Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2020; SP6: 167-170

Samsul Haque Ansary
Nadia Krishi Vigyan Kendra, BCKV, ICAR, Gayeshpur, Nadia, West Bengal, India

Nitai Mudi
Hooghly Krishi Vigyan Kendra, BCKV, ICAR, Chinsurah, Hooghly, West Bengal, India

Kironmay Barui
Howrah Krishi Vigyan Kendra, BCKV, ICAR, Jagatballavpur, Howrah, West Bengal, India

Anjan Kumar Chowdhury
Hooghly Krishi Vigyan Kendra, BCKV, ICAR, Chinsurah, Hooghly, West Bengal, India

Nikhil Gayen
Hooghly Krishi Vigyan Kendra, BCKV, ICAR, Chinsurah, Hooghly, West Bengal, India

Correspondence
Samsul Haque Ansary
Nadia Krishi Vigyan Kendra, BCKV, ICAR, Gayeshpur, Nadia, West Bengal, India

International Web-Conference
On
New Trends in Agriculture, Environmental & Biological Sciences for Inclusive Development
(21-22 June, 2020)

Comparative studies of late planted capsicum (*Capsicum annum*) for growth and yield under polyhouse and open field condition as influenced by different growth regulators

Samsul Haque Ansary, Nitai Mudi, Kironmay Barui, Anjan Kumar Chowdhury and Nikhil Gayen

Abstract
A study was conducted on late planted capsicum under two production system i.e polyhouse and open environment condition with three different hormonal treatments viz. application of triacontanol @ 0.5 ml/ litre at full bloom stage, application of planofix (4.5% NAA) @ 0.25 ml/ litre at full bloom stage, application of Ethrel @ 0.3 ml/ litre at full bloom stage along with a control. Growth and yield of capsicum were significantly influenced by different hormones under both conditions. Among the hormones, planofix had best effect to result highest fruit weight (122.2g and 97.4g), number of marketable fruits per plant (5.6 and 4.2) and yield (39.4 t/ha and 28.2 t/ha) in polyhouse and open field condition respectively. Whereas, ethrel treatment resulted highest number of total fruits (8.2 and 7.2) in polyhouse and open field condition respectively. Again polyhouse was more effective to increase yield of quality fruits in capsicum than open environment condition. About 40% yield increment was recorded under planofix treatment in polyhouse than open field.

Keywords: Capsicum, Hormone, Polyhouse, Open field

Introduction
Capsicum (*Capsicum annum* L.) also known as sweet pepper, bell pepper or Shimla Mirch belongs to the family Solanaceae is one of the most popular vegetables grown throughout India. It is rich in Vitamin A, Vitamin C and minerals like Calcium, Magnesium, Phosphorus, Potassium, etc. One medium green bell pepper can provide up to 8% of the recommended daily allowance of Vitamin A, 180% of Vitamin C, 2% of calcium and 2% of iron (Kelley and Boyhan, 2009) [10]. Capsicum is a cool season crop, but it can be grown round the year using protected structures where temperature and relative humidity (RH) can be manipulated. This crop requires day temperature of 25-30 °C and night temperature of 18-200C with relative humidity of 50-60% for better fruiting. If temperature exceeds 35 °C or falls below 120C, fruit setting is affected. There are several factors that influence the growth and yield of pepper, some of which include temperature, relative humidity, day length, photoperiod etc. Besides these factors the other important factors which significantly affect its production are nutrition, cultivar, growing system, soil fertility, plant density, etc. (Agarwal, *et.al*., 2007) [1]. In open field condition high temperature, low night temperature, high humidity and cold wind are limiting factors for growing capsicum. Cultivation in the open field tend to be much easier and less costly if some production technology like use of poly mulching can be applied along with some micronutrients and suitable hormonal sprays.
Greenhouses may increase crop yields by as much as two to three times as plants grown under open field conditions. The quality of the product is normally higher than open field and the dependency on chemicals is drastically reduced. The quality of fruits particularly flavour (sweetness, acidity), appearance (colour, shape, size, glossiness) and texture (firmness) may be influenced by the system of production since crops are exposed to varied external

environmental conditions (Dull, 1986). Chandra *et al*., (2000) and Singh *et al*., (2010) [7, 4, 15] indicated that polyhouses, poly-tunnels and plastic-mulching are most suitable solutions for yield increase of sweet pepper. Protected structures act as physical barrier and play a key role in integrated pest management by preventing spreading of insects, pests and viruses causing severe damage to the crop (Singh *et al*., 2003) [13]. The use of polyhouse and black plastic mulch, when combined with appropriate planting date, improves early and total yields of bell pepper in areas where the production is constrained by sub-optimal temperature conditions (Dhaliwal *et al*., 2017) [6].

Cultivation of capsicum is gradually increasing in Hooghly district of West Bengal due to high demand in the market. Many farmers are opted capsicum cultivation during late season i.e. January to April due to better market price. But farmers are facing many problems for its successful cultivation. One of the major limiting factors is poor fruit-set and early flower and fruit drop particularly during late crop which fetches high temperature during fruit-set. Low humidity and high temperature result in poor fruit set due to dropping of flower buds, flowers and small fruits caused by their abscission because of their excessive transpiration. However, growth regulators may be effective to reduce dropping of flowers and fruits in bell pepper and may increase fruit number, fruit size and fruit weight. Lack of proper application of micronutrients and hormones at proper growth stages leads to poor fruit-sets and low productivity. Therefore, application of micronutrients and hormones at optimum doses and proper growth stages is very essential for increasing production of capsicum. Again cultivation under polyhouse is always a good venture in terms of production and quality. The objective of the study was to identify better growth hormone for increasing fruit-set of late planted capsicum and to compare growth and yield of capsicum as influenced by greenhouse and open field production system.

Materials and Methods

The experiment was conducted during 2017-18 (December to April) at Instructional Farm of Krishi Vigyan Kendra, Hooghly, West Bengal. The experimental site comes under subtropical humid region. The average temperature ranges from 15-20oC during December-January and 25- 30oC during march-April. The soil of the experimental field was clay loam having high water holding capacity with pH around 6.6. The Capsicum variety taken was 'Delisha' which is a promising high yielding variety having ability to produce fruits under slightly higher temperature. The experiment consisted of two production system, i.e polyhouse and open environment condition with three different hormonal treatments along with a control. The treatments were T-1: application of triacontanol @ 0.5 ml/ litre at full bloom stage, T-2: application of planofix (4.5% NAA) @ 0.25 ml/ litre at full bloom stage, T-3: application of Ethrel @ 0.3 ml/ litre at full bloom stage and T-4: control (No use of hormone).

The experiment was laid out in a Randomized Block Design with five replications. Seedlings of 30 days old were transplanted during second week of December in double row bed system with spacing of 60cm in between rows and 45cm in between plants in both polyhouse and open field condition. Irrigation channels are laid out in between two crop rows. Both organic and inorganic fertilizers were applied as per recommended dose. After application of all basal fertilizers, poly mulch was placed and then planting was done at specified distance. Later foliar spray of water soluble fertilizers like 19:19:19 (N:P:K) was done @ 5g/L at 30 DAT (days after transplanting) and 50 DAT. Micronutrient mixture (comprising Zn, B, Mo, Cu) was sprayed twice @ 2.5g/L at 40 DAT and 60 DAT to all treatments. All other general agronomic practices were followed time to time. Harvesting of the crop was started at 70 days after planting. The different observations viz. plant height (cm) at 90 DAT, primary branches per plant, fruit diameter (cm), Average fruit weight (g), Number of marketable and total fruits per plant and Yield (t/ha) were recorded accordingly and the data of different parameters were statistically analyzed.

Results and Discussion: Vegetative growth characters

Vegetative growth of capsicum was highly influenced under different production system and application of plant growth hormone further influenced its development.

Table 1: Effect of growth regulators on vegetative growth of capsicum under polyhouse and open field condition

Treatments	Plant height (cm) at 90 DAT		Number of primary braches/plant	
	Poly house	Open field	Poly house	Open field
T-1	50.2	39.4	4.0	4.6
T-2	57.2	41.2	4.4	4.4
T-3	56.8	37.6	5.2	4.8
T-4 (Control)	62.8	38.6	4.6	3.8
SEm (±)	2.344	0.733	0.303	0.264
CD (at 5%)	7.22	2.26	0.93	0.82

Plant height

Plant height was influenced significantly by different hormonal treatments over control as shown in table-1. It was noticed that in polyhouse condition all hormonal treatments resulted to keep plant height shorter than control and highest plant height (62.8 cm) was observed in control followed by planofix treatment (57.2 cm). But in open condition highest plant height (41.2 cm) was observed in planofix treatment followed by triacontanol (39.4 cm) whereas ethrel treatment recorded lowest plant height (37.6 cm). In control climate of polyhouse hormones might affected plant height but in open condition it was not happened. Again it was clear that overall plant height was increased under polyhouse than open field. This may be attributed to the enhanced plant metabolic activities like photosynthesis and respiration due to favourable microclimatic condition under polyhouse. Higher plant height of capsicum under polyhouse was also reported by Ngullie and Biswas (2016) [11] and Nkansah *et al.* (2017) [12].

Number of primary branches per plant

Number of primary branches per plant was not so much influenced by the treatments and similar branching habit was found in both polyhouse and open condition indicating it is purely varietal character. Although highest number of primary branches per plant was recorded by ethrel treatment under both growing conditions (5.2 and 4.8 in polyhouse and open field respectively) as mentioned in table-1.

Fruit characters

Physical appearance like shape, size and colour of fruits were much influenced by growing environment and more attractive size and colour of fruits were obtained under polyhouse condition than open field. Good quality of capsicum fruits was due to growing of fruits under proper climatic condition. In polyhouse filtered sunlight might result dark green colour

of fruits. Increase fruit size was due to proper utilization of nutrients and freshness of fruits was due to protection against insect-diseases and all abiotic stress.

Fruit diameter and fruit weight

Table 2: Effect of growth regulators on fruit characters of capsicum under polyhouse and open field condition

Treatments	Fruit Diameter (cm)		Avg. Fruit weight (g)	
	Poly house	Open field	Poly house	Open field
T-1	7.04	6.06	117.8	84.8
T-2	7.22	6.58	122.2	97.4
T-3	6.62	5.92	107.2	85.6
T-4 (Control)	6.58	5.76	102.4	81.2
SEm (±)	0.1007	0.163	1.532	1.278
CD (at 5%)	0.31	0.50	4.72	3.94

Fruit diameter and fruit weight were significantly varied by different treatments both under polyhouse and open field condition as in table-2. Hormonal treatments increased fruit diameter and fruit weight of capsicum. Highest fruit diameter (7.22 cm and 6.58 cm respectively) and fruit weight (122.2 g and 97.4 g respectively) were recorded under planofix treatment in both polyhouse and open conditions, whereas ethrel resulted smaller fruits among the hormones. It was obvious that both fruit diameter and fruit weight were increased under polyhouse over open field. Better microclimatic condition might help proper utilization of nutrients which leaded to larger fruit. Ngullie and Biswas (2016) [11] also reported higher fruit diameter and fruit weight of capsicum grown under polyhouse. Singh *et al.* (2011) [14] stated that hybrid sweet pepper 'Tanvi' produced maximum fruit diameter, number of fruits/plant, individual fruit weight and yield in protected cultivation.

Yield component and Yield characters

The yield and yield components were significantly influenced by different hormonal treatments and experimental results under table-3 showed that all hormones had positive effect on fruit setting and yield.

Maximum number of marketable fruits per plant (5.6 and 4.2 respectively) was recorded under planofix treatment in both polyhouse and open field condition but ethrel recorded highest number of total fruits per plant (8.2 and 7.2 respectively) in both conditions. Fruits per plant were increased in polyhouse by all the treatments as compared to open field. Better microclimate under polyhouse leaded to increase fruit setting ability in capsicum. Kanwar *et al.*, (2014) [9] found higher number of fruits per plant in bell pepper under greenhouse growing condition. All the treatments significantly increased yield over control both in polyhouse and open field conditions. Yield increment was due to increase fruit size and fruit number per plant. Highest yield (39.4 t/ha and 28.2 t/ha respectively) was obtained under planofix treatment followed by ethrel in both polyhouse and open field condition. Das *et al.* (2015) [5] opined that application of 4-CPA @ 2000 ppm increase fruit set and yield by reducing flower and fruit drop in capsicum. This result is in agreement with the findings of Hasanuzzaman *et al*. (2007) and Appireddy *et al*. (2008) [8, 2] where they reported that, plant growth regulators increase the yield of bell pepper. The higher fruit yield under polyhouse condition may be attributed favourable climatic condition under polyhouse and protective ability against biotic and abiotic stresses (Singh *et al.*, 2010 and Ngullie and Biswas, 2016) [15, 11]. Similarly, Zende (2008) and Brar *et al.* (2005) [16, 3] also reported higher fruit weight and yield of capsicum under polyhouse. Dhaliwal *et al.* (2017) [6] reported that the use of polyhouse and black plastic mulch, when combined with appropriate planting date, improves early and total yields of bell pepper in areas where the production is constrained by sub-optimal temperature conditions.

Table 3: Effect of growth regulators on number of fruits & yield of capsicum under polyhouse and open field condition

Treatments	No. of marketable fruits/plant		No. of total fruits/plant		Yield (t/ha)	
	Poly house	Open field	Poly house	Open field	Poly house	Open field
T-1	5.2	4.0	7.6	6.2	36.4	23.8
T-2	5.6	4.2	7.8	6.8	39.4	28.2
T-3	5.4	4.0	8.2	7.2	37.4	24.8
T-4 (Control)	4.6	3.6	6.8	5.2	27.6	18.2
SEm (±)	0.265	0.268	0.297	0.339	0.666	0.486
CD (at 5%)	0.82	0.82	0.92	1.04	2.05	1.50



Conclusion

Based on the experimental results, it can be concluded that all hormonal treatments increased yield in capsicum under both polyhouse and open field condition. Among the hormones, planofix had best effect to increase fruit-set, number of fruits per plant, fruit size and yield. Ethrel had some positive effect to increase total fruit number per plant and yield. Again under polyhouse due to better microclimatic situation and protection from biotic & abiotic hazards yield of capsicum was considerably increased as compared to open field. About 40% yield increment was recorded under planofix treatment in polyhouse than open field. Therefore, cultivation of capsicum with application of hormones particularly planofix can bring ample scope for increasing crop yield in late planted capsicum to fetch more profit for the farmers. Again polyhouse can be effectively utilized for capsicum cultivation with application of planofix to increase more yield of quality fruits for getting better remuneration.

Acknowledgement

We are very thankful to Project Director, Agriculture Technology Management Agency (ATMA), Hooghly for

providing necessary financial assistance for conducting the research.

References

1. Agarwal A, Gupta S, Ahmed Z. Productivity of bell pepper (*Capsicum annum L.)* under greenhouse in high altitude cold desert of Ladakh. Acta Hort. 2007; 756:309-314.
2. Appireddy GK, Saha S, Mina BL, Kundu S, Selvakumar G, Gupta HS. Effect of organic manures and integrated nutrient management on yield potential of bell pepper (*Capsicum annuum*) varieties and on soil properties. Arch. Agron. Soil Sci. 2008; 24:127-137.
3. Brar GS, Sabale RN, Jadhav MS, Nimbalkar CA, Gawade BJ. Effect of trickle irrigation and light levels on growth and yield of capsicum under polyhouse condition. J. Maharashtra Agric. Univ. 2005; 30(3):325-328.
4. Chandra P, Sirohi PS, Behera TK, Singh AK. Cultivating Vegetable in polyhouse. Indian Hort. 2000; 45(3):17-32.
5. Das SK, Md. Dulal Sarkar, Alam MJ, Robbani MG, Kabir MH. Influence of Plant Growth Regulators on Yield Contributing Characters and Yield of Bell Pepper (*Capsicum annum*) Varieties. J. of Plant Sci. 2015; 10:63-69.
6. Dhaliwal MS, Sharma SP, Jindal SK, Dhaliwal LK, Gaikwad AK. Growth and yield of bell pepper as influenced by growing environment, mulch, and planting date. J. Crop Improv. 2017; 31(6):830-846.
7. Dull GG. Nondestructive evaluation of quality of stored fruits and vegetable. Food Tech. 1986; 40:106-110.
8. Hasanuzzaman SM, Hossain SMM, Ali MO, Hossain MA, Hannan A. Performance of different bell pepper (*Capsicum annuum* L.) genotypes in response to sythetic hormones. Int. J. Sustain. Crop Prod. 2007; 2:78-84.
9. Kanwar MS, Mir MS, Lamo K, Akbar PI. Effect of protected structures on yield and horticultural traits of bell pepper *(Capsicum annuum* L.*)* in Indian cold arids. Afr. J. Agric. Res. 2014; 9:874-880.
10. Kelley WT, Boyhan G. Commercial Pepper Production Handbook. The University of Georgia, Cooperative Extension, 2009.
11. Ngullie R, Biswas PK. Performance of capsicum under protected and open field conditions under Mokokchung district of Nagaland. Adv. Res. J. Crop Improv. 2016; 7(2):197-200.
12. Nkansah GO, Norman JC, Martey A. Growth, Yield and Consumer Acceptance of Sweet Pepper (Capsicum annuum L.) as Influenced by Open Field and Greenhouse Production Systems. J. Hort. 2017; 4(4):216-21.
13. Singh AK, Gupta MJ, Shrivastav R. Study of spacing, training-pruning and varieties of capsicum under polyhouse condition. Progressive Hort. 2003; 7:212-216.
14. Singh AK, Singh B, Gupta R. Performance of sweet pepper (*Capsicum annum*) varieties and economics under protected and open field conditions in Uttarakhand. Indian J Agric Sci. 2011; 81:973-975.
15. Singh B, Singh AK, Tomar B. In peri-urban areas protected cultivation technology to bring prosperity. Indian J. Hort. 2010; 55 (4):31-33.
16. Zende UM. Investigating on production techniques in capsicum under protected cultivation. M.Sc. Thesis, University of Agricultural Sciences, Dharwad, Karnataka (India), 2008, 97p.