CASSAVA FOR FUEL ALCOHOL

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INTRODUCTION

Oil supplies to Papua New Guinea are becoming increasingly more expensive and unreliable. As the country has no major oil resources of its own at present, there is a need to find alternative sources of energy, particularly fuel energy. Idealy, such sources would be renewable and also suitable for the widely variable population densities found here. One such source is ethyl alcohol made using carbohydrate (eg starch or sugar) from agricultural crops such as sugar cane, potato, sweet potato, sweet sorghum and cassava. Ethyl alcohol can be used either in a mixture with petrol (benzine) at up to one part alcohol to four parts benzine or as 100% alcohol in specially produced cars. Alcohol fuels are better than present petroleum fuels as they burn more cleanly and produce more power.

The Papua New Guinea Government has recently proposed the development of an alcohol fuels pilot plant in the Baiyer River area of the Western Highlands. The aim of this plant will be to evaluate the potential of cassava as a starch source and to identify and, hopefully, solve any problems in the manufacture of alcohol from this crop. If the pilot plant proves successful then large scale plants will be established in other suitable areas of the country.

This article is the first of a series in which the progress of the alcohol fuels project will be described. Initially, emphasis will be placed on the problems encountered in adapting cassava to commercial production methods. However, it is hoped that, through identification of improved cultivars and cultivation methods, the project will also benefit the small gardener.

There are many reasons for selecting cassava in preference to other crops, for use in this project. These include:-

1. Cassava is one of the most efficient converters of sunlight, by the process of photosynthesis, to dry matter. Therefore potential dry matter and tuber yields are extremely high.

2. The dry matter content of cassava tubers is 30-40%. This is higher than that of other root crops of comparable yield.

3. In cassava, tuber starch (the main source of alcohol) reaches levels of 90% of the

Part of this information has also been published in the Cassava Newsletter of the International Centre for Tropical Agriculture, Colombia.

TABLE 1. ALCOHOL YIELD OF SOME STARCH SOURCES IN PAPUA NEW GUINEA

Source	Crop productivity (t/ha/yr)	Alcohol yield (l/t)	(l/year)
Cassava	65	180	11 700
Potato	55	120	6 600
Sugarcane	45	67	3 015
Sweet potato	45	126	5 625
Sweet sorghum	35	55	1 925

total tuber dry matter content. The potential yields of alcohol from various starchy crops are shown in Table 1.

4. All the cassava tuber crop is available for use. No tuber material is required for replanting.

5. Cassava stems can be used as planting material; leaves as a source of protein in livestock rations, and both stems and leaves as a heat source for the alcohol producing process.

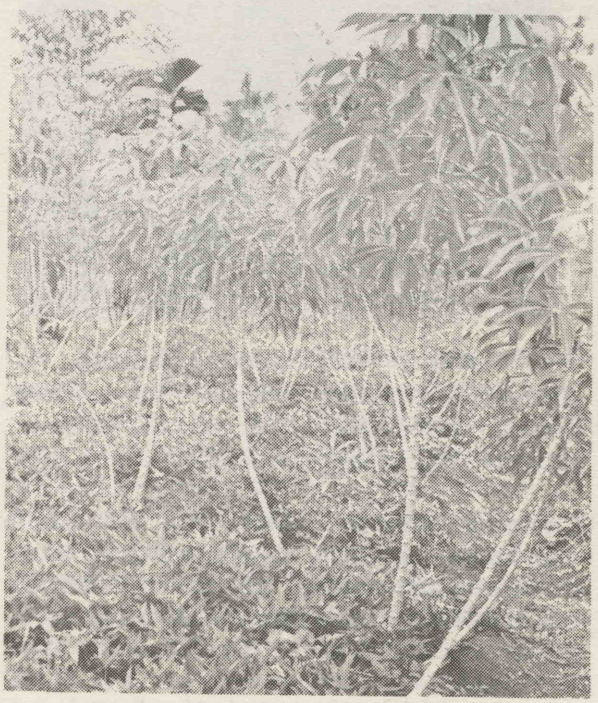
6. Cassava requires only one harvest per year which lowers overall cultivation costs in comparison to those of comparable root crops.

7. The technology for production of alcohol from cassava is suitable for relatively small production units. Thus it is suitable for smaller, inland communities in some parts of Papua New Guinea.

8. At present, there are few alternative economic uses for cassava to compete for the available production. This is an important point when other sources of carbohydrate include sugar cane potato and sweet potato.

SITE SURVEY

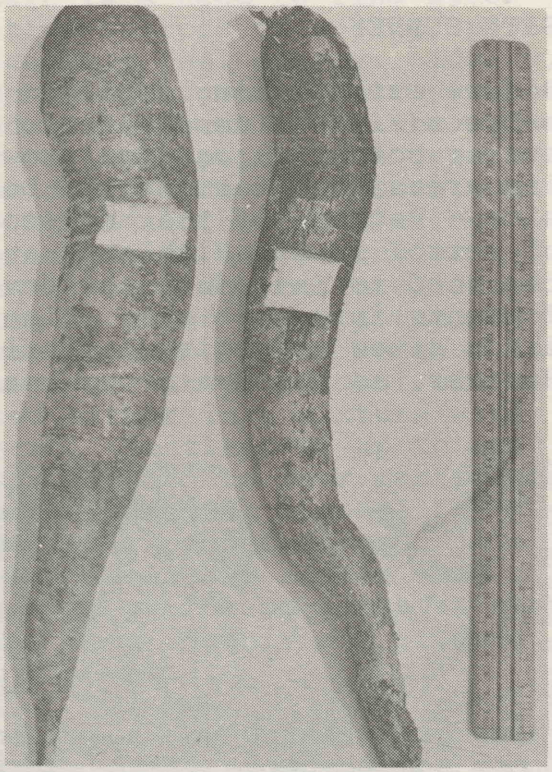
Before establishing a pilot project, it was necessary to survey potential cassava growing areas to determine the best site. Because of the high cost of petrol in the Highlands and the need to introduce new developments into this area, Highlands sites were given priority. However, as cassava grows best



Cassava growing with sweet potato in a traditional garden at Baiyer River

below 1 500 m above sea level and with less than 2 000 mm of rain per annum, the number of suitable sites in this area was limited. The Arona, Wahgi, Baiyer River, Bartree and Sugu Valleys were found to have the right conditions and were surveyed to evaluate potential cassava production levels and local cultivation methods.

While sweet potato (kau kau) is the most important staple food crop in the Highlands, cassava becomes increasingly important at lower altitudes (1 000-1 200 m) in the Baiyer River and



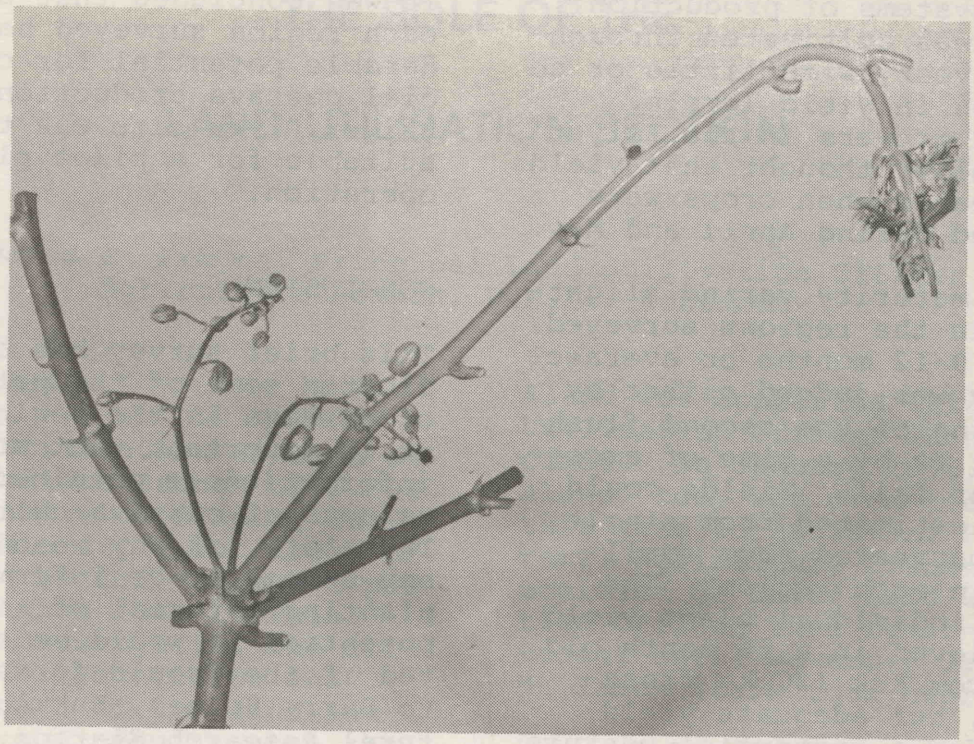
White and yellow cassava tubers. The yellow tuber (right) has a dark, ridged skin while the white tuber (left) has a smooth skin.

Chimbu areas. The low level of cassava in the diet at higher altitudes seems to be a matter of dietary preference rather than cultivation problems, as cassava is often grown at 1 500 -1 600 m by people from the Baiyer River region. Cassava tubers are also used, to a lesser extent, as a pig food but there was no evidence of the use of cassava foliage in animal diets.

Two distinct cultivar types were found throughout the region, with tubers either yellow fleshed and sweet or white fleshed and relatively bitter. However, no tubers appeared to have high levels of cyanide. There was considerable variation in leaf shape, size and colour, stem colour, and tuber size and shape within each type. However, there has been no systematic classification of cultivars in this region of Papua New Guinea.

Both types of cassava flower profusely throughout the year and produce fruit but, although the fruits contain seed, there have been no measurements made of its ability to grow. It was estimated that although yellow fleshed cultivars were lower yielding than white fleshed ones, they were often preferred

Cassava growing on a sole crop block. Note the spacing and range of plant ages.



Cassava flowers developing from the 'saddle' of a flowering branch.

in human diets, due to their better taste and cooking qualities. Traditional cassava cooking methods in the region are generally simple, involving either roasting or boiling, although small quantities may be mixed with meat or tinned fish before boiling or frying.

Apparently, little cassava is converted to flour or fermented to improve its nutritional value.

Traditional cassava cultivation systems were similar throughout the region with cassava being intercropped with banana, sugar cane and kau kau. Often, cassava was grown under shade, and produced long stems with few flower branches but proportionally high numbers of sucker branches (without flowers). Land preparation was minimal, except where mounds or raised beds were prepared. In this case, cassava was usually planted along the mound sides to reduce soil erosion. Excessively long (50-100 cm) planting setts were planted, usually at the rate of 2 to 3 per hole. Spacing varyied from close (30 cm) to wide (120 cm). There was no evidence of fertilizer application at any site and there were instances of mineral deficiency especially of potassium. Generally, roots were harvested only as required for food and very little was sold in the local markets. There was no evidence of the existance of cassava storage systems.

In the Baiyer River area, however, there was an increasing tendency to use improved planting methods to grow cassava as a semi-cash crop. In these systems, single setts (20-30 cm) cut from mature wood, were planted either on flat beds or on mounds in small blocks at a spacing of approximately 90 x 120 cm. Weeds were controlled by hand, but no fertilizers were applied. Cassava was not intercropped but was rotated with kau kau, maize and legumes.

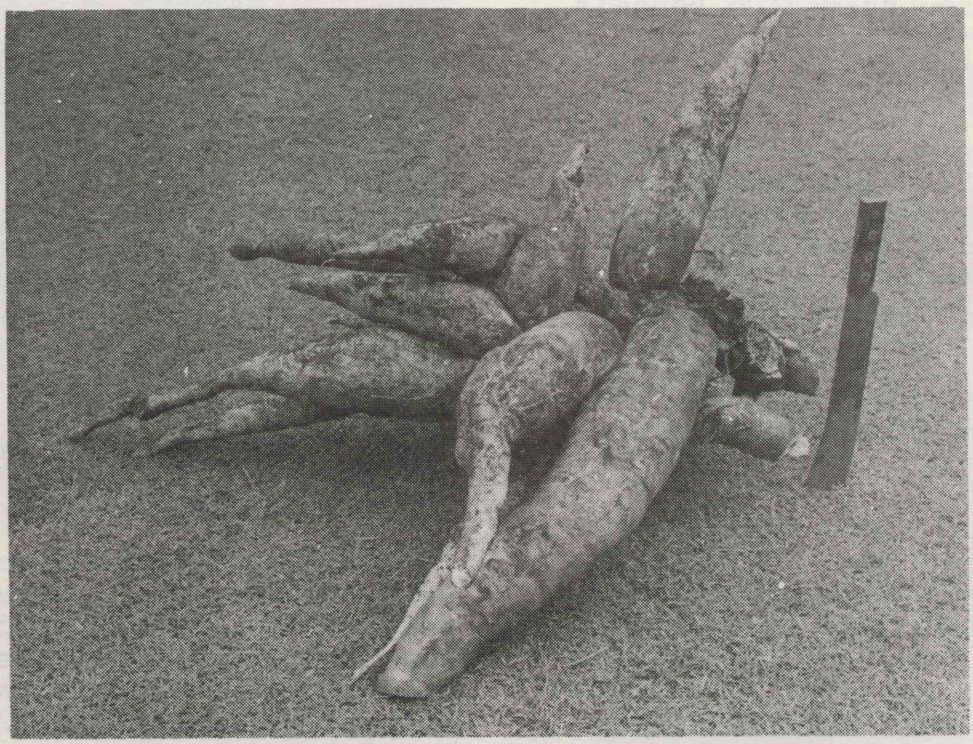
In all systems of production, cassava was cultivated throughout the year, with little or no variation in yield levels. However, growers in the Baiyer River Valley thought that yields were greater when crops were harvested during April and May.

Time to maturity varied slightly within the regions surveyed, but was 9-12 months on average. Maturity was judged either by the drying of the second flush of fruit or by a time of excessive leaf fall. Yields could only be estimated from single plants harvested from small groups in each region. The highest individual plant yield was achieved in a 16 month old plant from Kuk (30 kg fresh tubers), but adequate yield levels for a commercial venture were indicated at all sites.

It was concluded that although each region surveyed had considerable potential for commercial cassava production, the Baiyer River site was the most suitable for a pilot plant operation.

CONCLUSION

This brief survey has only indicated some of the potential of cassava in the region and it is important that more information is obtained on all aspects of cassava cultivation. Therefore, if any readers have any comments, or information on planting material of high yield potential it would be appreciated if they could forward them to Barry Holmes, Kuk Agricultural Research Station, P.O. Box 339, Mount Hagen, W.H.P.



Example of large tuber development in cassava grown in the Western Highlands. The approximate weight of this root was 30 kg.