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COMPARATIVE EFFECT OF AQUEOUS SEAWEED EXTRACT AND IBA ON FRUIT ABSCISSION IN WATERMELON AND OKRA

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Abstract

The research work was carried out at the University Research farm Bayero University, Kano in 2014 and 2015 and the aim was to test the extract of seaweed (Ascophyllum nodosum) in relation to Indole Butyric Acid (IBA) on fruit abscission in okra (Abelmeschus esculentus L.) and watermelon (Citrullus lanatus L.). The research was necessitated by the inability of most people in Kano and the drylands of Nigeria to meet the FOA recommended intake of 400g of vegetables per person per day or 150kg of vegetables per year. Fruit abscission is among important production limiting factors for these vegetables in Kano. Therefore, effectiveness of an extract from a novel plant species Ascophyllum nodosum in addition to widely used growth promoting compound (IBA) on the selected vegetables was explored in this research. The work involves pre and

post planting activities; preparation and application of test materials; management of experimental plots as well as monitoring and measurement of abscission parameters. Result obtained showed abscission was delayed by foliar application of the test materials because vegetables treated as control were observed to drop more flowers in all the trials and those treated with 50ppm IBA as well as 2.0g/L seaweed were observed to significantly drop least number of flowers. Therefore, at 2.0g/L, the extract of seaweed was found to be an effective promoting compound with similar effect to 50ppm IBA on the selected vegetable species investigated in the study. Based on the result of this preliminary work, the seaweed plant species (Ascophyllum nodosum) contains growth promoting compound that prevented fruit abscission.

Key words: Seaweed extracts, IBA, Okra, Watermelon and Abscission

Introduction

Production of vegetables besides its contribution to better health and quality of life is enhancing the economic and social status of gardeners in the world of agriculture and biological sciences. It is in this regard that fruiting and leafy vegetables such as Okra (*Abelmeschus esculentus* L.), Amaranth (*Amaranthus cruentus*) and watermelon (*Citrullus lanatus* L.) became highly valued crops, particularly in the Northern part of Nigeria. In terms of cultivated land area, Nigeria and Benin Republic are reported to have least production figures of these vegetables, while South Africa is ranked the highest producer in the continent (FAO, 2008). However, Nigeria has developed an ambitious agricultural plan to expand dry season agriculture so as to meet the growing food needs of our population and also export to earn foreign exchange.

Fruit abscission, poor growth, pest and diseases are among other factors affecting production of vegetables in Nigeria. Abscission of premature fruits which contribute to the poor performance and yield of vegetables is considered by many to be the most important physiological response regulated by Plant hormones.

For several years, there were only five widely known plant hormones and this include: Auxins, Cytokinins, Gibberellins (GAs), Abscisic Acid (ABA) and Ethylene. Some relatively new hormones are Jasmonic Acid (JA) derivatives, Salicylic Acid (SA), Brassinosteroids (BRs), Peptide hormones, Polyamines, Nitric oxide (NO), Karrikins, Triacontanol and Strigolactones to add to the list. Plant hormones are naturally produced by plants themselves (Srivastava, 2002). However, the concerns for contamination with carcinogenic compounds as well as other factors necessitated the search for biostimulant from traditional sources that could serve as natural hormone with activity on growth and yield of vegetable species. In this regard, the extract of some plant species including Moringa (*Moringa oleifera*), Tomato (*Solanum lycopersicon*), Carrot (*Daucus carota*), Coconut (*Cocos nucifera*) and Cucumber (*Cucumis sativus*) to mention a few have been used as growth regulators in experimental works (Phiri, 2010; Sandoval *et al*., 2014; Beata and Elżbieta, 2016). This approach is usually regarded as traditional because it involves the use of other plants. Other approach involving the use of human urine, yeast as well as marine resources were employed to promote plant growth. This approach seemed exciting and perhaps promising and therefore, the present work is part of the effort to search for viable alternative of growth promoting compounds from natural materials that are readily available in our ecosystem. Seaweed species is a common plant and relatively underutilized

bioresource from our aquatic environment with little utility as food or raw material for various applications by people. Extending the scope of testing the activity of a material that could potentiate growth of plants and in particular enhance yield and prevent common physiological phenomenon such as abscission of fruit would go a long way in complementing the role of IBA that are expensive for ordinary vegetable growers in this region will certainly be of great relevance. Therefore, the aim of this research was to assess the effectiveness of a natural extract from plant in relation to a commercial plant growth regulator on abscission in two selected vegetables.

Materials and Methods

The research was conducted at the Teaching and Research Farm of Faculty of Agriculture, Bayero University, Kano located in the Sudan Savannah agro ecological zone of Nigeria (Latitude 11˚58'N, Longitude 8˚25'E, and altitude 458m) under rainfed and irrigation in 2014 and 2015 respectively. The treatments consisted of Seaweed extract (1.5 and 2.0g/L) and IBA (50 and 100ppm) and each treatment replicated three times were laid in Complete Randomized Block Design. The treatments were applied by foliar spray using CP 20 Knapsack sprayer at 2, 4, 6 and 8 weeks after germination.
The plants after germination were managed by daily watering (for irrigation trial), fertilizer application and weed as well as insects control.
Qualitative and quantitative measurements were made for flower and fruits abscission at pre-harvest period:

- Number of flowers per plant: number of flowers was regularly observed after the first flower opening.
- Number of flowers dropped: this was determined by counting number of flowers dropped before developing into fruit.
- Number of fertilized flowers dropped: this was determined by counting flowers that developed into fruit but dropped prematurely before the harvest time.

Data collected on the above parameters were subjected to analysis of variance and significant difference within the means was detected using Fisher's least significant difference test at $p \leq 0.05$.

Results and Discussion

Number of flowers dropped at pre-mature stage from the two vegetable crops was found to be significantly affected by aqueous extract of seaweed and IBA (Table 1). Vegetables treated as control were observed to drop significantly more flowers in all the trials and those treated with 50ppm IBA and 2.0g/L seaweed were observed to drop significantly the least number of flowers.
For results on fruit abscission in rainfed trial, significantly higher number of fruits was abscised by the plants in the control plots while the least was with 50ppm IBA. At irrigation trial, the control plots also abscised significantly higher number of fruits than seaweed extract at 1.5 and 2.0g/L which dropped statistically similar number of fruits with 50 and 100ppm IBA.
The interaction analyses (Table 2) showed that plants of okra treated with 50 and 100ppm IBA have significantly dropped least pre-matured flowers during rainfed trial. In watermelon, plants treated with 50 and 100ppm IBA have dropped significantly few flowers when compared with what was

observed in the control but has recorded similar effect with the two concentrations of seaweed. Plants of both okra and watermelon left as control were however, observed to drop more flowers during rainfed trial. In irrigation trial, the interaction between okra and treatments on number of flowers dropped was not significant but for the interaction with watermelon, plants treated as control have recorded more number of dropped flowers than in other treatments.

Interaction on number of fruits dropped (Table 3) during irrigation trial was highly significant. Replications of okra and watermelon treated with IBAs and two concentrations of seaweed recorded few numbers of dropped fruits.

The influence of IBA on fruit and flower abscission observed in this study is largely due to the fact that many physiological processes such as root initiation, fruit ripening, floral initiation, breaking of bud dormancy, stimulation of guttation, leaf abscission, e.t.c. have shown similar responses to both auxin and ethylene (Hansen, 1946). Therefore, IBA being a plant hormone belonging to auxin family, its applications can also stimulate ethylene evolution.

Seaweed also according to Crouch and Van Staden (1993) contains compounds that can induce plant growth. In particular, the presence of cytokinins, gibberellins and/or betaines in seaweed is likely to have caused the effect because cytokinin-like compounds and gibberellins have been detected in the seaweed extract (Finnie and Van Staden, 1985) and betaines in species of the brown algae (Blunden *et al*., 1982) and any of these groups of compounds could be responsible for the control of abscission. Seaweed extracts act as biostimulants mainly due to the presence of plant hormones (Stirk *et al*., 2014). Main phytohormones identified in seaweed extracts are: auxins, cytokinins, gibberelins, abscisic acid and ethylene (Stirk *et al*., 2014; Matysiak *et al*., 2010). For example, auxin plays a key role in growth of plants by increasing and activating H-ATPase pumps. Auxin sends protons to apoplast space, resulting from decreasing pH, some enzymes will be activated which loosen cell wall. By increasing production of some soluble materials inside the cell, auxin decreases the water potential and finally let water enter into the cells. These procedures lead to growth of cell and finally growth of plant (Taize and Zieger, 2006).

In another development, Rolland *et al*. (2002) have suggested that sugars in seaweed may be responsible for some of the effect on plant growth. In addition, Crouch and Van Staden (1993) suggested that the beneficial effect of seaweed is possibly enhanced by supplementing with synthetic NPK fertilizer.

Table 1: Effect of aqueous extract of seaweed and IBA on fruits abscission in selected vegetables at BUK Research farm under rainfed and irrigation

Treatments	**Number of flowers abscised**		**Number of fruits abscised**	
Growth Regulators	Rainfed	Irrigated	Rainfed	Irrigated
Control	3.33a	1.44a	3.00a	1.11a
1.5g/L SW	2.11b	0.67bc	1.89b	0.56b
2.0g/L SW	0.76c	0.44c	1.33bc	0.33b
50ppm IBA	0.56c	0.44c	1.22c	0.67ab

100ppm IBA	0.89c	0.56bc	1.44bc	0.67ab
LSD (5%)	0.43	0.36	0.62	0.52
Vegetables				
Okra	1.57b	0.24b	1.33b	0.43b
Watermelon	3.62a	1.95a	3.24a	1.48a
Interaction				
Trt. x Veg.	**	**	**	NS

(1) Means followed by unlike letter within column are significantly different ($p \leq 0.05$) using Fisher's LSD
(2) LSD = Least Significant Difference (3) Conc = Concentration (4) Veg = Vegetables (5) SW = Seaweed
(6) IBA = Indole butyric acid (7)* = Significant Interaction (8) ** = Highly Significant Interaction

Table 2: Interaction between treatments and the vegetable crops on flower abscission at BUK Research Farm under rainfed and irrigation

	Rainfed		**Irrigation**	
Growth Regulators	**Okra Means ± SD**	**Watermelon Means ± SD**	**Okra Means ± SD**	**Watermelon Means ± SD**
Control	3.33±0.58	6.67±0.58	0.33±0.58	0.33±0.58
1.5g/L SW	2.33±0.58	4.00±0.00	0.33±0.58	0.33±0.58
2.0g/L SW	0.67±0.58	5.00±0.00	0.00±0.00	0.00±0.00
50ppm IBA	0.00±0.00	1.67±0.58	0.00±0.00	0.67±0.58
100ppm IBA	0.67±0.58	2.00±0.00	0.33±0.58	0.67±0.58
Mean	1.57	3.62	0.24	0.24
LSD (5%)	0.88	0.96	NS	NS

(1) LSD = Least Significant Difference (2) SW = Seaweed (3) IBA = Indole butyric acid (4) SD = standard deviation

Table 3: Interaction between treatments and the vegetable crops on fruits abscission at BUK Research Farm under rainfed and irrigation

	Rainfed		Irrigation	
Growth Regulators	**Okra Means ± SD**	**Watermelon Means ± SD**	**Okra Means ± SD**	**Watermelon Means ± SD**
Control	2.67±0.58	6.33±1.15	0.33±0.58	3.00±1.00
1.5g/L SW	2.33±0.58	3.33±0.58	0.33±0.58	1.33±0.58
2.0g/L SW	1.33±0.58	2.67±0.58	0.00±0.00	1.00±1.00
50ppm IBA	1.00±1.00	2.67±1.53	0.67±0.58	1.33±0.58
100ppm IBA	1.33±0.58	3.00±1.00	0.67±0.58	1.33±0.58
Mean	1.33	3.24	0.24	1.48
LSD (5%)	1.09	1.54	NS	NS

Conclusion

The study indicated that aqueous extract of seaweed (*Ascophyllum nodosum*) at 1.5 and 2.0g/L and IBA at 50 and 100ppm control abscission in the two vegetables. Therefore, the extract of seaweed has compared favorably well as an effective promoting compound with IBA on okra and watermelon investigated in this study. Thus, the Seaweed plant species (*Ascophyllum nodosum*) extract at a reasonable concentration levels has demonstrated its potential as growth promoting compound.

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