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Nutrient uptake of capsicum (*Capsicum annuum* var. *grossum* L.) as influenced by different nitrogen and potassium fertigation levels under poly house

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Abstract
The experiment was conducted in a naturally ventilated poly house at Water Technology Centre, Horticulture Farm, Rajendranagar, Hyderabad during *rabi* 2019-20 to find out the optimum N and K fertigation schedule for capsicum (*Capsicum annuum var. grossum* L.) crop. The experiment comprised of three replications in Factorial Randomized Block Design (FRBD) with two factors {*i.e.* N levels (4), K levels (3) } and twelve treatments Viz; N fertigation levels of 0 %, 120 % (216 kg N ha^{-1}) , 150 % (270 kg N ha^{-1}), 180 % (324 kg N ha^{-1}) and K fertigation levels of 0 %, 80 % (96 kg K_2O ha^{-1}), 100% (120 kg K_2O ha^{-1}) respectively. The 100 % RDF was 180, 90 and 120 kg N, P_2O_5 and K_2O ha^{-1}. The source of N was urea, P was single super phosphate (SSP) and K was white muriate of potash (MOP). A common dose of P was applied to all the treatments. The N and K were applied through drip fertigation on every fourth day during different crop growth stages. In the fertigation programme, during crop establishment stage (10 DAT to 14 DAT), 10 % of N and K_2O were applied in two splits. During vegetative stage, (15 to 46 DAT) 30 % of N and 20 % of K_2O were applied in eight splits. During flower initiation to fruit development (47 DAT to 74 DAT) 20 % of N and K_2O were applied in seven splits. From fruit development till final harvesting stage (75 DAT to 154 DAT) 40 % of N and 50 % K_2O were applied in 20 splits. Then the fertigation schedule was completed in a total of 37 splits. The soil of the experimental site was sandy loam in texture with low in available nitrogen (166.5 kg ha^{-1}), medium in available phosphorus (81.1 kg P_2O_5 ha^{-1}) and low in available potassium (245.4 kg K_2O ha^{-1}). Irrigation was scheduled at 0.8 Epan based on pan evaporation data. The total water applied to the crop was 414.8 mm. The highest total nitrogen, phosphorous, potassium uptake was noticed by application of 180% of recommended N (324 kg N ha^{-1}) and 100% of recommended K_2O (120 kg K_2O ha^{-1}) at all the growth stages of capsicum in poly house during *rabi* season. The total nitrogen uptake by capsicum ranged from 0.92 to 4.39 kg N ha^{-1} at 30 DAT, 5.52 to 17.02 kg N ha^{-1} at 60 DAT, 25.66 to 58.85 kg N ha^{-1} at 90 DAT and 61.78 to 137.64 kg N ha^{-1} at final harvest respectively. The total phosphorous uptake by capsicum ranged from 0.04 to 0.22 kg P ha^{-1} at 30 DAT, 0.53 to 2.46 kg P ha^{-1} at 60 DAT, 1.09 to 2.91 kg P ha^{-1} at 90 DAT and 3.10 to 11.37 kg P ha^{-1} at final harvest respectively. The total potassium uptake by capsicum ranged from 0.24 to 1.76 kg K ha^{-1} at 30 DAT, 2.26 to 7.11 kg K ha^{-1} at 60 DAT, 7.93 to 18.03 kg K ha^{-1} at 90 DAT and 13.17 to 28.43 kg K ha^{-1} at final harvest respectively.

Keywords: capsicum, nutrient uptake, N and K fertigation schedule, poly house, fertigation

Introduction
Capsicum (*Capsicum annuum* var. *grossum* L.) also referred to as sweet or bell pepper is a highly priced vegetable crop both in the domestic and international market. China is the major producer of capsicum and contributes 36 per cent of the worlds cultivated area with a production of 15.03 million tones. India contributes average annual production of 1.08 million tonnes from an area of 1.06 million hectare with a productivity of 1.12 t ha^{-1} Anonymous (2014) [2]. In Telangana it occupies an area of 150.2 ha, with 2873 metric tonnes production (Telangana State Horticulture Mission, 2018-19). The major capsicum producing states in India are Himachal Pradesh, Karnataka, Madhya Pradesh, Haryana, Jharkhand, Uttarakhand and Orissa.

In poly houses as a result of the shift from surface irrigation to drip method of irrigation, fertigation becomes the most common fertilization in the irrigated agriculture. The use of soluble and compatible fertilizers, good quality irrigation water, and application of actual crop and water need are the prerequisite of the successful fertigation system. The use of poly houses for commercial vegetable production and maximum net returns has been most common in Western countries (Chandra, 1985). In Telangana since 2014-15 government has started encouraging protected cultivation under poly houses by farmers by providing financial

support through subsidies. Presently the area under poly houses in Telangana is around 489.26 ha (Department of Horticulture, Telangana).

Nutrient uptake by capsicum at specific physiological stages of plant development is essential to developing a fertility program that maximizes nutrient uptake and accumulation to prevent periodic nutrient stress during the growth cycle (Hector *et al*, 1991) [5].

Materials and Methods

A field experiment in a 500 m^2 naturally ventilated poly house was conducted at Horticultural Farm, College of Agriculture, Rajendranagar, Hyderabad during *rabi* season of 2019-20. The soil of the experimental site was sandy loam in texture with a pH of 7.6, electrical conductivity of 0.75 dS m^{-1}, medium in organic carbon (0.7%), low in available nitrogen (166.5 kg N ha^{-1}), medium in available phosphorus (81.1 kg P_2O_5 ha^{-1}) and low in available potassium (245.4 kg K_2O ha^{-1}). Capsicum (pasarella) seeds were sown in pro trays on 5th August 2019 and 35 days old seedlings were transplanted on 10th September 2019 in a zig zag manner in a paired row pattern on raised beds. The total crop duration in the poly house during *rabi* season was noticed to be 156 days. The experiment comprised of three replications in Factorial Randomized Block Design (FRBD) with two factors {N levels (4), K levels (3) } with twelve treatments Viz; T_1 - Control (No N, K_2O), T_2 - N_0 (No fertilizer) + 80 % RD of K_2O, T_3 - N_0 (No fertilizer) + 100 % RD of K_2O, T_4 -120 % RD of N + K_0 (No fertilizer), T_5 – 120 % RD of N + 80 % RD of K_2O, T_6 – 120 % RD of N + 100 % RD of K_2O, T_7 – 150 % RD of N + K_0 (No fertilizer), T_8 -150 % RD of N + 80 % RD of K2O, T_9 – 150 % RD of N + 100 % RD of K_2O, T_{10} – 180 % RD of N + K_0 (No fertilizer), T_{11} – 180 % RD of N + 80 % RD of K_2O, T_{12}- 180 % RD of N + 100 % RD of K_2O. The 100 % (RDF) was 180, 90 and 120 kg N, P_2O_5 and K_2O ha^{-1}. The source of N was urea, P was single super phosphate (SSP) and K was white muriate of potash (MOP). A common dose of phosphorous was applied uniformly to all the treatments at basal. At different crop growth stages viz, 30, 60, 90 DAT and at final harvest (156 DAT) number of plant samples were collected ovendried at 60 ^{0}C and drymatter data was recorded for shoots and fruits.

The nitrogen and potassium were applied through fertigation by ventury which was carried out at three day interval i.e., on every fourth day. In the fertigation programme during the crop establishment stage (10 DAT to 14 DAT), 10 % of N and K_2O were applied in two splits. During the vegetative stage, (15 to 46 DAT) 30 % of N and 20 % of K_2O were applied in eight splits. During flower initiation to fruit development (47 DAT to 74 DAT) 20 % of N and K_2O were applied in seven splits. From fruit development and colour formation stage onwards till final stage (75 DAT – 154 DAT) 40 % of N and 50 % K_2O were applied in 20 splits. Then the fertigation schedule was completed in a total of 37 splits. In addition, the crop had received a common dose of (12.5 t ha^{-1}) vermicompost and (1.5 t ha^{-1}) neem cake and 90 kg P_2O_5 ha and also waste decomposer, vermi wash sprays at every 15 days interval. Irrigation was scheduled based on 0.8 E pan and the total water applied through drip at 0.8 E pan (common to all the treatments) was 384.8 mm. The water applied for nursery including special operations (bed preparation, wetting before transplanting) was 30.4 mm. Thus the total water applied was 414.8 mm. The weight of mature fruits harvested from each picking was recorded till the final harvest and the total yield of fruits per hectare was computed and expressed in tonnes per hectare.

The nutrients (N, P and K) uptake was calculated using nutrient concentration and dry matter yield or seed yield for that, plant samples and fruit samples at different crop growth stages were collected from each treatment, washed with tap water followed by 0.1 N HCl and distilled water. They were first dried under shade and then in hot air oven at 60^{0}C. The dried samples were ground in grinder and stored in butter paper covers and analyzed for N, P and K contents by adopting the standard procedures.

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%) x Dry matter (kg ha}^{-1})}{100}$$

$$\text{Nutrient requirement (kg ha}^{-1}\text{ day}^{-1}) = \frac{\text{Amount of nutrients applied during a particular crop growth stage (kg ha}^{-1})}{\text{Crop duration during that crop growth stage (days)}}$$

Results and discussion

1. Total nitrogen uptake (kg ha^{-1})

In general it was observed that there was a significant increase in the total nitrogen uptake with an increase in N and K fertigation levels. The interaction effect was found to be non significant at all the stages. At 30 DAT, the total uptake of nitrogen ranged from 1.27 to 3.13 kg N ha^{-1}, 1.69 to 3.07 kg N ha^{-1} and 0.92 to 4.39 kg N ha^{-1} among the N, K fertigation levels and their interactions respectively. Among nitrogen fertigation levels, the highest total nitrogen uptake was observed with N_{180} (3.13 kg N ha^{-1}) which was found to be statistically superior over other treatments and was found to be on par with N_{150} (2.75 kg N ha^{-1}). Significantly the lowest uptake was recorded with N_0 (1.27 kg N ha^{-1}). Among different potassium doses, significantly the highest total nitrogen uptake was recorded with K_{100} (3.07 kg N ha^{-1}) compared to all other levels. However the lowest was recorded with K_0 (1.69 kg N ha^{-1}) and it was on par with K_{80} (2.07 kg N ha^{-1}).

At 60 DAT the total uptake of nitrogen ranged from 6.81 to 13.62 kg N ha^{-1}, 8.13 to 12.79 kg N ha^{-1} and 5.52 to 17.02 kg N ha^{-1} among the N, K fertigation levels, and their interactions respectively. With respect to different nitrogen fertigation levels, the highest total nitrogen uptake was observed with N_{180} (13.62 kg N ha^{-1}) which was significantly superior over other levels and was statistically on par with N_{150} (12.01 kg N ha^{-1}) and significantly the lowest uptake was recorded with N_0 (6.81 kg N ha^{-1}). Among different potassium doses, a significant difference was noticed. However the highest total nitrogen uptake was recorded with K_{100} (12.79 kg N ha^{-1}) while the lowest was observed with K_0 (8.13 kg N ha^{-1}).

Total nitrogen uptake (shoot + fruit) at 90 DAT ranged from 28.62 to 48.19 and 31.34 to 47.31 kg N ha^{-1} among the N, K fertigation levels, 25.66 to 58.85 kg N ha^{-1} among interactions respectively. Among different nitrogen doses, the highest total nitrogen uptake was recorded with N_{180} (48.19 kg N ha^{-1}) which was found to be on par with N_{150} (44.04 kg N ha^{-1}) and superior over other levels and significantly the lowest total nitrogen uptake was recorded with N_0 (28.62 kg N ha^{-1}). With regard to potassium fertigation, a significant difference was noticed. The K_{100} (47.31 kg N ha^{-1}) recorded the highest total

nitrogen uptake and the lowest was recorded with K_0 (31.34 kg N ha^{-1}).

The total nitrogen uptake (shoot + fruit) at final harvest ranged from 71.87 to 120.22 kg N ha^{-1}, 83.69 to 115.67 kg N ha^{-1}, 61.78 to 137.64 kg N ha^{-1} among the N, K fertigation levels and their interactions respectively. Among nitrogen fertigation levels, N_{180} (120.22 kg N ha^{-1}) recorded the highest total nitrogen uptake which was significantly superior over other levels and was statistically on par with N_{150} (110.83 kg N ha^{-1}) and significantly the lowest total nitrogen uptake among nitrogen fertigation levels was recorded with N_0 (71.87 kg N ha^{-1}). With regard to various potassium doses, there was a significant difference noticed. The K_{100} (115.67 kg N ha^{-1}) recorded the highest total nitrogen uptake whereas the lowest was observed with K_0 (83.69 kg N ha^{-1}).

The total uptake of N by capsicum shoots + fruits increased with an increase in N and K fertigation levels and also with crop age. It increased considerably during the final harvest stage, indicating its continuation of requirement during the later part of the crop growth period also. An increase in dry matter production by fruits has caused the increase in uptake of N even at the final harvest stage. Higher uptake of N might be due to a continuous supply of moisture through drip fertigation which might have favored the nutrient transformations by enhancing microbial activity in the root zone. Nutrient uptake is a function of dry matter production, being an essential constituent of chlorophyll to increase chlorophyll formation and its ultimate effect on photosynthesis which intern results in improvement of dry matter production. Similar results were obtained with Subbiah and Rani Perumal (1994) [9] reported that an increase in uptake of N by chilli from 96 to 124 kg N ha^{-1} when N and K fertilization was increased from 50 % to 100 %. These results are in agreement with Ajeeth Singh (2016) [1] in chilli, Preethika (2018) [8] in sunflower. The Nitrogen requirement (kg/ha/day) of capsicum during vegetative stage, vegetative to first picking and first picking to final harvest was worked out to be 2.826, 2.300, 1.625 respectively

2. Total phosphorous uptake

There was an increase in the total phosphorous uptake with an increase in the N and K fertigation levels. Among the interactions, there was no significant difference observed for the total phosphorous uptake. At 30, 60 DAT the values ranged from 0.05 to 0.17 and 0.81 to 1.86 kg P ha^{-1}, 0.08 to 0.15, 1.04 to 1.76 kg P ha^{-1} among different nitrogen, potassium fertigation levels, and 0.04 to 0.22 and 0.53 to 2.46 kg P ha^{-1} among their interactions respectively. The highest total phosphorous uptake was observed with N_{180} (0.17, 1.86 kg P ha^{-1}) which was found to be significantly superior over other levels. It was followed by N_{150} (0.14, 1.69 kg P ha^{-1}). However N_{120} and N_0 were on par with each other. The lowest was recorded with N_0 (0.05, 0.81 kg P ha^{-1}). As the potassium applications were concerned Significantly the highest uptake was recorded with K_{100} (0.15, 1.76 kg P ha^{-1}). The lowest was recorded with K_0 (0.08, 1.04 kg P ha-1) but was found to be on par with K_{80} (0.10, 1.29 kg P ha^{-1}) respectively.

At 90 DAT, the total phosphorous uptake (shoot + fruit) varied from 1.54 to 2.32 kg P ha^{-1}, 1.65 to 2.27 kg P ha^{-1} and 1.09 to 2.91 kg P ha^{-1} among different N, K fertigation levels and their interactions respectively. Nitrogen fertigation of N_{180}, N_{120} (2.32 kg P ha^{-1}) recorded significantly the highest total phosphorous uptake which was found to be superior over N_{150} and N_0 (1.61, 1.54 kg P ha^{-1}). However N_{150} and N_0 were on par with each other. Among different potassium doses, K_{100} (2.27 kg P ha^{-1}) recorded the highest value which was found to be significantly superior over K_{80} (1.92 kg P ha^{-1}) and K_0 (1.60 kg P ha^{-1}). However K_{80} and K_0 were on par with each other

At the final harvest, the total phosphorous uptake (shoot + fruit) varied from 4.26 to 10.07 kg P ha^{-1}, 5.72 to 8.01 kg P ha^{-1} and 3.10 to 11.37 kg P ha^{-1} among different N, K fertigation levels and their interactions respectively. The total phosphorous uptake (shoot + fruit) increased with an increase in the N and K fertigation levels at the final harvest. The N_{180} (10.07 kg P ha^{-1}) recorded the highest total phosphorous uptake which was found to be significantly superior over other levels. However, N_{150} and N_{120} (6.92, 6.68 kg P ha^{-1}) were on par with each other. Significantly the lowest total phosphorous uptake was recorded with N_0 (4.26 kg P ha^{-1}). With regard to potassium fertigation, a significant difference was noticed. The K_{100} (8.01 kg P ha^{-1}) recorded the highest total phosphorous uptake while the lowest was recorded with K_0 (5.72 kg P ha^{-1}).

In general, the total uptake of P by capsicum shoots + fruits increased with an increase in N, K fertigation levels and it increased considerably at the final harvest stage indicating continuous requirement of P even during the later part of the crop growth period. An increase in dry matter production by fruits has caused an increase in uptake of P even at final harvest stage. In this experiment, fertigation of N and K only tested and a common dose of P was applied to all the treatments in a single basal dose by basal application. However, the continuous increase in uptake of P till the final harvest indicates that capsicum will give a good response even to the fertigation of P also. Hegde (1987) [6] reported an increase in N levels from 60 to 180 kg ha^{-1} to bell pepper resulted in an increase in uptake of P from 11.1 to 13.2 kg P ha^{-1} when fruit yield increased from 13.8 to 18.0 t ha^{-1}.

3. Total potassium uptake

The results regarding the uptake of potassium at 30, 60 and 90 DAT is presented in Table 4 and final harvest in Table 5 respectively. The interaction effect was found to be non significant at all the stages. At 30 DAT among different nitrogen fertigation levels, the highest total potassium uptake was recorded with N_{180} (1.29 kg K ha^{-1}) and was found to be superior over other levels. It was followed by N_{150} (1.12 kg K ha^{-1}), and the lowest was recorded with N_0 (0.39 kg K ha^{-1}). With respect to potassium fertigation levels a significant difference was noticed. However, K_{100} (1.24 kg K ha^{-1}) recorded significantly the highest potassium uptake while the significantly the lowest value was observed with K_0 (0.66 kg K ha^{-1}).

At 60 DAT a significant difference was observed among potassium fertigation levels. It ranges from 2.26 to 7.11 kg K ha^{-1}. With varied doses of nitrogen the highest total potassium uptake was recorded with N_{180} (5.68 kg K ha^{-1}) and was found to be on par with N_{150} (5.08 kg K ha^{-1}) and the lowest was recorded with N_0 (2.92 kg K ha^{-1}). Among different doses of potassium K_{100} (5.53 kg K ha^{-1}) recorded significantly the highest potassium uptake while the lowest was recorded with K_0 (3.51 kg K ha^{-1}).

At 90 DAT the total potassium uptake (shoot + fruit) varied from 8.79 to 14.62 kg K ha^{-1}, 9.75 to 14.66 kg K ha^{-1}, 7.93 to 18.03 kg K ha^{-1} Among different N, K fertigation levels and their interactions respectively. The total potassium uptake (shoot + fruit) among different nitrogen fertigation levels revealed that N_{180} (14.62, 17.44 kg K ha^{-1}) recorded significantly the highest total potassium uptake which was

superior over other levels. It was followed by N_{150} (13.67, 16.29 kg K ha^{-1}). Significantly the lowest total potassium uptake was recorded with N_0 (8.79, 11.31 kg K ha^{-1}). A significant difference was observed among potassium fertigation levels. However significantly the highest total potassium uptake was recorded with K_{100} (14.66, 17.29 kg K ha^{-1}) while significantly the lowest was recorded with K_0 (9.75, 12.59 kg K ha^{-1}).

At the final harvest, the total potassium uptake (shoot + fruit) varied from 15.88 to 24.52 kg K ha^{-1}, 17.94 to 24.07 kg K ha^{-1} and 13.17 to 28.43 kg K ha^{-1} among different N, K fertigation levels and their interactions respectively. The total potassium uptake of 24.52 kg K ha^{-1} was noticed with N_{180} among different nitrogen doses, which was found to be significantly superior over other levels and was statistically on par with N_{150} (22.85 kg K ha^{-1}). However, N_{150} and N_{120} (22.85, 20.52 kg K ha^{-1}) were on par with each other. The lowest total potassium uptake was recorded with N_0 (15.88 kg K ha^{-1}). A significant difference was noticed among potassium fertigation levels. However, K_{100} (24.07 kg K ha^{-1}) recorded the highest total potassium uptake while the lowest was recorded with K_0 (17.94 kg K ha^{-1}).

Similar to N and P uptakes, the total uptake of K by paprika shoots + fruits increased with an increase in N and K fertigation levels and also with crop growth stage. In general, lower uptake of K was noticed. It is due to low K contents in the capsicum shoots and fruits. Hegde (1987) [6] reported that an increase in N levels from 60 to 180 kg ha^{-1} to bell pepper resulted in an increase in uptake of K from 63.9 to 73.1 kg K ha^{-1} when fruit yield increased from 13.8 to 18.0 t ha^{-1}. Mounika (2016) [7] in chilli reported that the highest K uptake was recorded with 125 % RDK of K fertilizer. Ajeeth Singh (2016) [1] also reported that in chilli crop the lowest K uptake was observed with 50 % RDF in chilli. The potassium requirement of capsicum during vegetative stage, vegetative to first picking and first picking to final harvest was worked out to be 0.783, 0.850, 0.750 kg/ha/day respectively.

Table 1: Effect of N and K fertigation levels on total nitrogen uptake (kg ha^{-1}) of capsicum under poly house at 30, 60(shoot) and 90 DAT (shoot + fruit) during *rabi* 2019-20.

30 DAT					60 DAT				
	K_0	**K_{80}**	**K_{100}**	**Mean**		**K_0**	**K_{80}**	**K_{100}**	**Mean**
N_0	0.92	1.2	1.69	1.27	N_0	5.52	7.01	7.89	6.81
N_{120}	1.64	1.89	2.3	1.94	N_{120}	7.7	9.43	10.6	9.24
N_{150}	2.06	2.33	3.88	2.75	N_{150}	9.2	11.19	15.65	12.01
N_{180}	2.13	2.86	4.39	3.13	N_{180}	10.1	13.74	17.02	13.62
Mean	1.69	2.07	3.07		Mean	8.13	10.34	12.79	
	S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)		
N	0.15	0.45			N	0.55	1.61		
K	0.13	0.39			K	0.48	1.39		
(N*K)	0.27	NS			(N*K)	0.95	NS		

90 DAT														
Shoot					Fruit					Total uptake (kg ha^{-1})				
	K_0	**K_{80}**	**K_{100}**	**Mean**		**K_0**	**K_{80}**	**K_{100}**	**Mean**		**K_0**	**K_{80}**	**K_{100}**	**Mean**
N_0	19.55	20.17	23.66	21.12	N_0	6.11	6.76	9.61	7.49	N_0	25.66	26.93	33.27	28.62
N_{120}	23.13	24.88	29.67	25.89	N_{120}	8.33	9.95	11.06	9.78	N_{120}	31.46	34.84	40.73	35.67
N_{150}	23.27	31.38	41.99	32.21	N_{150}	9.71	11.36	14.40	11.83	N_{150}	32.98	42.74	56.39	44.04
N_{180}	24.92	37.55	43.69	35.38	N_{180}	10.34	12.92	15.16	12.81	N_{180}	35.26	50.47	58.85	48.19
Mean	22.71	28.50	34.75		Mean	8.62	10.25	12.56		Mean	31.34	38.74	47.31	
	S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)		
N	1.51	4.41			N	0.55	1.60			N	1.93	5.65		
K	1.31	3.82			K	0.47	1.38			K	1.67	4.89		
(N*K)	2.61	NS			(N*K)	0.95	NS			(N*K)	3.34	NS		

100% RDF = 180: 90: 120 kg N-P_2O_5-K_2O ha^{-1}, N_0 –No Nitrogen, N_{120} - 216 kg N ha^{-1}, N_{150} - 270 kg N ha^{-1}, N_{180}- 324 kg N ha^{-1}
K_0 –No potassium, K_{80} - 96 kg K_2O ha^{-1}, K_{100} - 120 kg K_2O ha^{-1}

Table 2: Effect of N and K fertigation levels on total nitrogen uptake (kg ha^{-1}) of capsicum under poly house at final harvest (shoot + fruit) during *rabi* 2019-20.

Final harvest														
Shoot					Fruit					Total uptake (kg ha^{-1})				
	K_0	**K_{80}**	**K_{100}**	**Mean**		**K_0**	**K_{80}**	**K_{100}**	**Mean**		**K_0**	**K_{80}**	**K_{100}**	**Mean**
N_0	23.98	25.89	31.67	28.18	N_0	37.8	40.83	55.45	44.69	N_0	61.78	66.72	87.12	71.87
N_{120}	31.36	36.04	39.1	35.50	N_{120}	50.6	58.6	66.58	58.60	N_{120}	81.96	94.64	105.68	94.09
N_{150}	34.21	38.28	47.32	39.94	N_{150}	55.93	71.85	84.91	70.90	N_{150}	90.14	110.13	132.23	110.83
N_{180}	35.11	42.96	49.17	42.42	N_{180}	65.77	79.19	88.47	77.81	N_{180}	100.88	122.15	137.64	120.22
Mean	31.17	35.79	41.82		Mean	52.53	62.62	73.85		Mean	83.69	98.41	115.67	
	S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)		
N	1.47	4.31			N	2.78	8.12			N	3.91	11.43		
K	1.28	3.73			K	2.4	7.03			K	3.38	9.9		
(N*K)	2.55	NS			(N*K)	4.81	NS			(N*K)	6.77	NS		

Effect of N and K fertigation levels on total phosphorous uptake (kg ha^{-1}) of capsicum under poly house at 30, 60 DAT (shoot) during *rabi* 2019-20.

30 DAT					60 DAT				
	K_0	K_{80}	K_{100}	Mean		K_0	K_{80}	K_{100}	Mean
N_0	0.04	0.04	0.06	0.05	N_0	0.53	0.87	1.03	0.81
N_{120}	0.06	0.08	0.10	0.08	N_{120}	0.84	1.25	1.18	1.09
N_{150}	0.09	0.12	0.20	0.14	N_{150}	1.17	1.53	2.37	1.69
N_{180}	0.11	0.17	0.22	0.17	N_{180}	1.60	1.53	2.46	1.86
Mean	0.08	0.10	0.15		Mean	1.04	1.29	1.76	
	S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)		
N	0.01	0.03			N	0.10	0.29		
K	0.01	0.02			K	0.09	0.25		
(N*K)	0.02	NS			(N*K)	0.17	NS		

Table 3: Effect of N and K fertigation levels on total phosphorous uptake (kg ha^{-1}) of capsicum under poly house at 90 DAT and at final harvest (shoot + fruit) during *rabi* 2019-20.

90 DAT														
Shoot					Fruit					Total uptake (kg ha^{-1})				
	K_0	K_{80}	K_{100}	Mean		K_0	K_{80}	K_{100}	Mean		K_0	K_{80}	K_{100}	Mean
N_0	0.80	1.18	1.37	1.12	N_0	0.29	0.37	0.61	0.42	N_0	1.09	1.55	1.98	1.54
N_{120}	1.54	1.72	1.43	1.56	N_{120}	0.71	0.74	0.80	0.75	N_{120}	2.25	2.46	2.23	2.32
N_{150}	0.69	0.77	0.92	0.79	N_{150}	0.73	0.68	1.04	0.81	N_{150}	1.41	1.45	1.96	1.61
N_{180}	0.82	1.21	1.51	1.18	N_{180}	1.02	1.01	1.40	1.14	N_{180}	1.84	2.22	2.91	2.32
Mean	0.96	1.22	1.31		Mean	0.69	0.70	0.96		Mean	1.65	1.92	2.27	
	S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)		
N	0.08	0.23			N	0.06	0.17			N	0.12	0.34		
K	0.07	0.20			K	0.05	0.15			K	0.10	0.29		
(N*K)	0.13	NS			(N*K)	0.10	NS			(N*K)	0.20	NS		

Final harvest														
Shoot					Fruit					Total uptake (kg ha^{-1})				
	K_0	K_{80}	K_{100}	Mean		K_0	K_{80}	K_{100}	Mean		K_0	K_{80}	K_{100}	Mean
N_0	0.62	0.64	0.78	0.68	N_0	2.49	3.82	4.45	3.58	N_0	3.10	4.46	5.23	4.26
N_{120}	0.81	0.93	0.92	0.88	N_{120}	4.82	6.00	6.57	5.80	N_{120}	5.64	6.93	7.49	6.68
N_{150}	0.85	0.98	1.08	0.97	N_{150}	4.52	6.46	6.88	5.95	N_{150}	5.37	7.43	7.96	6.92
N_{180}	1.07	1.36	1.49	1.31	N_{180}	7.69	8.72	9.88	8.77	N_{180}	8.76	10.08	11.37	10.07
Mean	0.84	0.98	1.07		Mean	4.88	6.25	6.95		Mean	5.72	7.23	8.01	
	S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)		
N	0.04	0.12			N	0.32	0.93			N	0.30	0.88		
K	0.04	0.11			K	0.27	0.80			K	0.26	0.77		
(N*K)	0.07	NS			(N*K)	0.55	NS			(N*K)	0.52	NS		

100% RDF = 180: 90: 120 kg N-P_2O_5-K_2O ha^{-1}, N_0 –No Nitrogen, N_{120} - 216 kg N ha^{-1}, N_{150} - 270 kg N ha^{-1}, N_{180}- 324 kg N ha^{-1}
K_0 –No potassium, K_{80} - 96 kg K_2O ha^{-1}, K_{100} - 120 kg K_2O ha^{-1}.

Table 4: Effect of N and K fertigation levels on total potassium uptake (kg ha^{-1}) of capsicum under poly house at 30, 60 (shoot) and 90 DAT (shoot+fruit) during *rabi* 2019-20.

30 DAT					60 DAT				
	K_0	K_{80}	K_{100}	Mean		K_0	K_{80}	K_{100}	Mean
N_0	0.24	0.32	0.62	0.39	N_0	2.26	2.91	3.61	2.92
N_{120}	0.68	0.81	1.02	0.84	N_{120}	3.59	4.48	4.76	4.28
N_{150}	0.83	0.97	1.56	1.12	N_{150}	3.96	4.62	6.65	5.08
N_{180}	0.90	1.20	1.76	1.29	N_{180}	4.21	5.72	7.11	5.68
Mean	0.66	0.82	1.24		Mean	3.51	4.43	5.53	
	S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)		
N	0.06	0.17			N	0.20	0.60		
K	0.05	0.14			K	0.18	0.52		
(N*K)	0.10	NS			(N*K)	0.35	NS		

90 DAT														
Shoot					Fruit					Total uptake (kg ha^{-1})				
	K_0	K_{80}	K_{100}	Mean		K_0	K_{80}	K_{100}	Mean		K_0	K_{80}	K_{100}	Mean
N_0	6.45	6.75	8.06	7.09	N_0	1.48	1.57	2.05	1.70	N_0	7.93	8.32	10.12	8.79
N_{120}	8.40	9.81	10.88	9.70	N_{120}	1.74	2.05	2.35	2.05	N_{120}	10.14	11.861	13.24	11.74
N_{150}	8.29	10.60	14.11	11.00	N_{150}	2.13	2.72	3.15	2.67	N_{150}	10.41	13.32	17.26	13.67
N_{180}	8.38	12.60	14.62	11.87	N_{180}	2.13	2.71	3.41	2.75	N_{180}	10.51	15.31	18.03	14.62
Mean	7.88	9.94	11.92		Mean	1.87	2.26	2.74		Mean	9.75	12.20	14.66	
	S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)				S.E.m±	C.D P=(0.05)		
N	0.49	1.43			N	0.09	0.27			N	0.56	1.63		
K	0.42	1.23			K	0.08	0.23			K	0.48	1.41		
(N*K)	0.84	NS			(N*K)	0.16	NS			(N*K)	0.96	NS		

100% RDF = 180: 90: 120 kg N-P_2O_5-K_2O ha^{-1}, N_0 –No Nitrogen, N_{120} - 216 kg N ha^{-1}, N_{150} - 270 kg N ha^{-1}, N_{180}- 324 kg N ha^{-1}
K_0 –No potassium, K_{80} - 96 kg K_2O ha^{-1}, K_{100} - 120 kg K_2O ha^{-1}

Table 5: Effect of N and K fertigation levels on total potassium uptake (kg ha^{-1}) of capsicum under poly house at final harvest (shoot + fruit) during *rabi* 2019-20.

Final harvest														
Shoot					Fruit					Total uptake (kg ha^{-1})				
	K_0	K_{80}	K_{100}	Mean		K_0	K_{80}	K_{100}	Mean		K_0	K_{80}	K_{100}	Mean
N_0	4.36	5.60	6.92	5.63	N_0	8.81	9.30	12.63	10.25	N_0	13.17	14.90	19.55	15.88
N_{120}	7.24	8.05	8.50	7.93	N_{120}	11.04	12.70	14.03	12.59	N_{120}	18.28	20.75	22.53	20.52
N_{150}	7.47	8.60	9.57	8.55	N_{150}	12.29	14.42	16.20	14.30	N_{150}	19.76	23.01	25.77	22.85
N_{180}	7.73	9.13	10.32	9.06	N_{180}	12.81	15.48	18.11	15.46	N_{180}	20.54	24.61	28.43	24.52
Mean	6.70	7.84	8.83		Mean	11.24	12.98	15.24		Mean	17.94	20.82	24.07	
	S.E.m±	C.D (P=0.05)				S.E.m±	C.D (P=0.05)				S.E.m±	C.D P=(0.05)		
N	0.35	1.02			N	0.55	1.62			N	0.81	2.38		
K	0.30	0.88			K	0.48	1.41			K	0.70	2.06		
(N*K)	0.60	NS			(N*K)	0.96	NS			(N*K)	1.41	NS		

100% RDF = 180: 90: 120 kg N-P_2O_5-K_2O ha^{-1}, N_0 –No Nitrogen, N_{120} - 216 kg N ha^{-1}, N_{150} - 270 kg N ha^{-1}, N_{180}- 324 kg N ha^{-1}
K_0 –No potassium, K_{80} - 96 kg K_2O ha^{-1}, K_{100} - 120 kg K_2O ha^{-1}

Table 6: Nutrient requirement (N &K) of capsicum (kg ha^{-1}day^{-1}) in poly house during *rabi* 2019-20

Crop stage	N requirement (kg ha^{-1}day^{-1})	g/m^2	K_2O requirement (kg ha^{-1}day^{-1})	g/m^2
Vegetative stage	2.826	0.283	0.783	0.078
Vegetative to first picking	2.300	0.230	0.850	0.085
First picking to final harvest	1.625	0.163	0.750	0.075

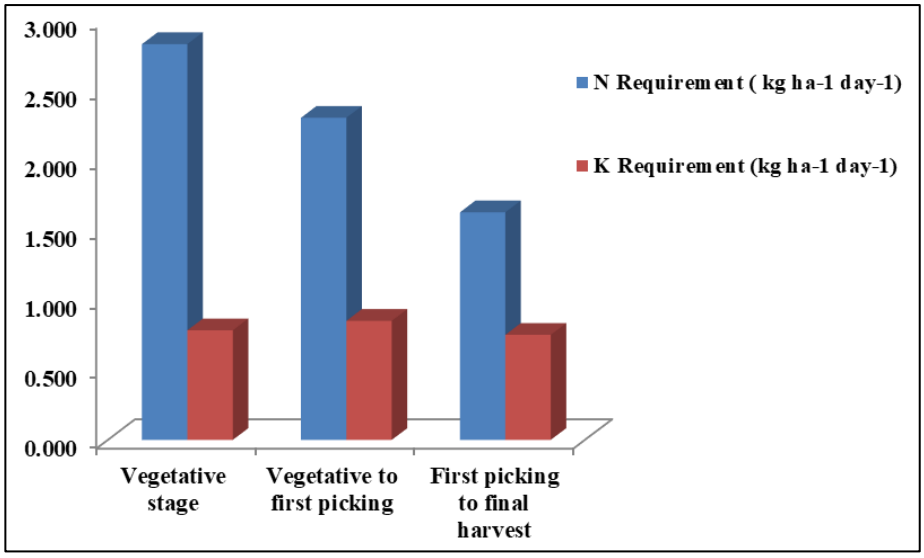
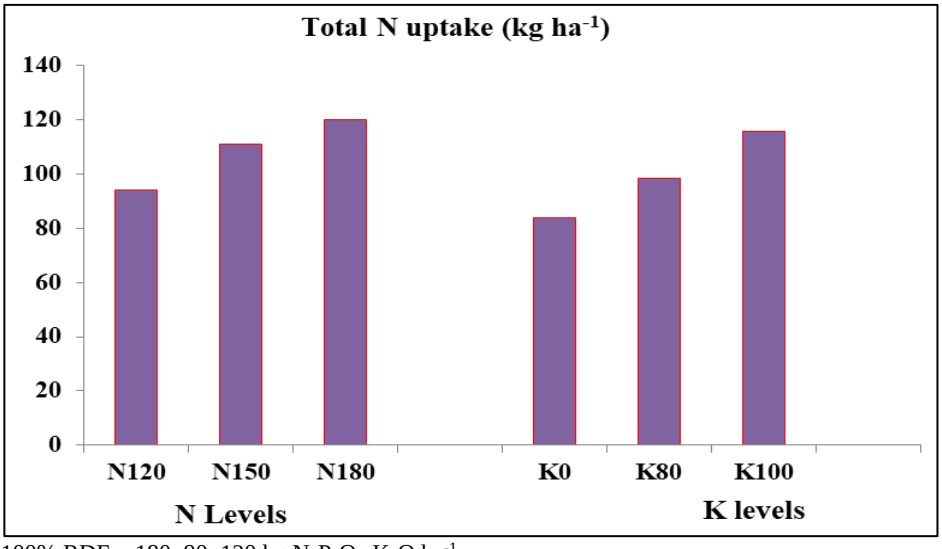


Fig 1: N & K requirement (kg ha^{-1}day^{-1}) of capsicum at different stages



100% RDF = 180: 90: 120 kg N-P_2O_5-K_2O ha^{-1},
N_0 –No Nitrogen, N_{120} - 216 kg N ha^{-1}, N_{150} - 270 kg N ha^{-1}, N_{180}- 324 kg N ha^{-1}
K_0 –No potassium, K_{80} - 96 kg K_2O ha^{-1}, K_{100} - 120 kg K_2O ha^{-1}

Fig 2: Total nitrogen uptake (kg ha^{-1}) of capsicum as influenced by different N and K fertigation levels at final harvest

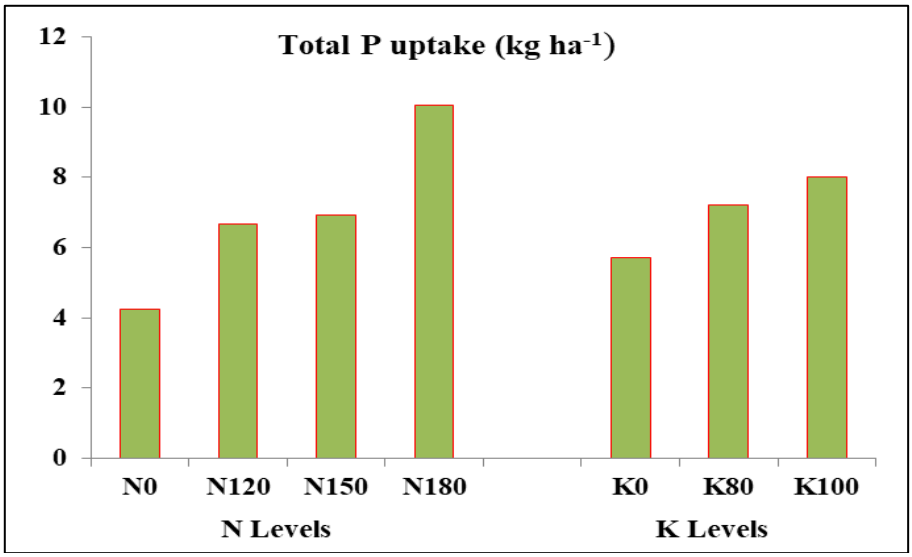
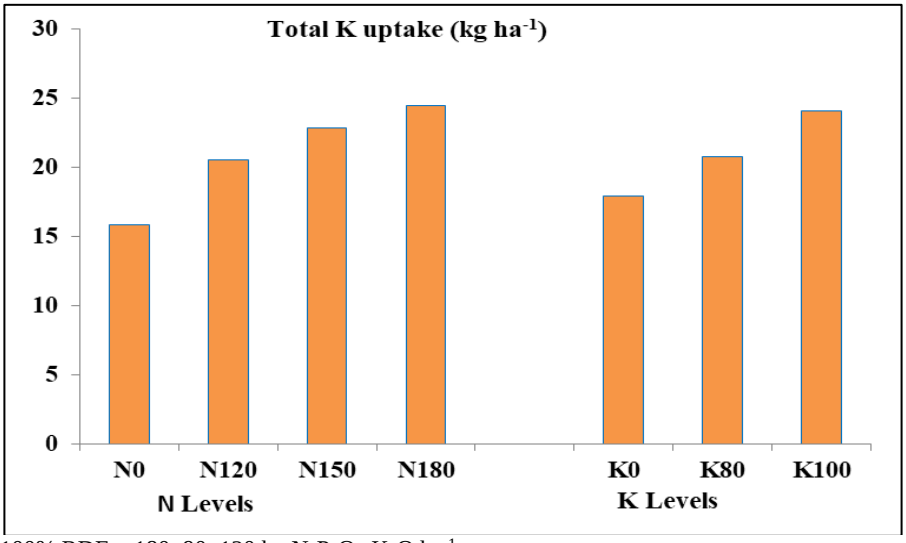


Fig 3: Total phosphorous uptake (kg ha^{-1}) of capsicum as influenced by different N and K fertigation levels at final harvest



100% RDF = 180: 90: 120 kg N-P_2O_5-K_2O ha^{-1},
N_0 –No Nitrogen, N_{120} - 216 kg N ha^{-1}, N_{150} - 270 kg N ha^{-1}, N_{180}- 324 kg N ha^{-1}
K_0 –No potassium, K_{80} - 96 kg K_2O ha^{-1}, K_{100} - 120 kg K_2O ha^{-1}

Fig 4: Total potassium uptake (kg ha^{-1}) of capsicum as influenced by different N and K fertigation levels at final harvest

Conclusion

Application of 180% of recommended dose of N (324 kg N ha^{-1}) and 100% of RD of K_2O (120 kg K_2O ha^{-1}) is recommended for cultivation of capsicum in naturally ventilated poly house which recorded the higher uptake of nutrients by the crop.

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