

STUDIES ON THE COCONUT PALM III.

COCONUT HUSK

A. THE MANURIAL VALUE OF COCONUT HUSK ASH

M. L. M. SALGADO, Ph.D., (Cantab), B.Sc., (Lond.), Dip.
Agric., (Cantab)

SOIL CHEMIST, COCONUT RESEARCH SCHEME

INTRODUCTION

THE present paper forms the first of a series of studies on the proper utilisation of husk for manurial purposes on coconut estates planned by the Soil Chemist's Department of the Coconut Research Scheme. Husks form one of the important by-products of the coconut palm that accumulate on estates, and except where husks can be sold at a remunerative price to fibre mills, these are mostly utilised in burying in shallow trenches between rows of palms, mulching round trees after manuring in circular trenches during drought, filling up drains and low lying portions of the land, and sometimes in the preparation of ash by burning. It is the object of this series of papers to examine critically these different methods of utilising husk. The present paper embodies results of investigations relating to the manurial value of coconut husk ash and the most suitable method for its preparation.

THE PRACTICE OF USING HUSK ASH AS MANURE

The high potash content of coconut husk ash was known quite a long time ago, the earliest analyses being those of Cochran (1897)⁽¹⁾ Bachoffen and Lepine (1900), the latter quoted by Prudhomme⁽³⁾. These analyses are all based on single nuts instead of large numbers and show considerable variation as shown in Table I. Cochran recommended the burning of coconut husks and returning the ashes to the soil, and pointed out that even at that time husks were being sold for less than their value as manure. He also drew attention to the high content of sodium chloride (salt) in the ash, and felt inclined to the view that a sufficient supply of common salt must exist in the soil or be supplied to the soil for the successful cultivation of coconuts. Later Rajapakse⁽⁴⁾ quoting Bamber's analyses calculated the cash value of the manurial constituents of husk ash, and recently Croucher and Martinez⁽⁵⁾ too have referred to the possibility of using husk ash as a potash manure.

TABLE I

RECORDED ANALYSIS OF COCONUT HUSK ASH

	By Lepine	Bachoffen	Cochran	Bamber	Croucher & Martinez
Total ash, per cent. of total weight	6.08	1.63	1.94	—	—
Sodium chloride	5.59	45.95	38.17	27.6	22.53
Salts of potassium	73.69	—	—	—	—
Potash (K_2O)	—	30.71	31.23	15.5	31.28
Salts of calcium	18.42	—	—	—	—
Lime (CaO)	—	4.14	3.33	—	7.87
Magnesia	—	2.19	3.60	—	—
Calcium phosphate	0.98	—	—	—	—
Phosphoric acid (P_2O_5)	—	1.92	1.18	3.5	—
Silica	1.32	8.22	6.80	—	—
Carbonic acid	—	—	—	8.45	9.50

During the war, when potash imports from Germany were restricted, and the price of sulphate of potash rose to as much as Rs. 308·00 per ton in 1915, it is reported that potash was recovered on a large scale from husk ash and sold at remunerative prices. In Malaya where husk is not utilised for the manufacture of fibre, it is the usual practice to burn husk heaps in the field and broadcast the ashes.

In the course of advisory work it was observed that among certain estates, it was the practice to utilise a portion of the husks by conversion to ash by burning, and samples submitted for report were found to contain as much as 15 per cent. to 27 per cent. of water soluble potash as shown in Table II below:—

TABLE II
ANALYSIS OF SAMPLES OF COCONUT HUSK ASH FROM ESTATES

No.	2A	3A	4	7
Method of preparation	Burnt in open heaps	Burnt in open heaps	Slowly burnt in pits	—
Moisture %	7·11	7·99	8·29	16·42
Residue insoluble in dil. nitric acid	58·27	52·80	30·30	—
Potash (K ₂ O) water, soluble	15·66	20·89	26·93	14·83
Phosphoric acid (P ₂ O ₅) ..	1·53	1·79	1·42	—

In view of the fact that the samples show considerable variation in their potash contents, and as no accurate data were available regarding the actual amounts of manurial constituents recovered in ash, it was decided to carry out a comprehensive investigation to determine the potash content of husks and the best conditions for the maximum recovery of potash by conversion to ash.

TABLE III
DETAILED ANALYSIS OF SAMPLES OF COCONUT HUSK ASH PREPARED FROM 100 HUSKS

	(1)	(2)	(3)
	per cent.	per cent.	per cent.
Moisture	2·47	4·87	7·81
Loss on ignition (carbon)	9·98	11·37	16·22
Residue insoluble in dilute nitric acid	23·00	24·45	34·86
Potash water soluble (K ₂ O) ..	35·60	32·72	31·36
Calcium oxide (CaO)	1·86	1·95	1·10
Magnesium oxide (MgO)	2·21	1·83	1·70
Phosphoric acid (P ₂ O ₅)	2·20	1·97	2·02
Carbonates (CO ₃)	13·10	14·01	12·26
Chloride as NaCl	23·32	21·95	20·29
Sodium oxide Na ₂ O	5·74	7·12	5·54

TABLE IV
RECOVERY OF ASH, POTASH & PHOSPHORIC ACID FROM 1000 COCONUT HUSKS

	Weight of 1000 husks lb.	Weight of ash from 1000 husks lb.	Ash per cent. of weight of husks	Potash (K_2O) per cent. of ash	Total Potash (K_2O) in 1000 husks lb.	Phosphoric acid (P_2O_5) per cent. of ash	Total Phosphoric acid (P_2O_5) in 1000 husks lb.
No. 1	141.65	24.91	1.76	35.60	8.87	2.18	0.54
No. 2	135.58	25.57	1.89	32.72	8.37	1.98	0.51
No. 3	118.50	25.57	2.16	31.36	8.02	2.02	0.52
Mean	131.90	25.37	1.93	33.23	8.42	2.06	0.52

EXPERIMENTAL

Three lots of 100 husks each were selected at random from a husk heap and carefully ashed by burning in a heap on a shallow tray made of corrugated sheets; the ash was weighed and subsequently analysed, using the analytical methods described below:—

METHODS OF ANALYSIS

Potash.—Water soluble potash was determined in an aqueous extract using the gravimetric-cobaltinitrite method as described by Treadwell and Hall⁽⁶⁾. Comparisons with the volumetric cobaltinitrite-permanganate method according to Milne⁽⁷⁾ showed good agreement.

Phosphoric acid was determined in a nitric acid extract as magnesium pyro-phosphate after previous precipitation as ammonium phosphomolybdate.

Calcium was determined in an aliquot of the nitric acid extract volumetrically after precipitation as oxalate, and *magnesium* in the filtrate as pyrosphosphate.

Chloride was determined in the aqueous extract and *sodium* by the Uranyl-zinc acetate method.

The data are summarised in Tables III and IV. The ash was found to contain as much as 30 to 35 per cent. potash, and two per cent. phosphoric acid. About 8 lb. of potash was recovered from 1,000 husks.

Experiments were carried out to determine the nature of the potash compounds in husk and find out if the potash salts tend to be easily leached. Two lots of husks were immersed in water in iron drums and retted for nearly two months. At the end of this period the total volume of retting water was measured and the potash in the solution determined. The retted husks were dried, ashed, and the potash in the ash estimated. The results are summarised in Table V and it will be observed that in spite of the fact that some of the husks were not completely immersed, and the experiment a rough one, over 50 per cent. of the potash salts in the husks, which exist mainly as the chloride and the carbonate, had been dissolved.

TABLE V
SOLUBILITY OF POTASH IN COCONUT HUSKS

No.	Total ash in retted husks gms.	Per cent. potash in ash	Total potash in ash gms.	Potash in solution gms.	Total potash in original husk gms.	Per cent. of potash soluble
1	156	14.61	22.8	32.4	55.2	58.7
2	222	22.54	50.0	36.0	86.0	41.8

The husks whose analyses are shown in Tables III and IV were obtained from a heap that had been exposed for some months to the usual monsoon rains, and in view of the observations stated in the previous paragraph regarding the solubility of the potash compounds in husk, there was the possibility that a certain amount of the potash may have been leached by rain. In order to test this point, fresh husks, immediately after husking, were ashed in lots of 100 and the ash analysed as before. The husks were obtained from nuts collected from the same field (having a sandy loam soil), from which the first lot of husks whose analyses are shown in Tables III and IV were obtained.

The results are shown in Table VI below :—

TABLE VI
COMPOSITION OF THE ASH OF FRESH COCONUT HUSKS UNEXPOSED TO RAIN
(LOAMY SOIL)

No.	Total wt. of ash from 1000 husks	Per cent. Potash (K_2O) in ash	Total Potash (K_2O) in 1000 husks
5 ..	38·24 lb.	38·75%	14·81 lb.
6 ..	36·08 lb.	39·16%	14·12 lb.
Mean ..	37·16 lb.	38·96%	14·47 lb.

It will be observed from a comparison of Tables IV and VI that in fresh husks the amount of potash recovered is nearly double that of similar husks exposed to heavy rains, and amounts to about 15 lb. potash from 1,000 husks. The ash so obtained is a high grade potash manure, containing nearly 40 per cent. of potash.

As the soil type may have an influence on the potash content of husks, four lots of fresh husks from a gravelly field in the estate were ashed, and the ash analysed. The results are shown in Table VII.

TABLE VII
COMPOSITION OF ASH FROM COCONUT HUSKS UNEXPOSED TO RAIN
(GRAVELLY SOIL)

No.	Total wt. of ash from 1000 husks	Per cent. Potash (K_2O) in ash	Total Potash (K_2O) in 1000 husks
8	28·79 lb.	29·7	8·54 lb.
9	30·79 lb.	32·2	9·91 lb.
10	30·62 lb.	31·1	9·52 lb.
11	30·15 lb.	31·5	9·50 lb.
Mean	30·08 lb.	31·1	9·36 lb.

The potash content of husks from trees growing on gravelly soil is much lower than those growing on a sandy loam and amounts to about 9 lb. from 1,000 husks.

DISCUSSION

CASH VALUE OF POTASH IN HUSKS

From the data shown in the previous tables it would be of interest to calculate the cash value of husks on the basis of the potash present. To produce a ton of ash containing 25 per cent. potash it is necessary to burn about 40,000 husks from nuts of trees growing on a loamy soil, and 60,000 husks in the case of nuts from a gravelly field. A ton of this manure can be valued at Rs. 85·00 so that on the basis of potash alone, 1,000 husks of the former would be worth about Rs. 2·00, and the latter Re. 1·50. This shows how uneconomical it is to sell husks to the mills at prices below these amounts.

The ideal method of utilising husks is to bury in trenches, between palms, especially on gravelly soils, but it often happens that far more husks accumulate than can be used according to the programme of cultivations. When this is anticipated conversion of the fresh husks to ash soon after husking, can be recommended.

METHOD OF PREPARING THE ASH

It may be mentioned that the preparation of ash should be carried out under a slow fire in order to obtain the maximum recovery of potash, and high temperatures should be avoided as potash salts are likely to be lost by volatilisation. High temperatures, especially when the husks are contaminated with sand, tend to produce fused hard clinker-like masses of ash in contrast to the fine dry powder of ash when the husks are burnt under a slow fire. In order to obtain a uniform grade of ash contamination with sand and stones should be avoided. The estate samples whose analyses are reported in Table II have been considerably contaminated in this manner, as shown by the large percentage of residue insoluble in dilute nitric acid. As the ash has a tendency to absorb moisture it should be stored in a dry place.

USE OF HUSK ASH IN MANURE MIXTURES

It should be noted that, in view of the alkalinity of husk ash, it is not safe to mix it with ammoniacal manures such as sulphate of ammonia, as these would react with the loss of ammonia.

SUMMARY

1. The ash obtained from burning coconut husks is a valuable potash manure, containing about 35 per cent. potash. About 2 per cent. phosphoric acid is also present. Complete analyses of samples of husk ash are recorded.

2. As the potash of husks exposed to heavy rains tend to be leached, the ash should be prepared soon after husking.
3. Husks from trees growing on loamy soils contain more potash than in those from gravelly soils ; about 15 lb. potash per 1,000 husks in the former and 10 lb. in the latter.
4. On the basis of the potash present, 1,000 husks from a field with a loamy soil would be worth about Rs. 2·00, and from a gravelly soil about Re. 1·50.

ACKNOWLEDGMENT.

Thanks are due to my Assistant, Mr. E. Chinnerasa, for carrying out most of the analyses recorded.

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