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Research Paper

The effect of different weed management methods on the growth Performance of Rough Lemon Citrus Rootstock (Citrus jambhiri (L) Lush) In Okigwe, Southeast, Nigeria

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ABSTRACT

Field experiments were conducted during the growing seasons of 2012 and 2013 at the citrus nursery of National Horticultural Research Institute, Mbato sub-station Okigwe, Imo State, Nigeria, to evaluate the effect of different weed management methods on the growth performance of citrus rootstock, rough lemon (*Citrus jambhiri (L) Lush*). The treatments were live mulch using cowpea (*vigna unguiculata*), dry mulch with grass residue, herbicide (Touchdown) and control (un-weeded). The experiment was a randomized complete block design (RCBD) replicated four times. The soil of the study area is acidic, sandy loam derived from shale /sandstone and are generally classified as ultisol. Data were collected on plant height (cm), stem girth (cm), number of leaves, number of branches and canopy spread (cm) as well as weed density and biomass at 4, 8 and 12 weeks after treatment application. The result of the trial revealed that live mulch followed by dry mulch with grasses gave significant ($p>0.05$) growth performance relative to the control in all the parameters measured in both years. Highest plant height of 89.1 cm, number of leaves (47.8), number of branches (2.4) and stem girth of 1.32 cm were respectively recorded for live mulch in 2012 while the least plant height of 71.9 cm was recorded for the control at 12 weeks after treatment application in the same year. Mulching with cover crop and dry weed residue resulted in enhanced growth of rough lemon citrus rootstock in Mbato Okigwe zone.

Keywords: Citrus rootstock, growth performance, weeds management, mulching, rough lemon

INTRODUCTION

Weeds are naturally occurring plants that are injurious in agricultural systems (worsham, 1991). Weeds harbor insects and disease organisms, serve as alternate hosts to pests, compete with crops for nutrients, moisture, light and space (Anderson, 1983). They may increase insect and disease damage to crops, decrease the quality of crops or cause harm to animal health that feeds on them. Weeds reduce crop yield and quality by competing with the crops (Akobundu, 1987). Live mulch crops such as cowpea(*Vigna unguiculata*) and watermelon(*Citrulus lanatus*) could suppress weed population, reduce weeding costs and frequency as well as provide better quality vegetables (Ojo and Taiwo, 2011).The use of weed residue mulch may serve to reduce the cost of sustaining soil fertility on farms. It is established that mulching of surface soil moderates soil temperature and reduce evaporative loss of water. It is expected that increased supply of organic matter from weed mulch and the physical changes in soil would enhance mineralization of nutrients from the organic sources, leaching of nutrients could also be reduced by the physical presence of mulch which reduces rainfall impact.

Citrus (*Citrus spp*) is one of the most important fruit trees grown in Nigeria for fresh consumption and as raw materials in the tropics and sub-tropics (Adewale et al., 1996). Citrus cultivation is on the increase in Nigeria because of the awareness on its nutritional value, as a cheap source of vitamin C and as one of the most important raw materials in fruit juice industry (Olaniyan and Babalola, 2002, Aubert and Vullin, 1998). There is high demand for budded citrus seedlings for planting. Citrus seedlings provide the foundation for citrus industry and the farmers who specialize in growing citrus are concerned with the time required for the seedlings to reach buddable stage, which in turn is affected by weed infestation, variety and nutrient availability (Lawal et al 2009).Weeds compete with citrus seedlings for nutrients, light, water, space and harbor insects that attack citrus (Futch and Singh, 2000). Competition between weeds and mature citrus tree for nutrients and water is less severe than for younger plants (Davis and Albrigo, 1994). Nevertheless, severe weed pressure may reduce yields (Jordan, 1981). Control of weed growth is a major source of expense especially in

tropical areas such as Nigeria where high temperatures and rainfall support excessive weed growth (Davis and Albrigo, 1994). the traditional method of weed control in citrus nursery is hand weeding because of the closeness of seedlings and their delicate nature. Weed control in citrus is expensive, their removal by repeated manual weeding or hoeing adds to the production cost, apart from the risk of damaging the young roots and shoots (Ikisan, 2000). Although many control measures have been adopted, information is scanty on the use of live mulch, dry grasses and herbicides as control measure in Mbato, Okigwe Imo State Nigeria; hence, the need for this trial with the objective to assess the efficacy of the different weed control methods in the citrus nursery.

MATERIALS AND METHOD

The experiment was conducted during the early growing seasons of 2012 and 2013 at the Citrus nursery of National Horticultural Research Institute (NIHORT) Mbato Sub-station Okigwe Imo State Nigeria (Latitude 5o 33' N, Longitude 7o23' E and 130m above sea level). The trial was superimposed on a five months old existing rough lemon(*Citrus jambhiri (L) lush)* rootstock nursery planted out at a spacing of 40cmx40cm giving a plant population of 62,500/ha. The soil of the site is classified as ultisol derived from shale/sandstone. The soil was sandy loam characterized by low organic matter, low CEC and are highly leached. The trial zone enjoys over 2,200mm of rainfall with temperature range of between 240C and 330C. Composite samples of the top soil (0-20cm) depth were taken. The samples were analyzed for physical and chemical properties. The soil comprised of pH 4.8, total Nitrogen (1.36 g/kg), Organic Carbon (6.50 g/kg) Available Phosphorus (5.82 mg/kg), Excha.K (0.17 cmol/kg), Excha. Ca (2.86 cmol/kg), Excha. Mg (1.70 cmol/kg), ECEC (0.14 cmol/kg), Sand (758 g/kg), Silt (174 g/kg), Clay (680 g/kg). The predominant weeds observed in the experimental site and environ includes *Panicum maximum, Imperata cylindrical, Ageratum conyzoides, Aspilia Africana, Chromolena odorata, Peninesetum purpurem,Euphobia hetrophylla and Bidena pilosa*. The design of the experiment was Randomized complete Block Design (RCBD) with four replications. The plot size was 3mx3m with total land area of 225m2. The treatments comprised of live mulch (cowpea), Dry mulch, herbicide and a weedy check control (un-weeded). The live mulch (cowpea) was planted at 25cm × 25cm. The dry mulch made up of dry grass residue were weighed out and applied at 10 t/ha. Synthetic herbicide (Touchdown) with glyphosate as the active ingredient was applied as a treatment.

Data were collected on the seedlings plant height, canopy spread, number of leaves, number of branches and stem girth at 4 , 8 and 12 weeks after treatment application. Plant height was measured with a meter rule from the surface of the soil to the tip of the tallest leaf. Plant girth was measured by using Venire caliper. Number of branches and number of leaves were calculated by counting. Also, weed data (weed density and weed biomass) were collected using the 1mx1m quadrate. Weed control efficiency (WCE) of each treatment was calculated using the formula according to Thakral et.al. (1988);

$$WCE\ (\%) = WDWC\text{-}WDWT/WDWC \times 100$$

Where WDWC= Weed dry weight in weedy check.
WDWT= Weed dry weight in treatments.

All data collected were analyze using the analysis of variance (ANOVA) using general linear model procedure of the statistical analysis system (SAS Institute, 2003) and means were compared using the least significant deference at (P=0.05).

RESULTS AND DISCUSSION

The soil of the analyzed soil sample of the experimental area revealed that the soil is sandy loam, acidic and low in organic matter content. Nitrogen was low with values of 1.36g/kg. A total of 13 weed species were identified within the nursery site, ten of which are broad leaf family and three in grass family. The effect of the different weed management methods on the growth of rough lemon (*Citrus jambhiri (L) Lush*) at four, eight and twelve weeks after treatment application in 2012 are summarized in Table 1. The result indicates that live mulch and dry mulch with residue significantly ($p>0.05$) showed higher growth performance in all the parameters measured at both 8 weeks and 12 weeks after treatment application (WATA) relative to the control. Highest plant height (89.1cm), number of leaves (47.8), number of branches (2.4) and stem girth (1.32) values were recorded with live mulch at 12 WATA.

Similar trend of results were also recorded in 2013 (Table 2). Although there were no significant differences ($p=0.05$) in number of branches and stem girth at 4 and 8 WATA, highest values of 3.14 and 1.51 were obtained for live mulch followed by dry mulch with grasses relative to the control.

Table 1: Effect of weed management methods on the growth of rough lemon at 4, 8 and 12 weeks after treatment application in 2012.

	Plant height (cm)			Number of leaves			Number of branches			Stem girth (cm)			Canopy spread (cm)		
Treatment	4 WAT	8 WAT	12 WAT	4 WAT	8 WAT	12 WAT	4 WAT	8 WAT	12 WAT	4 WAT	8 WAT	12 WAT	4 WAT	8 WAT	12 WAT
Control	28.8	41.2	71.9	20.1	30.3	45.2	1.30	1.88	2.10	0.41	0.65	1.17	15	28.1	40.9
Live mulch	43.62	62.7	89.1	26.43	58.16	47.8	1.68	2.08	2.4	0.49	0.78	1.32	22	46.2	52.6
Dry mulch	32.37	55.2	87.3	24.28	49.4	46.1	1.65	2.04	2.15	0.45	0.72	1.18	21	38.5	43.8
Herbicide	30.7	46.3	81.5	22.47	36.6	41.7	1.62	2.00	2.05	0.43	0.68	0.96	20	36.7	41.2
LSD(0.05)	5.14	7.83	12.3	4.22	6.95	10.9	NS	NS	NS	NS	0.08	NS	6.8	12.9	15.7

WAT – Weeks after treatment application

Table 2: Effect of weed management methods on the growth of rough lemon at 4, 8 and 12 weeks after treatment application in 2013

	Plant height (cm)			Number of leaves			Number of branches			Stem girth (cm)			Canopy spread (cm)		
Treatment	4 WAT	8 WAT	1 2 WAT	4 WAT	8WAT	12WAT	4 WAT	8 WAT	12 WAT	4 WAT	8 WAT	12 WAT	4 WAT	8 WAT	12 WAT
Control	23.6	53.7	70.8	22.5	36.6	49.7	1.33	2.82	3.0	0.33	1.2	1.3	12.3	22.4	36.8
Live mulch	38.9	73.4	93.6	24.7	44.9	69.2	1.37	3.14	4.2	0.57	1.44	1.51	20.2	32.1	44.3
Dry mulch	33.6	69.4	85.5	27.1	38.6	51.8	1.66	2.96	3.5	0.48	1.1	1.46	20.6	30.3	58.8
Herbicide	24.3	51.2	71.5	20.6	33.7	45.2	1.33	2.88	3.6	0.39	1.29	1.37	18.9	27.4	31.7
LSD(0.05)	10.3	9.5	7.6	5.2	12.4	19.6	NS	NS	0.18	NS	NS	0.09	2.8	3.4	5.6

WAT – Weeks after treatment application

The growth performance of the citrus rootstock seedlings in plots treated with live mulch could be attributed to the ability of the live mulch to smolder weeds and suppress weed growth. This is in conformity with earlier findings of Akobundu,(1993) and Obiefuna (1989) who reported that prostrate crops like Egusi melon, cowpea suppressed weeds and reduced early weeding in maize. Also, Ofosu-Anim and Limbani, (2007) reported that cucumber intercropped with okra reduced weed infestation, pumpkin intercropped with maize reduced weed growth. Live mulches are useful tool for weed suppression in sustainable agricultural systems (Teasdale, 1996, Bond and Gundy, 2001, Kruidhof *et, al.2008*). The better Performance of the rough lemon rootstock in plots with live mulch could also be attributed to its ability to improve soil structure (Harris *et.al.* 1996), regulate soil water content (Hoyt and Hargrove, 1986), enhancement of soil organic matter, carbon dynamics and microbiological function (Steenwerth and Belina, 2008), reducing soil erosion (Malik *et.al.* 2000), and enhancement of populations of soil macrofauna (Blanchart *et.al.* 2006). Moreso, Iinicki and Enache (1992) reported that live mulch reduced weed biomass and increased soybean yield by 91% relative to weedy controlled plots. However, improved performance of the rootstock seedlings in the dry mulched plots could be attributed to improvement in some soil physical properties. Ewulo (2005) reported that mulching using dry grasses reduced soil temperature, soil pH and Increased soil organic matter as well as N, P and K values. Lal (1986) reviewed some literature on response of tropical crops to different mulch materials and concluded that yield of crops such as cassava; yam, cowpea and soybean were increased by mulching with crop residue and grasses. Adeoye (1984), reported positive response of sorghum yield to grass mulch. Ojeniyi and Adetoro (1993) found significant increase in yield of late season okro in response to mulching with crop residue and grasses.

Highest weed control efficiency (WCE) of 72.2% was recorded from plots with live mulch while the lowest WCE of 47.2% was recorded from plot with herbicide (Table 3).

Table 3: Weed density, weed biomass and weed control efficiency as influenced by different control methods.

Treatment	Weed density(plant/m^2)	Fresh weight(g/m^2)	Dry weight(g/m^2)	WCE (%)
Control	185	510	**72**	0.0
Live mulch	26	88	20	72.2
Dry mulch	38	96	22	69.4
Herbicide	168	129	38	47.2
LSD(0.05)	**28.2**	**36.7**	**12.4**	**12.8**

The least weed density of 26 plants/m^2 was recorded from plots where weeds are controlled with live mulch and this was significantly lower when compared with the control plot that recorded the highest weed density of 185 compared to other weed control methods.

CONCLUSION

Weed control methods using mulching materials (Live mulch and dry mulch) increased the performance of citrus rootstock seedlings (rough lemon) in Mbato Okigwe, Imo state, Nigeria. This can be attributed to the fact that mulch materials retain moisture and suppressed weed growth thus reducing competition with the citrus seedlings. In weedy check (control) plots, there were severe competition between citrus seedlings and weeds for soil nutrients. The treated plots also showed low weed density and dry weed biomass compared to weedy check plots

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