Cassava root yield response to nutrient omission, tillage and biomass management

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Cassava is the most important staple in Nigeria and the wider region. Root yield average is around 12 Mg/ha, far below the estimated potential of 80-100 Mg/ha. Today's varieties are largely cassava mosaic tolerant thus low yields are not disease related. Although cassava is perceived as a crop with low nutrient requirements, nutrient uptake of a crop that exceeds the current average is likely higher than the supply from soil resources. There are no recent fertilizer recommendations in Nigeria that would be based on rigorous research. Therefore a nutrient omission trial combined with tillage and biomass management treatments was conducted to determine the most limiting nutrient and the effects of tillage and biomass management of previous fallow vegetation.

Materials and methods

The trial was conducted at IITA Ibadan, on Entisol cleared from 12 years old bush/early forest regrowth, dominated by *Leucaena leucocephala*. Trees were uprooted and removed from the land, debris and non-tree biomass was removed or retained and burned. Tillage was no-till flat soil versus ridging at 0.75m distance. Cassava cv. TME 419 was planted at 0.75 x 0.8m (16667 ha^{-1}), replicated 4 times. Plots had 16 plants and were surrounded on all sides by a border row.

The omission trial comprised (in kg/ha): 90 N, 40 P, 120 K, 15 Mg, 20 S, 1 Zn and 0.5 B; each nutrient omitted from the full set plus one full set and a no fertilizer control. N and K rates were split into 3 equal doses. P, Mg, S, Zn and B were applied in one dose at about 6 weeks after planting (WAP), the second and third N and K doses were applied at 12 and 24 WAP.

Final harvest was taken at 1 year after planting by separating green stems bearing leaves from lignified stems (including the planting stick) and tuberized roots. Roots were separated into marketable roots and those not deemed fit for consumption or processing. Subsamples of all plant parts except non-marketable roots were taken for dry matter determination. All yield data are dry matter data at 0% moisture. Root yield data are expressed in dry matter useful roots.

Results

Cassava plant density, stems/plant and thus stem density were higher after ridging and when biomass was burned (Table 1). Dry matter yield of green stems with leaves, the useful root yield and the total biomass yield was higher after ridging and when biomass was burned. Lignified stem biomass had the same tendency, yet differences were not significant. The dry matter based Harvest Index followed the same trend and was 2% higher when biomass was burned.

Nutrient omission had no significant effects on any cassava yield parameter. However, the sequence of nutrients along the yield gradient and the patterns of response appear to reveal a strong differential response of the aboveground biomass production versus the production of tuberized roots. Figures 1 – 3 show the sequence of yield loss. For aboveground biomass (1), omitting N caused the largest loss; Zn and P appear least important and omitting any other elements attained yields close to the zero control. For rot production (2) P, Mg and K caused the largest losses, S appeared least important . Total biomass production had a slightly different response pattern, with a clearer advantage of the full set of nutrients. Important to note is that omitting Mg appears to cause a large yield loss in all plant parts.

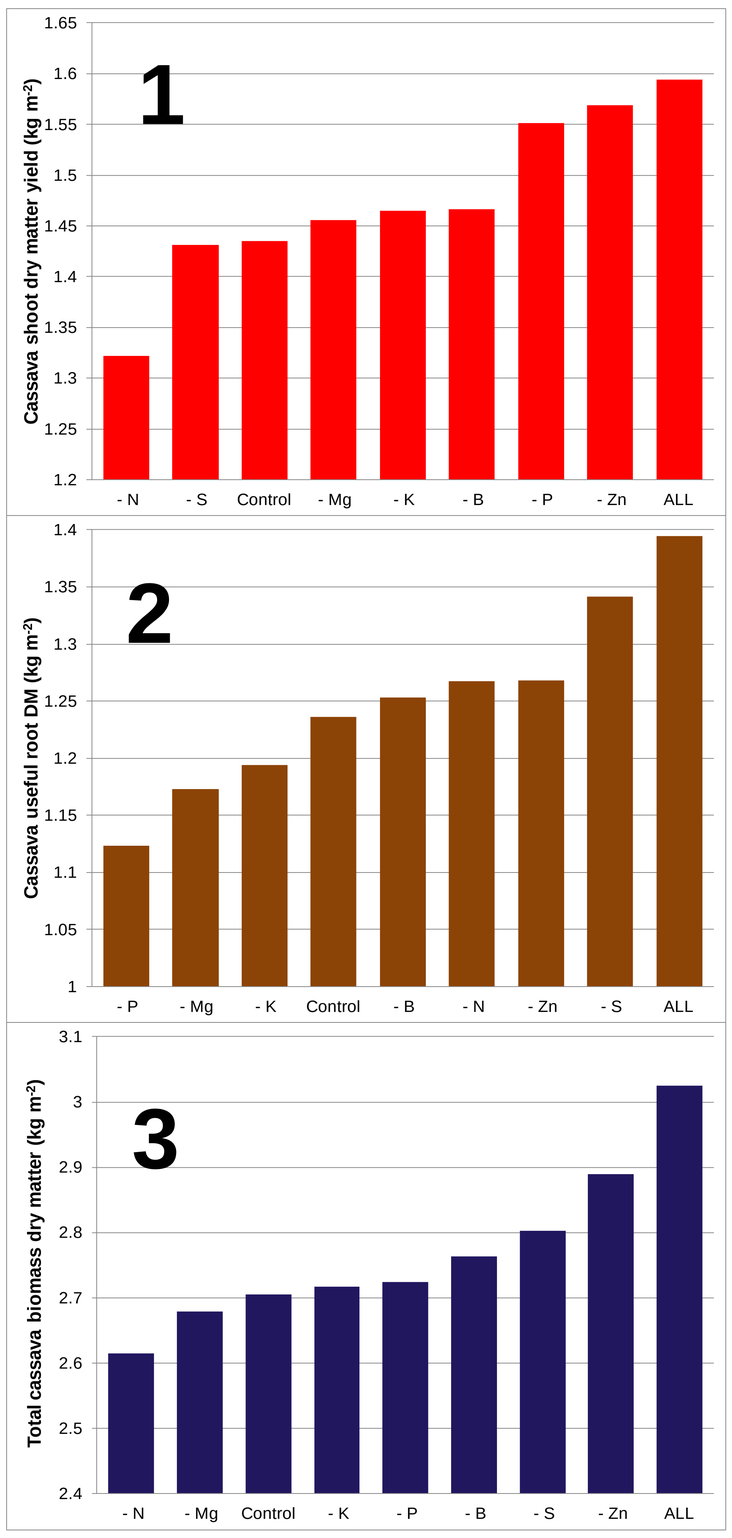

Figure 1 - 3: Aboveground (1), useful root (2) and total (3) biomass dry matter production response to omission of nutrients, Ibadan, Nigeria, 2012 – 2013.

Nutrient omission did not interact with tillage or biomass management. Trace elements such as B and Zn appear not important in cassava yield formation. The differential effect of P omission on root versus shoot production may require further investigation. Root yield of 11-14 Mg ha^{-1} DM equivalent to 33 - 50 Mg ha^{-1} fresh roots, indicate that plant density, varietal choice and soil quality are as well of great importance.

It appears that maximizing cassava root yields requires research into the physiology of the crop and the elucidation of the shoot (leaves) root filling relationship. A HI < 0.5 is not desirable as it indicates that shoot mass production was favoured. Considering the high cost of fertilizer shoot growth (which absorbs higher nutrient quantities than the roots) should be limited to the minimum required to attain high root yields.

Table 1: Plant and stem density and dry matter yields of cassava as affected by tillage and biomass management, Ibadan, Nigeria, 2012 – 2013.

	plants/m2	stems/plant	stems/m2	DM leaves kg/m^2	DM stems kg/m^2	DM useful roots kg/m^2	DM total kg / m^2	Harvest Index (dm base)
notill	1.56	1.82	2.84	0.214	1.222	1.171	2.657	0.458
ridge	1.60	2.11	3.38	0.251	1.265	1.329	2.88	0.473
p diff tillage	ns	<.0001	<.0001	0.0075	ns	0.0008	0.0054	ns
burned	1.61	2.06	3.33	0.246	1.247	1.331	2.856	0.476
removed	1.55	1.87	2.89	0.219	1.24	1.169	2.682	0.456
p diff biom mgt	0.0062	<.0001	<.0001	0.0427	ns	0.0007	0.0275	0.0201

Removing green stems with leaves

Removing green stems from lignified stems

Separating useful roots

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