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SUBSTITUTION OF WATER HYACINTH (*Eichhornia crassipes* (Mart.) Solms) AS GREEN MANURE ON THE PERFORMANCE OF ELEPHANT GRASS (*Pennisetum purpureum*)

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ABSTRACT

Experiment was conducted to investigate Water Hyacinth (*E. crassipes* (Mart.) Solms) as green manure (GM) on the performance of Elephant Grass (*P. purpureum*). Two different forms of water hyacinth (wilted-Water Hyacinth, W-WH and composted-Water Hyacinth, C-WH) were incorporated into the field of Elephant Grass. It was conducted in the experimental site, Forage Crops Science Laboratory, Department of Nutrition and Animal Feeds, Faculty of Animal Agriculture, Diponegoro University, Semarang, INDONESIA. Completely randomized design in series experiment (2 x 6) with 3 replications was used throughout the experiment. Treatments consist of two different form of water hyacinth (W-WH, P_1 and C-WH, P_2) and the level of WH: Urea (U) composition (T_0, T_1, T_2, T_3, T_4, T_5). Both in the P_1 and P_2 treatments were consists of T_0 (0% P_1 : 0% U); T_1 (0% P_1: 100% U); T_2 (25% P_1 : 75% U); T_3 (50% P_1 : 50% U); T_4 (75% P_1 : 25% U); T_5 (100% P_1 : 0% U) as groups 1; and T_0 (0% P_2 : 0% U); T_1 (0% P_2 : 100% U); T_2 (25% P_2 : 75% U); T_3 (50% P_2 : 50% U); T_4 (75% P_2 : 25% U); T_5 (100% P_2 : 0% U) as groups 2. Amount of tillers (AT), amount of leaves (AL) and dry matter (DM) yield were recorded during the experiment. Data were statically analyzed using ANOVA, and Duncan multiple range tests were employed for further analysis. Experiment resulted that there were no significantly differences on the AT, AL and DM yield due to the treatment of P. While there were significantly differences in the treatment of T and interaction (P x T) on AT, AL and DM yield, with the exception occurred on AT of T treatment. Result of experiment suggested that the addition of WH (W-WH and C-WH) did not significantly effective in increasing soil N availability, while the level of those two forms of WH with Urea combination seemed more effective in affecting the performance of elephant grass (*P. purpureum*).

Keywords: Composted-Water Hyacinth, Elephant Grass (P. Purpureum), Green Manure, Wilted-Water Hyacinth

INTRODUCTION

The utilization of Water hyacinth (WH) as green manure (GM) may enable to control the environmental problems associated with its presence. From the agricultural viewpoint, WH residues may be utilized as GM, compost, and animal feed (Gopal,

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1987). The addition of organic materials such as WH into farmland may be useful for maintaining the soil fertility. This is due to the fact that the incorporation of WH into soil-crop systems may enhance the soil N status through the rapid progression of decomposition and mineralization of the added WH.

During a 50-day incubation period of incorporated WH and rice straw in both wetland and upland soils, it was observed that the decomposition rate of WH in wetland soil (90%) was higher than that in upland farming soil (70%). These figures were higher compared to the decomposition rate of rice straw, which was 50% and 30% in wetland and upland soils, respectively (Honmura, 2000). The quality of the residues, including the chemical composition and C/N ratio, may influence the differences in the decomposition rate of WH and rice straw residues (Constantinides and Fownes, 1994).

In our previous experiment, it was found that N released from W-WH incorporated into soil-rice systems were recovered from the shoots and roots of the rice crops, respectively (Widjajanto *et al.,* 2001). The amount of W-WH incorporated in rice cropping affected the recovery of N in the system. N recovery by the addition of 25% W-WH to soil-rice systems was higher compared to the levels of 50, 75% and 100% (Widjajanto *et al.,* 2002). On the other hand, it was found that a higher application of WH as GM can be recommended for radish, okra, green soybean and corn which showed a stronger response in terms of vegetative growth (widjajanto *et al.,* 2003). However the evaluation of wh application in the pasture systems has not been conducted yet.

MATERIALS AND METHODS

Experimental location and soil used

The field experiment was conducted in Forage Crops Science Laboratory, Faculty of Animal Agriculture, Diponegoro University, Semarang, INDONESIA. It is located about 280 m above the sea level, with average rainfall is about 2,347 mm year^{-1}. The minimum and maximum temperature, respectively, were 24,2°C and 30°C (average 27,8°C). The soil used is latosol with the following chemical properties: pH_{H2O} 5.5; pH_{KCl} 4.7; 0.27% total N; 1.91% total-C; 0.27 me% exchangeable-K; 5.06 me% exchangeable-Ca; 3.20 me% exchangeable-Mg; 8.06 ppm available -PO; 3.29% OM and C/N ratio 7 : 1.

Experimental procedure and chemical analysis

The WH used was collected from its habitat in the Rawapening lakes, Central Java Province (CJP) (about 50 km South of the CJP Capital, Semarang City). The chemical properties of W-WH were determined on a dry weight basis as follows: 1.79% N, 1.32% P, 2.14% K, 0.22% Na, 2.14% Ca, 0.12% Mg, 42.64% $C_{organic}$, and C/N ratio 24 : 1. The C-WH was prepared using such materials as WH, animal wastes, ash and stimulated with aerobically effective bacteria (*Stardec*) produced by "the Lembah Hijau Organic Farming" District of Sukoharjo, CJP, INDONESIA. The chemical properties of C-WH, then were determined on a dry weight basis as follows: 2.20% N, 1.27% P, 2.42% K, 0.30% Na, 2.26% Ca, 0.17% Mg, 38.18% $C_{organic}$, C/N ratio 17 : 1.

Thirty-six squares (3.5 x 2.5 m) were set up as experimental site. Soil sample then was taken from experimental site for chemical analysis. Elephant grass was planted

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in the experimental site with distance of planting 50 x 75 cm. Concurrently, basic fertilizers (P_2O_5, SP-36 and K_2O, KCl) were applied. One week later, Nitrogen fertilizer (Urea) was added. Trimming was conducted 40 days later. Treatments were implemented day after trimming. Amount of tillers and leaves were recorded every week, while DM yield were determined at the end of growth season. At harvest crops were sampled and sun shine-dried, and followed by oven-dried at 105°C for about 24 hours.

Experimental design

Completely randomized design in series experiment (2 x 6) with 3 replications was used throughout the experiment. Treatments consist of two different forms of WH (W-WH, P_1 and C-WH, P_2) and levels of WH: Urea (U) composition (T_0, T_1, T_2, T_3, T_4, T_5). Both of the P_1 and P_2 treatments were consists of T_0 (0% P_1 : 0% U); T_1 (0% P_1: 100% U); T_2 (25% P_1 : 75% U); T_3 (50% P_1 : 50% U); T_4 (75% P_1 : 25% U); T_5 (100% P_1 : 0% U) as groups 1; and T_0 (0% P_2 : 0% U); T_1 (0% P_2 : 100% U); T_2 (25% P_2 : 75% U); T_3 (50% P_2 : 50% U); T_4 (75% P_2 : 25% U); T_5 (100% P_2 : 0% U) as groups 2. Amount of tillers (AT), amount of leaves (AL) and dry matter (DM) yield were collected throughout the experiment. Data were statically analyzed using ANOVA, and Duncan multiple range tests were employed for further analysis.

RESULTS AND DISCUSSION

Table 1.Amount of tillers, leaves and DM yield of P. purpureum

Form of WH	Doses of Fertilizer						Average
	T_0	T_1	T_2	T_3	T_4	T_5	
Amount of Tillers							
W-WH	$31,7^{ab}$	$35,3^{a}$	$19,7^{abcd}$	13^{d}	$18,7^{abcd}$	12^{d}	$21,7^{a}$
C-WH	17^{cd}	$14,7^{d}$	$17,7^{cd}$	$16,7^{bcd}$	$20,7^{abcd}$	28^{abc}	$19,1^{a}$
Average	$24,3^{a}$	25^{a}	$18,7^{a}$	$14,8^{a}$	$19,7^{a}$	20^{a}	
Amount of Leaves							
W-WH	$298,7^{a}$	$339,3^{a}$	177^{bc}	$157,7^{c}$	$167,3^{c}$	$122,7^{c}$	$210,4^{a}$
C-WH	$172,7^{c}$	$249,3^{ab}$	$304,7^{a}$	$174,7^{bc}$	291^{a}	$277,3^{a}$	$244,9^{a}$
Average	$235,7^{b}$	$294,3^{a}$	$240,8^{ab}$	$166,2^{c}$	$229,2^{b}$	200^{bc}	
DM yield				kg m^{-2}			
W-WH	$4,6^{d}$	$6,6^{ab}$	$6,3^{abc}$	$4,2^{d}$	$5,5^{bcd}$	5^{cd}	$5,4^{a}$
C-WH	$4,8^{cd}$	$4,91^{cd}$	$5,5^{bcd}$	$5,6^{bcd}$	$7,3^{a}$	$5,3^{bcd}$	$5,6^{a}$
Average	$4,7^{bc}$	$5,8^{abc}$	$5,9^{ab}$	$4,9^{bc}$	$6,4^{a}$	$5,2^{bc}$	

Superscripts ^{a,b,c,d} T_0, T_1, T_2, T_3, T_4, T_5

Different letter of each group of treatment showed significantly differences at $P<0.05$

Experiment resulted that there were no significantly differences on AT, AL and DM yield due to the treatment of P. While there were significantly differences in the treatment of T and interaction (P x T) on AT, AL and DM yield, with the exception occurred on AT of T treatment (Table 1.). Result of experiment suggested that the addition of WH both W-WH and C-WH effectively influenced the performance of *P. purpureum*.

The addition of either organic or inorganic matter into soil may be responded by soil microorganisms through the process of mineralisation-imobilisation (Widjajanto *et al.*, 2003). The rate of mineralisation is depending on such factors as the quality and

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quantity of added-organic matter, temperature, and C/N ratio. In this study, the N content of C-WH was higher than that of W-WH. However, the C/N ratio of these two forms of WH is in the same range (high) (Hardjowigeno, 1995). These chemical content may influenced the rate of mineralisation and resulted in low released of inorganic elements. The released of inorganic N into soil may not increase the soil N availability. Therefore, these two forms of WH did not significantly influence the performance of *P. purpureum.*

The doses of WH did not significantly influence the AT, while it affected the AL and DM yield. The AL increased from control to 25% of added WH, and then decreased considerably. Whereas, DM yield increased from control to 75% of added WH, with the exception occurred at 50% and 100% of added WH. This is may be due to the fact that N demand of crops in the 75% of added WH may be supplied by urea and continued by the N released from the mineralisation of added WH. On the basis of the obtained data, it was concluded that up to 75% of added WH suggested to be applied in the field.

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