

Effects of nitrogen fertilization on pounded yam sensory and physico-chemicals properties



Yam is a demanding crop in terms of organic matter and soil fertility, especially the most appreciated and market-valued cultivars (early maturing *Dioscorea rotundata*) used to prepare the popular dish futu (pounded yam). Traditionally cultivated in slash and burn cropping systems after a long fallow period in West Africa, yam cultivation is now confronted with a scarcity of fertile soil available for clearing. Thus there is an urgent need to develop alternative techniques for maintaining yam production, such as mineral fertilization. Nevertheless in West Africa it is commonly believed that chemical fertilizer has a negative effect on the sensory qualities of yam.

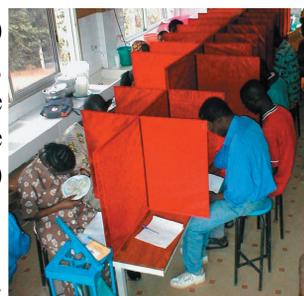
Objective of the study

This experiment has been carried out in the Republic of Benin over 2 years in order to assess the effect of nitrogen fertilization on sensory quality and physico-chemical properties of pounded yam.

Methodology

Morokoro and Kpouna, two high quality yam landraces (*Dioscorea rotundata*) were grown with three different doses of nitrogen (F0 = nil, F1 = 40, F4 = 130 kg of N.ha⁻¹). In order to evaluate the effect of nitrogen on the growing period and therefore on tuber maturity, three date of harvests were organized monthly: (D1) one month before, (D2) one month later and, (D3) at the farmers' usual harvest time.

A sensory test was carried out with a panel of 20-25 ordinary consumers. Some physico-chemical tests were performed.



In 2003, a triangular test was organized to determine whether or not there is a qualitative influence of nitrogen fertilization on pounded yam sensory quality. Each member of the panel received two plates containing one of the fertilized samples and the check (not fertilized). Alternatively two portions of the check or the fertilized sample were provided. Each taster had 3 samples, of which two came from the same product. Tasters were asked to identify the non repeated sample and identify which attribute made the difference (taste, texture, or colour).

The probability of not having a difference between fertilized and unfertilized pounded yam samples was calculated following the binomial law:

$$P = \sum_{k=r}^n C_n^k p^k q^{(n-k)}$$

and 'r' is the number of correct answers, 'n' is the number of answers, p = 1/3 and q = 2/3.

In 2004, a rating test was organized to assess which of the sensory attributes (texture or taste) were affected and in which proportion. Only one variety was tested, Morokoro. Tasters had to give marks for sample regarding texture and taste (from 1-bad to 5-excellent).

Conclusions

Experiment in 2003 showed a significant effect of nitrogen fertilization on pounded yam sensory quality in most situations whatever the cultivar. For early (D1) and normal (D2) dates of harvest, heavy fertilization (F4) always had a significant effect. In 2004 rating test permitted us to quantify this effect. The negative effect of fertilization decreased and even inverted itself while delaying harvest time. Low fertilization rate seemed to have only a slight effect on pounded yam quality and only at first date of harvest. At normal time of harvest and for low fertilization rates, sensory quality was not affected. For higher rates, only a delay in harvest time allowed pounded yam quality to recover sufficiently. It is likely that nitrogen fertilization by improving aerial plant development will elongate the crop cycle.

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Table 1: Number of correct answers and probability to reject the assumption of "no difference between fertilized and unfertilized sample of pounded yam" (H0).

Date	Variety	Rep.	Treatment	No. of tasters	No. of correct answers	Significance level	
D1	Kpouna	1	F1	31	22	***	
			F4	31	25	***	
		Morokoro	1	F1	26	26	***
	2		F1	26	9	ns	
			F4	30	30	***	
	D2	Kpouna	1	F1	26	19	***
F4				26	13	ns	
2			F1	26	25	***	
			F4	26	25	***	
Morokoro			1	F1	30	28	***
				F4	30	22	***
		2	F1	28	28	***	
D3		Kpouna	1	F1	30	14	ns
				F4	29	15	*
			2	F1	26	24	***
		F4		26	26	***	
		Morokoro	1	F1	30	14	ns
	F4			30	26	***	
2	F1		30	8	ns		
			F4	30	23	***	

ns: non significant, *: p<0.05, **: p<0.01, ***: p<0.001

Results - 2003

In 17 out of 22 sessions, tasters observed a significant difference between fertilized and unfertilized samples (Table 1). For the first 2 date of harvest, F4 was always different from F0. On date 3, differences seemed to decrease. Tasters also indicated that differences occurred mainly for texture

(84%) and colour (65%). Except for D1, tasters expressed a preference for the unfertilized sample. Physico-chemical measures showed that vegetation duration increased dry matter (from 28% to 34% for D1 and D3), luminance and free sugar content but decreased firmness. For these measures, no difference between treatments was identified.

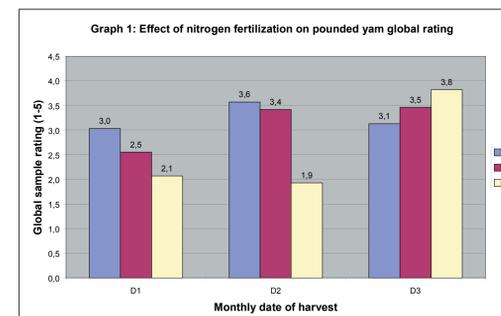
Results - 2004

Table 1: Effect of nitrogen fertilization on pounded yam quality at three dates of harvest.

Date	Treatment	Taste rating	Texture rating	Global rating
D1	F0	3.4 ^{Aa}	2.7 ^{Aa}	3.0 ^{Aa}
	F1	3.0 ^{Ba}	2.1 ^{Aba}	2.5 ^{Ba}
	F4	2.4 ^{Ca}	1.7 ^{Ba}	2.1 ^{Ca}
D2	F0	3.7 ^{Ab}	3.4 ^{Ab}	3.6 ^{Ab}
	F1	3.8 ^{Ab}	3.0 ^{Ab}	3.4 ^{Ab}
	F4	1.7 ^{Bb}	2.1 ^{Ba}	1.9 ^{Ba}
D3	F0	3.4 ^{Aab}	2.8 ^{Aa}	3.1 ^{Aa}
	F1	3.6 ^{ABb}	3.3 ^{Ab}	3.5 ^{ABb}
	F4	3.8 ^{Bc}	3.9 ^{Bb}	3.8 ^{Bb}

A, B, C: indicate significant difference between treatments for a date (p<0.05).

a, b, c: indicate significant difference between dates for a treatment (p<0.05).



The sensory panel showed significant difference between treatments (Table 2). Taste, texture and global rating followed roughly the same trends. For date 1 and 2, global rating decreased with nitrogen fertilization (Graph 1). On date 3, the tendency reversed itself. Both fertilized treatments improved their rating with time while unfertilized samples reached their maximum rating at normal date of harvest. Since 2003 physico-chemical analyses have not identified significant differences between treatments.



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