Ali, Z., Shahzad, H., Hussain, M., Mushtaq, S., Haider, M.S., & Shafiq, M. (2019). Combined effect of different doses of plant growth regulators (IBA and Zeatin) on the physiology of *Capsicum annum* L. fruit. World Journal of Biology and Biotechnology, 4(3), 11-14.
DOI: https:/doi.org/10.33865/wjb.004.03.0226

(Online) ISSN 2522-6754 | 2019 | (Print) ISSN 2522-6746
WORLD JOURNAL OF BIOLOGY AND BIOTECHNOLOGY
Volume: 4 | www.sciplatform.com | Issue: 3

COMBINED EFFECT OF PLANT GROWTH REGULATORS (IBA AND ZEATIN) ON PHYSIOLOGICAL PARAMETERS OF *Capsicum annum* L. FRUIT

Zain Ali, Habiba Shahzad, Mubasshir Hussain, Sehrish Mushtaq, Muhammad Saleem Haider, Muhammad Shafiq
Institute of Agriculture Sciences, University of the Punjab, Lahore, Pakistan.

ABSTRACT

Combined effect of two exogenously applied PGR i.e. IBA and Zeatin, on the fruit of *Capsicum annuum* L was assessed in a designed experiment. Plants were grown in pots with nine treatments and three replications. The treatments were comprised of T1-IBA 1000ppm+Zeatin 100ppm, T3-IBA 1000ppm+Zeatin 300ppm, T5-IBA 4000ppm+Zeatin 100ppm, T7-IBA 4000ppm+Zeatin 300ppm and T9-Control. T1, T3, T5, T7 were applied only at the time of floral buds emergence, whereas T2, T4, T6 and T8 were applied by dipping the floral buds during emergence and at the time of fruit development. The results showed that only T1 manifested enhance in photosynthetic pigments content i.e. chlorophyll a, chlorophyll b, total chlorophyll and carotenoids and its fruits showed Dark green color. The physical parameters of fruit remained unaffected by PGR's application.

Key word: Chilli fruit, IBA, zeatin, physical parameters, photosynthetic pigments.

*Corresponding email address: shafiq.iags@pu.edu.pk
Received: 11 July 2019 **Accepted: 19 August 2019**

INTRODUCTION

Capsicum annuum L belonging to family *Solanaceae* is a vegetable cum spice of notable importance in economy of Pakistan. Chilli is the third most produced vegetable in Pakistan (GOP, 2015-2016). It is grown extensively in many parts of the country because it has wide range of adaptability and can withstand heat and moderate cold. The fruits are available in market throughout the year and are mainly used in cuisine adding spiciness to the dishes and also have many medicinal uses and health benefits. Plant growth regulators (PGR's) are not only produced naturally by the plants but are also prepared artificially. Such artificially prepared plant growth regulators are known as synthetic PGR's. Synthetic PGR's are applied exogenously to the plants because of their many beneficiary roles regarding plant's growth and development. Many past Studies have focused on auxins and cytokinins entailing the assessment of various concentrations, formulations and treatments to examine the plant's response to their application.

Indole-3-butyric acid (IBA) belongs to the auxin-family of plant growth hormones with the chemical formula $C_{12}H_{13}NO_2$. IBA was first identified in maize (Babczinski and Fischer, 1991) is considered to be a precursor of indole-3-acetic acid (IAA) and the most excessively found natural auxin functioning in plant (Ludwig-Müller, 2000). IBA, a multifunctional plant growth regulator is prominent across the globe for the induction of adventitious roots and its diverse role in the growth development of plant. IBA stimulates the fruit growth and effects it's quality (Amin and Elsh, 2007). However in past research scientists has reported that IBA have significant effect on the photosynthetic pigments of plant (Amin and Elsh, 2007; Piotrowska-Niczyporuk and Bajguz, 2014). Zeatin, (6-[4-hydroxy-3-methyl-but-2-enylamino]adenine) having the chemical formula $C_{10}H_{13}N_5O$ is one of the most widely studied and common cytokinin in the world (Rattan and Sodagam, 2005). Zeatin was distinguished as the first genuinely existing cytokinin in immature maize endosperm (Letham, 1973) and abundantly found in coconut milk. Zeatin has provided impactful evidence in past research to play a significant role in improvement of the chlorophyll content and greening in plant. Zeatin also effects on fruit development (Hopping, 1976) and promotes cell division (Kieber, 2002). Its commonly used with Murashige and Skoog and other media and also helps in the induction of adventitious roots and shoots (Masekesa *et al.*, 2016). The effect of exogenously applied Zeatin has never been studied before on *C. annuum* L plant.

OBJECTIVES

This experiment was intended to examine the mutual effect of IBA and Zeatin, which has not been investigated previously, on the physical, morphological characteristics and the photosynthetic pigments of the fruit of *C. annuum* L. This is the first ever attempt which shows the results of application of combined doses of IBA and Zeatin specifically on the fruit of *C. annuum* L.

MATERIALS AND METHODS

The experiment was performed at the greenhouse of the Institute of Agricultural sciences, University of the Punjab, Lahore. Korean variety of *Capsicum annuum* L. was used in this experiment and was grown in the warm and humid climate at 26°C. The experiment was laid out following Completely Randomized Design (CRD). Nursery of the chilli seeds were sown in pots (9cm) containing 6 kg of mixed sandy loam soil. Each pot was fertilized by applying NPK @ 60, 30 and 25 mg kg-1 soil respectively at the time of seedlings transplantation while the second half dose of N was applied at the appearance of fruit buds. The plants were also irrigated at scheduled time to avoid drought and dehydration. The plants were given nine treatments and one chilli plant was maintained per pot. The treatments comprised of T1-IBA 1000ppm+Zeatin 100ppm, T3-IBA 1000ppm+Zeatin 300ppm, T5-IBA 4000ppm+Zeatin 100ppm, T7-IBA 4000ppm+Zeatin 300ppm and T9-control (Paul and Aditi, 2009). T1, T3, T5 and T7 were applied only at the time of floral buds emergence by dipping the buds separately in solutions for 5 sec and T2, T4, T6 and T8 having

the same concentration of solutions were applied first at the time of floral bud emergence and second by dipping the fruit when it started developing (again for 5 seconds), method followed by Hopping (1976). For T2, T4, T6 and T8 the interval of days between the first and the second time application was kept the same. The experiment was replicated three times. In control, the plants were only fertilized and irrigated and they were given the same amount of water as were given to other plants. All other agricultural practices were kept same for all plants throughout the period of plant growth till harvesting. The fruits were harvested when they attained their maximum size. After harvesting the effects of these treatments on the physical parameters (Fruit length, Fruit diameter, Fruit fresh and dry weight, No. of seeds, Fresh and Dry seeds weight) and the photosynthetic contents of the chilli fruit were studied. Chlorophyll (a & b), Total chlorophyll and the Carotenoid contents were measured as method described by Arnon (1949). The collected data from the experiment was analyzed statistically by using analysis of variance (ANOVA) and the means of the treatment were compared in accordance with least significant difference (LSD) at 5% level (Steel *et al.*, 1997) using computer based software; Statistix 8.1®.

RESULTS AND DISCUSSIONS

All the physical parameters of fruit which were studied *i.e.* fruit length, fruit diameter, fresh fruit weight, dry fruit weight, number of seeds, fresh seeds weight and dry seeds weight were found to be non-significant due to the exogenous application of combined doses of IBA and Zeatin as shown in (figures 1-6).

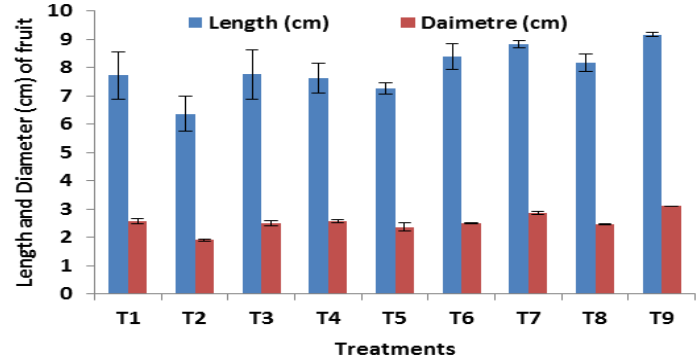

Figure 1: Physical parameters (length and diameter (cm) of chilli after application of plant growth regulators (IBA and Zeatin).

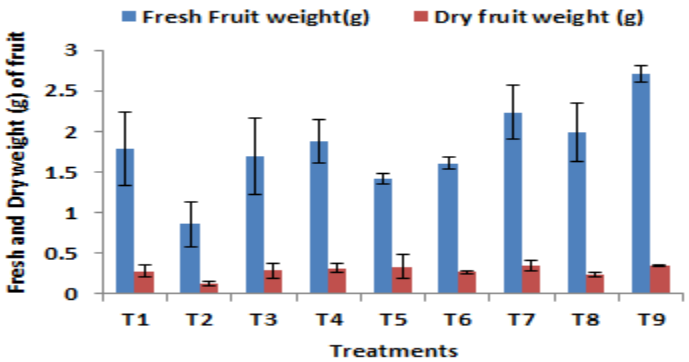

Figure 2: Fresh and dry fruit weight (g) of chilli after application of plant growth regulators (IBA and Zeatin).

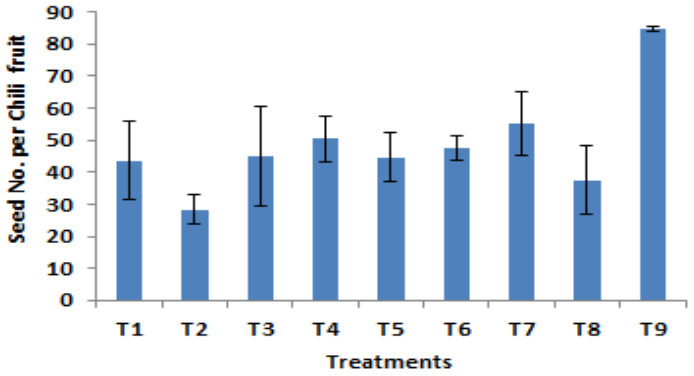

Figure 3: Seed numbers per fruit of chilli after application of plant growth regulators (IBA and Zeatin).

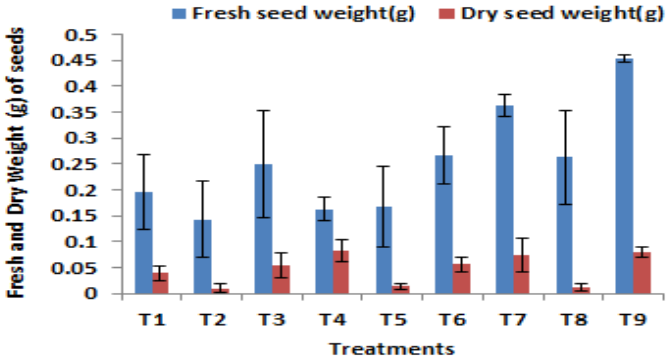

Figure 4: Fresh and dry weight (g) of seeds of chilli fruit after application of plant growth regulators (IBA and Zeatin).

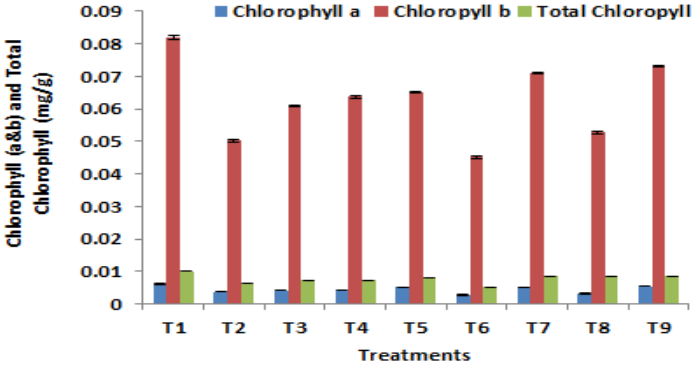

Figure 5: Chlorophyll a & b, total chlorophyll contents (mg/g) of chilli fruit after application of plant growth regulators (IBA and Zeatin).

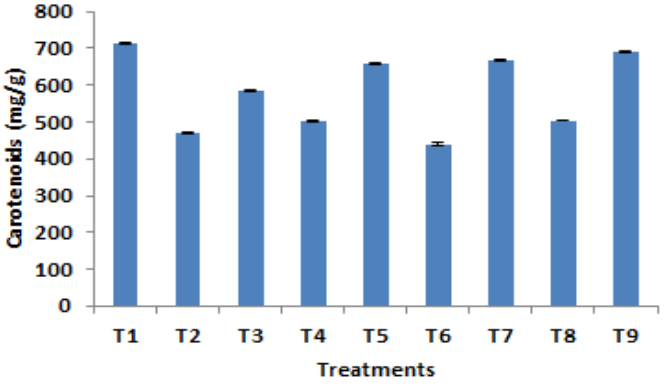

Figure 6: Carotenoid contents (mg/g) of chilli fruit after application of plant growth regulators (IBA and Zeatin).

Not any of the treatments showed a notable effect on the physical parameters of fruit. Generally talking about plant growth hormones, when they were applied exogenously, showed a prominent improvement in the physical attributes of the fruit of plant which in turn ensures the better fruit quality (Patel *et al.*, 2016). Same is true in case of IBA and Zeatin, when used separately or in combination with other plant growth hormones, as it is evident by the results of Amin and Elsh (2007) and Aliyu *et al.* (2011). But in our experiment these two hormones on combined application did not produce significant results. This might be due to the reason that these were applied in combination and plant shows different response when the hormones were used in combination as compared to when they are tested alone (Ludwig-Müller, 2000). Second reason could be the use of higher concentrations as Pierik and Steegmans (1975) use higher concentrations of IBA, NAA and reduced weight of Hyacinth bulblet were found. However, Aliyu *et al.* (2011) used less concentration of IBA and Zeatin which gives positive effects. The method of application of hormones *i.e.* dipping method could also be cause of such kind of outcome. Dipping method has been used by Hopping, (1976) where it has good effect on the fruit of Chinese gooseberry but it might have not worked good in case of chilli fruit. Foliar application of these hormones might have produced different results because this method is most commonly used (Ouzounidou *et al.*, 2010; Tamilselvi, 2014; Patel *et al.*, 2016). Unlike the results shown in case of physical parameters, a prominent effect of exogenously applied (IBA+Zeatin) on the photosynthetic pigments content *i.e.* chlorophyll a, chlorophyll b, total chlorophyll and carotenoids present in fruit of chilli were reported (table 1).

TR	CH a	CH b	Total CH	CAR content
T1	6.17 A	0.0820 A	0.01 A	715.16 A
T2	3.79 E	0.0502 H	6.28 E	470.90 G
T3	4.21 D	0.0610 F	7.28 D	585.01 E
T4	4.19 D	0.0638 E	7.38 D	502.81 F
T5	5.15 C	0.0652 D	8.16 C	658.50 D
T6	2.82 G	0.0451 I	5.16 F	439.67 H
T7	5.15 C	0.0711 C	8.59 B	668.46 C
T8	3.24 F	0.0527 G	8.68 B	503.90 F
T9	5.47 B	0.0732 B	8.70 B	690.71 B

Table 1: Effect of different treatments of IBA and Zeatin on chlorophyll contents and carotenoids of chilli (*Capsicum annuum*) fruit.

TR = Treatments, CH= Chlorophyll and CAR = Carotenoids.

Among all treatments T1 showed exceptional results *i.e.* intensified photosynthetic pigments content as compared to other treatments. Only T1, comprising of IBA (1000ppm+ Zeatin100ppm) showed the positive results. Enhanced photosynthetic pigments content in case of T1 as evident by our results is supported by the findings of Amin and Elsh (2007), Piotrowska-Niczyporuk and Bajguz (2014) and Shaddad *et al.* (2011). IBA caused an increase in photosynthetic pigments content (Çag *et al.*, 2003) where the photosynthetic pigments of plant were augmented in response to Zeatin application. Only in T1, combined doses of IBA and Zeatin produced the results likewise those recorded in case of their separate application. All other treatments decreased the photosynthetic pigments content. They showed the lesser values of photosynthetic pigments content than control while T6 gave the lowest values. Color of the fruits was also noticed in (figure 7).

Figure 7: Effect of different treatments of Ziatin and IBA on chlorophyll contents of chilli fruit.

T1 produced dark green color of chilli fruit. As compare to control. This is an indication of enhanced photosynthetic pigments content. While fruits of T6 were light green or yellowish in color. Lesser concentration of these hormones and their application only at the time of floral bud emergence are significant in obtaining an intensified and improved photosynthetic pigment. So, the concentrations of IBA and Zeatin above 1000 ppm and 100 ppm respectively are not recommended for use.

CONCLUSION

It was concluded from this study that through exogenous application of IBA and Zeatin hormone efficient increase in chlorophyll contents were found.

Conflict of Interest

Author has no conflict of interest.

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