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# GROWTH AND YIELD OF CHILLI (*CAPSICUM ANNUUM* L.) AS INFLUENCED BY DIFFERENT GROWTH REGULATORS

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**ABSTRACT**

The experiment was carried out at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswa vidyalaya during 2012-14 in chilli cv. Beldanga. Three concentration of four growth regulators namely NAA (25, 50 and 75 ppm), $GA_3$ (20, 40 and 60 ppm), 2, 4-D (5, 7.5 and 10 ppm) and ethrel (300, 400 and 500 ppm) were included in this investigation. The regulators were applied as foliar spray at 30 and 60 days after transplanting. There were altogether 13 treatments including control (water spray).In both the years, the seedlings were transplanted during middle of November in 2m x 1.6m plot at 50x40 cm spacing accommodating 16 plants per plot. The experiment was laid out in RBD with three replication. The NPK dose was 150: 80: 80 kg/ha.Among different treatments maximum plant spread (E-W) [46.97 cm], number of fruits per plant (94.83), fruit length (6.80 cm), yield per plot (2.72kg/3.2$m^2$) and projected yield per hectare (6.37 t) were observed in plants raised from application of NAA 75 ppm.Maximum plant height (75.60 cm), plant spread in North-South direction (46.53 cm), number of days to flowering (47.56) and maximum fruit diameter (1.24 cm) were recorded in $GA_3$ 60 ppm treated plants. The projected yield under untreated control was 4.34 t/ha.From yield maximization point of view the most effective treatment was NAA 75 ppm under alluvial plains of West Bengal for production of chilli

## INTRODUCTION

India is the largest producer of chillies in the world (Athaneria *et al.,* 2011). It is grown for use as a vegetable, spice and condiment under tropical, sub-tropical and temperate climates (Hazra *et al.,* 2011).It is used in almost all dishes for imparting pungency. It is one of the important spices used very widely in culinary, pharmaceutical and beverage industries throughout the world (Tamil selvi and Vijaya raghavan, 2014). Dried fruits are used to make universal curry powder and curry paste. The fruit of chilli contain carbohydrates, vitamin A and vitamin C. Fresh green and ripe chillies are used to make all kinds of pickles, different sauces and paste. The red colour, capsanthin is used in high quality cosmetic preparations like lipstick. The essential oil, oleoresin is used in the food and beverage industries.The pungency is due to an active principle "Capsaicin" an alkaloid present in pericarp and placenta, which are a digestive stimulant and an important ingredient of daily diet and a cure for many rheumatic problems. Capsaicin has also substantial anti genotoxic and anti carcinogenic effects. The antioxidants present in the chilli wipe out the radical bodies that could build up cholesterol causing major heart diseases such as atherosclerosis. It increases supply of nutrients to the tissues and also acts as gastrointestinal detoxicants helping in digestion of food. Chillies such as red pepper have carotenoid lycopene, which prevents cancer disease, lowers blood cholesterol, causes the brain to release endorphins in runners, protective against peptic ulcer disease, relieve rheumatic pain etc.

Even though India occupies a dominant position in production of chilli, we are still not able to exploit the full potential of this crop (Ashoka *et al.,* 2013). In West Bengal, it is cultivated in an area of about 65,930 ha with a production of about 6, 43,677 tonnes.Plant growth regulators have potential ability to increase productivity of crops.Chilli in general have high rate of flower drop. In chilli over 60% of the flowers produced in a plant are shed; by decreasing flower drop, yield can be increased considerably (Tamil selvi and Vijaya raghavan, 2014). The production of chilli is reduced due to flower and fruit drop, which is caused by physiological and hormonal imbalance in the plant particularly under un favourable condition such as extremes of temperature i.e too low or high temperature (Erickson and Makhart, 2001). Studies on the effect of plant growth regulators in chilli have revealed that the application of some of the growth regulators has been found effective in reducing the flower and fruit drop thereby enhancing production of chilli per unit area and per unit time (Balraj *et al.,* 2002; Chowdhary *et al.,* 2006; Sultana *et al.* (2006), Singh *et al.,* 2010 and Athaneria *et al.,* 2011). Kannan (2009) evaluated the three growth regulators namely NAA (25 and 50 ppm), $GA_3$ (25 and 50 ppm) and 2,4-D (5 and 10 ppm) and recorded highest yield of chilli with NAA 50 ppm during both summer and winter season.

However, information regarding the effectiveness of plant growth regulators on growth and yield of chilli in alluvial plains of West Bengal is meager. The present study was, therefore, conducted with suggested concentration of imposed PGRs as foliar spray to determine the effective growth regulators and concentrations promoting growth and yield in commercial chilli cultivar namely Beldanga.

## MATERIALS AND METHODS

The present experiment was undertaken during the rabi (winter) season of two consecutive years *i.e.*, 2012-13 and 2013-14 for studying the effect of growth regulators on the growth and yield of chilli at the Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal. The experimental area was demarcated into 39 plots of 2.0 x 1.6 m dimension with irrigation channels of 0.30 m wide. Three concentration of four growth regulators namely NAA (25, 50 and 75 ppm), $GA_3$ (20, 40 and 60 ppm), 2, 4-D (5, 7.5 and 10 ppm) and Ethrel (300, 400 and 500 ppm) were included. The regulators were applied as foliar spray at 30 and 60 days after transplanting (DAP). There were altogether 13 treatments including control (water spray).In both the years, the seedlings were transplanted during middle of November at 50x40 cm spacing accommodating 16 plants per plot. The experiment was laid out in RBD with three replication.

The NPK dose was 150: 80: 80 kg/ha.Well rotten FYM @ 20 t/ ha was applied at the time of field preparation. The full dose of phosphorus, potash and half dose of nitrogen were applied as basal dressing. Remaining half dose of nitrogen was applied 45 days after planting as top dressing. Urea, single super phosphate and muriate of potash were used as a source of nitrogen, phosphorus and potassium, respectively. Five plants from each plot were randomly selected and tagged for assessing the parameters of each treatment. The observations regarding plant height, spread of plants were recorded at 45 and 105DAP.The projected yield per hectare was calculated on the basis of yield per plot, considering 75% area occupied by chilli in the present experiment. Data recorded on different parameters of chilli for both the years were pooled together and analyzed statistically (Panse and Sukhatme, 1985) to express the result.

## RESULTS AND DISCUSSION

Among different treatments (Table 1 and 2) maximum plant spread East-West direction [46.97 cm], number of fruits per plant (94.83), fruit length (6.80 cm), yield per plot (2.72 kg/ 3.2m 2) and projected yield per hectare (6.37 t) were observed in plants raised from NAA 75 ppm treated plants. The increase in such yield and its components may be due to influence of growth regulators on better growth of plant, higher fruit set and lower flower and fruit drop. The plants sprayed with growth regulators remained physiologically more active to build up sufficient food reserve (source) for developing flowers and fruits (sink). Such results were also obtained by Natesh *et al.* (2005) in chilli.

Maximum plant height (75.60 cm), plant spread in North-South direction (46.53 cm) and maximum fruit diameter (1.24 cm) were recorded in $GA_3$ 60 ppm treated plants (Table 1 and 2). Statistically significant results were observed for days to flowering with different growth regulator treatments. The most delayed flower initiation takes place in plants treated with $GA_3$ 60 ppm (47.56 days) as compared to earliest flowering (38.26 days) in NAA 75 ppm (Table 1). The maximum stalk length (3.61cm) was noticed in ethrel 500 ppm treated plants as compared to minimum value (3.08cm) under control. Maximum fresh weight of 20 fruits (39.25g) was noticed in NAA 50 ppm treated plants as compared to lowest fruit weight (31.99g) in 2,4-D 7.5ppm treated plants. In respect of dry weight of 20 fruits the maximum (9.39 g) and minimum (6.82g) values were observed in $GA_3$ 20 ppm and ethrel 500 ppm treated plants (Table 2). Better performance of NAA might be due to appropriate growth of plants, control of abscission layer in full bloom stage and acceleration in fruit development by the positive hormonal actions. These results are supported by the findings of Khurana *et al.* (2004),Chowdhary *et al.* (2006) and Athaneria *et al.* (2011).

The projected yield under untreated control was 4.34 t/ha. Among the four plant growth regulators the increasing trend in respect of both growth and yield parameters were noticed in case of both NAA and $GA_3$ but opposite trend was noticed in respect of 2,4-D and ethrel.

An increase in the growth parameters could be attributed to the increase in meristematical activity of apical tissue due to exogenous application of auxins. As growth regulators such as NAA and $GA_3$ are involved in increasing photosynthetic activity, efficient translocation and utilization of photosynthates causing rapid cell elongation and cell division in growth pattern of the plant or stimulation of growth, besides increasing the

**Table 1: Influence of growth regulators on vegetative growth and flowering of chilli (Pooled data**

| Treatment | Plant height (cm) | | Plant spread (E-W) [cm] | | Plant spread (N-S) [cm] | | Days |
|---|---|---|---|---|---|---|---|
| | 45DAP | 105DAP | 45 DAP | 105DAP | 45 DAP | 105DAP | to flowering |
| NAA 25ppm | 33.83 | 60.33 | 25.10 | 43.80 | 25.40 | 42.65 | 46.25 |
| NAA 50ppm | 35.97 | 63.37 | 27.07 | 45.98 | 25.35 | 44.42 | 39.82 |
| NAA 75ppm | 38.53 | 70.23 | 26.04 | 46.97 | 27.44 | 45.27 | 38.26 |
| $GA_3$ 20ppm | 27.73 | 58.67 | 23.71 | 45.47 | 23.75 | 44.09 | 42.53 |
| $GA_3$ 40ppm | 28.70 | 62.00 | 24.57 | 45.39 | 26.50 | 44.57 | 39.28 |
| $GA_3$ 60ppm | 32.30 | 75.60 | 23.67 | 46.50 | 25.34 | 46.53 | 47.56 |
| 2,4-D 5ppm | 33.80 | 57.97 | 19.70 | 37.75 | 22.49 | 42.10 | 43.14 |
| 2,4-D 7.5ppm | 38.50 | 64.13 | 23.03 | 44.97 | 20.77 | 43.69 | 41.38 |
| 2,4-D 10ppm | 31.80 | 59.10 | 22.60 | 38.70 | 19.14 | 38.80 | 38.72 |
| Ethrel 300ppm | 37.27 | 66.10 | 21.10 | 40.83 | 20.49 | 43.50 | 40.13 |
| Ethrel 400ppm | 34.17 | 59.47 | 21.44 | 41.73 | 20.67 | 42.87 | 41.28 |
| Ethrel 500ppm | 32.23 | 45.20 | 20.70 | 36.87 | 17.95 | 37.80 | 46.75 |
| Control | 27.47 | 56.90 | 21.70 | 38.40 | 19.50 | 41.93 | 43.76 |
| S.Em(±) | 0.935 | 1.940 | 2.155 | 1.468 | 1.758 | 0.968 | 1.057 |
| C.D. (p=0.05) | 2.912 | 6.044 | NS | 4.573 | 5.476 | 3.015 | 3.292 |

NS = Non-significant

**Table 2: Influence of growth regulators on fruit characters and yield of chilli (Pooled data)**

| Treatment | Number of fruits per plant | Fruit length (cm) | Fruit diameter (cm) | Stalk length (cm) | Fresh weight of 20 fruits (g) | Dry weight of 20 fruits (g) | Yield per plot (kg/ 3.2m$^2$) | Projected yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| NAA 25ppm | 79.98 | 6.15 | 1.02 | 3.26 | 36.09 | 8.17 | 2.16 | 5.07 |
| NAA 50ppm | 88.83 | 6.70 | 1.09 | 3.15 | 39.25 | 7.67 | 2.58 | 6.05 |
| NAA 75ppm | 94.83 | 6.80 | 1.21 | 3.38 | 39.17 | 9.05 | 2.72 | 6.37 |
| $GA_3$ 20ppm | 81.70 | 6.68 | 1.14 | 3.15 | 38.41 | 9.39 | 1.96 | 4.60 |
| $GA_3$ 40ppm | 85.56 | 6.48 | 1.14 | 3.18 | 35.81 | 8.02 | 2.26 | 5.29 |
| $GA_3$ 60ppm | 87.86 | 6.09 | 1.24 | 3.15 | 33.40 | 7.84 | 2.33 | 5.46 |
| 2,4-D 5ppm | 75.83 | 6.46 | 1.12 | 3.50 | 34.20 | 8.06 | 2.09 | 4.89 |
| 2,4-D 7.5ppm | 79.13 | 6.29 | 1.19 | 3.60 | 31.99 | 7.67 | 1.67 | 3.91 |
| 2,4-D 10ppm | 63.37 | 5.90 | 1.21 | 3.59 | 32.91 | 7.93 | 1.33 | 3.11 |
| Ethrel 300ppm | 73.93 | 6.62 | 1.07 | 3.16 | 33.44 | 7.76 | 1.98 | 4.64 |
| Ethrel 400ppm | 71.53 | 6.24 | 1.08 | 3.41 | 33.42 | 7.85 | 1.54 | 3.85 |
| Ethrel 500ppm | 59.83 | 6.18 | 1.06 | 3.61 | 32.35 | 6.82 | 1.25 | 2.91 |
| Control | 70.97 | 6.08 | 1.05 | 3.08 | 33.56 | 8.13 | 1.85 | 4.34 |
| S.Em(±) | 1.799 | 0.145 | 0.114 | 0.055 | 1.227 | 0.370 | 0.102 | 0.249 |
| C.D. (P=0.05) | 5.603 | 0.453 | 0.354 | NS | 3.822 | 1.151 | 0.317 | 0.777 |

NS = Non-significant

uptake of nutrients (Dicks, 1980). Similar beneficial effect of growth regulators also obtained by Natesh *et al.* (2005),Sultana *et al.* (2006),Deshmukh (2010), Athaneria *et al.* (2011)and Rongsennungla *et al.* (2012) inchilli. The beneficial effect of plant growth regulators also noticed by several workers in different crops like in Rose (Muthukumar *et al.,* 2012), Papaya (Ramteke *et al.,* 2015) and Banana (Mulagund *et al.*, 2015).

The plants sprayed with NAA and $GA_3$ remained physiologically more active to build up sufficient food reserve for developing flowers and seed. Such results were also obtained by Natesh, *et al.* (2005) and Deshmukh (2010) in chilli. The increase in fruit size could be due to accelerated rate of cell enlargement and formation of larger intercellular spaces during later part of fruit growth as a result of NAA application. Increase in fruit weight might be due to increase in seed content, fruit size as well as rapid multiplication and enlargement of cell. Higher fruit size and fruit weight with NAA application in the present investigation corroborate with findings of Katwale and Saraf (1990).

The treatment NAA at 50 ppm recorded the highest estimated yield per hectare (12.89 and 12.28 t) during winter and summer respectively. Increased yield due to NAA application was reported by Lyngdon and Sanyal (1992) in capsicum and Sharma *et al*. (1999) in bell pepper. Increased yield due to the application of 2, 4-D at 10 ppm was reported by Pampapathy and Rao (1975) in chilli but no positive response of 2, 4-D was noticed with higher concentration in the present investigation.

Improvement in pepper growth and yield under $GA_3$ application compared to the control was observed. This might be ascribed to more efficient utilization of food for reproductive growth (flowering and fruit set), higher photosynthetic efficiency and enhanced source to sink relationship of the plant, reduced respiration, enhanced translocation and accumulation of sugars and other metabolites. Inhibition of growth performance on exposure to the other PGRs occurred (Georgia *et al.,* 2010).

From yield maximization point of view the most effective treatment was NAA 75 ppm followed by NAA 50 ppm and $GA_3$ 60 ppm under alluvial plains of West Bengal for chilli production.

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