Annals of Plant and Soil Research 25(4): 660-664 (2023)
https://doi.org/10.47815/apsr.2023.10319

Effect of various levels of nitrogen on yield attributes of sweet pepper (*Capsicum annuum* L. var. grossum) under temperate conditions of Kashmir

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Received: August, 2023; Revised accepted: November, 2023

ABSTRACT

A field investigation was undertaken during kharif seasons of 2021 and 2022 at Vegetable Experimental Farm of Division of Vegetable Science, SKUAST-Kashmir, Shalimar with an objective to study the effect of various levels of nitrogen on yield attributes of sweet pepper (Capsicum annuum L. var. grossum) under temperate conditions of Kashmir. The experiment was laid out in split plot design with four replications to evaluate different treatments. The experiment was carried out with two varieties of sweet pepper (California Wonder and Nishat-1) as main plot treatments and five levels of nitrogen as sub plot treatments (0, 80, 120,140 and 160 kg ha^{-1}) during two consecutive kharif seasons of 2021 and 2022. Results indicated that different nitrogen levels markedly increased yield and yield attributing traits in sweet pepper. The pooled data over years 2021 and 2022 regarding yield and yield attributing parameters was found to be maximum when the crop was fertilized with 120 kg N ha^{-1} recording maximum values for fruit length (7.88 cm), fruit diameter (6.62 cm), number of fruits plant^{-1} (11.13), average fruit weight (57.45 g), fruit yield plant^{-1} (0.64 kg), fruit yield plot^{-1} (10.29 kg) and fruit yield hectare^{-1} (238.14 q). Therefore maximum yield was obtained from plants subjected to 120 kg N ha^{-1} (N_2 level) which were statistically at par with 140 kg N ha^{-1} (N_3 level) and 160 kg N ha^{-1} (N_4 level) hence can be recommended for improving the production of sweet pepper.

INTRODUCTION

Bell pepper (*Capsicum annuum* L. var. grossum) belongs to family Solanaceae with chromosome number 2n = 2x = 24. It is also known as sweet pepper, green pepper and Shimla mirch. It is grown worldwide for its delicate taste, pleasant flavor and colour and is also one of the most leading crop grown under protected structures. It differs from common hot pepper/chilli with respect to size and shape of fruits, use and amount of capsaicin. Sweet pepper consists of tall and stout plants with generally large sized fruits which are smooth, thick fleshed, inflated with depression at the base. Sides of the fruits are usually furrowed. Fruits are 3-4 lobed, broadly oblong, bell or apple shaped, generally green at immature stage and yellow or orange red or red when mature and non-pungent or mild in flavor. In India sweet pepper is grown over an area of 35 thousand hectares with a production of 560 thousand metric tonnes (Anonymous, 2020). In Jammu and Kashmir, it is grown as summer crop over an area of about 1.21 thousand hectares with an annual production of 13.63 thousand metric tonnes (Anonymous, 2018). Nitrogen is an essential nutrient which is a determining factor in crop production and is absorbed primarily in the form of nitrate. It constitutes about 1.5-6% of the dry weight of many crops apart from being a constituent of many organic compounds, nucleic acids and protein compounds (Sanjuan *et al.,* 2003). Plants absorb nitrogen mainly in the nitrate (NO_3^-) and ammonium (NH_4^+) forms, both of which are metabolised by plants. Nitrogen also mediates the utilization of potassium, phosphorus and other elements in plants and the optimum amounts of these elements in the soil cannot be utilized efficiently if nitrogen is deficient in plants. The yield depends upon certain factors, among these; proper balanced nutrition plays a significant role. Bell pepper requires optimum nitrogen application for higher yield as it imparts good vegetative growth necessary for proper development of fruit. Nitrogen is usually applied in splits in the field to avoid various nitrogen losses as nitrogen is highly volatile so in order to prevent such losses, split application of fertilizers is given as it fulfill the crop requirements at the time of need. Application of optimum quantity of nitrogen during the crop growing period is essential for maximizing the yield profit as well as for reducing the environmental pollution (Reddy and Tiwari, 2018).

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MATERIALS AND METHODS

The experiment was laid out for two consecutive years of 2021 and 2022 during Kharif seasons at Experimental Field of Division of Vegetable Science, Sher-e-Kashmir University of Agricultural Sciences and Technology, Shalimar, Kashmir. The experiment was laid out in split plot design with four replications to evaluate different treatments. The experiment was carried out with two varieties of sweet pepper (California Wonder and Nishat-1) as main plot treatments and five levels of nitrogen as sub plot treatments (0, 80, 120,140 and 160 kg ha^{-1}). Forty (40) plots of 2.4 m × 1.8 m size were prepared as per layout specification to accommodate 16 plants $plot^{-1}$. Recommended dose of phosphorus and potassium (90:60 kg ha^{-1}) was provided through diammonium phosphate and muriate of potash. The source of nitrogen in the experiment was urea (46%), which was applied as per the treatments in two split doses i.e. half of nitrogen was applied as basal dose at the time of transplantation and the remaining half 30 to 40 days after transplanting. A few gap filling was done by healthy plants whenever it was required. Irrigation along with other intercultural operations and plant protection measures were taken as and when necessary. Data were collected on yield and its attributing parameters viz., fruit length, fruit diameter, number of fruits per plant, average fruit weight and fruit yield and analyzed statistically. The length of fruit was measured from fruit base to the top with the help of digital vernier calliper of five selected fruits from each treatment and their average was taken as the length of fruit. Diameter of fruit was measured at the middle portion of five selected fruits from each plot with a vernier calliper and the average was calculated and expressed in centimeter. Total number of fruits harvested at different pickings from five selected plants in each treatment was added and average was calculated to work out fruit number per plant. Fresh weight of capsicum fruits from five randomly selected plants from each plot were taken at the time of second picking and weighed and their average was calculated. The total yield per plant was calculated by adding the yield of all the harvests (matured fruits) of tagged plants and average was worked out. The total fresh fruit yield per plot was obtained by adding fresh fruit yield from each picking in the plots. The yield $plot^{-1}$ (kg) was converted into q ha^{-1} for each treatment. Data collected were subjected to analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Data presented in Tables 1, 2 and 3 revealed significant effect of various levels of nitrogen on yield and yield attributing traits in sweet pepper. Perusal of the pooled data over years 2021 and 2022 revealed that higher fruit length of 7.76 cm, fruit diameter of 6.79 cm, number of fruits $plant^{-1}$ of 11.62, average fruit weight of 57.13 g, fruit yield $plant^{-1}$ of 0.66 kg, fruit yield $plot^{-1}$ of 10.65 kg and fruit yield $hectare^{-1}$ of 246.52 q was recorded in variety Nishat-1 and lower fruit length of 6.66 cm, fruit diameter of 5.60 cm, number of fruits $plant^{-1}$ of 8.68, average fruit weight of 53.05 g, fruit yield $plant^{-1}$ of 0.46 kg, fruit yield $plot^{-1}$ of 7.37 kg and fruit yield $hectare^{-1}$ of 170.61 q was recorded in variety California Wonder.

Table 1: Effect of various levels of nitrogen on fruit length (cm) and fruit diameter (cm) in sweet pepper

Pooled data of fruit length and fruit diameter (2021-2022)						
	Fruit length (cm)			Fruit diameter (cm)		
Variety N-Levels	V_1 (California Wonder)	V_2 (Nishat-1)	Mean	V_1 (California Wonder)	V_2 (Nishat-1)	Mean
N_0 (0 kg ha^{-1})	6.17	6.90	6.54	5.15	6.18	5.66
N_1 (80 kg ha^{-1})	6.34	7.24	6.79	5.39	6.39	5.89
N_2 (120 kg ha^{-1})	7.12	8.65	7.88	5.95	7.29	6.62
N_3 (140 kg ha^{-1})	6.91	8.12	7.52	5.87	7.10	6.48
N_4 (160 kg ha^{-1})	6.73	7.89	7.31	5.63	6.87	6.25
Mean	6.66	7.76		5.60	6.76	
		C.D ($p \leq 0.05$)				
V		0.475			0.133	
N		0.319			0.133	
V x N		0.794			0.266	

Further perusal of the pooled data over years 2021 and 2022 also showed that maximum fruit length of 7.88 cm, fruit diameter of 6.62 cm, number of fruits plant^{-1} of 11.13, average fruit weight of 57.45 g, fruit yield plant^{-1} of 0.64 kg, fruit yield plot^{-1} of 10.29 kg and fruit yield hectare^{-1} of 238.14 q was recorded when the crop was fertilized with 120 kg N ha^{-1} (N_2) which was significantly superior to all other treatments while as significantly minimum values were recorded in control (N_0- 0 kg Nha^{-1}). Therefore maximum yield was obtained from plants subjected to 120 kg N ha^{-1} (N_2 level) which was statistically at par with 140 kg N ha^{-1} (N_3 level) and 160 kg N ha^{-1} (N_4 level).

Table 2: Effect of various levels of nitrogen on number of fruits plant^{-1} and average fruit weight in sweet pepper

Pooled data of number of fruits plant^{-1} and average fruit weight (2021-2022)						
	Number of fruits plant^{-1}			Average fruit weight (g)		
Variety N-Levels	V_1 (California Wonder)	V_2 (Nishat-1)	Mean	V_1 (California Wonder)	V_2 (Nishat-1)	Mean
N_0 (0 kg ha^{-1})	6.60	9.48	8.04	50.65	54.21	52.43
N_1 (80 kg ha^{-1})	8.50	11.0	9.75	51.90	56.07	53.98
N_2 (120 kg ha^{-1})	9.63	12.62	11.13	55.21	59.69	57.45
N_3 (140 kg ha^{-1})	9.50	12.59	11.05	54.21	58.17	56.19
N_4 (160 kg ha^{-1})	9.17	12.41	10.79	53.27	57.53	55.40
Mean	8.68	11.62		53.05	57.13	
C.D ($p \leq 0.05$)						
V	1.08			3.23		
N	0.86			3.49		
V x N	1.94			6.52		

Interaction effect of varieties and nitrogen levels on yield and yield attributing traits were found to be significant ($p \leq 0.05$). Treatment combination V_2N_2 (Nishat-1 and 120 kg N ha^{-1}) recorded maximum fruit length of 8.65 cm, fruit diameter of 7.29 cm, number of fruits plant^{-1} of 12.62, average fruit weight of 59.69 g, fruit yield plant^{-1} of 0.75 kg, fruit yield plot^{-1} of 12.07 kg and fruit yield hectare^{-1} of 279.45 q which were significantly superior to all other treatments however treatment combination V_1N_0 (California Wonder and 0 kg N ha^{-1}) recorded minimum values for all the traits. The reason for increase in fruit weight might be due to the accelerated mobility of photosynthates from source to sink and its accumulation in fruits at optimum doses of nutrient, increasing the rate of nitrogen fertilizers increases the average fruit weight but at higher doses (excessive nitrogen) total weight start to decreases.

Table 3: Effect of various levels of nitrogen on fruit yield plant^{-1}, fruit yield plot^{-1} and fruit yield hectare^{-1} in sweet pepper

Pooled data of fruit yield plant^{-1}, fruit yield plot^{-1}and fruit yield hectare^{-1} (2021-2022)									
	Fruit yield plant^{-1} (kg)			Fruit yield plot^{-1} (kg)			Fruit yield hectare^{-1} (q)		
Variety N-Levels	V_1 (California Wonder)	V_2 (Nishat-1)	Mean	V_1 (California Wonder)	V_2 (Nishat-1)	Mean	V_1 (California Wonder)	V_2 (Nishat-1)	Mean
N_0 (0 kg ha^{-1})	0.33	0.51	0.42	5.34	8.22	6.78	123.61	190.18	156.89
N_1 (80 kg ha^{-1})	0.44	0.61	0.52	7.05	9.82	8.44	163.38	227.37	195.37
N_2 (120 kgha^{-1})	0.53	0.75	0.64	8.50	12.07	10.29	196.82	279.45	238.14
N_3 (140 kgha^{-1})	0.51	0.73	0.62	8.1	11.74	9.96	189.32	271.75	230.53
N_4 (160 kg ha^{-1})	0.48	0.71	0.60	7.77	11.40	9.58	179.92	263.87	221.89
Mean	0.46	0.66		7.37	10.65		170.61	246.52	
C.D ($p \leq 0.05$)									
V	0.039			0.59			13.66		
N	0.052			0.84			19.60		
V x N	0.091			1.43			33.26		

These findings corroborate with the results obtained by Shahi *et al*. (2021) in brinjal. The increased fruit weight might also be due to optimum supply of nitrogen which promoted

flowering and fruiting and supply of food material which contributed to increased fruit weight and fruit yield per plant as reported by Rabindra and Srivastava (2006). The highest fruit yield could be attributed to the fact that nitrogen helps to build high-quality foliage and plays an important role in carbohydrate synthesis via photosynthesis, resulting in better yield. This was in agreement with the findings of Subedi *et al*. (2023) in chilli. Furthermore, the increase in yield might be due to more carbohydrate production and assimilation in fruit by the effect of nitrogen, phosphorus and potassium reported by Baloch *et al*. (2014) in radish. It was also reported by Aminifard *et al*. (2012) that nitrogen stimulated and enhanced the reproductive growth characters that were in agreement with the findings of Nawaz *et al*. (2012), Kumar *et al*. (2013) and Hozhbryan (2013) in tomato. The sufficient supply of three major nutrients nitrogen, phosphorus and potassium is anticipated to regulate plant physiological functions and morphological responses favourably (Shree *et al.,* 2014). The positive response shown by yield parameters to nitrogen could be directly linked to the well-developed photosynthetic surfaces and increased physiological activities leading to more assimilates being produced and subsequently translocation of assimilates and utilized for fast fruit development. This is in conformity with the findings of Aminifard and Bayat (2018) in capsicum and Nisar *et al*. (2023) in tomato. According to Wei *et al*. (2009) excess nitrogen application causes osmotic stress, which can cause oxidative damage injuring many important cellular components, such as lipids, protein, DNA and RNA leading to reduced growth and eventual yield of plants. According to Aydinsakir *et al*. (2019) and Matsumura *et al*. (2020) the buildup of too much nitrate can lower agricultural yield because it inhibits photosynthesis and enzyme activity.

CONCLUSION

Among the major nutrient required by crops, nitrogen is perhaps the most important nutrient because of its biological roles and because it is required in large quantities by the plants. In light of the results, it can be concluded that for obtaining highest fruit yield, application of 120 kg N ha^{-1} was found to be optimum for growing sweet pepper under temperate conditions of Kashmir.

REFERENCES

Aminifard, H.M. and Bayat, H. (2018). Influence of different rates of nitrogen fertilizer on growth, yield and fruit quality of sweet pepper (*Capsicum annum* L. var. California Wonder) *Journal of Horticulture and Postharvest Research* 1(2): 105-114.

Aminifard, M.H., Aroiee, H., Nemati, H., Azizi, M. and Khayyat, M. 2012. Effect of nitrogen fertilizer on vegetative and reproductive growth of pepper plants under field conditions. *Journal of Plant Nutrition* **35**: 235- 242.

Anonymous. (2018). Horticultural Statistics at a Glance by Horticulture Statistics Division, *Department of Agriculture Cooperation and Farmers Welfare*.

Anonymous. (2020). Area production of horticultural crops by Horticulture Statistics Division, *Department of Agriculture Cooperation and Farmers Welfare*.

Aydinsakir, K., Karaca, C., Ozkan, C.F., Dinc, N., Buyuktas, D. and Isik, M. 2019. Excess nitrogen exceeds the European standards in lettuce grown under greenhouse conditions. *Agronomy Journal* **111** (2): 764–769.

Baloch, P.A., Uddin, R., Nizamani, F.K., Solangi, A.H. and Siddiqui, A.A. (2014) Effect of nitrogen, phosphorus and potassium fertilizers on growth and yield characteristics of radish (*Raphanus sativus* L.). *American-Eurasian Journal of Agriculture and Environment Science* 14(6), 565-578.

Hozhbryan, M. 2013. Effect of different levels of urea on the growth and yield of tomato. *Journal of Novel Applied Sciences* **2**(53): 1031-1035.

Kumar, M., Meena, M.I., Kumar, S., Maji, S. and Kumar, D. 2013. Effect of nitrogen, phosphorus and potassium fertilizers on growth, yield and quality of tomato var. Azad T-6. *The Asian Journal of Horticulture* **8**(2): 616-619.

Matsumura, A., Hirosawa, K., Masumoto, H. and

Daimon, H. 2020. Effects of maize as a catch crop on subsequent garland chrysanthemum and green soybean production in soil with excess nitrogen, *Scientia Horticulturae* **273**: 109640.

Nawaz, H., Zubair, M. and Derawadan, H. 2012. Interactive effects of nitrogen, phosphorus and zinc on growth and yield of tomato (*Solanum lycopersicum). African Journal of Agricultural Research* **7**(26): 3792-3769.

Nisar, F., Mufti, S., Lone, B., Majid, I., Afroza,B., Mushtaq, F., Din, S., Nabi, J. and Javeed,I. (2023). Effect of Transplanting Dates and Nitrogen Levels on Yield Attributes of Tomato in Temperate Region of Kashmir. *Biological Forum – An International Journal* 15(3): 72-77.

Rabindra, K. and Srivastava, B.K. 2006. Residual effect of integrated nutrient management on growth, yield and yield attributes of tomato. *Indian Journal of Horticulture* **63**: 98-100.

Reddy, G.R.A. and Tiwari, K.N. (2018) Assessment of CROPGRO-Bellpepper model under different nitrogen levels through fertigation. *International Journal of Agricultural Engineering* 11(1): 101-107.

Sanjuan N, Clemente G, Ubeda L. (2003). Environmental effect of fertilizers. Crop Management and Post-harvest Handling of Horticultural Products: Crop Fertilization, Nutrition and Growth. Enfield, USA: Science Publishers, Inc: p1-53.

Shahi, R., Yadav, A., Shekhar, C. and Kumar, S. (2021) Effect of different doses of nitrogen on growth and yield of brinjal (*Solanum melongena* L.) Cv. Pusa purple long Kanpur, India. *The Pharma Innovation Journal* 10(9): 1228-1230.

Shree, S., Singh, V.K. and Kumar, R. 2014. Effect of Integrated Nutrient Management on yield and quality of cauliflower (*Brassica oleracea* var. botrytis L.). *An International Quarterly Journal of life Sciences* **9**: 1053-1058.

Subedi, P., Bhattarai, P., Lamichhane, B. and Khanal, A. (2023). Effect of different levels of nitrogen and charcoal on growth and yield traits of chili (*Capsicum annuum* L.) *Heliyon*.

Wei GP, Yang LF, Zhu YL, Chen G. (2009). Changes in oxidative damage, antioxidant enzyme activities and polyamine contents in leaves of grafted and non-grafted eggplant seedlings under stress by excess of calcium nitrate. *Scientia Horticulture* 120: 443 - 451.