

## Value Addition To Pineapple Residues From Zero Burning

M. H. A. Huseini and O. H. Ahmed

Faculty of Agriculture  
Universiti Putra Malaysia  
43400 UPM, Serdang, Selangor  
Malaysia

Telephone Number of Corresponding Author: 03-89466961

E-mail of Corresponding Author: huseini@agri.upm.edu.my

**Key words:** Pineapple leaves / value addition / economic viability/ tropical peat

### Introduction

Pineapple is one of the major fruits in Malaysia. The Malaysian pineapple industry employs about 7,000 workers (small holders and estate, and cannery). The industry earns between US\$19.32 million and US\$20.89 million from 'table' pineapple and canned pineapple exports, respectively (AGRIQUEST, 1999/2000). The bulk of pineapple cultivation is practiced on peat, and in the absence of effective and efficient way of recycling pineapple residues, the residues are managed through in situ open burning before subsequent replanting. However, due to the ripple effects of the 1997 fires and haze outbreak in and around Malaysia, the need to come out with an economically competitive alternative to open burning of crop residues (including pineapple residues) has in recent times been a major public concern. About 426 hectares of forestland was affected in Malaysia (Ahmad, 1999) but fires and haze related cost in this country stood at US\$ 321 million (Mohd Shahwahid and Jamal, 1999). In situ burning of pineapple residues on peat is followed by four applications of muriate of potash (KCl), China phosphate rock, and urea at 65, 135, 191, and 233 DAP, respectively. However there is poor synchrony between the release of K, P, and N and their uptake (Ahmed, 1999; Ahmed *et al.*, 2000; Razzaque, 1999). The irony is that these nutrients are being underutilized at a time when Malaysia is known to be one of the heaviest users of fertilisers (based on a unit land area) in the world even though most of the fertilisers used in the country are imported. For 1995/1996, Malaysia used 233 kg NPK ha<sup>-1</sup> fertiliser, compared with a worldwide use of only 83 kg ha<sup>-1</sup> (AGRIQUEST 1999/2000). In 1998, the fertiliser import bills for potassic, phosphatic, and nitrogenous fertilisers amounted to US\$116, US\$39 and US\$106 m, respectively (AGRIQUEST 1999/2000) Studies were conducted to: (i) Investigate the effect of the modification of the existing N, P, and K programme and residue management practice on pineapple fruit yield, (ii) Compare the economic viability of in situ decomposition of pineapple residues untouched (IDPR), the ZBT-zero burn technique, and in situ burning pineapple residues (IBPR), (iii) Quantify the amount of humic acid (HA) that could be extracted from composted pineapple leaves using 0.1M potassium hydroxide (KOH) produced from pineapple leaves and that of analytical grade (0.1M KOH), (iv) Compare the elemental composition (C, H, N, O, and S), functional groups (carboxylic, phenolic OH, and total acidity), and spectral characteristics of HA extracted from composted pineapple leaves using KOH from pineapple leaves and that of analytical grade, and (v) Investigate the potential value added agricultural products that could be produced from pineapple leaf residue

### Materials and Methods

The fertiliser programmes used were: (i) Application of N (176, 176, 176, and 176 kg ha<sup>-1</sup>), P (11, 11, 7, and 7 kg ha<sup>-1</sup>), and K (89, 89, 188, and 188 kg ha<sup>-1</sup>) fertilisers at 65, 135, 191, and 233 days after planting (DAP) (FP1), respectively (the usual practice); (ii) Application of N (176, 176, and 176 kg ha<sup>-1</sup>), P (11, 11, and 7 kg ha<sup>-1</sup>) and K (89, 89, and 188 kg ha<sup>-1</sup>) fertilisers at 65, 135, and 191 DAP (FP2), respectively, and (iii) Application of N (176, 264, and 264 kg ha<sup>-1</sup>), P (11, 14, and 11 kg ha<sup>-1</sup>) and K (89, 183, and 285 kg ha<sup>-1</sup>) fertilisers at 65, 135, and 191 DAP (FP3), respectively. The performances of these rates were studied under IDPR, ZBT, and IBPR (the usual practice). Standard procedures were used to analyze N, P, and K, and yield estimation. The Net Present Value (NPV) was used to compare the economic viability of IDPR, ZBT, and IBPR using the model of Hewitt and Lohr (1995). Standard procedures were used to produce KOH, compost, and humic substances from pineapple leaf residue

### Results and Discussion

In situ decomposition of pineapple residues without any interference (IDPR), ZBT, or IBPR did not improve fruit yield in the first rotation of the pineapple planting. Fruits yields of FP1, FP2, and FP3 under each of IDPR, ZBT, and IBPR were not statistically different. Application of N, P and K fertilisers at 65, 135 and 191 DAP (FP2) can serve as a competitive alternative to PF1 (existing fertilisation programme). Besides the fact that N, P, and K uptake and the yields of the two programmes were not statistically different, it was possible to save as much as US\$110.17 ha<sup>-1</sup> under FP2 through a reduction of N, P, and K fertilisers by 188, 176, and 7 kg ha<sup>-1</sup>, respectively. Taking into account the cost of environmental pollution associated with burning of pineapple residues, NPV analysis revealed that either the IDPR

or the ZBT practices can serve as an economically competitive alternative to IBPR. Potassium hydroxide (0.1M KOH) from pineapple leaf residue extracted 20% HA from composted pineapple leaves residue while that of analytical grade (0.1M KOH) extracted 30%, however, the elemental composition (C, H, N, O, and S), the functional groups (carboxylic, phenolic OH, and total acidity), and the spectra characteristics of the HA extracted using these extractants were generally similar. Potassium hydroxide from pineapple leaves can therefore be used to extract reasonable amount of HA without appreciably altering the elemental and functional groups constitution as well as the spectra characteristics of this humic substance. The potential of using KOH from pineapple leaves residue in humic substances therefore looks promising. Useful agricultural products such as K-humate, and K-fuvate were also produced from pineapple leaf residue

### Conclusions

The existing four times application of N, P, and K fertilisers (FP1) could be reduced to three (FP2) without sacrificing the existing average fruit yield and besides, FP2 is a cost saving a practice. As much as US\$110 ha<sup>-1</sup> could be saved (through the reduction of N, P, and K by 188, 176, and 7 kg ha<sup>-1</sup>) if adopted. Potassium hydroxide from pineapple leaf residue can be used to extract humic substances in composts

### Benefits from the study

In situ decomposition of pineapple residues with (ZBT) or without (IDPR) minimal disturbance of the residues before subsequent replanting are both economically viable. But it will be more practical if value is added to the residues so that the residues can serve as an additional source of income for farmers. On small-scale basis, agricultural products such as compost, KOH, humic acids, K-humate, K-fulvate, ash residue after extraction of KOH and humin are some of the products that can be obtained from pineapple leaves. A scale up of this study will therefore be a good omen to the Malaysian pineapple industry. Potassium hydroxide extracted from pineapple leaves residue can be used in humic substances extraction. Apart from being able to extract some reasonable amount of HA (20%), the elemental and functional groups composition and spectral characteristics of this HA compared well with those extracted with analytical grades (KOH, NaOH).

### Patent(s), if applicable:

Writing patent claims

### Stage of Commercialization, if applicable:

None

### Project Publications in Refereed Journals

1. Ahmed OH, Husni MHA, Anuar AR and Hanafi MM. 2003. Production of humic acid from pineapple leaf residue. *Journal of Sustainable Agriculture* 22 (1):113-124.
2. Ahmed OH, Husni MHA, Anuar AR and Hanafi MM. 2003. Economic viability of pineapple residues recycling. *Journal of Sustainable Agriculture* 21(4):129-137.
3. Ahmed OH, Husni MHA, Anuar AR and Hanafi MM. 2002. Effect of Residue management practices on yield and economic viability of Malaysian pineapple production. *Journal of Sustainable Agriculture*. 20(4): 83-93.
4. Ahmed OH, Husni MHA, Anuar AR and Hanafi MM. 2002. Economic viability of modifying residue management and potassium application in pineapple cultivation. *Tropical Science*. 42: 107-110.
5. Ahmed OH, Husni MHA, Anuar AR and Hanafi MM. 2002. Nitrogen and pineapple residue use in pineapple production. *Tropical Science*. 42: 174-177.
6. Ahmed OH, Husni MHA, Anuar AR and Hanafi MM. 2001. Pineapple residue management practices and fertilizer regimes: effects on P and K uptake, yield, and some economic implications. *Pertanika Journal of Tropical Agriculture Science* 24 (2): 123-129.

### Project Publications in Conference Proceedings

1. Ahmed O.H., M.H.A. Husni, A.R. Anuar and K. Ambak. 2000. Some advances in pineapple residue management on tropical peat. *Soil Sc. Conf. of Malaysia: Soils 2001*. April 17-20, 2001. Kota Kinabalu, Sabah (Abstract published).

2. Ahmed, OH, MHA Husni, AR Anuar, MM Hanafi, and SR Syed Omar. 2000. Humic substances utilization: Some recent developments. In: Extended Abstract of International Symposium on Sustainable Land Management: Paradigms for the new millenium. Organized by the Malaysian Society of Soil Science. Kuala Lumpur, August, 8-10. p 97
3. Husni MHA, Ahmed OH and Melling LJ 2000. Crop residue burning and the amendmets of the Malaysian environmental quality regulations. In: Proceedings of the Soil Science Conference Malaysia 1999 (Shamshuddin J and Fauziah I eds.). Organised by the Malaysian Society of Soil Science, Seremban Negeri Sembilan, April 21-22. 1999. Pp 306-311
4. Husni MHA, Ahmed OH, Koh SK and Melling LJ 1999. Sustainability of pineapple cultivation on peat. In: Proceedings of the Workshop on Working Towards an Integrated Peatland Management for Sustainable Development 1999. Organised by the Sarawak Institute of Development 1999, Kuching, Sarawak, 17-18 August, 1999
5. Ahmed OH, Husni MHA and Awang Noor AG. 2000. Zero-burning in pineapple cultivation on tropical peat: an alternative of burning pineapple residues?. In: Proceedings of the Soil Science Conference Malaysia 1999 (Shamshuddin J and Fauziah I eds.). Organised by the Malaysian Society of Soil Science, Seremban Negeri Sembilan, April 21-22, 1999. pp 155-161

**Graduate Research**

Name of Graduate	Research Topic	Field of Expertise	Degree Awarded	Graduation Year
Osumanu Haruna Ahmed	Towards Sustainable Management Of Pineapple Residues	Soil Fertility and Management	Ph.D	2002

IRPA Project number: 01-02-04-0320  
 UPM Research ClusterAFF  
 Project Leader Ahmad Husni bin Mohd. Hanif