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Editorial Note

During the past few years, cassava cultivation has aroused great interest due to its possibilities of utilization in human and animal nutrition and for industrial purposes. Numerous investigations are being carried out to determine the most adequate production and processing techniques for cassava exploitation. Thus a great amount of important literature has been produced which should be disseminated among the cassava workers' network.

Since we believe that the objective of the Cassava Newsletter *is to serve as an effective channel of communication between CIAT's Cassava Program and those who are interested in research on this crop, we invite you to submit technical notes, advances of the development of new technologies, events, theses, uses, and any other type of information that you feel should be communicated to your fellow cassava workers.*

We would also like to thank those people who kindly contributed to this issue.

Please send your contributions to the following address:

Cassava Information Center
CIAT
Apartado aéreo 6713
Cali, Colombia

The Editors

Conferences, Seminars, Workshops

Workshop Participants Discuss Evaluation of Promising Cassava Varieties

The first Workshop on Evaluation of Promising Cassava Varieties in Latin America and the Caribbean was held in Cali, Colombia, May 10-14, 1982. Participants from Cuba, Dominican Republic, Haiti, Mexico, Paraguay, Brazil, Peru, Ecuador, Colombia, and the cassava staff at CIAT attended this important event, which was sponsored by the International Development Research Centre and organized by CIAT.

Representatives of each country presented papers which reflected the advance and current state of cassava research and cultivation in their countries, which are considered as pioneers in cassava research.

Discussions centered on the results, constraints, and mechanisms of cooperation; methods for agronomic evaluation of promising materials; and the difficulties of certification of seed. The bases for creating a Latin American group that would serve as a center for the periodic evaluation of research in cassava, the need for improved information exchange through a dynamic and frequent newsletter, and the mechanisms for a more active exchange of promising materials were also discussed.

Highlights in research included the release of variety CMC-40, outstanding in eight participant countries and currently a commercial variety in Cuba, Haiti, Colombia, and Brazil. This variety is also known as Mantiqueira in Brazil and Madame Jacques in Haiti. CMC-40 has now been disseminated to the rest of Latin America, following excellent results in Colombian evaluation trials with this variety.

The proceedings of this workshop will soon be available.

Cassava Toxicity and the Thyroid Gland

The Workshop on Cassava Toxicity and the Thyroid Gland and Aspects of Research and Public Health was held at the headquarters of the International Development Research Centre (IDRC) in Ottawa, Canada, May 31- June 2, 1982.

This workshop was organized by Dr. John Gill, Director of the Health Division of the IDRC, and Dr. R. Ahluwalia was in charge of the general coordination of this event, which was sponsored by the IDRC.

Topics covered were cassava and endemic goitre, public health and nutritional aspects of endemic goitre and cretinism, cassava production and utilization, the use of cassava in animal feeding, trends in genetic research on cassava, cassava processing, and nutritional education.

The proceedings will be published by the IDRC late in 1982.

Methodology: Quick Estimation of Dry Matter Content of Cassava Roots Possible Using Rapid Evaluation Technique

Clair H. Hershey

The dry matter content of cassava roots is of critical importance to its quality and its market acceptability. For nearly all cassava uses, but particularly for fresh eating, a high percentage of dry matter is desirable. Among the materials held in CIAT's world germplasm collection, considerable genetic variation exists as regards percentage of dry matter, from a level of less than 20% dry matter to over 40% (evaluated under CIAT-Palmira conditions).

Growing conditions, especially temperature and rainfall patterns, can have a strong influence on dry matter content. However, it is a relatively highly heritable characteristic, apparently multigenically controlled with predominantly additive gene effects. Consequently, when breeding cassava, selection for dry matter content can be highly effective.

The standard laboratory method for determination of dry matter content involves a simple calculation of the proportion of dry weight of an oven-dried sample relative to its fresh weight. This method is too time-consuming for the large number of samples which need to be evaluated in a breeding program. Moreover, a drying oven is often not convenient to the selection site.

Another methodology, which compares the relationship between specific gravity (calculated with weight of a sample in air and in water) and dry matter content of roots, has been widely adopted as a rapid evaluation method. Although faster and more convenient than oven drying, considerable time is required for preparation and weighing of samples, which limits the usefulness of this method to the middle and later stages of selection, where the number of samples is reduced.

Salt Solution Method

To estimate dry matter content in cassava roots, CIAT has developed a modified rapid evaluation technique that requires a minimum of materials and can be carried out even at the field level. This rapid evaluation method is based on the principle of the high relationship between root dry matter and root specific gravity, as is the previous method. However, instead of an exact measurement of the sample, specific gravity is estimated by whether the sample sinks or floats in a solution of common table salt (NaCl) in water, with a known specific gravity.

In the field, three medium-sized roots are chosen from the harvested plot. A cork borer approximately two cm in diameter is used to take a sample, cut transversely through the center of each root. For ease of sampling, the borer may be mounted on a handle or a lever of simple design. The peel is removed from the samples and they are placed in a plastic bag, along with a tag identifying the plot number.

Samples are placed in a specially designed holder, consisting of perforated plastic tubes, closed at the bottom, with a handle. The inner surface of these tubes should be completely smooth, so as to not impede the movement of the sample up or downward.

A series of salt solutions is prepared which covers the normal range of densities for cassava roots (see table). One-liter plastic beakers are ideal for this purpose, but any container of similar capacity could be used. To simplify the rating system, these solutions are numbered from lowest to highest concentration (from 1 to 6) with a container of unsalted water before No. 1. Pre-weighed packets of salt to be used in making the series of solutions can be prepared prior to evaluation, so that the process is not impeded at this point.

Samples are then passed through each solution, beginning with the water to wash off any surface dirt, until all of the samples have floated. Each of the three samples is given an individual rating based on the solution in which it first floats to the surface.

Ratings are then averaged to give a mean rating for the plot. For example, if two samples floated in solution 2 and the third in solution 3, the plot rating would be 2.33. Selection can be made on the basis of these crude ratings, or the ratings can be converted to an approximate dry matter content on the basis of the formula: dry matter = $0.0358X + 0.1915$, where X = mean rating in salt solutions.

Approximately 250-300 samples can be passed with less than a 10% change in

Concentrations of NaCl, corresponding specific gravity and equivalent dry matter content of cassava roots

Solution Code	NaCl Concentration (g/l solute)	Specific Gravity (20° C)
1	50	1.0347
2	100	1.0680
3	150	1.1002
4	200	1.1316
5	250	1.1623
6	300	1.1926

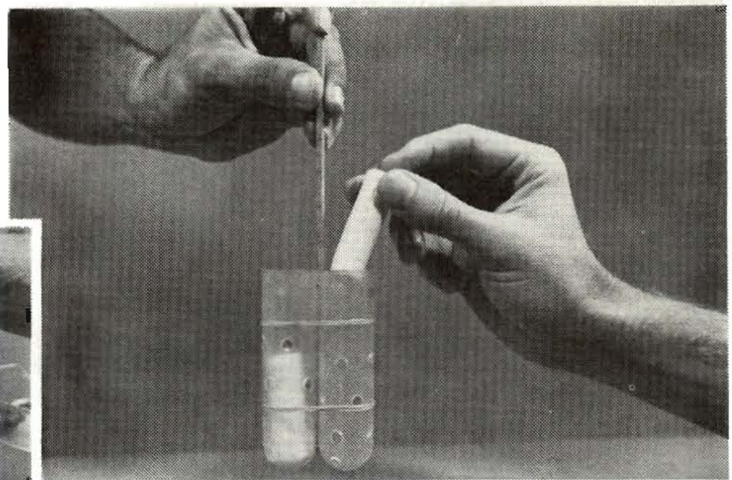


Photo 1. Placing the sample in the holder for testing in the different solutions.

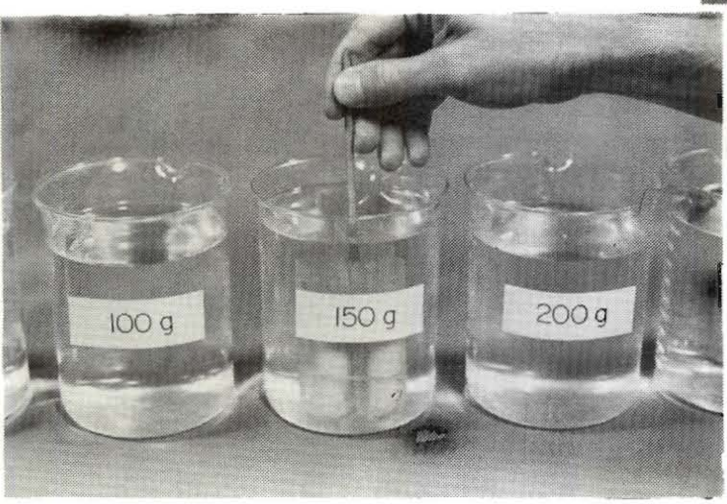


Photo 2. Solution in which the samples sink.

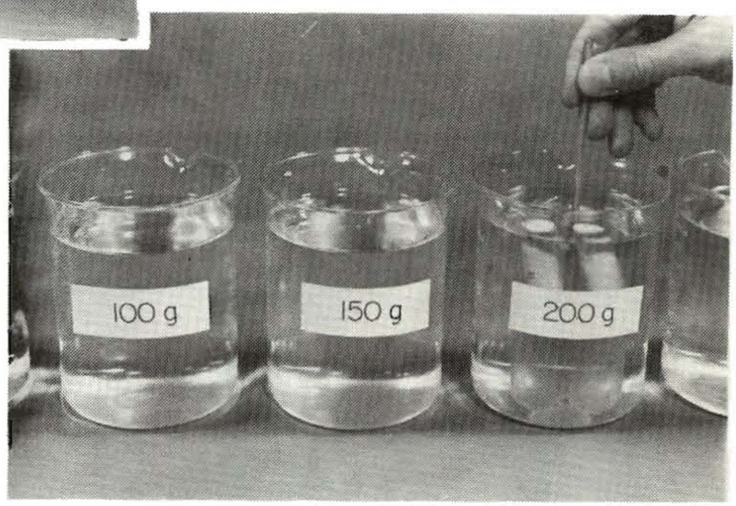


Photo 3. Solution in which the samples float.

the NaCl concentrations of the solutions. Solutions should be changed periodically to avoid erroneous readings.

Comparison of Rapid Evaluation Techniques

To compare the rapid method of evaluation in salt solutions to measurement of specific gravity by weighing in air and in water, a test was conducted using a harvest sample of three plants per plot; 113 plots. A random sample of 3-5 kg of roots from each plot was weighed in air and in water. From the same sample, three medium-sized roots were subsampled with a cork borer and rated using the test described above. A highly significant correlation was evident between the two evaluations (r = 0.86**).

Effectiveness of Method in Selecting for Breeding

During the past two years, the rapid evaluation technique has been tested as a methodology for selecting for dry matter content in selected trials at CIAT, Palmira and in Media Luna, in the north of Colombia. The method was proved effective in this practical breeding program.

In two different studies, one at Palmira and the other at Media Luna, preliminary selections were done by the salt solution method while evaluations of the yield trials, harvested one year later in each case, were done using the method of weight in air and weight in water. Linear correlations between the two trials were 0.62** and 0.56**, respectively.

Applications

The rapid screening technique based on floating of root samples in a series of salt solutions is recommended for the early stages of selection in a cassava breeding program where large numbers of samples need to be analyzed. Modifications can be easily made to suit individual program needs, in sampling methodology or number, and specific gravity of salt solutions used.

For example, one could use a single solution which represented the lowest acceptable root specific gravity. Samples which float in that solution would be rejected, and those that do not float would be subjected to further selection criteria. This "accept or reject" approach would be most appropriate in the F_1 stage where very large numbers of individual plants need to be evaluated.

In the latter stages of selection, where a reduced number of genotypes are being evaluated, more precise measurements for root dry matter content are recommended.

CASSAVA INTERCROPPING

D. E. Leihner

This article is a summary of a CIAT publication of the same title, which will contain complete information on the concepts introduced here. This book will be available, in Spanish and English, by the end of 1982.

Cassava is of American origin, but today it is cultivated in tropical Africa, Asia, and America. Adapted to a wide range of ecological conditions, cassava is known for its tolerance to low soil fertility, drought, and pests. This is why the crop continues to hold an important position in traditional tropical cropping systems, particularly on small farms.

Cassava is often found in mixed stands, grown with a variety of other food or cash crops. On the basis of his own experience, the traditional farmer adopts this mixed cropping system in order to reduce the risk of crop failure, stagger production times, make the best use of land and labor resources, and provide a varied diet.

Intercropping is practiced in different ways. **Mixed intercropping** is the simultaneous growing of crops in an undefined, irregular arrangement, whereas in **row intercropping**, a well-defined planting pattern is followed. **Strip intercropping** is the simultaneous growing of crops in strips wide enough to allow independent cultivation but sufficiently narrow to induce crop interactions. Finally, **relay intercropping** is the planting of crops in a well defined time sequence leading to a partial coincidence of crop cycles. Recent estimates indicate that 40% or more of the cassava grown in America and at least 50% of that grown in Africa is intercropped. In Asia this percentage is likely to be lower. Characteristic crop combinations and sequences have been developed in each region, with cassava often the last crop at the end of relay intercropping systems. The most complex of the cassava intercropping systems is found in Africa, in the homestead gardens of rural farming families.

Yield advantages in intercropping result from a modification of crop competition. When crops that grow over similar periods of time are intercropped, differences in their morphology may reduce the competition in space ("instantaneous" competition). On the other hand intercropping species with different growth duration may diminish competition in both space and time ("long term" competition).

Cassava, a long season crop, is slow in its initial development; therefore intercropping a short-duration crop may increase the biological efficiency of the system as a whole. Similarly, at the end

Management and Evaluation of Cassava Intercropping Systems

of its cycle, cassava does not completely utilize all available growth factors, which allows successful intercropping at this late stage as well.

Although they fulfill the needs of small farmers, traditional cassava intercropping systems are frequently characterized by low productivity. This results from the combination of inadequate plant types with inappropriate relative planting times, planting densities, and crop arrangements, as well as from low soil fertility and the absence of phytosanitary measures. To obtain a biologically balanced and productive cropping system, the selection of plant types suitable for intercropping is important. Cassava types with intermediate vigor and medium-to-late ramification appear to be ideal for intercropping. They initially impose a low level of competition on the intercrop, and yet they have high yield potential. Cassava-maize intercropping, however, requires a more vigorous cassava type, since maize is a fast-growing, dominant crop.

Grain legumes most suitable for intercropping with cassava have a growth period of less than 100 days. An erect or prostrate growth habit is best, though climbing types may be intercropped at the end of the cassava growth cycle.

An important management aspect of intercropping is the regulation of interspecific competition through control of relative planting times. Planting cassava and intercrops at the same time usually results in a well-balanced system with the greatest biological productivity and efficiency of land use. Under a developed cassava canopy, light conditions for an intercrop improve as cassava grows beyond its stage of maximum light interception. Therefore, intercropping into standing cassava should be done at the latest possible time.

Low individual planting densities are a frequent problem in traditional intercropping systems. However, an excessively high planting density of one intercrop component may result in a high competitiveness and yield of this component at the expense of the other(s). When two crops are involved, maintaining optimum sole-crop planting densities results in the most efficient utilization of growth factors and in the greatest total yield.

Most cassava types reach optimum root yield at, or even below, 10,000 plants/ha. This also appears to be the best intercropping density for cassava in combination with grain legumes and maize.

Optimum sole crop densities for grain legumes can be used for intercropping without greatly affecting cassava yields. Even in maize, appropriate sole crop densities of 20,000 to 40,000 plants/ha can be used for intercropping with cassava as long as an adequate arrangement of crops is adopted.

In a cassava sole crop, square planting (usually 1 x 1 m) gives the earliest ground cover resulting in the most efficient growth and the least competition between individual plants. However, for intercropping, the square planting pattern makes the accommodation of an intercrop difficult and leads to a high degree of interspecific competition due to the early canopy closure of cassava. Results from many trials have shown that the cassava planting pattern can be modified from square to rectangular (e.g., 2 x 0.5 m) without sacrificing cassava yield, as long as the total planting density is maintained.

For grain legume intercrops, an even distribution within the space available between cassava plantings is desirable to provide early ground cover, which minimizes both inter- and intraspecific competition. An even distribution of the legumes may be achieved with either double or triple rows between cassava plantings.

In intensely managed intercropping systems, nutrient uptake is greater than in sole crops. The maintenance of soil fertility is, therefore, of paramount importance. Cassava roots remove K in the greatest quantity, followed by N, Ca, Mg, and P. The most common intercrops, such as grain legumes or maize, also remove large quantities of N, K, and P. Selection of intercrop species that combine symbiotic N-fixing capacity, or increased P-absorption capacity due to mycorrhizal association, with adaptation to soil conditions prevalent in cassava growing areas, specifically to acid soils of poor fertility, can aid in maintaining an acceptable level of productivity.

When these nutrients are supplied through fertilization, the response of cassava, grain legumes, or maize may be very different when grown as sole crops rather than as intercrops. This means that it is necessary to study the intercropping system directly with regard to nutrient response and the establishment of optimum fertilizer levels under different soil conditions.

By observing the response of the component crops in a cassava intercropping system to applied nutrients information on the nutrient competition that occurs when the absorption zones of plants overlap can be obtained. This competition occurs more often, and at an earlier stage, in densely planted intercropping systems than in sole crops.

In practice, nutrient competition results in reduced vegetative growth and productivity, and nutrient concentration in plant tissue may be affected. Growth and yield measurement, observation of fertilizer response, and tissue analysis are therefore useful methodologies for quantification of nutrient competition.

Conditions for insect pest and disease development are generally less favorable, and the risk of economic damage is lower, in mixed crops than in pure stands, although there are exceptions to this rule. The advantages of intercropping are lower risk of epidemic outbreaks of pests and, in many cases, their reduced incidence in genetically diverse plantations. Many insect pests and diseases of cassava, and of the most frequent intercrops, are host-specific. They thrive only on one of the associated crops and not on the other(s). Additionally, weeds are generally suppressed more by high total density, rapid ground-covering intercrop plantings than by sole crops. Thus, with intercropping there is a reduced need, or even no need, for chemical pest-control inputs. Intercropping systems can be evaluated by a number of criteria. One is the "land equivalent ratio" (LER).

LER represents the relative land area that is cultivated in single culture with two or more crops, and that is necessary in order to obtain the same production as can be obtained from these crops when grown in association. The LER is, therefore, a measure of both the biological productivity of the intercropping system and its land use efficiency.

Crop production, however, is not solely a function of land area, crop management, and environment as is implied by the LER. It is also related to the duration of crop cycles, that is, the time for which land is occupied. This duration is taken into account by including the time factor in the LER concept through the use of the "area time equivalency ratio" (ATER).

In order to evaluate the degree of competition between intercrops, the calculation of a "competitive ratio" (CR) is possible. The CR is obtained by dividing the individual LER (ratio intercrop yield/sole crop yield) of one crop by that of another crop, correcting for the portion of space assigned to each crop.

The usefulness of these concepts is that intercropping can be compared with single culture. Comparing different practices within the intercropping system is also possible by using these methodologies.

Reader's Corner

Dear Sirs:

As you may have read in a recent WHO Weekly Epidemiological Record and the popular press, there has recently been a large epidemic of spastic paraplegia in a drought-stricken area of Mozambique, due to cyanide intoxication. The main source of the cyanide is almost certainly cassava.

We hope that you and your readers may be of help to us in our work on cyanide toxicity due to cassava by providing information on HCN toxicity and detoxification methods. We are especially interested in material on the effects of drought and detoxification methods on HCN levels in cassava.

Sincerely yours,

Julie Cliff
Facultade de Medicina
Universidade Eduardo Mondlane
Maputo
Mozambique

The Cassava Information Center does not have information available on this specific disease. Any references on this topic would be greatly appreciated; these may be sent directly to Dr. Julie Cliff or to our Documentation Center. However, 68 references corresponding to research papers on the effect of soil and climatic conditions on the HCN content in cassava, HCN toxicity and detoxification in cassava were sent. These included among others :

CHRONIC CASSAVA toxicity; proceedings of an interdisciplinary workshop, 1973. London, England, 1973. Edited by B. Nestel and R. MacIntyre. Ottawa, Canada, International Development Research Centre. 163p.

KAILASAM, C.; SELVARAJ, K.V.; SELVARANGARAJU, G.; KALIAPPA, R.; MUTHUSWAMY, P. 1977. Influence of soil moisture regimes under different fertilizer treatments on the HCN content of tapioca. Madras Agricultural Journal 64(6):399-401. Engl. 6 Refs.

Dear Editor:

I am the recipient of a recently funded Federal Research Project (406-USA) on "Cassava as a Crop Feed and Food in Guam and Micronesia." As far as I know, there is no published research data on cassava production and utilization in this area of the Pacific Ocean.

We are starting to identify the cultivars that are present in Guam. We would appreciate suggestions from colleagues on where we may obtain improved cassava cultivars that may be adaptable to volcanic shallow soils (pH - acid to basic), humid tropical weather conditions, and the low and moderately high rainfall of Micronesia.

Sincerely,

A.L. Palafox
Professor, CALS-AES
University of Guam
Mangilao, Guam 96913

The Cassava Information Center has sent 24 abstracts on the literature available on cassava production and utilization in Micronesia. These included among others :

CHANDRA, S. 1978. The production, marketing and consumption of root crops in Fiji. In The adaptation of traditional agriculture. Canberra, Australian National University. Development Studies Centre. Monograph no. 11:303-323. Engl.

MADDISON, P. 1979. Pests associated with cassava in the Pacific Region. Cassava Newsletter no. 5:10-14. Engl., 6 Refs.

SIVAN, P. 1977. Evaluation of local cassava varieties in Fiji. Fiji Agricultural Journal 39(2):105-109. Engl., Sum. Engl., 14 Refs.

Upon request, the Cassava Information Center can provide abstracts, as indicated above, or whole documents may be ordered through the Center's photocopy service.

Dear Sirs:

In our proposed development program for industrial use of cassava, we wish to investigate the use of cassava flour incorporated with wheat flour in bread-making. We understand that you have information on the subject in your library and have perhaps carried out research work in the field.

Yours sincerely,

A.N.D. Potts
Manager: Technical Projects
Chibuku Breweries Limited
P.O. Box 3304
Salisbury
Zimbabwe

The Cassava Information Center has sent 70 abstracts on the literature available on the use of cassava flour incorporated with wheat flour in bread-making. These included among others :

LEITAO, R.F.F.; VITTI, P.; MORI, E.E.M. 1977. A mistura de trigo, milho, mandioca e soja em pastas alimenticias. (A mixture of wheat, maize, cassava and soybean flours in food pastes). Boletim do Instituto de Tecnologia de Alimentos no. 50:187-204. Port., Sum. Port., Engl., 20 Refs.

MADE, C. VAN DER. 1973. Bread from composite flours; progress report with reference to Brazil. In Composite flour programme; development of bakery products and paste goods from cereal and non-cereal flours, starches, and protein concentrates. Documentation package. 2 ed. rev. Rome, Food and Agriculture Organization of the United Nations, Food and Agricultural Industries Service, v.1, pp. 95-96. Engl.

TSEN, C.C. 1979. Using nonwheat flours and starches from tropical crops as bread supplements. In Inglett, G.E. and Charalambous, G., eds., International Conference on Tropical Foods: Chemistry and Nutrition, Honolulu, Hawaii, 1979. Proceedings. New York, N.Y., Academic Press. pp.239-248. Engl., Sum. Engl., 12 Refs., Illus.

Mycorrhizal Associations: Important for Cassava Grown on Soils Low in P

In much of the tropics, especially in Latin America, phosphorus (P) deficiency is the main limiting nutritional factor for cassava. Many trials in Colombia and Brazil have shown that root yields can be doubled, tripled, or quadrupled by P application.

Because of its coarse and poorly branched root system cassava is an inefficient absorber of P, having one of the highest P requirements among all crops, when grown in nutrient solution. However, when grown in P-deficient soils, cassava seems less responsive to P fertilizers than many other crops, and high yields are sometimes obtained without P fertilization. For example, yields of 50 t/ha were achieved in CIAT-Quilichao with only 1.5 ppm available soil P.

This ability to grow well on some low-P soils is due to the association of cassava roots with certain soil fungi, called vesicular-arbuscular (VA) mycorrhiza. These fungi live in symbiosis with cassava, utilizing plant carbohydrates as an energy source, but supplying the plant with some essential nutrients, which are absorbed from the soil by the fungal hyphae and translocated to the roots.

This symbiotic source of supply is particularly important in the case of those nutrients that have little mobility in the soil, such as P, Zn, and Cu. Without mycorrhiza a root can absorb P only from an area about 1-2 mm around each root. For a plant with a sparse root system (such as cassava) much of the "available" soil P remains out of reach of the root system. However, mycorrhizal hyphae can penetrate the soil as far as 7 cm away from the root* and thus, increase tremendously the soil volume that can be exploited for P uptake.

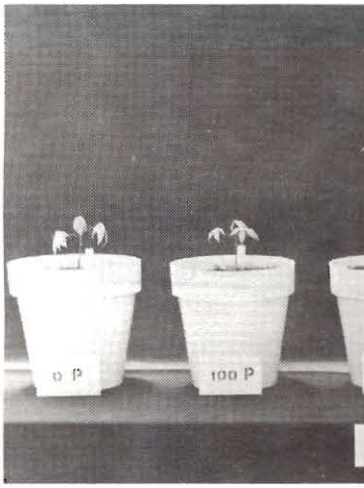
VA mycorrhiza produce hyphae in and around the roots, and form arbuscles and vesicles inside the root cortex. Phosphorus absorbed by the external hyphae of the fungus is released to the plant roots in the arbuscles where interchange of substances between host and fungus occur.

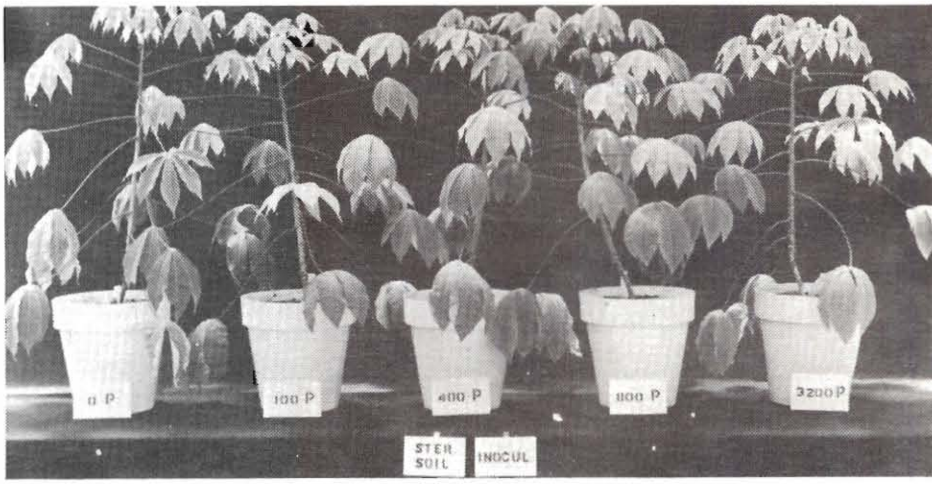
VA mycorrhiza are naturally present in most soils, but large differences in efficiency exist among the 70-odd species that have presently been identified. Some soils may have a low population of VA mycorrhiza or the mycorrhiza present may not be very efficient in absorbing soil phosphorus. Other soils may have a highly efficient mycorrhizal population.

The photos show that when the native mycorrhizal population is eliminated by soil sterilization, cassava needs extremely high P applications for maximum growth. However, if the mycorrhizal association is re-established by inoculation, there is very little response to applied P. This marked response to inoculation in a sterilized soil shows the importance of mycorrhiza in the P nutrition of cassava.

In most natural soils cassava forms an association with the native mycorrhizal strains. For this reason, inoculation with introduced and more efficient strains can only be of practical significance when the introduced strain is well adapted to the conditions in the soil and can compete with native micro-organisms.

Since 1980 the Mycorrhiza Project at CIAT, funded by the German Government (GTZ) and under the leadership of Dr. Ewald Sieverding, has been collecting, purifying, and evaluating the efficiency of large numbers of mycorrhizal strains in





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* RHODES, L.H., and GERDEMANN, J.W. 1975. Phosphate uptake zones of mycorrhizal and non-mycorrhizal onions. New Phytologist 75:555-561.

R.H. Howeler

order to identify highly efficient strains for particular soil and climatic conditions. The plant nutrition section of CIAT's Cassava Program has been investigating some of the factors that influence mycorrhizal efficiency, such as use of P fertilizers or fungicides, insecticides, or herbicides. The best methods of inoculum production and inoculum application are also being investigated.

While significant responses to inoculation in field-grown cassava have so far been obtained only in sterilized soil, it is expected that the use of better strains will make field inoculation in non-sterilized soil an attractive alternative to using high levels of fertilizer P. Even should inoculation prove to be impractical, it is of utmost importance that we appreciate the dependence of cassava on an efficient mycorrhizal association, so that agronomic practices aimed at optimizing the efficiency of the native mycorrhizal population can be implemented. Examples of these practices are rotation, intercropping, use of mulch, as well as limiting the use of chemicals that adversely effect these extremely important soil fungi.

Keeping in Touch...

S.N. Anyaegbu, National Root Crops Research Institute, PMB 1006, Umudike, Umuahia, Nigeria

Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICIT), Apartado 70617, Los Ruices, Caracas, Venezuela (Cultivation systems and production)

Brian R. Cooper, CARDI, University Campus, St. Augustine, Trinidad

José M. España C., Apartado aéreo 1160, Santa Marta, Magdalena, Colombia (Weed control)

Maria Victoria Eiras Grossmann, Universidade Estadual de Campinas, Depto. de Tecnologia de Cereais-FEAA, Campus Universitário, 13100 Campinas, SP, Brazil (Alcohol from cassava)

Lupi Hernawati, Jl. Malabar 10, Bogor, Indonesia (Storage)

Thomas F. Kelsey has changed his address as follows: P.O. Box 14954, North Palm Beach, FL 33408, USA

J. Leesberg, Investigación Agro-Sociología, CENDA, Apartado 700, Santo Domingo, Dominican Republic (Beans/cassava intercropping systems)

John H. Newton, Tate & Lyle Technical Services Ltd., Enterprise House, 45 Homesdale Road, Bromley, BR2 9TE, England (Utilization)

J.I. Olanihun, Aiyegbaju Livestock and Agricultural Farms Ltd., P.O. Box 92, Shaki Oyo State, Nigeria

G.V. Olsen Associates, 170 Broadway, New York, NY 10038, USA

David Raggay, University of the West Indies, St. Augustine, Trinidad (Economic aspects of the production of starch and animal feeds)

Gustavo Román C., Fundación OFA, Cr 7 no. 29-34 Piso 3, Bogotá, D.E., Colombia (Physiological effects due to HCN toxicity)

T.U. Selvin Vaides Arrue, Centro Universitario del Norte, Universidad de San Carlos de Guatemala, Coban, Alta Verapaz,Guatemala (Animal feeding)

Vo Thi Hai, 11, Rue Leon Mignotte, 91570 Bievres, France (Processing)

Thesis Work in Cassava

Rogerio Ramírez T. and **Julio P. Bautista C.** (Undergraduate work) Root diseases caused by *Armillaria* and *Rosellinia* sp. Universidad Técnica de Ambato (Ambato, Ecuador).

Javier Rodríguez B. and **Luis Eduardo Buitrago** (Undergraduate work) Double row planting system in cassava. Universidad Tecnológica de los Llanos (Villavicencio, Meta, Colombia)

Cassava Production Statistics

Cassava, the fourth most important energy staple of the tropics, provides food and income for 750 million people. Total estimated production reached 122 million tons in 1980, with 38% of production in Africa, 36% in Asia, and 26% in America. *(Source, FAO)*

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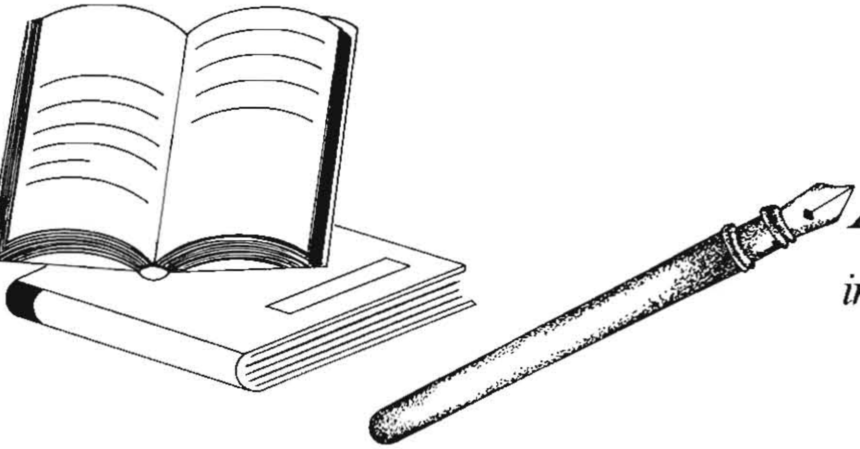

Advances in Cassava Research

Different Plant Spacings Affect Efficiency of Yield Selection

Kazuo Kawano, Charn Tiraporn, Somsak Tongsri, and Yoshiaki Kano

At the Centro Internacional de Agricultura Tropical, twenty genotypes were evaluated on medium to high fertility soils in a relatively moderate tropical climate for single-plant yield and harvest index in segregating populations and single-row trials at different plant spacings. The same genotypes were also evaluated for unit-area yield in a replicated large-plot trial to assess efficiency of selection.

Broad-sense heritability for the yield of a single plant in segregating populations was much higher than that for harvest index, regardless of the spacing used. The correlation of single-plant yield in segregating populations with unit-area yield was invariably lower than the correlation of harvest index with unit-area yield.

This result indicates that harvest index is a better selection criterion than is single-plant yield in segregating populations or in single-row trials, when the final objective of the selection is unit-area yield. Competition between genotypes appeared to be the major cause for a low correlation between single-plant yield and unit-area yield.

The most efficient spacings were 1 x 2 m in segregating populations, and 2 m between rows in single-row trials.

Full results of this experiment will be published in the July-August issue of Crop Science.

Critical Tissue Concentrations Determin[illegible] for Micronutrient Deficiency/Toxic[illegible]

R.H. Howeler, D.G. Edwards, and C.J. Asn[illegible]

The programmed nutrient addition technique was used in a series of five experiments to determine the response in growth and micronutrient content of cassava cv. M Aus 10, to eight supply levels of boron, copper, iron, manganese, and zinc. The nine-week-long experiments utilized 22 liter pots of nutrient solution.

The supply levels for each micronutrient covered the range from severe deficiency to toxicity. Critical tissue concentrations were determined by relating total dry matter production to the nutrient concentration in the youngest fully expanded leaf blades.

Critical concentrations for deficiency (μg/g) were: boron, 35; copper, 6; manganese, 50; and zinc, 30. Critical con[illegible]centrations for toxicities in the sa[illegible] index tissue (μg/g) were: boron, 1[illegible]; copper, 15; manganese, 250; and z[illegible], 120.

In the iron experiment, the data w[illegible] too variable to allow precise determin[illegible]tion of critical concentrations for [illegible]ciency and toxicity. Critical micr[illegible]trient concentrations in the petioles [illegible] the youngest fully expanded leave[illegible] also determined, but offered no [illegible]tage over the leaf blades.

Full results of this experiment w[illegible] published in Volume 5 of the Jo[illegible] of Plant Nutrition.

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