

ALLEY CROPPING ON AN ULTISOL IN SOUTHEASTERN NIGERIA

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Abstract: An alley cropping trial was carried out on an acidic Typic paleudult in the humid forest zone of southeastern Nigeria using three indigenous (*Anthonotha macrophylla*, *Dactyladenia barteri*, *Harungana madagascariensis*) and two exotic (*Calliandra calothrysus* and *Flemingia macrophylla*) hedgerow species. Early growth of *Anthonotha* was slow. *Harungana* and *Calliandra* could not withstand repeated pruning and died 3 to 4 years after establishment. *Dactyladenia* performed better than *Anthonotha* and *Flemingia*. Alley cropping did not have any distinct effect on soil properties. Among alley cropped plots, cassava yield was highest in *Flemingia* and *Dactyladenia* plots, while the control plot recorded the lowest yield. Cowpea yields were high in *Calliandra* and *Dactyladenia* plots. *Dactyladenia* plots were the least infested with weeds. *Dactyladenia* and *Flemingia* appeared to be suitable species for alley cropping on acid soils at low altitude.

1. Introduction

In southeastern Nigeria, cassava and yam are the major staple food crops grown in distant fields. Family farms consist of a concentric pattern of fields, on which fertility is maintained by fallowing, clearance systems, cropping patterns and sequences. Each field differs in the length of fallow, the number of arable crop species grown and distance from the home. The farther the field is from the home, the longer the fallow period and the fewer the number of arable crop species grown. Distant or outlying fields are the farthest away from the home. Soil fertility restoration in these fields is essentially a function of the fallow period [Okigbo 1979, 1986].

Productivity of the distant fields has continued to decline as a result of decades of cycles of varying fallow length and increased intensity of exploitation with low or no chemical inputs.

This paper discusses some results of investigations on the performance of three indigenous and exotic species used as hedgerows in alley farming trials on an Ultisol in southeastern Nigeria.

2. Materials and Methods

The trial was conducted at the Michael Okpara College of Agriculture, Umuagwo near Owerri in southeastern Nigeria. The soil is classified as Typic Paleudult. The top soil has a sandy loam texture [Cobbina et al. 1990]. Rainfall in the area is bimodal with an annual mean of 2,100 mm. The rainy season runs from March to November with a short break between July and August. Maximum temperature is about 31°C and minimum is

replaced by *Pterocarpus santalinoides*. *Calliandra* hedgerows died in 1991 and were replaced by *Alchornea cordifolia*.

3.2 Weed infestation

Weed infestation in the trial was determined in 1989 and 1991 (table 2). In 1989, plots alley cropped with *Anthonotha* hedgerows showed the highest weed weight and *Dactyladenia* the lowest. In 1991, the control plot had the highest weed weight while *Dactyladenia* still had the lowest. The control plot also had the highest number of grasses and *Dactyladenia* the lowest.

Table 2. Weed infestation under different hedgerow species

Treatment	Fresh weed weight ($t \text{ ha}^{-1}$)		Mean numbers of weeds 1991		
	1989	1991	Grasses	Sedges	Broad leaves
<i>Anthonotha</i>	7.78a	3.37c	18.4c	1.0c	26.3a
<i>Dactyladenia</i>	1.74b	2.60d	3.8d	0.33c	14.5b
<i>Harungana/</i>	5.16a	5.39b	44.6a	5.67b	26.3a
<i>Pterocarpus</i>					
<i>Calliandra</i>	6.17a	4.56c	26.5b	0.33c	6.5c
<i>Flemingia</i>	5.17a	4.72b	11.3cd	1.0c	14.0b
Control	6.75a	6.09a	52.7a	6.67a	•7.7c

Note: Data within same column carrying the same letter are not significantly different ($P < 0.05$) according to Duncan's test.

Table 3. Analysis of surface soil (0-15 cm) collected in 1991

Treatments	pH (H_2O)	Org. C (%)	Bray 1 P (mg/g)	Extractable cations				CEC meq/ 100 g^{-1}
				K	Na	Ca	Mg	
(meq 100 g^{-1})								
<i>Anthonotha</i>	4.7	0.74	9.6	0.14	0.23	0.61	0.14	0.006
<i>Dactyladenia</i>	4.8	0.64	21.7	0.10	0.37	0.60	0.13	0.006
<i>Harungana/</i>	4.6	0.93	12.9	0.10	0.25	0.36	0.14	0.01
<i>Pterocarpus</i>								
<i>Calliandra</i>	4.5	0.46	16.4	0.23	0.35	0.36	0.13	0.01
<i>Flemingia</i>	4.5	0.45	12.4	0.15	0.25	0.53	0.15	0.006
Control	4.6	0.87	10.4	0.09	0.23	0.40	0.14	0.01

3.3 Soil analysis

Results of soil analysis done in 1991 showed no distinct effect on soil properties of the four years of alley cropping with different hedgerow species (table 3). Comparing the soil analysis data with results obtained in 1989, there was an increase in extractable P because of fertilizer application, but only a little change in the other soil parameters measured.

3.4 Crop performance

Cassava and cowpea yields were obtained in 1989 (table 4). Cassava yield was highest in the control plot, however, there was no significant difference in yield between the control, *Anthonotha* and *Dactyladenia* treatment plots. Yields were lowest in the *Calliandra* and *Harungana/Pterocarpus* treatments. Cowpea second season yield in 1989 was highest in the plots with *Anthonotha* and *Dactyladenia* hedgerows. The lowest cowpea yield was recorded in the *Harungana/Pterocarpus* treatment plot.

Table 4. Cassava and cowpea yield in 1989 and maize plant height (8th week after planting) in 1991

Treatment	1989 Cassava	1989 Cowpea	1991 Maize plant height (m)	
	(t ha ⁻¹)		0.5 m from hedgerow	2 m from hedgerow
<i>Anthonotha</i>	17.43ab	1.2ab	0.83b	1.07b
<i>Dactyladenia</i>	15.20ab	1.59a	1.25a	1.31ab
<i>Harungana/</i> <i>Pterocarpus</i>	6.43cd	0.98c	0.84b	0.85b
<i>Calliandra</i>	5.01d	1.63a	0.52d	0.82b
<i>Flemingia</i>	13.46bc	1.09bc	0.66c	1.83a
Control	21.91a	1.02bc	-	-

Note: Data within column carrying the same letter(s) are not significantly different ($P < 0.05$) according to Duncan's test.

The height of maize plants adjacent to the hedgerows were lower than those grown in the middle of the alley (table 4). The growth of maize plants was best in the plots with *Dactyladenia* and *Flemingia* hedgerows.

Mean yields of melon intercropped in 1991 were 19 fruits per plot for *Anthonotha*, 29 for *Dactyladenia*, 9.3 for *Harungana/ Pterocarpus*, 18.2 for *Flemingia*, 9.0 for *Calliandra* and 7.0 for the control treatments. *Dactyladenia* plots gave the highest yield. Maize yield in 1991 in the trial plots decreased in the following order: *Dactyladenia*>*Flemingia*>*Calliandra*>*Harungana/Pterocarpus*>*Anthonotha*> and the control (figure 1). Grain yield of maize plants grown adjacent to hedgerows was much lower than those in the middle of alleys with *Dactyladenia* and *Flemingia* treatments. With the other hedgerow species, the grain yields of plants grown near the hedgerows were little different from those in the middle of the alleys.

4. Discussion

The study showed that only three out of the five hedgerow species tested can withstand rigorous pruning when grown on acid soils at low altitude. Regrowth of *Calliandra* and the shallow-rooting *Harungana* was poor after repeated pruning. Although other studies [IITA 1986] have shown that *Calliandra* coppiced well with repeated pruning at mid to high altitude, this study indicates that *Calliandra* is not well suited for alley cropping at low altitude.

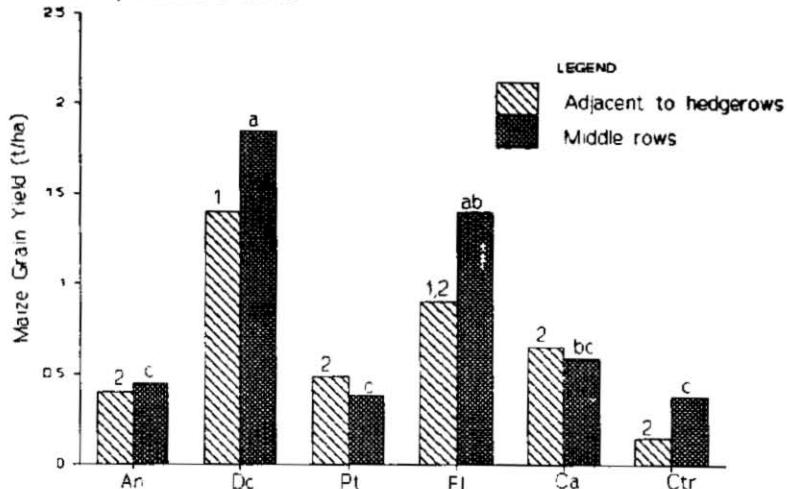


Figure 1. Grain yield of maize in control and alley cropped plots. An = *Anthonata*, Dc = *Dactyladenia*, Pt = *Pterocarpus*, Fl = *Flemingia*, Ca = *Calliandra*, Ctr = control (no tree). Bars with same letter or number are not significantly different at $P < 0.05$.

The lower weed infestation recorded in the *Dactyladenia* plots can be attributed to its fast growth rate which resulted in more partial shading during the off-cropping season. In addition, the mulching effect of large quantities of slow decomposing prunings from *Dactyladenia* may also suppress weed growth. The higher maize and cassava yields obtained on the *Dactyladenia* plots may thus be attributed to lower weed infestation and mulching effect. *Dactyladenia* and *Flemingia* appear to be the most suitable hedgerow species for use in alley cropping in areas with nutrient deficient and acid soils. Further research is needed to assess the sustainability of the system for a longer period of intensive cropping with or without fallowing.

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