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Weed Control Efficacy and Arbuscular Mycorrhizal (AM) Colonization of Upland Rice Varieties as Affected by Population Densities

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Abstract
Field experiments were conducted in 2011 and 2012 at the Teaching and Research Farm of the Federal University of Agriculture, Abeokuta (Latitude 7 20`N and Longitude 3 23`E) in the Forest/ Savanna Transition Agro- ecological zone of South Western Nigeria to determine the weed control efficacy and AM colonization of upland rice varieties at different population densities. The experiment was a 3x3 factorial arranged in a Randomized Complete Block Design (RCBD) and replicated three times. The three plant population used included 333, 333; 250, 000 and 166, 666 plants per hectare obtained by planting at 20cm x 15cm, 20cm x 20cm and 20cm x 30 cm respectively, while the three rice varieties used were ITA 150, NERICA 2 and OFADA. The results obtained from the study showed that plant population at 333, 333 plants per hectare significantly ($p < 0.05$) reduced weed population, number of tillers per hill and yield of rice varieties. Moreover, the local rice variety, OFADA was observed to be significantly ($p < 0.05$) taller than the other varieties, reduced weed biomass and consequently gave better yield advantage over the other tested varieties (ITA 150 and NERICA 2). Panicle length and days to 50% flowering were significantly ($p<0.05$) longer in OFADA and NERICA 2. Planting density did not affect AM root colonization but significant differences were observed among the rice varieties with respect to spore abundance.
Keywords: rice, arbuscular mycorrhizal, plant population, varieties

Introduction

Rice is a major food crop in the tropics probably because of its ease of preparation and its wide acceptance as food within and all over the tropics (Carsky, 1992). It provides staple food of over 3 billion people, representing nearly half of the world population (Manful, 2010) In Nigeria rice is the sixth major crop in cultivable area after sorghum, millet, cowpea, cassava and yam. Rice production in Nigeria in 2006 was estimated at 2.1 million mega grams while consumption was 3.71 million mega grams. The balance of 1.6 million mega grams was obtained by importation. (WARDA, 2008).

Weeds are presently one of the major biotic constraints to increased rice production. In West Africa, between 27% and 37% of the total labour invested in rice is taken up by weeding (WARDA, 1998). In the main rice growing ecologies-mainly the rain-fed ecologies and those suitable for irrigated rice-weeds are the main constraints, reducing production by up to 40% and potentially causing total crop failure if left uncontrolled (WARDA, 2006).

One major way of reducing the frequency of weeding is through increased plant population (Murphy and Swanton, 1996). Research indicates that increasing crop density can maximize the space occupied by the crop and put competitive pressure on weeds (Mohler,2001; Finney and Creamer, 2008). However, increasing the plant density may put higher demand on the nutrients, light and water requirements of the plant. There is therefore the need to improve the nutrient uptake of the crop if higher plant density will be used to control weed infestation in upland rice. This could easily be achieved through the understanding of interaction of rice with AMF (Koide and Dickie, 2002).

Arbubscular mycorrhiza is a symbiosis between some soil fungi and plants that helps to obtain nutrients from the soil by means of their intimate relationships with root system and the efficiency of the plant in absorbing nutrients may largely depend on this association. Most agricultural crops can perform better and more productive when well colonized by AMF fungi. Arbuscular mycorrhizal symbiosis increases the phosphorus and micro nutrient uptake and growth of their plant host (George et al 1992. The roots of most plants are invaded by AMF and forms mycorrhiza with plants root. Also the interaction between AMF and weed have a dual significance in ecological farming but are relatively unexamined (Vatovee et al., 2005).

The aim of this study was to assess the effect of rice variety and plant density on weed control, arbuscular mycorrhiza fungi spore count and colonization and yield of upland rice .

Materials and methods

Two field trials were conducted at the Teaching and Research Farm of the Federal University of Agriculture, Abeokuta, in 2011 and 2012 cropping seasons. The field was laid out in a 3 x 3 factorial arranged in a Randomised Complete Block with three replications. The treatment combinations were three plant population

densities of 333,333 plants ha^{-1}, 250,000 plants ha^{-1} and 166,666plants ha^{-1} and three rice varieties ITA 150, NERICA 2 and OFADA. The gross and net plot sizes were $6m^2$ and $4m^2$ respectively, with one 1m separating the plots. Land preparation was done once prior to the start of the trial.

Soil samples were collected randomly prior to planting. Samples were taken from each plot randomly at depth of 0-15 cm and samples from each plot were bulked into polythene bags. Physical and chemical analyses were conducted on the samples ie.(Total nitrogen, available phosphorus, CEC, TEA, Base saturation, K, Ca, Mg, Organic Carbon and Soil pH.). Data were collected on plant height, at 4, 6, 8, 10 and 12 weeks after planting (WAP) while data on leaf area, number of hills per m2 and number of tillers per hill were measured 9 WAP. Data was also obtained on the days to 50% flowering.Yield and yield components of rice were measured panicle length, panicle weight and grain yield/ha. Weed parameters were measured on weed density, and dry weight. At eight weeks after planting AM colonization and spore count were determined. Root samples were randomly selected from the rice plants, washed with clean water and cut into 1 cm. Each sample was put into vials and labeled properly. Fifty percent ethanol was poured into each of the screw vials to preserve the roots and they were kept at room temperature. The ethanol were later washed from the roots with clean water after which 10% KOH was added to the roots. The root samples were heated for 50 minutes at 80^{o} C in water to remove the KOH. The samples were then mixed with 5 % H_2O_2 and left to stay for 5 minutes. The root samples were washed thoroughly with water and placed back into screw vials. Staining solution was added into the samples and allowed to stay for 2 hours. The dye was washed off with water. The root samples were distained in 50 % glycerol. Grid plate intersection method (Giovanetti and Mosse, 1963) was used to determine the percentage AM colonization by counting the number of mycorrhizal roots and total roots. % mycorrhizal Colonization = No of infected roots X100/Total No of roots observed. To determine the spore abundance, the sample soil was sieved, decanted and centrifuged. 20g of different soil samples were weighed and passed through a series of sieves (0.05µm, 0.0063µm and 0.0045µm) arranged on top of each other through wet sieving using distilled water. The soil samples collected at the base or bottom sieve (i.e. 45µm) were then washed into different test tubes with distilled water and then centrifuged for 2 minutes at 2000 rev./min., after which the water abve the settled soil sample was quickly poured out and replaced with 40% sucrose solution, stirred and centrifuged again for another 2 minutes at the same revolution. The sucrose solution above the settled soil sample (supernatant) is quickly poured in 0.0045µm sieve and washed with distilled water (using a wash bottle) into a petri dish and carefully observe under a compound microsope for spore population count.

All data collected were subjected to statistical analysis of Analysis of Variance (ANOVA) using GENSTAT Statistical package version 4.0 and significant means separated using Fisher's Protected Least Significant Difference (LSD) at $\alpha = 0.05\%$.

Results and discussion

Table 1 presents the soil physico-chemical properties of the experimental site before the commencement of the trial.

Table 1: Soil physico-chemical analysis of the Experimental Plot before Planting

Soil property	2011	2012
pH (H2O)	7	6.8
pH (KCl)	6.6	6.3
Organic carbon (%)	1.55	1.24
Total Nitrogen %	0.089	0.094
Organic matter	2.67	2.14
Available P (mg/kg)	21.63	16.44
TEA (cmolKg-1)	0.3	0.3
Ca (cmolKg-1)	8	5.6
Mg (cmolKg-1)	5.2	5.3
K+ (cmolKg-1)	0.46	0.36
Na (cmolKg-1)	0.64	0.22
ECEC	14.6	11.78
BS	97.95	98.75
Sand (g/kg)	694	730
Silt (g/kg)	130	124
Clay (g/kg)	176	146
Texture	Sandy loam	Sandy loam

The weed flora composition was mainly dominated by *Panicum maximum* (Jacq.) *Chromolaena odaorata* (L.) King and Robinson , *Euphorbia heterophylla* (Linn.) and *Andropogon spp* in 2011 while *Talinum triagulare*, *Chromolaena odaorata* (L.) King and Robinson, *Euphorbia heterophylla* (Linn.) and *Tridax procumbens* (Linn.) dominated the field in 2012 (Table 2). Other minor weeds found on the experimental plot

are *Cyperus rotundus* and *Imperata cylindrical.*

The study showed that weed population was significantly ($p<0.05$) affected by rice varieties at 8 WAP while plant population density affected weed biomass at 4 and 8 WAP in 2011. Weed growth was significantly ($p<0.05$) reduced by OFADA up to 86.8 % compared with the maximum obtained from ITA 150 (Table 3)

In 2011, plant height was significantly influenced by variety at 6, 8, 10 and 12 WAP. The local variety OFADA was observed to be significantly ($p<0.05$) taller than the other varieties. Plant density of 333,333 plants per ha significantly reduced plant height by about 22.5% compared with the maximum (110.4 cm) obtained from 250,000 plants per ha (Table 4). However, lower population of 166,666 further reduced the plant height to about 105.2cm. Significant interaction was obtained between the rice variety and plant population on plant height at 8 WAP. In 2011, both the rice variety and plant population density had no significant effect on the plant height (Table 5).

Leaf area and number of tillers per m^2 were not significantly affected by rice variety and plant density in both 2011 and 2012 (Tables 6 and 7). However, number of tillers per hill was affected by plant densities in 2011 while days to 50% flowering were affected by the rice varieties. In 2012, days to 50% flowering varied with rice cultivars and plant population densities. ITA 150 reached 50% flowering earlier than other varieties (NERICA 2 and OFADA). It was observed that plant population of 333,333 plants per hectare significantly enhanced tiller production in NERICA 2 and ITA 150 better than OFADA. Significant interaction ($p<0.001$) was obtained between rice variety and plant population density with respect to days to 50% flowering.

Yield parameters such as panicle length and grain yield were significantly affected by the rice cultivar in 2011 and 2012. Though panicle weight was not significantly affected by rice variety and plant density in 2011, significant differences ($p<0.001$) were observed in 2012. Panicle weight was reduced by 35 % in NERICA 2 while the lowest population density caused a reduction of 16 % in panicle weight. Significant interaction was also observed between the rice variety and plant population on the yield parameters (Table 8)

Generally, in 2011 AM spore abundance was not affected by the rice varieties as well as plant population density (Table 9). However AM colonization % was significantly affected by the rice varieties. In 2012, ITA 150 and OFADA had higher significant AM colonization than NERICA 2. The use of high population density tends to favor AM spore abundance especially ITA150 with the plant density of 333,333 plant per ha having an average of 27.84 in 2011 and 2012 compared with NERICA (17.52) and OFADA (22.52). However, the trend for AM root colonization tends to follow an opposite pattern whereby the higher the plant density the lower the root colonization.

Discussion

The result from this study indicated that plant population at 333, 333 plants per hectare reduced the weed population at 4 and 8 WAP. Reduction in weed population was probably due to the high tillering ability of the rice varieties used which is one of the qualities of the improved varieties (especially ITA 150 and NERICA) which ensured the efficient utilization of growth resources (Kolo and Umaru, 2011)

High population density (narrow spacing) reduced plant height compared to lower population density probably because of higher interception of light by the rice crop; this perhaps may have encouraged photosynthetic activity and enhanced growth of the crop as most of the light that is supposed to fall on the ground or weeds must have been intercepted by the crop. Rao (2009) stated that the growth and photosynthetic rates of plant are normally affected by the quantity of light. An increased in light leads to greater growth and photosynthetic rate while the rate is decreased as light is reduced.

The study also showed that lower plant density in ITA 150 and NERICA 2 increased the number of tillers per hill. This might be due to the wider spacing between the hills providing better opportunity for the crop to make adequate utilization of the available resources. This is particularly evident in the higher %AM colonization of the roots of these two varieties (ITA 150 and NERICA 2) which averaged 69.5 and 57.89 % respectively at 166,666plants per ha. Arbuscular mycorrhizal has been reported to help to improve the soil structure by increasing water holding capacity of the soil and tap nutrients that could be leached by rain. It also supplies phosphorus to the host plant in a higher quantity that the root can obtain on its own. (Sieverding, 1991). Zhang *et al*., (2007) also stated that AMF has been found to associate with upland rice and as well as having large influence on plant growth by increasing the shoot and root biomass.

The rice varieties ITA 150, NERICA 2 and OFADA varied significantly in the panicle length and grain yield at plant population of 333, 333plants per ha. There was increased height, larger leaf area, higher number of tillers per hill as well as longer panicle length in OFADA which consequently increased its yield. It has been reported that different genotypes show differential responses to increasing population per unit land area. (Kolo and Umaru ,2011). The study showed that there was decreased AM colonization as plant density increases. This finding is line with the work of LI *et al.,* (2006) that plant densities show great diversity on arbuscular mycorrhizal fungi because plant densities decreases AMF colonization and contribute to phosphorus uptake by plants.

Conclusion

The results showed that the local variety, OFADA planted at a spacing of 20cm x 15 cm (333, 333 plants/ha) significantly ($p<0.05$) reduced weed dry weight compared with the rice varieties (ITA 150 and NERICA 2). Due to the better competitive ability and higher spore abundance in the root zone of this variety, the growth and yield characteristics were better enhanced than other varieties. Also, on the average Arbuscular mycorrhizal root colonization of the rice was not significantly affected by the density of planting and variety of rice. However, AM spore abundance was significantly increased under OFADA. It is therefore concluded that for favourable AM- plant population density interaction, OFADA production can be improved by planting at a population density of 333,3333 plants per ha in this ecology.

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Table 2: Weed Floral Composition at the Upland Experimental Site.

Weed Type	Family	Growth form	Level of Infestation 2011	2012
				++
Panicum maximum (Jacq.)	*Poaceae*	PG	+++	
Talinum triangulare	*Portulaceae*	PBL	++	+++
Cyperus rotundus	*Cyperaceae*	PsG	++	+
Imperata cylindrical	*Poaceae*	PG	++	+
Chromolaena odorata (L.) King and Robinson	*Asteraceae*	PBL	+++	+++
Euphorbia heterophylla (Linn.)	*Euphorbiaceae*	ABL	++	+++
Andropogon tectorum	*Poaceae*	PG	+++	++
Andropogon gayanus	*Poaceae*	PG	+++	+
Cyperus esculentus (Linn.)	*Cyperaceae*	PsG	+	+
Tridax procumbens (Linn.)	*Asteraceae*	ABL	++	+++

+ = Low weed infestation
++ = Medium weed infestation
+++ = High weed infestation
ABL = Annual Broadleaf
PG = Perennial Grass
AG = Annual Grass
PBL = Perennial Broadleaf
PsG = Perennial Sedge

Table 3: Effect of plant population density on weed biomass and weed density of upland rice varieties in 2011 and 2012 wet seasons.

Treatments	Weed Dry Weight (g/m^2)				Weed Density ($plant/m^2$)			
	2011		2012		2011		2012	
Variety (V)	**4WAP**	**8WAP**	**4WAP**	**8WAP**	**4WAP**	**8WAP**	**4WAP**	**8WAP**
ITA 150	21.8	25.7	26.4	65.7	47.6	34.9	125.6	19.8a
NERICA 2	11.3	47.6	26.9	40.3	43.1	33.8	108.6	19.1a
OFADA	21.2	33.3	23.5	48.6	46.0	33.8	117.1	10.6b
SE±	Ns	ns	Ns	Ns	Ns	Ns	Ns	2.00*
Density (plant/ha) (D)								
333,333	8.5a	25.7a	23.0	47.0	41.6a	32.9	123.9	17.4
250,000	25.3ab	47.6ab	23.6	46.8	32.2ab	37.6	11.7	17.8
166,666	20.5b	33.3b	30.2	60.9	62.9b	32.0	115.7	14.2
SE±	6.35*	8.52*	Ns	Ns	Ns	Ns	Ns	Ns
Interaction SE± (V x D)	Ns	ns	Ns	Ns	Ns	Ns	Ns	Ns

Means followed by the same letter are not significantly different at 5% level of probability using Fisher's Protected LSD at 5% level of probability..
WAP = Weeks after planting, **ns** = not significant,* = significant.

Table 4: Effect of plant population density on plant height of upland rice varieties in 2011 wet seasons

Variety (V)	Density (D) (plants/ha)	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
ITA 150	333, 333	**21.5**	**40.90**	**61.40**	**89.00**	**108.90**	**124.10**
	250, 000	**21.40**	**38.10**	**61.60**	**92.00**	**98.9**	**119.40**
	166, 666	**22.27**	**38.80**	**64.70**	**94.4**	**100.9**	**116.80**
NERICA II	333, 333	**19.27**	**34.40**	**52.70**	**89.8**	**105.7**	**121.70**
	250, 000	**18.27**	**36.70**	**51.40**	**85.4**	**104.8**	**117.30**
	166, 666	**17.73**	**34.00**	**51.70**	**88.10**	**113.4**	**122.10**
OFADA	333, 333	**21.80**	**41.50**	**60.70**	**90.10**	**119.00**	**134.4**
	250, 000	**22.73**	**41.10**	**61.90**	**110.4**	**119.60**	**129.7**
	166, 666	**22.30**	**36.30**	**59.30**	**105.2**	**114.00**	**124.6**
SED (±)							
Variety(V)		**0.75*** **	**Ns**	**3.00*** **	**3.04*** **	**3.86*** **	**2.63*** **
Density (D)		**Ns**	**Ns**	**Ns**	**3.04***	**Ns**	**Ns**
V X D		**Ns**	**Ns**	**Ns**	**5.26***	**ns**	**Ns**

Ns= not significant, * = significant at p<0.05, ***= significant at p<0.0001

Table 5: Effect of plant population density on plant height of upland rice varieties in 2012 wet seasons

Variety (V)	Density (D) (Plants/ha)	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP
ITA 150	333, 333	**22.34**	**35.5**	**66.3**	**94.9**	**96.81**	**101.8**
	250, 000	**23.4**	**39.4**	**61.9**	**89.9**	**92.99**	**112.7**
	166, 666	**19.00**	**36.42**	**63.3**	**98.9**	**100.55**	**106.1**
NERICA II	333, 333	**26.37**	**39.8**	**70.1**	**94.9**	**94.95**	**105.5**
	250, 000	**21.8**	**38.70**	**63.6**	**94.8**	**95.05**	**99.5**
	166, 666	**24.34**	**39.90**	**70.9**	**93.6**	**102.00**	**103.9**
OFADA	333, 333	**24.90**	**40.68**	**72.8**	**101.7**	**99.47**	**103.4**
	250, 000	**23.31**	**39.30**	**68.1**	**91.6**	**90.81**	**97.9**
	166, 666	**23.00**	**37.53**	**68.0**	**95.2**	**103.04**	**104.2**
SED (±)							
Variety (V)		**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**
Density(D)		**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**
V X D		**Ns**	**Ns**	**Ns**	**Ns**	**ns**	**Ns**

Ns= not significant

Table 6: Leaf area, number of hills per m^2, number tillers per hill and Days to 50% flowering, of upland rice varieties at different plant population densities in 2011

Variety (V)	Density (Plants/ha)	Leaf Area (cm^2) at 9WAP	Number of hills per m^2	Number tillers per hill	Days to 50 % Flowering
ITA 150	333, 333	**48.90**	**21.33**	**5.58**	**83.00**
	250, 000	**55.10**	**16.67**	**6.48**	**85.33**
	166, 666	**38.00**	**18.67**	**7.5**	**85.33**
NERICA II	333, 333	**44.30**	**18.67**	**5.33**	**96.00**
	250, 000	**56.00**	**19.33**	**5.92**	**96.00**
	166, 666	**44.6**	**18.67**	**7.58**	**99.00**
OFADA	333, 333	**46.2**	**23.33**	**5.67**	**99.00**
	250, 000	**58.3**	**22.00**	**7.58**	**93.00**
	166, 666	**53.6**	**18.00**	**7.17**	**96.00**
SED (±)					
Variety (V)		**Ns**	**Ns**	**Ns**	**1.61*** **
Density (D)		**Ns**	**Ns**	**0.52*** **	**Ns**
V X D		**Ns**	**Ns**	**Ns**	**Ns**

Ns= significant, *** = significant at P<0.0001

Table 7: Leaf area, number of hills per m^2, number tillers per hill and Days to 50% flowering, of upland rice varieties at different plant population densities in 2012

Variety (V)	Density (D) (Plants/ha)	Leaf Area (cm^2) at 9WAP	Number of hills per m^2	Number tillers per hill	Days to 50 % Flowering
ITA 150	333, 333	**46.6**	**23.25**	**8.00**	**83**
	250, 000	**45.9**	**18.52**	**7.20**	**83**
	166, 666	**47.2**	**16.26**	**6.60**	**84**
NERICA II	333, 333	**42.9**	**23.22**	**7.20**	**95**
	250, 000	**48.6**	**21.55**	**7.53**	**96**
	166, 666	**50.5**	**17.75**	**7.63**	**97**
OFADA	333, 333	**9.0**	**23.98**	**7.53**	**98**
	250, 000	**51.3**	**22.15**	**7.63**	**93**
	166, 666	**49.70**	**19.00**	**7.53**	**94**
SED (±)					
Variety (V)		**Ns**	**Ns**	**Ns**	**0.11****
Density (D)		**Ns**	**Ns**	**Ns**	**0.41****
V X D		**Ns**	**Ns**	**Ns**	**0.58****

Ns = significant, ** = significant at p<0.001

Table 8: Yield and yield components of upland rice varieties at different plant population densities in 2011 and 2012

Variety (V)	Density (D) (Plants/ha)	Panicle Length (cm)			Panicle Weight (g)			Yield (t/ha)		
		2011	**2012**	**Mean**	**2011**	**2012**	**Mean**	**2011**	**2012**	**Mean**
ITA 150	333, 333	21.95	23.60	22.75	3.06	3.46	3.26	3.35	1.77	2.56
	250, 000	21.74	22.10	21.92	2.65	2.90	2.78	3.07	1.93	2.5
	166, 666	22.16	22.28	22.22	2.26	2.64	2.45	2.66	1.07	1.87
	Mean	**21.95**	**22.66**	**22.31**	**2.66**	**3.00**	**2.83**	**3.03**	**1.59**	**2.31**
NERICA II	333, 333	22.71	20.83	21.77	4.28	2.07	3.18	2.39	1.32	1.86
	250, 000	23.75	20.97	22.36	2.57	1.77	2.17	3.30	1.58	2.44
	166, 666	23.45	20.87	22.16	2.26	1.98	2.12	3.15	1.37	2.26
	Mean	**23.30**	**20.89**	**22.09**	**3.04**	**1.94**	**2.49**	**2.95**	**1.42**	**2.19**
OFADA	333, 333	24.19	22.69	23.44	4.11	2.28	3.19	5.4	1.67	3.54
	250, 000	22.13	21.70	21.92	2.55	2.10	2.33	4.30	1.36	2.83
	166, 666	23.70	21.10	22.4	2.94	1.93	2.44	3.49	1.13	2.31
	Mean	**23.34**	**21.83**	**22.58**	**3.20**	**2.10**	**2.65**	**4.39**	**1.38**	**2.89**
SED (±)										
Variety (V)		**0.44*****	**0.45***		**Ns**	**0.06****		**0.35***	**0.04***	
Density (D)		**Ns**	**0.29***		**Ns**	**0.087****		**Ns**	**0.13***	
V X D		**Ns**	**Ns**		**ns**	**0.04***		**Ns**	**Ns**	

Ns= not significant, * = significant at p<0.05, ** = significant at p<0.001

Table 9: Percentage AM colonization and AM Spores Abundance as affected by rice Variety and Plant Density in 2011 and 2012

Variety (V)	Density (D) (Plants/ha)	AM spore Abundance			AM Colonization(%)		
		2011	2012	Mean	2011	2012	Mean
ITA 150	333, 333	40.00	15.67	27.84	63.3	25.33	44.32
	250, 000	24.30	3.67	13.99	78.9	40.67	59.79
	166, 666	9.30	7.33	8.32	83.3	56.0	69.65
	Mean	**24.54**	**8.89**	**16.72**	**75.17**	**40.67**	**57.92**
NERICA II	333, 333	28.70	6.33	17.52	60.00	41.33	50.67
	250, 000	35.30	5.0	20.15	51.1	32.0	41.55
	166, 666	29.70	7.33	18.52	61.1	54.67	57.89
	Mean	**31.23**	**6.22**	**18.73**	**57.4**	**42.67**	**50.04**
OFADA	333, 333	31.70	13.33	22.52	76.70	42.67	59.69
	250, 000	17.00	9.0	13.00	62.20	44.0	53.1
	166, 666	20.00	31.33	25.67	81.10	33.33	57.22
	Mean	**22.9**	**17.89**	**20.40**	**73.33**	**40.00**	**56.67**
SED (±)							
Variety (V)		**Ns**	*		**7.06***	**Ns**	
Density (D)		**Ns**	*		**Ns**	**Ns**	
V X D		**Ns**	*		**Ns**	**ns**	

Ns= not significant, * = significant at $p<0.05$

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