An investigation into the role of plant hormones in the perturbation of seed dormancy in Okra seeds

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ABSTRACT
Abscisic acid (ABA) was observed to have induced dormancy in the okra seed treated with it as it gave just about 5% germination rate. The Control (without any growth regulator) had 50 percent germination rate after 10 days. Gibberellic acid promoted seed germination as 99.5 percent of the seeds germinated within 10 days after sowing. It promoted seed germination by breaking dormancy in the seeds. In treatment 3 (T3) containing abscisic acid and Fluridone, seed germination was 40% after 10 days and increased to 75% after 14 days from the date of seed sowing, suggesting that Fluridone inhibited the effect of ABA by breaking dormancy in the seeds. In treatment 4 (T4), GA_3 inhibited the effect of ABA by breaking seed dormancy and promoting seed germination, however, the rate of seed germination was significantly lower than in treatment 2 (T2), where gibberellic acid was the sole plant growth regulator. Gibberellic acid stimulated the elongation of plant internodes. Plants treated with gibberellic acid were at least three (3) greater in height in comparison to other treatments after 28 days of acclimatization.

KEYWORDS: Abscisic acid; Gibberellic acid; Seed dormancy; Okra; Growth inhibitors; Seed germination; etc.

1.0 INTRODUCTION

Okra is an herbaceous annual plant in the family *Malvaceae* growing to a height of 0.8 to 1.5 m. It is grown for its edible seed pods. Okra seeds are a good source of protein, vegetable oil, vitamins A and B, phosphorus, and iodine (Khushsk, et. al, 2003). It is also grown for its leaves and tender seed pods for food, and its fibre for paper production. It has small erect stems that can be bristly or hairless with heart-shaped leaves. The leaves are 10–20 cm long with 5–7 lobes. The flowers have five white to yellow petals which are 4–8 cm in diameter. The seed pod is a capsule up to 20 cm in length, with numerous seeds. Okra pods contains valuable nutrients, such as fibre, which help to lower serum cholesterol, risk of heart disease and keep intestinal tract healthy (Broek, et al., 2007). Powdery mildew, a fungal disease, establishes itself via mycelial growth across the surface of the Okra plant.

2.0 MATERIALS AND METHOD

2.1 Experimental design

C	T1	T3	T4	T2
T1	T4	C	T2	T3
T3	C	T2	T1	T4
T2	T3	T4	C	T1

Control (No growth regulator); Abscisic acid (ABA = T1); Gibberellic acid (GA_3 = T2); Fluridone and ABA (T3); ABA and GA_3 (T4).

2.2 Treatment of seeds

Okra seeds were surface-disinfected in 0.1% $HgCl_2$ for one minute and thoroughly washed in distilled water. Twenty seeds were sown in each large petri dish containing either distilled water (as Control) or abscisic acid (ABA = T1) or Gibberellic acid (GA_3 = T2) or Fluridone and ABA (T3) or ABA and GA_3 (T4). Each treatment was replicated four (4) times under same laboratory conditions *in vitro*. The petri dishes were placed in 4 rows and 4 columns in a large tray and placed on a laboratory bench. At the time of seed sowing, seeds were placed on petri dishes that contained No. 2 Whatman filter paper and 5ml of distilled water or 500mg/L of either a plant growth regulator or a combination of a growth regulator and its inhibitor. The Control had no plant growth regulator or inhibitor. Fourteen (14) days after seed sowing, the total number of germinated seeds was counted in each petri dish. The seedlings were then transferred into the greenhouse after 28 days from the date of seed sowing. Foliar application of the treatments, with the concentration of 50 ppm, was given to young okra seedling in the greenhouse 7 days after transplanting. The second foliar application was conducted after 14 days from the first. Plant heights were measured in the greenhouse after 28 days of transplanting and acclimatization.

3.0 RESULTS AND DISCUSSION

Abscisic acid (ABA) was observed to have induced dormancy in the okra seed treated with it as it gave just about 5% germination rate. The Control (without any growth regulator) had 50 percent germination rate after 10 days of sowing. Seeds treated with gibberellic acid started germination 3 days after sowing, while those of the Control took 7 days to commence germination. Gibberellic acid promoted seed germination as 99.5 percent of the seeds germinated with 10 days after sowing. Gibberellic acid promoted seed germination by breaking dormancy in the seeds. In treatment 3 (T3) containing abscisic acid and Fluridone, seed germination was 40% after 10 days and increased to 75% after 14 days from the date of seed sowing, suggesting that Fluridone inhibited the effect of ABA by breaking dormancy in the seeds. A similar result was obtained in treatment 4 (T4) which was a combination of abscisic acid (ABA) and Gibberellic acid (GA_3) where GA_3 inhibited the effect of ABA by breaking seed dormancy and promoting seed germination. This result is in line with that obtained by de Mello et al., 2009) where, in the greenhouse, the percentage of seeds that germinated was almost 100% after 8 days from sowing. It appears that the increase in the rate of germination was caused by lipid and starch degradation promoted by gibberellic acid. The released solutes and necessary energy from the hydrolysed starch were then utilized for germintion. Further, the results of this study, suggest that the increased rate of seed germination may also be a result of the consistency of moisture and warm temperature coupled with the effect of GA_3 that broke the seed endodormancy. The work of

Trigiano and Gray (1953) also reported the dominant role of gibberellins in breaking dormancy and promoting seed germination. Furthermore, GA_3 applied to the seeds may have caused *de novo* synthesis of alpha-amylase in the seed endosperm which released simple sugars as a source of energy for germination. The above results are further supported by the work of Bewley and Black (1985) which reported that gibberellic acid broke seed dormancy in a number of genera. More so, Kitchen and Meyer (1991) reported a similar result of gibberellic acid effect and recommended a combination of stratification or scarification for increasing the effect of gibberellic acid in breaking seed dormancy. According to Gaba (2005) exogenous application of gibberellin is required for germination as it promotes germination via multiple mechanisms such as inducting the production of hydrolytic enzymes that weaken the testa and endosperm cap and stimulate expansion of the embryo. In treatment 4 (T4), however, the rate of seed germination was significantly lower than in treatment 2 (T2), where gibberellic acid was the sole plant growth regulator. Plant heights were measured in the greenhouse after 28 days of transplanting and acclimatization. Gibberellic acid stimulated the elongation of plant internodes. Gibberellic acid also promoted leaf growth and apical dominance. Plants treated with gibberellic acid were at least three (3) greater in height in comparison to other treatments after 28 days of acclimatization. The biosynthesis and signaling transduction pathways of abscisic acid and gibberellic acid play vital roles in seed development, dormancy, and germination (Leubner-Metzger, 2005).

4.0 CONCLUSION

The use of plant hormones offers great opportunities for modulating plant growth and development, and will remain a significant tool for plant improvement, especially for improving plant adaptation to various kinds of environmental stress. Crop improvement for the sake of nutritional value and market demands greatly underscores the usefulness of plant hormones and plant growth regulators in agriculture and plant science.

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