Original Research Article

Effect of Potassium Fertigation Levels on Jalapeno Pepper Growth in Red Bole Soil Under Polyhouse Conditions

ABSTRACT

A field experiment was conducted at InstructionalFarmPolyhouse, Dr. Sharadchandra Pawar College of Agriculture, Baramati during June 2023 to September 2023. The study aimed to investigate the Influence of Graded levels of Potassium Fertigation on Growth of Jalapeno Pepper Grown in Red Bole Soil Under Polyhouse. The experiment was laid out in Randomized Block Design (RBD) with four replications. The treatments were five, viz., T_1- Control, T_2- Recommended dose of fertilizer, T_3- Recommended dose of nitrogen and phosphorus (RDNP) + 125% Recommended dose of potassium (RDK), T_4- Recommended dose of nitrogen and phosphorus (RDNP) + 150% Recommended dose of potassium (RDK) and T_5- Recommended dose of nitrogen and phosphorus (RDNP) + 175% Recommended dose of potassium (RDK). Data were taken on growth contributing characters and the collected data were statistically analyzed for evaluation of the treatment effects.Data on growth parameters, including plant height, leaf area and chlorophyll content, were recorded at 20, 35, 50 and 65 days after transplanting (DAT) and analyzed statistically. The results indicated that the maximum plant height (95.65 cm), leaf area (61.61 dm^2) and chlorophyll content (58.83) at 65 DAT were significantly higher in treatment T5 (RDNP + 175% RDK). This study concludes that the application of RDNP + 175% RDK via fertigation from 10 DAT to 60 DAT is optimal for the growth of Jalapeno pepper in red bole soil under polyhouse conditions, highlighting its potential for improving crop yield and quality.

Keywords: *Jalapeno Pepper, Fertigation, Potassium, Growth, Days after transplanting*

1. INTRODUCTION

In many nations across the world chilli pepper (*Capsicum annuum* L.) is now a valuable spice and cash crop making it the third most important crop in the Solanaceae family and was Portuguese introduced in 16^{th} century in India. Chilli originated in south and central America. Due to its pungent taste, lustrous green fruits and availability of hot chilli (*Capsicum annuum* L. Solanaceae, 2n = 24) is one of the most preferred spice or taste enhances in the world (Gade *et al*. 2020). Chilli peppers (*Capsicum annuum*)are not just hot flavored fruits of capsicum pepper plants but also good source of vitamins, minerals and antioxidants and most commonly used as a fresh or dried spice. Green chilli fruits provide the following nutritional values per 100 grams: 111 mg vitamin C, 454 I.U. of vitamin A, 0.91% mineral matter and 6.7% fiber. Indian chillies are widely recognized as one of the spiciest vegetables across the globe having high SHU units and are popular among the good enthusiasts. Chilli cultivation is taken majority in tropical and

subtropical climatic condition. Around 25 species in the genus capsicum have been identified but only five are domesticated and grown *C. annuum* L, *C. chinense, C. frutescens* L, *C. baccatum* Land *C. pubescens*. (Ratna *et al.* 2018). Chilli cultivation is widespread globally, covering an area of about 1.776 million hectares. This extensive cultivation results in a total production of approximately 7.182 million tons of chilli peppers. India is currently the world's largest producer and exporter of chilli peppers. In India, Andhra Pradesh is the leading state in chilli cultivation. It has the maximum area dedicated to growing chillies, covering about 131.3 thousand hectares, which accounts for approximately 16.94% of the total chilli cultivation area in the country.

Jalapeno chilli (*Capsicum annum*) literally meaning from Jalapa got its unique name from the Spanish city which is the capital of Veracruz, aMexicanstate where this pepper was first cultivated. Scientific name Jalapeno is *Capsicum annum* which is aspecies of the plant genus capsicum. Jalapenos grow in soil that has a pH of 4.5 to 7. The hotness ofJalapeno peppers will clear sinuses andhelp to relievesymptomsofcolds such as fever and sorethroats. The seeds are found in the center of a Jalapeno pepper and are surrounded by a membrane that contains most of the capsaicin in Jalapeno which makes it the most pungent part of the pepper. Potassium has the role in increasing the pigment of the chilli and also affects the pungency. Jalapeno Peppers are rich source of potassium. Jalapeno contains Iron, magnesium, manganese, phosphorus and copper in trace amounts. Potassium plays a pivotal role and facilitates the production ofphotosynthates and their transport to storage organs of the plant such as fruits in Jalapeno chilli enhancing theirconversion into starch, protein, vitamins and oil. While in Jalapeno chilli deficiency of potassium may lead to being arrested rate of photosynthesis and the rate of translocation and enzymesystems.

Jalapenos contain capsaicin, which is known for its anti-inflammatory and pain-relieving properties. They may also boost metabolism and promote weight loss and widely used in various cuisines, adding flavor and heat to dishes. They are popular in salsas, sauces, and as toppings for many foods. In many cultures, especially in Mexican cuisine, jalapenos play a crucial role in traditional dishes and culinary practices. Jalapenos contain capsaicin, which is known for its anti-inflammatory and pain-relieving properties. They may also boost metabolism and promote weight loss. Nutritive value of jalapeno pepper per 100 gm, calories 29 kcal, water 92.4 gm, protein 0.91 gm, fat0.35 gm, carbohydrate 6.5 gm, fiber 2.0 gm, sugar 3.6 gm. Vitamin content in Jalapeno pepper 118.6 mg Vit C, 0.249 mg Vit. B6 and 1,463 IU Vit. A. The minerals in Jalapeno pepper 322 mg potassium, 14 mg magnesium, 18 mg calcium and 0.61 mg iron are present.

Potassium plays a role in strengthening plant cell walls and enhancing resistance to diseases. Deficiency can weaken plants, making them more vulnerable to pests and diseases. The pepper plant is sensitive to the lack of soil moisture; therefore, they will require careful management i.e. soil preparation, irrigation scheduling, mulching and used drought-tolerant varieties. Potassium (K) plays several critical roles in the cultivation of Jalapeno peppers, influencing both yield and fruit quality. Adequate potassium levels improve water use efficiency and drought resistance, essential for optimal growth in controlled environments and enhances the uptake of other essential nutrients, particularly nitrogen and phosphorus. This synergistic effect can lead to improved growth rates and higher yields of Jalapeno pepper. Potassium influences fruit set, size and quality. It is involved in the synthesis of proteins and carbohydrates, which contribute to the development of flavorful and high-quality fruits. A balanced potassium supply can enhance the color, firmness and sugar content of Jalapeno pepper.

2. MATERIAL AND METHODS

2.1 Geographical Location and Experimental Site

Baramati city comes under the Pune district of Maharashtra state. It is situated in south east zone at the latitude 18.14 ^{0}N and longitude 74.52 ^{0}E. The elevation is 563 m above mean sea level. The Instructional farm situated 4 km away from Malegaon village and about 6.8 km away from Baramati tehsil place. The field experiment was conducted at the Instructional farm, Polyhouse, Dr. Sharadchandra Pawar College of Agriculture, Baramati.

2.2 Design of Experiment

The field experiment was conducted in Randomized Block Design (RBD) with 4 replications and 5 treatments in each replication.

2.3 Treatment Details

The experimental details of treatment, which were comprised 5 treatments are presented in Table 1.

Table. 1: Treatment details

Tr. No.	Treatments
T_1	Control
T_2	RDF– (100:50:50) (N, P_2O_5, K_2O kgha^{-1})
T_3	RDNP+ 125% RDK
T_4	RDNP + 150%RDK
T_5	RDNP + 175% RDK

2.4 Transplanting

All the beds were saturated by providing sufficient quantity of water through drip system before transplanting. The four week old healthy and uniform chilli seedlings were transplanted at the spacing of 90 cm x 45 cm on the raised beds.The roots of seedling along with coco peat were placed in soil and slightly pressed for easy establishment of seedling. Placement of plant was zigzag. Each treatmentwas having twenty-one plants with four replications.

2.5 Fertigation

Drip irrigation system was installed for application of water and fertilizer. Fertigation was done through water soluble fertilizers through soil in control throughout the cropping period. water soluble fertilizers were applied at an interval of 10, 30, 45 and 60 days after transplanting.

2.6 Cultural Practices

2.6.1 Weeding and irrigation

Manual weeding was done whenever weeds were noticed to keep the plots clean. Drip irrigation was resorted for irrigating the plot frequently to maintain the optimum moisture levels in the soil. All the plant protection measures were taken to control pests and diseases as and when necessary, as per package of practice.

2.6.2 Staking

The plants were staked with the help of jute thread and tied to a barbed wire 30 days after transplanting to prevent lodging of plants.

2.7 Details of Observation

Five plants were selected in each replication as observational plants to record the data on defined characters in research trial.

2.7.1 Growth contributing characters

2.7.1.1 Plant height (cm)

The height of plant was recorded in centimeter (cm) at different days after transplanting of crop duration. Data were recorded as the average of 5 plants selected at random from each plot. The height was measured from the ground level to the tip of the plant by meter scale. Data was taken at 20, 35, 50 and 65 DAT.

2.7.1.2 Leaf area (dm^2)

Leaf area was recorded by taking leaf from bottom, middle and top portion of the plant using leaf area meter (panomax leaf area meter) at 20, 35, 50 and 65 DAT then average was worked out and expressed in dm^2.

2.7.1.3 Chlorophyll content

The leaf chlorophyll content was determined by using a SPAD-502 meter (Konika Minolta, Japan). At vegetative, flowering and harvesting stage fully opened and matured leaves were selected for to check the chlorophyll content middle and bottom portion of leaf inserted in SPAD meter. Record the value of randomly selected five plants in between 9:30 to 10:30 a.m. hour and it is expressed in spad units.

2.7.1.4 Statistical Analysis

The data generated after the chemical and physical observations recorded from soil and plant as per the scheduled programmed mentioned above was statistically analysed by adopting Randomized Block Design (RBD) as suggested by Panse and Sukhatme (1985).

3. RESULT AND DISCUSSION

3.1 Plant height

The data on plant height of Jalapeno pepper is displayed in Table 2 and fig. 1 showed that application of graded levels of potassium fertigation had a significant effect on plant height at 20, 35, 50 and 65 DAT. The highest plant height of Jalapeno pepper obtained in the treatment applied to RDNP + 175% RDK recorded (37.73 cm), (49.20 cm), (72.65 cm) and (95.65 cm) after 20, 35, 50 and 65 DAT was at par with T_4 treatment. The lowest plant height wasobserved in control treatment (28.03 cm), (34.53 cm), (59.97 cm) and (72.27 cm) after 20, 35, 50 and 65 DAT. Potassium involved in the process of cell expansion and also promote the strong root system, which in turn support better above-ground growth, including increased plant height. Potassium plays a crucial role in plant metabolism and it is essential for several processes that promote vegetative growth and development according to Bassiony *et al.* (2010). Sabina *et al*. (2023) demonstrated that potassium may increase nitrogen assimilation, resulting to improved plant height and vegetative development.More or less similar finding was reported by Adhikary *et al.* (2006),Bose *et al.* (2006), El-Nemr *et al.* (2012), Bhuvaneswari *et al.* (2013),Golcz *et al.* (2015), Hassan *et al.* (2016), Hegazi *et al.* (2017) and Kakar *et al.* (2024).

Table. 2.Influence of graded levels of potassium fertigation on plant height of Jalapeno pepper

Tr. no.	Treatment	Plant height (cm)			
		20 DAT	35 DAT	50 DAT	65 DAT
T_1	Control	28.03	34.53	59.97	72.27
T_2	RDF– (100:50:50) ($N,P_2O_5,K_2O kg ha^{-1}$)	31.05	42.45	66.75	84.56
T_3	RDNP+ 125% RDK	32.59	43.75	69.08	85.06
T_4	RDNP + 150%RDK	35.92	48.54	74.80	92.36
T_5	RDNP + 175% RDK	37.73	49.20	76.62	95.65
	S. Em ±	0.85	1.28	1.80	2.25
	CD (P= 0.05)	2.62	3.96	5.56	6.96

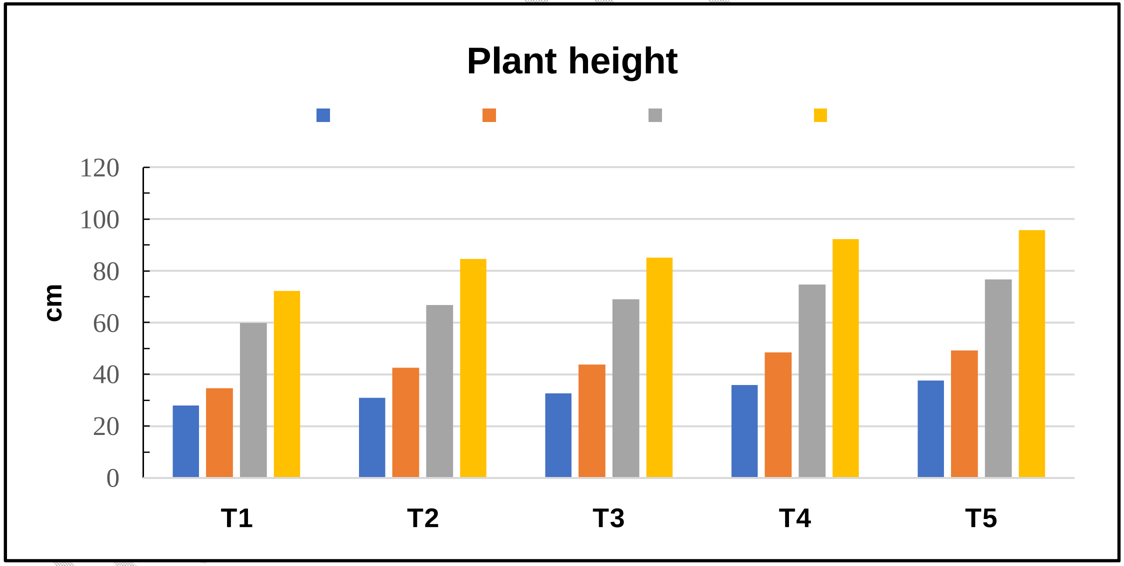

Fig. 1.Influence of graded levels of potassium fertigation on plant height of Jalapeno pepper

3.2 Leaf area

The data regarding the leaf area of Jalapeno pepper significantly influenced the graded levels of potassium fertigation are presented in Table 3 and graphically represented in fig. 2. The highest leaf area of Jalapeno pepper obtained in the treatment applied to RDNP + 175% RDK recorded (18.62 dm^2), (36.01 dm^2), (48.32 dm^2) and (61.61dm^2) after 20, 35, 50 and 65 DAT which was at par with treatment T_4 which received RDNP + 150%RDK and lowest leaf area was observed in control treatment (10.11 dm^2),

($26.39\ dm^2$), ($36.24\ dm^2$) and ($43.31 dm^2$) after 20, 35, 50 and 65 DAT. Potassium played a crucial role in maintaining the osmotic balance within plant cells by regulating water uptake and retention. This regulation was vital for sustaining turgor pressure, which was necessary for cell expansion and had a direct impact on leaf area. According to Mishra and Sahu. (2014) stated that expanded leaf area was obtained through appropriate nutrition consumption in response to greater dosages of nitrogen, potash and their combination. Similar result also reported byBharamappa *et al*. (2009), Brahma *et al.* (2010), Rikza *et al.* (2021), Selim *et al.* (2021) and Kusumiyati *et al.* (2022).

Table. 3.Influence of graded levels of potassium fertigation on leaf area of Jalapeno pepper

Tr. no.	Treatment	Leaf area (dm^2)			
		20 DAT	35 DAT	50 DAT	65 DAT
T_1	Control	10.11	26.39	36.24	43.31
T_2	RDF– (100:50:50) ($N, P_2O_5, K_2O kg ha^{-1}$)	14.05	30.21	40.24	48.35
T_3	RDNP+ 125% RDK	14.59	31.58	42.83	53.01
T_4	RDNP + 150%RDK	17.31	35.29	46.61	57.74
T_5	RDNP + 175% RDK	18.62	36.01	48.32	61.61
	S. Em ±	0.52	1.12	1.11	1.42
	CD (P= 0.05)	1.62	3.45	3.44	4.40

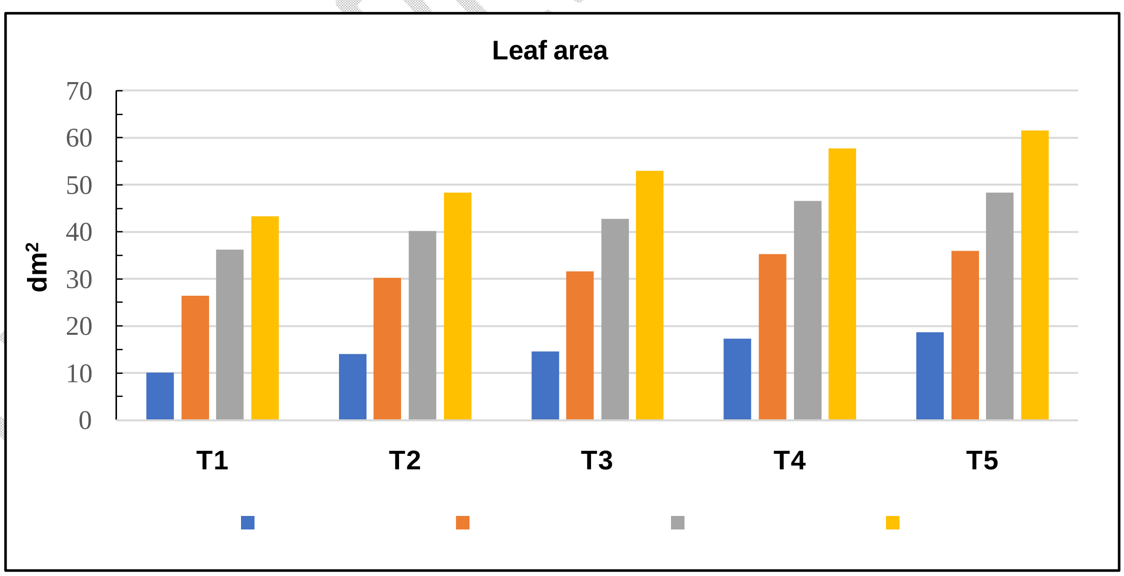

Fig. 2.Influence of graded levels of potassium fertigation on leaf area of Jalapeno pepper

3.3 Chlorophyll content

The results related to chlorophyll content has been presented in Table 4 and graphically depicted in 4. The chlorophyll content in leaves significantly influenced the graded levels of potassium fertigation. The greatest chlorophyll content was found in treatment T_5 (RDNP + 175% RDK) which received (45.66), (53.61), (62.78) and (58.83) after 20, 35, 50 and 65 DAT and it was found to be at par with T_4- RDNP + 150% RDK treatment. Whereas the significantly minimum chlorophyll content (35.22), (37.63), (46.97) and (42.0) was recorded in the treatment T_1after 20, 35, 50 and 65 DAT where no fertilizer was applied during the experimentation. Potassium plays a crucial role in the absorption and transport of essential nutrients, including nitrogen, a vital component of chlorophyll. Chlorophyll is the primary component in the vegetables and fruits that gives them their green colour according to Malik *et al.* (2011).Similar result also obtained by Kamal (2013) and Gokul *et al.* (2020).

Table. 4.Influence of graded levels of potassium fertigation on chlorophyll content in leaves of Jalapeno pepper

Tr. no.	Treatment	Chlorophyll content (SPAD units)			
		20 DAT	35 DAT	50 DAT	65 DAT
T_1	Control	35.22	37.63	46.97	42.00
T_2	RDF– (100:50:50) ($N:P_2O_5:K_2O$ kgha^{-1})	38.73	42.26	52.73	47.91
T_3	RDNP+ 125% RDK	40.68	44.42	55.96	52.43
T_4	RDNP + 150%RDK	44.24	48.93	60.97	57.25
T_5	RDNP + 175% RDK	45.66	53.61	62.78	58.83
	S. Em ±	1.10	1.41	1.52	1.45
	CD (P= 0.05)	3.41	4.36	4.68	4.48

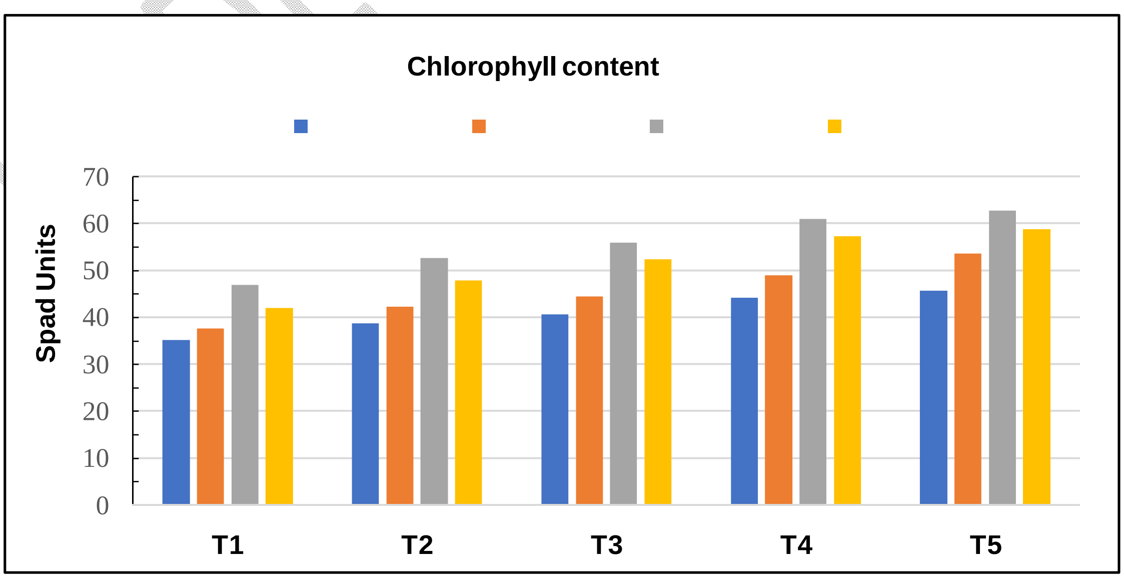

Fig.3.Influence of graded levels of potassium fertigation on chlorophyll content in leaves of Jalapeno pepper

4. CONCLUSIONS

Based on the results it could be determined that the Influence of Graded Levels of Potassium Fertigation on Growth of Jalapeno Pepper Grown in Red Bole Soil Under Polyhouse. Enhancing the concentration of RDK above the recommended dose particularly at 175% (T_5) levels, significantly enhanced plant height, leaf area and chlorophyll content suggesting that a higher potassium supply promoted better growth.

Recommendation for farmer

I. Conduct soil tests to determine nutrient levels and tailor fertigation schedules based on the specific nutrient needs of the crop.

II. Implement a balanced approach by incorporating the recommended doses of nitrogen, phosphorus and potassium, adjusting ratios according to growth stages.

III. Utilize graded potassium fertigation, starting with lower levels and gradually increasing based on plant response. Treatments with higher potassium levels (e.g., 175% RDK) have shown better growth outcomes.

IV. Use a combination of macro (nitrogen, phosphorus, potassium) and micronutrients based on soil test results. Implement a nutrient management plan that incorporates both organic and inorganic fertilizers to enhance soil health.

ACKNOWLEDGEMENTS

The authors express their sincere gratitude to Dr. Sharadchandra Pawar College of Agriculture, Baramati, for providing the essential facilities required for conducting this research. Special thanks are extended to Prof. R. D. Gaikwad, Prof. R. G. Pondkule and Prof. B. N. Tambe for their invaluable guidance and support throughout the research process.

DISCLAIMER

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT,etc.) and text-to-image generators have been used during writing or editing of manuscripts. COMPETING INTERESTS: Authors have declared that no competing interests exist.

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