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Effect of Aqueous Moringa Leaf Extract (*Moringa Oleifera*) on the Phenology and Growth Parameters of Three Tomato Varieties Under Different Water Regimes in Dutse, Nigeria

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Abstract
Lack of adequate fertilizer, varietal differences and water stress are some of the factors that limit the growth and yield of tomato. Moringa leaf extract (MLE) is one of the recent natural bio-stimulants use for enhancing growth, yield and stress tolerance in plants because it contains various phytochemicals. The experiment was carried out to find out the effect of aqueous moringa leaf extract on the phenology and growth parameters of three tomato varieties under different water regimes. The pot experiment consisted of 27 treatments. A split plot arrangement in completely randomize design with three replications was used for this experiment. The treatment evaluated in this study showed significant difference in all the phenology and growth parameters measured. The MLE at 100% was observed to be the optimum concentration for reducing negative effects of water stress and increasing the growth and decreasing the phenology of tomato plant. 100% MLE decreased the phenology of tomato. Tomato showed shorter days to flowering and fruiting. Varietal differences also affected the growth of the tomato varieties. The tomato varieties responded differently to the moringa extract. The study observed that UC85B recorded the highest plant height (78cm), number of leaf per plant (149), number of branches (24) and leaf area (21.5) whereas the lowest result was observed with ROMA VF with plant height (15cm), number of leaf per plant (23), number of branches (5) and leaf area (10). From the results, it can be concluded that moringa leaf extract could be a potential bio-stimulant for improving growth and yield of tomato plant under water stress.

Keywords: Moringa leaf extract, Tomato, Water regimes, Phenology, Growth

INTRODUCTION
One of the main factors restricting the development and productivity of crop plants is drought. Models of crop growth indicate that this problem will only get worse in the future (Bijalwan *et al.,* 2022). Nigeria is probably going to be one of the nations that suffers the most as a result of climate change. Drought is a condition that affects the entire nation of Nigeria despite its diverse natural zones. Though the degree of vulnerability varies, the Sudano-Sahelian zone, which includes the Northern Guinea Savanna, is a dry sub-humid and semi-arid region in the north that is more susceptible to drought than the more humid regions in the south (Abubakar *et al.,* 2019). The states that make up the Sudano-Sahelian region include Jigawa, Kebbi, Sokoto, Zamfara, Katsina, Kano, Yobe, Gombe, and Borno (Abubakar *et al.,* 2018). Drought alters a variety of plant's processes such as physiological, biochemical, and

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even organs like the reduction in the sizes of leaf, stems, and roots. It also affects the quantity, size, and quality of fruits and seeds thus, lowering the yields (Pervez *et al.,* 2009). Varietal differences also affect or determine the growth and yield of crops (Goreta *et al.*, 2005). Tsegaye *et al*. (2007) reported that growth characters of crops such as plant height, vine length, leaf area, number of leaves or branches, and fruit production were influenced by genetic factors of the different varieties.

Tomato (*Solanum lycopersicum* L.) as a vegetable crop with significant nutritional source of the vitamins A, C and carotenoids (such as lycopene), is vulnerable to biotic and abiotic stresses (Pervez *et al*., 2017). Drought stress seriously impairs the vegetative and reproductive functions of most tomato cultivars with consequent slow vegetative growth and decrease in seed development (Conti *et al.,* 2019). There are several ways to lessen the risks such as developing stress-tolerant plants, stress-resistant varieties, *in vitro* selection, and using plant growth hormones (Abscisic acid, Gibberellin, cytokinin, Salcylic acid), antioxidants (ascorbic acid, Hydrogen peroxide) and osmo-protectants through foliar applications and seed treatments (Yusuff *et al*., 2020).

The highly prized plant moringa (*Moringa oleifera Lam. moringaceae*) is primarily grown in tropical and subtropical climates. It is utilized in industry for food and for medicine. These days, natural plant growth bio-stimulants are widely employed to grow plants under both favorable and unfavorable circumstances. Moringa leaf is one of the recent natural bio-stimulants for plant growth, *Moringa oleifera*, is crucial for enhancing yields, nutritional quality, and stress tolerance in plants. The 80% ethanol extract made from *Moringa oleifera* leaves contains growth-promoting factors or cytokinine-type hormones (Maishanu *et al.,* 2017). Furthermore, MLE has high concentrations of phytohormones such gibberellins, cytokinins, and auxins. Moreover, MLE is a useful chemical that delays fruit senescence, encourages plant growth and deeper root development, increases crop output and quality under both normal and stressful situations (Mashamaite *et al.,* 2022).

Lack of adequate fertilizer, varietal differences and abiotic stresses are some of the factors that limit the growth and yield and of tomato as a vegetable, possibly limiting its extensive cultivation to certain areas (Abubakar *et al*., 2018). Jigawa is one the northern states in Nigeria that are arid probably as a result of persistent drought conditions (Abubakar *et al*., 2018). This could be the reason why tomato cultivation in Jigawa is only limited to few areas. Tomato as a cash crop is second to none for quick cash amongst the rural population and in addition many varieties are early maturing types that are favored by the rural farmers. However, in spite of these positive attributes, the abiotic stresses especially the drought has contributed immensely to challenges of profitable tomato farming in Jigawa state. Tomato plants though relished by many as a vegetable, spice and condiment is often vulnerable to many pests, diseases and other environmental adversities which could lead to profit loss. In most cases, reversing the effects of these stresses becomes unachievable due to costs, timing and peculiarities of the methods. Thus, researches using cost effective methods such as foliar application of plant extracts, becomes not only necessary but inevitable in view of the increasing environmental degradation, inflation and exponential population increase. Numerous studies on different crops reported that foliar application of *Moringa oleifera* leaf extract to the crops mitigate various abiotic stresses on plant such as drought, salinity, acidity etc, it also accelerates plant growth, and boosts crop yield (Yusuff *et al.* 2020; Ngcobo and Bertling 2021; Yuniati *et al.* 2022; Mahdawe *et al*. 2023; and Farooq *et al*. 2023). This clarifies the obvious need for experimentation to determine the effect of moringa leaf extract on phenology and growth parameters of tomato under water stress.

MATERIALS AND METHODS

Study Area

The experiment was conducted at the school farm, Federal University Dutse (FUD), Jigawa State. Dutse lies on latitude 11°42'04"N and longitude 9°20'31"E with an elevation of 439m, dry season commences from October to May, and wet season between June to September (Abubakar *et al.,* 2023).

Collection and Preparation of Experimental Materials

The fresh *Moringa olifera* leaves were obtained from Jigawa State Agricultural and Rural Development Agency (JARDA). The three tomato varieties seeds were purchased from Musty Agro Allied Nigeria Limited Kano State. The equipment were collected from FUD Biology laboratory and Botanical Garden (gypsum block or tension meter, muslin cloth, spraying gun, hoe, shovel, rake, watering can, weighing scale, measuring tape).

Experimental Design

A split plot arrangement in completely randomize design was used for this experiment (Khan *et al.,* 2021; and Abubakar *et al.,* 2021). The experimental design has three replicates for each treatment. The treatments consisted of three tomato varieties (UC 85 B, UTC and ROMA VF), three water regimes, 0 (every day watering), 7 (7 days watering) and 14 (14 days watering) and crude moringa extracts concentrations consisting of 100%, 50% and 0% crude extract. The watering regimes were kept in the main plots and the three tomato varieties (V_1, V_2, V_3) and the Moringa leaf extract concentrations (100%, 50% and 0%) were randomized within the subplots. The pots were arranged randomly in three (3) blocks of 81 plants with different variety and concentrations labeled $V_1 M_0$, $V_1 M_{50}$, $V_1 M_{100}$, $V_2 M_0$, $V_2 M_{50}$, $V_2 M_{100}$, $V_3 M_0$, $V_3 M_{50}$ and $V_3 M_{100}$ under three different water regimes (0 days, 7days, and 14days) and each was replicated three times.

Preparation Methods of Moringa Leaf Extract (MLE)

Moringa leaf extract (MLE) was prepared in accordance with the steps outlined by Bashir *et al*. (2014). The extract was obtained by pounding fresh *Moringa olifera* leaf together with a bit of water (about 200m1 per 1kg of fresh leaf). A muslin cloth was used in sieving the leaf extract. The fine filtrate obtained served as the crude extract, the residue was discarded. After extracting the crude, two concentrations were stem out from the crude moringa leaf extract (M_{50} with 50%, and M_{100} with 100%). A spraying gun was used to spray the seedlings in each of the sac. About 25ml of the different percentage of the concentration was directly spread on the leaves of each seedling (Odo, 2018). However, the different concentrations referred to as treatments were prepared, viz: 1kg of fresh *Moringa olifera* leaves. One hundred (l00ml) of water collected was also sprayed at the stem base of the plant labeled M_0 with 0% at the same time which served as control.

Raising of Tomato Seedlings: Seed bed preparation commences immediately after obtaining the seeds. Seed bed was prepared and was watered for two (2) days. The tomato seeds were then sprayed on the seed bed. All factors required for successful germination was considered to obtain vigorous seedlings for the study. To provide mulch for the tomato seedlings prior to germination, dry grasses were used atop the seedbed after sowing. Farm yard manure was applied to the seedbed to complement its fertility. Pots were filled up halfway with the mixture of sandy soil and farm yard manure in a ratio of (2:1). The pots were then watered for the soil to saturate. One seedling was transplanted in each pot after reaching about biro size in the seedbed. Watering and all other agronomic practices were performed simultaneously until all plants were established at 2 weeks after transplanting. Subjection of the seedlings to

water stress commences from week 2 after transplant. The extract of *Moringa oleifera* leaf was spread at four (4) different times. The moringa leaf extract was applied as foliar spray after imposition of water stress. The first spread was at week 2 after transplant and the first reading was taken, the 2nd was at the week 4, third was at week 6, the 4th at week 8 after transplant, those labeled M_0 served as control; they were only sprayed with water at the same time. The experiment was conducted in a screen house to protect the plant from rainfall water after the imposition of drought stress. All agronomic practices such as watering, weeding and pesticide application was accorded timely and adequately in accordance with the standards. Data for growth parameter (height in cm, number of leaves, number of branches and leaf area) were recorded from 2 weeks after transplanting, data for phenology were recorded at 50% flowering.

Data analysis

Data collected from the split plot design in the study area was subjected to a two-way analysis of variance (ANOVA) and where significant, the treatment means was separated by least significant difference (LSD) as described by General statistic software or GenStat (17th edition).

RESULTS AND DISCUSSIONS

Results

Effect of moringa leaf extract, water regime, and variety on the height of tomato plant under water stress

The result (Table 1) indicated that plant height varies with different moringa leaf extract concentrations. There is no significant difference in terms of plant height at 2WAT and 4WAT at LSD of 5.92 and 6.97 respectively. Plant height at 6 and 8weeks after transplant are statistically different with 100%MLE and 50% MLE having the highest plant height and the lowest was recorded at 0%MLE at LSD of 8.46 and 6.84 respectively. In terms of watering regimes, it was observed that there is no significant difference in the plant height at 2WAT and 4WAT at LSD of 5.92 and 6.92 respectively. Plant height at 6 and 8WAT are different statistically with 1week and 2weeks having the highest plant height and the lowest was recorded at daily water regime at LSD of 8.46 and 6.84 respectively. The study revealed that there is no significant difference in terms of plant height between the tomato varieties at 2WAT 4WAT, 6WAT and 8WAT at LSD of 5.73, 7.04, 9.05 and 11.36 respectively.

Table 1: Effect of moringa leaf extract, water regime, and variety on the height of tomato plant under water stress

Moringa extract	PH2WAT	PH4WAT	PH6WAT	PH8WAT
0%	11.2	15.3	20.44b	27.0b
50%	13.2	19.8	29.61a	46.0a
100%	14.2	22.0	29.83a	45.11a
LSD (5%)	5.92	6.97	8.46	6.84
Water regime				
1wk	13.2	19.8	29.83	46.00a
2wk	14.2	22.9	29.61	45.11a
Daily	11.2	15.3	20.44b	27.00b
LSD (5%)	5.92	6.97	8.46	6.84
Variety				
ROMA VF	12.3	18.1	26.5	36.0
UC85B	15.3	22.1	30.6	42.1
UTC	10.9	16.3	22.8	40.0
LSD (5%)	5.73	7.04	9.05	11.36

*Values with different superscript are different statistically at 5% level of significance according to fisher's protected least of significant difference.

Key: PH2WAT (Plant Height 2 Weeks after Transplant)

Effect of moringa leaf extract, water regime, and variety on the number of leaves of tomato plant under water stress

Table 2 showed that there is no significant difference in terms of number of leaves at 2WAT, 4WAT and 6WAT at LSD of 8.40, 11.63 and 16.2 respectively. Number of leaves at 8WAT is different statistically with 100% and 50% having the highest number of leaves and the lowest was recorded at 0% at LSD of 16.35. In terms of watering regimes, it was observed that there is no significant difference in the number of leaves at 2WAT, 4WAT and 6WAT at LSD of 8.40, 11.63 and 16.35 respectively. Number of leaves at 8WAT were statistically different with 1wk and 2wk has the highest plant height and the lowest was recorded at daily water regime at LSD of 16.35. The study revealed that there is no significant difference in terms of number of leaves between the tomato varieties at 2WAT, 4WAT, 6WAT and 8WAT at LSD of 7.96, 11.93, 18.53 and 20.04 respectively.

Table 2: Effect of moringa leaf extract, water regime, and variety on the number of leaves of tomato plant under water stress

Moringa extract	NL2WAT	NL4WAT	NL6WAT	NL8WAT
0%	18.8	21.9	35.2	46.78b
50%	17.6	26.2	48.4	67.44a
100%	20.6	32.2	55.8	76.89a
LSD (5%)	8.40	11.63	16.2	16.35
Water regime				
1wk	17.6	26.2	48.4	67.44a
2wk	20.6	32.2	55.8	76.89a
Daily	18.8	21.9	35.2	46.78b
LSD (5%)	8.40	11.63	16.82	16.35
Variety				
ROMA VF	17.8	25.7	45.7	54.4
UC85B	22.8	31.4	52.4	69.6
UTC	16.3	23.2	41.3	67.1
LSD (5%)	7.96	11.93	18.53	20.04

*Values with different superscript are different statistically at 5% level of significance according to fisher's protected least of significant difference.
Key: NL2WAT (Number of leaves 2 Weeks after Transplant)

Effect of moringa leaf extract, water regime, and variety on the number of branches of tomato plant under water stress

Table 3 showed that there is no significant difference in terms of number of branches at 2WAT, 4WAT and 6WAT at LSD of 1.247, 1.395 and 1.724 respectively. Number of branches at 8WAT is different statistically with 100% and 50% having the highest number of leaves and the lowest was recorded at 0% at LSD of 2.218. In terms of watering regime, it was observed that there is no significant difference in the number of leaves at 2WAT, 4WAT and 6WAT at LSD of 1.24, 1.395 and 1.724 respectively. Number of leaves at 8WAT are statistically different with 1wk and 2wk has the highest number of branches and the lowest was recorded at daily watering regime at LSD of 2.218. The study revealed that there is no significant difference in terms of number of branches between the tomato varieties at 2WAT, 4WAT and 6WAT and 8WAT at LSD of 1.175, 1.540, 1.806 and 2.442 respectively.

Table 3: Effect of moringa leaf extract, water regime, and variety on the number of branches of tomato plant under water stress

Moringa extract	NB2WAT	NB4WAT	NB6WAT	NB8WAT
0%	4.33	5.00	6.11	8.44b
50%	4.67	6.11	7.56	10.78a
100%	5.00	6.67	8.00	11.22a
LSD (5%)	1.247	1.395	1.724	2.218
Water regime				
1wk	4.67	6.11	7.56	10.78a
2wk	5.00	6.67	8.00	11.22a
Daily	4.33	5.00	6.11	8.44b
LSD (5%)	1.247	1.395	1.724	2.218
Variety				
ROMA VF	5.00	6.11	7.56	10.78
UC85B	5.00	6.22	52.4	69.6
UTC	4.00	5.44	6.44	9.44
LSD (5%)	1.175	1.540	1.806	2.442

*Values with different superscript are different statistically at 5% level of significance according to fisher's protected least of significant difference.
Key: NB2WAT (Number of Branches 2 Weeks after Transplant)

Effect of moringa leaf extract, water regime, and variety on leaf area of tomato plant under water stress

Table 4 showed that there is no significant difference in terms of leaf area at 2WAT, 4WAT and 6WAT and 8WAT at LSD of 1.903, 2.570, 3.538 and 4.920 respectively. In terms of watering regime, it was observed that there is no significant difference in the leaf area at 2WAT, 4WAT and 6WAT and 8WAT at LSD of 1.903, 2.570, 3.538 and 4.920 respectively. The study found that there is no significant difference between the tomato varieties in terms of leaf area at 2WAT, 4WAT and 6WAT and 8WAT at LSD of 1.932, 2.571, 3.709 and 5.48 respectively.

Table 4: Effect of moringa leaf extract, water regime, and variety on leaf area of tomato plant under water stress

Moringa extract	LE2WAT	LE4WAT	LE6WAT	LE8WAT
0%	4.28	9.50	11.72	14.39
50%	5.62	8.72	14.00	18.89
100%	5.11	9.33	14.72	20.28
LSD (5%)	1.903	2.570	3.538	4.920
Water regime				
1wk	5.62	8.72	14.00	18.89
1wk	5.11	9.33	14.72	20.28
Daily	4.28	9.50	11.72	14.39
LSD (5%)	1.903	2.570	3.538	4.920
Variety				
ROMA VF	4.54	8.72	12.89	16.3
UC85B	5.63	9.22	13.00	18.3
UTC	4.83	9.39	14.56	19.0
LSD (5%)	1.932	2.571	3.709	5.48

*Values with different superscript are different statistically at 5% level of significance according to fisher's protected least of significant difference.
Key: LE2WAT (Leaf Area 2 Weeks after Transplant)

Effect of moringa leaf extract, water regime, and variety on phenology of tomato plant under water stress

Table 5 showed that there is significant difference in terms of days to flowering with 0% MLE treatment having the longest days to flowering, 50% and 100% MLE treatment having the shortest days to flowering at LSD of 3.949. In terms of days to fruiting it shows that there is

significant difference where 0% MLE treatment have the longest days to fruiting, 50% and 100% MLE treatment have the shortest days to fruiting at LSD of 11.68. In terms of water regime it was observed that there is significant difference in days to flowering. 1wk and 2wk water regime have the longest days to flowering and the shortest days to flowering was recorded in daily Water regime at LSD of 15.70. In terms of days to fruiting it was observed that there is significant difference where 1wk and daily Water regime have the longest days to fruiting and the shortest days to fruiting was recorded in 2wk water regime at LSD of 11.68. The study found that there is no significant difference between the tomato varieties in terms of days to flowering and days to fruiting at LSD of 5.074 and 20.41 respectively.

Table 5: Effect of moringa leaf extract, water regime, and variety on phenology of tomato plant under water stress

Moringa extract	Days to flowering	Days to fruiting
0%	55.56a	84.75
50%	48.49b	81.11ab
100%	49.00b	70.11b
LSD (5%)	3.949	11.68
Water regime		
1wk	38.56a	81.11ab
2wk	54.11a	70.11b
Daily	17.56b	81.11ab
LSD (5%)	15.70	11.68
Variety		
ROMA VF	52.56	18.8
UC85B	50.11	20.8
UTC	50.78	38.8
LSD (5%)	5.074	20.41

*Values with different superscript are different statistically at 5% level of significance according to fisher's protected least of significant difference.

DISCUSSION

The treatment evaluated in this study varied in all the phenology and growth parameters measured. The present study included three tomato varieties, three moringa leaf extract concentration and three watering regimes. The phenology and growth parameters measured are plant height, number of leaves, number of branches, leaf area, days to flowering and days to fruiting. Variations among the treatment were recorded. The increase in the growth parameters as a result of extracts used in this research significantly increased the growth of tomato varieties used in this research. This luxuriant growth of the tomato plants might be due to the volume (25ml) of *Moringa oleifera* leaf extracts used. The magnitude of the increase that appeared might depend mainly on the concentrations used (50% and 100%).

Maishanu *et al.* (2017) pointed out that these days, natural plant growth bio-stimulants are widely employed to grow plants under both favorable and unfavorable circumstances. One of the recent natural bio-stimulants for plant growth, *Moringa oleifera* is crucial for enhancing growth and stress tolerance in plants. Moringa leaf extract (MLE) is considered effective because of its high concentration of fiber, carbohydrates, protein, vitamins, phenolics, and free proline. It has been established in this research that at 2WAT, 4WAT and 6WAT and 8WAT, the result shows that plant sprayed with 100% moringa leaf extract exhibited the highest plant height. The plant height was initially 14.2cm, which to increased 22.0cm, 29.83cm and 45.11cm, the number of leaves 20.6, 32.2, 55.8, 76.89, the number of branches also increased to 5.00, 6.67, 8.00, 11.22 and the leaf area 5.62, 9.33, 14.72, 20.28, respectively. It could be deduced that the chemical components incorporated in the extracts used might be responsible to promote the development of these tomato plants in comparison with the control treatments.

This could be explained by the fact most of the tomato plants grown in the trials are highly sensitive to the extracts used followed by the influence of the water regime and variety. In this work, it was reported that treatment 100%MLE had the highest number of growth and yield parameters of the tomato plants. It was, therefore, found to be the most appropriate concentration for increasing the healthy vegetative growth parameters of the tomato plants. This was probably due to the high concentration of the growth-promoting substances contained in this treatment. It was also observed that at 2WAT, 4WAT and 6WAT and 8WAT 50% MLE treatment followed with the highest plant height (13.2cm, 19.8cm, 29.61cm and 46.0cm),1 number of leaves (17.6, 26.2, 48.4 and 67.44), number of branches (4.67, 6.11, 7.56 and 10.78a respectively), leaf area (5.11, 8.72, 14.00 and 18.89) respectively. This indicates that a reduction in the concentration of *Moringa oleifera* leaves extract might have affected the growth of tomato plants. 0% MLE treatment (Control), at at 2WAT, 4WAT and 6WAT and 8WAT was found to have the least of all the growth parameters with the lowest plant height (11.2cm, 15.3cm, 20.44cm and 27.0cm), number of leaves (18.8, 21.9, 35.2 and 46.78), number of branches (4.33, 5.00, 6.11 and 8.44b respectively), leaf area (4.28, 9.50, 11.72 and 14.39) respectively. In terms of phenology, the result shows that plant sprayed with 100% and 50% moringa leaf extract have the shortest days to flowering and fruiting (49.00b, 70.11b and 48.49b, 81.11ab respectively) and the longest days to flowering and fruiting was found from the control 0%MLE treatment (55.56a and 84.75 respectively).

The present study revealed that the well-watered plant (control) and the water stress plant had no much difference in terms of vegetative growth of the tomato plant. The water stressed plant grow even better than the well-watered plant. In terms of phenology, the result shows that 2wk watering treatment have the longest days to flowering (54.11a) and the shortest days to flowering was found from the daily watering treatment (35.56b). The result revealed that 1wk and daily watering treatment have the longest days to fruiting (81.11ab) and the 2wk watering treatment have the shortest days to fruiting. This could be attributed to the spray of moringa leaf extract to the tomato plant. The findings of this study is in collaboration with the findings of Ngcobo and Bertling (2021) who discovered that MLE considerably enhanced tomato plant height, leaf count, and branch count. This confirms that *Moringa oleifera* leaf is very rich in zeatin, the hormone cytokinin, which increases crops' resistance to drought. The result of the present study is also in agreement with the result of Odo (2018) on the productivity of tomatoes under deficit irrigation, MLE can improve the plants' ability to withstand water stress. The result of this study also concurs with the findings of Mashamaite *et al.* (2022) who observed that MLE is a useful chemical that encourages plant growth under both normal and stressful situations. The findings of this research is also in line that of Yusuff *et al.* (2020) who found that plants grow more quickly, become more resistant to stress, and produce more when their leaf are sprayed with Moringa leaf extract.

The variation in plant height, number of leaves, number of branches and leaf area could be due to genetic disparities and growth characteristics among the varieties since they were grown under the same environmental conditions. In terms of phenology, ROMA VF have the longest days to flowering and fruiting (52.56 and 88.8 respectively) followed by UTC with (50.78 and 78.8 respectively) and the shortest days to flowering and fruiting (50.11 and 70.8 respectively) was found from UC85B. This result is in line with findings of Goreta *et al*. (2005) who stated that varietal differences affect or determine the growth of crops. The finding of this study is in agreement with that of Tsegaye *et al*. (2007) who reported that growth characters of crops such as plant height, leaf area, number of leaves or branches, and fruit production were influenced by genetic factors of the different varieties. The findings of this study is in collaboration with that of Ibrahim *et al*. (2000) who reported that the difference in

growth indices of crops is normally attributed to their genetic constitution. The result of this study is also in agreement with that of Todd (2010) who indicated that growth characters differed among crop varieties and therefore suggested that breeders must select most promising combiners in their breeding programs. The cultivars' differences in growth and its components may be due to variations in genetic structure, mineral concentration and potentials to transport photosynthetic materials within plants.

CONCLUSION

The use of moringa leaf extract as a natural growth enhancer has been further proven by this work. The moringa leaf extract increases growth and decrease the phenology of tomatoes when applied on the foliage of the tomato plants. This experiment confirmed that plants sprayed with 100% MLE showed better results for all the studied parameters as compared to controls. In terms of variety, UC 85B recorded the highest in vegetative growth and ROMA BF recorded the least in all the parameter. This bio-stimulant not only enhances the growth and decrease the phenology but also help the plant withstand drought stress and is friendly to the environment and humans.

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