

EFFECT OF NAA ON GROWTH AND YIELD ATTRIBUTES OF CHILLI (*CAPSICUM ANNUUM* L.) PRODUCTION UNDER INTEGRATED USE OF ORGANIC AND INORGANIC FERTILIZERS

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KEYWORDS

Chilli
NAA
RDF
Vermi compost

Received on :
13.01.2016

Accepted on :
20.05.2016

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ABSTRACT

The present experiment was carried out with chilli cv. Jawaher mirch 218 with a view to study the effect of NAA and integrated use of organic and inorganic fertilizers. The experiment was framed with four levels of NAA (0 ppm, 25 ppm, 50 ppm and 75 ppm) and five levels of vermi compost along with RDF (V₀-100% Recommended dose of fertilizer i.e., 120:60:60 Kg N P K/ha, V₁-100% N through Vermi compost (VC), V₂-75% N through VC + 25% (RDF), V₃-50% N through VC + 50% (RDF), V₄-25% N through VC + 75% (RDF) having 20 treatment combinations, replicated thrice. The results of the experiment showed that the combined application of NAA 50 ppm + 50% N through vermi compost along with 50% RDF i.e. P₂V₃ gave significantly highest number of fruits/plant (73.86) and yield (121.20q/ha) whereas foliar spray of 50 ppm NAA + 100% RDF i.e. P₂V₀ produced maximum plant height (71.80 cm) and number of branches /plant (12.63). The foliar application of 50 ppm NAA and 100% N through vermi compost i.e., P₂V₁ gave maximum fruit length (8.73 cm), fruit diameter (1.46 cm) and fruit weight (2.91g). The sole application of NAA (50 ppm) and 50% N through vermi compost were also found beneficial for higher fruit yield 108.39 q/ha and 102.46 q/ha respectively.

INTRODUCTION

Chilli (*Capsicum annuum* L.) is one of the important annual commercial vegetable cum spice crop belongs to the family Solanaceae. Chilli being a heavy feeder and exhaustive crop responds very well to nutrient application. The high use of chemical fertilizers to increase vegetable production has been widely recognized but its long run impact on soil health, ecology and other natural resources are detrimental. Adoption of integrated use of organic and inorganic fertilizers offers scope for sustainable crop production as well as maintenance of soil health (Lal and Kanaujia, 2013). Vermicompost in agriculture is economical with regard to food production and more eco-friendly to environment and soil protection (Haynes *et al.*, 1999). The unique advantage of using vermicompost is that it helps to build and sustain soil condition and fertility which is necessary for prolonged agricultural activities and also reduces bad odour and prevent pollution of soil, air and water. The higher yields in the plants might be due to the fact that vermicompost supplied direct available nutrients such as nitrogen to the plants and this organic fertilizer improved the proportion of water stability of the soil (Hendrix *et al.*, 1994). The production of chilli is reduced due to flower and fruit drop which is caused by physiological and hormonal imbalance in plants particularly under unfavorable environmental condition such as extremes of temperature i.e. too high or low temperature (Erickson and Makhart, 2001).

Naphthalene acetic acid (NAA), a synthetic auxins have gained immense importance in horticultural crops. NAA stimulate germination, rooting and flowering in several vegetables. It also helps in fruit setting and prevention of premature flower and fruit drop. The consistent efforts are being made to reduce the flower and fruit drop in chilli by spraying NAA (Pandey *et al.*, 1980, Hariharan and Unnikrishnan, 1983 and Lata and Singh, 1993). NAA improves the internal physiology of plants in terms of better supply of water, nutrient and other biocompounds vital for their proper growth and development (Meena and Dhaka, 2003) and (Khurana *et al.*, 2004). In view of the above, the investigation was undertaken to find out the growth and yield parameters of chilli production under integrated use of organic and inorganic fertilizers along with foliar spray of NAA.

MATERIALS AND METHODS

The present experiment was carried out in the Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural College Sabour during summer season 2014. The experiment was laid out in a factorial randomized block design, replicated thrice with variety Jawaher Mirch 218. Naphthalene Acetic acid (NAA), vermi compost as organic manure and inorganic fertilizer such as urea, single super phosphate (SSP) and murate of potash (MOP) were used. There were four levels of NAA (P₀ - 0 ppm, P₁ - 25 ppm, P₂ - 50 ppm and P₃ - 75

ppm) and five levels of vermicompost along with RDF (V_0 -100% Recommended dose of fertilizer *i.e.*, 120:60:60 Kg N P K /ha), V_1 -(100% N through Vermicompost), V_2 -(75% N through VC + 25% RDF), V_3 -(50% N through VC + 50% RDF) and V_4 -(25% N through VC + 75% RDF) having 20 treatment combinations. The soil of the experimental plot was sandy loam in texture having pH 7.8 and electrical conductivity (EC) of 0.11 dS/m. The soil was low in organic carbon (0.42%) having available nitrogen (125.11 kg/ha), phosphorus (26.28 kg/ha) and potassium (206.18 kg/ha). Organic carbon, pH, available nitrogen, available phosphorus and potassium were analyzed following the method furnished by Piper (1950), Schofield and Taylor (1965), Jackson (1963), Olsen *et al.*, (1954) and Toth & Prince (1944), respectively. Treatment wise vermicompost and full dose of P_2O_5 and K_2O as well as 1/3rd dose of nitrogen were applied and mixed thoroughly and then plots were dressed for transplanting. Well developed healthy and uniform seedling attaining an age of 35 days were uprooted from the nursery and transplanted with a spacing 50cm x 30cm. First top dressing of 1/3rd N as urea was done after 20 days after transplanting and 2nd top dressing was done 50 days after transplanting. The treatment wise NAA was sprayed early in the morning when dews have evaporated. First spray of NAA was done after 35 days after transplanting and second was at the time of flowering. The observations were recorded on vegetative characters such as plant height, number of primary branches per plant and yield attributing characters like number of fruits per plant, fruit length, fruit diameter, fruit weight, fruit yield per plant, and yield (fresh green fruit) q/ha. The statistical analysis of the data recorded in all observation was carried out by the method of "Analysis of variance" prescribed by Fisher and Yates (1963). Comparison of treatment was made with the help of critical differences (CD).

RESULTS AND DISCUSSION

The results revealed that the NAA 50 ppm (P_2) produced highest plant height (68.72 cm) and number of primary branches per plant (12.21). The promoting effect on plant height by the application of NAA is might be due to its action as a group of auxins, the cell wall probably reacted favorably and high deposition of cell wall material took place due to high catalyzing activities of carbohydrates and pectinase. NAA treatment might be attributed to the activation of cell division and cell elongation in the auxiliary buds, which had a promoting effect on increased number of primary branches. These results are in collaboration with the findings of Kannan *et al.* (2009), Athaneria *et al.* (2011), Veishnav *et al.* (2012) and Tyagi *et al.* (2014). The maximum plant height (67.89 cm) and number of primary branches per plant (12.03) were associated with sole application of RDF which was significantly superior to sole application of vermicompost (V_1) or different levels of vermicompost along with RDF. Formation of taller plants under the supply of higher dosages of fertilizers directly relates to the function of major nutrients, NPK in plant's metabolism. According to Russell (1963) nitrogen is an energy storer in plant body. Being a constituent of amino acids, nucleotides, nucleic acids, a number of coenzymes, auxins, cytokinins and alkaloids, it induces cell elongation, cell

enlargement and cell division. Phosphorus is a constituent of nucleic acid, phytin and phospholipids. Phosphorus is also an essential constituent of majority of enzymes which are of great importance in the transformation of energy, in carbohydrate metabolism, fat metabolism and also in respiration in plants. Similarly, potash is essential in formation and transfer of starches and sugars. It also regulates water conditions within the plant cell and water loss from plant by maintaining the balance between anabolism, respiration and transpiration (Yawalkar *et al.* 1992). Thus, adequate supply of the three major nutrients NPK is expected to regulate plant physiological functions and morphological responses favourably. These results are in close agreement with the findings of Yadav *et al.*, (2003), Haque *et al.*, (2004) and Chadha *et al.*, (2006).

It is evident from the data (Table 1) that application of NAA at 50 ppm (P_2) gave highest number of fruits (71.33), fruit length (8.55 cm), fruit diameter (1.41 cm), fruit weight (2.81 g), fruit yield per plant (202.53 g) and fresh fruit yield q/ha (108.39). However, NAA at 75 ppm (P_3) was at par with fruit length and fruit weight. The increase in fruit length and diameter might be attributed to increase in the number of cells as well as elongation of cells which is characteristic action of NAA. These results are supported by Kannan *et al.*, (2009). Better performance of NAA might be due to appropriate growth of plants, control of abscission layer in full bloom stage which accelerates fruit setting and increase in number of fruits, which ultimately increased yield. These results are also in close conformity with earlier findings of Khurana *et al.*, (2004) and Choudhary *et al.*, (2002).

Fruit length, diameter and average fruit weight were influenced significantly due to different levels of vermicompost along with RDF. Treatment V_1 (100% N through VC) registered maximum fruit length (8.67 cm), fruit diameter (1.36 cm) and fruit weight (2.78 g) and found significantly superior to the rest levels of vermicompost along with RDF. This might be due to sole application of vermicompost caused shorter plant height, lesser number of branches which ultimately produced less number of fruits, so the synthesized food materials which were later translocated into developing fruits resulting in increased fruit length, fruit diameter and fruit weight. These results are in agreement with the findings of Vimera *et al.*, (2012), Verma *et al.*, (2012), and Chumei *et al.*, (2013). However, maximum number of fruit (69.36), fruit yield per plant (184.69 g), fresh green fruit yield (102.46 q/ha) were recorded in V_3 (50% N through VC + 50% RDF). The possible reason might be due to use of optimum utilization of nutrients from the combine application of vermicompost along with recommended dose of fertilizers, exceeding the capacity of root absorption and enhancing the source-sink relationship and also maintained the physiology of plant which reduce the fruit drop and increase the number of fruits and ultimately increase yield. These results are in close conformity with earlier finding of Hangarge *et al.* (2002), Karupiah (2005), Mohammed Rafi *et al.* (2002) and Shashidhara (2000).

The interaction effect between NAA and vermi compost along with RDF levels were found to be quite superior to their individual effect. Among the treatment combinations P_2V_0 (50 ppm NAA + 100% RDF) exhibited significantly highest values

Table 1: Effect of levels of NAA on growth and yield attributes of chilli

Levels of NAA	Plant height (cm)	No. of primary branches/plant	Number of fruits/plant	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit yield/plant (g)	Fresh fruit yield (q/ha)
P ₀ (0 ppm)	55.17	10.4	55.66	7.85	1.12	2.11	119.09	66.03
P ₁ (25ppm)	62.61	11.23	65	8.15	1.23	2.61	162.57	88.87
P ₂ (50ppm)	68.72	12.21	71.33	8.55	1.41	2.81	202.53	108.39
P ₃ (75ppm)	68.06	11.79	69.44	8.47	1.38	2.79	196.65	104.84
CD at 5%	0.62	0.13	0.61	0.08	0.014	0.029	1.8	0.95

Table 2: Effect of levels vermicompost along with RDF on growth and yield attributes of chilli

Levels of vermicompost along with RDF	Plant height (cm)	No.of primary branches/plant	Number of fruit plant	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (cm)	Fruit yield/plant (g)	Fresh yield (q/ha)
V ₀ (100 % RDF)	67.89	12.03	58.5	7.77	1.18	2.44	147.58	76.52
V ₁ (100%N through VC)	57.54	10.53	60.4	8.67	1.36	2.78	164.35	90.3
V ₂ (75%N through VC + 25% RDF)	62.07	10.91	66.65	8.45	1.33	2.63	178.6	97.61
V ₃ (50% N through VC + 50% RDF)	64.7	11.98	69.36	8.17	1.26	2.59	184.69	102.46
V ₄ (25% N through VC +75% RDF)	65.98	11.6	67.88	8.2	1.26	2.46	175.82	93.26
CD at 5%	0.77	0.16	0.76	0.09	0.01	0.03	2.25	1.19

Table 3: Combined effect of NAA and vermicompost along with RDF on growth and yield attributes of Chilli

P X V	Plant height (cm)	No. of primary branches/plant	Number of fruits/plant	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit yield/plant (g)	Fresh fruit yield (q/ha)
POV0	60.23	11	47.33	6.67	0.85	1.76	94.53	54.51
POV1	47.73	9.07	52.4	8.59	1.27	2.56	107.28	60.46
POV2	52.26	9.2	56.4	8.25	1.2	2.25	126.9	69.37
POV3	57.13	11.2	61.8	7.98	1.16	2.18	134.72	73.64
POV4	58.47	11.13	60.4	7.76	1.13	1.8	132.05	72.18
P1V0	67.8	12.17	52.86	7.36	1.14	2.53	127.53	69.72
P1V1	50.5	9.63	65.4	8.69	1.29	2.77	149.16	81.54
P1V2	61.96	10.47	68.4	8.37	1.3	2.62	179.21	97.96
P1V3	65.6	12.13	70.6	8.2	1.24	2.6	183.56	100.34
P1V4	67.2	11.73	67.73	8.12	1.2	2.55	173.39	94.78
P2V0	71.8	12.63	68.2	8.59	1.38	2.75	186.04	91.2
P2V1	61.13	11.83	70.4	8.73	1.46	2.91	204.42	111.75
P2V2	67.3	12.17	71.6	8.62	1.42	2.85	208.06	113.73
P2V3	68.73	12.47	73.86	8.31	1.4	2.8	212.3	121.2
P2V4	69.6	11.97	72.6	8.49	1.39	2.76	201.83	104.08
P3V0	71.73	11.93	65.6	8.46	1.35	2.73	182.23	90.66
P3V1	65.8	11.59	69.2	8.68	1.44	2.87	196.57	107.45
P3V2	66.73	11.8	70.2	8.58	1.38	2.81	200.26	109.4
P3V3	67.36	12.11	71.2	8.19	1.35	2.78	208.19	114.66
P3V4	68.67	11.53	70.8	8.45	1.35	2.74	196.03	102
CD at 5%	5.38	1.13	5.31	0.65	0.13	0.25	15.64	8.29

of plant height (71.80 cm) and number of primary branches (12.63). This might be due to the fact that NAA and NPK enhance the cell division and cell elongation which cause increase in plant height and number of branches. The combined application of NAA and vermicompost *i.e.*, P₂V₁ (50 ppm NAA + 100% N through VC) recorded significantly higher fruit length (8.73 cm), fruit diameter (1.46 cm) and fruit weight (2.91 g). The combine supplementation of 50 ppm NAA and 50% N through vermicompost along with 50% RDF *i.e.* P₂V₃ exhibited significantly maximum number of fruits (73.86), fruit yield per plant (212.30 g), and fresh fruit yield

(121.20 q/ha). This might be due to the fact that combine application provides sufficient nutrients to plant for proper growth and development. NAA and NPK enhance the mobilization of photo assimilates at a faster rate which increase number of fruits and ultimately yield. These results are in close agreement with the findings of Kalshyam (2011), Singh and Mukherjee (2002), Hangarge *et al.* (2002) and Karupiah (2005). Therefore, it can be concluded based on the above results and discussion, foliar application of NAA 50 ppm + 50% N through vermi compost alongwith 50% RDF was found beneficial and this treatment can be used for higher yield of

chilli.

ACKNOWLEDGEMENT

The authors acknowledge, Chairman, Department of Horticulture, (Vegetables and Floriculture), Bihar Agricultural College, Bihar Agricultural University, Sabour, India for providing all the required infrastructure and facilities for the present work and those scientists whose published works has been cited in the text of this research paper.

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