FERTILISER N EFFICIENCY IN RICE PRODUCTION: 
I. EVALUATION OF K, MG AND CU STATUS AND 
THEIR ADSORPTION BEHAVIOUR IN RICE SOILS 
UNDER MUDA IRRIGATION SCHEME

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Introduction

Most rice soils of Malaysia are deficient in N. Therefore, 
fertiliser N application is essential to meet the demands of 
the crop but if any one of the other essential nutrients is defi- 
cient in soil, crops cannot utilise the applied N properly and 
consequently efficiency of N becomes lower. Recent investiga-
tions showed that rice crops suffer from Cu and Mg defi- 
cency in many sites in the Muda Irrigation Scheme, the larg-
est rice growing area of Malaysia. Copper deficiency is due 
to low soil Cu status whereas Mg deficiency is attributed to 
high K content in soil, which restricts Mg uptake. Therefore, 
it is necessary to know the K, Mg and Cu status of the soils 
of this area to recommend proper fertiliser dose. When any 
nutrient element like K, Mg or Cu is applied to the soil, a 
substantial portion of it is adsorbed in the soil. The adsorp-
tion phenomenon depends on soil properties. When any 
material containing that element may be needed to get im-
mediate crop response.

Materials and Methods

Soil samples were collected from fifteen locations under fif-
teen soil series from the Muda Irrigation Scheme, Kedah. 
The samples consisted of 11 marine alluvial soils and 4 riv-
erine alluvial soils. The samples were analysed for ex-
changeable K, Mg and available Cu. Potassium and Mg were 
analysed by 1 N ammonium acetate extraction method. 
Available Cu was analysed by 0.05 N HCl extraction 
method. Copper adsorption study was carried out in three 
selected soils (Idris, Tebengau and Kangar), differing in pH, 
CEC and organic matter content. Different amounts of Cu (0, 
100, 200, 300, 400 and 500 μg/g) were added to the soil 
samples and incubated at room temperature for 15 days. Af-
ter 15 days, Cu content in the supernatant solutions was 
measured by atomic absorption spectrophotometer and the 
amount of Cu adsorbed (μg/g) was calculated. The adsorp-
tion data were fitted into Langmuir, Freundlich and Temkin 
equations. Maximum adsorption capacity was calculated 
from Langmuir equation while buffering capacity (capacity 
of soil to retain the adsorbed Cu) was calculated from Tem-
kin equation. Similarly, K and Mg adsorption studies were 
carried out in three selected soils (Guar, Hutan and Kangar), 
differing in pH, CEC and organic matter content.

Results and Discussion

The contents of K, Mg and Cu ranged from 0.12 to 0.44 
cmol/kg, 0.09 to 6.17 cmol/kg and 0.04 to 3.10 mg/kg, re-
spectively. Deficiency of K, Mg and Cu was found in 4, 3 
and 6 soils, respectively. The average K and Mg contents of 
marine alluvial soils were higher than those of riverine allu-
vial soils. On the other hand, the average Cu content in ma-
rine alluvial soils was lower than that of riverine alluvial 
soils. Copper adsorption increased gradually with increasing 
level of added Cu in all the soils. The rate of increase was the 
highest in Kangar series followed by Tebengau and Idris, re-
spectively. Correlation between Cu adsorption and pH was 
significant (r = 0.772) whereas correlation of adsorption with 
either organic matter content or cation exchange capacity 
was non-significant. In Kangar and Tebengau series, Cu ad-
sorption data fitted in Langmuir, Freundlich and Temkin 
equations whereas Cu adsorption data in other soil (kangar) 
fitted in Freundlich and Temkin equations. Maximum Cu ad-
sorption capacity was 833 mg/kg in Tebengau series while it 
was only 588 mg/kg in Idris series. Copper buffering capacity 
was the highest in Kangar series (1030 mg/kg) followed by 
Tebengau (170 mg/kg) and Idris (116 mg/kg), respectively. Correlation between Mg adsorption and pH was sig-
ificant (r = 0.949) whereas correlation of Mg adsorption 
with cation exchange capacity or organic matter content was 
not significant. Maximum adsorption capacity was the high-
est in Kangar (57 mmol/kg) followed by Hutan (48 mmol/kg) 
and guar (23 mmol/kg), respectively. Correlation between K 
adsorption and pH was significant (r = 0.881) whereas cor-
relation between K adsorption with either organic matter 
content and cation exchange capacity was not significant. 
Maximum adsorption capacity was the highest in Guar (112 
mmol/kg) followed by Kangar (50 mmol/kg) and Hutan (34 
mmol/kg), respectively.

Conclusions

Deficiencies of K, Mg and Cu occur in different rice soils in 
the Muda Irrigation Scheme. It indicates the necessity to 
conduct experiments on K, Mg and Cu response of rice in 
order to recommend appropriate fertiliser rate in different 
soils to obtain higher yield over the present yield level. Ad-
sorption of K, Mg and Cu depends on soil pH. In soils with 
higher adsorption capacity of an element, more fertiliser 
material containing that element may be needed to get im-
mediate crop response.