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**Research Article**

# Effects of Aqueous Leaf Extract of *Datura stramonium* on Vegetative Traits of Selected Maize (*Zea mays* L.) Varieties in Nigeria

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**Abstract:** *Datura stramonium* contains allelochemicals which have allelopathic properties that have the potential to inhibit or stimulate vegetative plant growth. Aqueous leaf extract of *D. stramonium* at 25%, 50% and 100% concentrations were applied to determine their effects on plant height, number of leaves per plant, leaf length, root length and internode length of two maize varieties (Sammaz-39 and Oba super-06) under field conditions. Distilled water (0%) served as control.The treated maize seeds were planted in the experimental field and the plots were laid as randomizedcomplete block design (RCBD) replicated three times.Results on the effects of *D. stramonium* leaf extract were determined for each treatment concentration. Results showed that *D. stramonium* leaf extract significantly increased plant height of Sammaz-39 at a concentration of 50% at 10WAP and also of Oba super-06 variety at a concentration of 50% at 8 and 10WAP. Number of leaves per plant was significantly decreased at 10WAP in Sammaz-39 at 100% concentration while Oba super-06 variety showed a significant decrease in number of leaves per plant at 50% concentration at 8WAP. The highest leaf length was observed at 25% concentration of *D. stramonium* leaf extract in Sammaz-39 at 8WAP and at 25% concentration for Oba super-06 at 2, 4, 6 and 8WAP. But at 10WAP, highest leaf length was observed in the control (0%). Root length was significantly increased in treated seeds of the two varieties; highest root length was observed at 50% concentration in both Sammaz-39 and Oba super-06. Internode length on the contrary, was significantly decreased at high concentration of 100% in Sammaz-39 while no significant difference was observed in the internode length of Oba super-06 variety. This study reveals that high concentration (100%) of *D. stramonium* leaf extract has inhibitory effects on number of leaves per plant, leaf length and internode length while lower concentrations (25% and 50%) has stimulatory effects on vegetative characters like root length, plant height and leaf length of the two maize varieties examined.

**Keywords:** allelochemicals, aqueous leaf extract, *Datura stramonium*, inhibitory effects, stimulatory effects.



## INTRODUCTION

Maize is a cross-pollinated, monoecious plant that belongs to the grass family (Gnanmurthy *et al.*, 2006). It is the most widely grown cereal in the world and is the leading cereal of the world in terms of productivity (Irfan *et al.*, 2017). In Nigeria, maize is the second most cultivated crop in terms of harvest (5.8 million ha salons to cassava 7.2 million ha). Nigeria is the second largest producer of maize in Africa after South Africa (FAO, 2014). Maize is chiefly used as food for livestock and in the production of corn ethanol, high maltose corn syrup and other products such as sorbitol, maize starch powder, liquid glucose, corn steep liquor and modified starches, little of it is consumed directly by man (Foley, 2013). Maize remains a staple food across the world due to its high nutritional value with high levels of starch, valuable proteins and oil.

Thorn apple (*Datura stramonium* L.) commonly known as devils trumpet is a poisonous blossoming flowering plant belonging to the family Solanaceae. The seeds and flowers of all the species are poisonous due to the presence of allelochemicals which have allelopathic effects on survival of native plants (Nuhu and Ghani, 2002). A series of allelochemicals in form of alkaloids, atropine, hiosciamine and scopolamine are found in *D. stramonium* (Butnariu, 2012). These allelochemicals are said to inhibit cell division or auxin production that induces the growth of shoot and root (Gholami *et al.*, 2011; Sakadzo *et al.*, 2018). The release of these allelochemicals by plants with allelopathic potential has been reported to have either deleterious or beneficial effects on other plants associated in the same locality (Zhang *et al.*, 2003).

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Based on this assertion, this study was designed to determine the effect of *Datura* leaf extract on vegetative traits of maize varieties in Nigeria.

# MATERIALS AND METHODS

**Source of Research Materials**

Two varieties of maize seeds namely Sammaz-39 and Oba super-06 were obtained from Lower Niger River Basin Development Authority, Ilorin, Kwara State. The leaves of *D. stramonium* were collected from the Biological garden, Center for Preliminary and Extra Moral Studies (CPES), Federal University of Technology, Minna, Bosso Campus. The experiment was conducted in the experimental garden, Department of Plant Biology, Federal University of Technology, Minna.

**Preparation of Test Materials (*Datura* leaf extract)**

The collected leaves of *D. stramonium* were purified of soil residue using distilled water, air dried and then pounded into powdery form; the powdered sample from the leaves was weighed to give 50 gram. The mixture was then prepared by mixing 500ml of distilled water with 50gof the powdered sample in a closed conical flask; the conical flask was kept at room temperature (20 - 25$^{o}$C) for 72hours to allow auto extraction of plant metabolite. The mixture was kept in dark room to avoid undesired reaction that might be caused by direct light. The mixture was then filtered using Muslin cloth to get stock solution with concentration of 0.1g/ml (100%).Two concentrations of 25% and 50% were then made from the stock solution using dilution method (C1V1=C2V2) where C1 and V1are the concentration and volume of the stock solution respectively and C2 and V2 are the concentration and volume of new attributed solution.

**Treatment of Maize Seeds and Experimental Design**

Seed samples were surface sterilized with 0.1% mercuric chloride solution for 2 minutes and washed twice with distilled water. The seeds were then soaked in different concentrations (100%, 50% and 25%) of leaf extract prepared form *D. stramonium* for 2 hours. Seed samples soaked in distilled water served as control. The experiment was arranged in a randomized complete block design (RCBD) with four treatments replicated three times. Treatments were distilled water (control) and aqueous *D. stramonium* leaf extracts applied at 100%, 50% and 25% concentration as a ratio of plant extract powder to 500 ml distilled water.

**Data Collection**

Data on plant height, number of leaves per plant, leaf length, root length and internode length was recorded. Number of leaves per plant was determined by direct counting at 2 weeks, 4 weeks, 6 weeks, 8 weeks and 10 weeks after planting (WAP). During the experiment period, plant height, leaf length, root length and internode length were measured using a meter rule at 2 weeks interval from planting date till the 10$^{th}$ WAP.

**Data Analyses**

Quantitative data collected were subjected to Analysis of Variance (ANOVA) at 5% significance level and Duncan's Multiple Range Test (DMRT) was used to separate the means where significant differences were noted.

# RESULTS AND DISCUSSION

The results showed a significant increase in plant height of the treated plants. Sammaz-39 recorded a significant increase in plant height at 50% concentration at 2WAP and 10 WAP and at 100% concentration at 4, 6 and 8 WAP. Oba super-06 variety showed an insignificant reduction in plant height at 2, 4 and 6 WAP. However, at 8 and 10 WAP, 50% concentration showed a significantly higher plant height when compared to the control and other treatment concentrations (Table 1). The notable increase in plant height may be attributed to the stimulatory effect of *D. stramunium* on the growth of maize plant at medium and high concentrations. Similar findings have been reported by Pacanoski *et al.* (2014) who stated that, the lower (1/2 and 1/5) *D. stramonium* roots aqueous showed stimulatory effect on the seed germination of maize.

No significant difference was recorded in the number of leaves per plant of Sammaz-39 at 2, 4, 6 and 8 WAP but at 10 WAP, 100% concentration showed significantly lower number of leaves per plant compared to other treatment concentrations and control. Oba super-06 variety also showed no significant difference in the number of leaves per plant for the different treatment concentrations as well as control at 2, 4, 6 and 10 WAP. On the contrary, 8WAP recorded a significantly lower number of leaves per plant at 50% concentration of *D. stramonium* leaf extract (Table 2).

In Sammaz-39, the highest leaf length was recorded in the control at 2 WAP and 10 WAP and at 25% concentration for 4, 6 and 8 WAP. Oba super-06 variety on the other hand, showed significantly higher leaf length at low concentration of 25% *D. stramonium* leaf extract at 2, 4, 6 and 8 WAP (Table 3). This might be as a result of the inhibitory effect of the leaf extract on cell division at moderate and higher concentrations of 50% and 100% respectively. This observation concurred with the findings of EL-Shora *et al.* (2015) who reported that *D. stramonium* inhibits cell division and can interfere with auxin production which induces growth. *D. stramonium* leaf extract has also been reported to decrease leaf chlorophyll content by Filemon *et al.* (2013).

Significantly higher root length was recorded in both Sammaz-39 and Oba super-06 varieties at 50% concentration of *D. stramonium* leaf extract. The root length of all treatment concentrations was higher than the control in both cases. However, Oba super-06

showed no significant difference in root length by the control and at 25% concentration of *D. stramonium* leaf extract (Figure 1). This might be attributed to the stimulatory effect of *D. stramonium* on roots. Similar findings have been reported by Pacanoski *et al.* (2014). Hussain and Reigosa (2011) have on the contrary, reported inhibitory effect of *D. stramonium* on root and shoot length of *Dactylis glomerata*, *Lolium perenne* and *Rumex acetosa*.

Notable reduction was observed in internode length of Sammaz-39 at high concentration (100%) of *D. stramonium* leaf extract. Oba super-06 on the other hand showed no significant difference in internode length of the treatment groups and the control (Figure 1). Reduction in internode length maybe as a result of reduced cell division caused by the allelopathic effect of *D. stramonium*. This result is in conformity with reports of Sakadzo *et al.* (2018) who reported a decrease in the shoot length of *Amaranthus hybridus* treated with *D. stramunium* leaf extract.

## CONCLUSION

Conclusively, aqueous leaf extract of *D. stramonium* enhanced plant height and root development in the maize plant varieties examined at 50% concentration but at higher concentration of 100%, the extract retards root length; this indicated that 50% is the optimum concentration to enhance beneficial trait in maize plant. This study also revealed the inhibitory effects of aqueous leaf extract of *D. stramonium* on number of leaves per plant, leaf length and internode length. However, there is need for further research and observation on the effects of *D. stramonium* on other traits like the yield attributes of the crop.

**Table 1:** Effect of *D. stramonium* leaf extract on plant height of maize

| Treatment | 2WAP | 4WAP | 6WAP | 8WAP | 10WAP |
|---|---|---|---|---|---|
| **SAMMAZ-39** | | | | | |
| Control | 24.53±2.07$^{ab}$ | 53.67±3.46$^{ab}$ | 73.93±2.83$^{a}$ | 98.07±3.32$^{ab}$ | 108.70±6.53$^{a}$ |
| 100% | 24.00±4.87$^{ab}$ | 63.00±8.68$^{b}$ | 84.47±1.70$^{b}$ | 109.13±9.77$^{b}$ | 137.20±11.79$^{b}$ |
| 50% | 27.17±3.40$^{b}$ | 59.90±6.77$^{ab}$ | 83.77±7.29$^{ab}$ | 102.67±4.82$^{ab}$ | 141.73±6.92$^{b}$ |
| 25% | 20.70±2.86$^{a}$ | 52.13±13.48$^{a}$ | 76.00±19.92$^{a}$ | 94.13±26.04$^{a}$ | 116.90±29.89$^{a}$ |
| Total | 24.1 | 56.68 | 79.54 | 101 | 126.13 |
| **OBA SUPER-06** | | | | | |
| Control | 22.43±3.65$^{ab}$ | 54.00±2.75$^{a}$ | 80.40±9.76$^{b}$ | 104.27±13.92$^{ab}$ | 127.70±13.40$^{b}$ |
| 100% | 18.77±1.78$^{a}$ | 46.70±2.26$^{a}$ | 69.00±5.13$^{a}$ | 92.03±5.30$^{a}$ | 110.40±9.87$^{a}$ |
| 50% | 20.93±3.70$^{ab}$ | 48.17±2.83$^{a}$ | 79.77±10.24$^{b}$ | 109.53±16.03$^{ab}$ | 132.63±14.96$^{b}$ |
| 25% | 24.17±2.72$^{ab}$ | 48.57±3.93$^{a}$ | 69.17±7.70$^{a}$ | 93.50±10.58$^{a}$ | 114.23±14.54$^{a}$ |
| Total | 21.58 | 49.36 | 74.59 | 99.83 | 121.24 |

Values are means ± SE of means, values along the same column with different superscripts are significantly different at ($P<0.05$) tested by DMRT

**Table 2:** Effect of *D. stramonium* leaf extract on number of leaves per plant

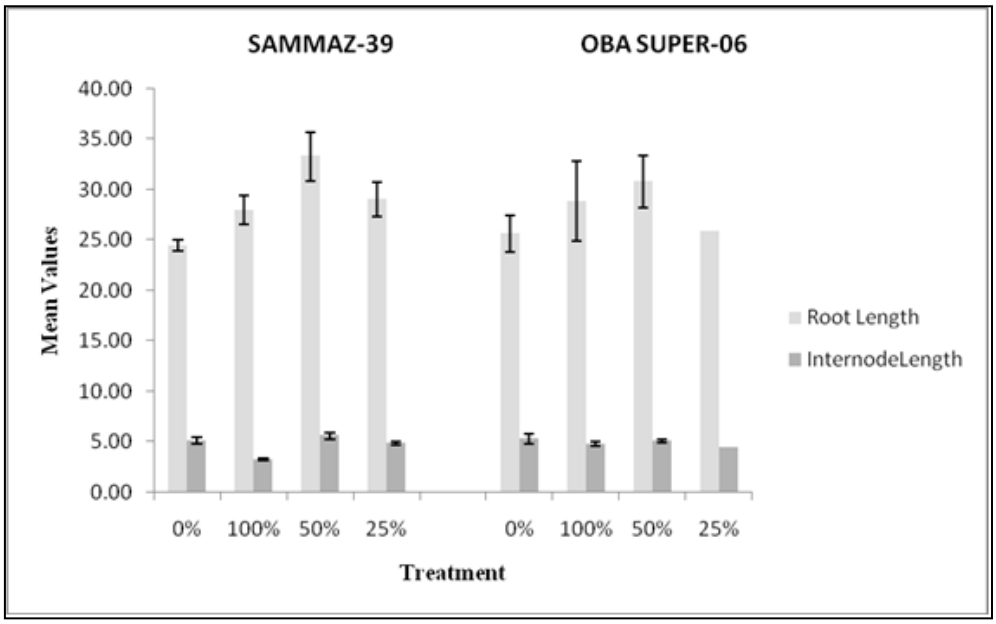
| Treatment | 2WAP | 4WAP | 6WAP | 8WAP | 10WAP |
|---|---|---|---|---|---|
| **SAMMAZ-39** | | | | | |
| Control | 7.00±5.80$^{a}$ | 9.33±0.67$^{a}$ | 11.67±0.33$^{a}$ | 13.33±0.67$^{a}$ | 16.67±0.33$^{b}$ |
| 100% | 6.33±0.33$^{a}$ | 10.00±0.00$^{a}$ | 12.33±0.67$^{a}$ | 14.67±0.88$^{a}$ | 15.00±0.58$^{a}$ |
| 50% | 6.67±0.33$^{a}$ | 10.00±0.00$^{a}$ | 12.67±0.88$^{a}$ | 15.33±0.88$^{b}$ | 16.67±0.88$^{b}$ |
| 25% | 7.00±0.58$^{a}$ | 9.67±0.67$^{a}$ | 12.00±1.00$^{a}$ | 15.00±1.15$^{b}$ | 16.00±0.58$^{b}$ |
| Total | 6.73 | 9.75 | 12.17 | 14.58 | 16.08 |
| **OBA SUPER-06** | | | | | |
| Control | 6.33±0.88$^{a}$ | 9.00±0.58$^{a}$ | 11.67±1.20$^{a}$ | 14.67±1.20$^{b}$ | 16.00±1.00$^{a}$ |
| 100% | 6.33±0.67$^{a}$ | 9.00±0.58$^{a}$ | 11.67±0.88$^{a}$ | 14.33±0.88$^{b}$ | 15.00±1.00$^{a}$ |
| 50% | 6.67±0.33$^{a}$ | 9.33±0.33$^{a}$ | 11.33±0.33$^{a}$ | 13.67±0.88$^{a}$ | 15.67±0.33$^{a}$ |
| 25% | 7.00±0.58$^{ab}$ | 9.33±0.67$^{a}$ | 10.67±0.88$^{a}$ | 14.00±1.00$^{b}$ | 15.33±0.88$^{a}$ |
| Total | 6.58 | 9.17 | 11.33 | 14.17 | 15.50 |

Values are means ± SE of means, values along the same column with different superscripts are significantly different at (P<0.05) tested by DMRT

**Table 3**: Effect of *D. stramonium* leaf extract on leaf length

| Treatment | 2WAP | 4WAP | 6WAP | 8WAP | 10WAP |
|---|---|---|---|---|---|
| **SAMMAZ-39** | | | | | |
| Control | 30.97±1.59[a] | 55.53±3.10[a] | 65.30±4.23[a] | 68.40±3.71[ab] | 68.00±3.44[b] |
| 100% | 29.23±6.32[a] | 53.40±5.98[a] | 68.77±9.17[a] | 69.17±6.90[b] | 67.03±3.72[a] |
| 50% | 29.87±1.76[a] | 55.63±3.58[a] | 63.57±5.37[a] | 67.03±3.96[a] | 67.50±3.08[a] |
| 25% | 29.30±3.91[a] | 58.30±6.52[a] | 69.33±9.86[a] | 70.73±4.41[c] | 66.57±4.12[a] |
| Total | 29.84 | 55.72 | 66.74 | 68.83 | 67.28 |
| **OBA SUPER-06** | | | | | |
| Control | 26.80±3.44[a] | 54.73±7.54[a] | 61.13±5.97[a] | 65.67±3.62[a] | 70.70±3.46[b] |
| 100% | 28.17±2.92[a] | 50.70±5.37[a] | 67.30±4.24[b] | 66.33±3.28[a] | 65.13±4.00[a] |
| 50% | 29.13±3.67[a] | 53.73±1.28[a] | 60.43±4.68[a] | 65.43±2.11[a] | 69.13±4.26[a] |
| 25% | 34.53±2.75[b] | 58.57±4.72[b] | 67.60±3.91[b] | 70.00±2.51[b] | 68.73±2.98[a] |
| Total | 29.66 | 54.43 | 64.12 | 66.86 | 68.42 |

Values are means ± SE of means, values along the same column with different superscripts are significantly different at (P<0.05) tested by DMRT




**Figures 1:** Effect of *D. stramonium* leaf extract on root and internode length of maize

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