

YIELD RESPONSE OF TOBACCO TO DIFFERENT LEVELS OF NITROGEN AND POTASSIUM ON ALLUVIAL SOIL IN KELANTAN

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RINGKASAN

Semua paduan-paduan treatment ternyata memberikan hasil yang lebih tinggi dibandingkan dengan control. Tindakbalas Niterojan terhadap hasil adalah lurus (linear). Takat Niterojan sebanyak 50.4 kg ha⁻¹ menunjukkan hasil lebih tinggi yang nyata dibandingkan dengan takat niterojan di antara 33.6 ke 44.8 kg ha⁻¹, walaupun tiada kenyataan perbezaan yang didapati pada takat Niterojan yang kemudian. Tiada kerosakan, mengikut pandangan kasar terhadap mutu daun balai (curved leaves) dengan menggunakan 50.4 kg N ha⁻¹. Tiada perbezaan hasil yang didapati di antara takat potassium yang berlainan. Paduan treatment yang paling baik ialah pada takat antara 39.2 kg N ha⁻¹ dan 168.1 kg K₂O ha⁻¹, yang mana nilai ini lebih kurang didapati daripada "differentiation of the multiple regression equation".

INTRODUCTION

The yield of tobacco in the United States of America (USA) and Japan usually exceeds 2,000 kg ha⁻¹ compared to 800 kg ha⁻¹ in Malaysia and India. The level of nitrogen applied in the USA and Japan ranges from 30–50 kg ha⁻¹ (AKEHURST, 1968). In Malaysia the application of nitrogen is at 20 kg ha⁻¹ and this may account for the low yield of tobacco recorded in this country.

COLLINS, HAWKS & KITTREL (1974) found that the quantity of nitrogen applied to tobacco usually has more effect on the yield and quality than any other nutrients. For most soils on which tobacco is grown in USA the best results are obtained with 62–84 kg ha⁻¹ nitrogen. GARNER, BACON, BOWLING & BROWN (1934) noted that nitrogen is the key element and it has important effects on the development of the tobacco leaf and on its properties after it has been cured. CROUS (1971) also reported that nitrogen is the most critical major nutrient in the production of flue cured tobacco.

Potassium is the main constituent of the tobacco ash (AKEHURST, 1968). LOVETT (1959) reported that increasing the levels of applied potassium resulted in increases in the leaf area and leaf weight per unit area of the flue cured tobacco. He also observed that high level of potassium has beneficial effects on the colour of the flue cured leaves and lower level of potassium produced leaf that turned brown rapidly when curing temperature was raised to 120°F. ANON (1955) recorded that high quality leaves were obtained with high potassium application. COLLINS *et al.* (1974) found that the amount of K₂O applied should not exceed 157 kg ha⁻¹ although it was reported that the tobacco farmers in North Carolina were applying K₂O in excess of 224 kg ha⁻¹.

The objective of the trial is to study the effect of varying nitrogen and potassium levels on the yield of tobacco on alluvial soil.

MATERIALS AND METHODS

The trial was conducted on alluvial soil in Kelantan in the 4th tobacco season, 1975. The site was previously planted with padi during the padi main season.

The levels of N in kg ha⁻¹ applied as 50% NO₃-N and 50% NH₃-N were: N₁ = 33.6; N₂ = 39.2; N₃ = 44.8; N₄ = 50.4.

The levels of K₂O in kg ha⁻¹ applied were: K₁ = 134.5; K₂ = 168.1.

The control was CCM Tobacco Mixture No. 8 applied at 20.2 kg N ha⁻¹ and 134.5 kg K₂O ha⁻¹.

The plot size was 2.7 m x 2.3 m. The treatments were arranged in four replications in a factorial randomized complete block design. The Virginian tobacco variety used was McNair 14. The tobacco plants were planted in a 0.9 m x 0.4 m spacing giving a total population of 23,910 plants ha⁻¹.

The basal fertilizer was applied one day before transplanting at 2/3 the total tested nitrogen ha⁻¹, 168.1 kg P₂O₅ ha⁻¹ and 1/3 the total tested potassium per hectare. Side application of fertilizer was applied 2 weeks after transplanting at 1/3 and 2/3 the total tested nitrogen and potassium respectively.

The cultural practices from sowing to harvesting of the crop were carried out as described by LEONG (1975). Topping of the tobacco plants was carried out when 30% of the population have flowered (LEONG, 1975a).

First harvesting commenced 45 days after planting. The total number of harvest was 10 with each round at 3-4 days intervals. The dry weight and the total leaf number per plant were recorded.

The leaves were cured in the barns of the Perbadanan Perusahaan Pertanian Sdn. Bhd., Kelantan.

RESULTS AND DISCUSSION

Significant differences in the dry weight yield were detected between the treatments (*Table 1*). Increasing nitrogen application resulted in significantly higher yield than the currently recommended level of CCM fertilizer mixture No. 8. This shows that the currently recommended level of 20 kg N ha⁻¹ is too low for maximization of tobacco yield in Kelantan. Yield response to nitrogen was linear indicating that increasing N application up to 50.4 kg ha⁻¹ would result in positive yield response. The N level at 50.4 kg ha⁻¹ gave a significantly higher yield, though no significant differences in yield were detected between N levels of 33.6 to 44.8 kg N ha⁻¹ (*Table 2*). This confirmed the importance of nitrogen and the need to increase the level applied per hectare in order to increase the yield noting that there should be no deterioration in the visual quality of the cured tobacco leaves. There was no significant difference in the yield between the two levels of potassium.

The NK interaction was significant and a response surface equation was obtained:

$$Y = 1477.70 - 4.11N - 54.02K - 6.45N^2 - 49.45NK$$

where Y = yield (kg ha⁻¹)

N = level of nitrogen

K = level of potassium

On differentiating the multiple regression the optimum combination of N and K₂O was obtained at N = 39.0 kg ha⁻¹ and K₂O = 154.7 kg ha⁻¹. This combination approximated to the treatment at 39.2 kg N ha⁻¹ and 168.1 kg K₂O ha⁻¹. This was confirmed by the DMR test where the treatment was one of the preferred treatment combination (Table 3).

No significant differences in the mean leaf number per plant were detected for all the treatments and their interactions.

TABLE 1. ANALYSIS OF VARIANCE OF THE EFFECTS OF DIFFERENT LEVELS OF NITROGEN AND POTASSIUM ON THE LEAF NUMBER/PLANT AND THE DRY WEIGHT (KG HA⁻¹) YIELD

Source of variations	df	F value	
		Av. leaf no./plant	Dry weight yield (kg ha ⁻¹)
Treatment	(8)	1.7133 N.S.	7.2915**
Treatments vs. Control	1	1 N.S.	33.6697**
N	(3)	1.1454 N.S.	3.1793**
N Linear	1	—	4.2591*
N Quadratic	1	—	3.6169 N.S.
N cubic	1	—	1.6618 N.S.
K	1	1 N.S.	1.1861 N.S.
NK	(3)	2.8916 N.S.	4.6460*
KN _L	1	—	0.2047 N.S.
KN _Q	1	—	3.7006 N.S.
KN _C	1	—	10.0327**
Mean		19.4	1640.4
S.D.		1.0	128.6
C.V. %		5.2	7.8

N.S. Denotes non-significance.

* Significance at 5% level.

** Significance at 1% level.

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TABLE 2. TWO WAY TABLE OF MEAN YIELD IN KG HA⁻¹ AND THE LEAST SIGNIFICANT DIFFERENCE TEST FOR THE DIFFERENT LEVELS OF NITROGEN AND POTASSIUM

		N ₁ (33.6 kg ha ⁻¹)	N ₂ (39.2 kg ha ⁻¹)	N ₃ (44.8 kg ha ⁻¹)	N ₄ (50.4 kg ha ⁻¹)	K Mean
K ₁ (134.5 kg ha ⁻¹)		1628	1587	1734	1689	1660
K ₂ (168.1 kg ha ⁻¹)		1675	1732	1512	1918	1709
N	Mean	1651	1659	1623	1804	1684
		L.S.D. _{0.05}	Between main effect mean of N		=	133
		L.S.D. _{0.01}			=	180
		L.S.D. _{0.05}	Between mean of N x K interaction		=	188
		L.S.D. _{0.01}			=	254

TABLE 3. DUNCAN MULTIPLE RANGE TEST (P = 0.05) FOR THE INTERACTION EFFECTS OF NITROGEN AND POTASSIUM ON THE FLUE CURED (DRY WEIGHT) YIELD IN KG HA⁻¹

Treatment combinations	Mean yield
42	1918
31	1734
22	1732
41	1689
12	1670
11	1628
21	1587
32	1512

Side scoring of numericals indicates non statistical significance.

1st Number (Nitrogen levels in kg ha ⁻¹)			2nd Number (Potassium levels in kg ha ⁻¹)		
1	=	33.6	1	=	134.5
2	=	39.2	2	=	168.1
3	=	44.8			
4	=	50.4			

SUMMARY

All the treatment combinations yielded significantly higher compared to the control. The yield response to nitrogen was linear. The level of nitrogen at 50.4 kg ha⁻¹ yielded significantly higher than the levels of 33.6 to 44.8 kg ha⁻¹ with no significant differences between N treatments up to 44.8 kg N ha⁻¹. No deterioration of the visual quality of the cured leaves was observed at 50.4 kg N ha⁻¹. No significant yield difference was detected between the different levels of potassium. The best treatment combination was at 39.2 kg N ha⁻¹ and 168.1 kg K₂O ha⁻¹ which approximated to the value obtained from differentiation of the multiple regression equation.

REFERENCES

- AKEHURST, B.C. (1968). *Tobacco*. Longman Group Limited, London pp. 114–141.
- ANON (1955). Fertilizing flue cured tobacco. Tobacco Research Board of Rhodesia and Nyasaland (pamphlet).
- COLLINS, W.K., HAWKS, S.N. & KITTREL, B.U. (1974). Efficient fertilization of tobacco. *Extension leaflet 194, North Carolina Agriculture Extension Service, U.S.A.*
- CROUS, P.J. (1971). Effects of soil fumigation and forms of nitrogen on growth yield, value of tobacco grown on two soil types *Agron. J.*, 63(2), 221–224.
- GARNER, W.W., BACON, C.W., BOWLING, J.D. and BROWN, D.E. (1934). The nitrogen nutrition of tobacco *Tech. Bull. U.S. Dept. Agric.*, 414.
- LEONG, A.C. (1975). Tobacco cultivation in Kelantan (Mimeo.).
- LEONG, A.C. (1975a). Effects of spacings and varieties at two levels of topping on the yield and quality of flue cured Virginian tobacco (Mimeo.).
- LOVETT, W.J. (1959). Studies on the metabolism of detached tobacco leaves. I. The influence of potassium nutrition on the growth of tobacco and the quality of cured leaf. *Aust. J. Agric. Res.*, 10, 27–40.

Appendix 1. The National Tobacco Board Planting Schedule 1975, Kelantan

Crop Season	Soil Groups	Bris Soil		Other Soil Groups	
		Sowing	Planting	Sowing	Planting
First		15.11.74	15.01.75	15.11.74	15.01.75
Second		02.01.75	02.03.75	05.02.75	05.04.75
Third		05.03.75	05.05.75	15.03.75	15.05.75
Fourth		05.04.75	05.06.75	15.04.75	15.06.75