Journal of
Plant Sciences

ISSN 1816-4951

Academic
Journals Inc.

www.academicjournals.com

Journal of Plant Sciences 9 (2): 51-57, 2014
ISSN 1816-4951 / DOI: 10.3923/jps.2014.51.57

Influence of Plant Material (Tithonia, Neem, Gliricidia) on Weed Infestation under Amaranth Cultivation

[1]A.T. Ajibola and [2]T.O. Modupeola
[1]Department of Agronomy, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, P.M.B, Ogbomoso, Oyo State, 4000, Nigeria
[2]National Horticultural Research Institute, P.M.B, Idi-Ishin, Jericho, Ibadan, Oyo State, 5432, Nigeria

Corresponding Author: A.T. Ajibola, Department of Agronomy, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, P.M.B, Ogbomoso, Oyo State, 4000, Nigeria

ABSTRACT

The field experiment was conducted during at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Nigeria. To evaluate the rate of Amaranth growth to different plant based mulching materials and their response to weed infestation. There were three plant materials incorporated into the soil which are tithonia, neem, gliricidia with four weed levels being weed free, weed once, weed twice. They were replicated three times making a total of thirty-six experimental plots. The experiment was laid out in a Randomized Complete Block Design (RCBD), data collected was subjected to Analysis of Variance (ANOVA) and means were separated using Duncan Multiple Range Test (DMRT) at 5% probability level. Results from the experiment showed that better growth and yield of amaranth was obtained in the weed free plot. Both duration of weed eradication and weed infestation had significant effect on plant height, stem girth and yield of amaranth. In general, all these parameters increase as the duration of weed amaranth competition decreased, while growth parameters increase with an increase in weed eradication. However, highest value was obtained from tithonia mulch plots and neem mulch produced the lowest value on plant height and yield while gliricidia mulch gave the lowest value of stem girth.

Key words: Tithonia, neem, gliricidia, weed infestation and amaranth cultivation

INTRODUCTION

Amaranthus is the most important annual leaf vegetables in the tropics. Vegetables are herbaceous crops cultivated for their edible fruit, stem, leaf or root. *Amaranthus* is promising vegetable crop often adapted to limited growing conditions such as low nutrient soil, it is also well adapted to both arid and humid environments (Liu and Stutzel, 2004). *Amaranthus curentus* is a popular leafy vegetable cultivated in Nigeria and other West Africa countries (Saunders and Becker, 1984). *Amaranthus* has a short growing period of four to six weeks and serves as encouragement to farmers as a source of income during dry season especially amongst the rural and urban dwellers where it serves as a source of employment, they thrive well on soils with high organic matter. Recently, interest in organic fertilizers arose from high cost and scarcity of inorganic fertilizers. Despite the adaptation of vegetables to limited growing conditions such as low nutrient soils in both arid and humid environment, amaranth cultivation is facing series of problems, one of which is competition of weeds for water and nutrient causing stunted, retarded growth and leading to low crop productivity and quality. Weeds are characterized with rapid

growth, has wide adaptation to the environment, has high competitive ability and are highly prolific, thereby reducing the amount of revenue generated from the cultivation of amaranth. Therefore, the research was conducted to evaluate the effect of different plant biomass (Tithonia, Neem and Gliricidia biomass) at different weed levels on the growth, yield and performance of amaranth.

MATERIALS AND METHODS

A field experiment was carried out during the period of 2012 cropping seasons at the Teaching and Research farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, (8°10'N and 4°10'E) a location in the guinea savannah zone of south-west Nigeria. The treatment was laid out in a factorial experiment and fitted into a randomized complete block design with three replicates. The plot was divided into three blocks, each containing 12 beds to give a total of 36 beds. There were 12 treatments combination introduced, as derived from combination of three plant biomass and four weed levels, each treatment was replicated thrice. All treatment were applied at recommended rate of 5 t ha^{-1}. The treatments include: Tithonia+weedy, tithonia+weed once, tithonia+weed twice, tithonia+weed free, neem+weedy, neem+weed once, neem+weed twice, neem+weed free, gliricidia+weedy, gliricidia+weed once, gliricidia+weed twice, gliricidia+weed free. Each plot size was 2×2 m and seeds were sown using spot drilling method with an inter row spacing of 0.5 m. Data collection commenced from 2 WAS and was taken at weekly interval till maturity. The following data were collected; plant height, stem girth, weed biomass, harvest index, weed identification. All data collected were subjected to analysis of variance (ANOVA) using the SAS-GLM procedure (SAS, 1989) and means were separated using Duncan Multiple Range Test (DMRT) at 5% probability level.

RESULT AND DISCUSSION

The effect of tithonia mulch on the height of amaranth as presented in Table 1. Tithonia mulch had significant difference on plant height of amaranth throughout the experimental period with T1W3 having a significantly higher values throughout the study period. At 6 WAP, values recorded in T1W3 was significantly higher (35.83 cm) and different from the other treatment, this was followed by T1W2 (29.73 cm) while the lowest value was recorded in T1W1 (25.52 cm) except at the second and fourth week after planting. As weeding regime increased, plant height increased except with the weedy check (T1W0) which from 4 WAP to 6WAP had a higher value (26.77 cm) than T1W1 probably due to etiolation effect resulting from competition of weed. Ali *et al.* (1999) supported differences in plant height, they reported that plant height was increased in those plots

Table 1: Effect of tithonia mulch on plant height of amaranth

	WAP (cm)				
TRT	2	3	4	5	6
T1W3	2.39^{a}	5.60^{a}	23.92^{a}	29.88^{a}	35.83^{a}
T1W0	2.22^{ab}	3.78^{b}	16.71^{c}	21.60^{bc}	26.77^{bc}
T1W1	2.12^{ab}	3.85^{b}	16.61^{c}	18.61^{c}	25.52^{c}
T1W2	1.99^{b}	4.13^{b}	20.31^{b}	24.29^{b}	29.73^{b}

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, WAP: Weeks after planting, T1W3: Tithonia+Weed free, T1W0: Tithonia+Weedy, T1W1: Tithonia+Weed once, T1W2: Tithonia+Weed twice

Table 2: Effect of tithonia mulch on stem girth of amaranth

	WAP (cm)				
TRT	2	3	4	5	6
T1W3	0.50^{a}	0.70^{ab}	1.16^{a}	1.63^{b}	2.33^{ab}
T1W0	0.43^{a}	0.60^{b}	1.16^{a}	1.73^{b}	2.13^{bc}
T1W1	0.56^{a}	0.86^{ab}	1.23^{a}	2.16^{a}	2.40^{a}
T1W2	0.66^{a}	1.00^{a}	1.40^{a}	1.86^{ab}	2.10^{c}

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, WAP: Weeks after planting, T1W3: Tithonia+Weed free, T1W0: Tithonia+Weedy, T1W1: Tithonia+Weed once, T1W2: Tithonia+Weed twice

Table 3: Effect of tithonia mulch on weed biomass of amaranth

TRT	Weed biomass (g)
T1W3	0.00^{c}
T1W0	54.91^{a}
T1W1	49.57^{a}
T1W2	34.62^{b}

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, WAP: Weeks after planting, T1W3: Tithonia+Weed free, T1W0: Tithonia+Weedy, T1W1: Tithonia+Weed once, T1W2: Tithonia+Weed twice

Table 4: Effect of tithonia mulch on the harvest weight of amaranth

TRT	Harvest weight (kg)
T1W3	83.90^{a}
T1W0	69.33^{b}
T1W1	73.16^{b}
T1W2	82.50^{a}

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, T1W3: Tithonia+Weed free, T1W0: Tithonia+Weedy, T1W1: Tithonia+Weed once, T1W2: Tithonia+Weed twice

in which weeds were controlled. Table 2 show the effect of tithonia mulch on the stem girth of amaranth. There was significant difference in stem girth of amaranth except at 2 and 4 WAP. At 6 WAP, T1W1 (2.40) that was significantly higher from the other treatment except T1W3 while the lowest value was recorded in T1W2 (2.10). This is in agreement with the work of Fuksa *et al.* (2004) who reported similar result in the negative effect caused by weeds were also observed in the stalk diameter 0.1 m above the ground. Effect of tithonia mulch on weed biomass of amaranth (Table 3) show that the highest value of weeds weighed was recorded in T1W0 (54.91 g) which was significantly different from the others except T1W1(49.57 g) and this was followed by T1W2 (34.62 g). The weight of weeds gradually decreased as the duration of weeding regime increased. These results are in line with those of Sedghi *et al.* (2008) who reported that there was an increase in weed biomass with an increase in weed crop competition period. Table 4 shows the effect of tithonia mulch on the harvest weight of amaranth. There was significant difference in yield as affected by weed infestation. T1W3 produced the highest fresh yield (83.90 kg) but was not significantly different from T1W2 (82.50 kg), this was followed by T1W1 which was not significantly different from T1W0 which gave the lowest yield recorded (69.33 kg). This is in line with the findings of Tollenaar *et al.* (1994) who reported that yield decreases due to weed infestation throughout the vegetation period. Table 5 shows the effect of neem mulch on plant

Table 5: Effect of neem mulch on plant height of amaranth

	WAP (cm)				
TRT	2	3	4	5	6
T2W3	1.91[a]	3.06[a]	13.25[a]	15.41[a]	17.39[a]
T2W0	1.95[a]	2.17[b]	2.82[c]	12.54[b]	13.92[c]
T2W1	1.79[a]	2.11[b]	5.57[b]	7.13[c]	8.81[d]
T2W2	1.94[a]	2.40[b]	6.85[b]	11.09[b]	15.85[b]

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, T2W3: Neem+Weed free, T2W0: Neem+Weedy, T2W1: Neem+Weed once, T2W2: Neem+Weed twice

Table 6: Effect of neem mulch on stem girth of amaranth

	WAP (cm)				
TRT	2	3	4	5	6
T2W3	0.63[a]	0.90[a]	1.36[a]	2.10[a]	2.33[a]
T2W0	0.66[a]	0.96[a]	1.23[ab]	1.96[ab]	2.30[a]
T2W1	0.43[b]	0.63[b]	1.20[ab]	1.63[ab]	2.20[ab]
T2W2	0.50[a]	0.80[ab]	1.06[b]	1.53[b]	2.03[b]

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, T2W3: Neem+Weed free, T2W0: Neem+Weedy, T2W1: Neem+Weed once, T2W2: Neem+Weed twice

Table 7: Effect of neem mulch on weed biomass of amaranth

TRT	Weed biomass (g)
T2W3	0.00[d]
T2W0	51.18[a]
T2W1	32.95[c]
T2W2	43.45[b]

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, T2W3: Neem+Weed free, T2W0: Neem+Weedy, T2W1: Neem+Weed once, T2W2: Neem+Weed twice

height of amaranth. Neem mulch had significant difference on the plant height of amaranth throughout the experimental period except at 2 WAP. T2W3 was significantly higher from 3 to 6 WAP during the study period. At 6WAP, T2W3 gave the highest value (17.39 cm), this was followed by T2W2 with a height of 15.85 cm and T2W1 had the lowest plant height (8.81 cm). Benga *et al.* (2001) who reported that weed infestation decreases the height of plants. Table 6 shows the effect of neem mulch on the stem girth of amaranth. Neem mulch had a significant difference on the stem girth of amaranth throughout the study period. At 6WAP, T2W3 was significantly higher (2.33) but not significantly different from the other treatments except T2W2 which recorded the lowest value (2.03). The effect of neem mulch on weed biomass in amaranth as presented in Table 7. Neem mulch had significant difference on weed biomass produced in the amaranth plot. Weed biomass recorded in T2W0 plot had the highest value (51.18 g) which was significantly different from the other treatment; this was followed by the value recorded in T2W2 plot (43.45 g) while the lowest value was recorded in the T2W3 plot (0.00 g). These results are in line with those of Sedghi *et al.* (2008) who reported that there was an increase in weed biomass with an increase in weed-crop competition period. Table 8 shows the effect of neem mulch on the harvest weight of amaranth. Neem mulch had significant difference in the yield of amaranth. T2W3 and T2W2 were significantly different from the others. T2W3 has the highest value

Table 8: Effect of neem mulch on the harvest weight of amaranth

TRT	Harvest weight (kg)
T2W3	62.46[a]
T2W0	35.60[c]
T2W1	47.70[b]
T2W2	51.76[a]

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, T2W3: Neem+Weed free, T2W0: Neem+Weedy, T2W1: Neem+Weed once, T2W2: Neem+Weed twice

Table 9: Effect of gliricidia mulch on plant height of amaranth

	WAP (cm)				
TRT	2	3	4	5	6
T3W3	2.15[a]	2.82[a]	7.61[a]	13.91[a]	17.86[a]
T3W0	1.87[b]	2.32[ab]	6.41[a]	9.98[b]	11.80[c]
T3W1	1.94[ab]	2.91[a]	7.35[a]	11.15[ab]	16.82[ab]
T3W2	1.86[b]	2.06[b]	5.89[a]	8.50[b]	12.51[bc]

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, T3W3: Gliricidia+Weed free, T3W0: Gliricidia+Weedy, T3W1: Gliricidia+Weed once, T3W2: Gliricidia+Weed twice

Table 10: Effect of gliricidia mulch on stem girth of amaranth

	WAP (cm)				
TRT	2	3	4	5	6
T3W3	0.50[a]	0.66[b]	1.10[a]	1.50[b]	2.00[ab]
T3W0	0.56[a]	0.90[ab]	1.20[a]	1.50[b]	2.00[ab]
T3W1	0.66[a]	1.00[a]	1.33[a]	2.16[a]	2.36[a]
T3W2	0.46[a]	0.70[b]	0.96[a]	1.30[b]	1.96[b]

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, T3W3: Gliricidia+Weed free, T3W0: Gliricidia+Weedy, T3W1: Gliricidia+Weed once, T3W2: Gliricidia+Weed twice

(62.46 kg) this was followed by the value recorded in T2W2 (51.76 kg), however, the least yield was recorded in T2W0 (35.60 kg) and this could be due to high level of weed infestation which increased the competition that lowered plant yield. Weeds compete for water, nutrient and sunlight making the crops to suffer and in most cases leads to a total crop failure. This result agreed with the report of FAO (1986), that weeds which are plants growing where they are not wanted tend to inhibit the growth and yield of crop. Table 9 shows the effect of gliricidia mulch on plant height of amaranth. There was significant difference across the treatment throughout the study period except at 4WAP. At 6WAP, T3W3 had the highest value (17.86 cm) recorded and was significantly different from the others except T3W1. T3W2 was not significantly different from T3W0 which gave the lowest value of height (11.80 cm) recorded. This is in line with the findings of Kamal *et al.* (1983) who revealed that difference in plant height is attributed due to various intensities of weed competition with plant. Table 10 show the effect of gliricidia mulch on the stem girth of amaranth. There was significant difference in stem girth except at the second and fourth week after planting. At 6WAP, T3W1 gave the highest value (2.36) but not significantly different from the others except T3W2 which had the least value (1.96). This is in agreement with the work of Fuksa *et al.* (2004) who reported similar result in the negative effect caused by weeds were also observed in the stalk

Table 11: Effect of gliricidia mulch on weed biomass of amaranth

TRT	Weed biomass (g)
T3W3	0.00[d]
T3W0	51.55[a]
T3W1	34.93[b]
T3W2	24.60[c]

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, T3W3: Gliricidia+Weed free, T3W0: Gliricidia+Weedy, T3W1: Gliricidia+Weed once, T3W2: Gliricidia+Weed twice

Table 12: Effect of gliricidia mulch on the harvest weight of amaranth

TRT	Harvest weight (kg)
T3W3	63.80[a]
T3W1	67.53[a]
T3W0	49.13[b]
T3W2	70.23[a]

Values with the same letter for each parameter along the same column are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level, T3W3: Gliricidia+Weed free, T3W0: Gliricidia+Weedy, T3W1: Gliricidia+Weed once, T3W2: Gliricidia+Weed twice

Table 13: Check list of weeds observed on the experimental plot

Common names	Botanical names	Family names	Classification based on form	Classification based on lifecycle
Wild Mexican sunflower	*Tithonia diversifolia*	Asteraceae	Broad leaf	Perennial
Tridax	*Tridax procumbens*	Asteraceae	Broad leaf	Perennial
Siam weed	*Chromolaena odorata*	Asteraceae	Broad leaf	Perennial
Purple nutsedge	*Cyperus rotundus*	Cyperaceace	Sedge	Perennial
Umbrella grass	*Mariscus falbelliformis*	Cyperaceace	Sedge	Perennial
Spurge weed	*Euphobia heterophlla*	Euphorbiacea	Broad leaf	Annual
	Seteriab arbata	Poaceae	Grass	Perennial
Bahama grass	*Cynodon dactylon*	Poaceae	Grass	Perennial
	Acroceras zizanioids	Poaceae	Grass	Perennial
Spear grass	*Imperata cylindrica*	Poaceae	Grass	Perennial
Water leaf	*Talinum triangulare*	Portulaceae	Broad leaf	Annual
Spiny amaranth	*Amaranthus spinosus*	Amaranthacea	Broad leaf	Annual
Water primerose	*Ludwigia hyssopifolia*	Onagraceae	Broad leaf	Annual

diameter 0.1 m above the ground. Table 11 shows the effect of gliricidia mulch on weight of weed biomass in amaranth. The treatments were significantly different from each other. However, T3W0 gave the highest value (51.55 g) of weed biomass, this was followed by T3W1 (34.93 g) while the least value was recorded in T3W3 (0.00 g). Table 12 shows the effect of gliricidia mulch on the harvest weight of amaranth. There was significant difference in the treatments. At harvest, T3W3, T3W2, T3W1 were significant but there were significant different in T3W0. However, T3W0 gave the least yield (49.13 kg) while the highest value was obtained from T3W2 (70.23 kg). This is in line with the findings of Maqsood *et al.* (1999) who reported that as weed crop competition increased, the yield decreases. Table 13 shows the check list of weeds observed on the plot. Weeds were classified based on the family name, common name, form and lifecycle. Natural broad leaved weeds were the most dominant of the total weed biomass observed followed by the grassy weeds and the sedge weeds.

In conclusion, all the parameters increase as the duration of weed amaranth competition decreased, while growth parameters increase with an increase in weed eradication. However, highest value was obtained from tithonia mulch plots and neem mulch produced the lowest value on plant height and yield while gliricidia mulch gave the lowest value of stem girth.

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