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Effect of Row Spacing and Cutting Interval on Products Forage and Antinutrition of Orok-Orok (*Crotalaria juncea)*

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ABSTRACT

The purpose of this observation is to acknowledge the different cutting interval between the row spacing on high production and low antinutrition for *Crotalaria juncea*. The material used is *Crotalaria juncea* seed *(Crotalaria juncea)* and basic fertilizer (urea, phosphate, and KCl). determination yield and quality of *Crotalaria juncea* in the Laboratory of Diponogoro University, Semarang, and determination antinutrisi in the Laboratory of Gajah Mada University Yogyakarta. A factorial completely randomized design in experiment 3x2 with four replication. The first factor is row spacing of J1: 10x20 cm, J2: 15x20 cm, J3: 30x20 cm, and D1: 10, D2: 5 weeks cutting interval. This study was aimed to investigate row spacing and cutting interval on products, quality (crude protein and crude fiber) and levels of alkaloid. Experiment result that forages yield and level of alkaloid response to cutting interval together at row spacing. Extend the cutting interval of 5 to the 10 weeks will improve forage results and levels of alkaloid, but crude protein content decreased. The row spacing of 10 to the 30 cm will reduce forage productivity but no significant on levels of crude protein, crude fiber, and levels of alkaloid.

Keywords: *Crotalaria juncea (Crotalaria juncea), products, quality, cutting interval, row spacing, levels of alkaloids.*

1. INTRODUCTION

Problem frequently encountered was the lack of production and good quality forage. A solution to solve this problem by utilizing the local forage *Crotalaria juncea* (*Crotalaria juncea*). Advantage rattle pod is quite high in protein, about 20% (Chaudhury *et al.,* 2012). However *Crotalaria juncea* also has a weakness that it contains alkaloids pyrrozilidine as a antinutrisi. The environment management factors that involve of human behavior, one of which is about row spacing and cutting interval. The row spacing correlated to the density of the population that able to grow on a field, meanwhile, the cutting interval related to the accurate management of defoliation when maximum production and quality of plant. Extend the impact of cutting interval in the opportunity of photosynthesis in plants to accumulate the longer, so that will improve forage production and lower quality. The decline in quality is caused due to the continued increase in the accumulation of cell wall components (crude fiber) content of cells resulting components (crude protein) decreased. When antinutrisi levels of stress caused by short cutting interval. Population density in an area closely related to the quantity of light received by the plant. When antinutrisi levels of stress caused by short cutting interval. Population density in an area closely related to the quantity of light received by the plant. Population density is low because of the wide spacing resulted in light received per unit leaf area multiplied resulting in increased photosynthesis, leaf structure turns a thick and smaller attended formation of lignin. Lignin is one of the results of secondary metabolites due to plant stress. So it can be assumed that environmental factors are also able to create products of secondary metabolites such as alkaloids of Crotalaria juncea (*Pyrrolizidine*).

2. METHODS

The implementation of the observation is involving the preparation, the implementation, and laboratory analysis. The preparation of the observation including the soil analysis to know the content of N, K, and P that available in the soil, and the procedure of pH based on BPT (2005). After the end of the observation, the observer also has to analyze the content of N inside the soil based on BPT (2005). P fertilizer used is SP 36 (36% P_2O_5), K fertilizer used was KCl (52% K_2O), and N fertilizer used is urea (46% N) with the doses 20 kg / ha N, 40 kg / ha P_2O_5 and 80 kg / ha K_2O. Defoliation *Crotalaria juncea* at D1 done as much as 1x, at age 10 weeks after planting, when defoliation on D2 do 2x as much, ie at the age of 5 weeks after planting and 5 weeks after the first defoliation, so that can know the result and quality of forage *Crotalaria juncea* on the same age is 10 weeks with different cutting interval. Research parameters measured were percent dry matter, production of dry matter, crude protein, crude fiber, and levels of alkaloids.

2.1 Percent Dry Matter

The determination of water content refers to AOAC (2000). The principle of this method is the loss of mass during the heating for sometime in the temperature of 105^0 C then the mass will be constant. The procedures of the analysis of Water Content and Dry Material is as

follow: take the sample of the rattle pod forage, then measured for 200 gram, next, heat it in the air and put it in an oven with the temperature of 105^0 C until reaching a constant mass.

2.2 Production of Dry Matter

Production Of Dry Matter(kg/ha) = total green matter x Persent dry matter (%).

2.3 Crude Protein

Determining the rough protein refer to AOAC (2000) with *kjeldahl* method. The principle of this methods is changing N to NH_3 by using the method of destruction, distillation, and titration.

2.4 Crude Fiber

The determination of rough fiber refers to AOAC (2000). The standard of this method is that all organic compound will soluble when boiling with H2SO4 1,25 % and NaOH 3,25 % exclude the rough fiber and the ash.

2.5 Levels of Alkaloids

Manufacture alkaloid extract using organic solvents to dissolve the alkaloid contained in the sample. Having formed the extracts, separation of alkaloid components based on polarity and determination of properties using TLC densitometer instrument

3. RESULT

3.1 The Products of *Crotalaria Juncea*

Response of percent dry matter and production of dry matter is similar to the cutting interval at different row spacing. This is possibility caused by tight spacing and short cutting interval has not become a limiting factor. Suspected of limiting factor is the temperature, because temperature reached 27° C, while the optimum temperature for growth *Crotalaria juncea* is 20° C. Dry matter content and dry matter production at 10 weeks of cutting interval significantly ($P < 0.05$) higher than 5 weeks cutting interval (Table 1). Tukey HSD test results stated that the production of dry matter among row spacing 10 and 15 cm not significantly, but the dry matter production at this row spacing significantly ($P < 0.05$) higher than at a spacing of 30 cm (Table 1). Dry matter production and dry matter content at intervals of 10 weeks of defoliation significantly ($P < 0.05$) higher than 5 weeks cutting interval (Table 1).

Table 1. Avarage value of production dry matter and percent dry matter in *Crotalaria juncea* planted in row spacing and cutting interval

Row spacing	Cutting interval		Means
	5 weeks	10 Weeks	
	Percent Dry Matter (%)		
10	15.99	23.57	(19.78±6.81)
15	16.02	23.66	(19.84±7.06)
30	16.55	22.54	(19.54±5.55)
Means	$(16.18±0.91)^b$	$(23.26±1.41)^a$	
	Production Dry Matter (ton/Ha)		
10	5.04	9.91	$(7.48±2.54)^a$
15	4.05	9.19	$(6.62±2.83)^a$
30	3.27	6.01	$(4.64±1.49)^b$
Means	$(4.12± 0.95)^b$	$(8.37± 1.58)^a$	

Different letters indicate the significant differences at $P<0.05$ in Tukey HSD test

Orthogonal polynomials spacing showed a response to the dry matter production is linear according to the equation Y: 9082.68 – 1418.11X (R^2 = 0.16). This means that increasing its width spacing will reduce dry matter production *Crotalaria juncea*. R^2 value of 0.16, meaning that only 16% of the spacing effect on dry matter production, while the remaining 84% influence of several factors that are not included in the study.

3.2 The Quality of *Crotalaria Juncea*

Table 2. Avarage value of crude protein and crude fiber in *Crotalaria juncea* planted in row spacing and cutting interval

Row spacing	Cutting interval		
	5 weeks	10 weeks	Means
	Crude protein (%)		
10	22.06	19.66	(20.86± 1.57)
15	24.43	20.27	(22.35± 2.45)
30	24.31	19.2	(21.75± 2.71)
Means	(23.60± 1.33)[a]	(19.71± 1.02)[b]	
	Crude fiber (%)		
10	27.53	30.61	(29.07± 1.41)
15	27.67	29.74	(28.71± 1.28)
30	27.12	30.20	(28.66± 1.77)
Means	(27.44± 0.77)[b]	(30.18± 0.55)[a]	

Different letters indicate the significant differences at P<0.05 in Tukey HSD test

Response of crude fiber and crude protein is similar to the cutting interval at different row spacing. This is possibility caused by tight spacing and short cutting interval has not become a limiting factor. Suspected of limiting factor is the temperature, because temperature reached 27° C, while the optimum temperature for growth *Crotalaria juncea* is 20° C. Cutting interval significantly (P <0.05) the levels of crude fiber and crude protein, but row spacing not significantly the levels of crude fiber and crude protein. Tukey HSD test results that cutting interval 5 weeks resulted in crude protein levels significantly (P <0.05) higher than cutting interval of 10 weeks, but for the crude fiber content significantly (P <0.05) higher at 10 weeks compared to cutting interval is 5 weeks (Table 2). Orthogonal polynomial test results showed that the treatment did not affect the row spacing of crude fiber and crude protein.

3.3 The Levels of Alkaloid of *Crotalaria Juncea*

Table 3. Avarage value level of alkaloid in *Crotalaria juncea* planted in row spacing and cutting interval

Row spacing	Cutting interval		
	5 weeks	10 weeks	Means
	---------- ppm ----------		
10	527.75	478.13	(502.94± 109.17)
15	507.22	611.16	(559.19± 55.87)
30	504.89	591.81	(548.35± 61.95)
Means	(513.29 ±33.05)[b]	(560.37± 76.68)[a]	

Different letters indicate the significant differences at P<0.05 in Tukey HSD test

Response of level of alkaloid is similar to the cutting interval at different row spacing. This is possibility caused by tight spacing and short cutting interval has not become a limiting factor. Suspected of limiting factor is the temperature, because temperature reached 27° C, while the optimum temperature for growth *Crotalaria juncea* is 20° C. Cutting interval significantly (P <0.05) the levels of alkaloid, but row spacing not significantly the levels of alkaloid. Tukey HSD test results that cutting interval 10 weeks resulted in levels of alkaloid significantly (P <0.05) higher than cutting interval of 5 weeks (Table 3). Orthogonal polynomial test results showed that the spacing treatment had no effect on levels of alkaloids.

4. DISCUSSION

Decrease in dry matter production with increasing row spacing. This relates to the amount of populasion the field. The amount of plant population at a distance of planting 10 cm as much as 15 plants per row while the distance planting 30 cm only 5 plants per row. It is backed by the statement Samani et al. (1999) that an increase in the production of dry matter and fresh matter is influenced by amount of of plants per unit experiments. Plants are short cutting interval decreased leaf area than plants long cutting interval. This is due to the plant has a chance to grow longer so that leaves a width, forage production is also increased. According Djukri and Purwoko (2003) the plant leaf is wider and serves more chlorophyll to capture light and is used for photosynthesis. In this study, the role of row spacing has not been able to affect the quality of the crop, this is due to the closer row spacing of the intensity of light received is still able to be used optimally for the process of photosynthesis. Coelho et al., (2007) that the intensity of the light is a stimulant in the biosynthesis or accumulation of secondary metabolites. Results showed no effect of spacing on level of alkaloid, caused by the intensity of light received by the plant is the same.

5. CONCLUSION

Experiment result that forages yield and level of alkaloid response to cutting interval together at row spacing. Extend the cutting interval of 5 to the 10 weeks will improve forage results and levels of alkaloid, but crude protein content decreased. The row spacing of 10 to the 30 cm will reduce forage productivity but no significant on levels of crude protein, crude fiber, and levels of alkaloid.

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