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Sucker Management for Sustainable Productivity Improvement of Plantain Based Food Crop Mixtures

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ABSTRACT

This investigation exploited the growth phase differentials in time, space, location to improve the productivity among the sucker types: maiden, sword sucker and peeper in plantain /food crop mixture. The total crop yields of three crops mixtures (sole plantain; plantain+maize and plantain+soybean) were evaluated for the plant and ratoon crops. In the ratoon crop, four sucker combinations per mat: (maiden +sword sucker; maiden + peeper; sword sucker + peeper, and maiden + sword sucker + peeper) were randomized for the three crop mixtures in a split plot arrangement in three replicates. In the plant crop, the plantain matured about the same time and had similar yields. However, mixtures out yielded the monoculture.

In the ratoon crops cycle, plantain was harvested at 10 weekly interval when 3 suckers (maiden, sword sucker and peeper) were retained per mat in the intercrop but at 15 weekly intervention in sole plantain. The total annual productivity/ha/system of intercrops was significantly higher than that of monoculture especially when maiden, sword sucker and peeper were intercropped with maize. The soil acidity improved under intercropping system within two years of cropping. Plantain yield decreased (21.4%) in sole plantains. Finally the focus for sustainable plantain mixture productivity improvement research in the humid tropics was articulated.

Key Words: Plantain Maiden, Peeper, Mixtures, and Productivity.

INTRODUCTION

Plantain (*Musa paradisiacae* L) is prevalent in the tropical home gardens which several authors (Ndubuizu, 1976; Akobundu et al, 1992; Fernandez and Nair ,1986) described as a very complex agroecosystem in which man attempts to provide within reach, all cultivated food, feed and medicinal crops to satisfy man's needs at all times . The diverse and high-density species composition (Lagemann, 1981, Okigbo, 1975) conferred on home gardens inherent ecological stability and high crop productive system through resources (energy and nutrient) recycling (Wilson et al. 1986, and Okigbo and Greenland, 1976). Plantain production system in home gardens accounts for over 50% of total world plantain output (Olayide 1979).

Recently, the home garden has stimulated interest among researchers, and developmental donor agencies because of its proven sustainable promise (Okigbo, 1975, Lagemann; 1981) for the predominantly resource poor and landless urban, peri-urban and rural dwellers. The size constraint of home gardens notwithstanding, new home gardens are evolving through government, non-

overnmental housing/resettlement programmes, and community/army rehabilitation (Eweka et al. 1979). Plantain has been identified as top rank demand crop (Akobundu et al 1992) in home gardens of southeastern Nigeria. The immense prospects for plantain therefore calls for the development of an efficient land use system based on improved intensive production system without reduction in resource base. This is achievable through exploitation of the natural physiological sequence of sucker development in time, location and space. Thus available niches as created by crop harvest are utilized.

These openings are then utilized for late season intercrops while the plantain sucker for the ratoons are selected and managed such that only suckers at tolerant plantain vegetative growth phase (Obiefuna 1983) are exposed to the adverse dry season. In effect, plantain growth is enhanced in dry season and seasonal plantain availability is minimized. This paper therefore investigated the productivity of various plantain based food crop mixtures under different ratoon sucker combinations per mat within food crop intercrops grown in the alleys.

MATERIALS AND METHODS

The experiment was conducted at Owerri (5°27'N and 7 °02'E) in a simulated compound input production system (Obiefuna, 1987). The four-year-old fallow farm was ploughed and harrowed. The soil is the tropical Ultilsol sandy loam (86.5% sand, 8.5% clay, 5.0% silt, pH 4.8, 1.7 organic carbon, 0.42% total nitrogen, 9.75 ppm phosphorus, 0.82, 0.57 exchangeable calcium, magnesium and potassium meg/100g respectively.

Sword suckers were harvested from the university plantain orchard and planted 3.0 x 2.0m apart with 2.0m interplot paths. In the plantain alley, maize (Zea mays, FARTZ 27) and soybean (Glycine max L. Merr cv TGX 536 02D) were each planted in four rows of 1.0 x 0.5m, in the respective plots. Organic manure was applied at an annual rate of 20t/ha in three equal installments. The farm was weeded regularly. Each crop was harvested at maturity, and field data taken.

The experimental design was a split plot of three replicates in which the three plantain based crop mixtures; sole plantain, plantain + maize and plantain + soybean) were split for the main plots. Four sucker combinations per mat (maiden + sword sucker, maiden + peeper, sword sucker + peeper; and maiden + sword sucker + peeper were randomized for the subplots. Analysis of variance (ANOVA) was used to evaluate treatment effects and mean separation was based on the least significant differences (LSD) at the 5% probability level (Steel and Torrie, 1980).

The severity of plantain black sigatoka disease was assessed on the five youngest leaves at harvest based on visual observation and scoring according to the following format:

Severity Estimation	Scale Interpretation
0	0
1-20	1
21-40	2
41-60	3
61-80	4
81-100	5

Core soil samples (0-30cm deep on 1m radius) were taken at random in each plot and evaluated for crop root distribution density. Entrapped roots were carefully extracted by washing through a sieve, then oven dried for 72 hours at 60°C and then weighed. Soil pH was determined in water and 0.1*N* KCl using a pH meter in a soil\liquid suspension of 1:2.5.

RESULTS AND DISCUSSION

The sole and intercropped plantains matured about the same time and with similar yields in the plant crop (Table 1). The productivity (total yield per unit area) of the intercrops was similar to that of the monoculture. The plantain + maize intercrop out yielded the plantain +soybean. The ratoon crop yields under the various sucker combinations and intercropping (Table 2) showed significant yield variations.

The lowest yield of plantain/mat was obtained when maiden and sword suckers were retained per mat, particularly in monocultures. Although the plantain yield per mat improved under intercropping systems when maiden and sword suckers were retained, the highest yields were obtained when maiden, sword sucker and peeper were retained per mat in both monoculture and intercropped systems. The physiological basis of sucker development in plantain (Anno and Lambert, 1976, Swenen, 1984) accounted for the morphological characterization of maiden, sword sucker and peeper as distinct successors (suckers as ratoons) or propagules after the plant crop harvest (Ndubuizu and Okafor, 1976).

Although desuckering to two suckers/mat (3200 plants/ha) improved plantain yield in orchards (Obiefuna et al 1983), higher yields were still obtained at higher proportions (3332-4998) due to improved

Table 1. Bunch yield of plantain (t/ha) and grain yields of maize and soybean (t/ha) in various combinations.

	Plantain harvest	Crop Yields Tons/ha		
Cropping Systems	(MAP)* Plantain	Maize	Soybean	Total
Sole plantain	11.6 12.8	0.0	0.0	12.8
Plantain+ maize	11.4 13.8	2.8	0.0	16.6
Plantain+ soybean	11.5 12.4	0.0	1.2	13.6
LSD 0.05	*NS NS*	*NS*	*NS*	*2.4*

** MAP - Months After Planting*

Table 2: Mean annual yields of plantains and crops under various intercropping systems and sucker combinations.

Intercropping	Sucker Plantain	Maize	Soybeans	Total yield System:	Combination
SOLE PLANTAIN	Maiden + sword Sucker	10.0	0.0	0.0	10.0
	Maiden + Peeper	11.6	0.0	0.0	11.6
	Sword sucker + Peeper	11.8	0.0	0.0	11.8
	Maiden + Sword Sucker + peeper	12.4	0.0	0.0	12.4
PLANTAIN+ MAIZE	Maiden + Sword sucker	13.2	2.4	0.0	15.6
	Maiden + Peeper	14.8	1.1	0.0	15.9
	Sword sucker + peeper	13.4	1.8	0.0	15.2
	Maiden + Sword sucker Peeper.	15.4	1.2	0.0	16.6
PLANTAIN+ Soybean	Maiden + sword sucker	13.4	0.0	1.0	14.0
	Maiden + Peeper	14.6	0.0	2.0	16.6
	Sword sucker + peeper	13.8	0.0	1.6	14.4
	Maiden + Sword sucker + peeper	15.8	0.0	1.0	16.8
	LSD 0.05	1.42	NS	NS	2.31

** Mean for two years harvest.*

stand climate (Okigbo and Greenland, 1976, Monteith, 1972), enhanced by systematic plantain succession in time and space thereby creating multistorey cropping pattern (Okigbo, 1980) in mutually synergistic competition for natural resources (Wilson et al. 1986).

However, the yields of maize, and soybean respectively were similar irrespective of the sucker combinations. The productivity of plantain intercrops was significantly higher than that of the monoculture especially when maiden, sword sucker and peeper were intercropped annually with maize. Furthermore, intercropping plantain+maize had superior aggregate yield over the intercrop involving soybean.

Plantain was harvested very frequently (within 10-12 weekly intervals) when maiden, sword sucker and peeper were retained per mat under the intercropping system. The frequency however reduced to 15-17 weekly intervals in monoculture especially when maiden and sword sucker were retained.

Although the population/harvest was high (4998) when maiden, sword sucker and peeper were retained per mat, the plantain yield significantly increased in both monoculture and intercropping system because maiden, sword sucker and peeper exploited the growth resources and environment in relay over time resulting in frequent harvests probably for food and steady income.

The component yield availability showed sustainable production through diversified risk through staggered plantain growth and yields optimal manure demand and cost effectiveness.

The severity of black sigatoka disease of plantain at harvest was significantly reduced by intercropping and sucker management. Thus, when maiden, sword sucker and peeper were maintained the severity of black sigatoka disease was minimal irrespective of the intercropping system. The mixed crop species probably controlled the severity of sigatoka disease (Emebiri and Obiefuna, 1992, Ortiz et al 1995).

The soil acidity significantly reduced from pH 4.6 to 5.6 when plantains were intercropped. (Table 3) However, there was no appreciable difference in soil acidity either between or within the respective intercropping systems. The annual cultivation of mixed crop species (Ortiz et al. 1995) in the intercroppings system improved soil physical and chemical properties for an enhanced crop productivity (Lal, 1974, 1976, Devos and Wilson 1979). The presence of these annual crops and food legumes could have contributed significantly to nitrogen economy in crop succession (De et al. 1983) and probably stabilized cereal grain productivity (Halliday, 1982).

Wind damaged more plantains in monoculture than in the intercrop. However, most wind damage occurred when maiden and sword sucker were retained per mat irrespective of the cropping system. Plantains intercropped with maize recorded least wind damage irrespective of the sucker types retained per mat.

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Table 3: The post-experimental soil status and plantain related characteristics.

Intercropping System:	Sucker Combination	Soil pH	Wind Damage (%)	Plantain Harvest Frequency (ws)	BSS(%)	Root weight(g)
SOLE PLANTAIN	Maiden+ Sword Sucker	4.6	28.6	17.4	25.6	33.8
	Maiden+ Peeper	4.6	21.0	16.8	28.8	242.2
	Sword sucker + peeper	4.8	23.6	16.4	26.0	240.6
	Maiden + Sword sucker + peeper	4.4	12.8	15.2	20.2	248.4
PLANTAIN+ MAIZE	Maiden+ Sword sucker	5.5	16.4	1.8	18.8	244.8
	Maiden + Peeper	5.5	15.6	12.6	15.6	260.5
	Sword sucker + peeper	5.4	14.5	12.4	16.2	264.5
	Maiden + Sword sucker + peeper	5.6	14.4	10.4	14.4	286.2
PLANTAIN+ Soybean	Maiden + sword sucker	5.6	16.8	12.6	15.4	248.5
	Maiden + Peeper	5.6	12.5	12.6	15.0	262.5
	Sword sucker + peeper	5.6	12.4	12.4	15.0	260.5
	Maiden + Sword sucker +Peeper	5.6	10.8	10.2	12.0	268.6
	LSD 0.05	0.2	3.6	2.02	5.2	4.8

**BSS = Black Sigatoka Severity (%).*

minisett/maize/melon 0 WAPM and 14 WAPM, respectively. The implication of these results is that the higher maize (1.27 t/ha) and egusi melon (about 1.00 t/ha) yields were to compensate for the low seed yam yields in 1997 while in 1998, the three crop combination where minisetts were introduced at 0 and 14 WAPM favoured higher seed yam yields. The stand geometry for melon in 1997 was applied to all plots with melon. In 1998 when melon population was reduced by 50%, it was also applied to all plots with melon such that only year effects were affected.. The most acceptable option therefore is the system where the yam minisetts are intercropped with melon/maize either on the same day or are introduced not later than 14 days after melon, provided the melon population is 20000/ha.

Conclusions

We can draw the following conclusions from this study:

1. Yam minisetts performed better when grown early in the season, either as sole crop or as intercrop.
2. Intercropping yam minisetts was more productive than sole cropping, in terms of total productivity.
3. For optimum yield of the component crops, the yam minisetts should be introduced into melon/maize either on the same day with melon or not later than two weeks after planting melon.

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