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Intercropping Citrus Rootstock Seedlings with Seed Melon in the Nursery

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Abstract: The benefit of intercropping in the nursery is yet to receive the necessary research attention. Two experiments were conducted to assess the effect of intercropping seed melon at various spacings with citrus rootstock seedlings in the nursery. The intercropped seed melon did not affect the growth and development of the companion citrus seedlings at various patterns of planting melon. The citrus rootstock seedlings grown alone or intercropped with melon, produced plant girth, which ranged from 0.53 to 0.57 cm and 0.84 to 0.99 cm at 14 and 28 weeks after planting citrus in the nursery, respectively. The yields of seed melon grown in mixture with the citrus seedlings were significantly different. Melon suppressed weeds more with closer spacings of sowing and produced significantly lower weed spectrum and weed rating than sole crops of citrus seedling. The study showed that intercrop of melon at the spacings of 2×1 m, 2×2 m and 4×2 m used in this study are beneficial and tolerable for growing seed melon in association with citrus rootstock seedlings before budding.

Key words: Seed melon, egusi-melon, intercropping, citrus seedlings, rootstock

INTRODUCTION

In Nigeria, there is a renewed awareness of the importance of fruits in up-grading the nutrition of the greater people that feed mainly on starchy food. As a result, the growing of citrus seedlings is being intensified to meet the national target of fruit production. Consequently, many citrus nurseries and farms are springing up to complement the effort of government agencies such as National Horticultural Research Institute. However, the present sole cropping system of raising citrus seedlings in the nursery before field transplanting takes about 18 months. This is a fairly long period and under the tropical environment, the fragile soil is usually exposed to the hazards of erosion and fast regeneration of weeds. To forestall these agronomic setbacks, the cropping systems of the humid tropics are usually characterized by the use of cover crops or livemulch such as melons and legumes.

The most popular melon in Nigeria is *Citrullus lanatus* (seed melon). It is commonly called 'Egusi' in Nigeria. It belongs to the family, *Curcurbitaceae*. The seeds of the melon contain about 20-45% edible oil and 30-40% protein and which is rich in the enzyme urease[1]. It also makes highly cherished condiments for soup in Nigeria and probably elsewhere. Although the primary objective of growing economic livemulch may be to earn extra income or get varieties of food to meet family requirements, the carpet of vegetative materials formed by the livemulch, enables the protection of the soil from erosion and suppress weeds reasonably[2-5]. Biological weed control in crop production includes the use of low-growing crops such as egusi melon, to protect the soil from erosion and to smoother weeds[6]. Weed control using water-melon in tomato plot[7], seed melon in okra plot[8], cowpea in maize plot and *Psophocarpus palustris* in maize[9] seed melon (egusi-melon) in maize plot[10] have been grown successfully. Also, seed melon grown with pepper or okra as livemulch at various densities of sowing, were found to be compatible and beneficial[11,12]. A lot more benefits than the foregoing do accrue to the farmer when crops grown together are compatible. For example, Pino and Labrada[13] reported that the yields of tomato produced under the maize shade increased by 5-6t ha^{-1} with better fruit quality in comparism with tomato grown in monoculture. These advantages were attributed to modifications in the environment, such as reduction in radiation intensity of about 25% and the reduction of white fly by 24%. It is the objective of this study to assess the compatibility of various densities of growing seed melon in established citrus rootstock seedling nursery.

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MATERIALS AND METHODS

The study involved two trials, which were conducted at National Horticultural Research Institute (NIHORT), Ibadan, Nigeria (7° 24N, 3° 48E). The physico-chemical properties of the soil at the experimental site were as follows: pH, 7.5; Organic matter, 0.73%; Total N, 0.06%; and Available P, 7.84ppm. The exchangeable cations (mg 100 kg^{-1} soil) were as follows: Ca, 541; Mg, 112; Na, 66.7; and K, 82. The sand, silt and clay fractions were 89.8, 5.4 and 4.8% respectively. The two trials were conducted during the rainy season on the same citrus nursery plot before budding the juvenile seedlings. The 1st trial was initiated in April on a newly established plot, planted to six-month old citrus (*Cleopatra mandarin*) rootstock seedlings, which were transferred from the pre-nursery to a field nursery at a standard spacing of 40×30 cm. This period coincided with the on-set of the rainy season in the ecological zone. The second trial was repeated on the same plot in August immediately after the maturity of the melon grown in the first trial (14WAS). The melon was planted during the august break, when there was a dry spell. Randomized complete block design was used with four replications. Each plot measured 10×5 m. The treatments involved cropping pattern of citrus seedling or seed melon in pure stands and their combinations with melon, having a varying spacing for the melon component, commonly used under tropical production systems. The seed melon was planted a week after transplanting the citrus seedlings into the field. At planting, four seeds of melon per stand were sown and later thinned to 2 plants per stand, a week after seedling emergence. Each stand of melon seedling received 40 g of N.P.K. 15:15:15 at two weeks after emergence. Fertilizer was applied to citrus seedlings at 4 weeks after planting at the rate of 200 kg N, 100 kg P_2O_5 and 100 kg K_2O ha^{-1}. There were two weed control regimes. The first was carried out using hoe two weeks after seedling emergence and the second was by roguing when the melon vines had covered the ground reasonably. Insect pests were controlled with cypermetrine (Cymbush™) sprayed at the rate of 0.5 mL per litre of water.

At the maturity of the component melon, number of leaves, number of braches, plant height and plant girth of citrus seedlings were taken. The girth was estimated with veneer callipers at 10 cm from the base of the plant. Two representative quadrats measuring 2 by 2 m were taken per plot to determine yield components of melon. Weed data were also taken using the quadrat method. Data analysis was a two-way analysis of variance method and the mean differences were separated with Least Significant Difference (LSD) at p = 0.05.

RESULTS

Citrus seedling: This study showed that intercropping of seed melon and their densities of sowing did not affect the growth and development of citrus seedlings for the two trials conducted Table 1. Similarly, when the second trial of seed melon intercropping followed the first on the same plot, the growth of citrus seedling intercropped with seed melon compared favourably with citrus grown alone Table 1.

Seed melon: The yield and yield component of seed melon intercropped with citrus seedlings or grown alone in the first trial with respect to number of fruits m^{-2}, fruit weight and fruit circumference, were similar. The seed yield in the intercrop where superior to that of sole crop Table 2. In the second trial, melon intercrop with citrus grown at a spacing of 2×1 m produced the highest value of fruit number per m^2, but was inferior in individual fruit weight. Melon grown alone at a spacing of 2×2 m produced a higher fruit and seed yield. However, the fruit weight per m^2 did not differ with the varied cropping pattern. With regard to seed yield per m^2, sole crop melon produced the highest value of 152g m^{-2} Table 2. Seed yield per m^2 outyielded the melon grown in mixture with citrus seedlings by value of about 14-20%.

Weed interference: The types of weed on the experimental site included *Acalipha ciliata, Ageratum consizoides, Amaranthus spinosus, Euphorbia heterophylla* and *Tridax procumbens*. Others were *Panicum maximum, Bracharia lata, Oryza longisteminata* and *Maricus alternifolius.* Sole crop of citrus seedlings had significantly highest weed spectrum and weed rating when compared to plot sown to melon Table 3. Similarly, fresh and dry weight of weed per unit area of sole crop of citrus more than doubled the those plots intercropped with seed melon and the plot which had closest spacing of melon (2×1 m) depressed weed significantly Table 3. The presence of melon depressed weed weight by 49-70% and 19-41% in the first and second trials respectively.

Economic returns and mixture productivity: The income m^{-2} obtained as a result of intercropping melon with citrus seedlings were superior in the first trial while this was reversed to the advantage of the sole cropped melon in the second trial. The relative yields of melon component in the intercrop of second trial were lower than those of the first trial Table 4. The relative yield produced by seed melon were however high and ranged

Table 1: Growth and development of sole and intercropped citrus rootstock seedlings after seed melon harvest

	1st Trial (14 WAP[a])				2nd trial (28 WAP[a])			
Cropping pattern	No. of branches	No. of leaves	Plant ht.	Plant girth	Plant ht.	Plant girth	No. of branches	No. of leaves
Citrus alone	4	69	56	0.54	125	0.97	7	93
Citrus+seed melon (2×1 m)	3	56	47.6	0.57	104	0.84	7	61
Citrus+seed melon (2×2 m)	3	48	49.6	0.55	96	0.91	7	71
Citrus+seed melon (4×2 m)	4	58	41	0.53	120	0.99	10	79
Mean	3	58	48.0	0.55	111	0.93	7.7	76
LSD ($p \leq 0.05$)	NS	NS	NS	NS	NS	NS	NS	NS

a. = Weeks after planting citrus in nursery, NS = Means are not significantly different

Table 2: Yield and yield components of seed melon grown alone and intercropped with citrus seedlings in the nursery

	1st Trial (13 WAP)				2nd trial (27 WAP)			
Cropping pattern	No. of fruits No.m^2	Fruit weight kgm^{-2}	Fruit Circum.[b] cm.	Seed yield gm^{-2}	No of fruits No.m^{-2}	Fruit weight kg	Fruit weight kgm^{-2}	Seed yield gm^{-2}
Seed melon alone (2×2 m)	5	4.7	38	86	3.8	1.8	6.6	152
Citrus+seed melon (2×1 m)	6	6.4	40	123	4.3	1.4	5.9	120
Citrus+seed melon (2×2 m)	6	6.3	39	122	3.3	2.0	6.5	131
Citrus+seed melon (4×2 m)	6	5.4	39	109	4.0	1.6	6.5	131
Mean	6	5.7	39	110	3.8	1.7	6.4	134
LSD ($p \leq 0.05$)	NS	NS	NS	*	*	*	NS	*

WAS = Week after planting citrus rootstock seedlings, Circum = Circumference of melon fruits, NS and * = Means are not significantly different and significantly different respectively

Table 3: Rating, spectrum and yield of weed at maturity of seed melon grown with citrus rootstock seedlings and their sole crops

			1st Trial (14WAP)		2nd Trial (28 WAP)	
			Weed weight (gm^{-2})		Weed weight (gm^{-2})	
Cropping pattern	Weed rating[a]	Weed spectrum[b]	Fresh	Dry	Fresh	Dry
Citrus alone	4.3	7	1438	297	1430	487
Seed melon alone (2×2 m)	3.3	4	728	136	705	300
Citrus+seed melon (2×1 m)	1.4	4	443	74	737	272
Citrus+seed melon (2×2 m)	2.4	4	617	107	727	270
Citrus+seed melon (4×2 m)	2.5	3	688	126	1177	365
Mean	2.4	4	782	148	955	399
LSD ($p \leq 0.05$)	*	*	*	*	*	*

a. = Weed rating of 1-5; 1 = low density of weeds and 5 = high density of weeds, b. = Weed spectrum indicates the number of dominant weed species in, plot, * = Means are significantly different, WAP = weeks after planting citrus rootstock seedlings

Table 4: Income, relative yields and Land Equivalent Ratio (LER) of intercropping citrus rootstock seedlings and seed melon.

	Income[a] (N m^{-2}) from melon		Relative yields[b]		LER[c]	
Cropping pattern	1st	2nd	1st	2nd	1st	2nd
Seed melon alone (2m x2m)	21.5	38.0	1	1	1	1
Citrus+seed melon (2×1 m)	30.8	30.0	1.43	0.79	2.43	1.79
Citrus+seed melon (2×2 m)	30.5	32.8	1.42	0.86	2.42	1.86
Citrus+seed melon (4×2 m)	27.3	33.5	1.26	0.86	2.26	1.86
Citrus alone	0	0	1	1	1	1

a. Price of seed melon is based on N250 kg^{-1}; (N130 = US\$1), b. Relative yields are based on those of sole crop. c. LER = Land equivalent ratio assumes that the relative yields contributed by citrus was 1, since the growth was not affected by seed melon intercrop.

between 0.79 and 1.43. The relative yields of citrus were given a hypothetical value of 1, since they were not depressed by the presence of melon. This translated the Land Equivalent Ratio (LER) to range from 1.79 to 2.43. Therefore, the efficiency in the utilization of land by intercropping melon more than doubled in the first trial, while they gave efficiency of land utilization that almost doubled in the second trial.

DISCUSSION

The girth obtained for citrus in this study at 28WAP are comparable to the diameter of a pencil which shows that they have all reached buddable size irrespective of the cropping pattern or densities of growing melon with citrus. The compensatory trend between number of fruit m^{-2} and weight/fruit in the pattern of planting are similar in both trials. This study has shown that melon is compatible with citrus and can control weeds to a reasonable level in citrus nursery. Similar observations have been made with other crops[8,11,12,14]. The ground cover created by seed melon deprived the weeds of much needed sunlight and therefore etiolated. Weed suppression and possibly, soil moisture conservation provided by creeping seed melon, is desirable agronomic need for tropical environment. It is possible that additional returns obtained from seed melon in this study can partly offset the running costs of raising citrus seedlings. Such innovation could expand the area that can be used for raising citrus seedlings to meet national targets, for the production of citrus seedlings.

The major advantage derived from the intercrop is most probably due to the different architectures and growth patterns of the component crops. The citrus seedling is upright and less vigorous in growth, while the seed melon forms a carpet of vigorous vegetative growth. The latter imposes high growth requirement while the former is probably lower in growth requirement because of its slow rate of growth. The crop combination of melon and citrus is therefore complimentary. Another plausible reason for the successful intercrop may be due to limited competition for environmental growth factors. Competition for growth factors in intercrop is synonymous with competition of crops with weeds. Such competition may either be for light, nutrient or water. Water was not limiting during the growing seasons, because there was adequate rainfall during the growing season. Both crops derive their photosynthetic active radiation from different zones. The citrus seedlings had minimal shade. The only likely competition here was for nutrient, since the roots of both crops grow very long to forage for nutrients, which were adequately applied.

This study has shown that intercrop of melon at the spacings of 2×1 m, 2×2 m and 4×2 m are economic and tolerable ranges of sowing seed melon, when in association with citrus seedlings in the field nursery. It is also possible to grow two crops of seed melon before budding, when properly timed.

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