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Effect of different levels of potassium on growth and flowering of Papaya var. Red Lady

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Abstract

A field experiment was conducted at the horticultural field of Nagaland University to study the effect of different levels of potassium on growth and flowering of papaya var. Red Lady. The result of the investigation revealed that attributes *viz.*, plant height, plant girth and the number of leaves increased as level of potassium increased, where maximum girth (185.2m), height (31.3cm) and number of leaves (21.7) were recorded in T₈ treated plants and maximum days taken for flowering was under T₀ (185) and lowest in T₈. Total number of flowers set and fruit set was recorded in T₅. It was also revealed that T₅ had a positive effect on fruit yield (26.13t/ha). Overall appearance like flower colour, fruit skin colour and pulp colour were not affected by any level of K application.

Keywords: Red lady, potassium, nutrition, growth, flower, yield

Introduction

Papaya (*Carica papaya* L.) is the most economically important commercial fruit crop in the tropical and sub-tropical regions because of high remuneration, nutritional and medicinal values (Hazarika *et al.*, 2016) [3]. It's cultivation in north-east India has not been commercialized to the extent it deserves. The area and production of papaya is low and also productivity is extremely low. According to the records in the north eastern states, the low productivity is due to cultivation of local varieties. The constraints of papaya cultivation in north-east region are namely: moisture stress, frost from December- March, soil erosion, pest and disease infestation. (Singh *et al.*, 2010) [15].

As papaya is a heavy yielder it requires large amount of nutrients for its growth including nitrogen, phosphorous and potassium. In relation to potassium, papaya presents a higher demand may be due to the sweetness of its fruit. Since potassium is also referred as the quality nutrient element for crop production (Usher wood, 1985) [17] which improves the major parameters of papaya fruits such as pulp thickness and sweetness.

The papaya fruit has gained commercial importance over the years because of the demand for its varied uses. Due to its year-round fruiting behaviour and short pre-bearing period makes it different from other fruit crops. Papaya responds well to the application of organic and inorganic fertilizers. However, the quantification of nutrient requirements on papaya under Nagaland conditions has not been studied. So, the present study was conducted with the objectives like, to study the effect of different levels of potassium on growth, flowering and yield of Papaya cv. Red Lady.

Materials and Methods

An experiment was conducted at research farm of Department of Horticulture, School of Agricultural Sciences and Rural development, Nagaland University, Medziphema campus during 2019-20. Medziphema campus lies in the sub-humid tropical region with high humidity and moderate temperature 12°C to 32°C, having moderate to high rainfall (2000-3000mm) and RH of 70-80%. The study was laid out in Randomised block design with nine treatments *viz.*, T₀: Control, T₁: 100g K₂O/ Plant, T₂: 150g K₂O/ plant, T₃: 200g K₂O/ Plant T₄: 250g K₂O/ Plant T₅: 300g K₂O/ Plant T₆: 350g K₂O/ Plant T₇: 400g K₂O/ Plant T₈: 450g K₂O/ Plant, which are replicated thrice. Nitrogen and phosphorous at a recommended dose of 200:150 g/ plant.

Growth parameters like plant height (m), plant girth (cm), no. of leaves per plant, chlorophyll content of leaves (mg/100g), flower parameters like days taken for flowering after transplanting, total no. of flowers per plant, no. of fruit set per plant, fruit drop per plant (%)

and no. of fruits retained per plant till harvest were taken. Yield attributes like average fruit weight (kg), yield per plant (kg) yield per hectare (t) were recorded. Physico-chemical characteristics like TSS ($^{\circ}$ B), total sugar (%), reducing sugars (%), non-reducing sugars (%), titratable acidity (%), ascorbic acid (mg/100g) were recorded for assess the quality of papaya cv. Red Lady. The data recorded was analysed by the analysis of variance method and the significant sources of variation were tested by error mean square using 'F' test (Panse and Sukhatme, 1989)^[11].

Results and discussion

The analysis of variance for individual characters revealed significant differences among genotypes. The data observed with respect to the growth parameters were presented in Table 1.

The effect of various doses of potassium nutrition on papaya was significantly influenced, such that greater the potassium supply. The treatment T₈ (200.150:450 g NPK/plant) showed highest plant height (1.85 m) followed by T₇ (200:150:400 g NPK/ plant) (1.64 m). The minimum plant height was recorded in the plants under control (1.26 m). The increase in the plant height may be due to cell enlargement and corresponding increase in nodal length of the plant by more availability of nutrients and growth substances as a result of higher accumulation of photosynthates in response to potassium application. Similar findings have also been reported by Kumar *et al.*, 2017^[7]. The T₈ recorded highest plant girth of (31.31cm) followed by T₇ and least recorded in T₀ with the size of 17.6cm. Similar results were found in the study of Parmer *et al.*, 2017^[12].

Maximum no. of leaves were found in T₈ (21.77) followed by T₇ (19) whereas the least no. of leaves were found in T₀ (12.33). Similar results were found in the study of Bindhu, 2015.

The increase in no. of leaves might be due to participation of growth substances and nutrients in plant metabolic process.

Chlorophyll content of leaves at flowering had no significant impact. However, the highest chlorophyll content was recorded in the leaves of T₁ (0.52 mg/100g) and lowest in T₃ (0.28 mg/100g).

Significant difference was found in days taken for flowering. Maximum days of 185.33 days was taken for flowering after transplanting under the treatment T₀ followed by T₁ (181.11). The least time taken for flowering was shown for T₈ (170.53). Flower formation is most likely caused by changes in phyto hormones balance expression effected by 'K' nutrition (Marschner, 1995)^[9].

Total no. of flowers produced per plant of papaya has been presented in Table 2. The results revealed that the maximum no. of flowers (20.11) was produced in T₅ followed by T₆(17.33) and the least no. of flowers was under T₀ (13.67) followed by T₁ (14.63) respectively. As per the observation recorded, the number of fruit set per plant was maximum under T₅ (15.33). The minimum number of fruit set per plant was recorded under T₈ (12.67) followed by T₀ (12.83). The

data on fruit drop percentage was presented in Table 2. which showed non-significant effect of the different levels of potassium. The highest fruit drop was recorded in T₀ (27.76%) followed by T₃ (15%). The lowest fruit drop was recorded under T₆ (10.85%) followed by T₂ (11.08%). The reason behind the fruit drop might be due to drop of fertile flowers and young fruits occurred under extreme temperature and moisture stress conditions. Similar findings were also reported by Spreer *et al.*, 2007^[16]. Highest number of fruits retained per plant till harvest under T₅ (14.33) followed by T₆ (13.33) whereas minimum value was counted under T₀ (9.17) followed by T₈ (11.00).

The data regarding average fruit weight was presented in Table 3. The maximum fruit weight was recorded in T₅ (0.75kg) followed by T₆ (0.64kg) and lowest was recorded in T₀ (0.39kg). Similar findings were also recorded by Kumar *et al.*, 2006^[5]. The possible reason for increase in fruit weight may be due to high rate of cell enlargement and cell division. The data presented on effect of potassium on yield /plant in Table 3. The highest yield per plant was recorded under T₅ (10.46kg) followed by T₆ (8.91kg) and lowest in T₀ (3.61kg). The result was in conformity with Purohit, 1977^[13] and Bindhu, 2015. Kumari (2015) reported that it might be due to higher doses of potassium augments carbon assimilation and protein synthesis where potassium influenced the weight of fruit indirectly. With respect to yield /ha recorded under T₅ (26.13t) and the lowest yield was recorded from T₀ (9.01t). The higher yield per hectare was due to the effect of fruit set and fruit weight which influenced the cumulative effect of yield per hectare (Kumari, 2015).

The data pertaining to Physio-chemical characteristics was presented in Table 4. The highest TSS was estimated in T₈ (13.63 $^{\circ}$ B) followed by T₇ (13.39 $^{\circ}$ B) and minimum TSS content was recorded in T₀ (10.63 $^{\circ}$ B). Similar results were observed by Chattopadhyay (1981)^[2] in banana and Jawandha *et al.*, (2017)^[4] in plum. The highest total sugar content was determined under T₈ (11.83%) followed by T₇ (11.77%) whereas minimum value was found in T₀ (8.30%). Wahdan *et al.*, (2011)^[18] reported that potassium act as a role in increasing formation and accumulation rate of sugars. The highest reducing sugar content was observed in T₈ (9.13%) followed by T₇ (9.10%) and lowest was recorded under T₀ (6.53%) followed by T₁ (7.40%). The similar findings were reported by Sarker and Rahim (2013)^[14] in Mango. The highest non-reducing sugar was recorded in T₇ (2.47%) and the lowest in T₂ (1.70%). The highest titratable acidity was recorded in T₆ (0.39%) and lowest in T₁ (0.24%). Similarly, Kumar *et al.*, (2006)^[5], Sarker and Rahim, (2013)^[14] reported that acidity content significantly decreased with increase in potassium supply as external doses of nutrients. The reduction in acidity content under potassium treatment might be owing to increased TSS of the fruits. The highest ascorbic acid was recorded in T₆ (40.9 mg/100g) and minimum in T₀ (2.89 mg/100g). These results were similar with the findings of Meena *et al.*, (2006)^[10] in Ber.

Table 1: Effect of potassium application on the growth parameters at flowering stage of papaya var. Red Lady.

Treatments	Plant height (m)	Plant girth (cm)	No. of leaves/plant	Chlorophyll content of leaves (mg/100g)
T ₀	1.26	17.60	12.33	0.36
T ₁	1.45	18.67	13.33	0.52
T ₂	1.50	20.65	14.66	0.41
T ₃	1.52	19.63	15.55	0.28
T ₄	1.54	21.77	14.44	0.48
T ₅	1.54	23.14	17.44	0.48
T ₆	1.59	26.88	18.33	0.47
T ₇	1.64	28.03	19.00	0.33
T ₈	1.85	31.31	21.77	0.50
SE m±	0.06	0.97	0.81	0.089
CD @ 5%	0.18	2.93	2.44	NS

Table 2: Effect of potassium application on the flowering attributes of papaya var. Red Lady

Treatments	Days taken for flowering	No. of flowers/plant	No. of fruit set/plant	Fruit drop /plant (%)	Fruits retained/plant till harvest
T ₀	185.33	13.67	12.83	27.76	9.17
T ₁	181.11	14.73	13.33	14.99	12.00
T ₂	174.44	15.50	13.67	11.08	12.83
T ₃	175.11	16.17	15.00	15.00	11.67
T ₄	176.33	16.23	13.33	12.45	11.67
T ₅	176.44	20.11	15.33	12.92	14.33
T ₆	177.33	17.23	15.00	10.85	13.33
T ₇	173.77	16.07	13.33	14.65	11.33
T ₈	170.53	15.27	12.67	13.24	11.00
SE m±	1.23	0.70	0.42	5.72	0.56
CD @ 5%	3.69	2.11	1.28	NS	1.68

Table 3: Effect of potassium application on yield attributes of Papaya var. Red Lady.

Treatments	Average fruit weight(kg)	Yield/plant(kg)	Yield/ha(t)
T ₀	0.39	3.61	9.01
T ₁	0.48	5.79	14.42
T ₂	0.49	6.29	15.73
T ₃	0.50	5.80	14.49
T ₄	0.63	7.38	18.46
T ₅	0.75	10.46	26.13
T ₆	0.64	8.91	22.26
T ₇	0.58	6.53	16.32
T ₈	0.53	5.79	14.48
SE m±	0.06	0.83	2.08
CD @ 5%	0.18	2.50	6.25

Table 4: Effect of potassium application on the Physio-chemical characteristics of papaya var. Red Lady.

Treatments	TSS (°B)	Total sugars (%)	Reducing sugars (%)	Non-Reducing sugars (%)	Titrateable acidity (%)	Ascorbic acid (mg/100g)
T ₀	10.63	8.30	6.53	1.77	0.34	2.89
T ₁	10.85	9.60	7.40	2.20	0.24	3.12
T ₂	11.63	9.90	8.20	1.70	0.26	3.31
T ₃	12.68	10.53	8.33	2.20	0.30	3.58
T ₄	12.88	10.83	8.70	2.13	0.35	3.74
T ₅	13.13	10.93	8.80	1.90	0.32	3.64
T ₆	13.29	11.43	9.00	2.27	0.39	4.09
T ₇	13.39	11.77	9.10	2.47	0.32	3.75
T ₈	13.63	11.83	9.13	1.87	0.28	3.43
SE m±	0.48	0.29	0.21	0.30	0.019	0.21
CD @ 5%	1.46	0.89	0.65	NS	0.058	0.64

Conclusion

The growth attributes like plant height, plant girth and no. of leaves were found maximum in T₈ treated plants. Flowering characters such as total no. of flowers, fruit set and no. of fruits was found highest in T₅ treated plants. Similarly T₅ gave highest weight of fruits per plant and yield. In terms of quality

attributes, TSS, total sugars, non-reducing sugars was found in T₈. It can be concluded that T₅ (200:150:300g NPK/Plant) was found the best treatment in respect to overall performance, however T₆ and T₈ could be considered as next best treatments in respect to fresh fruit yield.

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