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THE EFFECTS OF WATER STRESS ON THE EARLY GROWTH OF TWO COMMON VARIETIES OF MANGO (*Mangifera indica* L.) IN ADAMAWA STATE

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ABSTRACT

The research work on "The effects of water stress on the early growth of two common varieties of Mango (*Mangifera indica* L.) in Adamawa State" was carried out in the FAU/TCP farm, Faculty of Agriculture, Adamawa State University, with the aim of finding out the extend to which these varieties cant tolerate water stress and which variety was more tolerant at the early stages of growth. Bush (Irwin) and Kent varieties of Mango were collected from the FAU/TCP farm. The mangoes were labeled Bush; "B" and Kent; "K", each was grouped into two; "A" and "B". The experiment was carried in a screen house under controlled conditions. All the experimental plants received equal treatments, except for water supply which was varied to determine the level of resistance of these plants to water stress. The plants in groups "A" i.e. "KA" and "BA" had varied quantities of water but given at the same time while plants in groups "B" i.e. "KB" and "BB" had the same quantities of water but varying time of watering, the parameters determined were; "Plant Height" and "Number of Leaves". IBM SPSS was used to analyze the data with the Pearson Correlation at both 0.01 and 0.05 Significant Levels. There were significant changes in both varieties with changes in the quantity of water and time of watering, but the Kent Mango showed more tolerance to water stress hence, people growing Mangoes in areas with little water are advised to grow the Kent variety of Mango.

Key Words: Mango, Water Stress, Kent, Bush (Irwin)

INTRODUCTION

The genus *Mangifera* originates in Tropical Asia, with the greatest number of species found in Borneo, Java, Sumatra, and the Malay Peninsula. The most-cultivated *Mangifera* species, *M. indica* (mango), has its origins in India and Myanmar (Bally, 2006; Mehta, 2017; Edward & Dennis, 1994)

The most common varieties/cultivars of mango include but not restricted to the following: Kent Mango, Tommy-Atkins Mango, Haden Mango, Keitt Mango, Bush (Irwin) mango (Irwin), Zill, Kensington, Neldica, Heida, Moni-K, Fairchild, Gouvie, Haden, Pope, Rapoza, Sensation (ARC-Institute for Tropical and Subtropical Crops, 2000; Bally, 2006).

Mango has a great number of uses which include: Food, Medicinal, Animal fodder, Honey (the flowers are a good and rich source of nectar), timber, fuel, tannin/dye, etc. (Bally, 2006; Lauricella, Emanuele, Calvaruso, Giuliano, & D'anneo, 2017; Gilman & Watson, 1994)

Mango can adopt itself to a wide range of climates it strives well in tropical and subtropical areas deep alluvial soils which are well drained and rich in orange water are best for cultivation. On the other hand, an important feature of the mango is its ability to perform well even in low rainfall of 750mm, if this is well distributed over eight to nine months. Such dry areas also fulfil the condition of high insulation (ARC-Institute for Tropical and Subtropical Crops, 2000; Traub & Auchter, 2013).

Mangoes are adopted to many soil types they will grow in almost any well – drained soil whether sandy loam or clay, but avoid heavy, wet soils. A pit between 5.5 and 7.5 is preferred. (Bally, 2006)

Mango can be propagated both through seed and vegetable means. The seed has limited period of viability ranging from 80 – 100 days when stored under cool condition this is commonly done by placing the seeds between layers charcoal or saw dust viability can be changed by floatation of the seed should be discarded seeds for planting should be collected de-pulped and air dried in a cool place. The dried seed are planted in seed beds basket, plots, polythene port when planted in a seed beds they should be spaced at 40 – 45 cm vegetation propagation from the stem cutting is considered viable options to large scale propagation from seed (Edward & Dennis, 1994; Bally, 2006).

METHOD

EXPERIMENTAL SITES

The research work was carried out in the FAU/TCP farm, faculty of agriculture, Adamawa State. Two varieties of ripe mangoes were collected in FAU/TCP farm. The mangos were peeled using knife.

VIABILITY TEST OF SEEDS

The peeled seeds were subjected to viability test, using viability test method. A bucket full of water was also gotten, the seeds were put into the bucket; viable seeds sink into the bottom of the bucket while seeds that are not viable floated on top of water. After the test, viable seeds were collected and put on an iron tray, then sun dried and the seed coats were removed. This is to enable the seeds to germinate on time and ready for planting.

PREPARATION OF NURSERY BEDS

Saw dust was collected and poured on a cleared ground about 7 – 10 cm high. The saw dust was watered for two days before sowing of seeds (Barros, Rezende, Campos, & Maia, 2017; Marhenah, 2016; Agboola, Oseni, Adewale, & Shonubi, 2018). Seeds collected were sown immediately after removal of seed coat; the seeds were sown on the prepared nursery.

MIXTURE OF SOIL SAMPLE

The composition of the soil mixture that was used as roofing medium in the polythene bag was ratio of 1:2:1 sandy, loam soil and cow dung (Omogoye, 2015; Muhereza, Pritchard, & Murray-Prior, 2014).

FILLING OF POLYTHENE BAGS

After mixing the soil as required, the polythene bags were three quarter filled with the soil, watering was done immediately for two days, polythene bags were perforated at the bottom by making a crave so as to give room for proper drainage of water and also to avoid water logging.

TRANSPLANTING

Transplanting was done one week after germination of seedlings; the seedlings were transplanted from the nursery bed to the polythene bags. Hand trowel was used in transplanting the seedlings so as to avoid damaging or cutting the primary roots.

LABELING OF POLYTHENE BAGS

Two varieties of mango seedlings were used; Bush and Kent varieties. The Bush mangos were labeled with “B” while the Kent mangos were labeled with “K” each of the varieties was grouped into two (2) groups; “A” and “B”. hence we had

1. KA = Kent group “A”
2. KB = Kent group “B”
3. BA = Bush group “A”
4. BB = Bush group “B”

Each group was further divided into three (3) e.g. KA1, KA2 & KA3 and there were four (4) replications example shown bellow

1. $KA1_{i}$ $KA1_{ii}$ $KA1_{iii}$ $KA1_{iv}$

2. KA2 $_{i}$ KA2 $_{ii}$KA2 $_{iii}$ KA2$_{iv}$
3. KA3 $_{i}$ KA3 $_{ii}$ KA3 $_{iii}$ KA3$_{iv}$

TREATMENT

The experiment was carried in a screen house under controlled conditions; all the experimental plants received equal treatments, except for water supply which was varied to determine the level of resistance of these plants to water stress.

The plants in groups “A” i.e. “KA” and “BA” had varied quantities of water but given at the same time while plants in groups “B” i.e. “KB” and “BB” had the same quantities of water but varying time of watering.

Details of water supply are shown below:

1. KA1, BA1 = 2mls of water once a week
2. KA2, BA2 = 20mls of water once a week
3. KA3, BA3 = 50mls of water once a week
4. KB1, BB1 = 20mls of water every 2 days
5. KB2, BB2 = 20mls of water once a week
6. KB3, BB3 = 20mls of water once in 2 weeks

DATA COLLECTION

The parameters determined were as follows:

1. Plant height
2. Plant stem girth
3. Number of leaves

Measurements of plant height was done using a simple ruler and was done in centimeters (cm), the number of leaves were taken by counting the number of leaves on each plant while the stem girth was taken using a Vanier caliper. The research lasted for a period of 3 months. The readings were taken at intervals of 2 weeks (fourth nightly).

RESULTS

Data Presentation

The averages of the data from the replications were taken and presented in tables one to six while details of the results are given in appendix

Table 1: Increase in length of Kent mango

ID	KA1	KA2	KA3	KB1	KB2	KB3
1	12.43	16.05	14.67	16.95	17.42	14.75
2	14.07	17.37	16.67	19.07	18.62	16.45
3	14	17.55	17.37	19.8	18.72	17.35
4	14.07	17.57	18.3	20.42	21.7	17.5

Table 2: Increase in length of Bush Mango

ID	BA1	BA2	BA3	BB1	BB2	BB3
1	12.87	11.55	16.5	13.62	10.87	10
2	13.52	12.37	17.37	15.12	13.5	10.35
3	13.57	12.8	17.62	16.12	14.73	11.9
5	13.69	13.12	19.1	19.12	12.97	12.16

Table 3: Increase in Number of Leaves of Kent Mango

ID	KA1	KA2	KA3	KB1	KB2	KB3
1	4.75	7.25	4.75	5.5	6	3.5
2	7.25	9.25	6.5	7.5	8.5	6.25
3	7	9.25	6.75	8.25	8.75	6
4	7.25	9.5	7.5	8.75	9.64	6

Table 4: Increase in Number of Leaves of Bush Mango

ID	BA1	BA2	BA3	BB1	BB2	BB3
1	3.5	3.5	4.5	5.25	3.5	2.5
2	6	5.5	7.25	6	4.5	4
3	5.75	6	6.25	7.5	5.66	4.66
4	6	5.75	7.5	7.75	4.66	6

GRAPHS

Using the results above Tables 1 to 6 (the averages) the graphs bellow were plotted and used for the discussion in chapter five

Fig: 1 **Increase in length of Kent mango**

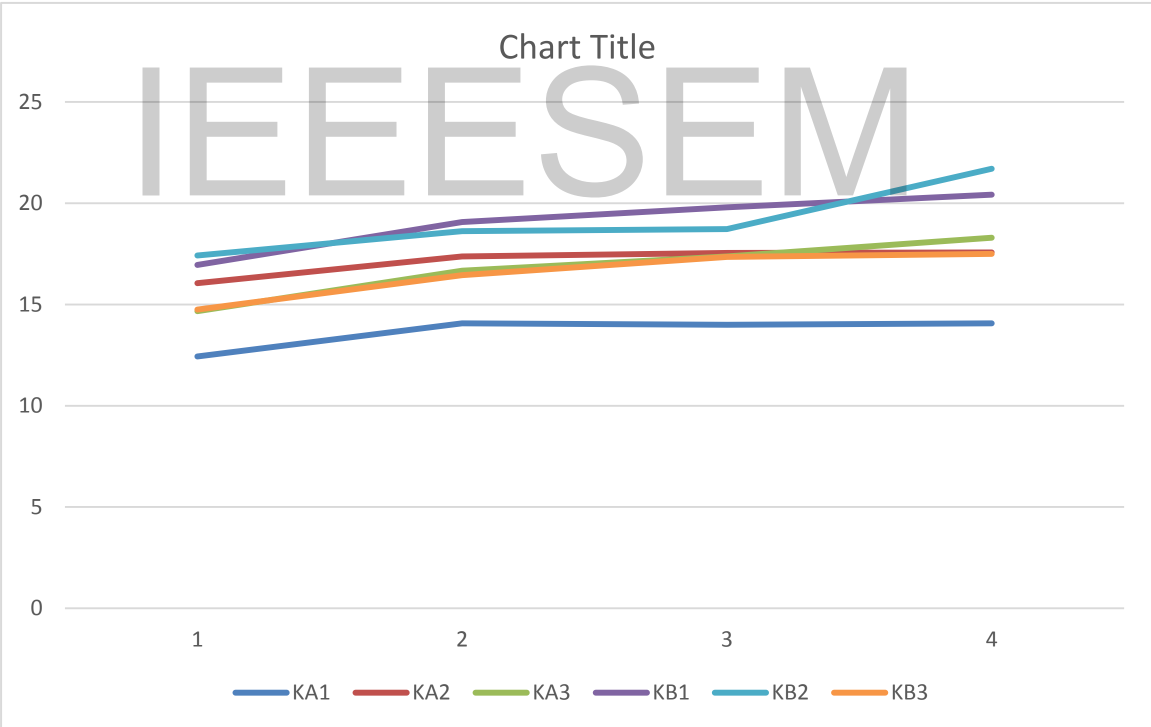

Fig 2 Increase in length of Bush Mango

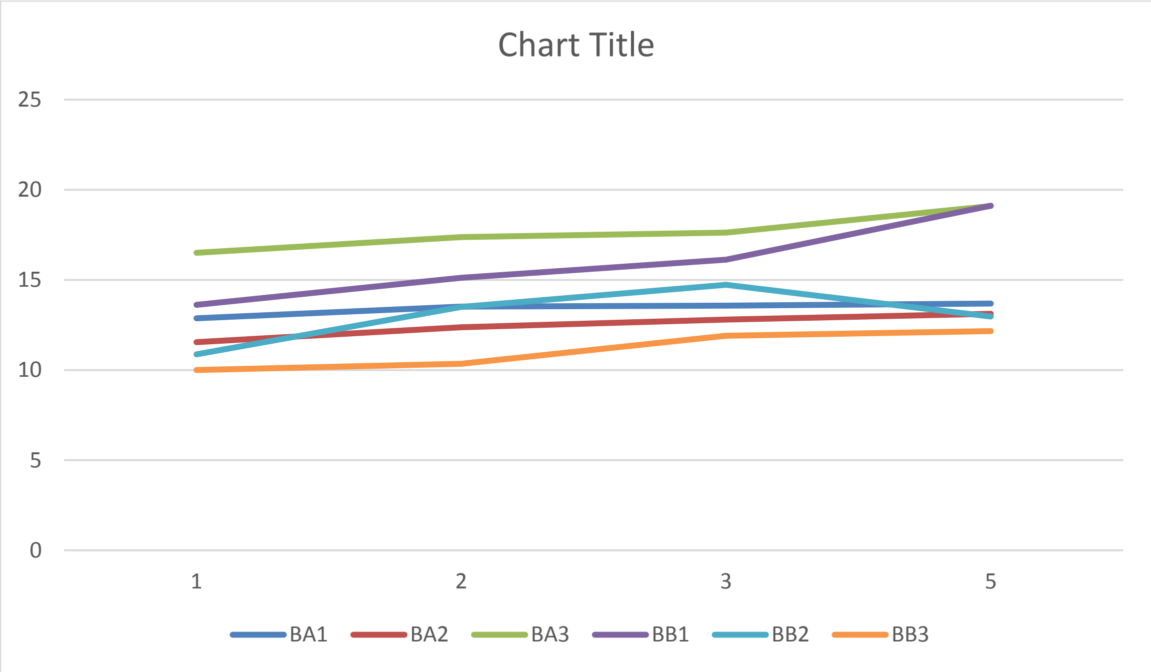

Fig 3 **Increase in Number of leaves of Kent Mango**

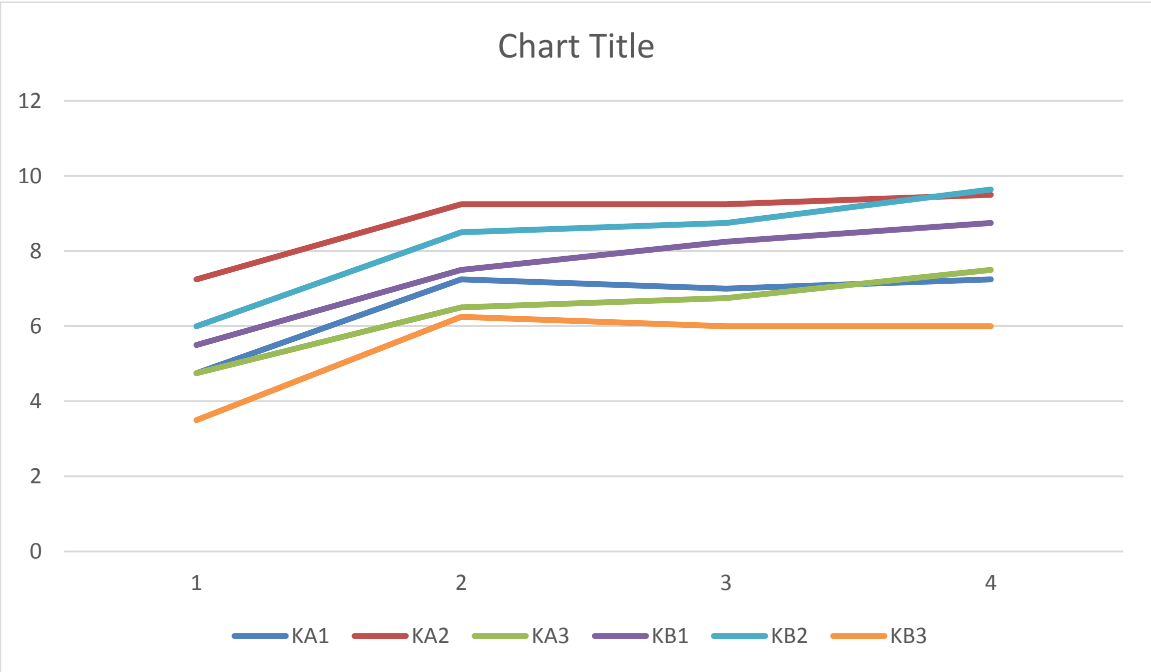

Fig 4: **Increase in Number of leaves of Bush Mango**

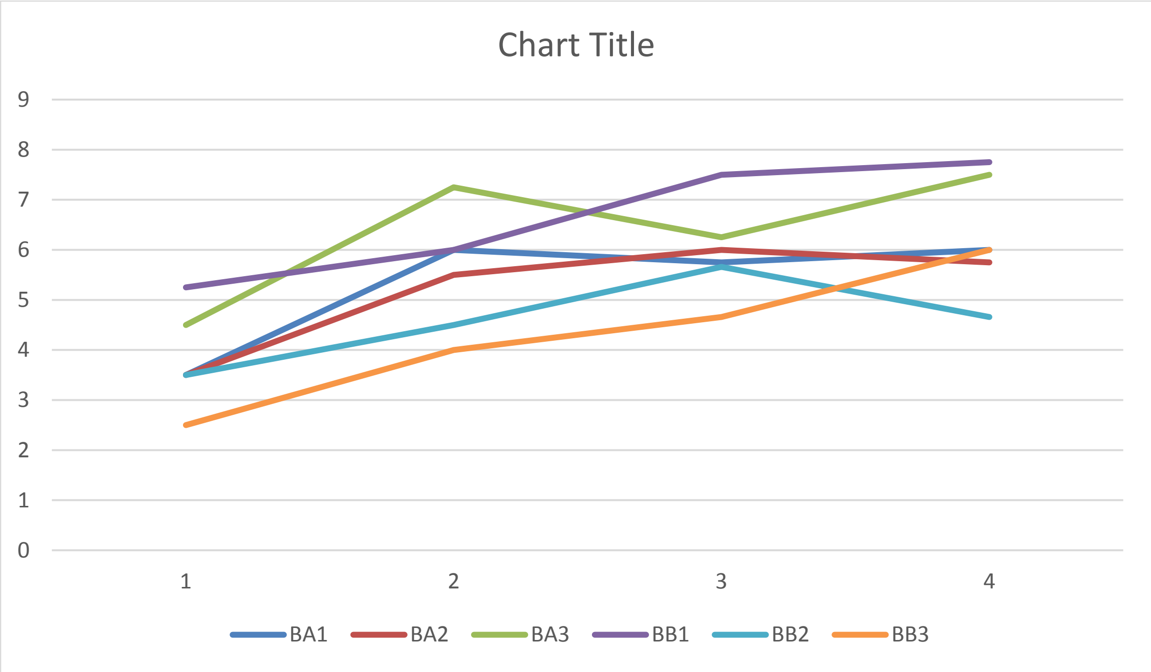

Table 5 Table of Correlation of Increase in Height of Kent Mango

Correlations

		KA1	KA2	KA3	KB1	KB2	KB3
KA1	Pearson Correlation	1	.989*	.902	.929	.635	.924
	Sig. (2-tailed)		.011	.098	.071	.365	.076
	N	4	4	4	4	4	4
KA2	Pearson Correlation	.989*	1	.941	.966*	.674	.968*
	Sig. (2-tailed)	.011		.059	.034	.326	.032
	N	4	4	4	4	4	4
KA3	Pearson Correlation	.902	.941	1	.996**	.870	.980*
	Sig. (2-tailed)	.098	.059		.004	.130	.020
	N	4	4	4	4	4	4
KB1	Pearson Correlation	.929	.966*	.996**	1	.823	.992**
	Sig. (2-tailed)	.071	.034	.004		.177	.008
	N	4	4	4	4	4	4
KB2	Pearson Correlation	.635	.674	.870	.823	1	.759
	Sig. (2-tailed)	.365	.326	.130	.177		.241
	N	4	4	4	4	4	4
KB3	Pearson Correlation	.924	.968*	.980*	.992**	.759	1
	Sig. (2-tailed)	.076	.032	.020	.008	.241	
	N	4	4	4	4	4	4

Key

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6 increase in height of bush mango

Correlations

		BA1	BA2	BA3	BB1	BB2	BB3
BA1	Pearson Correlation	1	.958*	.829	.810	.827	.780
	Sig. (2-tailed)		.042	.171	.190	.173	.220
	N	4	4	4	4	4	4
BA2	Pearson Correlation	.958*	1	.915	.917	.749	.921
	Sig. (2-tailed)	.042		.085	.083	.251	.079
	N	4	4	4	4	4	4
BA3	Pearson Correlation	.829	.915	1	.996**	.424	.849
	Sig. (2-tailed)	.171	.085		.004	.576	.151
	N	4	4	4	4	4	4
BB1	Pearson Correlation	.810	.917	.996**	1	.423	.883
	Sig. (2-tailed)	.190	.083	.004		.577	.117
	N	4	4	4	4	4	4
BB2	Pearson Correlation	.827	.749	.424	.423	1	.633
	Sig. (2-tailed)	.173	.251	.576	.577		.367
	N	4	4	4	4	4	4
BB3	Pearson Correlation	.780	.921	.849	.883	.633	1
	Sig. (2-tailed)	.220	.079	.151	.117	.367	
	N	4	4	4	4	4	4

Key

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7: Showing Correlation for Increase in Number of Leaves of Kent Mango

Correlations

		KA1	KA2	KA3	KB1	KB2	KB3
KA1	Pearson Correlation	1	.994**	.936	.925	.954*	.996**
	Sig. (2-tailed)		.006	.064	.075	.046	.004
	N	4	4	4	4	4	4
KA2	Pearson Correlation	.994**	1	.965*	.960*	.978*	.984*
	Sig. (2-tailed)	.006		.035	.040	.022	.016
	N	4	4	4	4	4	4
KA3	Pearson Correlation	.936	.965*	1	.990*	.998**	.904
	Sig. (2-tailed)	.064	.035		.010	.002	.096
	N	4	4	4	4	4	4
KB1	Pearson Correlation	.925	.960*	.990*	1	.989*	.899
	Sig. (2-tailed)	.075	.040	.010		.011	.101
	N	4	4	4	4	4	4
KB2	Pearson Correlation	.954*	.978*	.998**	.989*	1	.927
	Sig. (2-tailed)	.046	.022	.002	.011		.073
	N	4	4	4	4	4	4
KB3	Pearson Correlation	.996**	.984*	.904	.899	.927	1
	Sig. (2-tailed)	.004	.016	.096	.101	.073	
	N	4	4	4	4	4	4

Key

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 8: Showing the Correlation of Increase in Number of Leaves of Bush Mango

Correlations

		BA1	BA2	BA3	BB1	BB2	BB3
BA1	Pearson Correlation	1	.964*	.951*	.737	.755	.827
	Sig. (2-tailed)		.036	.049	.263	.245	.173
	N	4	4	4	4	4	4
BA2	Pearson Correlation	.964*	1	.850	.843	.897	.840
	Sig. (2-tailed)	.036		.150	.157	.103	.160
	N	4	4	4	4	4	4
BA3	Pearson Correlation	.951*	.850	1	.651	.529	.838
	Sig. (2-tailed)	.049	.150		.349	.471	.162
	N	4	4	4	4	4	4
BB1	Pearson Correlation	.737	.843	.651	1	.808	.935
	Sig. (2-tailed)	.263	.157	.349		.192	.065
	N	4	4	4	4	4	4
BB2	Pearson Correlation	.755	.897	.529	.808	1	.646
	Sig. (2-tailed)	.245	.103	.471	.192		.354
	N	4	4	4	4	4	4
BB3	Pearson Correlation	.827	.840	.838	.935	.646	1
	Sig. (2-tailed)	.173	.160	.162	.065	.354	
	N	4	4	4	4	4	4

Key
*. Correlation is significant at the 0.05 level (2-tailed).

DISCUSSION

The earth which is home to all living organisms has water distributed all over it, and all forms of life need water for survival, this water distribution on the surface of the earth is not even. While some places have water in excess, others have scarcity of water and these plants have adapted to several water conditions for their survival. Drought (water stress) is one the major abiotic stress factors that affect all organisms' lives including human in terms of health and food (Akinci & Losel, 2012; Farroq, Husain, Wahid, & Siddique, 2012; Chutia & Borah, 2012).

Mango has become naturalized and adapted throughout the tropics and subtropics. Much of the spread and naturalization has occurred in conjunction with the spread of human populations, and as such, the mango plays an important part in the diet and cuisine of many diverse cultures. (Bally, 2006)

The research work on "The effects of water stress on the early growth of two common varieties of Mango (*Mangifera indica* L.) using the Pearson correlation to analyze the data at both 0.01 and 0.05 Significant Levels. There were significant changes in both varieties with changes in the quantity of water and time of watering, but the Kent Mango showed more tolerance to water stress.

This finding agrees the findings of other researchers who have worked on other plants (Farroq, Husain, Wahid, & Siddique, 2012; Boutraa, Akha, & Al-Shoaibi, 2010)

Considering the vast positive/great importance of mangos, there is need for the government to encourage the growth of mangoes, most especially in the northern parts of the country where rain is scarce and mangoes are also scarce. Hence, people growing Mangoes in areas with little water are advised to grow the Kent variety of Mango, whereas researches should be encouraged to do further research on varieties of mangoes that can withstand water stress.

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