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EFFECT OF BURNED RICE HUSK ON GROWTH AND NUTRIENT UPTAKE OF COWPEA GROWN IN AN ALUMINUM TOXIC-SOIL

Surasak Seripong[1] *and Amnuaysilpa Suksri*[2]

ABSTRACT: The pot experiment was carried out under glasshouse at Khon Kaen University to study the effect of burned rice husk on dry matter yields and nutrient uptake of cowpea grown in aluminum-toxic soil. The treatment consisted of four levels of burned rice husk (0,12.50, 25.00, and 37.50 ton/ha.) and aluminum (0, 60,120 and 180 mg Al/kg of soil). The design of experiment was a factorial design arranged in randomized complete block with three replications. The results showed that dry matter yields of shoot and root of cowpea were affected by the percentages of soil aluminum saturation, the decrease in the amount of shoot plus root dry matter yields between the control treatment and the first level of aluminum treatment was as large as 47%. The percentages of soil aluminum saturation at approximately 25-30% reduced 50% dry matter yields of both shoot and root respectively. The three levels of burned rice husk increased dry matter yields over the control up to 33%, 51% and 62% respectively. Burned rice husk increased the uptake of N, P, K, Ca and Mg significantly but the reverse was with an increase in the amount of aluminum added to the soil.

INTRODUCTION

About 50% of major soil groups in Northeast Thailand are those of an acid soils (Suwanarit, 1985), with low amount of organic matter and soil nutrients content. The use of agricultural waste products is obviously untended by growers, the amount available each year seems somewhat enormous e.g. rice husk, filter cake of sugarcane or bagasse pith and etc. It is of tangible interest to look upon such agricultural waste products as to recycle nutrients for the cultivation of crops and to improve soil condition for growth. Some published data have shown such a valuable uses e.g. Su (1982), Lerner (1983), Lerner and Utzinger (1986). These workers have shown the improvement of acid soil by the use of agricultural waste products. Yasothon soil is normally an acid soil and obviously shown Al toxicity to crop plants (Katawetin,1982).Therefore, it should be valuable, and academically important to carry out more work on agricultural waste products in order to utilize them to obtain better crop production apart from leaving them untended.

[1] Department of Soil Science, Khon Kaen University,Khon Kaen 40002.

[2] Department of Agronomy, Khon Kaen University, Khon Kaen 40002 .

MATERIALS AND METHODS

The pot experiment was carried out under glasshouse at Khon Kaen University during June-July 1989. The treatment consisted of burned rice husk (0, 12.5, 25.00 and 37.50 ton/ha.) and aluminum ($AlCl_3$) at the rates of 0, 60, 120, and 180 mgAl/kg soil. The complete fertilizer (15-15-15) was used for fertilizer basement at the rate of 0.625 gm/pot (50 kg/rai). The fertilizer, aluminum and burned rice husk were throughly mixed to the soil used accordingly.The design of experiment used was a factorial arranged in randomized complete block. Cowpea seeds variety Vita-3 were used at the rate of 5-6 seeds/pot. The moisture content of soil in each pot was maintained at approximately field capacity level by means of weighing. One week after sowing, the seedlings were thinned leaving two seedlings per pot. The plant samples were taken at 30 days after sowing. The plant samples were separated into shoot and root. They were oven dried for one week at 70 ° c. The shoot dried plant materials were ground into meshes for the plant tissue analysis of N, P, K, Ca, Mg and Al uptake. After harvesting of the plant samples, soil samples in each pot were air dried for two weeks and were analysed for minerals content. The methods in analysing the soil and the plant tissues were as that of Chapman and Pratt (1961). The data obtained were statistically analysed.

RESULTS AND DISCUSSION

Dry Matter Yield

For dry matter yield, with the aluminum treated plants, there was a trend found with both shoot and root dry matter i.e. an increase in the amount of burned rice husk in the soil increased dry matter of both shoot and root of the crop plant, whilst an increase in the amount of aluminum in the soil decreased both shoot and root dry matter yields (Table 1). With an increase in the amount of aluminum to the soil, the effect due to treatment was greater for root than shoot particularly between the average values of control and the highest level of Al the values were 68% for shoot and 72% for root. This is evidently clear that aluminum has its large toxicity to the crop plant. The results agreed with the work carried out by Ahmad and Tan (1986), they found that shoot and root of soybean dry matter were severely affected by increased aluminum treatments. Aluminum toxicity started to affect plant growth seriously at the rate of 50 mg $Alkg^{-1}$ of soil. The effect of aluminum toxicity was greater with root than shoot agreed with the work reported by Foy (1984).With this result, it is evidently found that the addition of burned rice husk decreased harmful toxicity of aluminum in soil resulted in greater amount of dry matter for both shoot and root. The effect can be attributed to the percentages of

Table1. The influence of burned rice husk and aluminum treatments on growth of cowpea.

Aluminum (mgAl/kg)	Burned rice husk (ton/ha) 0	12.50	25.00	37.50	Mean
	shoot dry weight (gm/pot)				
0	3.39	3.97	4.89	4.89	4.29
60	1.94	1.94	2.36	2.50	2.19
120	1.09	1.78	1.91	1.98	1.69
180	0.90	1.25	1.50	1.86	1.38
Mean	1.83	2.24	2.67	2.81	

LSD(0.05): Burned rice husk (B) = 0.48,
Aluminum (A)=0.48,
BxA = 0.96

	Root dry weight (gm/pot)				
0	1.28	2.18	2.20	2.31	1.99
60	0.86	1.16	1.19	1.26	1.12
120	0.49	0.94	0.83	1.03	0.82
180	0.31	0.49	0.60	0.85	0.56
Mean	0.74	1.19	1.21	1.36	

LSD(0.05): Burned rice husk (B) = 0.20,
Aluminum (A) = 0.20
BxA = 0.40

aluminum saturation as found in table 2. The average amount of aluminum saturation was decreased with an increase in the amount of burned rice husk added to the soil whilst an increase in the amount of aluminum added to the soil increased the amount of aluminum saturation. The results also showed that the relative dry

Table 2. The effects of burned rice husk and aluminum addition on percentage of soil aluminum saturation[1/]

Aluminum (mgAl/kg)	Burned rice husk (ton/ha)				Mean
	0	12.50	25.00	37.50	
0	12.73	17.74	21.69	13.11	16.32
60	39.21	31.41	29.07	25.31	31.25
120	52.50	42.39	39.89	36.46	42.81
180	54.27	59.90	46.16	36.67	49.25
Mean	39.68	37.86	34.20	27.89	

LSD(0.05) :
Burned rice husk (B)=7.06
Aluminum (A)=7.06
BxA=14.12

$$^{1/}\%\ \text{Al saturation} = \frac{\text{Exch. Al (me/100 g) x 100}}{\text{Sum of K, Ca, Mg, H and Al (me/100 g)}}$$

matter yields of shoot and root decreased with an increase in the amount of soil aluminum saturation (Fig.1.). An increase in the amount of burned rice husk added to the soil might increased soil pH due to its high content in the amount of Ca, Mg, and K as reported by Seripong (1988) and Panchaban *et al.* (1989). The value of soil pH increased with the decrease in the amount of aluminum saturation was reported by Abruna *et al.*(1974).

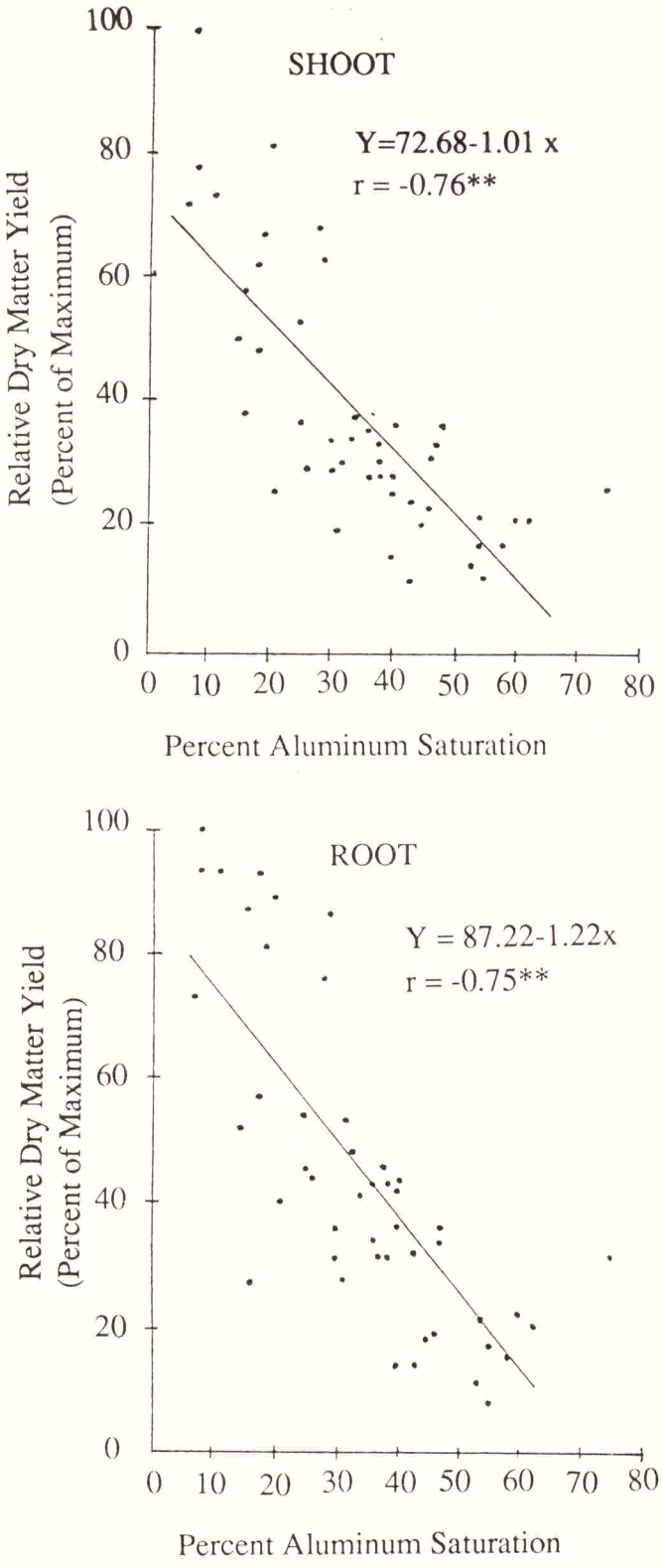

Fig.1. Relationship of percent soil Al saturation to shoot and root dry weight of cowpea.

Nutrient Uptake

With the nutrient uptake, the results indicated that an increase in the amount of burned rice husk added to the soil increased the uptake of N, P, K, Ca and Mg significantly. On the contrary, an increase in the amount of aluminum added to the soil decreased the uptake of N, P, K, Ca and Mg significantly (Table3). The amount

Table 3. The main effect of burned rice husk and aluminum treatments on total nutreint uptake of cowpea shoots.

Treatment	Nutrients					
	N	P	K	Ca	Mg	Al
Burned rice husk (ton/ha)	mg/pot					
0	42.05	8.89	34.22	16.76	6.09	0.14
12.50	52.35	14.42	55.74	20.68	7.37	0.16
25.00	67.33	20.28	63.53	23.91	8.87	0.17
37.50	72.62	24.66	71.10	27.68	8.44	0.18
LSD (0.05):	11.14	4.46	9.94	5.37	1.77	0.04
Aluminum (mg Al/kg)	mg/pot					
0	112.05	41.44	94.90	36.56	14.64	0.27
60	55.39	13.12	56.77	21.40	7.00	0.16
120	36.46	7.79	41.84	17.09	5.06	0.13
180	30.44	5.89	31.07	13.93	4.08	0.09
LSD (0.05) :	11.14	4.46	9.94	5.37	1.77	0.04

of nutrient uptake was greater with an increase in the amount of burned rice husk can be attributed to an increase in the amount of available soil nutrients as a result

of the release of nutrient form itself and perhaps to the higher soil pH values. An increase in the amount of aluminum added to the soil decreased the uptake of soil nutrient might be due to the less amount of available soil nutrient as the soil property became more acidity. The results confirmed the work found by Barligar *et al*. (1987), Rengel and Robinson (1989).

CONCLUSIONS

To sum up, dry matter yields of both shoot and root of cowpea were affected most by the amount of aluminum content in the soil, the higher the amount of aluminum saturation the smaller the amount of both shoot and root dry matter yields and so did the amount of nutrient uptake. To overcome the problem of harmful aluminum toxicity, in this study, burned rice husk at the highest amount or perhaps greater amount than this work added to the soil can be helpful to raise up higher soil pH values and available soil nutrient.

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