Influence of mulching materials on the growth of citrus and weed suppression potential of mulching materials in citrus nursery

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ABSTRACT

A field experiment was conducted at National Horticultural Research Institute, Ibadan, Nigeria to evaluate the influence of mulch materials on growth performances of *Cleopatra mandarin (Citrus reticulata)* rootstock and budded shaddock (*Citrus grandis*) scion performances and also to determine the effect of mulching materials on citrus in the nursery. The mulch materials were *Azadirachta indica* (neem) leaf, *Eugenia uniflora* (pitanga) leaf, *Terminalia catappa* (tropical almond) leaf, black plastic polythene while hoe weeding was used as control. Results revealed that there were significant differences amongst the treatments in stem diameter, plant height, number of citrus leaves and number of branches. Tropical almond leaf mulch increased stem diameter by 51%, pitanga leaf mulch increased plant height by 32.5%, black plastic mulch increased number of citrus leaves by 46.1% and neem increased number of branches by 52.6%, sixteen weeks after transplanting for *Cleopatra mandarin* rootstock, while, pitanga leaf mulch and neem leaf mulch increased stem diameter by 20%, scion length by 15.6% while, neem leaf mulch increased number of leaves by 6.5% and number of branches by 2.3 %, twelve weeks after budding, for budded shaddock scion. Weed biomass was reduced by 48.6% in plot mulched with black plastic, while, root spread was increased by 41.2% in plot mulched with *A. indica* leaves as compared to hoeing (Control).

Key words: *mulch material, rootstock, scion, weed biomass, root architecture, citrus*

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INTRODUCTION

In many agricultural systems around the world, competition from weed is one of the major factors reducing crop yield and farmers income. Knott (1992), Akobundu (1986) and Olayinka (2002) reported that weed caused the greatest yield reduction by competing for moisture, nutrients and light. Different methods are used to control weeds in citrus. Application of herbicides followed by cultural practices which includes hoeing and hand weeding was found to be significantly superior to herbicide alone, but it increases cost of production and further reduce economic return to growers. Also in developing countries, herbicides are rarely accessible at a reasonable cost; hence farmers often need to rely on alternative methods for weed management. However, recent environmental concerns regarding herbicide use have promoted interest in alternative methods of weed control.

Mulches may help decrease herbicide use by providing a non-chemical means of reducing impact of weed interference in citrus farm. Numerous studies have examined the ability of mulches to suppress weeds and affect crop yield. Akobundu (1986) also noted that mulching with fresh leaves gave better yield than plastic mulch in the tropics and subtropics. Research has also shown that residue from cover crops or other organic mulches must be present in very high amount to provide a high level of physical suppression of annual weeds. For example, Teasdale and Mohler, (2000) reported that greater than 75% inhibition of weed emergence is consistently achieved only when mulch biomass exceeds 8 t/ha and mulch thickness exceeds 10cm.

The contribution of dried leaves to weed control and increased soil fertility will largely depend on the amount and decomposition rate of the biomass applied. These materials used as mulch prevent the young roots of the citrus seedlings from drying out, prevent moisture loss from the soil and induce a cool micro-climate that is required during early growth stage. Teasdale and Mohler (2000) noted that the release of phytotoxic compounds from crop residue can inhibit weed root and hypocotyl growth immediately following germination and prevent emergence of weed seedlings.

Plastic mulches have various beneficial effects on crops including an increase in soil temperature, conservation of soil moisture, texture and fertility, weed control, and pest and disease control. The objectives of this work were:

i) To evaluate the influence of *Terminalia catappa* leaves, *Azadiracta indica* leaves, *Eugenia uniflora* leaves and plastic mulch in weed suppression.
ii) To evaluate the effects of the mulch materials on growth performance of *Cleopatra mandarin* rootstock and budded shaddock (*Citrus grandis*) scion.

MATERIALS AND METHODS

The experimental site was National Horticultural Research Institute (NIHORT) Ibadan, ($7^0 54^1$N, $7^0 30^1$E, and 213 meters above sea level). Ibadan lies in the derived savannah of South Western Nigeria. The area has a bimodal rainfall distribution, which peaks in June/July and September. The early rain occurs between late April and July, while the late rain occurs from September to November. There is characteristic dry spell in August (August break) before the commencement of late rains. The dry season is from November to March. The annual rainfall is about 1280mm. Annual temperature at the location ranges from an average minimum of 24.8^0C and 24.4^0C for 2008 and 2010 respectively to a maximum of 29.0^0C in 2008 and 2010 respectively.

The mulching materials used were *Terminalia catappa* leaf mulch, *Azadirachta indica* leaf mulch, *Eugenia uniflora* leaf mulch, black polyethylene sheet and hoe weeding as control. They were applied to four months old *Cleopatra mandarin* citrus rootstock seedlings transplanted in May 2009 and shaddock scion budded on the rootstock in April 2010 in 3m x 3m plot size. The leaf biomass for the mulch was applied at 10 t/ha. Mulch materials were applied after transplanting of *C. mandarin* rootstock seedlings to the nursery and after budding of shaddock scion on the rootstock at 9 kg dry weight per plot. The experiment was carried out in randomized complete block design with four replicates.

Data were collected on number of leaves, number of branches, plant height, stem diameter at ground level for rootstock seedlings, scion length, scion diameter at bud union level, soil temperature at 5 cm depth using soil thermometer, soil moisture content at 5 cm depth using tensiometer, root length, root spread, fresh and dry weight of weeds.
All data were subjected to Analysis of variance using SAS analysis programme.

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RESULTS AND DISCUSSION

Influence of Mulch Materials on *Cleopatra mandarin* Rootstock Seedlings and Budded Shaddock Seedling Performance

Highest stem diameter of 1.06cm was recorded from plots mulched with *T. catappa* leaves 16 weeks after transplanting (WAT) and this was significantly higher when compared with the control that recorded the least stem diameter of 0.70cm for *Cleopatra mandarin* rootstock, while plots mulched with *E. uniflora* recorded the highest stem diameter of 0.60cm for shaddock seedlings twelve weeks after budding (WAB). This was not significantly different from other mulched plots and the control (Table 1). Pitanga mulch recorded the highest plant height of 79.50cm at 16 WAT and 57.00cm at 12 WAB for *Cleopatra mandarin* rootstock and shaddock seedling respectively but there were no significant differences amongst other mulch materials and the control hoeing weeding.

Table 1: Influence of mulch materials on growth parameters of Cleopatra mandarin rootstock seedlings And budded shaddock scion performance

	Cleopatra mandarin rootstock seedlings 16 WAT (2009)				Budded shaddock seedlings 12 WAB (2010)			
TRT	SD(cm)	PH(cm)	NL	NB	SD(cm)	SL(cm)	NL	NB
E.uniflora	1.00a	79.50	61.25a	7.00ab	0.60a	57.00a	15.40a	2.00ab
A. Indica	1.00a	79.25a	78.50a	7.25a	0.58a	55.30a	16.40a	3.00a
T. Catappa	1.06a	78.30a	80.40a	7.20a	0.50a	53.70a	13.60a	0.60bc
Plastic	0.86ab	71.75a	89.25a	7.00ab	0.55a	53.30a	14.60a	1.00bc
Hoeing	0.70b	60.00a	61.25a	4.75b	0.50a	49.30a	15.60a	0.30c

Means followed by the same letter(s) are not significantly (p>0.05) difference by DMRT.
SD- stem diameter, PH-plant height, NL-number of leaves, NB-number of branches, Sl-scion length.

Table2: Influence of mulch materials on weed biomass, Temperature and soil moisture content

	Cleopatra mandarin rootstock seedlings 16 WAT (2009)				Budded shaddock seedlings 12 WAB (2010)			
TRT	Fresh Weight (g/m2)	Dry Weight (g/m2)	Soil Temp (0c)	Soil Moist (%)	Fresh Weigh (g/m2)	Dry Weight (g/m2)	Soil Temp (0c)	Moist (0c)
E. Uniflora	530.0a	180.0a	26.70c	1.37a	45.0b	9.50b	29.30bc	5.66ab
A. Indica	500.0b	155.0b	27.00b	1.10b	35.0c	8.50c	29.00c	4.33b
T. Catappa	470.0d	70.0d	26.70c	1.10b	15.0d	6.50d	29.40abc	6.66a
Plastic	175.0e	50.0e	27.30a	2.05a	0.0e	0.0e	30.20a	6.33a
Hoeing	260.0e	90.0c	27.00b	1.25b	210.0a	48.00a	29.40ab	4.66b

Means followed by the same letter(s) are not significantly (P>0.05) difference by DMRT.

Table 3: Root architecture as affected by mulch materials

TRT	Root length	(cm)Root spread (cm)
E.uniflora	24.30a	35.00ab
A. Indica	25.00a	48.00a
T. Catappa	24.00a	29.00b
Plastic	24.30a	22.40b
Hoeing	24.30a	34.00ab

Means followed by the same letter(s) are not significantly (p<0.05) different by DMRT

Similarly, highest number of leaves of 89.25 and 16.4 were recorded at 16 WAT for *Cleopatra mandarin* rootstock with plastic mulch and shaddock scion at 12 WAB with *A. indica* leaves, but these were not significantly different from other mulched plots as well as the control hoeing weeding. Plots mulched with *A .indica* leaves recorded the highest number of branches of 7.25 at 16 WAT and 3.0 at 12 WAB for both *Cleopatra mandarin* rootstock and shaddock scion respectively and these were significantly different from the control plots which recorded the least number of branches of 4.75 at 16 WAT and 0.3 at 12 WAB respectively.

Influence of mulch materials on weed biomass, soil temperature and soil moisture content

The least weed fresh and dry weight of 175.0g/m^2 and dry weight of 50.0g/m^2 were recorded 16 WAT from plots with plastic mulch for *Cleopatra mandarin* rootstock while no weed was recorded during budded shaddock seedling growth season. The highest weed fresh and dry weight of 530.0g/m2 and 180.0g/m2 was recorded form Pitanga mulched plots and these were significantly different from other mulched plots and control (Table 2). For both *Cleopatra mandarin* rootstock, and budded shaddock seedling, highest soil temperature of 27.30^{o}c and 30.20^{o}c was recorded from plastic mulch plots and these were significantly higher than other mulched plots. Plastic mulched plots, retained more soil moisture of 2.05% for *Cleopatra mandarin* rootstock, while *T.catappa* mulched plots had the highest soil moisture of 6.66% for budded shaddock seedlings and these were significantly different from other mulched plots.

Root architecture as influenced by mulch materials.

Highest root length of 25.0cm and root spread of 48.0cm was recorded for plots mulched with *A.indica* leaf mulch. There were no significant differences amongst the treatment for root length, while there was significant differences amongst pitanga mulched plot, *A.indica* leaf mulch and the control plots for root spread (Table 3). The present result also indicated that mulched plot had the lowest weed biomass when compared with non-mulched plot. It means that mulch materials reduces weed seed germination by preventing appropriate stimuli for germination such as temperature, oxygen tension and light intensity from reaching the weed seeds.

The present result and observation on plant growth showed that mulched *Cleopatra mandarin* rootstock seedling were generally taller, have more leaves, more branches and attained stem diameter that enhances easy budding of shaddock scion than in un-mulched plots.The more favourable soil environment under mulch materials during the early part of the growing season after budding may have resulted in the increase in scion diameter, scion length, and plant branches. The increase in *Cleopatra mandarin* rootstock seedlings and shaddock seedling performance may be attributed to controlling of evaporation by mulch materials through moisture retention and lack of competition from weeds.

These findings are in accordance with Shamal *et al* (1990) who reported that high moisture in the soil increased root proliferation and thus enhanced availability of nutrient to crop roots, and Ramarkrishna *et al* (2006) who reported that optimum soil moisture ensures good seed emergence and seedling growth during early and mid season, and these results also agreed with those reported by Olabode *et al* (2004).

CONCLUSION

Covering soil surface with mulch materials such as neem leaves, almond leaves and black plastic mulch have thorough moisture retention, root proliferation and increased root density, enhanced vegetative growth of *Cleopatra mandarin* rootstock seedlings and budded shaddock seedling performance when compared with un-mulched plots. Weeds in the mulched plots are easier to pull because the soil is softer due to higher moisture level, larger pores and greater aggregation and or frequently shallow rooting under mulched materials

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