PRODUCTION MODELLING OF PINEAPPLE GROWN ON TROPICAL PEAT: NUTRIENT BUDGET AND CYCLING

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Introduction

Large-scale pineapple cultivation on peat in Malaysia is characterised by pineapple residue burning after harvesting followed by excessive fertilisation. The ever increasing cost of fertiliser, the increasing awareness of the polluting effects, excessive fertilisation on the environment coupled with the greater concern about air pollution through open burning, call for not only studies on the movement of nutrients in the pineapple production system, but also the valuation of the burnt and unburnt pineapple residue management practices as these may help in justifying the practices. The objectives of the study were to quantify the movement of nutrients in pineapple production system and to conduct economic valuation of the burnt and unburnt pineapple residue management practices.

Materials and Methods

Treatments used were: (i) leaves residue removed and no fertilisation, (ii) leaves residue burnt and no fertilisation, (iii) leaves residue removed and no fertilisation, and (iv) leaves residue burnt and fertilisation. Soil sampling at the depths of 0-5, 5-25 and >25 cm was done before, during and after fertilisation stages. Phosphorus, K, Ca and Mg losses through leaching and surface runoff were estimated using the subtraction method and rainfall simulator respectively. Dry ashing and the double acid methods were used for total and extractable P, K, Ca and Mg respectively. At maturity, 3 plants were sampled from each treatment and partitioned into roots, stem, leaves, fruit, crown and peduncle and their dry weight, P, K, Ca and Mg concentrations determined. The product of the total yield/ha and farm-gate price gave the gross revenue of crop production. Cost of labour was based on the wage system practised by the estate. Farm-gate prices were used for farm materials and other inputs. Interest rate of 12% on capital was adopted. Polluter Pay Principle, the Malaysian Environmental Quality (Clean Air) Regulations, 1978 on burning of waste (Environmental Quality Act, 1974) and Air Pollutant Index (Department of Environment, 1996) were used to value pollution (Husni et al. 1998). Land Expectation Value (LEV) was used to compare the viability of the two practices.

Results and Discussion

Irrespective of treatment difference, P and Mg distribution was highest in fruit, followed by leaves, stem, crown, peduncle and roots. The order for K was fruit, leaves, stem, peduncle, crown and roots. The sequence for Ca was leaves, stem, fruit, crown, peduncle and root for the unburnt and burnt without fertilisation while that of the unburnt and burnt with fertilisation was stem, leaves, fruit, crown, peduncle and root. Due to low nutrient recovery (Ahmed et al. 1998), the addition of 1.31 Mg/ha ash through burning increased P, K, Ca and Mg uptake and yield insignificantly. The estimated P, K, Ca and Mg addition (input) to the pineapple nutrient cycle for the burnt with fertilisation were 54.25, 816.48, 103.31 and 23.54 kg/ha and that of the unburnt with fertilisation were 35.56, 576.05, 100.17 and 4.93 kg/ha respectively. In terms of inputs, fertiliser contributed the highest amounts (kg/ha) of P (35.56), K (557.09), and Ca (62.48). Ash contributed the highest amount of Mg (18.60 kg/ha) under the burnt practice. The total amounts of P, K, Ca and Mg loss under the burnt with fertilisation were 18.44, 300.45, 66.06 and 8.63 kg/ha and those of unburnt with fertilisation were 23.19, 244.88, 45.79 and 5.49 kg/ha. Leaching constituted the single major source of P, K, Ca and Mg loss for both the burnt with fertilisation (11.57, 183.69, 59.15 and 5.20 kg/ha) and unburnt with fertilisation (11.70, 143.40, 40.52 and 2.60 kg/ha) due to inefficient match of fertilisation periods with optimum nutrients uptake. Second to P, K, Ca and Mg loss through leaching occurred through fruit harvest for the burnt with fertilisation (5.72, 71.61, 2.26 and 2.03). But in the case of the unburnt with fertilisation except Mg (1.62), P, K, and Ca (6.52, 51.16 and 2.66 kg/ha) loss through crop residue removal was second to leaching. With the exception of Mg, where input and output were approximately the same for the unburnt with fertilisation, a positive balance (unutilised nutrients) at the end of cropping was recorded for P, K, Ca and Mg under the burnt with fertilisation (19.71, 373.09, 29.86 and 10.95) and P, K and Ca for the unburnt with fertilisation (4.94, 266.17 and 48.24). The gross revenue of pineapple production under burning increased by RM 90.00 upon the addition of 1.31 Mg/ha ash. Costs of pollution (Gittinger, 1982) at the fines of RM 10,000.00, RM 100,000.00 and RM 500,000.00 were estimated at RM 238.25, RM 2,382.47 and RM 11,912.30. As much as RM 174.63/ha is saved during land preparation for the burnt practice (RM 44.32) compared to the unburnt practice (218.95) and these operations were the sole contributors of the difference in the total cost of production and the incremental net benefit as a whole for both practices. Land Expectation Value revealed that burning is economically viable under the fine of RM 10,000.00 but with the current fine of RM 100,000.00 and RM 500,000.00 about to be gazetted, burning is not a viable practice.

Conclusions

Substantial amounts of P, K, and Ca (particularly through fertilisation but not through ash) are added to the nutrient cycle of pineapple but are inefficiently utilised due to inappropriate fertilisation frequency. The current fine on open burning renders the practice of burning pineapple residue uneconomical. Continuous cropping under unburnt practice may lead to Mg deficiency.

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