Effects of Cultivars and Plant Spacing on Foliage and Sucker Production of Taro [*Colocasia esculenta (* L.)] on the Plains of Nsukka, Nigeria

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Abstract
A field experiment was conducted during 2008 and 2009 farming seasons at the Linkage Farm of the University of Nigeria, Nsukka to assess the effects of the cultivars and plant spacing on foliage and sucker production of taro on the plains of Nsukka. The experiment was laid in a 3 x 5 factorial experiment in randomized complete block design (RCBD) in which factor A forms plant spacing comprising 0.3 m x 1.0 m, 0.4 m x 1.0 m and 0.5 x 1.0 m while factor B forms taro cultivars consisting of Nkong, Odogolo, Nworoko, Coco-India and Nachi. There were 15 treatment combinations with three replicates. Data were analyzed using descriptive statistics and analysis of variance at 5% level of probability. The results indicated significant cultivar effects on the number of leaves/plant during 2008 and 2009 farming seasons throughout the four intervals of measurement. Within these periods, Coco-India produced the highest number of leaves/plant. Also, there were significant differences of cultivar effect on the number of suckers/plant in both seasons throughout the measuring intervals with coco-India producing the highest number of suckers/plant in several times. But, in most cases, plant spacing produced non-significant effects on the traits in both seasons, whereas effect of cultivar x plant spacing interaction differed significantly on the traits in both seasons.

Keywords: *Taro, cultivar, foliage, tillering, cocoyam, accessions*

INTRODUCTION

Cocoyam is a monocotyledonous crop that has the attribute of an underground stem. It differs from yam as it is not a tuber but a corm. Edible cocoyams or aroids belong to the family of plants called Araceae with two genera of which are taro(*Colocasia esculenta*) and Tania (*Xanthosoma sagittifolium*) (Uguru, 2011).Cocoyam is a general name for both taro and Tania in southeastern Nigeria. It is called *ede* in Igbo, *ikpong* in Efik, *isukoko* in Yoruba and *gwaza /mankani* in Hausa. Cocoyam is grown mainly for the corms and cormels in south eastern Nigeria, although the foliage (leaves), petioles and flowers are also eaten as vegetables in soup during the vegetables-

lean periods. The leaves can be fed to cattle and pigs as browse. They are also used for wrapping processed food like fufu and sliced cooked oil bean seed (Ezedinma, 1987) . Cocoyam leaves are equally used for wrapping and preserving kola nuts , bitter cola as well as fermenting *ogiri* .The young leaves and petioles contain about 23% protein on dry weight basis. They are rich in calcium , phosphorous , iron vitamin C, thiamin , riboflavin, and niacin which are important constituents of human diet (Onwueme, 1999; Ndon *et al.*, 2003).The leaves are used as nutritious spinach with preparation of stews and sauces in Ghana (Asumadu *et al*., 2011). The corms and cormels of cocoyam which are the major economic part contain about 15% to 39% carbohydrates, 2 to 3% protein and 70 to 77% water (Ndon *et al.*, 2003).
In a socioeconomic survey conducted by Quaye *et al*. (2010), they found out that majority of the farmers in Ghana mainly cultivated cocoyam for both the cormels and leaves , but very few of them cultivated it purposely for the cormels only.

Where cocoyam is grown in Uganda , taro corms have high economic values in urban markets .Its production provides employment to many people and the crop maintains good ground cover(soil conservation) in the fields (Talwana *et al.*, 2009).Taro is a staple food for many people in developing countries in Africa , Asia , and the pacific (Agueguia *et al*., 1992).It is mainly produced in Nigeria and China, but it is most important per capita in oceanic (Howeler *et al*.,1993, Onwueme , 1999).

In spite of the advances made in cocoyam research, several factors remain as challenges to sustain cocoyam production in Nigeria. The ignorance of the nutritive values and diversities of food forms from cocoyam by a large percentage of the populace is a major limiting factor to the general acceptability and extensive production of the crop. The notion that cocoyam is a poor man's crop is still prevalent and needs to be discarded through proper extension of information (NRCRI,2009).Due to the above challenges ,this study is aimed at determining the optimum foliage- and sucker- producing cultivar and plant spacing of taro [*Colocasia esculenta* (L.)]. Schott on plains of Nsukka , Nigeria..

MATERIALS AND METHODS

The field experiment was conducted at the Linkage Farm of the University of Nigeria, Nsukka, Enugu State. Nsukka lies on a longitude 6^0 45^1 E and latitude 7^0 12.5^1N with altitude 447m above sea level. This study was carried out between June and December each cropping season. Daily weather conditions on temperature and relative humidity were collected and recorded. Soil samples were collected at the experimental site at the depth of 0-20cm with an auger. The samples were properly mixed to get a composite sample from which a subsample was used for laboratory analysis to determine the physico-chemical characteristics of the soil. Three local cultivars of taro were sourced from the study area among which was: *Odogolo, Nworoko* and *Nachi*. Two others- *Nkpong* with accession number NCe 005 and Cocoa-India (*Ugwuta)* with accession number NCe 001 were obtained from National Root Crop Research Institute (NRCRI), Umudike, bringing the total number to five. A piece of land with a dimension of 11m× 38 m was cleared. The land was ploughed, harrowed and ridged with a tractor. The ridges were converted into plots of bed manually. Each plot of bed measuring 2 m × 3 m with a gap of 0.50 m and 1.0 m within and between the plots, respectively was created. Twenty, fifteen and twelve cornels with an average weight of 17.5g each were planted with planting spaces of 0.3m × 1.0m, 0.4m × 1.0m and 0.5m × 1.0m, respectively. The experiment was laid out in a 3 × 5 factorial in randomized complete block design (RCBD) in which factor A forms plant spacing comprising: 0.3 m X 1 .0 m, 0.4 m X 1.0 m and 0.5 m X 1.0 m while factor B forms taro cultivars consisting of *Nkpong*, *Odogolo*, *Nworoko*, Coco-India and *Nachi*. There were a total of 15 treatment combinations with three replicates. Weeding was done at four and six weeks after planting (WAP). Data were collected on the number of leaves and sucker per stand. The field data collected was subjected to analysis of variance (ANOVA) using Genstat 7.1 second edition according to the procedure described by Obi, (2001).

Figure 1: Weather records of Nsukka during the periods of the experiments

Month	Rainfall (mm)		Max. Temp.		Min. Temp (^{0}C)		R. H (%)	
	2008	2009	2008	2009	2008	2009	2008	2009
Jan.	0.00	53.59	31.39	31.90	20.32	21.45	56.03	71.39
Feb.	0.00	2.19	34.14	32.46	21.97	22.79	57.16	73.30
Mar.	61.23	0.00	33.77	33.61	22.87	23.32	74.13	72.81
Apr.	143.30	180.60	31.73	31.73	22.00	21.60	74.83	76.20
May	254.01	283.69	31.16	30.23	20.81	21.41	75.00	74.16
June	186.43	152.37	29.83	29.13	21.40	20.83	76.93	74.67
July	246.10	248.17	28.94	28.65	20.84	20.58	78.16	74.84
Aug.	203.20	260.33	27.81	27.48	20.68	20.84	79.55	75.84
Sept	326.02	175.76	27.60	27.87	20.80	20.63	78.67	74.67
Oct.	198.63	387.10	29.48	28.39	20.87	20.26	76.35	74.94
Nov.	08.38	103.18	31.10	29.83	22.00	19.30	74.35	63.80
Dec.	10.98	00.00	31.50	32.70	22.88	30.70	72.93	65.35
Mean	136.52	153.92	30.70	30.31	21.45	21.98	72.88	72.59

Figure 2: Physico-chemical properties of the soil of the experimental site before planting.

Parameter	Value
Sand (%)	16.00
Silt (%)	20.00
Clay (%)	64.00
pH (H_20)	5.00
pH (KCl)	4.60
Organic carbon (g/kg)	0.60
Organic matter (g/kg)	1.03
Total nitrogen (g/kg)	0.05
Exchangeable bases (cmol/kg soil)	
Sodium	0.10
Potassium	0.09
Calcium	1.00
Magnesium	0.80
Cation exchange capacity (CEC)	6.00
Base saturation (%)	33.00
Phosphorus (mg/kg)	2.60
Exchangeable acidity (cmol/kg)	

EA	1.40
Al	1.00
H	0.40

RESULTS

Data in Figure 1 showed that the average rainfall for 2009 cropping season was higher than that of 2008 by 12.75% while other weather parameters were relatively the same. The highest amount of rainfall was recorded in the Month of October, 2009 cropping season. The soil was texturally clayey and moderately acidic with a pH of 5.0. The soil was too low in organic carbon, organic matter, calcium, phosphorus and moderate in cation exchange capacity (CEC) (Figure 2). Data on Table 1 showed that at 6 weeks after planting (WAP) in 2008 and 2009, Coco-India significantly ($p \geq 0.05$) produced the highest number of leaves/plants compared to other cultivars. On the other hand, plant spacing performance was statistically the same ($p \geq 0.05$). There was also significant cultivar x plant spacing interactions ($p \geq 0.05$). Coco-India x 0.5 m x 1.0 m spacing interaction significantly ($p \geq 0.05$) produced the highest number of leaves/plant. At 8 WAP, there was a significant effect ($p \geq 0.05$) on cultivar differences as Coco-Inda significantly produced the highest number of leaves/Plant which was followed by Nworoko, whereas plant pacing did not produce significant effect on the trait. There was also significant interaction effect between cultivar (Coco-India) and wider plant spacing at 8 WAP. At 12 WAP, Coco-India still maintained the most significant effect on cultivar differences ($p \geq 0.05$) which was followed by Nworoke cultivar, while plant spacing did not show a significant effect on the number of leaves/Plant. However, the most significant cultivar x plant spacing interaction effect was observed between Coco-India and minimum planting spacing (Tables 1 and 2). At 16 WAP, there was also a significant effect on cultivar Differences on the trait as Coco-India significantly produced the highest number of leaves/plant. On the other hand, plant spacing had no significant effect on the trait in 2008 but differed significantly in 2009 cropping season. However, a significant cultivar x plant spacing interaction effect was recorded ($p \geq 0.05$) in both seasons (Tables 1 and 2). Data in Tables 5 and 6 indicated significant cultivar effects ($p \geq 0.05$) at 6 WAP on the number of suckers/plants in both seasons with Nachi significantly producing the highest number of suckers/plant of all the cultivars. On the other hand, Plant spacing did not produce significant effect on the trait in 2008, although the maximum plant spacing produced the highest number of suckers/plant in 2008, but differed significantly in 2009 cropping season. However, there were significant cultivar x plant spacing interaction effects on the trait with Coco-India and Nworoko x maximum plant spacing interaction producing the highest significant number of sucker/plant in 2008 and 2009, respectively. At 8 WAP, cultivars significantly affected the trait with Nworoko and Coco-India producing the highest significant number of suckers/plant in 2008 and 2009, respectively. On the other hand, plant spacing did not produce significant effect on the trait in both seasons. More so, cultivar x plant spacing interaction effect did not also significantly influence the trait in 2008, but produced a significant effect ($p \geq 0.05$) in 2009 (Tables 3 and 4). At 12 WAP, effect of cultivars on the trait was significant with Nworoko in 2008, but non-significant in 2009, although Nworoko and Odogolo produced the highest number of suckers/plant. Nevertheless, significant cultivar x plant spacing interaction effects was observed in both seasons. Nworoko and Odogolo x plant spacing of 0.4 m x 1.0 m interaction produced the highest significant number of suckers/plant ($p \geq 0.05$) in 2008 and 2009, respectively (Tables 3 and 4). At 16 WAP, there was a significant effect of cultivar ($p \geq 0.05$) on the number of suckers/plant with Nworoko producing the highest significant number of suckers/plant in both seasons. On the other hand, plant spacing differed significantly on the trait in 2008 with 0.4 m x 1.0 m spacing producing the highest significant number of suckers/plant, but it was non-significant in 2009, although 0.4 m x 1.0 m spacing produced the highest number of suckers/plant(Tables 3 and 4). Nevertheless, cultivar x plant spacing interaction effect produced significant influence on the number of suckers/plant in both seasons. Nachi x minimum plant spacing interaction effect significantly produced the highest number of suckers/plant while in 2009 Odogolo x spacing (0.4 m x 1.0 m) interaction significantly produced the highest number of suckers/plant (Tables 3 and 4).

DISCUSSION

The agro-meteorological data in Table 1 showed that there were remarkable differences in the rainfall and temperature. There was 12.7% reduction in the average rainfall in 2008 and 21.4% reduction in the average rainfall between August and September in 2009 during which taro establishment takes place. The variations in these weather parameters might have resulted in the variations expressed in the growth parameters in 2009 cropping season. This result was in agreement with the result obtained by Daniells *et al.*(2008) who reported that radiation, temperature and rainfall as weather parameters affect the growth and total yield as well as the time taken to reach maturity. The significant cultivar effects (Tables 1 and 2) in both seasons could be attributed to genotypic variations which was in tandem with the result obtained by Iram *et al*. (2009) who reported that variations in agronomic traits were due to genotypes which are essential for crop improvement. The significant cultivar effect might be traced to the optimum rainfall (2500 mm) and temperature (25^{oc}) requirements which were available to the crop in both seasons. This result was in agreement with that of Robin (2008) who reported that the taro site selection must meet the following requirements- optimum rainfall (2500 mm), temperature ($25^{oc)}$ and P^H (5.5) (Fig. 1 and 2). The non-significant effect of plant spacing on the number of leaves/plant in the several intervals of measurement in the two seasons could be explained as due to the high proximity of plant spatial arrangements and mutual shading of leaf canopies which created poor light interception for photosynthesis (Tables 1 and 2). This report is in line with the result obtained by Silva (1988) who noted the closer spacing treatment produced poor growth and yield. The significant cultivar x planting spacing interactions across the measuring intervals in both seasons was as a result of positive interactions among growth factors in the area (Tables 1 and 2). Furthermore, the significant cultivar effect on the number of Suckers/plant might be attributed to genotypic variations which enabled the cultivars express their full potentials (Tables 3 and 4). The non-significant plant spacing effect on the trait could be traced to poor spatial arrangement of the crop as the wider spatial orientation produced the highest number of suckers/plant though it was non-significant (Tables 3 and 4). This result is in agreement with the experimental report of Atiquzzaman *et al*. (2008) who observed a greater production of leaves and suckers/hill at a wider spacing. However, Tumuhimbise *et al*. (2009) observed greater production of number of leaves and suckers/plant at closer Spatial arrangements. Also, the significant cultivar x spacing interaction effects across the measuring intervals in the two years was due to positive interactions between genotypic and environmental factors.

Conclusion

At present, there are no documentations in respect to production of taro leaves and suckers with plant spacing in the plains of Nsukka of Enugu State. Since Coco-India and wider spacing produced the highest number of leaves and suckers per plant in the several intervals of measurement in both seasons, I would recommend Coco-India cultivar and wider spacing for taro production to farmers in Enugu State of Nigeria.

REFERENCES

Agueguia CA. Fatokum and Halm SK (1992). Protein analysis of ten cocoyam, *Xanthosoma sagittifoluim* (L.) Schott and *Colocasia esculenta* (L.) Schott genotypes, Root Crops for food security in Africa, Proceedings of the fifth triennial symposium, Kampala, Uganda. Pp. 348.

Asumadu HEL Omenyo and F Tetteh (2011). Physiological and Economic Implications of leaf harvesting on vegetative growth and cornel yield of cocoyam (*Xanthosoma sagittifolium).* Journal of Agronomy. 10(4): 112-117.

Atiquzzanam M Ali, MM Mondal, MA Begum, MZFA and Aktheri QT (2008). Effect of spacing on the growth and yield of Mukhikachi. Journal of Agro-forestry and Environment, 2(1):1-6.

Daniells JW, Hughes M, Traynor M, Vawdrey L and Astridge D (2008). Taro Industry Development: The first step. RIRDIC Publication no 09/066

Ezedinma FOC (1987). Prospects of cocoyam in the food system and economy of Nigeria. Proceedings of 1st National Workshop, August 16-21, 1987 NRCRI, Umudike, Nigeria. Pp.128.

Howeler RH, Ezumah HC and Midmore DJ (1993). Tillage systems for roots and tuber crops in the tropics. Soil and Tillage Research 27:211-240.

Iramu E, Wegih ME, and Singh D (2009). Genetic hybridization among Genotypes of taro (*Colocasia esculenta*) and recurrent selection for leaf blight resistance. Indian Journal of Science and Technology. 3(1):96-101.

National Root Crops Research Institute (NRCRI), Umudike, Nigeria, cocoyam programme, (2009). www.nrcri.gov.ng/cocoyam.

Ndon BA, Ndulaka NH and Ndaeyo NU (2003). Stabilization of yield parameters and some nutrient components in cocoyam cultivars with time in southern Nigeria. Global Journal of Agricultural Science 2:74-78.

Obi IU (2001). Introduction to factorial experiments, for Agricultural, Biological and Social Sciences Research (2nd Ed).Optimal Publisher Ltd Nigeria.Vii + 92p.

Onwueme IC (1999). Taro cultivars in Asia and the pacific, RAP publication 1999/16, Food and Agricultural Organization of the United Nations Regional Office for Asia and the pacific Bankok, Thailand.

Quaye W, K Adofo, KO Ayeman and Nimoh (2010). Socioeconomic survey of traditional commercial production of cocoyam and cocoyam leaf. Afr. J. Food Agric. Nutri. Dev., 10:406-4078.

Robin GC (2008).Commercial dasheen [*Colocasia esculenta* (L.) Schott Var.*esculenta*] Production and Post-harvest Protocol for the OECS, p.8

Silva JA (1988). Preliminary Results of Dryland taro Spacing and Fertilizer Timing. Dwight Sato, p.79

Tumuhimbise R, Talwana HL, Osiru DSO, Serein AK, Ndabikunze BK, Nandi JOM and

Palapala V (2009). Growth and development of Wetland grown taro under different plant populations and seeded types in Uganda. African Crop Science Journal, 17(1):49-60.
Uguru MI (2011). Crop production tools, techniques and practice (Rev.Ed). Full pub.com, Nsukka, Pp. 55-57.

Table 1: Main effect of cultivars, planting spacing and their interaction on the number of leaves/stand at 6,8,12 and 16 weeks after planting (WAP) for 2008 cropping season

Plant spacing	**CULTIVARS**					
	Nkpong	*Odogolo*	*Nworoko*	Coco-India	*Nachi*	Mean
At 6 WAP						
0.3mx1.0m	3.42	4.75	4.25	8.58	4.50	5.10
0.4mx1.0m	4.33	4.75	3.75	7.25	4.00	4.52
0.5mx1.0m	3.83	4.92	4.92	10.08	4.75	5.70
Mean	3.86	4.81	4.31	8.64	4.42	5.21
At 8 WAP						
0.3mx1.0m	4.50	7.00	8.67	10.92	8.25	7.87
0.4mx1.0m	5.17	6.08	7.42	13.50	8.25	8.08
0.5mx1.0m	4.00	6.17	10.17	16.42	8.08	8.97
Mean	4.56	6.42	8.75	13.61	8.19	8.31
At 12 WAP						
0.3mx1.0m	8.00	9.75	21.58	23.10	18.33	16.15
0.4mx1.0m	7.67	9.92	19.92	21.92	18.00	15.48
0.5mx1.0m	7.17	11.33	17.33	19.25	15.58	14.13
Mean	7.61	10.33	19.61	21.42	17.31	15.26
At 16 WAP						
0.3mx1.0m	8.00	9.58	20.67	21.33	21.50	16.22
0.4mx1.0m	9.17	11.08	21.25	22.83	19.17	16.70
0.5mx1.0m	6.50	9.58	21.25	22.83	19.17	16.70
Mean	7.89	10.08	19.78	20.08	18.75	15.32

	WAP			
	6,	8,	12,	16
F-LSD (P=0.05) for comparing two cultivars means =	1.72,	3.51,	3.11,	3.25
F-LSD(P=0.05) for comparing two spacing means =	ns	ns	ns	2.52
F- F LSD(P=0.05) for comparing two c x s means =	2.97	6.08	5.38	6.63

Table 2: Main effect of cultivars, plant spacing and their interaction on the number of leaves/plant at 6,8,12 and 16 weeks after planting (WAP) for 2009

Plant spacing	**CULTIVARS**					
	Nkpong	*Odogolo*	*Nworoko*	Coco-India	*Nachi*	Mean
At 6 WAP						
0.3mx1.0m	4.33	4.92	4.58	5.75	5.08	4.93
0.4mx1.0m	4.08	4.50	5.67	6.17	5.25	5.15
0.5mx1.0m	4.67	4.33	4.75	6.50	5.50	5.12
Mean	4.36	4.61	5.00	6.14	5.22	5.07
At 8 WAP						
0.3mx1.0m	4.71	5.75	6.92	8.25	6.50	6.43
0.4mx1.0m	4.25	6.33	5.92	8.50	5.83	6.17
0.5mx1.0m	4.67	4.83	6.25	10.33	5.08	6.23
Mean	4.56	5.64	6.36	9.03	5.81	6.28
At 12 WAP						
0.3mx1.0m	1.25	3.62	3.33	2.75	4.08	3.02
0.4mx1.0m	1.42	5.00	3.75	3.42	3.25	3.37

0.5mx1.0m	1.58	3.67	3.58	1.50	5.42	3.15
Mean	1.42	4.11	3.56	5.56	4.25	3.18
At 16 WAP						
0.3mx1.0m	1.92	4.75	8.42	3.25	7.40	5.15
0.4mx1.0m	2.92	1.58	7.83	2.58	6.50	6.08
0.5mx1.0m	2.05	7.00	7.50	2.00	5.50	4.90
Mean	2.44	7.44	7.92	12.61	6.47	5.38

	WAP			
	6	8	12	16
F-LSD (P=0.05) for comparing two cultivars means =	1.04	1.76	1.38	1.37
F-LSD(P=0.05) for comparing two spacing means =	ns	ns	ns	1.06
F-LSD(P=0.05) for comparing two c x s means=	1.80	3.05	2.32	2.38

Table 3: Main effect of cultivars, plant spacing and their interaction on the number of suckers/plant at 6,8,12 and 16weeks after planting (WAP) for 2008 cropping season

Plant spacing	**CULTIVARS**					
	Nkpong	*Odogolo*	*Nworoko*	Coco-India	*Nachi*	Mean
At 6 WAP						
0.3mx1.0m	0.00	0.75	0.17	1.42	0.67	0.60
0.4mx1.0m	0.17	0.50	0.25	1.33	0.33	0.52
0.5mx1.0m	0.00	1.00	0.92	2.00	0.42	0.87
Mean	0.06	0.75	0.44	1.58	0.47	0.66
At 8 WAP						
0.3mx1.0m	0.17	1.08	2.92	2.50	2.17	1.77
0.4mx1.0m	0.83	1.33	2.33	2.83	2.42	1.95
0.5mx1.0m	0.25	1.50	5.25	3.42	2.00	2.08
Mean	0.42	1.31	3.50	2.92	2.19	1.93
At 12 WAP						
0.3mx1.0m	3.42	3.67	6.72	5.17	7.17	5.25
0.4mx1.0m	3.42	3.58	6.17	5.00	5.83	4.80
0.5mx1.0m	2.67	4.25	5.75	4.25	5.25	4.43
Mean	3.17	3.83	6.21	4.81	6.08	4.82
At 16 WAP						
0.3mx1.0m	2.92	3.76	6.92	4.50	8.00	5.20
0.4mx1.0m	4.08	4.17	6.92	5.17	6.08	5.28
0.5mx1.0m	2.00	3.00	6.00	3.67	5.25	3.98
Mean	3.00	3.61	6.61	4.44	6.44	4.82

	WAP			
	6	8	12	16
F-LSD (P=0.05) for comparing two cultivars means =	1.20	1.20	1.08	1.03
F-LSD(P=0.05) for comparing two spacing means =	ns	ns	0.84	0.80
F-LSD(P=0.05) for comparing two c x s means =	20.7	ns	1.88	1.79

Table 4: Main effect of cultivars, plant spacing and their interactions on the number of suckers/plant at 6,8,12 and 16weeks after planting (WAP) for 2009

Plant spacing			**CULTIVARS**			
	Nkpong	*Odogolo*	*Nworoko*	Coco-India	*Nachi*	Mean
At 6 WAP						

0.3mx1.0m	0.08	0.33	0.08	0.08	0.50	0.22
0.4mx1.0m	0.08	0.58	0.75	0.50	0.58	0.850
0.5mx1.0m	0.50	0.58	0.83	0.42	0.50	0.57
Mean	0.22	0.50	0.5	0.33	0.53	0.43
At 8 WAP						
0.3mx1.0m	0.42	0.83	1.58	0.67	0.75	0.85
0.4mx1.0m	0.08	0.67	0.75	1.17	0.50	0.63
0.5mx1.0m	0.42	0.25	0.25	1.58	0.42	0.58
Mean	0.31	0.58	0.86	1.14	0.56	0.69
At 12 WAP						
0.3mx1.0m	0.33	2.08	2.67	2.17	2.75	2.00
0.4mx1.0m	0.50	4.25	3.42	1.42	2.08	2.33
0.5mx1.0m	0.83	2.25	2.50	3.25	2.75	2.32
Mean	0.56	2.86	2.86	2.28	2.53	2.22
At 16 WAP						
0.3mx1.0m	0.08	2.33	3.58	1.25	3.00	2.06
0.4mx1.0m	0.83	4.73	4.00	0.92	2.25	2.55
0.5mx1.0m	1.00	2.92	1.00	3.33	2.33	2.23
Mean	0.64	3.33	3.50	1.06	2.86	2.28

	WAP			
	6	8	12	16
F-LSD (P=0.05) for comparing two cultivars means =	0.36	0.67	1.18	0.83
F-LSD(P=0.05) for comparing two spacing means =	0.28	ns	ns	ns
F-LSD(P=0.05) for comparing two c x s means=	0.62	1.16	2.04	1.44