Research Article

Impact of Plant Growth Regulators on the Growth and Yield Characteristics of Chili (*Capsicum annum* L.)

Tehseen Ali Jilani[1]*, Javaria Sherani[2], Sadaf Javaria[3], Kashif Waseem[1], Muhammad Salman Hameed[4], Noor Ul Ain[3], Ali Zaman[5] and Umar Khitab Saddozai[6]

[1]Department of Horticulture, Faculty of Agriculture, Gomal University. Dera Ismail Khan, Pakistan; [2]Department of Horticulture, Faculty of Agricultural Sciences, Ghazi University. Dera Ghazi Khan, Pakistan; [3]Institute of Food Science and Nutrition, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Pakistan; [4]Sstate key Laboratory of Pesticides and Chemical Biology, College of Chemistry, Central China Normal University, Wuhan, China; [5]Institute of Microbiology, Faculty of Veterinary and Animal Sciences, Gomal University, Dera Ismail Khan, Pakistan; [6]Department of Agronomy, Faculty of Agriculture, Gomal University. Dera Ismail Khan, Pakistan.

Abstract | Chili (*Capsicum annum* L.) is a popular food spice along with many medicinal benefits. The experiment to investigate the impact of plant growth regulator on the growth and yield characteristics of chili was conducted during Kharif season 2022 at the Horticultural research area, Faculty of agriculture, Gomal University. D.I. Khan. The experiment was laid out ten treatment with complete randomized block design and replicated three time. The treatment includes T1-control, T2-NAA@30ppm, T3-NAA@60ppm, T4-NAA@90ppm, T5- GA3 50ppm, T6- GA3 100ppm, T7- GA3 150ppm, T8- NAA@30ppm + GA3 50ppm, T9-NAA@60ppm + GA3 100ppm and T10-NAA@90ppm + GA3 150ppm. The outcome shows that the use of plant growth regulators significantly alters the growth and yield-related features in chili. Result revealed that the application of NAA@60ppm obtained significantly higher plant height (65.64), days for flowering (42.39), no of flowers (19), fruit length (6.97cm), fruit weight (2.60g), fruit diameter (2.99) and yield per plot (149.25), while the NAA@90ppm was outcome higher no of branches (22.50).

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***Correspondence** | Tehseen Ali Jilani, Department of Horticulture, Faculty of Agriculture, Gomal University. Dera Ismail Khan, Pakistan; **Email:** tehseenali@gu.edu.pk
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Introduction

Chili pepper (*Capsicum annuum* L.) is a highly significant spice crop grown across most tropical and subtropical regions worldwide (Raj *et al*., 2016). It is cultivated for its pungent fruits, which are consumed in both fresh and dried forms (Kumar *et al*., 2018). Globally, chili is the second most important Solanaceous crop after tomato, playing a crucial role in exports from many countries (Ahmed *et al*., 2022).

In Pakistan, during the 2021-2022 growing season, chili cultivation spanned 58,169 hectares, yielding 144,160 tons (FVCSP, 2022). Ranked third in area and production after onion and garlic, chili is grown year-round in many parts of Pakistan, with its fruits available in markets throughout the year (Chaudhary *et al*., 2006; Jilani *et al*., 2016). Chili peppers are rich in vitamins A and C and are widely used in the production of various condiments such as pickles, sauces, and pastes (Anolisa *et al*., 2020). In Pakistan, chili serves as an important cash crop, with its use extending to flavoring a wide range of foods including meats, ketchup, cheese, snacks, and sausages (Kumar *et al*., 2018). However, one of the main challenges in chili production is the premature dropping of flowers and fruits, which can be exacerbated by hormonal imbalances and unfavorable environmental conditions like extreme temperatures (Chaudhary *et al*., 2006). Studies estimate that more than 60% of chili flowers are typically shed before fruiting, but production can be significantly enhanced by reducing this loss. In addition to effective management techniques and genetic potential, the application of plant growth regulators (PGRs) has shown to substantially reduce blossom drop, thereby improving yields (Chellamuthu, 2014; Gare *et al*., 2017).

PGRs represent a new generation of agrochemicals, following pesticides, herbicides, and fertilizers. When used in small amounts, they regulate plant growth by either promoting or inhibiting natural developmental processes (Ahmed *et al*., 2022). PGRs improve fruit set by enhancing photo-assimilate movement and optimizing source-sink interactions, thereby influencing critical stages such as flowering, fruit formation, and ripening (Anolisa *et al*., 2020). Their ability to regulate growth at various stages from seedling development to fruit ripenin makes them invaluable for boosting crop productivity.

Currently, around 60 PGRs are commercially available, with gibberellins and naphthalene acetic acid (NAA) being particularly important for enhancing vegetative growth and fruit set (Tamilselvi and Vijayaraghavan, 2014; Chellamuthu, 2014). GA3, the most abundant gibberellin, regulates key developmental processes like stem elongation, germination, and fruit formation, while NAA promotes fruit setting and enhances fruit size, sweetness, and maturation (Gare *et al*., 2017). Studies show that the foliar application of GA3 and NAA significantly improves fruit setting and reduces flower and fruit drop, leading to higher yields (Srinivas *et al*., 2017; Akhtar *et al*., 2018; Mahindra *et al*., 2018). Plant growth regulators (PGRs) are crucial for the growth and development of chilli plants. Better plant growth, flowering, fruiting, and seed development are achieved by their promotion of cell division, elongation, and differentiation (Baghel *et al*., 2024). PGRs can also boost resilience to biotic and abiotic stressors, increase nutrient uptake efficiency, and raise crop yield and quality. Certain global recognition of PGRs in improving crop development, productivity and useful tool that growers can employ to meet consumer demand and enhance crop potential, this study was designed to evaluate the effects of plant growth regulators on the growth and yield characteristics of chili peppers (*Capsicum annuum* L.).

Materials and Methods

This experiment was conducted at vegetable Research area in Department of Horticulture, Faculty of Agriculture, Gomal University, DIKhan during 2022. The climate of Dera Ismail Khan is arid subtropical, with quite dry, very mild winters (but during which it is often cold at night), and very hot summers, which are also relatively rainy because of the monsoon. The experiment was designed in Complete Randomized Block Design (CRBD) with 10 treatments, each of which was replicated three times. In this experiment Sanam variety was chosen. It was arranged at a spacing of 60 x 45 cm during the Kharif season. After transplantation, growth regulators were given out 30, 60, and 90 days which was summarized of T1-Control, T2-NAA@30ppm, T3-NAA@60ppm, T4- NAA@90ppm, T5- GA3 50ppm, T6- GA3 100ppm, T7- GA3 150ppm, T8-NAA@30ppm + GA3 50ppm, T9-NAA@60ppm + GA3 100ppm and T10-NAA@90ppm + GA3 150ppm, respectively. Split dosage of N along with full dosage of P and K were applied during land preparation whereas the left over dose of N was applied later transplanting. The data taken from growth characteristics, plant height (cm), no of branches were noted from five marked plants from individually plot while the yield characteristics like no of days for flowering, fruit length (cm), fruit width (cm), fruit diameter (cm) and yield per plot (kg) were taken. The gathered data were statistically analyzed, and the mean difference was determined using Duncan's Multiple Range Test (DMRT) and ANOVA technique.

Table 1: *Impact of different PGR on the growth characteristics of chilli (Capsicum annum L.).*

Mean	30 DAT	60DAT	90 DAT	Mean
Control	19.90±3.21	33.58±2.22	44.56±2.16	32.68
NAA 30ppm	22.63±2.30	40.72±2.20	53.59±2.19	38.98
NAA 60ppm	27.48±2.17	47.56±2.17	65.64±2.22	46.89
NAA 90ppm	25.38±2.13	42.56±2.20	59.80±2.31	42.58
GA3 50ppm	22.40±2.15	39.40±2.11	49.65±2.18	37.15
GA3 100ppm	21.37±3.31	34.74±2.24	44.56±2.22	33.56
GA3 150ppm	20.48±2.20	29.97±1.08	41.36±2.18	30.6
NAA 30ppm + GA3 50ppm	18.99±1.70	36.73±2.24	46.62±2.24	34.11
NAA 60ppm+ GA3 100ppm	19.44±2.15	33.57±2.19	43.80±2.29	32.27
NAA 90ppm + GA3 150ppm	18.64±2.30	32.63±2.17	41.64±2.25	30.97
Grand mean	21.67	37.15	49.12	
CV	10.89	5.59	4.51	
Lowest range	18.64	29.97	41.36	
Highest range	27.48	47.56	65.64	

Table 2: *Impact of different PGR on the growth characteristics of chilli (Capsicum annum L.).*

Mean	30 DAT	60DAT	90 DAT	Mean
Control	5.18±2.05	8.61±1.74	19.20±2.06	11
NAA 30ppm	4.55±2.18	7.43±2.19	19.55±2.17	10.51
NAA 60ppm	4.34±1.88	8.49±2.13	21.65±2.24	11.49
NAA 90ppm	5.38±2.14	8.99±1.66	22.50±1.86	12.29
GA3 50ppm	4.51±2.13	9.35±2.10	21.12±1.77	11.66
GA3 100ppm	6.45±2.19	11.37±2.17	25.73±2.23	14.52
GA3 150ppm	5.38±2.14	7.73±2.24	20.31±2.13	11.14
NAA 30ppm + GA3 50ppm	4.57±2.19	7.64±2.23	19.79±2.31	10.67
NAA 60ppm+ GA3 100ppm	5.39±2.11	7.08±2.10	19.40±2.15	10.62
NAA 90ppm + GA3 150ppm	5.54±2.08	7.41±2.16	20.38±2.17	11.11
Mean	5.13	8.41	20.96	
CV	41.13	24.61	10.06	
Lowest range	4.34	7.43	19.20	
Highest range	6.45	11.37	22.50	

Results and Discussion

Growth characteristics

Plant height (cm) and the number of branches per plant at 30, 60, and 90 days post-transplant were measured and are shown in Tables 1-2 as growth parameters.

The finding of the following table showed that the statistically maximum plant height was observed in treatment T3 (NAA 60ppm) at 30 DAT, 60DAT and 90DAT with (27.48, 47.56 and 65.64 cm) respectively, while the minimum plant height was taken in treatment T10 (NAA 90ppm + GA3 150ppm) and T7 (GA3 150ppm) at 30 DAT, 60DAT and 90DAT with (18.64, 29.97 and 41.36cm). NAA acts as a growth hormone, which might be contribute to the rise in plant height. NAA is an agent that increases photosynthetic activity and boost up the efficiency in photo-synthetic translocation and usage, which might be a valuable purpose for fast cell division within the plants growing region or a growth enhancer. The findings in chilli are consistent with those of (Shankhwar *et al*., 2017; Raj *et al*., 2016; Chaudhary *et al*., 2006). The impacts of auxins on apical dominance might be the reason for the plant height increase. In addition to enhancing nutritional intake, PGRs play an important role to boosted the activity of photosynthetic, effective absorption of products from photosynthetic processes, fast growth-related cell division and elongation, which resemble the finding of (Gupta *et al*., 2015; Shankwar *et al*., 2017; Gait *et al*., 2018).

A considerable difference observed in no. of branches using the PGRs applying are illustrated in Table 2. The significantly maximum number of branches have been found in treatment T6 (GA3 100ppm) and T4 (NAA 90ppm) at 30, 60 and 90 DAT with value (6.45, 11.37 and 22.50 cm), while the least no of branches were perceived in treatment T3 (NAA 60ppm), T2 (NAA 30ppm) and T1 (control) with (4.34, 7.43 and 19.20 cm). Highest mean value have taken (12.19 cm) in treatment T4 (NAA 90ppm). In all treatments, the no of branches/ plant constantly greater from 30 to 90 days post transplantation. The enhanced osmotic intake of water and nutrients, the effect of PGRs have sustained constant swelled force despite cell wall failure, might be due the rise in all growth characteristics of chilli plants (Anolisa *et al*., 2020; Gait *et al*., 2018; Mohamed, 2017).

Yield characteristics

A significant difference have recorded in days to flowering due to PGRs application, which has shown in Table 3. Significantly maximum (50.99) no of days needed for blossoming in T1 (control) while it was observed minimum (42.39 days) in T3 (NAA 60ppm). This may be due to enhanced auxin production in root tissue as a result of NAA's increased activity. Their simultaneously travel to buds in the axillary region would ultimately have delivered a more effective source for mobilization of photosynthetic assimilation. In the early stages, this assisted the shift from the plant development to productive phases. Kannon *et al*. (2009) showed that initial blooming was seen when NAA 50ppm (39.100) days were needed for fifty percent flowering, followed by NAA 25ppm (42.00) days as compared to control.

Influence of PGRs on flowering are demonstrated in Table 3. Significantly maximum no of flowers (19.00) are found in treatment T3 (NAA 60ppm) followed by treatment T4 (NAA 90ppm) with (14.00) while the minimum number of flowers (6.66) were spotted in treatment T1 (control). The implementation of PGRs resulted in a statistically higher no of flowers was produced. The outcome confirm the finding of (Anolisa *et al*., 2020; Askari and Mortazaeinezhad, 2016).

Maximum fruit length (6.97cm) in treatment T3 (NAA 60ppm) followed by treatment T4 (NAA 90ppm) with value (6.29cm) whereas the minimum fruit length (5.78cm) in treatment T1 (control). This could be linked to a rise in cell wall and elongation of cell, which a frequent function of PGRs. Similar finding were revealed by (Anbarasi and Venkatraman, 2022; Surendar *et al*., 2020).

Table 3: *Impact of different PGR on the yield characteristics of chilli (Capsicum annum L.).*

PGR	Days for flowering	No of flowers	Fruit length (cm)	Fruit weight (g)	Fruit Diameter	Yield/plot (kg)
Control	50.99±1.17	6.66±1.52	5.78±2.21	1.33±0.88	2.56±0.70	75.69±5.54
NAA 30ppm	47.49±2.28	9.00±2.10	5.97±1.45	1.96±0.90	2.53±0.98	109.42±5.55
NAA 60ppm	42.39±2.28	19.00±2.00	6.97±1.15	2.60±0.80	2.99±0.79	149.25±5.58
NAA 90ppm	48.72±2.30	14.00±2.00	6.29±1.24	1.71±0.86	2.59±0.82	112.14±5.56
GA3 50ppm	50.44±1.99	11.00±1.99	5.78±1.25	1.79±0.92	2.31±0.91	125.13±5.57
GA3 100ppm	48.30±2.00	12.00±1.98	6.27±1.25	2.08±0.89	2.69±0.93	139.07±5.61
GA3 150ppm	49.45±2.02	8.33±1.15	6.20±1.38	2.21±0.96	2.73±0.86	112.72±5.86
NAA 30ppm + GA3 50ppm	47.66±0.96	7.00±2.00	5.94±1.47	2.19±0.94	2.12±0.84	98.56±5.84
NAA 60ppm+ GA3 100ppm	46.50±1.96	8.00±2.00	6.19±1.48	2.32±0.86	2.81±0.93	93.64±5.94
NAA 90ppm + GA3 150ppm	46.19±2.07	8.00±4.00	6.12±1.47	2.19±0.70	2.37±0.91	105.12±5.91
Mean	47.81	10.30	6.15	2.13	2.57	112.74
CV	3.97	20.09	23.25	40.84	33.46	5.07
Lowest range	42.39	6.66	5.78	1.33	2.12	75.69
Highest range	50.99	19	6.97	2.60	2.99	149.25

Significantly maximum fruit weight (2.60g) was recorded in treatment T3 (NAA 60ppm), which was at par with (2.32g) in treatment T9 (NAA 60ppm+ GA3 100ppm) while the minimum fruit Weight (1.33g) was observed in treatment T1. Kumaar *et al*. (2018) stated that the application of Auxin and GA3 helped in quick growth, development, increase blooming and fruiting in chilli crop. Weight of fruit is determined by length and diameter of fruit, both of which was greater in T3NAA@60ppm. Related result was found through (Raj *et al*., 2016; Revanappa, 1998; Sharma *et al*., 1999).

Likewise, the treatment T3 (NAA@60ppm) was largest fruit diameter (2.99), which was followed by (NAA 60ppm+ GA3 100ppm) with (2.32 cm), whereas the smallest fruit diameter was observed in T8 (NAA 30ppm + GA3 50ppm) with (2.12 cm). The increase in cell membrane and elongation is might be the foliar application of axin resulted increase in fruit diameter. The increase in fruit diameter is most likely result of an increase in cell number and elongation, which are both influenced by auxin activity. Raj *et al*. (2016) concluded that the fruit diameter considerable increased with NAA @60ppm in kharif seasons.

The highest fruit yield per plot (kg) (149.25) was noted in treatment T3 (NAA 60ppm), which was followed by treatment T6 (GA3 100ppm) with value (139.07) while the lowest fruit yield observed (75.69) in treatment T1. This might be as NAA is most probable to have increased photosynthetic activity in the plant, which in response led to a better output of carbohydrates and associated products that acted as boosted the growth, fruit diameter and fruit weight, which resulted higher yield of chillies. These findings coincide with Patel *et al*. (2016). Sanjay and Singh (2019), Vandana and Verma (2014) revealed that the plants treated with PGRs, particularly NAA and GA3, produced the largest total and early output of chili.

Conclusions

According to the above findings, foliar application of treatment T3 with NAA@50ppm performed better in terms of growth and yield charecteristics.

Novelty Statement

This research explores the potential of PGRs to optimize vegetative growth, enhance flowering and fruit set, and improve overall yield.

Author's Contribution

Tehseen Ali Jilani: Conducted research, collected data and prepared manuscript.
Javaria Sherani, Sadaf Javeria and Kashif Waseem: Supervised the study.
Muhammad Salman Hameed, Noor ul Ain, Ali Zaman and Umar Khitab: Performed data analysis, reviewed manuscript and made changes.

Conflict of interest
The authors have declared no conflict of interest.

Referances

Ahmed, I.H.M., E.F. Ali, A.A. Gad, A. Bardisi, A.M. El-Tahan, O.A. Abd Esadek, M.T. El-Saadony and A.S. Gendy. 2022. Impact of plant growth regulators spray on fruit quantity and quality of pepper (*Capsicum annuum* L.) cultivars grown under plastic tunnels. Saudi J. Biol. Sci., 29(4): 2291–2298. https://doi.org/10.1016/j.sjbs.2021.11.062

Akhter, S., T. Mostarin, K. Khatun, F. Akhter and A. Parvin. 2018. Effects of plant growth regulator on yield and economic benefit of sweet pepper (*Capsicum annum* L.). Agriculture, 16(2): 58–64. https://doi.org/10.3329/agric.v16i02.40343

Anbarasi, D. and M. Venkatraman. 2022. Effect of plant growth regulators on growth, yield and quality characters of chilli (*Capsicum annuum* L.). Annls Plant Soil Res., 24(4): 543-546. https://doi.org/10.47815/apsr.2022.10206

Anjos, G.L., G.C. Moreira, C.N. Carneiro and F.D.S. Dias. 2022. Effect of phytoregulators on the composition of phenolic compounds in chili peppers (*Capsicum frutescens*) and exploratory analysis. Sci. Hortic., 292: 110660. https://doi.org/10.1016/j.scienta.2021.110660

Anolisa, M., Al-Imran, R. Hossen, A.T.M.R. Islam and S.K. Das. 2020. Effect of plant growth regulators on growth and yield of chili (*Capsicum annuum* L.). J. Phytol., 12(6): 117–120. https://doi.org/10.25081/jp.2020.v12.6466

Anonymous, 2022. Fruit, vegetables and condiments statistics of Pakistan. Ministry of national food security and research economic wing, Islamabad. Pakistan.

Askari, O. and F. Mortazaeinezhad. 2016. Improving quality indices of Rosa 'Yellow Finesse' using methyl jasmonate and benzyl adenine. J. Central Eur. Agric., 17(2): 369-378. https://doi.org/10.5513/JCEA01/17.2.1717

Baghel, V. Singh and D. Singh. 2024. Effect of plant growth regulators on growth, yield and quality of chilli (*Capsicum annuum* L.). Asian J. Soil Sci. Plant Nutr., 10(2): 320-326. https://doi.org/10.9734/ajsspn/2024/v10i2289

Chaudhary, B., M. Sharma, S. Shakya and D. Gautam. 2006. Effect of plant growth regulators on growth, yield and quality of chilli (*Capsicum annuum* L.) at Rampur, Chitwan. J. Inst. Agric. Anim. Sci., 27(January): 65–68. https://doi.org/10.3126/jiaas.v27i0.697

Chellamuthu, T., 2014. Impact of plant growth regulators and formulations on growth of chilli (*Capsicum annuum* L.). Plant Gene Trait., 5(8): 2014. https://doi.org/10.5376/pgt.2014.05.08

Gait, A.E., M. Eman, A.O. Gomaa, A.M. Youssef and A.E. Nemr. 2018. Effect of kinetin and GA3 treatments on growth and flowering of *Dendranthem agrandiflorium* cv. Art Queen plants. Middle East J. Agric. Res., 7: 801-815.

Gare, B.N., P.U. Raundal and A.V. Burli. 2017. Effect of plant growth regolators on growth, yield and yield attributing characters of rainfed chilli (*Capsicum annuum* L.). Adv. Agril. Res. Tech. J., 1(2):195-197.

Gupta,Y.C., K. Sharad, B.P. Sharma, S.R. Dhiman and S. Puja. 2015. Effect of gibberellic acid (GA3) and planting dates on growth, flowering and seed yield of China aster *Callistephus chinensis* (L.) Nees. Progr. Hortic., 47(2): 260-266. https://doi.org/10.5958/2249-5258.2015.00047.0

Jilani, T.A., K. Waseem and M.S. Jilani. 2016. Effect of weed management techniques for better growth and yield of pea (*Pisum sativum* L.). Pak. J. Agric. Sci., 53(4): 901–909. https://doi.org/10.21162/PAKJAS/16.5368

Kannan, K., M. Jawaharlal and M. Prabhu. 2009. Effect of plant growth regulators on growth and yield parameters of *Paparika* cv. Ktpl-19. Agric. Sci. Digest., 29(3): 157-162.

Kumar, P., S. Pathak, K.S. Amarnath, P.V.B. Teja, B. Dileep, K. Kumar, M. Singh and A. Siddique. 2018. Effect of growth regulator on morpho-physiological attributes of chilli: A case study. Plant Arch., 18(2): 1771–1776.

Mahindre, P.B., A.K. Jawarkar, S.M. Ghawade and V.D. Tayade. 2018. Effect of different concentration of plant growth regulators on growth and quality of green chilli, J. Pharma. Pract., SP1: 3040-3042.

Mohamed, F.Y., 2017. Effect of some growth stimulants on growth, flowering and postharvest quality of aster (*Symphyotrichum novi- belgii* L.) cv. Purple Monarch. Middle East J. Agric. Res., 6(2): 264-273.

Patel, V.P., E. Pall and S. John. 2016. Comparative study of the effect of plant growth regulators on growth, yield and physiological attributes of chilli (*Capsicum annuum* L.) cv. Kashi Anmol. Int. J. Farm Sci., 6(1): 199-20.

Raj, C., K. Holebasappa, J.K. Hore and S. Das. 2016. Effect of plant growth regulators on growth and yield of chilli (*Capsicum annuum* L.). Res. Crops, 17(2): 320–323. https://doi.org/10.5958/2348-7542.2016.00053.X

Revanappa, 1998. Influence of growth regulators on fruit parameter, yield and parameter in green chilli cultivars. Karnataka J. Agric. Sci., 12(1): 122-126.

Sanjay, S. and T. Singh. 2019. Effect of gibberellic acid on growth, yield and quality parameters of chilli (*Capsicum annuum* L.). J. Pharmacogn. Phytochem., 8(2): 2021–2023.

Shankhwar, B., A.K. Nigam., N. Vasure and D. Vishvakarma. 2017. Effect of different plant growth regulators on growth of chilli (*Capsicum annum* L.) cv. PUSA JWALA. Agric. Update, 12(Special-5): 1187–1189. https://doi.org/10.15740/HAS/AU/12.TECHSEAR(5)2017/1187-1189

Sharma, A.K., R.S. Ratian and Pathania. 1999. Effect of plant growth regulators on yield and morphological traits in brinjal (*Solanum melongena* L.). Agric. Sci. Dig., 12: 219-222.

Sreenivas, M., A.B. Sharangi and A.C. Raj. 2017. Evaluation of bio-efficacy and phytotoxicity phytotoxicity of gibberellic acid on chilli. J. Crop Weed, 13(3): 174–177.

Surendar, P., K. Sekar., K. Sha and Kannan. 2020. Effect of plant growth regulators on growth of chilli (*capsicum annuum* L.). Plant Arch., 20(4): 1544–1546.

Tamilselvi, C. and H. Vijayaraghavan. 2014. Impact of plant growth regulators and formulations on growth of chilli (*Capsicum annuum* L). J. Plant Gene Trait., 5: 1-3.

Vandana, P. and L.R. Verma. 2014. Effect of spray treatment of growth substances at different stages on growth and yield of sweet pepper (*Capsicum annum* L.) cv. Indra under green house. Int. J. Life Sci. Res., 2(4): 235–240.