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Short Scientific Reports

Fertilizer Recommendation for Coconut Based on Mitscherlich-Bray Equation

Fertilizer application tailored to the needs of optimal production is the current strategy in crop management. In evaluating crop responses in relation to soil tests Mitscherlich–Bray equation is used for phosphorus and potassium and further extended to nitrogen by Mackay, Mac Echern and Bishop (1963), Ranganathan et al., (1969), Balasundaram et al., (1977) and Biddappa and Patnaik (1977). In the present study applicability of Mitscherlich–Bray equation for site specific fertilizer recommendation for coconut is attempted.

Information from a 15 year old field experiment conducted with three coconut varieties, *viz.*, West Coast Tall (WCT), Chowghat Dwarf Orange (CDO)×WCT, and WCT×CDO with three levels of fertilizers, M_0 – control; M_1 – 500 : 500 : 1000 and M_2 – 1000 : 1000 : 2000 g N, P_2O_5 and K_2O per palm per year respectively is used for the study.

Soil mineralisable nitrogen (Subbiah and Asija, 1956), available phosphorus (Bray–I) and available potassium 1 N NH_4 OAc were estimated by conventional procedures (Jackson, 1967).

The response function for yield was found to be linear for WCT and curvilinear for CDO×WCT and WCT×CDO in the limits of fertilizer levels tried. The attainable maximum yield (A) (Table I) was determined by plotting log yields (four year average) against the reciprocal of dose of nutrients (x) and extrapolating to $1/x \dashrightarrow 0$ (Ranganathan et al., 1969). The percentage yields were calculated by using maximum yields and yield attained at M_0 and M_1 levels (Y). By substituting the percentage yield and soil test value (b) in the equation, *viz.*, log (A–Y) = log A – C_1b – cx, the efficiency of soil form of nutrient (C_1) and of the fertilizer form (c) were calculated. In the discussion, the soil test values (b) at M_0 level were taken for computation of efficiency of soil form of nutrient towards yield contribution (Table II). From the table II, which gives the values of efficiency of native soil available nutrients for N, P and K, it can be inferred that the soil form of nutrients are more efficient than the added form of nutrient except for nitrogen in the case of hybrids. The variation realised in yield among cultivars over a range of soil test values (Table I) may be due to soil–fertilizer–nutrient–genotype interactions.

Baule equivalents of soil and fertilizer form of nutrients were calculated by dividing the Mitscherlich efficiency constant of 0.301 by respective efficiency factors C_1 or c (Table II). Baule units were obtained by dividing the soil test values by Baule equivalent of soil form

Table I. *Yield trend among cultivars and soil test values*

Cultivar	Yield of nuts/palm/year				Soil test value at M_0 treatment (ppm)		
	Theoretical maximum yield	Realised yield					
		M_0	M_1	M^2	N	P	K
WCT	83.4	12.3	48.8	64.5	73.0	16.5	19.2
CDO×WCT	80.5	21.8	75.7	78.0	71.8	19.6	18.8
WCT×CDO	61.4	9.3	53.1	57.1	78.8	9.4	17.4

M_0 – Control; M_1 – 500 : 500 : 1000 g and M_2 – 1000 : 1000 : 2000 g N, P_2O_5 and K_2O respectively.

Table II. *Efficiency coefficients of soil (C_1) and fertilizer (c) form of nutrients*

Cultivar	Nutrient	C_1	Baule equivalent for soil nutrient	Baule unit	C (at M_1 level)	BE for fertilizer nutrient	C_1/C
WCT	N	0.00095	316.8	0.23	0.00063	480.8	1.5
	P	0.00428	72.0	0.23	0.00063	480.8	6.8
	K	0.00359	83.8	0.23	0.00031	961.7	11.6
CDO × WCT	N	0.00191	157.3	0.46	0.00218	138.4	0.9
	P	0.00701	42.9	0.46	0.00218	138.4	3.2
	K	0.00731	41.2	0.46	0.00109	276.7	6.7
WCT × CDO	N	0.00090	333.0	0.24	0.00160	188.7	0.6
	P	0.00757	39.7	0.24	0.00160	188.7	4.7
	K	0.00400	75.8	0.24	0.00080	377.4	5.0

of nutrients. Normally for the production of 93.75 per cent of maximum yield 4 Baule units of soil nutrient (N or P or K as the case may be) is considered essential. The calculated Baule units range from 0.23 to 0.46 for soil N, P and K. The deficiency of Baule units of soil nutrients has to be made good to realise a targetted yield through fertilizer application, which could be computed by multiplying Baule equivalent of respective fertilizers with the difference between the desired Baule unit and the observed Baule unit of the soil. Under the frame work of the results obtained in this experiment, just to realise 50 per cent of maximum yields, CDO×WCT and WCT×CDO require only 75 : 75 : 150 and 144 : 144 : 288 g respectively of N, P_2O_5 and K_2O per palm per year (Table III). To obtain 87.5 per cent of maximum yield, the fertilizer application can be tailored to two thirds of the M_1 dose for CDO× WCT and just the M_1 dose for WCT× CDO. For 93.75 per cent of maximum yields CDO×WCT require the M_1 dose and WCT×CDO need two thirds of the M_2 dose of N, p_2O_5 and K_2O. This further confirms the superiority of the CDO×WCT hybrid in tapping and better utilization of soil and fertilizer nutrients. Thus the fertilizer application can be manipulated for a targeted production of nuts and also according to the economic status of the cultivator at a given time. The exceptionally higher rates of fertilizer dosage needed for WCT is due to the fact that the yield trend is linear under the doses tried and does not obey the requirements of Mitscherlich–Bray equation.

Table III. *Fertilizer recommendation based on Mitscherlich–Bray equation*

Cultivar	Nutrient	Baule units Fertilizer to be applied per palm/year			
		1 (50 %)	2 (75 %)	3 (87.5 %)	4 (93.75 %)
WCT	N	370	851	1332	1813
	P_2O_5	370	851	1332	1813
	K^2O	741	1703	2665	3626
CDO × WCT	N	75	214	352	490
	P^2O_5	75	214	352	490
	K_2O	150	427	704	980
WCT × CDO	N	144	333	521	710
	P_2O_5	144	333	521	710
	K_2O	288	666	1043	1420

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REFERENCES

BALASUNDARAM, C. S., CHANDRAMANI, R., HAMEED KHAN, H. and SHANMUGAM, M. 1977. Pour une meilleure utilisation de l 'Azote parle riz grace A l' etude des responses de la culture aux caracteristiques analytiques de sol. *Agronomic tropicale.* 32: 360–363.

BIDDAPPA, C. C. and PATNAIK, S. 1977. The correlation of nitrogen and phosphorus soil tests with response of paddy through modified Mitscherlich-Bray eqation. *Mysore J. agric. Sci.* 11: 28–33.

JACKSON, M. L. 1967. *Soil Chemical Analysis.* Prentice Hall of India Pvt. Ltd., New Delhi.

MACKAY, D. C. MAC ECHERN, C. R. and BISHOP, R. F. 1963. The relation of soil test values to fertilizer response by potatoes. II. Nitrate production and nitrogenous fertilizer requirements. *Canad. J. Soil Sci.* 43: 242–249.

RANGANATHAN, V., SOUNDARARAJAN, R., BALASUNDARAM, C. S. and GOVINDARAJ, K. 1969. Studies on the applicability of of Mitscherlich-Bray equation for correlating crop responses. *Fertilite.* 33: 31–34.

SUBBIAH, B. V. and ASIJA, G. L. 1956. A soil test procedure for assessment of available nitrogen in soil. *Curr. Sci.* 25: 259–260.