schomberg, H. H., Martin, N. L., Diaz-Perez, J. C., Pathak, S. C., Balkcom, K. S., and Bhardwaj, H. L. (2007). Potential for using sunn hemp as a source of biomass and nitrogen for the Piedmont and Coastal Plains regions of the Southeastern USA. *Agron. J.* 99: 1448-1457.
- [35] Sharma, A., Saha, T. N., Arora, A., Shah, R., and Nain, L. (2017). Efficient microorganism compost benefits plant growth and improves soil health in calendula and marigold. *Horticultura Plant Journal*, 3(2) March 2017: 67-72.
- [36] Syahri, R., Djajadi, Sumarni, T., and Nugroho, A. (2016). Effect green manure (*Crotalaria juncea* L.) and silica nano fertilizers concentration on growth and production of sugarcane after 9 months. *Jurnal*

- Produksi Tanaman, 4(1) Januari 2016: 73 - 81
- [37] Sutejo, M.M. (2002). Pupuk dan Pemupukan. PT Rineka  
a. Cipta. Jakarta. pp.177
- [38] Subaedah, St., B. Guritno, Syamsulbahri, Sastrosupadi, A. (2004). Respon Tanaman Jagung dan Perbaikan Sifat Kimia Tanah pada Beberapa Jenis Tanaman Penutup Tanah di Lahan Kering. *J. Agrivita* 26(3), 222-226.
- [39] Subaedah, S., Nirwana and Suriyanti (2014). Improvement of yield maize in the dry land who experience drought stress with use of organic matter. *Advances in Environmental Biology*, 8(22): 930-934.
- [40] Subaedah, S., Aladin, A., and Nirwana. "Fertilization of Nitrogen, Phosphor and Application of Green Manure of *Crotalaria juncea* in Increasing Yield of Maize in Marginal Dry Land," Proceeding International Conference on Food, Agriculture and Natural Resources, IC-FANRes. Agriculture and Agricultural Science Procedia, 9: 20 – 25, 2016.
- [41] Sukartono, Utomo, W.H., Kusuma, Z., dan Nugroho, W.H. (2011). Soil fertility status, nutrient uptake and maize (*Zea mays* L.) yield following biochar and cattle manure application on sandy soil of Lombok, Indonesia. *J. of Tropical Agriculture*, 49(1-2): 47-52.
- [42] Sumarni, T. (2014). Upaya Optimalisasi Kesuburan Tanah melalui Pupuk Hijau Orok-Orok (*Crotalaria juncea*) pada Pertanaman Jagung (*Zea mays* L.). Prosiding Seminar Nasional Lahan Suboptimal. Palembang. hal 368 – 372.
- [43] Thonnissen, C., Midmore, D. J., Ladka, J. K., Olk, D. C., and Schmidhalter, U. (2000). Legume decomposition and nitrogen release when applied as green manure to tropical vegetable production system. *Agron. J.*, 92: 253 – 260.
- [44] Tripathi, M. K., Chaudhary, B., Singh, S. R., and Bhandari,  
a. H. R. (2013). Growth and yield of sunnhemp (*Crotalaria juncea* L.) as influenced by spacing and topping practices. *African Journal of Agricultural Research*, 8(28) July 2013: 3744 – 3749.
- [45] White, P. J., and Brown, P. H. (2010). Plant nutrition for  
a. sustainable development and global health. *Ann. Bot.* 105(7) June 2010: 1073 – 1080.
- [46] Yadav, R. L., Dwivedi, B. S., Prasad, K, Tomar, O. K.,  
a. Shurpali, N. J., and Pandey, P. S. (2000). Field trends and changes in soil organic C and available NPK in long term rice-wheat system under integrated use of manures and fertilizers. *Field Crops Research*, 68(3) November 2000: 219 - 246.
- [47] Yuliana, A. I., Sumarni, T., and Fajriani, S. (2013). The effort to increase maize (*Zea mays* L.) production by using bokashi and green manure sunn hemp (*Crotalaria juncea* L.). *Jurnal Produksi Tanaman*, 1(1) Maret 2013: 36 – 46.
- [48] Ziblim, I. A., Gakpo, S. P., and Khan, A. T. (2013).  
a. Assessing soil amendment potentials of *Mucuna pruriens* and *Crotalaria juncea* when used as fallow crops. *Journal of Soil Science*

# Biomass Production and Nutrient from *Crotalaria Juncea* L as Green Manure in defferent Planting Distance and Age of Harvest

## ORIGINALITY REPORT

20%

SIMILARITY INDEX

17%

INTERNET SOURCES

13%

PUBLICATIONS

5%

STUDENT PAPERS

## PRIMARY SOURCES

1	<a href="http://www.tandfonline.com">www.tandfonline.com</a> Internet Source	4%
2	<a href="http://academicjournals.org">academicjournals.org</a> Internet Source	2%
3	<a href="http://pesquisa.bvsalud.org">pesquisa.bvsalud.org</a> Internet Source	2%
4	<a href="http://www.dpi.nsw.gov.au">www.dpi.nsw.gov.au</a> Internet Source	1%
5	<a href="http://www.hyperceptions.co.nz">www.hyperceptions.co.nz</a> Internet Source	1%
6	<a href="http://answersdrive.com">answersdrive.com</a> Internet Source	1%
7	Helena Kahiluoto. "Plant-available P supply is not the main factor determining the benefit from arbuscular mycorrhiza to crop P nutrition and growth in contrasting cropping systems", <i>Plant and Soil</i> , 07/08/2011 Publication	1%

8	<a href="http://repository.lppm.unila.ac.id">repository.lppm.unila.ac.id</a> Internet Source	1 %
9	Ming Y. Han, Li X. Zhang, Chong H. Fan, Li H. Liu, Lin S. Zhang, Bing Z. Li, Ashok K. Alva. "Release of nitrogen, phosphorus, and potassium during the decomposition of apple ( ) leaf litter under different fertilization regimes in Loess Plateau, China ", Soil Science and Plant Nutrition, 2011 Publication	1 %
10	Submitted to Texas Tech University Student Paper	1 %
11	<a href="http://ijcmas.com">ijcmas.com</a> Internet Source	<1 %
12	<a href="http://epdf.pub">epdf.pub</a> Internet Source	<1 %
13	<a href="http://ufdc.ufl.edu">ufdc.ufl.edu</a> Internet Source	<1 %
14	Eric B. Brennan, Nathan S. Boyd, Richard F. Smith, Phil Foster. "Seeding Rate and Planting Arrangement Effects on Growth and Weed Suppression of a Legume-Oat Cover Crop for Organic Vegetable Systems", Agronomy Journal, 2009 Publication	<1 %

15 M, K Tripathi, Chaudhary Babita, R Singh S, R Bh H, and ari. "Growth and yield of sunnhemp (Crotalaria juncea L.) as influenced by spacing and topping practices", African Journal of Agricultural Research, 2013.  
Publication

---

16 mafiadoc.com  
Internet Source

---

17 Yasmim Yathiará Gomes Araújo Morais, Patrícia Carneiro Souto, Sérgio Túlio Pereira Justino, Valdirene Henrique Nunes et al. "Synchronism of Production and Degradation of Litter in Fragment of Dry Tropical Forest in Paraíba, Brazil", Journal of Agricultural Science, 2019  
Publication

---

18 J. Bryan Hacker, Liana Jank. "Setaria", American Society of Agronomy, 2016  
Publication

---

19 Sustainable Potato Production Global Case Studies, 2012.  
Publication

---

20 ijwem.ulm.ac.id  
Internet Source

---

21 iopscience.iop.org  
Internet Source

---

22	<a href="http://text-id.123dok.com">text-id.123dok.com</a> Internet Source	<1 %
23	<a href="http://zidapps.boku.ac.at">zidapps.boku.ac.at</a> Internet Source	<1 %
24	"Innovations as Key to the Green Revolution in Africa", Springer Science and Business Media LLC, 2011 Publication	<1 %
25	<a href="http://access.onlinelibrary.wiley.com">access.onlinelibrary.wiley.com</a> Internet Source	<1 %
26	<a href="http://krishikosh.egranth.ac.in">krishikosh.egranth.ac.in</a> Internet Source	<1 %
27	<a href="http://www.pakinsight.com">www.pakinsight.com</a> Internet Source	<1 %
28	<a href="http://www.zef.de">www.zef.de</a> Internet Source	<1 %
29	<a href="http://pathofscience.org">pathofscience.org</a> Internet Source	<1 %
30	<a href="http://www.sciendo.com">www.sciendo.com</a> Internet Source	<1 %
31	Natanael Santiago Pereira, Ismail Soares, Fábio Rodrigues de Miranda. "Decomposition and nutrient release of leguminous green manure species in the Jaguaribe-Apodi region, Ceará, Brazil", Ciência Rural, 2016	<1 %

## Publication

---

Exclude quotes  On

Exclude bibliography  On

Exclude matches  < 5 words