Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

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Asian Journal of Plant Sciences 5 (3): 534-536, 2006
ISSN 1682-3974

Productivity of Cleopatra Mandarin Rootstock Seedlings Intercropped with Cucumber

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Abstract: Cleopatra mandarin *(Citrus reticulata reshni)* citrus rootstock seedlings were intercropped with cucumber *(Cucumis sativus Cv. Poinstett)* in the nursery at different plant densities of 10,000 (1×1 m), 4,444 (1.5×1.5 m), 2500 (2×2 m) and 1600 (2.5×2.5 m) ha^{-1} during the late planting season of 1998 and 1999. The studies were aimed at determining the optimum cucumber density compatible with Cleopatra mandarin citrus rootstock seedlings, which should also serve as income generation to the nursery citrus farmers with minimal hindrance to the growth of the citrus seedlings. The cucumber population above 2,500 plants ha^{-1} significantly affected the growth of Cleopatra mandarin rootstock growth seedlings. The percentage increases in plant height, number of leaves and stem diameter in intercrop of cucumber population below 2500 plant ha^{-1} were higher than rootstock seedlings intercropped with cucumber population above 2500 ha^{-1}. However cucumber growth was not affected by intercropping or the population intercropped with citrus. Cucumber intercrop of 10,000 ha^{-1} gave the highest yield of cucumber fruit, while the highest profit margin of 80.3% was recorded by cucumber intercrop of 4,444 ha^{-1}. Cucumber intercrop of 1600 ha^{-1} had the lowest profit margin of 66.2%. Cucumber population of 2500 ha^{-1}, which recorded 78.7% profit margin, is suggested as optimum for minimal hindrances to citrus seedlings growth and modest cucumber yield.

Key words: Rootstock seedling, cucumber, intercrop, plant density, growth, profit margin

INTRODUCTION

Production of budded citrus seedlings in an open field takes between 12-18 months depending on management before the budling is ready for orchard establishment. During this period no income is generated to the nurseryman. In order to optimize resource use there is the need to look into the possibility of including intercrop with citrus rootstock seedlings. The selection of the intercrop must be of short gestation period and would not affect the growth of citrus seedlings. Besides the intercrop should be income generating for the citrus farmers. Information is available on choice of intercrop to be included in established citrus orchard (Murray, 1984; Lameira and Oliveria, 1992; Olaniyan, 2001). However, the intercrop reported suitable in the citrus orchard might not necessarily be suitable for citrus nursery. Some of the reasons include spacing and the gestation period of the intercrop. The spacing in permanent orchards is wider than the one used in the nursery, also the orchard can accommodate intercrop with more than six months gestation period, which is not feasible in citrus nursery. Ojeifo *et al.* (1989) reported intercropping citrus rootstock seedlings with *colocynthis citrullus* (Egusi melon) and *Citrullus lanatus* (Water melon) spaced at 0.3×0.4 m in the nursery just before budding. Their finding showed that the intercrops were sources of income, when the seedlings were not ready for sales. The crop to be included has to command higher price in citrus intercrop. Cucumber *(Cucumis sativa)* is a crop that is usually grown during the dry season under irrigation in urban cities of southwestern Nigeria. It sells fast and command high price. Including it as an intercrop in citrus nursery will not only generate income to the nursery farmers but will also save cost of production because the intercrop has to be managed simultaneously with the citrus seedlings.

The study evaluated growth pattern of Cleopatra mandarin seedlings intercropped with different population of cucumber as well as the intercrop system.

MATERIALS AND METHODS

During the late planting seasons of 1998 and 1999 cucumber *(Cucumis sativa* cv. Pointsett) was intercropped with Cleopatra mandarin rootstock seedlings

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Table 1: Pre-planting soil analysis of the experimental site

Soil property	Values
pH (H_2O)	7.27
Organic Carbon (g kg^{-1})	6.70
Total Nitrogen (g kg^{-1})	0.60
Available P (mg kg^{-1})	6.93
Exchangeable cations (cmol kg^{-1})	
Ca	2.82
Mg	0.88
K	0.29
Effective CEC (cmol kg^{-1})	4.21
Exchangeable micronutrients (mg kg^{-1})	
Mn	86.00
Fe	8.80
Cu	0.60
Zn	5.70
Sand (g kg^{-1})	80.10
Silt (g kg^{-1})	147.00
Clay (g kg^{-1})	52.00

at the fruit nursery site of the National Horticultural Research Institute (NIHORT) in Ibadan. The site lies between longitude 3°50' and 3°52' East and latitudes 7°32' and 7°25' North. The soils in the experimental area belong to the main soil series of Egbeda and Iwo (Jaiyeoba, 1974). The annual rainfall was 1430 mm, maximum temperature range of 27.0-30.0°C and minimum temperature range was about 24.6°C. Relative humidity was 73-87, 38-47 and 83-95% at 0900, 1500 and 2100 h, respectively, (Metrological record, National Horticultural Research Institute, Ibadan). The physical and chemical properties of the soil at 0-15 cm were determined before the study commenced, are presented in Table 1. Six-months old Cleopatra mandarin *(Citrus reticulata Reshni)* rootstock seedlings spaced at 0.3×0.4 m (83,333 plants ha^{-1}) in staggered configuration were intercropped with Cucumber at spacing of 1.0×1.0 m, 1.5×1.5 m, 2.0×2.0 m and 2.5×2.5 m (10,000, 4,444, 2500 and 1,600 plants ha^{-1}, respectively). Each plot size was 5.0×10.0 m. The effects of intercropping were compared with sole Cucumber and sole Cleopatra mandarin rootstocks spaced 2.0×2.0 m and 0.3×0.4 m, respectively. Treatments were assigned in a randomized complete block design with 5 replications. Maintenance operation included manual hoe weeding; the plot was sprayed 2 times during each planting period with cymbush at the rate of 10 mLs/201 of water against insect attack, especially against insect defoliators on cucumber. The field was irrigated every 3 days to field capacity using overhead sprinklers.

Date collection on the growth of Cleopatra mandarin rootstock as affected by cucumber intercrop was determined at 4-week intervals using six rootstock seedlings from the middle row. Since cucumber is a climber, number of rootstock seedlings bent by the vines of the cucumber was also counted. Cucumber vines length was measured by meter's tape, cucumber fruit yield was determined in a transect of 50 m^2, starting from eight weeks after planting at weekly interval for eight weeks until senescence set in. The data were subjected to analysis of variance for detection of treatment effects. Records of all inputs and services were kept to calculate wages for labour, while prevailing market prices were used to calculate monetary yields of the intercrops.

RESULTS AND DISCUSSION

Cleopatra mandarin seedlings growth was largest in sole stands followed by seedlings intercropped with cucumber at 2.5×2.5 m (1,6000 plants ha^{-1}). Growth of citrus seedlings was progressively retarded as population of cucumber increased (Table 2). The number of citrus seedling 'bent' by cucumber vines also increased as population of cucumber intercrop increased. Bending of citrus seedling was caused by the weight of the cucumber vines that trailed on them. The vigor of citrus seedlings was progressively curtailed as the weight of vines on the citrus seedling increased. Such retardation in growth would lead to increase in time required by seedlings to attain buddable size and thus increase seedlings production cost. Therefore high population of cucumber, above 2,500 plants ha^{-1} was found inimical to Cleopatra mandarin citrus rootstock growth in the nursery.

Growth of cucumber was not significantly influenced by intercropping or by the population intercropped with citrus. However, yield of cucumber intercropped with citrus increased with population (Table 3). This suggest the aggressivity of cucumber to compete for growth resources when intercropped with Cleopatra mandarin rootstock seedlings which is noted for its slow growth (Oseni, 1987), Similarly, Olaniyan *et al.* (1998) reported in their study on the selection of suitable rootstock materials, that although, Cleopatra mandarin rootstock is most suited for the locality of this study, it is slow in growing.

Monocrop of Cleopatra mandarin rootstock seedlings did not record economic yield value because of time to attain economic maturity period, all the intercrops of Cleopatra mandarin had yield values for the Cucumber (Table 4). Cucumber intercrop of 1600 ha^{-1} had yield value of N122, 000. Cucumber at population of 4,444 ha^{-1} recorded the highest profit margin of 80.3%, but cucumber intercrop of 1600 ha^{-1} had the lowest profit margin of 66.2% (Table 4).

Intercropping citrus seedlings with cucumber is profitable but the optimum population of cucumber is important for its success. Whereas intercropping with cucumber resolves the issue of cash flow during the waiting period (Table 4), for seedling to attain buddable size in good time, excessively high populations should be

Table 2: Growth response of citrus rootstock seedlings to intercropping with cucumber 12 weeks after planting cucumber

		Seedling height (cm)			No. of leaves			Steam diameter (cm)			
Cropping system	Spacing (m)	B/F	A/F	Incr. (%)	B/F	A/F	Incr. (%)	B/F	A/F	Incr. (%)	No. of bent seedlings
Sole citrus		30.90	69.70	126.5	23.40	48.9	109.0	0.30	0.55	8.33	0.00
Citrus + Cucumber											
1,600 plants ha^{-1}	2.5×2.5	31.20	65.83	111.0	24.40	47.4	94.3	0.29	0.47	6.21	3.20
2,500 plants ha^{-1}	2×2	31.90	64.76	108.9	26.40	47.5	79.9	0.32	0.48	50.00	3.00
4,444 plants ha^{-1}	1.5×1.5	31.80	64.61	103.2	26.30	47.1	79.1	0.32	0.47	46.90	4.60
10,000 plants ha^{-1}	1×1	31.80	59.01	85.6	28.10	45.7	62.6	0.33	0.47	42.40	8.20
SEM		42.56			32.67			0.23			0.26

B/F- Before planting cucumber, A/F-12 weeks after cucumber planting, Incr.%-Percentage increase

Table 3: Growth and yield response of cucumber intercropped with seedlings

Cropping system	Vine length (m)	No. of fruit 50 m^{-2}	No. of $Plant^{-1}$	Weight of fruit (plant kg^{-1})	Weight of fruit (t ha^{-1})
Sole cucumber					
(2,500 plants ha^{-1}	1.01	254.0	20.4	4.40	11.00
Citrus + Cucumber					
1,600 plants ha^{-1}	1.01	138.0	17.3	3.80	6.10
2,500 plants ha^{-1}	1.03	212.0	17.0	3.60	9.10
4,444 plants ha^{-1}	0.97	220.0	9.9	3.50	15.40
10,000 plants ha^{-1}	1.09	394.0	7.0	1.80	17.90
SEM	0.48	15.4	1.1	0.62	0.14

Table 4: Productivity (₦) an hectare citrus rootstock seedling intercropped with different cucumber density

Cropping pattern	Yield (Kg)	Selling Price/kg (N)	Yield value (N)	Production cost (N)	Profit (N)	Profit margin (%)
Sole Cucumber						
2,500 plants ha^{-1}	11,000	20	220,000	47,940	172,060	78.20
Citrus + Cucumber						
1,600 plants ha^{-1}	6,100	20	122.000	41,260	80,740	66.20
2,500 plants ha^{-1}	9,100	20	182,000	47,940	134,060	73.70
4,444 plants ha^{-1}	15,400	20	308,000	60,660	247,340	80.30
10,000 plants ha^{-1}	17,900	20	358,000	104,520	253,480	70.80
Sole citrus						
(83,333 plants ha^{-1})	-	50	-	75,460	-	-

avoided. A population of 2500 (2×2 m) cucumber plant is suggested as optimum for minimal hindrance to citrus seeding growth and modest cucumber yield and revenue. In traditional Agriculture that is predominated by intercropping systems, benefits have been documented (Unamma *et al*., 1992). In this instance, sustaining the citrus rootstock nursery through the dry season period with regular watering is compensated by the returns generated from the intercropped cucumber.

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