UNIVERSITI PUTRA MALAYSIA

UREA EFFICIENCY IN MAIZE (*Zea mays var. saccharata*) UNDER SULPHUR TREATMENT IN AN ALKALINE SOIL

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By

MUHAMMAD NURHADI BIN ITHNIN

A project report submitted to Faculty of Agriculture, University Putra Malaysia, in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agriculture Science

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CERTIFICATION FORM

This project report entitled Urea Efficiency in Maize (*Zea mays* var. *saccharata*) Under Sulphur Treatment in an Alkaline Soil is prepared by Muhammad Nurhadi bin Ithnin and submitted to the Faculty of Agriculture in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agriculture Science.

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ABSTRACT

Malaysian soils are known to be acidic and highly weathered and fall under the orders of Oxisols and Ultisols. There are locations in Malaysia where the soils are alkaline and they are usually found near and in close proximity to mountains and hills that are of limestone. Limestone hills in Ipoh, Gua Musang, Langkawi and Niah could have soils in their vicinity having alkaline pH. Melangit series that is located at Bukit Bintang, Kangar, Perlis is an example of such an alkaline soil. This soil series is located near a limestone hill and has a pH reading of 7.8. The problem that is related with alkaline soil is the deficiencies of some nutrients including nitrogen (N), phosphorus (P) and micronutrients.

This study was conducted to investigate the urea efficiency uptake in maize under sulphur (S) treatments in an alkaline soil and to observe the growth of maize plant grown on an alkaline soil with S treatments. The hypothesis of this experiment is that the pH of the alkaline soil will be lowered due to the S treatments and thus will increase the effectiveness of nitrogen uptake from urea by plant. This experiment was conducted under glasshouse condition. The experimental design is randomized complete block design (RCBD). An amount of 3kg soil was used for each pot with one plant to each pot and was treated with 4 rates of sulphur (0g, 2.5g, 5g, and 10g per 1kg of soil). After a month, the source of nitrogen in the form of urea fertilizer was applied to the soil. Urea fertilizer was added to the soil at two rates (0g and 120 kg/ha) and maize seeds were planted. Normal rate of P and K fertilizer for maize were applied to all pots. The plants

were harvested after 35 days of planting. The fresh weight and dry weight of all plant parts were recorded. The soil pH was determined. The concentrations of nitrogen and sulphur in the soils and in the plants were determined. In this experiment, there is an interaction between sulphur and urea to the soil pH. The result shows that there is a decrease in pH of the soil which affects the urea efficiency uptake by plant. A large difference of treatment S15 with other treatments was shown in the nitrogen content in the soil. It is expected that the S treatments result in increased efficiency of the Urea fertilizer used. The high percentage of nitrogen content also results in high efficiency of nitrogen uptake by the plant (5.52% efficiency). The growth of the plant also corresponds to the different amount of sulphur applied. As for the conclusion, application of sulphur and urea showed an interaction to the soil pH, and show a positive result on the plant dry weight, availability of nitrogen in soil, and nitrogen efficiency uptake by plant.

ABSTRAK

Tanah–tanah di Malaysia amat terkenal dengan sifat berasid dan mudah terluluhawa yang banyak terdiri daripada jenis Oxisols dan Ultisols. Kebanyakan lokasi tanah beralkali di Malaysia adalah dari kawasan gunung dan berbukit yang mempunyai batu kapur. Batu kapur yang terdapat di kawasan Ipoh, Gua Musang, Langkawi dan Niah mempunyai nilai pH yang tinggi. Tanah siri Melangit yang terletak di Bukit Bintang, Perlis adalah salah satu daripada contoh tanah beralkali. Siri tanah ini terletak berdekatan dengan bukit batu kapur dan mempunyai pH 7.8. Masalah yang berkaitan dengan tanah beralkali adalah ia kekurangan dalam kandungan nutrisi termasuk nitrogen (N), fosforus (P), dan mikronutrien.

Eksperimen ini dijalankan untuk mengkaji kecekapan pengambilan urea bagi pokok jagung setelah menjalankan rawatan sulfur pada tanah beralkali bagi melihat pertumbuhan pokok. Hipotisis eksperimen ini pula adalah pH tanah alkali akan menurun disebabkan rawatan S, jesteru meningkatkan kecekapan pengambilan nitrogen dari urea oleh pokok. Eksperimen ini dijalankan di dalam rumah kaca. Reka bentuk eksperimen ini adalah reka bentuk blok sempurna (RCBD). Sebanyak 3kg tanah dan satu pokok digunakan bagi setiap pasu dan empat kadar sulfur digunakan (0g, 2.5g, 5g, dan 10g per 1kg tanah). Selepas sebulan, sumber nitrogen dalam bentuk baja urea diletakkan pada tanah. Baja urea diletakkan pada dua kadar (0g, dan 120kg/ha) dan biji benih jagung ditanam. Baja P dan K diletakkan pada kadar yang optimum bagi setiap pasu. Pokok akan dituai pada hari ke 35 selepas penanaman. Berat basah dan berat kering semua bahagian pokok direkod. pH tanah bagi setiap pasu juga ditentukan. Kandungan nitrogen

dan sulfur di dalam tanah dan di dalam pokok juga ditentukan. Dalam eksperiman ini, terdapat interaksi antara sulfur dan urea pada pH tanah. Hasil eksperimen ini menunjukkan bahawa terdapat penurunan pH tanah yang akan memberi kesan pada kecekapan pengambilan urea oleh pokok. Perbezaan yang ketara ditunjukkan oleh rawatan S15 berbanding rawatan yang lain pada kandungan nitrogen di dalam tanah. Jangkaan eksperimen ini adalah rawatan S akan meningkatkan kecekapan baja Urea yang digunakan. Peratus kandungan nitrogen yang tinggi juga memberi kesan pada peningkatan kecekapan pengambilan nitrogen yang tinggi. Kadar pertumbuhan pokok juga bertindak balas sesuai dengan kadar sulfur yang digunakan. Sebagai kesimpulan, aplikasi sulfur dan urea menunjukkan interaksi pada pH tanah, dan memberi kesan yang positif pada berat kering pokok, ketersediaan nitrogen di dalam tanah dan kecekapan pengambilan nitrogen oleh pokok.

CHAPTER 1

INTRODUCTION

Alkaline soil can be defined as a soil with high pH, which is more than 7. It has a poor soil structure and a low infiltration capacity. The derivation of the name came from the alkali metal group of elements which is the sodium belongs and that can induce basicity. This type of soil is also referred to as sodic soils. Alkaline soils usually occur in arid and semiarid region which has low rainfall and contain less clay. In terms of agriculture, alkaline soils are difficult to take into production. This is because it has low infiltration capacity and the number of crops that is tolerant to surface water logging is limited. Plants that are growing in alkaline soils are often smaller in size because of water and essential nutrients for plants are unable to penetrate the soil.

The sources of soluble salts in the soil are mostly of various proportions of the cations magnesium, sodium, calcium and anions sufate and chloride. The complication of high pH is because of the accumulation of calcium carbonate at some level of the soil profile. These accumulations are referred to as being calcareous. When these layers are shallow, roots of many plants have problem in growing.

Ammonia and ammonium-based N fertilizer that has been applied at any surface can cause nitrogen loss in form of ammonia gas to the atmosphere via ammonia volatilization. Urea and fluids containing urea has the greatest potential for volatilization to occur such as urea and ammonium nitrate. The conditions that affect volatilization are relevant across climates and regions. Most volatilization from urea

normally occurs during a two- to three-week period after application of fertilizers. The volatilization will depend on the rate of urea hydrolysis and the rate of ammonium converted to ammonia gas. One of the factors for this process to occur is soil moisture and precipitation. At the time of fertilization and distribution of fertilizer, the moisture conditions are the most important factors that could cause volatilization to occur.

Other main factor is the soil pH value. High pH in the soil can cause higher rates of volatilization by increasing the soil concentrations of ammonia dissolved in soil water. The application of urea fertilizer could temporarily increase the soil pH value. The rise in pH would increase the rate of ammonium conversion to dissolved ammonia, which increases the supply of dissolved ammonia available for volatilization. That is why urea fertilizers volatize more than nitrogen fertilizers.

When the soil has high value of pH, some of the essential elements that are needed for plant growth are less available. With this condition of the soil, it cannot be solved by applying N, P, K fertilizer to overcome the nutrient deficiency. However, the application of sulphur will lower down the soil pH, and thus, will improve the availability of nutrients. This happens when the sulphur undergoes oxidation process via microbial activity to reduce the pH.

Therefore the general objective of this study is to determine the effect of sulphur treatment under alkaline soil towards the effectiveness of nitrogen uptake by maize plant. The specific objectives of this study are:

1. To observe the urea efficiency in maize plant under sulphur treatment in alkaline soil.

2. To observe the growth of maize plant grown on alkaline soil with S treatments.

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