http://dx.doi.org/10.22161/ijeab/4.2.23 *ISSN: 2456-1878*

Effect of Nitrobenzene on Sweet Cucumber *(Cucumis sativus* L.*)* Yield and Yield Quality under Green House Condition

Shyamalee Kohombange[1*], J.P.Eeswara[1], Nandun Rathnasekara[2]

[1]Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka
[2]Epsilon Crest Research, 6/6, 67, Ward Place, Colombo 07, Sri Lanka
*Corresponding author

***Abstract* —** *Sweet cucumber (Cucumis sativus L.) is one of the most important vegetable crops grown extensively throughout the world especially in the temperate countries. Poor fruit-set was believed to be one of the major barriers to the tropical adaptation of sweet cucumber. Nitrobenzene is a combination of nitrogen and plant growth regulators, extracted from sea weeds that act as plant energizer, flowering stimulant and yield booster in crop production. The objectives of the present study were to examine the effect of nitrobenzene on sweet cucumber yield to evaluate the optimum dose of nitrobenzene for economically better yield. The study was conducted at a farmer poly tunnel located in Athgala (WU1). The experiment was laid out in a Completely Randomize Design (CRD) with four treatments randomized in three replicates. The treatments were T_1 – Control (without Nitrobenzene), T_2 – Nitrobenzene 10%, T_3 – Nitrobenzene 15%, T_4 – Nitrobenzene 20%. Plants were established in drip-fertigated bags in the Poly tunnel and standard crop management practices were done throughout the study. Nitrobenzene was sprayed to the seedlings 20 and 35 days after sowing. Albert solution, 6: 30: 30 fertilizer mixture 20: 20 fertilizer mixture and $Ca(NO_3)_2$ were used as recommended fertilizers. Measurements were taken on growth, flowering, Fruit setting and postharvest stages. The data obtained were subjected to the Analysis of Variance (ANOVA) procedure of Statistical Analysis System (SAS) 9.1. Duncan's New Multiple Range Test (DNMRT) was performed to compare the differences among treatment means at p=0.05. The highest values of plant growth parameters, reproductive parameters, yield parameters and postharvest parameters were observed in T4, i.e. 20% Nitrobenzene applied treatments. On the other hand the lowest values were recorded from T1 (control of the experiment). Specially, advanced flowering and fruit setting, number of flowers per plant and total yield per plant were recorded from T4, i.e. 20% Nitrobenzene applied treatments. So, 20% nitrobenzene applied plants showed superior results in contrast to other nitrobenzene levels with enhancing flowering, fruit setting, yield qualities as well as postharvest performances.*

***Keywords*— Sweet cucumber, Nitrobenzene concentrations, Flowering, Fruit setting, Poly tunnel.**

I. INTRODUCTION

Cucumber *(Cucumis sativus* L.) is an important vegetable and one of the most popular members of the family Cucurbitaceae [1]. It is a sub-tropical vegetable crop that grows successfully under conditions of high light, high humidity, high soil moisture, temperature and fertilizers in green-houses[2]. However, greenhouse cucumber farmers often encounter problems regarding the agronomy of the crop due to existing gaps in the local knowledge base. Cucumber demands high temperatures and soil moisture for satisfactory yield. An unfavorable climatic conditions cause problems, such as the reduction of female flowers [3], delay in fruit growth [4] and mineral disorders [5] reduced the quality and quantity of the yield. Premature fruit yellowing or light-coloured fruit is associated with low nitrogen (low EC), high temperatures, over-maturity, low light levels and high humidity (low vapour pressure deficit). Increasing the amount of light reaching the fruit, reducing the number of fruit per plant and increasing the concentration of fertilizer in the nutrient solution, may help to reduce the incidence of fruit yellowing [8]. Nitrobenzene is a combination of nitrogen and plant growth regulators, extracted from sea weeds that act as plant energizer, flowering stimulant and yield booster [7]. Nitrobenzene produces best results in combination with plant growth regulators, which have capacity to increase flowering in plant and also prevent flower shedding. It is specially recommended for vegetable crops and flowering plants [8]. Nitrobenzene 20% w/w is a new generation plant energizer and yield booster of low cost

http://dx.doi.org/10.22161/ijeab/4.2.23 *ISSN: 2456-1878*

PGRs compared to others. Nitrobenzene is quickly absorbed into the plants. It influences the bio chemical pathway of the plants to uptake more nutrients from the soil. It also increases the nutrient use efficiency thus improves the vegetative growth. Induces profuse flowering and helps in the retention of the flowers and fruits [9]. On the other hand, Nitrobenzene improves the organoleptic factors and keeping quality of the produce, which increases the harvestable yield of any crops [10]. As a further improvement step for greenhouse fruit set of sweet cucumber, Nitrobenzene can be adopted. Four sprays of nitrobenzene during 40, 55, 80 and 105 days after sowing (DAS) improve the yield up to 40% (Jeyakumar, 2005). Unfortunately, very limited researches have been carried out regarding the use of nitrobenzene on sweet cucumber varieties in Sri Lanka. Therefore, this research was designed to study the effect of nitrobenzene on sweet cucumber yield and the quality. Furthermore it was expected to assess the most effective nitrobenzene concentration to reduce cost of production in order to improve the profit.

II. MATERIALS AND METHODS

1.1 Experimental design and treatments

The experiment was laid out in a Completely Randomize Design (CRD) with four treatments randomized in three replicates. Here we used commercially available "Bloom Flower- 20% Nitrobenzene] solution. The treatments were four different concentrations of Nitrobenzene (%) applied to the seedlings to cover whole aerial parts of the plant as an aqueous spray by using a hand sprayer as given below.

Treatment	Nitrobenzene levels (%)
T1	Control (without Nitrobenzene)
T2	Nitrobenzene 10%
T3	Nitrobenzene 15%
T4	Nitrobenzene 20%

Planting materials and handling

The study was conducted at a farmer Poly tunnel located in Athgala (WU1- Wet Zone area in Up country), Sri Lanka. Plants were established in drip-fertigated bags in the Poly tunnel and standard crop management practices were done throughout the study. Nitrobenzene was sprayed at two weeks intervals after transplanting of seedlings in pots. Albert solution, 6: 30: 30 fertilizer mixture and Ca $(NO_3)_2$ were used as recommended fertilizers.

1.3 Measurements

Data were collected at one week intervals after first spraying. Measurements were taken on growth, yield and yield determining parameters with postharvest quality. Sweet cucumbers were harvested at an immature stage when they are in full size and green. The total yield per plant was measured directly in the field by using a digital balance with four digits. Ten fruits were selected randomly from each treatment and kept in normal environmental conditions and at the same time remaining five fruit samples were kept in refrigerator to determine the shelf life (days). At the same time weight loss was recorded at five days intervals by using a digital balance.

1.4 Statistical analysis

The data obtained were tabulated and analyzed subjected to the Analysis of Variance (ANOVA) procedure of Statistical Analysis System (SAS)9.1. Duncan's New Multiple Range Test (DNMRT) was performed to compare the differences among treatment means at p=0.05.

III. RESULTS AND DISCUSSION

3.1 Evaluation of plant growth parameters

Among different treatments tested the plant height, plant girth and leaf area index did not show any significant differences ($p>0.05$) between T2, T3 and T4, i.e. 10%, 15% and 20% Nitrobenzene applied treatments. However, control treatment showed the lowest values. On the other hand, the highest number of leaves per plant and number of flowers per plant was observed from the treatment T4, i.e. 20% Nitrobenzene applied treatment whilst the lowest number of flowers was observed from the control (Table 1). Nitrobenzene is a combination of plant growth regulators. So, the highest concentration of Auxin and Gibberellins is present in 20% of Nitrobenzene which influences the elongation of cells so that the plant height is increased dramatically. According to the study findings of Nickell [12] and Richard [13] that cell growth and elongation is influenced by Auxin and Gibberellins. Cytokinin and Auxin with higher ratios of Nitrobenzene influence the lateral growth of parenchyma cells in stem so that the plant girth was increased with higher concentrations of Nitrobenzene. The best concentration of Nitrobenzene is present in 20% Nitrobenzene which influence to increase flowering in plant, prevent flower shedding, enhance early flowering and plants take less time to flower so that the number of flowers is increased for the highest concentration of Nitrobenzene. The application of Nitrobenzene and their simultaneous transport to the auxiliary buds would have resulted in a better sink for the mobilization of photo-assimilates at a faster rate. This would have helped in the early transformation from the vegetative phase to reproductive

http://dx.doi.org/10.22161/ijeab/4.2.23 *ISSN: 2456-1878*

phase. The induction of early flower bud initiation might be influenced by triggering of such metabolic processes and narrowing of the carbon: nitrogen ratio by the significant accumulation of carbohydrates. The result on earliness in flowering in this experiment goes with the study findings of Singh and Mukherjee [14].

3.2 Evaluation of yield parameters

Among different treatment tested number of fruits per plant and total yield per plant show significant differences ($p>0.05$) between T1 and T4 i.e. control and 20% Nitrobenzene. This results showed, spraying growth regulator Nitrobenzene confirm maximum yield. Nitrobenzene is quickly absorbed into the plants, which has capacity to increase flowering in plants and maximum number of fruits per plant [9]. The highest yield per plant was recorded for 20% of nitrobenzene applied treatment and lowest yield per plant was recorded in control treatment. Nitrobenzene increase the fruit weight as well as bigger fruits is produced thus the total yield increase due to its application compare to control [15]. Nitrobenzene can be used as spray or in granular form, which increases flower forming substances by altering auxin, cytokinin, gibbrellic acid and Ethylene ratio favourably tilting to a higher level of flower forming substances, thereby increasing flowers by more than 40 to 45% and yield [16].

3.2 Evaluation of postharvest parameters

The highest shelf life in room temperature and refrigerator was recorded from T4, i.e. 20% Nitrobenzene applied treatment and lowest fruit weight was recorded from T1, i.e. control treatment. According to these results, nitrobenzene can extended the shelf life in room temperature conditions. The highest weight loss in room temperature was recorded from T1, i.e. control treatment and it has significantly difference among other treatments tested. On the other hand, there was no significant difference ($p>0.05$) among treatments T2, T3, T4, i.e. 10%, 15% and 20% Nitrobenzene. But, according to the mean values of weight loss in room temperature conditions showed 20% nitrobenzene decreased the weight loss of sweet cucumber and extended the postharvest qualities. There was no significant difference ($p>0.05$) among treatments on weight loss in refrigerator. But, average results show T4, i.e. 20% nitrobenzene applied treatment was decreased the weight loss in refrigerator and extended the postharvest qualities.

Table.1: Evaluation of plant growth parameters of sweet cucumber

Treatments	Plant height (cm)	Plant girth (cm)	Leaf Area Index	Number of leaves per plant
T1	157.55^{a}	3.60^{b}	0.67^{a}	23.52^{c}
T2	160.00^{a}	3.73^{ab}	0.68^{a}	24.22^{bc}
T3	164.53^{a}	3.85^{a}	0.69^{a}	24.92^{b}
T4	171.58^{a}	3.86^{a}	0.71^{a}	26.55^{a}

Note**:** Means followed by the same letter/s along the column are not significantly different at P=0.05

Table.2: Evaluation of plant reproductive parameters of sweet cucumber

Treatments	Number of days for flowering	Number of flowers per plant	Number of days for fruit setting	Number of fruits per plant
T1	28.33^{c}	5.88^{c}	33.33^{b}	23.33^{b}
T2	28.00^{ab}	6.97^{bc}	32.33^{a}	25.00^{ab}
T3	27.33^{b}	7.75^{b}	32.33^{a}	26.00^{ab}
T4	24.33^{a}	10.08^{a}	30.33^{a}	26.67^{a}

Note**:** Means followed by the same letter/s along the column are not significantly different at P=0.05

Table.3: Evaluation of yield parameters of sweet cucumber

Treatments	Total yield per plant (kg)	Fruit weight (g)	Fruit length (cm)	Fruit girth (cm)	Pericarp thickness (cm)
T1	4.66^{c}	207.0^{a}	17.6^{a}	13.68^{b}	9.4^{a}
T2	5.12^{bc}	210.4^{a}	17.7^{a}	13.84^{b}	9.5^{a}
T3	5.51^{ab}	212.0^{a}	17.8^{a}	14.10^{b}	9.8^{a}
T4	5.81^{a}	213.6^{a}	18.1^{a}	14.52^{a}	9.8^{a}

Note**:** Means followed by the same letter/s along the column are not significantly different at P=0.05

http://dx.doi.org/10.22161/ijeab/4.2.23 *ISSN: 2456-1878*

Table.4: Evaluation of postharvest parameters of sweet cucumber

Treatments	Refrigerator shelf life (days)	Room temperature shelf life (days)	Refrigerator weight loss (g)	Room temperature weight loss (g)
T1	18.2^{c}	7.0^{b}	20.2^{a}	72.0^{b}
T2	20.0^{b}	7.6^{b}	18.2^{a}	68.2^{a}
T3	20.6^{ab}	7.8^{b}	17.2^{a}	67.6^{a}
T4	21.4^{a}	8.6^{a}	17.2^{a}	66.2^{a}

Note**:** Means followed by the same letter/s along the column are not significantly different at P=0.05

IV. CONCLUSION

Results enumerated that the application of nitrobenzene had a significant ($p<0.05$) effect on growth, reproductive, yield and quality parameters of sweet cucumber. Nitrobenzene acts as a plant energizer, flowering stimulant and yield booster. Due to the more number of flowers it increases the yields by better quality of fruits. So, as a further improvement step for greenhouse fruit set of sweet cucumber, Nitrobenzene can be adopted. In the light of this situation application of 20% Nitrobenzene can be considered as an economically feasible treatment to get better yield from sweet cucumber under greenhouse condition. A long shelf life was observed in 20% Nitrobenzene applied treatment. Furthermore high Nitrobenzene levels showed a significant positive impact on postharvest quality of sweet cucumber with extending the shelf life.

REFERENCES

[1] Thoa DK (1998). *Cucumber seed multiplication and characterization*. AVRDC/ARC Training Thailand.

[2] El-Aidy, F., El-zawely, A., Hassan, N., El-sawy, M (2007). Effect of plastic tunnel size on production of cucumber in delta of Egypt. *Appl. Ecol. Environ. Res*. 5 (2), 11–24.

[3] Cantliffe, D.J (1981). Alteration of sex expression in cucumber due to changes in temperature, light intensity, and photoperiod. *Journal of the American Society of Horticultural Science,* Geneva 106 (2), 133–136.

[4] Medany, M.A., Wadid, M.M., Abou-Hadid, A.F (1999). Cucumber fruit growth rate in relation to climate. *Acta Horticulturae*, The Hague 486, 107–111.

[5] Bakker, J.C., Sonneveld, C (1988). Calcium deficiency of glasshouse cucumber as affected by environmental humidity and mineral nutrition. *Journal of Horticultural Science*, London 63 (2), 241–246.

[6] Janice Elmhirst (2006). *Crop Profile for Greenhouse Cucumbers in Canada*, Pesticide Risk Reduction Program Pest Management Centre Agriculture and Agri-Food Canada, 960 Carling Avenue, Building 57,Ottawa, Ontario, CANADA.

[7] Aziz MA, Miah MAM (2009). Effect of "Flora" on the Growth and Yield of Wetland *Rice. J Agric Rural Dev* 7: 9-13.

[8] Khalil S, Mandurah HM (1989). Growth and metabolic changes of Cowpea plants as affected by water deficiency and indole acetic acid. *J Agron Crop Sci* 163: 160-166.

[9] Mithila Deb, Sajal Roy, Imamul Huq SM (2012). Effects of nitrobenzene on growth of tomato plants and accumulation of Arsenic. *Bangladesh J Sci Res* 25: 43-52.

[10] Karim MF, Fattah QA (2004). Yield attributes and yield response of chickpea to nitrogen levels and Knap concentrations. *Bangladesh J Life Sci* 16:147-152.

[11] Jeyakumar, P. (2005). *Role of Growth Substances in Conservation Agriculture*. Department of Crop Physiology, Tamil Nadu University, Coimbatore-641 003.

[12] Nickell LG (1982). *Plant growth regulators, agricultural uses*. Springer-Verlag. Berlin, Heidelberg, New York.

[13] Pharis Richard P (1985). *Gibberellins and reproductive development in seed plants*. Plant Physiology Research Group, department of Biology. University of Calgary, Alberta, Canada.

[14] Singh, L. and Mukherjee, S. (2000). Agric. Sci. Digest, 20(2): 116-117.

[15] Singh K (2007). Effect of Low Poly-Tunnel on the Growth, Yield and Harvesting Span of Bell Pepper.

[16] Rathinasamy, Theenachandran (2005). Flowering stimulant composition using nitrobenzene. United States Patent Application 20050266997.