Impact of foliar application of moringa leaf extract on growth and yield of different cultivars of cucumber (*Cucumis sativus*) in Nigeria

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Abstract

Extreme dependency on synthetic fertilizers and other agricultural inputs like pesticides and herbicides poses risks to environmental and health hazards and has driven the quest for more justifiable and eco-friendly approaches. A field experiment was conducted during the 2024 growing season at Federal University Dutse Teaching and Research Farm, to examine the potential of Moringa Leaf Extract (MLE) as a natural, plant-based biostimulant to improve cucumber (*Cucumis sativus*) productivity. Three cucumber varieties were used Monalisa F1, Saira F1, and Poinsett, and were laid in a Randomized Complete Block Design with three replications. Data on crop growth and yield components were collected and analyzed. Except for the Number of branches and Number of fruits per plant, MLE application significantly enhanced most traits of cucumber, including days to 50% flowering, number of Fruit diameter, vine length, and number of leaves, Poinsett variety had high fruit length compared to Monelisa F1 and Saira F1, while Monalisa F1 had a high percentage of flowering compared to Poinsett and Saira F1. The application of MLE proved to be an effective biostimulant offering an alternative and environmentally friendly approach to enhance the productivity of cucumber in Sudan Savannah Zone of Nigeria.

Keywords: Bio-stimulant, Cucumber, Moringa leaf extract, Yield, Varieties

INTRODUCTION

The cucumber (*Cucumis sativus* L.) is a universally important plant cherished for its rich in vitamin C, beta-carotene, manganese and potassium, while being low in calories and high in folic acid, making it highly beneficial for human health (Dey *et al*., 2022; Patel *et al*., 2022). Cucumbers can be eaten fresh in salads or processed as prickles due to its water content, because of this reason it is suitable for cultivation in humid and moderate regions (Adeniran *et al.*, 2021). As the third most-cultivated vegetable plant worldwide, roughly 87.8 million metric tons (MMT) are grown annually on 2.2 million hectares (Statista, 2023). Stereotypically grown in fields or greenhouses to allow continuous production, cucumbers flourish in mild weather compared to other cucurbit families like watermelon (Ni and Punja, 2023). Besides its dietary status, it serves as an income earner for farmers and improves their livelihood, predominantly in countries like Nigeria, where it contributes to food security and economic growth (Adeniran *et al*., 2021). Overusing chemical fertilizers in agriculture has caused significant environmental issues, including pollution, soil degradation and rising production costs. These challenges underscore the urgent need for eco-friendly alternatives such as biopesticides and plant biostimulants, which can help control pests, enhance plant growth, and improve crop yield and quality (Fawzy *et al*., 2022; Ali *et al*., 2023). Traditional farming practices, particularly the heavy reliance on synthetic chemicals, pose a major challenge to modern agriculture. Their widespread use has resulted in soil degradation, water contamination and biodiversity loss (Kumar *et al*., 2022; Bansal *et al*., 2023). In response to these concerns, there is a rising demand for sustainable agricultural practices. Biopesticides and plant bio-stimulants, such as Moringa leaf extract, offer viable solutions by improving crop health and growth while reducing the negative impacts of conventional chemical inputs. These natural alternatives also support ecological restoration by enhancing soil microbial diversity and fertility (Liu *et al*., 2022; Suman *et al*., 2022).

Research into plant-based extracts like Moringa and Neem highlights their potential to replace synthetic chemicals, promoting environmentally sustainable and responsible farming practices. *Moringa oleifera*, often referred to as the "miracle tree," is highly valued for its exceptional nutritional and medicinal benefits. It contains zeatin, a natural cytokinin, along with various bioactive compounds that stimulate plant growth and improve stress resistance (Li *et al*., 2003; Nascimento *et al*., 2021). Moringa leaf extract (MLE) has emerged as an eco-friendly and cost-effective alternative to synthetic fertilizers and pesticides. By enhancing crop yield and health without causing environmental damage associated with chemical inputs, MLE plays a significant role in promoting sustainable agriculture (Fahad *et al*., 2020;Zhao *et al*., 2022).

MATERIAL AND METHODS

Description of the study area

The experiment was carried out during the 2024 rainy season at the Faculty of Agriculture Teaching and Research Farm, Federal University Dutse (11° 70'N, 9° 34' E). The location is within the Sudan savannah zone of Nigeria. The climate of the location is characterized by two seasons: The wet season (May – September) and the dry season (October – April) (JARDA, 2023).

Experimental design and treatments

The experiment was laid out in a Randomized Complete Block Design. The factors are:

• Cucumber varieties (Monalisa F1, Poinsett and Saira F1).

• Moringa leaf extract (Moringa leaf extract and no moringa leaf extract).

Cultural practices

Varietal description: *Monalisa F1*; is a long, slender, dark green variety of cucumber. It is highly resistant to scab, cucumber mosaic virus, and downy mildew. It matures within 40-50 days after sowing, with a potential yield of 20,000 – 41,000 kg per hectare. *Saira* F_1; cucumber. These high-yielding cucumber seeds produce light green cucumbers. The variety matures within 40-45 days, with a potential yield of 10,000-15,000 kg per hectare. *Pointsett*; this variety also called Pointsett 76 produces straight and dark-slicing cucumbers.

Land preparation: The experimental field was cleared with the use of a cutlass, rake and hoe. The size of 14 m x 14 m (196 m^2) was marked out using measuring tape, rope and peg. Land clearing was carried out using a cutlass, hoe, shovel and rake. The soil was tilled to fine- tilth. The field was demarcated into three (3) replications each containing six (6) plots. Eighteen plots (18) plots of 1 m x 1 m (1 m^2) with an inter-plot spacing of 0.5 m x 0.5 m each.

Seed Sowing: The seeds were sown directly to the field. A spacing of 50 cm x 70 cm inter and intra row was adopted. Two seeds were sown per hole at a depth of about 1-2 cm.

Weeding: Weeds were controlled with the use of a hoe and hand pulling. The first weeding was carried out two weeks after sowing and followed by others when due.

Harvesting: The harvesting was carried out at 60-70 days after sowing at multiple harvests.

Data collection

Three (3) plants were randomly selected on each of the plots and the growth and yield parameters were assessed at 4, 6, and 8 weeks after sowing.

Growth parameters

Vine length: The vine lengths of plants were measured using measuring tape from the base to the growing tip of the main vine on the tagged plants and the average was recorded.

Number of leaves per plant: Numbers of leaves per plant were determined by direct counting of the leaves per plant on the tagged plants and the average was recorded.

Number of branches per plant: numbers of branches per plant were determined by direct counting of the branches per plant on the tagged plants and the average was recorded.

Days to 50% flowering: days to 50% flowering was determined by counting the days from the date of sowing to the time half of the sown seeds flowered in each plot.

Yield parameters

Number of fruits per plot: this was determined by direct counting of fruits in each plot.

Number of fruits per plant: the number of fruits per plant was determined by direct counting of the number of harvested fruits from the sampled plants in each plot and divided by the number of tagged plants.

Fruit length (cm): fruits from three tagged plants in each plot were randomly selected at each picking and their lengths were measured between two polar ends with the help of measuring tape.

Fruit diameter (mm): fruits from three tagged plants in each plot were randomly selected at each picking and the fruit diameter was taken. The breadth was measured using vernier caliper in centimeters.

Statistical analysis

Data collected were subjected to analysis of variance (ANOVA) for randomized complete block design (RCBD) using GENSTAT 17th edition and the significant means were compared using the Duncan Multiple Range Test (DMRT) (Duncan, 1955).

Table 1: Effect of Moringa leaf extract on vine length and number of leaves of cucumber varieties

Treatments	Vine length			Number of leaves		
	4 WAS	6 WAS	8 WAS	4 WAS	6 WAS	8 WAS
Moringa leaf Extract						
MLE	32.1 a	87.5 a	106.4 a	5.15	10.6 a	23.2 a
No MLE	25.6 b	71.9 b	97.2 b	5.11	7.39 b	20.1 b
SE±	0.327	0.337	0.118	0.165	1.028	1.142
Varieties						
Monalisa F1	29.6	83.2	101	5.00b	7.67	21.3
Saira F1	32.2	77.0	96.1	4.50c	9.00	21.7
Poinsett	33.3	71.5	95.4	5.83a	11.00	22.5
SE±	0.242	0.413	0.221	0.202	1.259	1.398
Interaction MLE x Variety	NS	NS	NS	NS	NS	NS

Treatments mean within each group followed by the same letters are not significantly different from each other using the Duncan Multiple Range Test at a 5% level. WAS – Weeks after sowing, MLE- Moringa Leaf Extract

RESULTS AND DISCUSSION

Effect of moringa leaf extract on vine length and number of leaves

The effect of Moringa Leaf Extract on the Vine length of Cucumber is shown in Table 1. Moringa leaf extract showed significant differences in vine length at 4, 6 and 8 weeks after sowing. The treatment with moringa leaf extract had higher vine length in all the sampling weeks. The same effect was observed in all sampling weeks with no significant interaction. For the number of leaves, there was no significant difference in the number of leaves at 6 and 8 weeks after sowing (Table 1).

Our findings corroborate with that of Ahmed *et al*., (2020) who reported that growth attributes of cucumber Hesham F1 hybrid were significantly enhanced in response to foliar spray with MLE at different concentrations (1:20, 1:30 and 1:40) compared to the control. Also, Culver *et al.* (2012), Abou El-Nour and Ewais (2017) and Elzaawely *et al*. (2017) had reported that foliar application of MLE can be used as a plant biostimulant for enhancing tomato, pepper and snap bean growth parameters and productivity. Moringa leaves are rich in zeatin (naturally occurring cytokinin) hormone that enhances plant growth (Nagar *et al.,* 2006; Maswada *et al.,* 2017).

Effect of Moringa leaf extract on the number of branches

The effect of moringa leaf extract on the number of branches of cucumber varieties is shown in Table 2. There was no significant difference in the number of branches across the sampling weeks except at 6 weeks after sowing. Significant interaction was observed at 6 weeks after sowing. The combination of moringa leaf extract and poinsett variety produced the highest number of branches, while the combination of no moringa leaf extract and Saira F1 produced the lowest number of branches (Table 2).

Effect of Moringa leaf extract on fruit length, fruit diameter and number of fruits per plant

The effect of moringa leaf extract on fruit length, diameter, and number of fruits per plant of cucumber varieties is shown in Table 3. Moringa leaf extract and variety did not show significant differences in fruit length, fruit diameter, and number of fruits per plant. Also, no significant interaction was observed. Similar results were reported by Ahmad *et al*., (2020) The cucumber fruit yield and its quality were greatly enhanced due to MLE foliar application compared to the control in both seasons (Table 3). It was observed that the high dose of MLE (1:20) caused the maximum increase in the number of fruits/plants, average of fruit fresh weight, and fruits total yield of cucumbers by 33.9%, 20.5% and 46.6% in the 2017 season, respectively; and by 31.5%, 25.6% and 37.3% in the 2018 season, respectively.

Effect of moringa leaf extract on fruit length, fruit diameter, and number of fruits per plant

The effect of moringa leaf extract on fruit length, diameter and number of fruits per plant of cucumber varieties is shown in Table 3. Moringa leaf extract and variety did not show significant differences in fruit length, diameter, and number of fruits per plant. Also, no significant interaction was observed.

Table 2: Effect of Moringa leaf extract on the number of branches of cucumber varieties

Treatments	Number of branches		
	4 WAS	6 WAS	8 WAS
Moringa leaf Extract			
MLE	2.22	4.89 a	9.86
No MLE	2.00	4.33 b	8.56
SE±	0.165	0.253	0.687
Varieties			
Monalisa F1	2.16	4.00 c	9.17
Saira F1	2.16	4.60 b	9.00
Poinsett	2.00	5.17 a	9.50
Interaction MLE x Variety	NS	**	NS

Treatments mean within each group followed by the same letters are not significantly different from each other using the Duncan Multiple Range Test at a 5% level. WAS – Weeks after sowing, MLE- Moringa Leaf Extract

Table 3: Effect of Moringa leaf extract on fruit length, fruit diameter and number of fruits per plant of cucumber varieties

Treatments	Fruit Length (cm)	Fruit Diameter (mm)	Number of Fruits/Plants
Moringa leaf Extract			
MLE	15.2	39.3	2.77
No MLE	14.1	34.7	2.17
SE±	0.801	1.02	0.225
Varieties			
Monalisa F1	13.9	37.7	2.67
Saira F1	13.8	34.0	2.17
Poinsett	16.4	39.6	3.17
SE±	0.801	2.22	0.435
Interaction MLE x Variety	NS	NS	NS

Effect of Moringa leaf extract on days to 50 % flowering and number of fruits per plot

The effect of moringa leaf extract on days to 50% flowering and the number of fruits per plot of cucumber varieties is shown in Table 4. Moringa leaf extract did not show a significant difference on days to 50 % flowering. However, a significant interaction was observed in days to 50% flowering. Poinsett attained 50% flowering earlier than the remaining varieties which are statistically similar. Moringa leaf extract showed a significant difference in the number of fruits per plot, treatment with moringa leaf extract produced the highest number of fruits per plot. Variety did not show a significant difference in the number of fruits per plot. No significant interaction was observed. The combination of moringa leaf extract and poinsett attained 50% flowering earlier, while the combination of no moringa leaf extract and Monalisa F1 attained 50% flowering late (Table 4).

Our results corroborate with those of Ahmed *et al*., (2020) who reported maximum stimulation was recorded with the high dose of MLE (1:20), as it increased the number of flowers/plant, decreased the days to 1st female flower, and increased the fruit set (%) by 18.2%, 9.2% and 10.7% over control in the 2017 growing season, respectively; and by 38.4%, 44.8% and 17.1% over control in the 2018 growing season, respectively.

CONCLUSION

In this study, foliar application of moringa leaf extract (MLE) could promote the vegetative growth and 50% flowering of cucumber (*Cucumis sativus* L.), improving the yield. Our study demonstrated and supported the postulation that MLE might be used as an effective natural and highly safe bio-stimulants and a substitute for the excessive use of synthetic fertilizer and other agrochemicals in the production of high-quality vegetables and fruits.

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Table 4: Effect of Moringa leaf extract on days to 50% flowering and number of fruits per plot of cucumber varieties

	Days to 50% flowering	Number of fruits per plot
Treatments		
MLE	40.1	24.7 a
No MLE	43.3	18.3 b
SE±	3.12	2.685
Varieties		
Monalisa F1	46.2 a	16.3
Saira F1	44.5 b	18.2
Poinsett	40. 0 b	22.6
SE±	0.251	2.497
Interaction MLE x Variety	*	NS