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EFFECT OF POTASSIUM NITRATE ON YIELD AND QUALITY OF CHILLI

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ABSTRACT

The present investigation was conducted during 2019-20 and 2020-21 to study the effect of potassium nitrate on yield and quality of chilli. The experiment was conducted in randomized complete block design and replicated thrice during both the years. The experiment comprised of twelve treatment combinations of four nitrogen doses (0, 75, 100 and 125 kg N/ha) and three potassium levels (0, 30 kg K/ha and 30 kg K/ha along with foliar spray of KNO_3 @ 2%). Two equal splits of nitrogen i.e., one at the time of transplanting and remaining at first picking were applied in the plot where 75 kg/ ha N was incorporated. However, for 100 and 125 kg N/ha, application was made in three equal splits i.e., first at the time of transplanting, second and third at first and third picking of chilli. Foliar application of KNO_3 was made thrice i.e., at the time of flowering and after first and third picking of chilli. Potassium nitrate (KNO_3) @ 2% along with 100 kg N/ha and 30 kg K/ha proved to be significantly higher in growth parameters such as canopy width and number of branches; yield parameters such as fruit length, fruit diameter, green fruit yield (q/ha), red fruit yield (q/ha); quality parameters such as dry matter, colouring matter, capsaicin content in green and red chilli, and oleoresin content as compared to recommended dose of fertilizer (RDF) comprising 75 kg N/ha and 30 kg K/ha. Higher green and red ripe fruit yield of 8-18 % and 20-22 %, respectively in chilli was recorded due to an increase in above mentioned parameters as compared to RDF during both years. Similarly, higher dry matter (16-20%) and capsaicin content (6-9%) were recorded under same treatments. So, 100 kg nitrogen per hectare in three splits and 30 kg potassium per hectare along with three foliar sprays of KNO_3 @ 2% in chilli proved to be suitable for production of chilli under Punjab conditions.

Keywords: Capsaicin Content, Chilli, Foliar Application, Fruit Yield, Potassium Nitrate

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Indian cuisine is renowned and celebrated throughout the world for its spicy treat to the tongue. An unforgettable experience has been created by the spices which impart flavor and aroma to the food. Among the commonly utilized spices in Indian food, chilli is an inevitable ingredient (Saxsena, 2016). Chilli (*Capsicum annuum* var. *annuum* L.) is an important spice and condiment crop grown almost everywhere in the world. It thrives well in tropical and sub-tropical region (Dhaliwal, 2015). The chromosome number of chilli is 2n=24 and it belongs to the family Solanaceae (Naz *et al*., 2006). Chilli is also known for its medicinal effects and therapeutic uses like blood circulation, cholesterol and blood pressure maintenance, hence beneficial in heart disorders (Saleh *et al*., 2018). It is also used as a condiment in various food items like curry sauces, soups and chutney to add flavour and pungency; moreover, it is widely used in the preparation of various kinds of pickles. Green chilli is eaten raw in salads as well as cooked. Chilli powder is made up of 54% pericarp, 40% seed and 6% stalk (Prasad *et al*., 2016). Chilli contains numerous biochemical substances like alkaloid (capsaicin), vitamins, organic acids, minerals and flavonoids which are thought to be anti-carcinogenic by having antioxidant properties (Hasler and Clare, 1998). Chilli covers an area of 7.43 lac and 8.78 thousand hectares with production of 19.14 lac and 17.63 thousand tonnes and with productivity of 2576 kg/ha and 20.09 q/ha in India (Anonymous, 2021a) and Punjab, respectively (Anonymous 2021b).

Nutrients play an essential role in plant growth and development. Various nutrients have different biochemical and physiological roles in plant system. Nitrogen is a chief constituent of various important substances which occur in plants like protein, chlorophyll and nucleic acids (Singh and Kumar, 1999). Nitrogen application to chilli peppers exhibited an important role for rise in plant growth parameters, color and nutritive value of leaves and yield (Tumbare and Nikram, 2004). The crucial role of nitrogen for being an integral part of all amino acids in proteins and lipids, the structural complexes of cells and chloroplast made it the most important macronutrient for better plant formation and proper growth (Uddin *et al*., 2003).

Potassium is also considered to be an essential nutrient supplying 6% of plant dry weight (Hartz *et al*., 1998). Potassium is not a component of any organic molecule but, it plays a chief role in various biochemical and physiological processes i.e., osmoregulation process, regulation of stomata opening and closing, water use efficiency, translocation of sugars and

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formation of carbohydrates which effects crop quality, size of fruit and stimulates root growth (Chauhan, 2012). It is also called a quality nutrient because it directly enhances quality attributes of plants. Potassium nitrate is a water soluble potassic fertilizer containing 44% K_2O and 13% N suitable for foliar fertilization. The foliar spray of potassium nitrate in chilli considerably increases the growth and yield parameters by influencing various physiological and biochemical activities. In vegetable crop production, fertilization has a significant role to play, not only the nutrient but its source and method of application is also important. In future, foliar nutrient sprays will be of great utility because it reduces the total amount of fertilizer applied, increases the availability of trace elements and high efficiency of fertilizer application is also achieved (Haytova *et al*., 2013). Lester *et al*. (2006) pointed out that insufficient information regarding subsistence farming and conservative attitude like application of an inadequate dose of potassium in soil to fulfill the crop requirement for increased yields were the reasons for less availability of nutrients.

Chilli is a long duration crop, hence it requires an adequate supply of manures and fertilizers. To provide adequate nutrition for proper plant growth, the physiological stage of development must be studied. The application of different combinations of N & K fertilizers at fruit maturity and development may improve red colour, oleoresin content, pungency, growth, yield and quality (Ananthi *et al*., 2004). Therefore, there is a fundamental need to develop a nutrient management strategy for chilli that will not only improve nutrient use efficiency but also increase quality and yield of the produce. So, keeping in the view importance of potassium nitrate in enhancing quality and yield of various vegetables, the proposed investigation was conducted to determine the optimum concentration of potassium nitrate for better growth, quality and yield of chilli.

MATERIALS AND METHODS

The investigation was conducted at the Research farm of Vegetable Science and Biochemistry Laboratory, PAU, Ludhiana during 2019-20 and 2020-21. The experiment was conducted in randomized complete block design and replicated thrice. The nursery of chilli crop (CH 27) was sown in mid-November of 2019 and 2020 which was transplanted in mid-February 2020 and 2021 for two years. The crop was irrigated by furrow irrigation system. Rest of cultural practices were followed as per standard agronomic practices (Anonymous, 2021b). The experiment comprised of twelve treatment combinations of four nitrogen (0, 75, 100 and 125 kg N/ ha) and three potassium (0, 30, 30 kg K/ha along with foliar spray of KNO_3 @ 2%). Two equal splits of nitrogen i.e., one at the time of transplanting and remaining at first picking were applied in the plot where 75 kg/ ha N was incorporated. However, for 100 and 125 kg N/ha application was made in three equal splits i.e., first at the time of transplanting, second and third at first and third picking of chilli. Foliar application of KNO_3 was made thrice i.e., at the time of flowering, first and third picking of chilli. Growth related parameters i.e., Canopy width (cm), number of branches and yield related parameters i.e., Fruit length (cm), fruit diameter (cm), green & red ripe fruit yield (g/plant), fruit yield (q/ha) as well as quality parameters like dry matter, capsaicin content were estimated by method recommended by Bajaj and Kaur (1979) and oleoresin were estimated as per method suggested by Tandon *et al*. (1964).

RESULTS AND DISCUSSION

Growth parameters

Canopy width (cm)

Canopy width is an important parameter depicting the health of the plant. The data pertaining to the effect of different treatments on canopy width of chilli in all directions at final harvest is presented in Table 1. Data showed that maximum canopy width after final harvest was observed with treatment T_{12} (125 kg/ ha of N (Three split doses) + 30 kg/ ha of K + 3 foliar spray of KNO_3@ 2%) which was significantly higher than all other treatments. On the other hand, minimum canopy width was witnessed under control (T_1). The findings are in consonance with the observations of Khan *et al*. (2011) that higher dose of nitrogen resulted in higher canopy width as compared to other lower doses. Similarly, Stewart *et al*. (2003); Wahocho *et al*. (2015) observed that incorporation of inorganic sources of nitrogen and potassium enhances canopy width in chilli. Here, higher nitrogen and potassium in plants mean higher rates of accumulation of photosynthates, which accelerates canopy width of the plant.

Number of branches per plant

Ibrahim (2003) reported that number of branches per plant affect fruit yield of plant both directly and indirectly. It is an important trait which regulates fruit bearing ability of plant. Sometimes an association was found between number of branches, number of leaves, photosynthetic activity and LAI which promotes higher bearing ability of plant. The data pertaining to the effect of different treatments of nitrogen and potassium on number of branches per plant is presented in Table 1. Maximum number of branches per plant (7.33) were recorded with treatment T_{10} (125 kg/ ha of N + 0 kg/ ha of K) during 2019-20 and 2020-2021, which was significantly higher from all of other treatments. Treatments T_3, T_7, T_{11} and T_{12} was recorded to be statistically at par with each other in 2019-2020. Whereas, in pooled data number

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Table 1. Effect of different treatments on canopy width (cm) and number of branches per plant

S. No.	Treatment	Canopy width (cm)			Number of branches per plant		
		2019-20	2020-21	Mean	2019-20	2020-21	Mean
T_1	0 kg/ ha of N + 0 kg/ ha of K	47.12	48.07	47.6	5.78	5.69	5.73
T_2	0 kg/ha of N + 30 kg/ ha of K	54.57	56.35	55.46	6.40	6.62	6.51
T_3	0 kg/ ha of N + 30 kg/ ha of K + 3 foliar sprays of KNO_3@ 2%	58.70	59.48	59.09	6.67	6.38	6.52
T_4	75 kg of N (Two split doses) + 0 kg/ha of K	60.90	60.41	60.65	6.13	6.36	6.25
T_5	75 kg of N (Two split doses) + 30 kg/ha of K	62.90	61.79	62.34	6.04	6.23	6.14
T_6	75 kg of N (Two split doses) + 30 kg/ha of K +3 foliar sprays of KNO_3 @ 2%	70.02	71.85	70.94	5.96	6.00	5.98
T_7	100 kg/ha of N (Three split doses) + 0 kg/ha of K	66.52	69.8	68.16	6.98	6.73	6.85
T_8	100 kg/ha of N (Three split doses) + 30 kg/ha of K	73.70	78.28	75.99	6.44	6.68	6.56
T_9	100 kg/ha of N (Three split doses) + 30 kg/ha of K + 3 foliar sprays of KNO_3@ 2%	80.12	79.22	79.67	6.36	6.63	6.49
T_{10}	125 kg/ha of N (Three split doses) + 0 kg/ha of K	70.29	74.46	72.38	7.33	7.00	7.17
T_{11}	125 kg/ha of N (Three split doses) + 30 kg/ha of K	83.84	85.91	84.87	6.84	6.73	6.79
T_{12}	125 kg/ha of N (Three split doses) + 30 kg/ha of K + 3 foliar sprays of KNO_3@ 2%	92.29	91.71	92.00	7.16	6.92	7.04
CD (P = 0.05)		6.76	8.91	5.50	0.88	0.23	0.47

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of branches per plant with application of recommended dose of fertilizer (T_5) was recorded about 6.14, which was significantly higher from control T_1 (5.73). These findings are in accordance with the findings of Mohanty *et al*. (2001); Gare *et al*. (2001) showed that increasing the amount of nitrogen and potassium up to certain level helped to increase the number of branches per plant which in turn increased the fruit yield. A comparative relationship occurs between nitrogen application and accumulation of biomass in plants. So higher concentration of nitrogen results in higher content of biomass which further increases the number of branches.

Yield parameters

Fruit length

Fruit length is an important parameter in chilli. Fruit length is positively associated with fruit yield. Minimum fruit length was obtained with no fertilizer application (T_1). Whereas maximum fruit length was observed with treatment T_9 (100 kg/ ha of N (Three split doses) + 30 kg/ ha of K + 3 foliar spray of KNO_3@ 2%) which was significantly higher from rest of the treatments during both seasons. In pooled data, the fruit length attained under treatment T_9 was 12% more than that obtained with recommended dose (T_5) and 9.6% more than that obtained with no fertilizer application. But different treatments failed to show any significant effect on fruit length of chilli during first season. Data related to this finding is shown in Table 2. Similar findings were observed in experiment of Ananthi *et al*. (2004); Lodhi *et al*. (2019) in which surge in fruit length was observed with the rise in nitrogen and potassium application. Here, fruit length increased with the accumulation of biomass in plant which in turn is related with the concentration of nitrogen and potassium present in plant system.

Fruit diameter

Fruit diameter is positively related to the fruit yield. It is important for determining the actual size of the fruit. It also portrays the health of the fruit and consumption of secondary metabolites by plant. Data pertaining to fruit diameter is shown in the Table 2. Treatment T_9 (100 kg/ ha of N (Three split doses) + 30 kg/ ha of K + 3 foliar spray of KNO_3@ 2%) resulted in maximum fruit diameter (1.33 cm) which was significantly higher from rest of the treatments in pooled data. However, all the treatments failed to show any noteworthy effect on fruit diameter of chilli during both seasons. Fruit diameter obtained with control (T_1) was recorded lower than recommended dose. The results are in conformity with the findings of Golcz *et al*. (2012) which showed that there was decrease in fruit diameter with the increase in the level of potassium. Similarly, Hartz *et al*. (2001) found that soil drenched with higher dose of potassium did not affect fruit diameter significantly. The purpose behind this finding is that a high level of potassium results in high production of organic acids that leads to osmotic imbalance and adverse effects on nutrition

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Table 2. Effect of different treatments on Fruit length (cm), Fruit diameter (cm), Green fruit yield (g/plant), Green fruit yield (q/ha), Red fruit yield (g/plant), Red fruit yield (q/ha) of chilli.

S. No.	Treatment	Fruit length (cm)			Fruit diameter (cm)			Green fruit yield (g/plant)			Green fruit yield (q/ha)			Red fruit yield (g/plant)			Red fruit yield (q/ha)		
		2019-20	2020-21	Pooled data	2019-20	2020-21	Pooled data	2019- 20	2020-21	Pooled data	2019-20	2020-21	Pooled Data	2019-20	2020- 21	Pooled data	2019-20	2020-21	Pooled Data
T_1	0 kg/ ha of N + 0 kg/ ha of K	6.43	6.29	6.36	1.28	1.24	1.26	1351.80	1337.70	1344.80	206.00	201.40	203.70	914.30	912.60	913.40	188.10	176.50	182.30
T_2	0 kg/ha of N + 30 kg/ ha of K	6.46	6.31	6.39	1.27	1.23	1.25	1355.30	1356.70	1356.00	206.50	213.60	210.10	968.60	966.70	967.70	199.30	187.60	193.40
T_3	0 kg/ ha of N + 30 kg/ ha of K + 3 foliar sprays of KNO_3@ 2%	6.52	6.32	6.42	1.28	1.28	1.28	1484.90	1493.30	1489.10	226.30	229.90	228.10	1013.30	1016.50	1014.90	208.50	204.00	206.20
T_4	75 kg of N (Two split doses) + 0 kg/ha of K	6.47	6.38	6.43	1.27	1.28	1.28	1373.20	1406.70	1389.90	209.30	215.60	212.40	1000.80	991.20	996.00	205.90	193.60	199.80
T_5	75 kg of N (Two split doses) + 30 kg/ha of K	6.54	6.58	6.56	1.27	1.30	1.29	1516.50	1527.90	1522.20	231.10	252.70	241.90	1023.60	1037.80	1030.70	210.60	218.70	214.60
T_6	75 kg of N (Two split doses) + 30 kg/ha of K +3 foliar spray of KNO_3 @ 2%	6.84	6.81	6.83	1.31	1.29	1.30	1679.30	1670.00	1674.70	255.90	265.50	260.70	1156.60	1181.30	1169.00	237.90	252.20	245.10
T_7	100 kg/ha of N (Three split doses) + 0 kg/ ha of K	6.62	6.43	6.52	1.29	1.28	1.29	1581.50	1573.90	1577.70	241.00	235.90	238.50	1093.30	1086.50	1089.90	224.90	228.70	226.80
T_8	100 kg/ha of N (Three split doses) + 30 kg/ ha of K	6.63	6.54	6.58	1.29	1.29	1.29	1596.30	1596.60	1596.40	243.30	245.90	244.60	1098.10	1095.50	1096.80	225.90	242.90	234.40
$_T9$	100 kg/ha of N (Three split doses) + 30 kg/ha of K + 3 foliar sprays of KNO_3@ 2%	6.94	7.45	7.19	1.31	1.35	1.33	1796.70	1787.10	1791.90	273.80	273.40	273.60	1233.30	1242.30	1237.80	253.80	263.80	258.80
T_{10}	125 kg/ha of N (Three split doses) + 0 kg/ ha of K	6.61	6.39	6.50	1.29	1.32	1.31	1525.80	1491.70	1508.70	232.50	232.70	232.60	1040.00	1081.30	1060.60	213.90	222.50	218.20
T_{11}	125 kg/ha of N (Three split doses) + 30 kg/ ha of K	6.68	6.68	6.68	1.28	1.30	1.29	1634.00	1610.00	1622.00	249.00	246.30	247.70	1124.50	1146.00	1135.20	231.60	248.20	239.80
T_{12}	125 kg/ha of N (Three split doses) + 30 kg/ha of K + 3 foliar sprays of KNO_3@ 2%	6.84	7.00	6.92	1.29	1.31	1.30	1712.50	1725.60	1719.00	260.90	251.00	256.00	1196.70	1232.40	1214.50	246.20	253.60	249.90
CD (P = 0.05)		NS	0.08	0.20	NS	NS	NS	155.20	111.40	99.40	23.60	17.40	15.20	113.90	143.10	95.40	17.40	21.80	14.20

translocation in plant system which resulted in non-significant effect on fruit diameter.

Green fruit yield

The yield is also an important criterion for comparing the efficiency of different treatments. Yield potential is the deciding factor of adaptability of any crop plant. The data regarding the effect of different treatments on green fruit yield (g/plant) is presented in Table 2. Maximum yield (g/plant) was attained with T_9 (100 kg/ ha of N + 30 kg/ ha of K + 3 foliar spray of KNO_3@ 2%) which was significantly higher than all other treatments during both the seasons. In pooled data of two seasons, the maximum green fruit yield per plant (1791.87 g) was observed in treatment T_9 (100 kg/ ha of N + 30 kg/ ha of K + 3 foliar spray of KNO_3@ 2%) which was significantly higher by 17.71% and 33.25% from recommended dose of fertilizers and control, respectively. The results are in conformity with the findings of Solangi *et al*. (2013) that significant green fruit yield can only be achieved with definite dose of potassium and nitrogen. Similarly, Prasad *et al*. (2016) also found that various doses of nitrogen and potassium affect green fruit yield differently.

Red fruit yield

Red fruit yield (g/plant) is the measure of total quantity of red fruits produced. During both seasons and in pooled data the maximum yield recorded with T_9 (100 kg/ ha of N + 30 kg/ ha of K + 3 foliar spray of KNO_3@ 2%) was significantly higher than rest of the treatments. During 2019-20, treatment T_5, T_6, T_7, T_8, T_9, T_{11}, T_{12} and during 2020-21 treatment T_6, T_8, T_{11} and T_{12} were found to be statistically at par with each other. The results are in conformity with the findings of Dubey *et al*. (2017) that increasing dose of nitrogen and potassium resulted in increasing total red yield of chilli. Similar results were found by Hiremath *et al*. (2006); Ortas (2013) in pepper and tomato, respectively.

Quality parameters

Dry matter

Dry matter is the sum total of all constituents of plant excluding water. It is the result of spatial and temporal integration of all plant activities. In case of crop canopies studies, it is the most applicable parameter. The data related to the effect of different nitrogen and potassium fertilizer treatments on dry matter of chilli is presented in Table 3. Perusal of data showed that highest dry matter content (28.80% and 28.50%) during both seasons was recorded in T_9(100 kg/ ha of N + 30 kg/ ha of K + 3 foliar spray of KNO_3 @ 2%). However, in both seasons dry matter values attained with different treatments (T_6, T_7, T_8, T_9, T_{11} and T_{12}) were found to be statistically similar with each other. Same result was observed in pooled data of two seasons. These results are in conformity with Pervez *et al*. (2004) which showed a promoting effect of nitrogen was reported on accumulation of dry matter in chilli crop. Accumulation of dry matter depends upon the photosynthetic rate of plant which further depends upon the chlorophyll content.

Colouring matter (ASTA)

Capsanthin and capsorubin are the two main carotenoids pigments which are primarily responsible for colour development in chilli. These pigments impart orange to red colour in the fruit (Kendrick, 2012). In Table 3, pooled data showed that with T_9 (100 kg/ ha of N + 30 kg/ ha of K + 3 foliar spray of KNO_3@ 2%) there is about 6.50 % and 9.37% more colouring matter as compared to recommended dose of fertilizers (T_5) and control (T_1). In both seasons 2019-20 and 2020-21 as well as in pooled data of two seasons maximum colouring matter (240.1) was attained with the application of T_9 which was significantly better than rest of the treatments. However, during 2019-20 data has revealed that treatments T_6, T_9, T_{11} and T_{12} were found to be statistically similar with each other. Same results have been observed during 2020-21 as well as in pooled data of both seasons. The results were in accordance with the findings of Bidari *et al*. (2004) where increased concentration of colouring matter was observed with increased nitrogen and potassium application. However, it was noted that potassium dose had much higher effect on the content of colouring matter than nitrogen. The reason is that potassium regulates the availability of substrates which are responsible for synthesis of capsanthin and capsorubin pigments.

Capsaicin content in green chilli

In Table 3 data has showed that the maximum capsaicin content in green chilli was attained with the application of T_9(100 kg/ ha of N + 30 kg/ ha of K + 3 foliar spray of KNO_3 @ 2%) during 2019-20 (0.5390 %) and 2020-21 (0.5300 %) as well as in pooled data of two seasons (0.5345 %) which was significantly better than rest of all treatments. In pooled data with treatment T_9 (100 kg/ ha of N + 30 kg/ ha of K + 3 foliar spray of KNO_3@ 2%), 16.37 % and 24.68 % more capsaicin content in green chilli was recorded than recommended dose of fertilizers (T_5) and control (T_1) respectively; similar results were found by Data and Jana, 2009.

Capsaicin content in red chilli

Pungency of chilli is due to capsaicinoids and active compound of chilli called capsaicin. Capsaicin is mainly restricted to placenta and pericarp of chilli fruit which has various physiological functions. In Table 3 pooled data showed that with T_9 (100 kg/ ha of N + 30 kg/ ha of K + 3 foliar spray of KNO_3@ 2%) 7.48 % and

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Table 3. Effect of different treatments on Dry matter, colouring matter (ASTA units), Capsaicin content in green chilli (%), Capsaicin content in red chilli (%), Oleoresin content (%) of chilli.

S. No.	Treatment	Dry matter (%)			Colouring matter (ASTA units)			Capsaicin content in green chilli (%)			Capsaicin content in red chilli (%)			Oleoresin content (%)		
		2019-20	2020-21	Pooled data	2019-20	2020-21	Pooled data	2019-20	2020-21	Pooled data	2019-20	2020-21	Pooled data	2019-20	2020-21	Pooled data
T_1	0 kg/ ha of N + 0 kg/ ha of K	20.70	20.57	20.64	220.8	218.3	219.6	0.430	0.427	0.429	0.6833	0.6827	0.6830	9.13	9.15	9.14
T_2	0 kg/ha of N + 30 kg/ ha of K	21.47	21.67	21.57	222.4	222.6	222.5	0.438	0.434	0.436	0.6983	0.6977	0.6980	9.30	9.37	9.33
T_3	0 kg/ ha of N + 30 kg/ ha of K + 3 foliar sprays of KNO_3@ 2%	23.67	23.87	23.77	224.8	223.6	224.2	0.456	0.453	0.454	0.7190	0.7183	0.7187	11.01	11.07	11.04
T_4	75 kg of N (Two split doses) + 0 kg/ha of K	22.02	22.27	22.15	223.9	222.8	223.4	0.448	0.446	0.447	0.7040	0.7093	0.7067	10.63	10.43	10.53
T_5	75 kg of N (Two split doses) + 30 kg/ha of K	24.63	24.37	24.50	225.9	224.8	225.4	0.461	0.458	0.459	0.7290	0.7287	0.7288	11.48	11.49	11.49
T_6	75 kg of N (Two split doses) + 30 kg/ha of K +3 foliar spray of KNO_3 @ 2%	27.70	27.53	27.62	238.7	234.3	236.5	0.485	0.482	0.483	0.7650	0.7640	0.7645	12.65	12.55	12.60
T_7	100 kg/ha of N (Three split doses) + 0 kg/ha of K	26.20	25.97	26.09	228.6	226.8	227.7	0.469	0.467	0.468	0.7450	0.7447	0.7448	11.64	11.48	11.56
T_8	100 kg/ha of N (Three split doses) + 30 kg/ha of K	26.47	26.30	26.39	230.6	229.6	230.1	0.476	0.471	0.474	0.7520	0.7510	0.7515	12.06	12.18	12.12
T_9	100 kg/ha of N (Three split doses) + 30 kg/ha of K + 3 foliar spray of KNO_3@ 2%	28.80	28.50	28.65	240.7	239.4	240.1	0.539	0.530	0.535	0.7830	0.7833	0.7833	13.50	13.39	13.45
T_{10}	125 kg/ha of N (Three split doses) + 0 kg/ha of K	25.03	24.47	24.75	226.9	225.6	226.2	0.466	0.462	0.464	0.7343	0.7337	0.7340	11.59	11.54	11.57
T_{11}	125 kg/ha of N (Three split doses) + 30 kg/ha of K	27.07	26.83	26.95	233.6	232.3	232.9	0.479	0.476	0.478	0.7580	0.7573	0.7577	11.89	11.70	11.80
T_{12}	125 kg/ha of N (Three split doses) + 30 kg/ha of K + 3 foliar spray of KNO_3@ 2%	28.33	28.20	28.27	237.9	236.8	237.3	0.510	0.495	0.503	0.7687	0.7680	0.7683	12.74	12.42	12.58
CD (P = 0.05)		2.74	2.68	2.20	9.4	10.9	8.4	0.009	0.008	0.0078	0.0030	0.0031	0.0028	1.31	0.94	0.76

14.69 % more capsaicin content was obtained in red chilli as compared to recommended dose of fertilizers (T_5) and control (T_1). However, maximum capsaicin content (0.7833 %) was attained with the application of T_9 (100 kg/ ha of N + 30 kg/ ha of K + 3 foliar spray of KNO_3 @ 2%) which was significantly better than rest of the treatments. Veerana *et al*. (2000) showed that increase in potassium content significantly increase the capsaicin content in chilli fruit. The reason behind the finding is nitrogen in plant system helps to form various amino acids. Branched amino acids like valine and leucine plays the primary role in the synthesis of capsaicin (Sarma *et al*., 2004).

Oleoresin

Deep red coloured semi viscous liquid obtained from chilli is called as oleoresin. It is used in various food industries as a flavouring agent, colouring agent and preservative (Harp and Barrows, 2015). The data presented in Table 3 revealed that T_9 (100 kg/ ha of N + 30 kg/ ha of K + 3 foliar spray of KNO_3@ 2%) during both seasons 2019-2020 and 2020-21 as well as pooled data resulted in maximum oleoresin content (13.45%) which was significantly higher from recommended dose of fertilizers (T_5) 11.49% and control (T_1) 9.14%. This result is comparable with the findings of Prabhavathi *et al*. (2008) that higher level of potassium nitrate application brought about maximum oleoresin content in chilli fruit. Ananthi *et al*. (2004) in an experiment observed that nitrogen and potassium also increased oleoresin content in chilli upto certain level despite showing the increment in other growth factors.

From whole study, it can be concluded that the growth parameters such as canopy width and number of branches; yield parameters such as fruit length, fruit diameter, green fruit yield(q/ha), red fruit yield (q/ha); quality parameters such as dry matter, colouring matter, capsaicin content in green and red chilli, oleoresin content were higher due to interactive effect of KNO_3 as compared to RDF alone. To conclude, application of potassium nitrate (KNO_3) @ 2% along with 100 kg/ ha of N (Three split doses) and 30 kg/ ha of K showed overall better performance in growth, quality and yield of chilli than top dressed fertilizers alone.

Authors' contribution

Conceptualization of research work and designing of experiments (BJ, KS, DT, SJ); Execution of field/lab experiments and data collection (BJ, KS, SJ); Analysis of data and interpretation (BJ, KS, DT); Preparation of manuscript (BJ, KS, DT, SJ).

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