

PRELIMINARY CASSAVA YIELD TRIALS ON
SOILS OF THE ZANDERIJ FORMATION

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Summary

After assessing the latent interest in cassava growing in Surinam, two preliminary experiments with four selected clones are described; one on an unbleached sandy soil, the other on a sandy loam soil.

Vegetative growth was better on the sandy loam soil. Fresh root production of clone 2195 was unsatisfactory on both soils, and so was its total starch yield. When harvested after 15 months, fresh root yields tended to be higher than after 12. Clone Bitter IV combined fair root production with a starch content superior to the other clones. On the sandy soil starch content dropped between 12 and 15 months after planting.

Introduction

Cassava, *Manihot esculenta* Crantz, is indigenous in Surinam. Its roots are the main source of carbohydrates for the Amerindians and the Bushnegroes, inhabiting the rain forests of the interior and together constituting approximately 15% of the total population. In the coastal plain the Javanese cultivated an acreage of some 300 ha in 1969. The ways in which cassava and cassava products are used in Surinam are surveyed by Reynvaan and de Vos (1954) and by Ostendorf (1962).

There has long been a latent interest in establishing a more extended cassava culture, due to the following circumstances:

- Cassava may be used instead of rice or wheat as a starch source in the production of alumina from bauxite; 6,000 tons of flour per annum are expected to be needed in the near future to fulfil local requirements (Anon., 1972).
- Cassava roots are of increasing importance as constituents of feed for pigs and ruminants. Expansion of the beef-cattle industry and pig-farming, together with partial substitution of imported feedstuff by locally grown cassava are being stimulated by the government.
- Possibilities are being studied to replace part of the (imported) wheat flour

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for bread production by cassava flour.

— Eventually, exports of cassava pellets to the European Common Market may be considered. Recent data show greatly increasing demands, particularly in the Netherlands and Germany (Phillips, 1974).

Evaluation of the possibilities for large scale cassava growing in Surinam is rather difficult since research on the crop has been very limited. Since 1969 a small collection of cassava cultivars has been propagated and evaluated at CELOS (van Marrewijk et al., 1972). Part of the collection was obtained from the Agricultural Experiment Station, Paramaribo and consisted of local clones and introductions mainly from Indonesia. Additional material was imported from Brazil, Venezuela and Colombia and new local clones were collected by the author. Observations in trial plots and the results of a comparative yield trial (van Marrewijk, 1973) led to the ultimate selection of four clones for further testing. The results of two yield trials with these clones are presented below.

Materials and methods

At the recently cleared experiment farm of Coebiti, with different soil types of the Zanderij formation, two similar trials were conducted, one on a sandy loam, the other on an unbleached sandy soil. The local clones Bitter IV and Bitter V were compared with the accessions 2062 and 2195 from Venezuela. Clones Bitter IV and 2062 are erect types with firm stems, whereas clones Bitter V and 2195 have a bunchy appearance and thin branches. In clone 2062 side branches are scarce and will develop only at 150 cm or more above ground level; in the others branching is more abundant and usually starts at about 50 cm.

Each trial consisted of two complete blocks surrounded by guard rows. Individual plots comprised seven rows of four plants, spaced 1 x 1 m. Of each plant three adjacent rows were harvested 12 months after planting. Of the four remaining rows one served as a guard for the three to be harvested three months later. Harvesting was done in such a way that the trials could be regarded as split plot designs. No tillage took place; Gramoxone was used to kill the kudzu cover present and the plant hills were slightly rooted. Cuttings were planted in May 1972 in the middle of the long rains. Fertilizer was applied immediately upon planting and again half a year later, and consisted of 60 kg N/ha, 74 kg K₂O/ha, 60 kg P₂O₅/ha and 5 kg MgO/ha, applied as NPK-compound (15.-15.15) and sulphate of potash-magnesia.

During growth, plant performance was observed and plant height was measured. Harvesting was in May and August 1973, and yields of fresh roots was measured. Starch content was determined according to the extraction method of Krochman and Kilbride (1966).

Results

Large differences in vegetative growth were observed between crops on the two soil types. On the sandy loam the plants of all clones were distinctly sturdier and taller than those on the sand and showed fewer symptoms of water shortage (shedding leaves). The differences in plant height, which ranged from 80-100 cm for all clones, are illustrated in fig. 1. The difference between the erect types and the bunchy types are clearly demonstrated. From fig. 1 it can

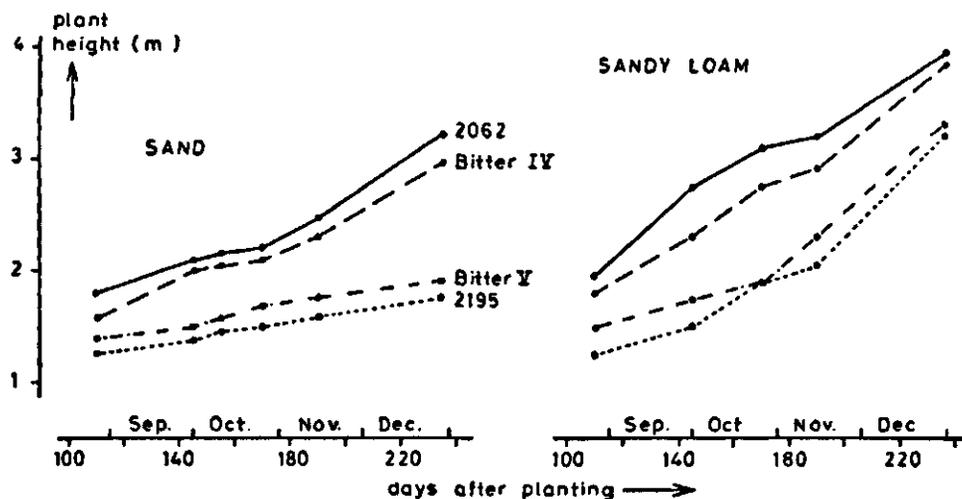


Fig. 1 Growth of four cassava clones on two soils of the Zanderij formation.

also be inferred that the growth rate was low in the dry period between August and mid-November, but improved after the rains had started. Only clones Bitter V and 2195 on the sandy soil behaved exceptionally in this respect; they continued to grow very slowly. By the end of the short rains (February 1973) all clones were attacked by *Cercospora cassavae*, a fungus causing necrotic leaf spots followed by heavy shedding of the leaves. The plants recovered soon after the rains had stopped.

Fresh root yields, subjected to an analysis of variance, showed that on the sandy loam soil clones differed significantly ($0.01 < P < 0.05$), and the planting-to-harvesting period had a less significant influence ($0.05 < P < 0.10$). On the sandy soil these effects were reversed; in neither trial an interaction between clones and growth period was found. The nature of these effects is depicted in table 1, where fresh root production, averaged over the two replicates, is shown. Clone 2195 is a distinctly poor yielder in comparison with the other clones.

Table 1 Equivalent fresh root yield of cassava on two soils, 12 and 15 months after planting (tons/ha)

Clone	Sandy loam			Sand		
	12	15	average	12	15	average
2062	35.8	44.2	40.0 a*	33.7	48.2	41.0 ab
2195	24.9	22.0	23.5 b	26.5	34.6	30.6 b
Bitter IV	38.8	45.8	42.3 a	39.2	44.0	41.6 ab
Bitter V	37.5	56.7	47.1 a	44.7	55.3	50.0 a
Average	34.3	42.4	38.3	36.0	45.5	40.8

* Figures in the same column followed by identical letters do not differ significantly at the 5% level.

As for the starch percentage, on the sandy loam soil a less significant effect of the growth period was found, but clones did not differ ($P > 0.10$). On the sandy soil clone Bitter IV had a significantly higher starch content than the other clones; starch content decreased highly significantly ($P < 0.01$) from 12 to 15 months after planting (see table 2). Interaction did not reach significance.

Table 2 Average starch content of unpeeled cassava roots on two soils, 12 and 15 months after planting (% w/w)

Clone	Sandy loam			Sand		
	12	15	average	12	15	average
2062	23.0	24.3	23.7 a*	29.1	23.7	26.4 b
2195	24.0	22.9	23.5 a	30.2	26.8	28.5 b
Bitter IV	25.5	26.5	26.0 a	36.0	29.1	32.6 a
Bitter V	21.1	22.8	22.0 a	28.3	22.5	25.4 b
Average	23.4	24.1	23.8	30.9	25.5	28.2

* see table 1

Combining fresh root yield and starch content, total starch production per plot was calculated. Though not presented in detail the figures show that on the sandy loam clone 2195 produces significantly less than the other clones, the same effect being less significant on the sand. On the sand no effect of the planting-to-harvesting period was found; on the sandy loam the effect was significant at the 10% level in favour of harvesting after 15 months. No interaction could be proved.

Summarizing the statistical calculations, it can be concluded that:

- clone 2195 had an inferior production level compared with the other clones, which did not differ from each other in terms of both fresh root yield and

total starch production. Among the other three clones Bitter IV was superior because of its higher starch content.

- on the sandy loam soil all three production characteristics, i.e. fresh root yield, starch percentage and starch yield, tend to profit from harvesting after 15 months instead of after 12. On the sandy soil, however, fresh root yield increased when harvesting was delayed three months, but as starch content decreased considerably, total starch production at the two harvest times did not differ. In this case harvesting after 12 months should be preferred, since less bulk weights has to be handled to obtain the same amount of starch and because of the gained time.

Discussion

At the second harvest on sandy loam root rot was found in all clones and was most severe in clone 2195. On the sandy soil rotten roots were observed only for clone 2195. It therefore appears that this clone is rather susceptible for root rot and that a heavier soil texture induces this phenomenon. The heavier texture may be connected with waterlogging, which is known to impede proper cultivation on the clay soils of the coastal plain (Hendriks, 1956; van Marrewijk et al., 1972). The occurrence of root rot could be one of the main reasons for the observed clone-effect on yield, as it was more pronounced on the sandy loam soil than on the sand.

Cassava trials on sandy loam soils of the savannah region were also conducted by Stahel and Müller (1933), mainly with the local clone Boeroetiki. They found that in consecutive plantings on non-fertilized plots fresh root yields 14 months after planting dropped from 17 tons/ha in the first cropping to 9.5 tons/ha in the second. The third crop, harvested after 18 months, yielded 11.5 tons/ha. From another source (Anon., 1933) newly cleared plots are reported to yield about twice as much as plots which had laid fallow for two years after clearing. These yield reductions can be attributed primarily to a loss of organic matter. Therefore the results of the present experiment, on a recently cleared area, should not be accepted as to represent the productive capacity of the soils; this would require further investigations.

The soils of the Zanderij formation are chemically poor, which makes fertilizer application indispensable, particularly under continuous crop cultivation. It has been reported that phosphorus and probably nitrogen had a positive effect on root production, whereas potassium and lime seemed to be of minor importance (Anon., 1931). In a later experiment, however, Boeroetiki and four clones from Indonesia yielded only slightly more than the control after applying 33 kg N/ha and 144 kg P_2O_5 /ha as Ammophos (Anon., 1933). The amounts of fertilizer applied in our experiments are to be considered as basic amounts since conclusive data are lacking. Further fertilizer experiments may reveal optimum amounts for cassava on these soils.

Harvesting in our experiments was after 12 and 15 months. Hendriks (1953) found on brown sandy soils of the Old Coastal Plain that five of the eight clones tested stopped root growth after six to eight months, producing 15—22 tons/ha fresh roots; the three other clones continued growing after 12 months and produced 33—40 tons of fresh roots per ha. In a concurrent trial one of these clones, Zoet 1, produced 48.5 tons/ha 14 months after planting.

Generally speaking, fresh root yields in our experiments were fair, except for clone 2195, although it should be remembered that plots were rather small (12 m² per subplot). Starch content tended to be higher on the sandy soil, and in fact was only acceptable for clone Bitter IV, particularly if harvested after twelve months.

The trials described in this paper should be regarded as a first step towards a research programme for cassava on the soils of the Zanderij formation and hence the experimental design, with only two replicates, was not very distinctive. Prospects for cassava growing on these soils would seem promising, however.

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