UNIVERSITI PUTRA MALAYSIA

ADJUSTING N, K, Mg AND Cu RATES FOR IMPROVEMENT OF FERTILIZER N USE EFFICIENCY IN RICE PRODUCTION IN MALAYSIA

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By

ABU TURAB MOHAMMAD ALI CHOUDHURY

Thesis Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy in the Faculty of Agriculture Universiti Putra Malaysia

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UPM

DEDICATED

TO

MY PARENTS

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LIST OF ABBREVIATIONS

AE	=	Atom Excess
BAU	=	Bangladesh Agricultural University
BRRI	=	Bangladesh Rice Research Institute
CEC	=	Cation Exchange Capacity
CRD	=	Completely Randomized Design
DLM	=	Department of Land Management
DMRT	=	Duncan's Multiple Range Test
Eh	=	Redox Potential
IAEA	=	International Atomic Energy Agency
IFDC	=	International Fertilizer Development Centre
IRPA	=	Intensification of Research in Priority Areas
IRRI	=	International Rice Research Institute
MARDI	=	Malaysian Agricultural Research and Development Institute
MINT	=	Malaysian Institute for Nuclear Technology Research
MOP	=	Muriate of Potash
NdfF	=	Nitrogen derived from Fertilizer
PU	=	Prilled Urea
RCBD	=	Randomized Complete Block Design
TSP	=	Triple Superphosphate

UPM = Universiti Putra Malaysia

USA = United States of America

USG = Urea Supergranule

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Doctor of Philosophy

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ABU TURAB MOHAMMAD ALI CHOUDHURY

October 1999

Chairman: Associate Professor Dr. Mohd Khanif Yusop

Faculty: Agriculture

The largest rice growing area of Malaysia is located in the Muda Irrigation Scheme. Recent investigations showed that N use efficiency by rice crop is very low in many locations of this Irrigation Scheme due to Cu and Mg deficiency. It is important to increase N use efficiency in rice culture in order to increase yield through better fertilizer management. Three laboratory, three greenhouse and one field experiments were carried out to determine the possible mechanisms for improvement of fertilizer N use efficiency in rice production. Potassium, Mg and Cu status of different rice soils were determined. Deficiencies of K, Mg and Cu were found in 5, 4 and 7 soils, respectively. Three laboratory experiments were carried out on adsorption of K, Mg and Cu in different rice soils. The data indicated that adsorption of K, Mg and Cu depends on soil pH.

The first greenhouse experiment was conducted to evaluate the effects of N and Cu fertilization on rice yield and fertilizer N use efficiency in rice culture. Nitrogen was applied as ^{15}N labelled urea. Estimated grain yield response to added N was quadratic in nature. Copper effect was not significant on grain yield. Effects of N and Cu were not significant on recovery (%) of fertilizer N. The second greenhouse experiment was conducted to evaluate the effects of N and Mg fertilization on rice yield and fertilizer N use efficiency in rice culture. Nitrogen was applied as ^{15}N labelled urea. Grain yield increased significantly due to N and Mg application. Fertilizer N uptake and recovery increased significantly with increasing Mg rates. These findings suggest that there is a prospect to increase grain yield and fertilizer N use efficiency by Mg application in Mg deficient soils. The third greenhouse experiment was conducted to evaluate the effects of K and Mg fertilization on yield, and K and Mg uptake by rice. Grain yield, K and Mg uptake increased significantly due to Mg fertilization whereas the effect of K was not significant. The field experiment was conducted to evaluate the effects Cu and Mg application on grain yield and agronomic efficiency of added N. Grain yield and agronomic efficiency of added N increased significantly due to Cu or Mg application. These findings suggest that combined application of Cu and Mg both at 10 kg ha^{-1} along with 120 kg N ha^{-1} can increase grain yield of rice by 24 % in soils deficient in both Cu and Mg.

Abstrak tesis yang dikemukakan kepada Senat Univesiti Putra Malaysia
Sebagai memenuhi syarat-syarat untuk ijazah Doctor Falsafah

PELARASAN KADAR N, K, Mg DAN Cu DALAM PENINGKATAN KEBERKESANAN EFFISIENSI BAJA N DALAM PENGELUARAN PADI DI MALAYSIA

Oleh

ABU TURAB MOHAMMAD ALI CHOUDHURY

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Pengerusi: Professor Madya Dr. Mohd Khanif Yusop

Fakulti: Pertanian

Kawasan penanaman padi terbesar di Malaysia terletak di Skim Pengairan Muda. Kajian terkini telah menunjukkan bahawa keberkesanan penggunaan N bagi padi adalah amat rendah disebabkan oleh kekurangan Cu dan Mg dalam kebanyakan lokasi skim pengairan ini. Peningkatan keberkesanan penggunaan N adalah penting untuk meningkatkan hasil pengeluaran melalui pengurusan pembajaan yang lebih baik. Tiga eksperimen makmal. tiga eksperimen rumah kaca dan satu kajian ladang telah dijalankan untuk menentukan mekanisma yang boleh mempertingkatkan keberkesanan penggunaan baja N dalam pengeluaran padi. Status K, Mg dan Cu dalam tanah sawah di kawasan tersebut telah ditentukan. Didapati 5 kawasan kekurangan K, 4 kawasan kekurangan Mg dan 7 kawasan kekurangan Cu. Tiga kajian makmal telah dijalankan untuk menentukan jerapan K, Mg dan Cu dalam beberapa jenis padi. Hasil analisis telah menunjukkan bahawa jerapan K, Mg dan Cu bergantung kepada pH tanah.