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NITROGEN UPTAKE EFFICIENCY AND NITRATE REDUCTASE ACTIVITY ON ELEPHANT GRASS AND KOLONJONO GRASSES WITH DIFFERENT COMPOSITION OF UREA AND ORGANIC FERTILIZER IN SALINE SOIL

Sumarsono, Syaiful Anwar, Susilo Budiyanto, D.W. Widjajanto
Faculty of Animal Agriculture, Diponegoro University, Semarang

ABSTRACT

Experiment was aimed to investigate the effect of different compositions of urea and organic fertilizer on the nitrogen uptake efficiency (NUE) and nitrate reductase activity (NRA) of Elephant grass (*Pennisetum purpureum*) and Kolonjono grass (*Panicum muticum*) in saline soil. It was conducted in the saline soil of Jerakah, Semarang city from June to September 2005. Chemical analysis was carried out in the Forage Crop Science Laboratory, Faculty of Animal Agriculture, Diponegoro University, Semarang. Elephant and Kolonjono grasses, urea and organic fertilizer, and saline soil were used throughout the experiment. Completely randomized design in series experiment (4 x 2), with 3 replications was used to arrange the experiment. The first factor consisted of fertilizer (control/ no added fertilizer, T_0; added urea 30 kg N ha^{-1}, T_1; added urea 60 kg N ha^{-1}, T_2; added organic fertilizer equally to 1.21 $C_{organic}$ T_3). The second factors were Elephant grass, R_1 and Kolonjono grass, R_2. There were significantly differences of the two parameters (NUE and NRA) between Elephant and Kolonjono grasses in the saline soil. The organic fertilizer increased both the NUE and NRA on Elephant and Kolonjono grasses compared to that of urea fertilizer.

Key words : elephant and kolonjono grasses, organic fertilizer, saline soil, urea

INTRODUCTION

Salinity stress often occurs due to the accumulation of salt resulted from salt deposit, intrusion of seawater, high evaporation and low rain fall. Sodium chloride (NaCl) is the dominant salt in the salinity stress. Saline soil mostly exists throughout the beach as salt accumulation due to the drought in the dry season. Organic matter (OM) may play important roles in availability of soil elements, maintaining soil moisture, and buffering soil elements that cause salinity, and therefore the existing of OM may increase elements availability (Buckman and Brady, 1982).

Recently, the content of OM in the most soil tends to decrease. About 80% of soils, mainly, dry soil contains $C_{organic}$ less than 1% (Aphani, 2001). This condition may cause the available elements may not be provided precisely. Besides, elements applied through fertilization may not be bound by soil components. It therefore may easily be leached, decrease cation exchange capacity, weaken soil aggregation, reduce microelements and decrease water bindings capacity. Soil with low OM content may cause the demand of N through fertilization increase with low efficiency due to high level of leaching.

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The decrease of soil OM content might reduce soil fertility and consequently affected the demand of inorganic fertilizer to increase (Aphani, 2001). Management of OM is one of goals in practicing organic agriculture (Mashima *et al.,* 1999). The application of organic fertilizer such as *biokom* and *bio guano super* increased the performance of rice. The use of *biokom* on rice plantation increased the production of rice , in Wonogiri and Karanganyar from 6.0 to 8.5 ton ha^{-1} and 5.0 to 8.3 ton ha^{-1}, respectively (Widjajanto and Miyauchi 2002). Organic matter such as crop residues, green manure, and animal wastes in the soil crops system may improve soil structure and promote the development of soil microorganisms (Yaacob *et al.,* 1988; Kerley *et al.,* 1996; Matsushita *et al.,* 2001; Widjajanto *et al.,* 2001; 2002; 2003).

Excess of elements on the media of crops growth may disturb the growth of crops through: (i) the competition with other important elements in the process of absorption, (ii) activity of enzyme, (iii) changing the essential elements from its role and changing the water structure (Marschner, 1986). Therefore, crops should be tolerant on the excess of NaCl on their growth media, decrease the absorption of Na^+ and or Cl by roots, and neutralize (buffering) the effect of NaCl in the roots areas or after absorption by crops.

Morphological and physiological stress due to toxicity of NaCl on the crops was indicated by the reduction of roots growth (Kusmiyati *et al.,* 2000), reduction of elements absorption (Soepandie, 1990; Kusmiyati *et al.,* 2000) and the change of crops structure, such as the reduction of the size of leaf, the thickness of leaf cuticles and the formation of wax layer on the surface of leaf, and early roots lignifications (Harjadi and Yahya, 1988).

Animal wastes as organic fertilizer increased the yield of *Leuchaena leucephala* (Sumarsono, 1997; Dewi *et al.,* 1998; Haswanto *et al.,* 1998). It also influenced the crops production in the mix cropping of Setaria and Centro (Sumarsono, 1983; 2001). Elephant and Kolonjono grasses have good tolerance on saline soil (Anwar *et al.,* 2003). Increasing OM content in the saline soil has improved the environmental growth of grasses, and therefore, in the pot trials, treatment of 4.5% $C_{organic}$ showed the best result (Sumarsono *et al.,* 2005).

MATERIALS AND METHODS

Experiment was conducted in the saline soil of Jerakah village, Semarang City, the capital of Central Java Province. Materials used were Elephant and Kolonjono grasses, organic fertilizer, urea, SP-36 and KCl. Nitrogen and nitrate reductase activity (NRA) analysis was carried out in the Forage Crop Science Laboratory, Faculty of Animal Agriculture, Diponegoro University, Semarang. Polyploid of Elephant (R_1) and Kolonjono (R_2) grasses were fertilized at 4 levels as follows: 0 (T_0), 30 kg N ha^{-1} (T_1), 60 kg N ha^{-1} (T_2) and organic fertilizer equal to Corganic (T_3).

The chemical composition of initial soil and organic fertilizer was analyzed before the experiment started. Twenty-four trial square (2 x 3 m^2) were prepared for field experiment. Basic fertilizers (150 kg P_2O_5 ha^{-1}, SP-36 and 150 kg K_2O ha^{-1}, KCl) were applied. Low doses of N fertilizer, 30 kg N ha^{-1} (Urea) was added as starter of early growth until trimming. Organic fertilizer, was incorporated into soil before stem of Elephant and Kolonjono grasses were planted (60 x 90 cm). Crops were left for about 30 days and trimming was conducted to homogenize the crops prior to treatments.

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Collecting data consisting of forage biomass, N uptake, NRA. were conducted after regrowth until defoliation. Data were analyzed using ANOVA and DUNCAN test.

RESULTS AND DISCUSSION

Chemical composition (N, P, K and C organic) of initial soil and organic fertilizer are presented in Table 1. Soil fertility should be increased to improve the growth of crops, especially using organic fertilizer (equal to 4.5% $C_{organic}$ of soil) at T3 Therefore, 1.21% of C $_{organic}$ was needed. This addition is equal to the application of 63.4 tons $ha^{-1}$of organic fertilizer

Table 2 shows that forage biomass, N uptake, and NRA of *P. purpureum* and *P. muticum* varied between these two grasses and among the levels of fertilization. At the same levels of fertilization the forage biomass, N uptake, and NRA of *P. purpureum* were higher than that of *P. muticum*. In either *P. purpureum* or *P. muticum* ,forage biomass and NRA at T3 were higher (P<0,05) than those of T0, but no signigincant differences compared to those of T2. Nitrogen uptake was influenced (P<0.05) by fertilization and interaction between fertilization and grasses. In either *P. purpureum* or *P. muticum*, ,N uptake at T3 was higher (P<0.05) compared to those at T0, T1 and T2. The N uptake efficiency of organic fertilizer reached 2.19 at *P. purpureum* and 1.95 at *P. muticum*.

Table 1. Chemical composition of initial soil and organic fertilizer

Components	Initial soil	Chemical criteria [1]	Initial organic fertilizer	Chemical criteria [1]
N	0.2 %	Low	1.75 %	High
P	7.84 ppm	Very low	2.30 %	High
K	0.29 me/100g	Low	2.36 %	High
C_{org}	3.29 %	Moderate	25.82 %	Very high
Organic matter	5.67 %	Moderate	44.52 %	High
C/N ratio	15	Moderate	14	Moderate

[1]Soil Research Center, Bogor (1983)

Forage biomass, N uptake, and NRA of both Elephant and Kolonjono grasses were presented in Table 2.

Table 2. Forage biomass, N uptake and NRA of elephant and kolonjono grasses

Treatments	Forage biomass kg m^{-2}	N uptake g m^{-2}	N uptake efficiency %	NRA µmol NO_2 g^{-1} h^{-1}
P. purpureum				
T0	1.91 ^{b}	27.51 ^{b}	1.00	0.510 ^{b}
T1	1.92 ^{b}	29.98 ^{b}	1.09	0.540 ^{b}
T2	1.96 ^{ab}	30.58 ^{b}	1.11	0.556 ^{ab}
T3	2.71 ^{a}	58.29 ^{a}	2.19	0.611 ^{a}
P. muticum				
T0	1.81 ^{b}	22.97 ^{c}	1.00	0.481 ^{b}
T1	1.90 ^{b}	34.51 ^{b}	1.50	0.536 ^{b}
T2	2.03 ^{ab}	36.45 ^{b}	1.59	0.455 ^{ab}
T3	2.12 ^{a}	44.18 ^{a}	1.92	0.623 ^{a}

^{a,b}The same superscripts of each group of treatment in the same column show differences (P<0.05)

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It is concluded that organic fertilizer showed better performance than urea at saline soil. This was indicated by all parameters (forage biomass, N uptake, NRA of both *P. purpureum* and *P. muticum*). The application of organic fertilizer up to 4,5% $C_{organic}$ of soil in saline soil may be expected to improve physical, chemical and biological features of soil, and therefore improve the performance of grasses.

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