

Optimizing spatial arrangements and planting schedules for cassava-watermelon intercropping in the Amazon Savannah

Edgley Soares Silva, Roberto Dantas de Medeiros, José de Anchieta Alves de Albuquerque, João Luiz Lopes Monteiro Neto, *Musibau Oyeleke Azeez, Ademar Bezerra Alves, José Maria Arcanjo Alves, Valdinar Ferreira Melo, Maria Beatriz Bernades Soares, Everton Luis Finoto

Table S1. Average values of number of fruits less than 5.0 kg per hectare (NF<5.0 kg ha⁻¹), number of fruits per hectare between 5.0 and 10.0 kg (NF 5.0 and 10 kg ha⁻¹), number of fruits greater than 10.0 kg per hectare (NF >10.0 kg ha⁻¹), total number of fruits per hectare, average mass and productivity of watermelon fruits (*Citrullus lanatus*) growing in intercropping with cassava (*Manihot esculenta*), under different spatial arrangements and planting times, Boa Vista, Roraima, 2025

Means	Spatial arrangement (A)					Media
	PCAPW (days)	I	II	III	V	
		NF < 5.0 kg ha ⁻¹ (CV1% 22.44 & CV2% 35.09)				
	0	688.99 aA	538.58 aA	1054.65 aA	605.31 aA	721.88 a
	10	656.91 aA	802.74 aA	951.60 aA	962.76 aA	843.50 a
	20	565.96 aA	733.39 aA	390.24 aA	818.99 aA	627.14 a
	30	555.99 aA	697.63 aA	382.97 aA	793.66 aA	607.32 a
	Mean	616.72 A	693.08 A	694.86 A	795.18 A	
	NF 5.0 and 10.0 kg ha ⁻¹ (CV1% 27.03 & CV2% 37.07)					
	0	2796.59 aA	3155.67 aA	2229.27 aA	2925.00 aA	2776.63 a
	10	1911.14 aA	2381.06 aA	2799.38 aA	2360.81 aA	2363.09 a
	20	2868.13 aA	2920.02 aA	2818.37 aA	2733.74 aA	2835.06 a
	30	2804.26 aA	2737.83 aA	2766.14 aA	2696.84 aA	2751.27 a
	Mean	2595.03 A	2798.64 A	2653.29 A	2679.09 A	
	NF > 10.0 kg ha ⁻¹ (CV1% 28.34 & CV2% 32.95)					
	0	2143.13 aA	2375.20 aA	2617.49 aA	2076.18 aA	2303.00 a
	10	1752.53 aA	2430.03 aA	2740.08 aA	2493.93 aA	2354.14 a
	20	2585.98 aA	2064.82 aA	3416.80 aA	2672.85 aA	2685.11 a
	30	2532.32 aA	1968.86 aA	3353.81 aA	2617.01 aA	2618.00 a
	Mean	2253.49 A	2209.73 A	3032.05 A	2464.99 A	
	Total number of fruits per ha ⁻¹ (CV1% 22.73 & CV2% 24.64)					
	0	5977.48 aA	5977.48 aA	5901.41 aA	5628.73 aA	5778.53 a
	10	5613.83 aA	5613.83 aA	6491.06 aA	4320.59 aA	5560.75 a
	20	5718.24 aA	5718.24 aA	6625.42 aA	6020.09 aA	6147.33 a
	30	5404.32 aA	5404.32 aA	6502.93 aA	5891.60 aA	5976.59 a
	Mean	5465.25 A	5678.47 A	6380.20 A	5939.27 A	
	Average fruit mass (kg) (CV1% 5.89 & CV2% 5.71)					
	0	8.16 aA	8.06 aA	8.13 aA	8.61 aA	8.24 a
	10	8.64 aA	8.26 aA	8.05 aA	8.30 aA	8.32 a
	20	7.75 aA	8.01 aA	8.18 aA	8.20 aA	8.03 a
	30	7.75 aA	8.01 aA	8.18 aA	8.20 aA	8.03 a
	Mean	8.07 A	8.09 A	8.13 A	8.33 A	
	Productivity (kg ha ⁻¹) (CV1% 25.09 & CV2% 24.35)					
	0	45427.50 aA	48040.00 aA	47617.50 aA	48190.00 aA	47318.75 a
	10	37037.50 aA	46202.50 aA	52147.50 aA	48075.00 aA	45865.56 a
	20	46705.00 aA	46722.50 aA	54005.00 aA	50835.00 aA	49566.87 a
	30	45705.00 aA	44222.50 aA	53005.00 aA	49835.00 aA	48191.87 a
	Mean	43718.75 A	46296.87 A	51693.75 A	49233.75 A	

followed by the same letters, lowercase in the columns and uppercase in the lines, do not differ from each other using the Tukey test at 5% probability. I = cassava planted in a single row (4.0 m x 1.0 m) on the same side of the watermelon sowing furrow; II = cassava planted in a single row (3.5 x 1.0 m) on the opposite side of the watermelon sowing furrow; III = cassava planted in a double row (3.5 x 1.0 x 0.5 m) on both sides of the watermelon sowing furrow and V = watermelon sown in a single row (4.0 m x 1.0 m). CV1=coefficient of variation corresponding to the residues of blocks and plots (arrangements); CV2=coefficient of variation corresponding to the residues of plots (periods of implementation of the arrangements); PCAPW=Planting cassava after planting watermelon (days)

Table S2. Average values of plant height, stem diameter, number of shoots, fresh shoot mass, dry shoot mass, chlorophyll a, and chlorophyll b in cassava plants (*Manihot esculenta* Crantz), grown in intercropping with watermelon (*Citrullus lanatus* L.), under different spatial arrangements and planting times, Boa Vista, Roraima, 2025.

PCAPW (days)	Spatial arrangement (A)				Mean
	I	II	III	IV	
	Plant height (m) (CV1% 8.99 & CV2% 9.45)				
0	2.26 aA	2.04 aA	2.05 aA	2.24 aA	2.14 a
10	2.14 aA	1.73 aA	2.06 aA	1.89 aA	1.96 b
20	2.15 aA	1.78 aA	1.85 aA	2.05 aA	1.95 b
30	1.92 aA	1.47 aA	1.32 aA	1.70 aA	1.60 c
Mean	2.12 A	1.75 C	1.82 BC	1.97 B	
Stem diameter (cm) (CV1% 13.95 & CV2% 10.07)					
0	3.29 aA	2.66 aA	2.74 aA	2.97 aA	2.92 a
10	3.06 aA	2.22 aA	2.32 aA	2.16 aA	2.44 b
20	3.03 aA	2.18 aA	2.17 aA	2.59 aA	2.49 b
30	1.95 aA	1.62 aA	1.74 aA	1.74 aA	1.77 c
Mean	2.83 A	2.12 B	2.24 B	2.37 B	
Number of stems (CV1% 23.90 & CV2% 23.59)					
0	2.43 aA	2.06 aA	2.50 aA	3.00 aA	2.50 a
10	2.56 aA	2.12 aA	3.25 aA	3.25 aA	2.79 a
20	2.25 aA	2.87 aA	2.31 aA	3.31 aA	2.68 a
30	1.93 aA	1.87 aA	1.75 aA	1.87 aA	1.85 b
Mean	2.29 B	2.23 B	2.45 AB	2.85 A	
Fresh aerial part mass (kg) (CV1% 32.58 & CV2% 25.38)					
0	2.13 aA	0.83 aB	2.46 aA	2.35 aA	1.94 a
10	1.50 aB	1.43 aB	1.47 bcB	2.35 aA	1.69 a
20	1.67 aA	1.51 aA	1.77 bA	1.36 bA	1.58 a
30	1.97 aA	1.52 aAB	0.93 cBC	0.47 cC	1.22 a
Mean	1.82 A	1.32 B	1.66 AB	1.64 AB	
Dry mass of aerial part (kg) (CV1% 33.47 & CV2% 24.43)					
0	0.49 aA	0.44 aA	0.45 bA	0.58 abA	0.49 a
10	0.61 aA	0.26 aB	0.78 aA	0.74 aA	0.60 a
20	0.52 aA	0.57 aA	0.55 abA	0.41 bcA	0.51 a
30	0.45 aA	0.46 aA	0.31 bA	0.15 cA	0.34 a
Mean	0.52 A	0.43 A	0.52 A	0.47 A	
Chlorophyll a (CV1% 10.90 & CV2% 6.90)					
0	28.11 aA	26.86 aA	26.93 aA	24.92 aA	26.70 a
10	26.62 aA	27.80 aA	29.08 aA	26.46 aA	27.49 a
20	26.60 aA	27.23 aA	27.90 aA	27.07 aA	27.20 a
30	25.63 aA	26.23 aA	25.42 aA	27.30 aA	26.14 a
Média	26.74 A	27.03 A	27.33 A	26.44 A	
Chlorophyll b (CV1% 22.65 & CV2% 13.65)					
0	4.65 aA	4.47 aA	4.28 aA	3.90 aA	4.32 a
10	3.97 aA	4.87 aA	4.67 aA	4.03 aA	4.39 a
20	4.36 aA	4.71 aA	4.93 aA	5.07 aA	4.77 a
30	3.56 aA	4.20 aA	3.72 aA	4.42 aA	3.97 a
Mean	4.13 A	4.56 A	4.40 A	4.35 A	

followed by the same letters, lowercase in the columns and uppercase in the lines, do not differ from each other using the Tukey test at 5% probability. I = cassava planted in a single row (4.0 m x 1.0 m) on the same side of the watermelon sowing furrow; II = cassava planted in a single row (3.5 x 1.0 m) on the opposite side of the watermelon sowing furrow; III = cassava planted in a double row (3.5 x 1.0 x 0.5 m) on both sides of the watermelon sowing furrow and IV = cassava planted in single cultivation in a double row (3.5 x 1.0 x 0.5 m) on both sides of the furrow. CV1=coefficient of variation corresponding to the residues of blocks and plots (arrangements); CV2=coefficient of variation corresponding to the residues of plots (periods of implementation of the arrangements); PCAPW=Planting cassava after planting watermelon (days)

Table S3. Average values of harvest index, total root number, commercial root number, average total root mass, average commercial root mass, total yield, and commercial yield of cassava (*Manihot esculenta*) grown in intercropping with watermelon (*Citrullus lanatus*) under different spatial arrangements and planting times, Boa Vista, Roraima, 2025.

PCAPW (days)	Spatial arrangement (A)				Mean
	I	II	III	IV	
	Harvest index (%) (CV1% 8.92 & CV2% 9.77)				
0	80.0 aA	87.0 aA	65.0 aA	71.0 aA	76.0 a
10	79.0 aA	68.0 aA	77.0 aA	62.0 aA	71.0 a
20	71.0 aA	66.0 aA	68.0 aA	74.0 aA	70.0 a
30	64.0 aA	53.0 aA	76.0 aA	83.0 aA	69.0 a
Mean	73.0 A	68.0 A	71.0 A	72.0 A	
Total number of roots (CV1% 31.02 & CV2% 17.75)					
0	36406.25 aA	21406.25 aB	24062.50 aB	22031.25 aB	25976.56 a
10	28593.75 bA	15312.50 aB	26093.75 aAB	25468.75 aAB	23867.18 a
20	23750.00 bcA	16875.00 aA	17343.75 aA	21093.75 aA	19765.62 a
30	20312.50 cA	16562.50 aA	22500.00 aA	19375.00 aA	19687.50 a
Mean	27265.62 A	17539.06 C	22500.00 B	21992.18 B	
Number of commercial roots (CV1% 34.40 & CV2% 25.76)					
0	24687.50 aA	13437.50 aA	17812.50 aA	17656.25 aA	18398.43 a
10	16406.25 aA	9843.75 aA	14062.50 aA	14218.75 aA	13632.81 ab
20	11718.75 aA	9062.50 aA	10312.50 aA	13906.25 aA	11250.00 b
30	12187.50 aA	8593.75 aA	13125.00 aA	9062.50 aA	10742.18 b
Mean	16250.00 A	10234.37 B	13828.12 A	13710.93 A	
Total average root mass (kg) (CV1% 32.04 & CV2% 26.37)					
0	0.60 aA	0.72 aA	0.48 aA	0.64 aA	0.61 a
10	0.52 aA	0.53 aA	0.54 aA	0.41 aA	0.50 ab
20	0.44 aA	0.49 aA	0.55 aA	0.50 aA	0.50 ab
30	0.45 aA	0.27 aA	0.36 aA	0.31 aA	0.35 b
Mean	0.50 A	0.50 A	0.48 A	0.47 A	
Average mass of commercial root (kg) (CV1% 32.02 & CV2% 29.47)					
0	0.78 aA	0.91 aA	0.71 aA	0.74 aA	0.78 a
10	0.65 aA	0.63 aA	0.74 aA	0.58 aA	0.65 ab
20	0.56 aA	0.71 aA	0.84 aA	0.66 aA	0.69 ab
30	0.63 aA	0.45 aA	0.42 aA	0.45 aA	0.48 b
Mean	0.65 A	0.67 A	0.68 A	0.61 A	
Total Productivity(kg ha ⁻¹) (CV1% 21.20 & CV2% 25.45)					
0	21346.87 aA	15323.43aB	11578.12 abB	14665.62 aB	15728.51 a
10	14589.06 bA	7764.06 bB	13342.18 aA	9878.12 abAB	11393.35 b
20	10257.81bcA	7273.43 bA	9556.25 abA	10409.37 abA	9374.21 b
30	9150.00 cA	4432.81 bA	7484.37 cA	5965.62 bA	6758.20 c
Mean	13835.93 A	8698.43 B	10490.23 B	10229.68 B	
Comercial productivity (kg ha ⁻¹) (CV1% 31.07 & CV2% 31.69)					
0	18253.12 aA	12181.25 aA	12545.31 aA	13381.25 aA	14090.23 a
10	10817.18 aA	5821.87 aA	9975.00 aA	8343.75 aA	8739.45 b
20	6546.87 aA	5728.12 aA	7884.37 aA	8900.00 aA	7264.84 bc
30	7235.93 aA	3478.12 aA	4929.68 aA	3859.37 aA	4875.78 c
Mean	10713.28 A	6802.34 B	8833.59 AB	8621.09 AB	

Means followed by the same letters, lowercase in columns and uppercase in rows, do not differ from each other according to Tukey's test at a 5% probability level.

I = Cassava planted in a single row (4.0 m x 1.0 m) on the same side of the watermelon sowing furrow. II = Cassava planted in a single row (3.5 m x 1.0 m) on the opposite side of the watermelon sowing furrow; III = Cassava planted in a double row (3.5 m x 1.0 m x 0.5 m) on both sides of the watermelon sowing furrow; IV = Cassava planted as a sole crop in a double row (3.5 m x 1.0 m x 0.5 m) on both sides of the furrow; CV1=coefficient of variation corresponding to the residues of blocks and plots (arrangements); CV2=coefficient of variation corresponding to the residues of plots (periods of implementation of the arrangements); PCAPW=Planting cassava after planting watermelon (days)