Improving Cassava root yields through fertilizer and supplementary dry season irrigation

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Introduction

The growing global demand for cassava cannot be met by the current production practices. In sub-Saharan Africa cassava is grown mainly on small holdings by low-income farmers, using little or no external inputs or irrigation. Most of Nigeria experiences a 4-5 months dry season during which cassava sheds leaves and growth ceases. With the onset of rains cassava mobilizes starch from roots and stems to form a new canopy, leading to root and starch yield depression, which to compensate for requires additional growing time. Irrigation of cassava is uncommon and considered too cost intensive for a crop with a high price volatility. These studies were conducted to assess the root yield increment to be expected from low-level simple manual irrigation.

Material and methods

Trials were established at IITA Ibadan to assess the effects of supplementary irrigation during the dry season, on fresh stem and root yield and the response to fertilizer. A three-factorial trial were planted: 1st factor - irrigation regime: I_0 (no irrigation) versus I_1 (2 mm/day), as furrow irrigation; 2nd factor - fertilizer application: F_0 (Nil) versus F_1 (75:20:90 kg ha^{-1} N:P:K), 3rd factor crop age at harvest -12 versus 15 months after planting (MAP). Irrigation started December 1st about 1 month after rains stopped. Water was applied every other day by pouring the required amount (equiv. 4 mm) into the furrows between cassava ridges. A 2nd trial was planted in the 2nd season to assess irrigation effects if the crop is small and has less canopy when the dry season starts. Four levels of water supply: 0, 0.5, 1.0 and 2.0 mm day^{-1} were applied by filling water into bottles inserted in the soil between plants (Fig. 1) all with and without fertilizer.

Figure 1: Used bottles inserted upside down into the soil to supply water with minimum losses (left), bore hole to pump water (middle), storage tanks (right).

Results

Irrigation increased the plant and stem density and the number of branches found at harvest significantly (Table 1). Fertilizer application only increased the number of branches. Increased crop age at harvest lead to reduced plant and stem densities. Irrigation, fertilizer and crop age at harvest affected the stem and root yields significantly (Table 2). Root yield had a significant fertilizer×crop age interaction (Fig. 2) Stem yield had a significant irrigation×crop age interaction (Fig. 3).

Table 1: Plant- and stem density and branches as affected by irrigation, fertilizer application and crop age at harvest. MAP = months after planting

	Plants	Stems	Branches
		# m^{-2}	
No irrigation	0.91	1.49	2.91
Irrigation	1.10	1.90	3.56
p diff irrigation	0.0005	0.0001	0.0048
Nil	0.98	1.63	2.89
Fertilizer	1.03	1.76	3.57
p diff fertilizer	0.3	0.18	0.0031
15 MAP	0.91	1.44	3.05
12 MAP	1.11	1.95	3.42
p diff crop age	0.0004	0.0001	0.109

Table 2: Stem and root yield as affected by irrigation, fertilizer application and crop age at harvest. MAP = months after planting

	Stem yield	Root yield
	Mg ha^{-1} fresh mass	
No irrigation	20.523	19.358
Irrigation	26.656	25.852
p diff	0.0067	<.0001
Nil	22.005	21.071
Fertilizer	25.174	24.138
p diff	0.144	0.0299
15 MAP	28.729	26.446
12 MAP	18.450	18.764
p diff	<.0001	<.0001

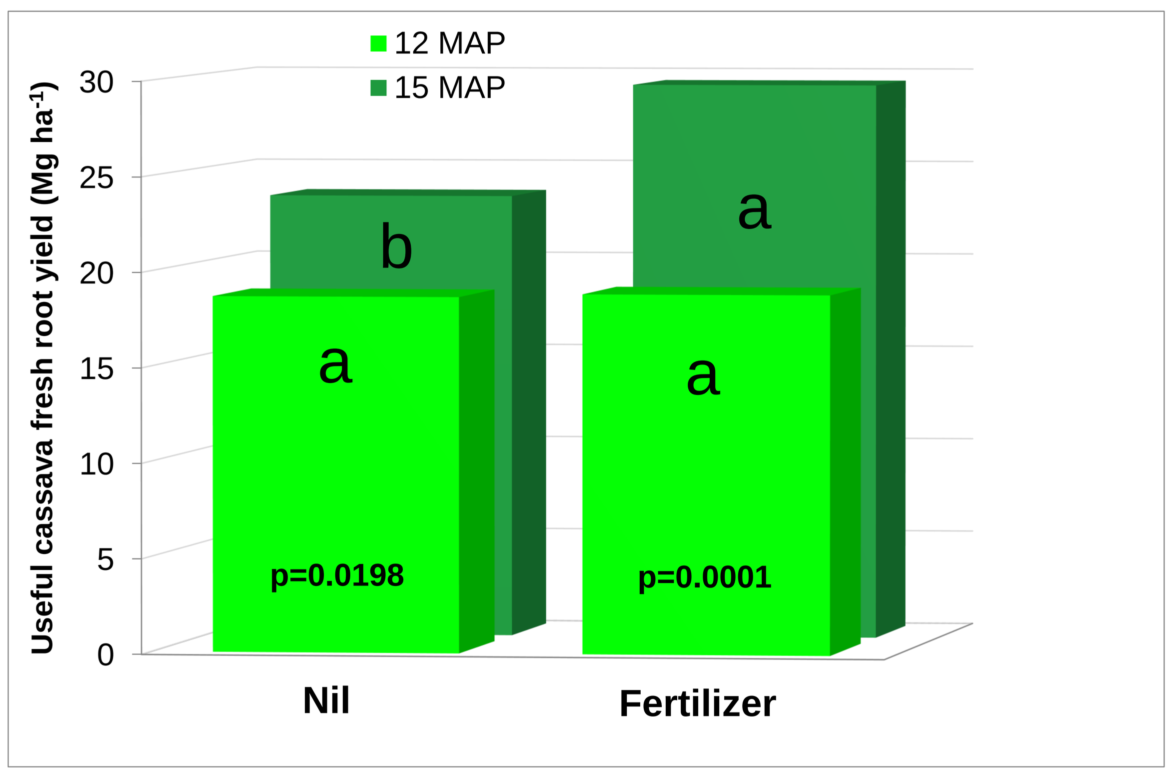

Figure 2: Cassava root fresh yield as affected by fertilizer application and crop age at harvest. P values within fertilizer treatments indicate levels of significance between crop ages. Columns with same crop age labelled with different letters are significantly different at p<0.0025 for 15 MAP.

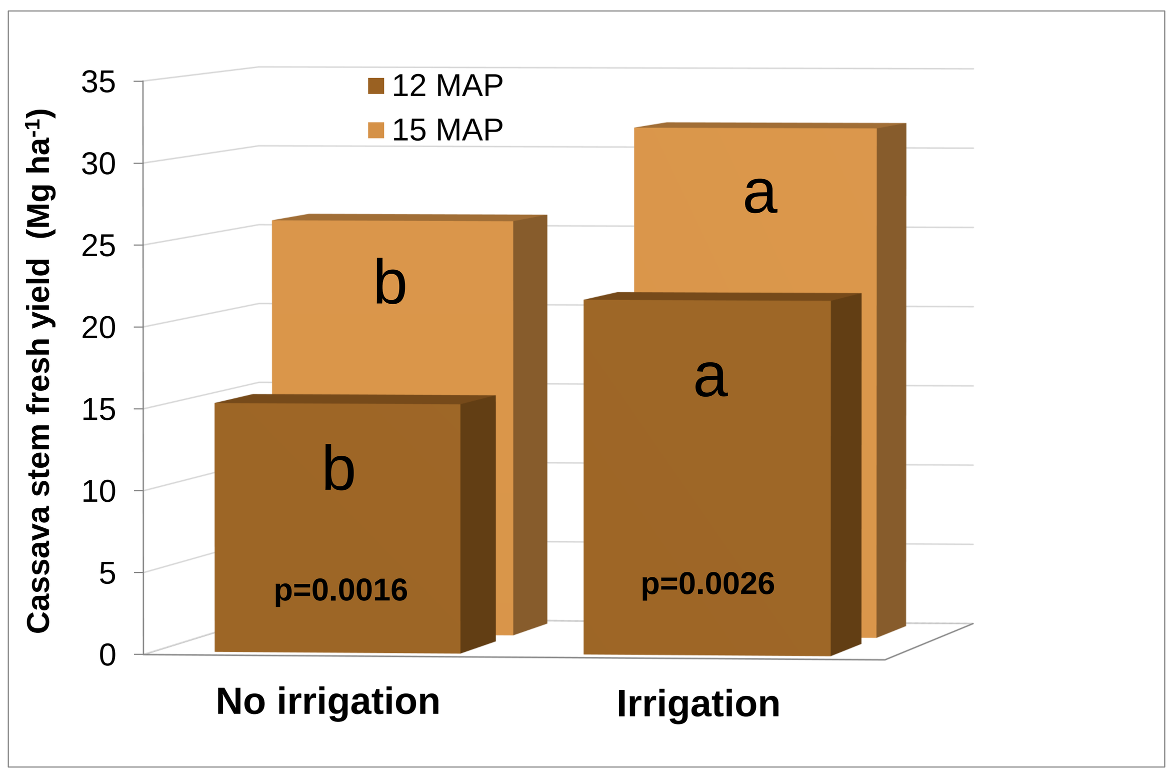

Figure 3: Cassava stem fresh yield as affected by irrigation and crop age at harvest. P values within irrigation treatments indicate levels of significance between crop ages. Columns with same crop age labelled with different letters are significantly different at p<0.0486.

Results continued

The second trial planted in the second season, thus close to the long dry season showed neither a significant response to irrigation in general, nor to the different levels of water supply. Neither plant density (Fig 4 a) nor stem density (Fig 4 b) or fresh (Fig 4 c) or dry root yields were significantly different between control (dry) and any of the irrigation levels. Similarly, fertilizer application did not affect plant and stem density and fresh and dry root yields. Stem fresh yield (Fig 4 d) was higher when fertilizer was applied (p<0.07).

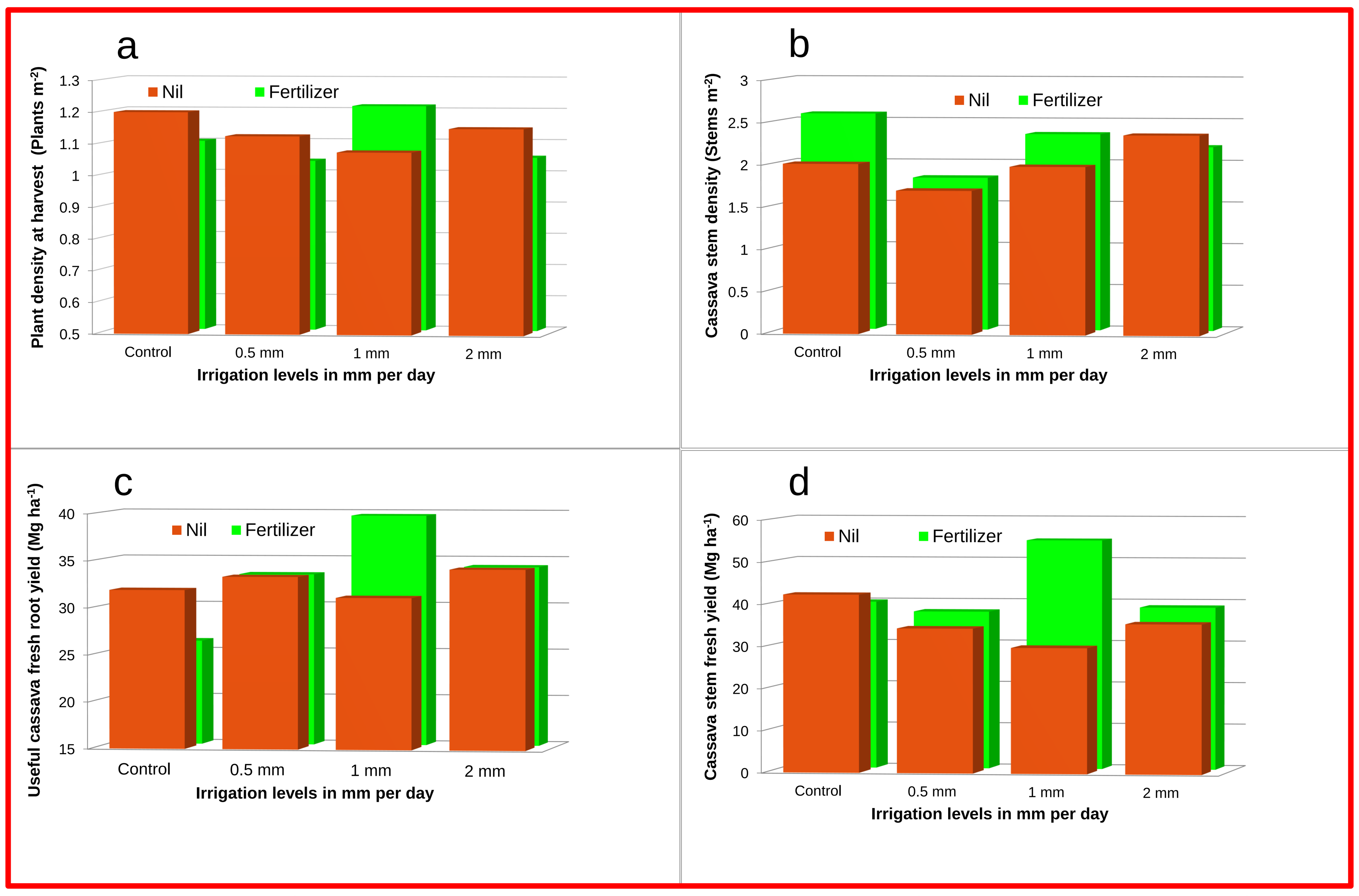

Figure 4: Cassava plant density (a), stem density (b) root fresh yield (c) and stem fresh yield (d) as affected by irrigation and fertilizer application.

Discussion

Irrigation appears to only have a positive effect if fully developed cassava receives supplemental water during the dry season. Young cassava appears to be able to compensate for the drought stress during the following wet season, eliminating potential benefits of irrigation. Delayed harvest appears to increase the fertilizer use efficiency, an unusual feature for which no comparable data were found. However, as nutrient uptake patterns in cassava are not well researched, it may be that the crop absorbs the nutrients yet requires a long phase to produce adequate biomass.