Nutrient Needs of Coconut-Based Fodder Production Systems in Homesteads of Kerala

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An experiment was conducted in Kerala to assess the nutrient requirements of a unique coconut-based fodder production system using soil testing and crop uptake as criteria. Fodder fertilization also produced a synergistic, yield improving effect within the main coconut crop indicating that appropriate fertilization of the forage intercrop benefited the entire cropping system.

Kerala State is located at the southernmost tip of the Indian sub-continent. The area enjoys a humid, tropical climate, and all arable lands are cultivated with either food or cash crops. As such, homestead farming remains popular because of the region's limited land resources. This system is unique to Kerala and is highly intensive and diverse with a variety of crops and animals immediately surrounding the home. The different enterprises are interdependent and complementary to each other. Rearing of dairy cattle is an important subsidiary occupation within every household. However, commonly small holding sizes do not easily permit farmers to adopt large scale fodder cultivation.

Fodder crops are cultivated on 7,000 ha which produces green fodder to meet only about 2% of the total dry fodder requirement of the state. At present, Kerala has 3.5 million head of cattle which require 6.0 M t of dry fodder per year, and only 4.0 M t is available. The important sources of dry matter available are crop wastes such as paddy straw, banana pseudostems and leaves, coconut leaves, pineapple waste, jack leaves, coca waste, road side grazing, weeds, and other materials which are very poor in nutrients. There is huge scarcity of green fodder in the summer season. Besides these sources, dairy farmers depend on highly priced concentrates for feeding cattle which offset their profit to a considerable extent. Hence, fodder cultivation will commonly find place in the existing homestead farming system. Coconut occupies a major area (0.75 M ha) in the state and the suitability of fodder crops as intercrops under coconut gardens is well established (Lakshmi et al., 1998; Pillai G.R. 1987). Thus fodder cultivation as an intercrop under coconut in homesteads is a viable alternative for the state to help fill its fodder deficit gap. This present investigation was designed to understand the nutrient requirement of a high yielding coconut-fodder cropping system and optimize its nutrient application.

Soil samples collected from the experimental area were analysed for their macro- and micronutrient status by studying nutrient sorption characteristics (Portch and Hunter, 2002). The site was a 25-year-old coconut plantation located at the Instructional Farm, College of Agriculture, Vellayani, Kerala. The coconut variety was West Coast Tall and the canopy of coconut filtered 50% of the incident solar energy to lower layers. The coconut stand was planted at a spacing of 7.5 m between palms. Excluding the 2 m area immediately around the base of palm, the remaining space was planted to guinea grass (*Panicum maximum*), a popular and nutritious, high yielding, palatable fodder crop which is tolerant to shade. The experiment was arranged in a randomised block design (RBD) with 16 treatments and three replications.

Abbreviations and notes for this article: M t = million metric tons; N = nitrogen; P = phosphorus; K = potassium; Mg = magnesium; B = boron; Zn = zinc; Mn = manganese.

Guinea fodder performance with variable nutrient doses.

Treatment levels for applied nutrients and their combinations were selected considering the most limiting nutrients, annual nutrient removal by crops, actual soil requirement, nutrient use efficiency, nutrient losses from the soil, and yield goals. Nutrients included N, P, K, Mg, and B (plus common doses of Zn and Mn) applied to both crops within the same plot. Variable nutrient doses were imposed to guinea grass while comparing official fertilizer doses to both crops and a zero fertilization control.

The coconut-guinea grass cropping system was studied for 3 years to assess the nutrient needs of the entire system. Since coconut is a perennial crop, actual responses to coconut fertilization are generally observed from the third year onwards. Hence the results from the third year are presented here for

Table 1. Effect of K and P on the yield of guinea grass and coconut.

Nutrient levels	Green fodder yield, t/ha	Nut yield of coconut, nuts/palm
K_2O levels, kg/ha		
100	78.2	86.5
150	76.0	80.8
200	88.4	107.2
Critical Difference (0.05)	3.4	2.4
P_2O_5 levels, kg/ha		
100	78.6	87.8
150	85.8	97.5
200	78.6	89.2
Critical Difference (0.05)	3.4	2.4

	Treatments	Green fodder yield, t/ha	Nut yield of coconut, nuts/palm	Net returns, Rs./ha
1	200:150:200+Mg+B (C_1)	94.5	107.4	150,232
2	200:100:200+Mg+B (C_1)	85.7	103.1	111,180
3	200:150:150+Mg+B (C_1)	81.7	92.8	95,198
4	200:150:150+B $(C_1)_{(-Mg)}$	67.7	66.9	73,331
5	200:150:150+Mg $(C_1)_{(-B)}$	69.7	67.5	61,000
6	200:150:150+Mg+B (C_0)	65.9	50.5	26,634
7	State recommendation	62.1	47.0	64,323
8	No fertilization	20.1	18.5	20,581
	Critical Difference (0.05)	8.6	4.1	

Table 2. Effect of selected treatments on the yield of fodder guinea and coconut.

C_1 = Application of nutrients as per state recommendation to coconut.
C_0 = No nutrient application to coconut.
State recommendations = Guinea: 200-50-50 kg N-P_2O_5-K_2O ha/year;
Coconut: 0.5-0.32-1.2 kg NPK palm/year (88-57-112 kg N-P_2O_5-K_2O/ha).
Mg and B were applied at 100 and 1 kg/ha.
Zn and Mn were applied uniformly to treatments 1 thru 6 at 7 and 10 kg/ha, respectively.

both crops. Cumulative yields of 18 harvests of each crop were analyzed during the study period.

Results revealed a positive yield response to the application of P and K in guinea grass while comparing the treatment averages at individual nutrient levels (**Table 1**). Application of 150 kg P_2O_5/ha and 200 kg K_2O/ha significantly increased fodder yield to 85.8 and 88.4 t/ha, respectively. The corresponding coconut yields of 98 and 107 nuts/palm/year corresponded to guinea grass yields indicative of a synergistic effect of fodder fertilization to the main coconut crop. Moreover application of Mg and B to guinea grass positively influenced both fodder and coconut yield (**Table 2**). In the absence of Mg there was 17 and 28% yield decline in forage and coconut yields respectively. Similarly, the forage and coconut yield decline in the absence of B was 15 and 27%, respectively.

Application of 200-150-200 kg N-P_2O_5-K_2O/ha plus 100 kg Mg/ha and 1 kg B/ha to guinea grass, along with a state recommended dose of 88-57-112 kg N-P_2O_5-K_2O/ha to coconut recorded the highest yields of 94.5 t/ha of green fodder and 107 nuts/palm/year. Profitability was also highest at Rs.150,232 (US$3,700) per annum under this treatment.

Guinea fodder as intercrop in coconut gardens.

Proper fertilization of guinea fodder contributes to coconut yields.

Guinea fodder as intercrop and coconut as main crop.

Conclusion

This study has also quantified the effect of improper fertilization in homestead farming. Results indicate that skipping fertilization altogether or opting to fertilize either the main crop or intercrop alone will drastically reduce yields in both crops as well as overall farmer profitability.

The feasibility of intercropping in coconut depends upon the judicious management of the intercrop to avoid excessive intercrop competition. Addressing the nutrient requirements of these intercropping systems is another key to creating compatibility intercropped systems. Application of required quantities of macro- and micronutrients at the appropriate time will enhance coconut-based fodder production systems. Results indicate a large benefit to dairy farmers who adopt such guinea grass production as an intercrop under coconut gardens. BC

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