INFLUENCE OF EXOGENOUS APPLICATION OF SALICYLIC ACID ON GROWTH AND FRUIT YIELD OF CUCUMBER (*Cucumis sativus* L)

Abstract:

The study determined the effect of foliar application rate of salicylic acid on growth and fruit yield of cucumber varieties with the aim of evaluating the effect of foliar application rate of salicylic acid on growth and fruit yield of cucumber varieties.

The study was conducted at Osun State College of Technology, Esa-Oke, Teaching and Research Farm between April and May, 2022. The experimental design was 2 x 3 factorial arrangements. The treatments consist of two cucumber varieties: Seminis and Olive Bold with three levels of salicylic acid (0, 50 and 100 ppm) application. Seeds of cucumber were sowed at 2 seeds per hole at 50 cm apart of intra and inter rows. Salicylic acid at 0 ppm, 50 ppm and 100 ppm were applied to the plant foliage at 3 and 5 weeks after sowing (WAS). Data were collected on growth parameters, number of fruit, fruit length, diameter and yield. Data obtained were subjected to analysis of variance (ANOVA) using statistical analysis system (SAS, 2003) version 9.1 while means were separated using Fisher's Least Significant Difference at 0.01 and 0.05 probability.

The results showed that foliar application rate of salicylic acid at 100 ppm resulted in longest ($P < 0.05$) vine length (109.27 cm), tendril length (18.50 cm), cucumber yield (9.89 kg/ha) and number of leaf (14.34) compared with 50 ppm and 0 ppm (control). The control gave the poorest cucumber yield (6.23 kg/ha).

The study concluded that foliar application of salicylic acid could be used to achieve effective growth and better fruit yield of cucumber.

Keywords: Cucumber, Salicylic, Seminis, Olive Bold, Foliar**,** Yield.

1.0 Introduction

Cucumber (*Cucumis sativus Linn*) is one of the major vegetable crops cultivated in the temperate and sub-tropical zones of the world (Ibeawuchi *et al.*, 2008; El-Wanis *et al.*, 2012). It originated from Northern India and belongs to the gourd family *Cucurbitaceae* . Worldwide, Cucumber has been ranked fourth among the most cultivated vegetable after tomatoes, cabbage and onions (Wehner, 2007) and China led the production of cucumber with a harvest of 72.78 millon tonnes

UNDER PEER REVIEW

accounting for almost 80 % of the total world production of cucumber followed by Turkey, Russia and Iran (FAOSTAT, 2020). Mali was noted as the largest producer of cucumber with harvest of 98,751 tonnes (Ekwu, 2007).

Cucumber fruits are often eaten raw and used industrially in the manufacture of different cosmetics like perfumes, creams, soap and pesticides as a result of the presence of steroid content (Wang *et al.*, 2007). It also relaxes nerves, muscles and keeps blood circulating smoothly due to presence of magnesium in cucumber fruits (Philip, 2010). Due to its high water content, cucumber fruit is highly diuretic and removed accumulated pockets of old waste materials and chemicals toxin. The fleshy part of the fruit contains ascorbic acid and caffeic acid, which help to relief skin irritations and decreased swelling (Okonmah, 2011).

The main stem of cucumber plant are rough, succulent, hairy and climbing, trailing or creeping and is often grown on frames or trellises. When begins growing, it is erect but soon after assumes a prostrate trailing habit and grows like a vine over the ground (Ajibola and Amojoyegbe, 2019).

Under long days and high light intensities male (staminate) flowers predominate, whereas under short days and low light intensities female (pistillate) flowers predominate (Choudhari *et al.*, 2002). Like that of other *cucurbitaceae*, when matured, cucumber fruit is noted for its high water content, which is around 95-96 % of its fresh weight (Ajibola and Amojoyegbe, 2019).

Plant growth hormones controls almost every aspect of plant growth and development, including cell division, elongation and differentiation with important on the final shape and plant cell (Stutte and Davis, 2003). Also, it involved in many physiological processes such as banning of pre harvest fruit drop, fruit inducement and increased the yield of fruit crops (Melissa and Nina, 2005)

Salicylic acid is plant phenolic compound acts a key role in regulating plant physiological processes such as photosynthesis, ion uptake growth, biosynthesis (Ashraf *et al*., 2010). Inducement of stomatal closure, improvement of carbohydrate and nitrate reductase activity in was triggered by the low exogenous concentration of salicylic acid is plant and this may increase crop yield (Rivas-san, Vicente and Plasencia, 2011, Fariduddin *et al.*, 2003).

Low yield of the crop has been attributed to the lack of cultural practice information from the peasant farmers and agronomical problems such as water and salt stress, flower abortion and these resulted to limited fruit setting.

UNDER PEER REVIEW

Since salicylic acid has enhanced plant growth attribute under water stress and modulate several physiological and biochemical processes in plant (Tahereh *et al.*, 2014 and Hayat *et al.*, 2010). The study however determined the effect of foliar application rate of salicylic acid on growth and fruit yield of cucumber plant.

2.0 Materials and methods

2.1 The study site

The study was conducted at Teaching and Research Farm of the Osun State College of Technology, Esa-Oke, Nigeria between April and May, 2022. Esa-Oke is a city situated within the forest savannah transition zone of Southwest Nigeria on latitude $07^0$45'N and Longitude $04^0$53'E at an elevation of about 578 m above sea level. The rainfall pattern is bimodal with peaks in July and September of each year and within the range of 1000 -1240 mm resulting in two seasons of early (March – July) and late (August–November) seasons with slight irregularities in rainfall distribution.

2.2 Experimental design

The experiment was set up on 2 x 3 factorial arrangements in Randomized Complete Block Design. The treatments were two varieties of cucumber (Seminis and Olive Bold), and three levels of Salicylic acid (0 ppm, 50 ppm, and 100 ppm). The plot size measured 2 x 3 m, and each plot was separated from other by 1 m path.

2.3 Land Preparation and Field Management

The field plot was prepared manually using cutlass and hoe. Cucumber seed (Seminis and Olive Bold) was sown at 0.5 m intra row and inter row spacing. At 3rd and 4th week after sowing (WAS), salicylic acid at 0 ppm, 50 ppm and 100 ppm was applied by foliar method to the cucumber plant and manual weeding was done by hoeing regularly.

2.4 Data collection and statistical analyses

The vine length, vine diameter, tendril length were measured and leaves area was determined at 4 and 6 week after sowing (WAS) while number of leaves, number of branch and number of tendril were countered at 4 and 6 week after sowing (WAS). Days to first flowering was taken as the day the first flower was observed on 50 % of plants per plot. Number of fruit was counted, fruit length, fruit weight and fruit diameter were measured at harvest and fruit yield

UNDER PEER REVIEW

per hectare was determined using the formula of Oloyede *et al. (*2013). The data collected were subjected to descriptive and quantitative analysis using analyses of variance (ANOVA) of (SAS, 2003). Means of significant treatments were separated using the Fisher's Least Significant Difference at 0.05 probability level (Steel and Torrie, 1987)**.**

3.0 Results and Discussion

The Table 1 below shows the effect of cucumber varieties on vine length, vine diameter and tendril length. The Seminis variety of cucumber produced the longest vine length (64.18 cm) while compared with Olive Bold with vine length (59.22 cm). This implies that the vine of Seminis variety of cucumber increased by 87.83 % than Olive Bold cucumber variety. The vine diameter of Seminis variety was wider (4.21 cm) than Olive Bold (3.89 cm) with 92.39 %. Similarly, Seminis had the longest tendril length (11.43 cm) than that of Olive Bold (9.76 cm) with 67.12 %. The significant differences in the morphological characters of cucumber varieties may be due to genetic variability in those cucumber varieties which was in accordance with the findings of Golabadi and Golkar (2012) who reported that variation in cucumber could be due to seasons and varieties for almost all traits except fruit girth.

Table 2 shows the influence of foliar application rate of salicylic acid on vine length, tendril length and number of leaf. The foliar application rate of 100 ppm of salicylic acid resulted in longest vine length (109.27 cm) as well as tendril length (18.50 cm) and number of leaf (14.34) compared with 50 ppm and 0 ppm (control). While compared with 0 ppm (control) and 50 ppm of salicylic acid applied to cucumber plants, 100 ppm increased the vine length by 33.62 %, Tendril length by 7.84 % and number of leaf by 18.34 % respectively. This compound had been proved to increase the length, weight (Gutierrez-Coronado *et al.,* 1998, Larque- Searedra *et al.,* 2010) and modify the plant morphology (Echerama –Machado *et al.,* 2007). This indicated that, the morphological attributes of cucumber plant can be achieved with the application of 100 ppm of salicylic acid, thus suggesting that application below 100 ppm of salicylic acid may not enhance the growth of cucumber. This was in support of research of (Anwar *et al.,* 2013), that foliar application of salicylic acid can improve the growth attributes of rice. The study therefore suggests that cucumber plant may require 100 ppm of salicylic acid for its growth.

Early flowering and maturity was influenced by variety of cucumber. For instance, Seminis variety matured early (29.87 days) and (31.64 days) than Olive Bold (30.18 days) and (32.73

UNDER PEER REVIEW

days) respectively (Table 3). The significantly differences in the flowering and maturity traits of cucumber varieties may be as a result genetic variability in those cucumber varieties.

The foliar application rate effect of salicylic acid gave excellent flowering and fruiting as shown in Table 4. The foliar application rate of 100 ppm of salicylic acid resulted in early flowering (18.22 days) and days to 50 % and 95 %maturity (24.16 and 27.68 days respectively). Salicylic acid was reported as a substance like plant hormone that keying in to the regulation of several physiological processes in plant as flowering (Anwar *et al.*, 2013).

The response of cucumber varieties to fruit attributes is presented in Table 5. The variety did not significantly affect the fruit weight; however, the number of fruit of cucumber, fruit length and yield were significantly improved by varieties. In addition, the highest number of cucumber fruit (15), longest fruit length (18.31 cm) and best fruit yield (6.42 kg/ha) were obtained from the Olive Bold cucumber variety compared with Seminis cucumber variety.

Considering the interaction effect of concentration of salicylic acid and cucumber varieties on fruit yield parameters is presented in Table 6. The concentration of 100 ppm of salicylic acid greatly improved the fruit weight (1.24 kg) and fruit yield (7.02 kg/ha) of Seminis variety. The number of fruit (16.04) obtained from the 100 ppm of salicylic acid in Olive Bold variety was higher than the Seminis variety. Cesar *et al.*, (2017) reported in their work, that the fresh and dry weight of the roots, shoots and grain yield of rice increased with foliar application of salicylic acid.

Conclusion

The study concluded that varietal effect influenced growth characters in Seminis cucumber variety; vine length, vine diameter, tendril length and early maturity and 100 ppm foliar application rate of salicylic acid enhanced the growth attribute of cucumber varieties. Similarly, Seminis cucumber variety produced excellent fruit diameter, fruit length, fruit weight and yield except the number of fruit that was higher in Olive Bold cucumber variety with the foliar application rate of 100 ppm of salicylic acid.

UNDER PEER REVIEW

Table 1: Effect of cucumber varieties on vine length, vine diameter and tendril length

Varieties	Vine length (cm)	Vine diameter (cm)	Tendril length(cm)
Seminis	64.18	4.21	11.43
Olive Bold	59.22	3.89	10.76
$LSD_{0.05}$	1.25	0.31	0.40

LSD: Least significant different

Table 2: Influence of foliar application rate of salicylic acid on vine length and tendril length

Salicylic acid (ppm)	Vine length (cm)	Tendril length (cm)	Number of leaf
0	61.09	12.67	9.41
50	97.82	14.12	12.04
100	109.27	18.50	14.34
$LSD_{0.05}$	3.42	1.91	1.06

LSD: Least significant different, PPM: Part per million

Table 3: Effect of cucumber varieties on days to 50% flowering, days to 50% maturity and days to 95% maturity

Varieties	D50%F	D50%M	D95%M
Seminis	21.12	29.87	31.64
Olive Bold	23.53	30.18	32.73
$LSD_{0.05}$	0.02	0.04	0.01

LSD: Least significant different, PPM: Part per million, D50%F: Day to 50% Flowering, D50%M: Day to 50 %Maturity, and D50%M: Day to 95 %Maturity.

UNDER PEER REVIEW

Table 4: Influence of foliar application rate of salicylic acid on days to 50% flowering, days to 50% maturity and days to 95% maturity

Salicylic acid (ppm)	D50%F	D50%M	D95%M
0	20.18	27.04	30.09
50	18.89	25.87	29.07
100	18.22	24.16	27.68
$LSD_{0.05}$	0.02	0.01	0.02

LSD: Least significant different, PPM: Part per million, D50%F: Day to 50% Flowering, D50%M: Day to 50 %Maturity, and D50%M: Day to 95 %Maturity

Table 5: Response of cucumber varieties to number of fruit, fruit length and fruit yield

Varieties	Number of fruit	Fruit length (cm)	Fruit yield (kg/ha)
Seminis	12	16.02	4.21
Olive Bold	15	18.31	5.45
$LSD_{0.05}$	0.23	0.89	0.46

LSD: Least significant different.

Table 6: The interaction effect of variety and salicylic acid on number of fruit, fruit weight and fruit yield as influenced by concentration of salicylic acid

Treatment	Seminis			Olive Bold		
Salicylic acid (ppm)	Number of fruit	Fruit weight (kg)	Fruit yield (kg/ha)	Number of fruit	Fruit weight (kg)	Fruit yield (kg/ha)
0	15.31	0.06	5.23	16.04	0.08	5.31
50	18.44	0.91	5.90	17.06	1.03	6.11

UNDER PEER REVIEW

100	21.75	1.24	7.02	18.12	1.56	7.92
$LSD_{0.05}$	1.45	0.07	0.95	1.11	0.05	0.83

LSD: Least significant different, PPM: Part per million, SA: **salicylic acid, kg/ha: kilogram per hectare**

References

Anwar, S., Iqbal, M., Raza, H.,and Iqbal N (2013). Efficacy of seed preconditioning with salicylic and ascorbic acid in increasing vigor of rice (Oryza sativa L) Seedling. *Parkistan Journal of Botany* 45: 157 -162.

Ajibola O.V., and Amujoyegbe B. J. (2019). Effect of seasons, mulching materials, and fruit quality on a cucumber (*Cucumis sativus* L.) variety. *Asian Journal of Agriculture and Horticulture Research*, 2019, pp 182- 187.

Cesar,T.H., Gabriel, A.G., Libia, T.T, Hugo, V. H., Yolanda, S.M., and Alfonso,L.S.,(2017). Effects of salicylic on growth, nutritional status and performance of maize (*Zea mays*).

Choudhari, S. M., and More, T. A, (2002). Fertigation, fertilizer and spacing requirement of tropical gynoecious cucumber hybrids. *International Society for Horticultural Sciences.*, 588: 233-240.

Echerama, M. I., Escobedo, G. M.,and Larque, A. S (2007): Responses of transformed Catharanthus roseus roots to femtomolar concentrations of salicylic acid. Plant Physiology and Biochemistry.45:501 – 507.

Ekwu, L. G., (2007). Vegetative and Yield Response of Cucumber (*Cucumis sativus* L.) to Staking and Nitrogen Fertilizer Application. *Journal of Applied Sciences*, 19(4): 7509-7519.

El-Wanis, A., Mona, M., Abdel- Bakey, M. H., and Salman, S. R., (2012). Effect of grafting and salt stress on the growth, yield and quality of cucumber growth in NFT system. *Journal of Applied Science Research*. 8 (10): 5059-5067

Fariduddin, Q., Hayat S.,and Ahmad A (2003): Salicylic acid influences net photosynthetic rate carboxylation efficiency, nitrate reductase activity, and seed yield in *Brassica juncea*. Photosynthetica 41: 281 – 284

UNDER PEER REVIEW

Ibeawuchi, I. I., Iheoma, O. R., Obilo, O. P., and Obiefuna, J. C., (2008). Effect of time mulch application on the growth and yield of cucumber (*Cucumis sativus* L.) in Owerri, Southeastern Nigeria, *Life Science Journal*, 5(1): 68 -71.

Gutierrerz-Coronado, M. A., Trejo-Lopez, C and Larque-Saavedra A (1998): Effects of salicylic on the growth of roots and shoots in soybean. *Plant Physiology and Biochemistry*, 36: 563 - 565.

Hayat, Q., Hayat, S, Irfan M and Ahmad A (2010). Effect of Salicylic acid on growth under changing environment. *A review Environment Experimental Biology*, 68: 14-25.

Golabadi, M and Golkar P (2012). Assessment of genetic variation in cucumber (*Cucumis sativus* L.) genotype. *European Journal of Experimental Biology*, 2(3): 826-831.

Okonmah, L. U., (2011). Effects of different types of staking and their cost effectiveness on the growth, yield and yield components of cucumber (*Cucumis sativus* L.). *International. Journal of Agricultural Science*, 1 (5) : 290-295.

Oloyede, F. M., Agbaje, G. O., and Obisesan, I. O., (2013). Effect of NPK fertilizer on fruit yield components of pumpkin (*Curcurbita pepo* L.). *African Journal of Food Agriculture Nutrition and Development*, 13(3):7755-7771.

Philip, (2010). The importance of minerals in the long term health of humans, pp.13-16.

SAS (Statistical Analysis System) Version 9.1. SAS Institute Inc., Cary,NC. 2003.

Steel, R. G. D., and Torrie, J. H., (1987). Principles and Procedures of Statistics. Mc Graw-Hill Book Co. Int. New York, 276 pp.

Wang, Y. H., Joobeur, T., Dean, R. A and Staub, J. E, (2007). Genome mapping, molecular markers and genetic engineering for cucurbit improvement in : Kole, C. Plants. 5, 315-324.

Wehner, T. C., (2007). Cucumbers, watermelon, squash and other cucurbits. In: *Encyclopedia of Food Culture*, pp 474-479.

UNDER PEER REVIEW