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Early Growth and Nutrient Accumulation of *Grevillea robusta* A. Cunn. in *G. robusta*/Maize Intercrop

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Abstract: *Grevillea robusta* seedlings were intercropped with maize (*Zea mays*) on a humid tropical Alfisol. Tree growth and nutrient concentration in tree leaves were monitored to assess the impact of competition between the young tree and maize. Intercropping maize and *Grevillea* significantly reduced the collar diameter and shoot biomass of *Grevillea robusta;* collar diameter by 32% and shoot dry weight by 39% four Months After Transplanting (MAT) and by 18.7 and 13.5%, respectively at 16 MAT. The lower values of percentage growth reduction at 16 MAT compared to 4 MAT indicates the capacity of the trees to make up for the lost growth with time. Concentrations of N and P in *Grevillea* leaves were lower (3.42 and 0.09%, respectively) in intercrop than in sole *Grevillea* (3.56 and 0.11%, respectively).

Key words: *Grevillea robusta*, agroforestry, intercropping, nutrients, biomass

INTRODUCTION

Intercropping in agroforestry involves planting of woody perennials with arable crops/pasture to obtain multiple uses from the same resources. The multiple output from intercropping makes it an attractive alternative to monocropping especially in developing countries where there is high population pressures on the land resource base. Nigerian farmers prefer intercropping to monocropping because of food security, maximization of income and beneficial effects of legumes on associated crops derivable from the practice[1,2].

Intercropping arable crops with N-fixing trees are usually favoured in many tropical agroforestry systems[3]. Interactions between woody and non-woody components of agroforestry are complex[4] and can be competitive or complementary[5]. Woody species in agroforestry are capable of better spatial and temporal utilization of available growth resources than annual species[6]. A sufficient amount of detail in the description of resource capture by component species are needed to evaluate both competition and complementarity or facilitation[7].

Most of the studies conducted on agroforestry intercropping emphasised the effects of such intercropping on the growth and yield of food crops and paid little attention to the woody components. Reasons being that the woody perenials are usually the dominant component while the arable crops are the component most likely to be adversely affected. Nteyombya and Gordon[8] reported a decline in the yield of food crops as the trees grow bigger and dominate. However, it has been observed that some annual crops are more likely to grow rapidly and dominate in the first one or two years of establishment. Little or no attention has been paid to the yield loss which may occur in the woody components at the early stages when the crops dominate.

Grevillea robusta A. Cunn is used in agroforestry in many areas of the highlands of east and central Africa and is reported to be mainly deep rooted with few lateral roots and correspondingly low levels of competition with associated crops for water and nutrients[9]. The tree is valuable in plantation for timber, but if cultivated at close spacings or in non forest situations, it could also be valuable for firewood[10]. This study was carried out to assess the effects of intercropping on early growth and nutrient accumulation of *Grevillea robusta* in Akure, Nigeria.

MATERIALS AND METHODS

Study site: The field experiment was carried out at the Teaching and Research Farm of the Federal University of Technology, Akure (latitude 7°17 N′, longitude 5°10 E′ 350 m a.s.l.), with 1500 mm per annum bimodal rainfall pattern. The soil type is humid tropical Alfisol with Organic Matter: 3.03%, Total N: 0.17% and pH H_2O (1:1) 5.9[11].

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Experimental design: The experiment was laid out in a Completely Randomised Design. The whole plot (30x50 m) was partitioned into six microplots of 15x15 m. The six microplots were randomly divided into two groups of three; one of the group (3 microplots) was for maize/*Grevillea* intercrop while the other group (3 microplots) was for *Grevilea* monocrop.

In the *Grevillea* monocrop plots, nursery grown *Grevillea robusta* seedlings were planted at a spacing of 2.5x5 m. In the maize/*Grevillea* intercrop plots, *Grevillea* seedlings were also planted at a spacing of 2.5x5 m and in addition, the first crop of maize was simultaneously sown at inter- and intra-row spacing of 1 and 0.25 m, respectively. The first maize rows in the intercropping plots were sown along the tree rows. Weeding of the plots was done regularly as necessary.

In the maize/*Grevillea* intercrop plots, the first crop of maize was planted in May 2002 and harvested in July 2002 leaving only *Grevillea* on the plots between July 2002 and April 2003. In April 2003 maize was again planted on these same plots and this was harvested in June 2003.

Data collection: Height and collar diameter (diameter at the base) of all *Grevillea* seedlings in all plots (maize/*Grevillea* and sole *Grevillea*) were measured prior to transplanting and at 1, 4 and 16 MAT.

At 16 MAT *Grevillea* tree with a collar diameter closest to the mean in each microplot was selected. These were cut at the base and separated into the three components: leaves, branches and stem. For each component of each plant, a fresh weight measurement and subsamples for drying and analysis were taken. Samples for analysis were air dried while samples for biomass determination were ovendried at 60°C to constant weight.

Plant analysis: Samples of plant biomass were analysed for N, P, K, Ca and Mg . Air dried plant samples were milled in a Willey mill to pass through a 1 mm sieve. 0.2 g of the milled plant material was digested and analysed as described by Anderson and Ingram[12]. Total N in each digest was determined by semi-micro kjeldahl procedure while Available P was determined by Bray-l method. For determination of K, Ca and Mg, each plant sample was dry ashed at 550°C. K was measured by flame photometry and Ca and Mg by atomic absorption spectrophotometry.

Statistical analysis: Shoot height, collar diameter, shoot dry weight and nutrient concentration in leaves of *Grevillea* in monocropping and intercropping plots were compared using the Student's t test. The statistical analyses were performed using Microsoft Excel software

RESULTS AND DISCUSSION

Effects of intercropping on growth of Grevillea: Growth characteristics of *Grevillea robusta* were not significantly affected by intercropping during the first month of growth in the field (Table 1). This suggests that there was no severe competition between maize and *Grevillea* during the first month of growth. This was due to limited tree/maize interactions because both the trees and the crops were just growing. However, in measurements taken 4 MAT significant differences were observed in collar diameter and shoot dry weight between monocropped and intercropped *Grevillea*. Collar diameter and shoot dry weight were 32 and 39%, respectively lower in intercropped than in monocropped *Grevillea*. Intercropping did not significantly influence the height growth at 4 MAT. At 16 MAT, the intercropped *Grevillea* also differ significantly from monocropped *Grevillea* with respect to collar diameter and shoot dry weight. Although the percentage difference was lower than at 4 MAT. The observed differences may be attributed to competition from maize . There might have been shading of the young tree seedlings by the more vigorous maize. The young *Grevillea* seedlings could also have been deprived of some essential soil nutrients by the rapidly growing maize. Intercropping was observed to reduce shoot dry weight by 13.5% at 16 MAT.

Effects of intercropping on leaf nutrient concentration: There was no significant differences in leaf N, P, K, Ca and Mg concentrations between the intercropped and monocropped *Grevillea*. The concentration of these nutrients in *Grevillea* leaves at 16 MAT is presented in Table 2. Values of N and P concentration in leaves on intercropped *Grevillea* were lower than for sole crops. These lower values may be due to competition for N and P by the rapidly growing maize that was intercropped with *Grevillea*. There has been reports of N deprivation in cases where trees were intercropped with non nitrogen fixing crops compared to intercropping with nitrogen fixers[3].

Table 1: Effects of intercropping on the growth of *Grevillea* seedlings

	1 MAT			4 MAT			16 MAT		
Parameter	Monocrop	Intercrop	t-test	Monocrop	Intercrop	t-test	Monocrop	Intercrop	t-test
Shoot height (cm)	9.16	9.65	NS	4.24	39.10	NS	166.0	162.5	NS
Collar diameter (cm)	0.32	0.33	NS	0.75	0.51	*	18.2	14.8	*
Shoot dry weight (g)	0.69	0.66	NS	12.80	7.80	*	166.3	153.9	*

* significant at p= 0.05; NS – Not significant

Table 2: Effects of intercropping on leaf nutrient content of *Grevillea* 16 MAT

Nutrient elements (%)	Monocrop	Intercrop	*t-test*
Nitrogen	3.56	3.42	NS
Phosphorus	0.11	0.09	NS
Potassium	2.64	2.65	NS
Calcium	1.62	1.64	NS
Magnesium	0.42	0.44	NS

NS−Not significant

This study provides insight into the negative impact of intercropping on young tree seedlings. The evidence from measurements taken at 4 MAT suggests that the competitive impact of intercropping was more pronounced on tree seedlings during this period. Although it is on record that the trees could be able to make up for the lost growth later during the dry seasons and when they assume dominace of the intercrop, this may take a reasonable length of time.

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