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Effects of the crude water extract of the leaves of *Moringa oleifera* on the germination and growth of *Amaranthus spinosus* and *Amaranthus hybridus*

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ABSTRACT

The comparative effect of crude leave extract of Moringa oleifera on germination and growth of Amaranthus spinosus and Amaranthus hybridus was studied. The plants seeds selected were planted in polyethylene bags filled with loamy soil, different extract concentrations of 5%, 10% and 15% were obtained from the leaf of M. oleifera using manual extraction method. The plants were well watered with the extracts of three different concentrations and allowed to grow under natural environmental condition. Parameters measured include: weekly height of plants, number of leaves produced by each plants at the end of the week, weekly stem girth and weekly leaf area of plant. The study showed that the extract of Moringa oleifera had negative effect on the growth of Amaranthus spinosus and Amaranthus hybridus. The effect was significantly higher at higher concentrations of the extracts. Moringa oleifera extract significantly reduced the leaf number, leaf area, stem height, fresh weight and dry weight in Amaranthus spinosus and Amaranthus hybridus when compared to those of the control. Additionally, the germination of Amaranthus spinosus and Amaranthus hybridus were delay considerable to the fourth and fifth weeks and in some replicate no germination was observed. The study further showed that the sensitivity of Amaranthus spinosus and Amaranthus hybridus to plant extracts differ. From the study Moringa oleifera had more negative effect on Amaranthus spinosus, hence, revealing more inhibitory activity on the growth of Amaranthus spinosus than on Amaranthus hybridus.

Keywords: *Amaranthus*, *Hybridus*, *Spinosus*, *Moringa oleifera*, Germination, Growth.

INTRODUCTION

Amaranthus hybridus L. popularly called “Amaranth or pigweed” is an annual herbaceous plant of 1-6 feet high. The leaves are alternate, petiole 3–6 inches long, dull green in colour and rough, hairy, ovate or rhombic with wavy margins. The flowers are small, with greenish or red Terminal panicles. Taproot is long, fleshy red or pink. The seeds are small and lenticellular in shape; with each seed averaging 1–1.5mm in diameter and 1000 seeds weighing 0.6–1.2g. It is rather a common species in waste places, cultivated fields and barnyards. In Nigeria, *A. hybridus* leaves combined with condiments are used to prepare soup [1], [2]. In Congo, their leaves are eaten as spinach or green vegetables [3]. These leaves boiled and mixed with a groundnut sauce are eaten as salad in Northern Nigeria and in Mozambique [4], [5]. Flowers tiny green flowers are borne in dense, elongated clusters, usually on the tip of the branches. They are borne in spikes or plumes and are white, green, pink or purplish in colour.

Spiny amaranth, *Amaranthus spinosus* sometimes called spiny pigweed, is a troublesome weed of vegetables, row crops, and pasture in warm climates. Native to the lowland tropics in the Americas, spiny amaranth has spread through tropical and subtropical latitudes around the world [6]. It has become a major weed of rice in the Philippines and is moving into temperate regions in the United States. Its widespread distribution and its sharp spines, which

deter grazing and interfere with manual weeding and harvest, have earned spiny amaranth designation as the world's 15th worst agricultural weed [6]. Spiny amaranth is an erect, often bushy, much-branched summer annual, growing to heights of 2–5 feet. Stems and leaves are smooth and hairless, sometimes shiny in appearance. Each leaf node along the stem bears a pair of rigid, sharp spines 0.5 inch long. Leaf blades are egg-shaped to diamond-shaped, with the broader end closest to the stem, 1–4 inches long by 0.5–2.5 inches wide. The petiole is approximately as long as the blade. Leaves may be variegated with a v-shaped watermark or area of lighter colour although this is not a definitive characteristic of this species, since some other amaranths can show a similar watermark. Like other pigweeds, spiny amaranth develops a strong taproot with a network of fibrous feeder roots. The taproot may or may not be distinctly reddish in color. Male and female flowers are borne on different regions of the same plant; linear or branched terminal spikes with mostly male flowers and globular axillary clusters of mostly female flowers [7].

Amaranth consists of 60-70 species, 40 of which are considered native to the Americas. They are grown in the temperate and tropical climates, and are used as grain or vegetable. They are highly nutritious, contain vitamins and minerals. The leaves, shoots, tender stems and grains are eaten as pot herb in sauces or soups, cooked with other vegetables, with a main dish or by itself. The plants are used as forage for livestock. Traditionally, the boiled leaves and roots are used as: laxative, diuretic, anti-diabetic, antipyretic, anti-snake venom, anti-leprosy, anti-gonorrheal, expectorant, to relieve breathing in acute bronchitis. It also has anti-inflammatory properties, immune modulatory activity, anti-androgenic activity and anthelmintic properties [8]**.**

The plant *Moringa oleifera* is a native to the Indian sub-continent and naturalized in tropical and sub-tropical areas around the world, it belongs to the family Moringaceae and is a deciduous tree or shrub, fast-growing, drought resistant, average height of 12m at maturity. This plant has twelve other varieties of species and they are *Moringa drouhardii, Moringa hildebrandtii, Moringa longituba, Moringa ovalifolia, Moringa peregrina ,Moringa pygmaea, Moringa rivae, Moringa ruspoliana, and Moringa stenoptala*. *Moringa oleifera* is a short, slender, deciduous, perennial tree, grows to about 10m tall, rather slender with droping branches; branches and stem are brittle, with corky bark; leaves are feathery, pale green, compound, tripinnate (30-60cm long) with many small leaflets. However, crude water extract from leave of *Moringa oleifera* was used to germinate, nurture and compare the growth of *Amaranthus hybridus* and *Amaranthus spinosus*.

MATERIALS AND METHODS

The *Moringa oleifera* leaves were gotten from Nnamdi Azikiwe University premises. The leave sample was then dried in the oven at the temperature of 70ºC. After drying, the leaves were ground into powder form using mortar and pestle. The powdered leave sample was boiled in water and later diluted to varying concentrations.

2.1 Planting

Loamy soil was used in the planting of the two *Amaranthus* species. Measured quantity of the soil was weighed 10g each and then placed inside the plastic poly bags readied for seed planting.

2.2 Experimental design

In the experimental design, *Moringa oleifera* had three concentrations; 5%, 10% and 15%, each concentration had three replicate.

2.3 Seed viability test

The seeds of *Amaranthus hybridus* were gotten from Gbarimgba market in Awka South Local Government Area. Before planting, seed viability test was carried out to know if the seeds will germinate, this was done manually by placing all the seeds in water; however, the ones that dropped to the bottom of the Petri dish were taken to be viable while those at the top of the Petri dish were taken not to be viable.

2.4 Sowing of seeds

After the viability test seeds were sown by broadcasting method in the poly bag and then left for three days before applying the crude water extracts of *Moringa oleifera* in their concentration to *Amaranthus hybridus* and *Amaranthus spinosus*.

RESULTS

3.1 Effect of *Moringa oleifera* Extract on the Productivity of *Amaranthus spinosus* and *Amaranthus hybridus*

Table 1 shows the weekly mean height of *Amaranthus spinosus* watered with extract of *Moringa oleifera* at various concentrations. The table indicates that comparatively, *Amaranthus spinosus* in the control (% extract) reported the highest height from the first week (4.0±1.000) to the fifth week (15.0±1.000). Samples treated with 5%

concentration of the extract only reported a mean height of 6.3±1.528 in the fourth week and 10.2±1.041 in the fifth week. Similarly, samples treated with 10% of the extract only reported a mean height of 2.7±1.528 in the fifth week. No height reading was observed for samples treated with 15% of the extract. The analysis of variance further indicates a significant difference in the mean height of *Amaranthus spinosus* between concentrations of extract ($p<0.05$).

Table 1: Weekly Mean Height of *Amaranthus spinosus* Grown with Crude Water Extract of *Moringa oleifera*

	Weekly Plant Height (cm) of *Amaranthus spinosus*				
Concentration*	Wk1	Wk2	Wk3	Wk4	Wk5
0%	4.0 ± 1.000^{b}	5.7 ± 1.528^{c}	8.7 ± 0.577^{d}	14.0 ± 1.000^{e}	15.0 ± 1.000^{e}
5%	-	-	-	6.3 ± 1.528^{c}	10.2 ± 1.041^{d}
10%	-	-	-	-	2.7 ± 1.528^{a}
15%	-	-	-	-	-

Results are in Mean ± Standard deviation
Rows/columns with the same superscript are not significantly different
P<0.05

Table 2 shows the weekly mean height of *Amaranthus hybridus* cultivated with extract of *Moringa oleifera* at various concentrations. The table indicates that comparatively, *Amaranthus hybridus* in the control (% extract) reported the highest height from the first week (4.2±0.054) to the fifth week (15.1±0.917). Samples treated with 5% concentration of the extract only reported a mean height of 6.5±1.495 in the fourth week and 10.3±0.212 in the fifth week. Similarly, samples treated with 10% of the extract only reported a mean height of 4.0±0.000 in the fifth week. No height reading was observed for samples treated with 15% of the extract. The analysis of variance further indicates a significant difference in the mean height of *Amaranthus hybridus* between concentrations of extract ($p<0.05$).

Table 2: Weekly Mean Height of *Amaranthus hybridus* Grown with Crude Water Extract of *Moringa oleifera*

	Weekly Plant Height (cm) of *Amaranthus hybridus*				
Concentration*	Wk1	Wk2	Wk3	Wk4	Wk5
0%	4.2 ± 0.054^{b}	5.7 ± 0.046^{b}	8.6 ± 0.502^{c}	14.6 ± 0.361^{d}	15.1 ± 0.917^{d}
5%	-	-	-	6.5 ± 1.495^{b}	10.3 ± 0.212^{c}
10%	-	-	-	-	4.0 ± 0.000^{a}
15%	-	-	-	-	

Results are in Mean ± Standard deviation
Rows/columns with the same superscript are not significantly different
P<0.05

Table 3 shows the weekly mean number of leaves of *Amaranthus spinosus* cultivated with crude water extract of *Moringa oleifera* at various concentrations. The table indicates that comparatively, *Amaranthus spinosus* in the control (% extract) reported the highest number of leaf from the first week (3.7±0.577) to the fifth week (8.3±0.577). Samples treated with 5% concentration of the extract only reported a mean number of leaves of 3.0±1.000 in the fourth week and 6.0±1.000 in the fifth week. Similarly, samples treated with 10% of the extract only reported a mean number of leaves of 2.3±0.577 in the fifth week. No leaf number reading was observed for samples treated with 15% of the extract. The analysis of variance further indicates a significant difference in the number of leaves of *Amaranthus spinosus* between concentrations of extract ($p<0.05$).

Table 3: Weekly Leaf Number of *Amaranthus spinosus* Grown with Crude Water Extract of *Moringa oleifera*

	Weekly Leaf Number of *Amaranthus spinosus*				
Concentration*	Wk1	Wk2	Wk3	Wk4	Wk5
0%	3.7 ± 0.577^{b}	4.7 ± 0.577^{b}	6.0 ± 1.000^{c}	7.0 ± 1.000^{d}	8.3 ± 0.577^{e}
5%	-	-	-	3.0 ± 1.000^{a}	6.0 ± 1.000^{c}
10%	-	-	-	-	2.3 ± 0.577^{a}
15%	-	-	-	-	

Results are in Mean ± Standard deviation
Rows/columns with the same superscript are not significantly different
P<0.05

Table 4 shows the weekly mean number of leaves of *Amaranthus hybridus* cultivated with crude water extract of *Moringa oleifera* at various concentrations. The table indicates that comparatively, *Amaranthus hybridus* in the control (% extract) reported the highest number of leaf from the first week (4.3±0.577) to the fifth week (9.0±0.000). Samples treated with 5% concentration of the extract only reported a mean number of leaves of 3.7±0.577 in the fourth week and 6.3±0.155 in the fifth week. Similarly, samples treated with 10% of the extract only reported a mean number of leaves of 4.7±0.577 in the fifth week. No leaf number reading was observed for samples treated

with 15% of the extract. The analysis of variance further indicates a significant difference in the number of leaves of *Amaranthus hybridus* between concentrations of extract ($p<0.05$).

Table 4: Weekly Leaf Number of *Amaranthus hybridus* Grown with Crude Water Extract of *Moringa oleifera*

	Weekly Leaf Number of *Amaranthus hybridus*				
Concentration*	Wk1	Wk2	Wk3	Wk4	Wk5
0%	4.3 ± 0.577^{b}	4.7 ± 0.577^{b}	6.3 ± 0.528^{c}	7.3 ± 0.528^{d}	9.0 ± 0.000^{e}
5%	-	-	-	3.7 ± 0.577^{a}	6.3 ± 0.155^{c}
10%	-	-	-	-	4.7 ± 0.577^{b}
15%	-	-	-	-	-

Results are in Mean ± Standard deviation
Rows/columns with the same superscript are not significantly different
P<0.05

Table 5 shows the weekly mean leaf area of *Amaranthus spinosus* cultivated with crude water extract of *Moringa oleifera* at various concentrations. The table indicates that comparatively, *Amaranthus spinosus* in the control (% extract) reported the highest leaf area of 2.6±0.569 in the first week to 8.0±0.947 in the fifth week. Samples treated with 5% concentration of the extract only reported mean leaf area of 2.8±0.451 in the fourth week and 4.5±0.153 in the fifth week. Similarly, samples treated with 10% of the extract only reported a leaf area of 1.9±0.265 in the fifth week. No leaf area reading was observed for samples treated with 15% of the extract. The analysis of variance further indicates a significant difference in the leaf area of *Amaranthus spinosus* between concentrations of extract ($p<0.05$).

Table 5: Weekly Leaf Area of *Amaranthus spinosus* Grown with Crude Water Extract of *Moringa oleifera*

	Weekly Leaf Area of *Amaranthus spinosus*				
Concentration	Wk1	Wk2	Wk3	Wk4	Wk5
0%	2.6 ± 0.569^{a}	4.2 ± 0.709^{b}	6.1 ± 1.644^{c}	6.8 ± 0.909^{c}	8.0 ± 0.947^{d}
5%	-	-	-	2.8 ± 0.451^{a}	4.5 ± 0.153^{b}
10%	-	-	-	-	1.9 ± 0.265^{a}
15%	-	-	-	-	

Results are in Mean ± Standard deviation
Rows/columns with the same superscript are not significantly different
P<0.05

Table 6 shows the weekly mean leaf area of *Amaranthus hybridus* cultivated with crude water extract of *Moringa oleifera* at various concentrations. The table indicates that comparatively, *Amaranthus hybridus* in the control (% extract) reported the highest leaf area of 3.3±0.173 in the first week to 8.1±0.054 in the fifth week. Samples treated with 5% concentration of the extract only reported mean leaf area of 3.0±0.126 in the fourth week and 4.7±0.304 in the fifth week. Similarly, samples treated with 10% of the extract only reported a leaf area of 2.7±0.577 in the fifth week. No leaf area reading was observed for samples treated with 15% of the extract. The analysis of variance further indicates a significant difference in the leaf area of *Amaranthus hybridus* between concentrations of extract ($p<0.05$).

Table 6: Weekly Leaf Area of *Amaranthus hybridus* Grown with Crude Water Extract of *Moringa oleifera*

	Weekly Leaf Area of *Amaranthus hybridus*				
Concentration*	Wk1	Wk2	Wk3	Wk4	Wk5
0%	3.3 ± 0.173^{a}	4.5 ± 0.469^{b}	6.7 ± 0.159^{c}	7.1 ± 0.646^{c}	8.1 ± 0.054^{d}
5%				3.0 ± 0.126^{a}	4.7 ± 0.304^{b}
10%					2.7 ± 0.577^{a}
15%	-	-	-	-	

Results are in Mean ± Standard deviation
Rows/columns with the same superscript are not significantly different
P<0.05

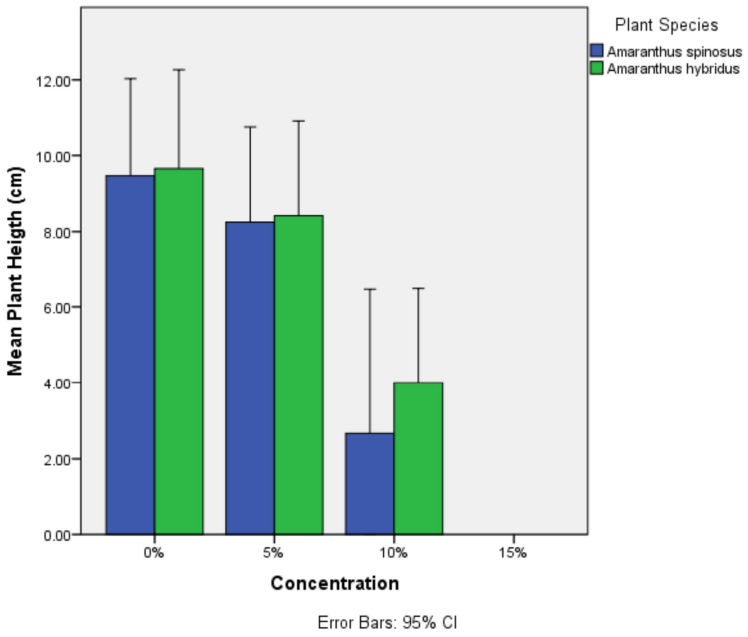

Figure 1: Showing the mean height of *Amaranthus spinosus* and *Amaranthus hybridus* in various concentrations of *Moringa oleifera* extract. The figure depicts that height of both *Amaranthus spinosus* and *Amaranthus hybridus* decreased with increasing concentration of the extract. In comparison, the height of *Amaranthus hybridus* was higher in all concentration of the extract when compared to those of *Amaranthus spinosus.* Analysis of variance further indicates a significant difference between the mean height of *Amaranthus spinosus* and *Amaranthus hybridus* in various concentrations of *Moringa oleifera* extract (p<0.05)

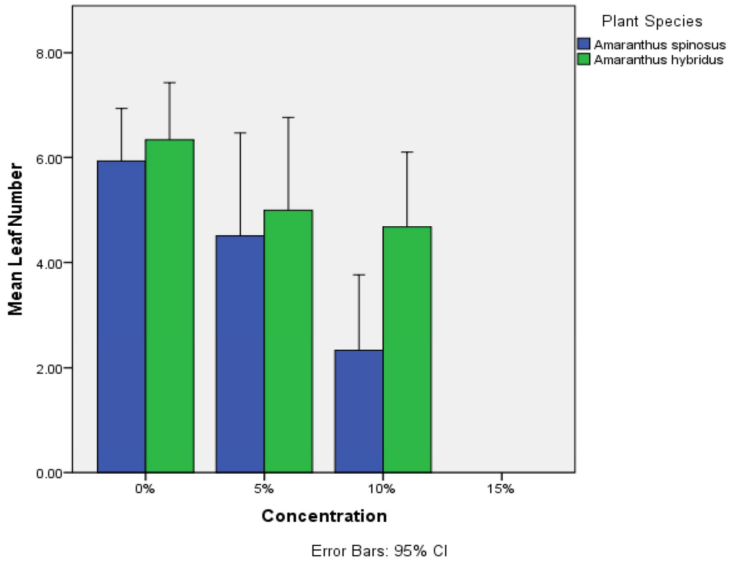

Figure 2: Showing the mean number of leaf produced by *Amaranthus spinosus* and *Amaranthus hybridus* in various concentrations of *Moringa oleifera* extract. The figure depicts that the number of leaf in both *Amaranthus spinosus* and *Amaranthus hybridus* decreased with increasing concentration of the extract. In comparison, the number of leaf of *Amaranthus hybridus* was higher in all concentration of the extract when compared to those of *Amaranthus spinosus.* Analysis of variance further indicates a significant difference between the mean height of *Amaranthus spinosus* and *Amaranthus hybridus* in various concentrations of *Moringa oleifera extract* (p<0.05)

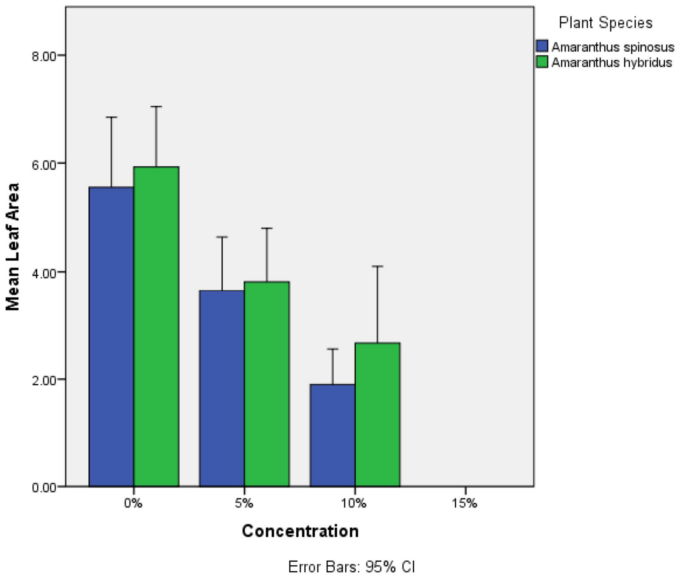

Figure 3: Showing the mean leaf area of *Amaranthus spinosus* and *Amaranthus hybridus* in various concentrations of *Moringa oleifera* extract. The figure depicts that the leaf area of both *Amaranthus spinosus* and *Amaranthus hybridus* decreased with increasing concentration of the extract. In comparison, the leaf of *Amaranthus hybridus* was higher in all concentration of the extract when compared to those of *Amaranthus spinosus.* Analysis of variance further indicates a significant difference between the leaf area of *Amaranthus spinosus* and *Amaranthus hybridus* in various concentrations of *Moringa oleifera* extract (p<0.05)

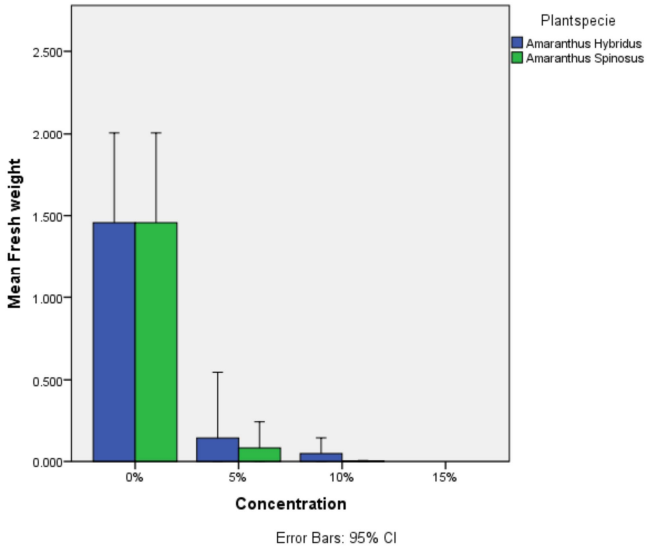

Figure 4: Showing the fresh weight (g) of *Amaranthus spinosus* and *Amaranthus hybridus* in extracts of *Moringa oleifera.* The figure depicts that the fresh weight of both plant decreases with concentration. In the control (0%) the fresh weights of *Amaranthus spinosus* and *Amaranthus hybridus* were the same while at 5% and 10% the fresh weights of *Amaranthus hybridus* was higher. Analysis of variance shows no significant difference between the fresh weight *Amaranthus spinosus* and *Amaranthus hybridus* cultivated with extracts of *Moringa oleifera.*

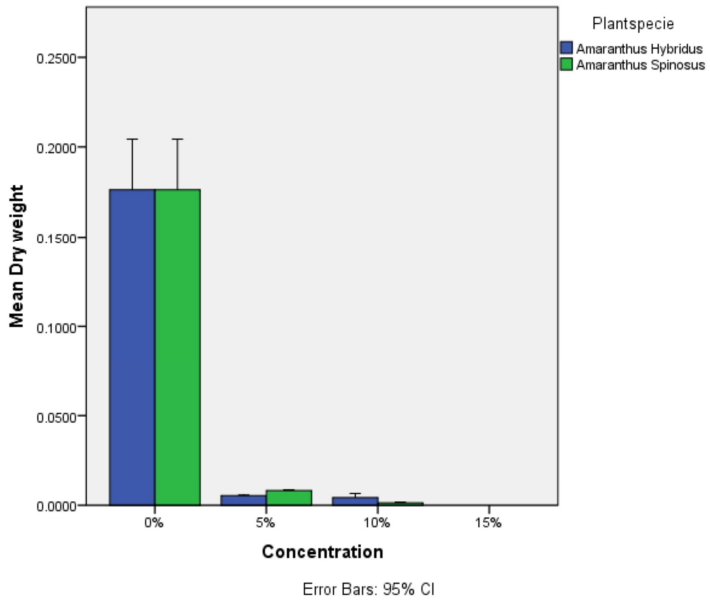

Figure 5: Showing the dry weight (g) of *Amaranthus spinosus* and *Amaranthus hybridus* in extracts of *Moringa oleifera.* The figure depicts that the dry weight of both plant decreases with concentration. In the control (0%) the dry weights of *Amaranthus spinosus* and *Amaranthus hybridus* were the same; at 5% the dry weights of *Amaranthus spinosus* was higher while at 10% the dry weights of Amaranthus *hybridus* was higher. Analysis of variance shows no significant difference between the dry weight *Amaranthus spinosus* and *Amaranthus hybridus* cultivated with extracts of *Moringa oleifera.*

DISCUSSION

The study showed that the extract of *Moringa oleifera* had negative effect on the growth of *Amaranthus spinosus* and *Amaranthus hybridus*. The effect was significantly higher at higher concentrations of the extracts. *Moringa oleifera* extracts significantly reduced the leaf number, leaf area, stem height, fresh weight and dry weight in *Amaranthus spinosus* and *Amaranthus hybridus* when compared to those of the control. Additionally, the germination of *Amaranthus spinosus* and *Amaranthus hybridus* were delayed considerably to the fourth and fifth weeks and in some cases no germination was observed. The results of this study were not consistent with the findings of [9] who reported a general improved crop performance in response to application of leaf extracts of *Moringa oleifera*. Following on, [10] studies on the negative effect of the plant extracts could be attributable to inhibitory substances in the plants. [11] reported that some extracts of plant such as *Eucalypt*us extract and *Morinda* extract have allelochemicals which could reduce and delay germination and crop yield.

The study further showed that the sensitivity of *Amaranthus spinosus* and *Amaranthus hybridus* to plant extracts differ. From the study *Moringa oleifera* had more negative effect on *Amaranthus spinosus*. [12] reported that the differences in sensitivity of *Amaranthus spinosus* and *Amaranthus hybridus* to plant extracts could be attributed to differences in the selectiveness of inhibitory growth substances. According [13] the resistant to inhibitory substance in crops differ and therefore could account for the differences in sensitivity of *Amaranthus spinosus* and *Amaranthus hybridus* to plant extracts

Finally, this study revealed that the inhibitory activity of *Morinda lucida* on the growth of *Amaranthus spinosus* and *Amaranthus hybridus* was higher when compared to those of *M. oleifera*. [11] explained that most plant like *Eucalypt*us extract and *Morinda* lucida have higher concentration of allolechemicals in their leaves. This could account for the inhibitory activity of *Moringa oleifera.*

This study therefore, indicated that *Moringa oleifera* leaf extracts are not desirable for cultivation of *Amaranthus spinosus* and *Amaranthus hybridus* because they delayed germination, significantly reduced the leaf number, leaf area, stem height, fresh weight and dry weight of the plants. This study therefore advocates for increase research in the inhibitory substances in *Moringa oleifera* leaf extracts.

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