Influence of Hormones and Imbibition on the Growth and Yield of *Abelmoschus esculentus* (Okra).

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Abstract: Plant growth regulators (Hormones) affect various aspects of plant physiology mainly vegetative and reproductive traits including growth and yield production. The efficacy of growth hormone solution in improving the growth and yield of okra was investigated. The seeds were presoaked in three different treatments (A = Gibberellin (GA,), B = Indole Acetic Acid (IAA) and C = propanol+ distilled water) for 3-4 hours. Plant height, stem girth, leaf Area, leaf width and number of leaf as well as dry matter (yield) of the seedlings were determined. It has been observed that the number of leaves, leaf Area and dry matter (yield) were significantly affected by imbibition (presoaking) and hormones. In case of presoaking seeds, highest imbibition rate supported the plant height. In case of hormones, Gibberellin (GA) produced highest leaf area, dry matter and number of leaves while the control (propanol+distilled water) was not favoured with imbibition.
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1. Introduction

Okra (*Abelmoschus* esculentus L) belongs to family Malvaceae[1] (Naveed et at., 2009). Okra originated in tropical Africa, grown in the Mediterranean region and wild forms are also found in India. Okra is cultivated since ages, and extensively disseminated from Africa to Asia, southern Europe and currently grown in many countries. Its total annual production in the world was about 4.8 million tonnes: and the share of india (4.528 M tonnes), Sudan (0.249 M tones, Nigeria (0.826 M tonne), Cote d' lviore (0.115M tonnes) and Pakistan (0.116M tonnes) in world production was 70, 1.7,1.7,4.5,15,2,2 respectively during year 2009 (FAOSTAT, 2009).

The production of okra as vegetable in Nigeria has rapidly increases in recent years because okra contains proteins, carbohydrate and vitamin C (Gophan et al, 2007, Dilruba et al., 2009) and plays a vital role in human diet (Kahlon et al., 2009). Consumption of young immature okra pods is important as fresh fruits, and it can be consumed in different forms (Ndunguru and Rajabu, 2004). Fruits can be boiled, fried or cooked (Akintoye et al., 2011). Okra has been known to be beneficial to people suffering from leucorrhoea and general weakness. Due to its high iodine content, its fruits are considered useful to control goitre and have medicinal value in curing ulcers and relief from haemorrhoids (Demir, 2001).

Growth and yield of okra depends upon many factors including, seed quality, nutrition, climatic conditions and cultural practicals (Kusvuran, 2012). Water imbibition is the first step in seed germinations. But nursery bed/crop field may lack adequate moisture content for the same, so, poor and delayed germination occurs. To combat this, farmers pre-soak the seeds in plain water for a few hours but this may cause seed damage in more than one ways of them, the major one is that, excess water may be trapped in the area of embryonic axis, nodal zone and cotyledons. This leads to suffocation resulting in delayed and poor germination as well as weak seedling growth (Orphanos and Heydecker, 1968, Heydecker, (1977). So, aqueous solution of any chemical having capability to supply O_2 at the embryonic axis during seed imbibition could be a worthwhile measure. As such, aqueous solutions of Gibberellin (GA), indole Acetic acid (IAA) and propanol were used in presoaking (imbibition) of the Ladys finger seeds.

2. Materials And Methods

A pot experiment was conducted at the screen house, Department of Crop Protection and Environmental Biology, University of Ibadan between October and December, 2012 germination method. Seed of Okra was bought from the market in Ibadan.

An experiment to determine the influence of imibibition on presoaked seeds of Okra in Gibberellin (GA), indole Acetic acid (IAA) and pronanol + distilled water.

2.1. Preparation of Stock Solution.

One gram (1g) of each hormone (Gibberellin), (GA), Indole Acetic acid (IAA) was dissolved in 1 litre of distilled water (1000 ppm) being measured

by measuring cylinder. Proper dissolution, 10mls of propanol was added to make up IL using distilled water and were labeled A and B while the control (c) contained 10mls of ethanol propanol with distilled water.

2.2 Imbibition Experiment

Three (3) petridishes thoroughly washed to contain Gibberellin (GA), Indole Acetic Acid (IAA) and propanol (control) were labeled A,B, and C. A total of 24 Seeds were divided into 3 portions (8seeds per petridish) and 8 seeds were weighed before putting inside the petridish (initial weight = Wo), after wards, 20mls of the stock solution of each hormone (A,B Aand C) was added to each petridish containing the seeds and were left for 3-4 hours to soak. After soaking the seeds were put on dried clean fitter paper to re –weight (W_1).

2.3 POT Experiment

Six (6) pots were filled with 400kg of humus soil of labeled A,B, and C, respectively.

The soaked seeds (weighed seeds) in A, B, and C were planted in fours (4's) into each pot with 2 replicates each (A (A, A_2), B (B_1, B_2) and C (C_1, C_2). Watering was done in 3 days (every other day) to avoid logging.

2.4 Data Collection And Analysis

The experiment was carried out for six (6) weeks and the data collection was done two weeks after planting (2WAP), Consecutively to measure stem height (SH) in cm), stem girth (SG in cm), leaf Area (LA) in cm^2, leaf length (LL), leaf width, (CLW) and the number of leaf (NL) were the growth parameters evaluated while the root weight (fresh and dry), shoot weight (fresh and dry) were the parameters evaluated for the yield.

2.4.1.1 Stem Height

The stem height was measured using metre ruler in centimeters.

2.4.1.2. Stem girth (SG)

The thickness of the stem was measured using thread and ruler in centimeters.

2.4.2 Leaf Area (L.A)

The surface area of the leaf was measured and calculated according to Asoegwu (1988) formula:

0.56 x length of midrib (cm) x widest where 0.56 = corrector factor. It was measured in cm^2

2.4.3 Number Of Leaf (Nl)

The number of leaves was measured by visible counting.

2.4.4 Shoot And Root Weight (SW & RW)

Shoot and root were weighed separately on weighing machine for fresh weight and dry weight in grams. Oven regulated to 120^0c for 48hours was used to dry the samples.

2.5 Data Analysis

All the parameters measured were presented in table and histograms to show the effects of hormones on growth and yield parameters of okra the mean values (average) were obtained using:

$\sum x/n$ where $\sum x$= sum of the treatment, n =total number of stands

3. Result And Discussion

The effect of growth hormones was highly significant on the stem height in which highest stem height 13.00 cm was observed in Indole Acetic Acid (IAA) while the shortest was observed in the control 10.00cm (Table 1) (figure 1).

3.1 Stem Girth

The highest mean value of stem girth 1.27cm was observed in okra seedlings treated with Gibberellin (GA) and indole Acetic acid (IAA) while the control had the least 0.70cm. (Table 1) and figure 1)

3.2 Leaf Area

The photosynthetic area of the plant (leaf area) was highly favoured with the treatment of Gibberellin ($12.04cm^2$) while the least mean value $7.35cm^2$ was observed in the control. (Table 1) and see figure1)

3.3 Number Of Leaf

The highest number of leaf (5) was observed in seeding treated with Gibberellin (GA) while the same number of leaf was observed in IAA and control (4) (table 1) figure 1.

3.4 Onset Of Germination

Early germination (3 days) was observed in seedling of okra treated with Indole Acetic acid (IAA) while late germinated was observed in the control (7days) (Table 1).

3.5 Root Weight

From table 2 the mean value of dry matter (yield) was at the maximum weight in the root of okra treated with gibberellin (7.74g 0.17g) the control had the least weight (0.33g, 0.08g) in both fresh and dry weight respectively.

3.6 Shoot Weight

From the table 2, significant weight was observed in the shoot of okra treated with GA (5.42g, 1.02g) and least weight in control (2.55g, 0.41g) both fresh and dry weight respectively.

Table 3 reveals the imbibition rate which is the rate at which dry seeds imbibe water.

Okra seed soaked in IAA (Auxin) had the highest imbibition rate (0.26g) while the control containing propanol had the least imbibition rate (0.15g).

Table 1: Mean values of growth parameters for the treatment of *A. esculentus*.

Treatment hormones	Growth Parameters				
	Stem Height (SH) (cm)	Stem girth (SG) (cm)	Leaf (LA) Area cm^2	Number of Leaf (NL)	Onset of germination (days)
A = Gibberelin (GA)	12.00	1.27	12.04	5	4
B = Indole Acetic Acid (IAA)	13.00	1.27	1.71	4	3
C = Control	10.00	0.70	7.35	4	7

Table 2: Mean values of Yield Parameters for the treatment of *A. esculentus*

Treatments	Root fresh weight (RF W_1) (g)	Shoot fresh weight (SFW_1) (g)	Root dry weight (RDW_2) (g)	Shoot dry weight (SDW_2) (g)
A (GA)	7.74	5.42	0.17	1.02
B (IAA)	0.50	4.35	0.10	0.73
C = Control	0.33	2.55	0.08	0.41

Table 3: Imbibition Rate of a esculentus seeds.

Treatment	Weight of dry seed (g) W_1	Weight of soaked seed (g) W_2	Imbibition rate (W2-W1)
A (GA)	0.54	0.74	0.25
B (IAA)	0.45	0.71	0.26
C = Control	0.49	0.64	0.15

4. Discussion

4.1.Imbibition Rate:

The results revealed that *Abelmoschus esculentus* (okra) had the greatest imbibition rate in auxin while the control had the least imbibition rate and this could be traced to the use of chemical (hormones) to break the seed coat.

It is therefore confirmed that soaking of okra seeds in IAA (as chemical) was effective in breaking of okra seed hardness to enhance germination. Control (c) had the least imbibition rate just because the seed coats were not permeable to gases (propanol + alcohol) a volatile gas. Another observation in this imbibition experiment was that control had tough seed. Coat which regulated germination by establishing barrier for imbibition and subsequent radicle emergent, gaseous exchange, particularly, oxygen uptake required for respiration and or for the outward diffusion of endogenous germination imbibitors. Hard seed coat limits the effectiveness of conditioning on okra seed germination.

Growth and yield of okra depends upon many factors including seed quality, nutrition, climatic conditions and cultural practices (Kusvuran, 2012). Chemical substances like plant growth hormones can bring changes in the phenotypes of plants and effectgrowth either by enhancing or by stimulating the natural growth regulatory systems from seed germination to senescene (Das and Das, 1995).

Maximum plant height (stem height) and early germination were observed in okra this could be traced to the effect of Auxin (IAA) in stimulating stem elongation and germination. This was in agreement with findings of Jalal, (2000) in which application of IAA significantly increased plant height in squash and cucumber plants.

Stem girth, leaf area (cm^2), number of leaf and dry masses of root and leaf of okra were significantly enhanced by the seed treatment with GA. Increase in dry weight by GA could be as a result of its role in early bolting and the increase in number of leaves because the more the leaves, the greater the photosynthate and the better the accumulation of dry matter (the better the yield). This is similar to the result of Ilias et al; (2002) who reported that stem and leaf dry masses and stem length were significantly enhanced by the application of GA. Also, Surendra et el, (2006) reported that GA_3 at 25 and 50ppm increased specific leaf weight and leaf area duration in okra when applied as foliar spray.

There was also variation in the onset of germination of the *Abelmosclus esculentus* after planting. The onset of germination occurred faster (early in IAA while the least onset of germination occurred in control. This could be traced to the role of auxins in cell elongation and naturally, auxins are said to be present in the meristematic regions (root tips and shoot tips).

5. Conclusion

In conclusion, the experiment revealed that to ensure the maximum accumulation of photosynthate in okra, GA should be used and to have effective plant height of vegetable, peak growth, proper imbibition must be done using auxins. It was also observed that use of alcohol or any related compound will reduce the growth and yield of okra.

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