Cassava agronomy: working out factor effects on root yield

Introduction

Cassava is one of the most important food and cash crops in Sub-Saharan Africa (SSA). However, its importance is not matched by research on cassava agronomy, the most important discipline supporting farmers' field crop production activities. A recent review found just 181 articles on cassava agronomy from SSA, of which 123 were from Nigeria. A large portion of these papers are relatively old, dating back some 20 or more years, thus from a time that diseases such as CMD did not exist and soil fertility had not degraded to levels of today.

Germplasm improvement responded to pest and disease problems by breeding and selecting highly performing pest and disease resistant varieties, which may not have the same responses to agronomic measures than older varieties. With a major change in varieties and changing soil fertility conditions as well as climate change along with cassava more and more emerging as a commercial crop providing raw material for the starch industry and related sectors, it appears high time that the basic agronomy of the new varieties under today's conditions is researched to furnish farmers with up to date relevant information on best agronomic practices to increase their yields and income.

The trial described here was designed to obtain information on the effects on root yields of contrasting cassava growth types, of different levels of tillage intensity, of intercropping with maize versus cassava monocrop, of the application of fertilizer and of the cassava plant density. The trial was a 5 times replicated orthogonal five-factorial experiment laid out as a RCBD with the factor plant density nested within the other factors. The cassava varieties were: TME 419, a highly CMD resistant, erect variety with a very low tendency to branch, branching occurs late and infrequent and TMS 972205, a low and profusely branching variety with a high CMD resistance. Tillage was done by ploughing followed by harrowing and ridging at 1 m distance between ridges versus planting into flat soil that was only harrowed. The cropping system was intercropping cassava with a 3-months-to-maturity maize variety seeded at 0.2m x 1m between the cassava rows (5 plants / m^2) versus a cassava monocrop. Fertilizer application was a base dressing of 200 kg/ha of NPK 15:15:15 at 2 WAP followed by a urea application equivalent to 60 kg N / ha at 4 WAP and two dressings of KCl equivalent to 50 kg/ha K each at 12 and 24 WAP, versus no fertilizer. The cassava density factor was nested within main plots by planting at 7 distances along a continuous line starting with 1m and reducing the distance by 0.1m to 0.4m resulting in 10000, 11111, 12500, 14286, 16667, 20000 and 25000 plants/ha. Cassava was harvested at 12 MAP.

All results are dry matter data (!) – note cassava roots contain about 65% water.

Results

Increasing cassava plant density had no positive effect on root yields. However, the varieties differed in their response to plant density. TME 419 had insignificant yield losses, while in TMS 972205 all densities above 10000 plants/ha produced significantly lower yields (Figure 1).

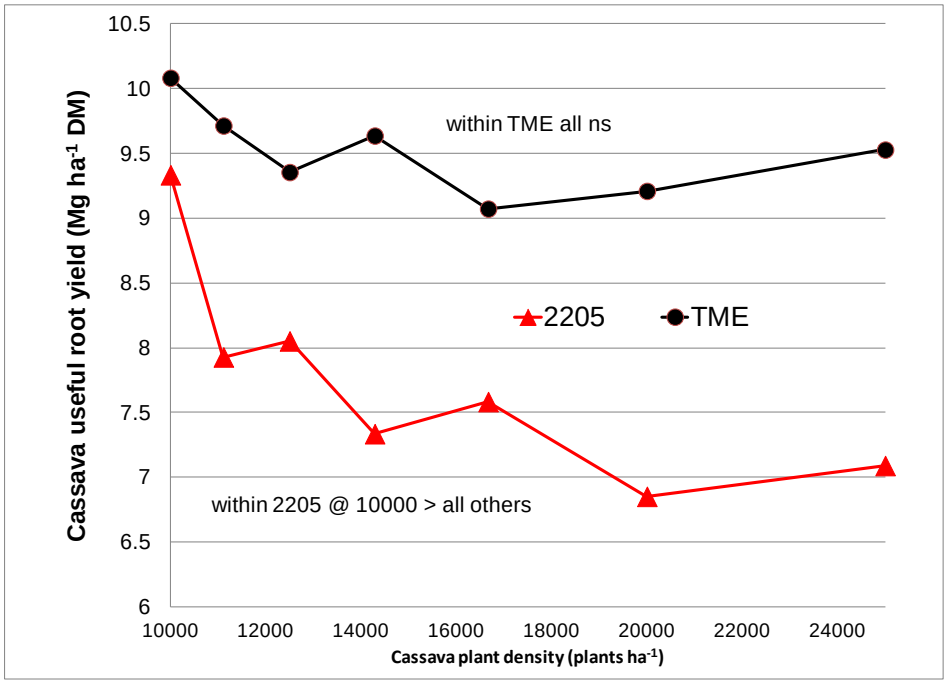

Figure 1: Cassava root dry matter yields as a function of plant density.

Intercropping with maize caused a highly significant variety x density interaction. The profusely branching variety had no response to the maize intercrop across all cassava densities, while TME 419 responded with significant root yield losses to the maize intercrop for all plant densities but the highest one (Figure 2).

Although the intercrop did reduce cassava root yields, the maize yields were sufficiently high to compensate for the loss and added income due to the higher prices of maize (Figure 3).

Tillage is very common in Nigeria and most smallholders mound or ridge manually, which is labour intensive. With decreasing soil fertility tillage may become increasingly important to attain profitable cassava yields. However, labour cost for manual tillage is difficult to determine. In this trial tillage was performed by tractors and caused a significant yield increase that attained about 100% return to the investment. However, this may not be the case if tillage is done manually and if the labor demand for tillage leads to a smaller cassava growing area within a household. Thus as long as land is not limiting (within a family holding) the yield increase with tillage has to be balanced against the area that could be cropped without tillage.

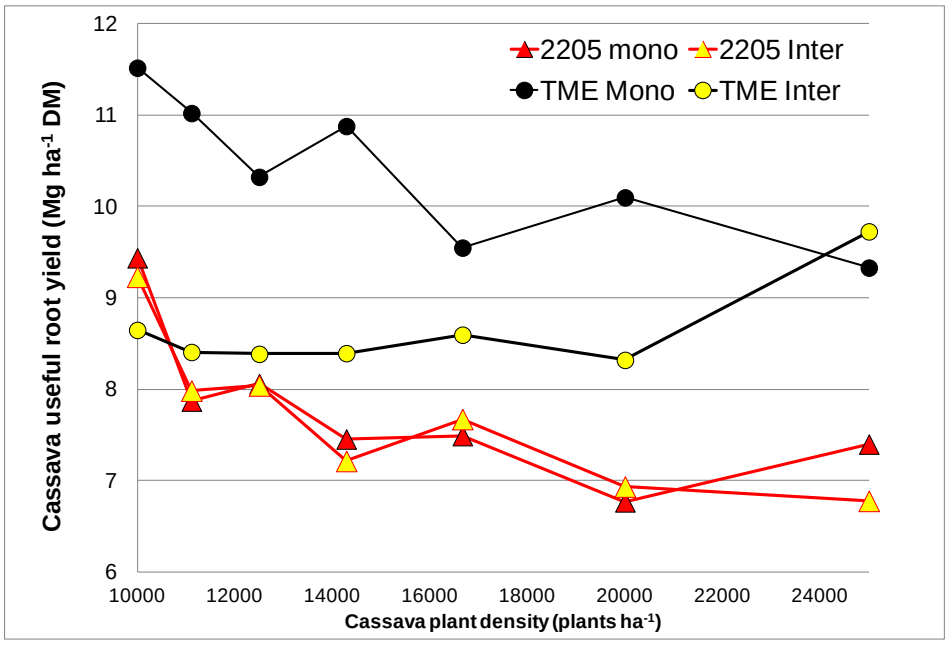

Figure 2: Cassava root yield response to cassava density and maize intercrop.

Fertilizer application increased cassava root yield significantly, yet the increase was insufficient to off-set the fertilizer cost. Compared with the no fertilizer treatment fertilizer application reduced the income by 13% (Figure 3).

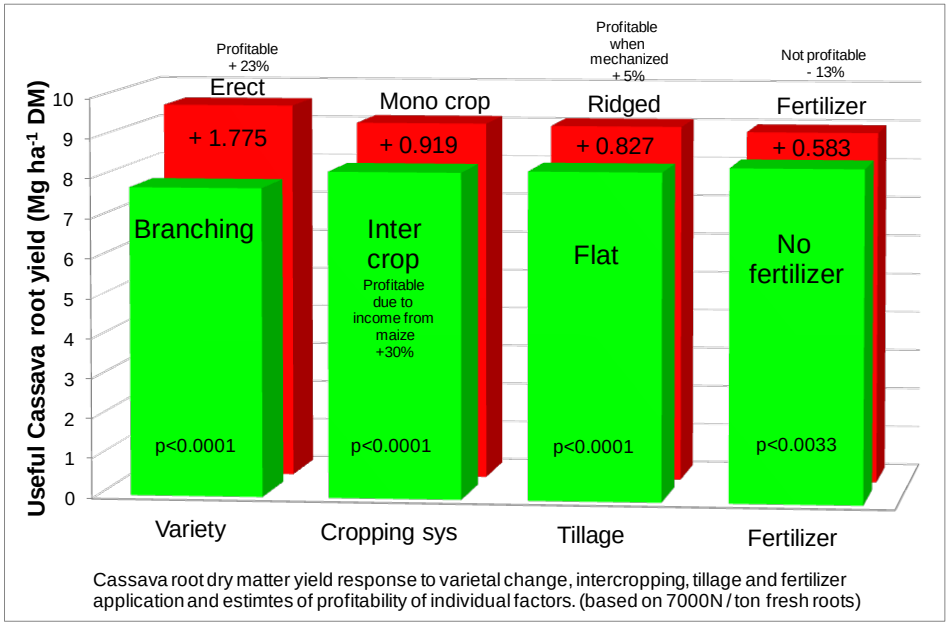

Figure 3: Cassava root dry matter yields as affected by variety, cropping system, tillage and fertilizer and effects on income.

Conclusion

The trial results show that the correct choice of factors is decisive for attaining high yields and high incomes. In this trial the least cost intensive measure, varietal choice had the highest yield increment. Considering that changing variety is a low cost (if any at all) measure, the Genotype x Environment (G x E) interactions should be investigated more intensively to enable farmers picking the best variety for their sites, soil conditions and investment capacity. Intercropping is a common technique in smallholder systems and cassava appears to be an ideal crop to exploit the soil resources in the early phases of growth more intensively without compromising the income. Past research showed that intercropping cassava had no effect on root yields, however many trials used reduced intercrop (maize or grain legumes) densities and thus had relatively low grain yields to add to the systems productivity. Here a maize density close to a monocrop density was used producing around 2 Mg/ha dry grain. The high maize density used here has most likely contributed to the reduced cassava root yields. As cassava and maize vary in growth types there appears good reason to investigate the compatibility of cassava and intercrop varieties to maximize yields of both crops. Further, the planting pattern of the cassava could be modified to provide wider inter-row spaces for intercrops yet maintaining the cassava density by planting closer within the row. Responses to such modifications are likely to be affected by the cassava growth type (erect versus branching) warranting further research into G x E x M interactions where M stands for Management and can comprise fertilizer, including minor and trace elements, variations in formulation and application techniques (foliar versus soil application, cassava leaf harvest effects on root yields, weed control and mechanization.

Compiled by S Hauser.