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EFFECT OF MORINGA LEAF AQUEOUS EXTRACT ON GROWTH AND FRESH YIELD OF LETTUCE (*Letuca sativa* L.) AND GARDEN (*Lepidium sativum* L.) CRESS

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ABSTRACT:

The potential effect of *Moringa oleifera* aqueous leaf extract on growth and fresh yield of Lettuce (*Letuca sativa* L.) and Garden cress (*Lepidium sativum* L.) was evaluated in the Greenhouse of Crop Science Department Kano University of Science and Technology Wudil for three years (2020 to 2022). The treatments consisted of four levels: control, where only water was added (M0), moringa leaf extract applied once at two weeks from emergence (M1), moringa leaf extract applied at two and four weeks from emergence (M2), and moringa extract applied every two weeks to maturity, starting from two weeks from emergence (M3), using 100ml of the extract each spray time. The trials were laid out in a Complete Randomized Design (CRD) and replicated four times. Results show that, moringa aqueous leaf extracts significantly increased plant height, number of leaves, leaf area, and leaf chlorophyll of the two crops evaluated. The highest total fresh weight was obtained with (M3) treatment. The study discovered an appropriate dose of moringa leaf aqueous extract that can be beneficial for farmers. Application at M3 can effectively support growth and development of lettuce and cress it is therefore, recommended for improvement and healthy output of total fresh weight so as to increase farmer's income.
Key words: Moringa, lettuce, garden cress, yield.

INTRODUCTION

Lettuce (*Letuca sativa* L.) is an annual plant and one of the most important vegetables and is mainly grown in the cool season of the year in tropical and subtropical countries (Abubakar, 2015). It is considered as a main salad crop (Shaheen, *et al.*, 2010). normally lettuce is eaten fresh where it is consider as a nutritious and aperitif vegetable that contains good amounts of minerals, vitamins (Ascorbic acid, calcium, iron and also rich in water) approximately 94.3% water, 1.2% protein, 0.2% fat, 2.9% carbohydrate (CHO), 0.7% fiber, and 0.7% ash (Ananda and Ahundeniya, 2012). It is rich in vitamin A, C, and E and minerals such as calcium, phosphorus, sodium, magnesium, and potassium (Tomasi, *et al.*, 2015). For farmers, it is among fast cash crop in the winter season.

Garden cress (*Lepidium sativum* L.) is a fast growing annual herbaceous crop and presently is cultivated for its edible shoots and leaves all over the world. Garden cress may also be referred to as pepper cress or and Persian broadleaf cress it is considered as an important leafy vegetable normally consumed raw as a green salad that has a high nutrient and medicinal value (Tiwari and Kulmi, 2004). The seed possesses several pharmacological properties like anti-Anemic, antioxidant, Glactogues, and many others and has tremendous potential for the development of functional food by fortification with it, they can be cooked with other vegetables and used to garnish food, the leaves are diuretic and gently stimulant (Diwakar, *et al.*, 2010). In another development by Snehal, Doke and Manisha Guha (2014), they pointed out that garden cress its highlights anti-diabetic, laxative,

hypocholesterolemic, fracture healing, analgesic, coagulant, diuretic, hepatoprotective, antiashthamatic, antidiarrheal, antispasmodic and anti cancer activities of garden cress seeds.

Lettuce and Garden cress are important crops for the supply of human nutritional requirements; more than half of the countries of Africa were designated by food and Agricultural Organization (FAO) as having short supply of these vegetables while millions of people live in Nigeria are having shortage supply of these crops (FAOSTAT, 2013). If current trends in population increase continue there will soon be millions more, these people must eat, and the wisest course for them is to produce their own vegetables FAOSTAT, 2013 and Abubakar, 2015). One of the constraints to sustained production of these vegetables is lack of hormonal application, and this leads to poor plant growth and development which results in decline in the production (El-Karamany, *et al.*, 2019).

Plant hormones can be used to increase yield because they influence every phase of plant growth and development. Traditionally, there are five groups of growth hormones which are listed: Auxins, Gibberellins, Abscisic acid, Ethylene and Cytokinins (Thuc, *et al.*, 2021). Each group contains both naturally occurring hormones and synthetic substances. Cytokinins regulate cell division and stimulate leaf expansion; it also enhances production of food as they are involved in cell growth and differentiation as their exogenous supply delays senescence of crop plants Fuglie, (2000). Zeatin is one form of the most common forms of naturally occurring Cytokinin in plants. Fresh *Moringa oleifera* leaves have been shown to have Zeatin, a Cytokinin related hormone (Culver, *et al.*, 2013). Moringa leaves sampled from various parts of the world were found to have high Zeatin concentrations of between 5µg and 200µg/g of leaves (El Awady, 2003).

Moringa leaf extract was sprayed onto leaves of onions, bell pepper, soya beans, sorghum, coffee, tea, chilli, melon, maize Rape and Cabbage and was shown to increase yields of these crops (Fuglie, 2000 and Culver, *et al.*, 2012). If moringa extract can increase yields, then the potential benefit to the smallholder farmers in Nigeria would be great because moringa leaf extract is environmentally friendly, and is locally available and affordable (low-cost) by local farmers (Noaman, *et al.*, 2010 and Culver, *et al.*, 2012).

The objective of the study was to find out the effect of moringa leaf aqueous extract on growth and yield of lettuce and garden cress.

MATERIALS AND METHODS

Experimental Site

The research was conducted at greenhouse of the Department of Crop Science, Kano University of Science and Technology, Wudil Kano State, (KUST) Latitude 11^0 52´ N and longitude 09^0 20´ E of the equator which is 475m above sea level in Sudan savanna ecological zone of Nigeria, during 2020 to 2022.

Treatment and Experimental Design

The experiment consisted of two different types of vegetable crops (Lettuce and Garden cress) that were sprayed with a moringa leaves aqueous extract at varying time (spray at one- and two-weeks interval of emergence) as indicated in the treatment combinations. The experiment was laid out in a Complete Randomized Design (CRD) and replicated four times.

Treatments combinations

1. Control with no moringa extract added (M0)
2. Moringa extract sprayed at 1 week after sowing (WAS) only (M1)
3. Moringa extract sprayed at 1 and 4 WAS only (M2)
4. Moringa extract sprayed at 1, 4 and 6 WAS only (M3)

Preparation of Moringa Aqueous Extract

Moringa plants were obtained from the school (KUST) orchard this was done in order to get plant with a correct leaf ages during aqueous extract preparation. An amount of 50g of the leaves was mixed with the 1500ml of 80% ethanol as suggested by (Marker and Backer 1996) the suspension was grounded and stirred using homogenizer in order for it to mix very well. The solution was then filtered using No 2 whatman's filter paper as described by Fuglie (2000). The said extract was diluted with the distilled water at a ratio of 1:32 (v/v) and then 100ml of this solution was sprayed directly to the plant in each pot as contained in the treatment combinations. The extract was used within five

hours of cutting the leaves to spray. (Extract or solution prepared not been used was then stored in a cooled refrigerator at temperature of 0ºC and is taken out when the need for it arise).

Pot Preparations

The pots were the one that can contains 10kg of the soil which was analysed for its physico-chemical properties, and was filed and placed in the greenhouse with a spacing of 0.5m between each plot and 1.0m between the replications so as to ensure adequate space to prevent spray drift to other unwanted plot. Seeds were first treated with Apron plus at the rate of 5g/1.5kg of seed before sowing and were sown (8 – 10 seeds) in each pot at a depth of 1.5cm and letter thinned to 5 plants per pot. The plots were watered and then covered with hay as a mulching. Fertilizer was applied using.

$$R = \frac{Y - W}{\text{Equivalent weight of soil/ha}}$$

Where:-

R = Weight of fertilizer to be put in to the pot

Y = Fertilizer rate per hectare

W = Weight of soil in the pot

2,000,000 = Equivalent Soil Weight per hectare.

The amounts use was 70 kg N/ha (0.92 g Urea /10kg soil), 100 kg P_2O_5/ha (0.45g SSP/10 kg soil) and 100 kg K_2O/ha (0.45g Sulphate of potash/10 kg soil). Weeds were removed by pulling at 2 and 4 WAS to allow the plants to be free from weeds for the period of the trials. Cypermethrine insecticide was use to control insect that occur in the lettuce plots and was use as per specify recommendation of the manufacturing company. Harvesting was done by uprooting the plant at 5 WAS for lettuce while that of garden cress at 5 WAS when each of the crops was fully matures and before flowers initiation.

During the growing period, some growth parameters such as Plant height, number of leaves, number of branches, leaf area, and Chlorophyll Content at 2, 4 and 6 WAS while fresh weight were measured at harvest. All data collected were subjected to analysis of variance (ANOVA). The Significant means were separated using students New-men's Keuls (SNK) as described by Snedecor and Cochran (1967).

RESULTS AND DISCUSSIONS

Effect of Moringa Leaf Aqueous Extract on Plant Height and Number of Leaves

The combine result of application of foliar moringa leaf extract on plant height on lettuce and Garden cress at 2, 4 and 6 WAS is presented in Table (Fig: 1 & 2 A & B). Greater plant height was recorded at (M3) across all sampling periods and this was significantly (P<0.05) taller on both crops evaluated than the control (M0). The control treatment resulted in statistically (P<0.05) shorter plants across all sampling periods. This is in line with the findings of Pal, *et al.* (2016) who reported increased N, P and K in uptake with application of growth regulator hormones Gibberellic Acid (GA3) resulted in increases in canopy height and number of leaves as compared with the control for cucumber. There was significantly (P<0.05) more leaves per plant with moringa extract applications at (M3) compared with the control (M0) and no difference between these number of leaves of both crops at 4WAS with moringa extract (M1) and (M2) (Fig. 2 A & B). Non application of the extract on all crops evaluated was found to results in less number of leaves across all sampling periods but was statistically similar with the some other treatments at 2WAS sampling period. Current study results support the growing evidence that the application of moringa extract promotes overall plant growth; indicated here by plant height and number of leaves per plant.

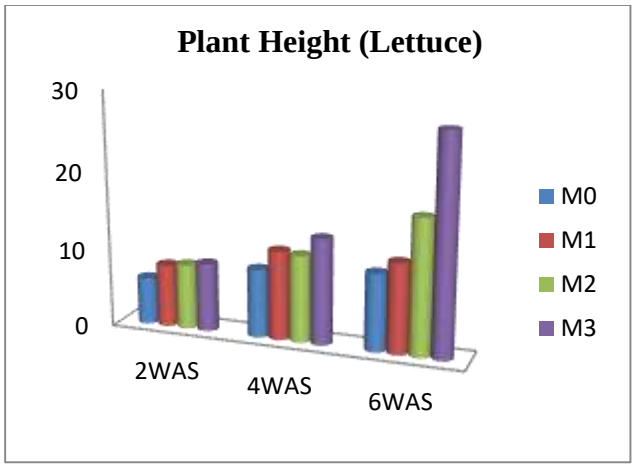

FIG 1: Lettuce Plant Height (A)

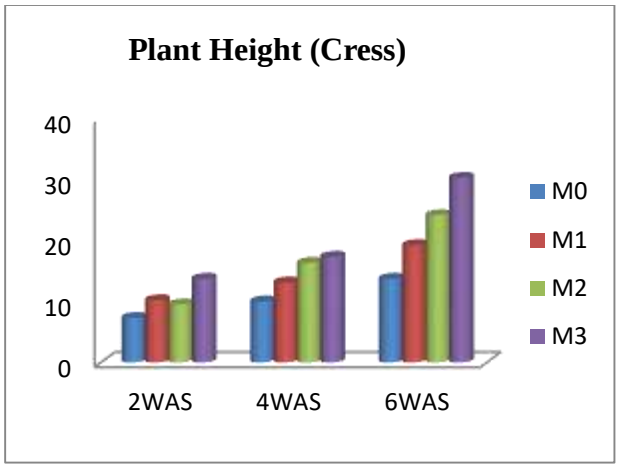

FIG 1: Garden Cress Plant Height (B)

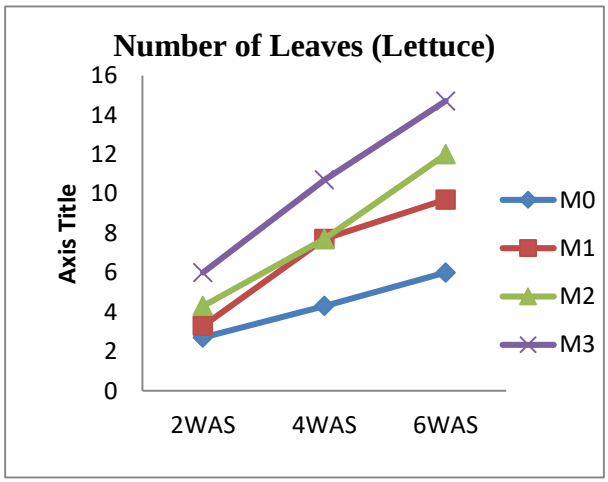

FIG 2: Lettuce Number of Leaves (A)

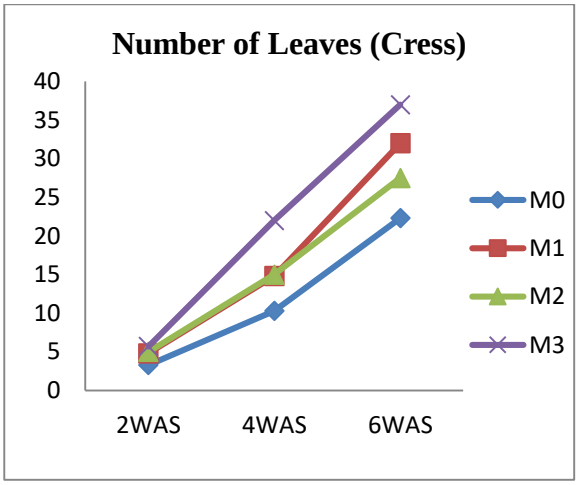

FIG 2: Garden Cress Number of Leaves (B)

Effect of Moringa Leaf Aqueous Extract on Leaf Area and Chlorophyll:

The combined effect of moringa extract on Leaf Area of lettuce and garden cress at all sampling periods (2, 4 and 6 WAS) is presented in (Table 1) and is significantly (P<0.05) different except that of lettuce at 2WAS that was not significant. The results show that, Application of moringa extract at (M3) treatment resulted in statistically wider leaf area (LA) (0.47 and 0.32) at 2 WAS and at 4 WAS (0.56 and 0.62) of garden cress, However, at 6 WAS the result of LA is statistically similar with all treatments (0.84, 0.73 and 0.72) except the control. All treatment recorded statistically wider LA with exception of the control treatment (M0) of the across all sampling periods of lettuce while narrower leaf area was observed that were comparable with some other treatments across all sampling periods and the crops (Table 1).

Table 1: Combined Effect of Moringa Extract on Leaf Area, Leaf Chlorophyll and Total Fresh Weight of Lettuce and Garden cress at Greenhouse of KUST Wudil During 2020 to 2022 Combined Result

Treatments	Leaf Area (WAS)			Leaf Chlorophyll (WAS)			Total Fresh Weight g/plot
	2	4	6	2	4	6	
Experiment One (LT)							
M0	0.37	0.61b	0.78b	2.9b	8.4b	17.3b	14.5c
M1	0.43	0.78a	1.01a	7.8a	15.9a	28.6ab	24.7bc
M2	0.32	0.78a	1.00a	4.9b	22.6a	35.8ab	32.4ab
M3	0.49	0.81a	1.03a	8.5a	18.8a	46.3a	44.7a
SE ±	0.082	0.038	0.021	0.86	2.03	6.06	4. 77
Experiment Two (GC)							
M0	0.12b	0.21b	0.55b	6.0b	15.8b	33.7b	24.5c
M1	0.18b	0.33b	0.72ab	7.3b	40.8a	57.5a	34.7bc
M2	0.32ab	0.56a	0.84a	8.8b	37.4a	69.5a	42.4ab
M3	0.47a	0.62a	0.73ab	11.8a	46.0a	64.3a	54.7a
SE ±	0.067	0.053	0.079	1.04	2.84	8.10	5.77

Means with the same letters on column are not significantly different at (p = < 0.05%) using SNK= student Newman-Keuls test. GC = Garden cress, LT = Lettuce, WAS = Weeks After Sowing, M0 = No Moringa Extract M1 = Moringa Extract applied at 2WAS, M2 = Moringa Extract applied at 2 and 4WAS, M3 = Moringa Extract applied at 2, 4, and 6WAS.

Total chlorophyll of lettuce and garden cress was significant (P<0.05) across all sampling periods that were statistically similar with all other treatments at 4 and 6 WAS, while non application of moringa extract resulted in statistically lighter chlorophyll that were comparable with some other treatment at 2 WAS Table 1. Application of moringa extract at (M3), (M1), (M2) at 4 WAS sampling periods resulted in higher mean values of lettuce chlorophyll that were statistically similar when (M1) and (M2) treatments were applied at 6 WAS. Non application of the extract (M0) resulted in statistically lighter mean values across all sampling periods (Table 1). Moringa aqueous extract is an important factor regulating chlorophyll content of plants and its application has been reported to increase chlorophyll indicators in Mung bean (El-Karamany, *et* al., 2019) and marketable lettuce (Tsiakaras, *et al.*, 2014). In another Development by Le, *et al.* (2021), pointed out that, GA3 significantly (p<0.05) increase in leaf concentration of chlorophyll and leaf area index of Sesame (*Sesamum indicum* L.).

Effect of Moringa Leaf Aqueous Extract on Total Fresh Weight:

The combined effect of moringa extract on total fresh weight of lettuce and Cress at 2, 4 and 6 WAS is presented in Table 1. The results indicated that, moringa extract highly significantly (P<0.01) influenced total fresh weight of lettuce and cress and this agree with the reported increased in dry matter with foliar application of GA3 treatments (Miceli *et al.*, 2019). Application of (M3) treatment resulted in heavier mean values that were statistically similar when (M2) was applied to both crops. Culver, *et al.*, (2013) pointed out that in moringa, there is Zeatin hormone in very high concentrations of between 5mcg and 200mcg/g of material from fresh moringa leaves, which increases growth, development and yields when sprayed to maize and common bean under field conditions. Lighter mean values were observed in plots treated with non moringa extract (M0) and were statistically similar with the application of one week and two weeks only (M1) Table 1.

CONCLUSION AND RECOMMENDATIONS

This study showed that use of moringa leaf extract as a growth hormone increased crop growth and yields. The extract showed the potential of increasing plant height, number of leaves, leaf area, chlorophyll and total fresh yield of lettuce and cress. Zeatin, a hormone in Moringa extract, is thought to be responsible. From the results of the study, it may be concluded that the higher the frequency of Moringa application the greater the increase in plant height, number of leaves, leaf area chlorophyll content and total fresh yield of the evaluated crops. The study shows that, moringa extract is a technology that has great potentials and also recommends for its application. The more the frequency of the application the (M3) the highest yield. Additional research is needed to determine the actual rate of moringa aqueous application that will give optimum fresh yield of the two crops.

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