EFFICIENT USE OF UREA AS NITROGEN FERTILIZER FOR MATURE OIL PALM IN MALAYSIA

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362

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For good oil palm growth and production, heavy fertilization is required especially with nitrogen (N). Based on the current area under oil palm, it is estimated that the N fertilizer requirement exceeds three million tonnes N a year. Currently, urea is mostly used in compound fertilizers for oil palm.

Urea has the added advantage of high N concentration (46%), reducing its costs of transport, handling and storage vis-à-vis other inorganic N fertilizers. Thus, applying urea straight on coastal and peat soils is cost-effective and widely accepted. However, its use on inland soils is most slow, due to concerns over the volatilization loss of ammonia.

This article describes an effective technique for direct urea application to oil palm and assesses the economics of its use for mature oil palm in Malaysia.

FIELD EVALUATION

Field trials were conducted by MPOB in collaboration with the research agencies of the major oil palm plantation groups for six years to compare the agronomic effectiveness of urea and ammonium sulphate fertilizers for mature oil palm. The palms were planted on various soils and under different climatic conditions. Two methods of application - to the weeded circle and overall broadcast were compared.

Three N fertilizers were used: ammonium sulphate (AS), standard granular urea (SGU) - 2.9 mm, and forestry grade urea (FGU) – 6.9 mm. Twelve trials (selected for being the most responsive to N) were used to compute the relative agronomic effectiveness (RAE) of urea to AS. The factors that affected the efficiency of applying urea fertilizer were identified.

AGRONOMIC EFFECTIVENESS OF UREA

The performance of urea and AS fertilizers on the FFB yields of mature oil palm on various soils and environmental conditions is shown in *Table 1*. The two sizes of granular urea were both effective as AS in producing high yield on the two soil types. Overall, broadcasting FGU was more effective than SGU on inland soils such as Bungor series.

The RAE of urea was computed based on the mean FFB yield obtained during the trial period (*Table 1*). The RAE for AS is taken at 100%. On inland soils, the average RAEs of SGU was 98%, and for the FGU 101%. Generally, the RAE of urea was similar to that for AS on both soil types.

The urea fertilizers performed much better on the coastal alluvial soils (*Table 1*). The mean RAE for SGU and FGU was 14% more than that by AS. However, even on some of the marginal inland soils such as the lateritic Batu Anam series, both urea granular sizes performed respectably (with RAE 95% and 91% for SGU and FGU, respectively).

Overall, based on their RAEs, urea was considered as effective or even better than AS (on certain soils and environmental conditions) for yield (*Table 1*). This finding is in agreement with Kwan (2002), who found urea to be as effective as AS on an inland Sabah soil. Earlier, Lim *et al*. (1985) had reported poor performance of urea, but this could be due to the smaller size urea (prilled) used as compared to the bigger granules now available and used in this study.

OVERALL BROADCAST APPLICATION

N fertilizers, in particular FGU, should not be applied in the weeded circle position. Overall broadcast method was clearly the superior method of application and is recommended for urea use.

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TABLE 1. MEAN FFB YIELD AND PERCENT RAE OF UREA AND AMMONIUM SULPHATE ON INLAND AND ALLUVIAL SOILS (overall broadcast application)

Soil Class/type	Estate Location		FFB yield (t $ha^{-1}yr^{-1}$)			% RAE+	
		Control	AS*	SGU	FGU	SGU	FGU
Inland							
Rengam	Jasin	21.18	26.55	26.25	24.12	101	92
Lanchang	Petaling	26.76	28.80	25.55	27.36	94	96
Rengam	Labu (Seremban)	25.08	29.51	27.46	32.19	96	104
Serdang	Dengkil	27.37	27.51	25.71	27.85	99	108
Bt. Anam	Segamat	18.67	28.23	26.54	28.19	95	91
Bungor	Bahau	27.76	33.52	29.24	33.24	91	101
Akob	Ulu Bernam	19.25	24.25	23.14	23.33	96	104
Rumidi	Sandakan	15.43	19.15	18.37	19.48	102	106
Paliu	Ulu Dusun	23.45	27.17	27.00	25.75	98	106
Merit	Mukah	18.69	22.48	23.39	25.52	107	101
	Average:					**98**	**101**
Alluvial							
Carey	North Carey	27.11	27.55	26.19	28.26	101	105
Briah	Teluk Intan	25.66	20.09	30.33	29.99	127	122
	Average:					**114**	**114**

*Notes:
AS - ammonium sulphate ; SGU- standard granular urea; FGU - forestry granular urea; RAE – relative agronomic effectiveness.

$$^{+}\%\ \text{RAE (Urea)} = \frac{\text{FFB Yield (Urea)}}{\text{FFB Yield (AS)}} \times 100$$

In the field, urea should not be applied in a band or pocket or even broadcast in the weeded circle to avoid a high concentration of fertilizers. FGU seems much more sensitive to the soil pH when applied into a restricted area. To be efficient, bigger urea granules should be broadcast overall and not only in the weeded circle.

FACTORS AFFECTING UREA EFFICIENCY

Urea should not be applied to the weeded circle if the soil pH is 4.8. In such situation, the efficiency can be expected to decrease by more than 10%. Water deficit and humidity can also reduce the efficiency of urea in the weeded circle during the first three days after fertilization.

High humidity normally occurs with high soil water saturation and high temperature, factors likely to increase the volatilization losses by urea. Water deficit can also affect the nutrient movement and plant uptake and eventually increase ammonia loss through volatilization. To improve the efficiency of application, timing it with the occurrence of rainfall is important.

The soil organic matter can have positive effects on the exchange sites for ammoniacal nitrogen, thus reducing volatilization. Drought and cover aggressiveness greatly reduce the efficiency of urea applied. Since the effect of drought was not important with SGU, overall broadcast application should be adopted, particularly for inland areas with a dry season.

Soil cover aggressiveness contributed greatly to the inconsistent efficiency of using urea. Therefore, eradication of *Mikania* is important, and soft weeds, such as *resam halus* (*Nephrolepis),* allowed as natural cover to improve and conserve soil moisture.

ECONOMIC ANALYSIS

The cost benefit or cost to revenue ratios (C/R), for both urea and AS were computed (*Table* 2). At the current market price for AS and urea (price ratio

TABLE 2. COST TO REVENUE RATIOS (C/R) OF UREA AND AS FOR MATURE OIL PALM ON INLAND AND ALLUVIAL SOILS

N fert.	Soil type	Fert. rate (kg $p^{-1}yr^{-1}$)	FFB yield (t $ha^{-1}yr^{-1}$)	Gross return+ (RM ha^{-1})	N Fert. appln. cost# (RM ha^{-1})	Other Fert. cost (RM ha^{-1})	C/R ratio
Urea	Alluvial	1.00	28.87	10,104.50	230.61	470.00	0.069
	Inland	2.00	25.99	9,096.50	413.49	630.00	0.115
AS	Alluvial	2.19	27.83	9,740.50	255.68	470.00	0.075
	Inland	4.38	26.72	9,352.00	452.96	630.00	0.116

Notes:

+ Based on FFB price of RM 350 t^{-1}

Based on current fertilizer price: AS @RM 455 t^{-1}
Urea @ RM 1120 t^{-1}
Price ratio AS:urea – 1:2.46

C/R ratio: total fertilizer cost to gross return.

1:2.46), urea for mature oil palm on alluvial soils gave the least cost ratio (C/R). However, on inland soils both AS and urea gave similar returns.

Since the prices of AS and urea fertilizers fluctuate over time, the choice of N source should depend on their price ratio. As a guide, at a price of 1:2.40, urea is preferable for both inland and alluvial soils.

CONCLUSION AND RECOMMENDATION

Based on field trial results, the RAE of urea was consistently high, at times even higher than that of AS, especially for FGU, on various soils and environmental conditions.

Urea, as N fertilizer for mature oil palm, is cost-effective, especially on alluvial soils. When the price ratio of AS to urea is less than 1:2.40, urea is more cost-effective than AS on both inland and alluvial soils.

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