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Effect of integrated nutrient management on growth and yield of papaya (*Carica papaya* L.) cv. Pusa Delicious

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Abstract

Papaya (*Carica papaya* L.) is an important and economically valued fruit crop of the tropical and sub-tropical regions across the globe. It is believed to be a native to southern Mexico and adjoining Central America. It belongs to the family Caricaceae bearing chromosome no. $2n=18$. Papaya is a good source of iron, Vit A, B and C. On the other hand the latex of papaya is a source of papain and chymopapain, has multifarious uses. Papaya is a heavy feeder of nutrients and requires judicious supply of nutrients at frequent intervals for better growth and fruiting. The application of heavy dose of fertilizers without knowing the soil status leads to deterioration in the soil physical and chemical compositions and also causes environmental pollution. Hence, it is imperative to shift from conventional nutrient management system to integrated nutrient management system for sustainable production as well as maintaining the soil health. The basic concept underlying the principal of INM is to maintain and improve soil fertility for sustaining the crop, use of all possible sources of nutrient and their scientific management for optimum growth, yield and quality of different crops in specific agro-ecological condition. The INM helps in restoring and sustaining soil fertility along with crop productivity. Further, it also helps in checking the emerging deficiency of nutrients other than N, P & K and favorably affects the physical, chemical and biological environment of soil.

Keywords: Papain, chymopapain, environmental, pollution, conventional and agro-ecological

Introduction

Carica papaya L. is commonly known as papaya in English, papita in Hindi belonging to dioecious in nature. Papaya is a powerhouse of nutrients and is available throughout the year. It is a rich source of three powerful antioxidant vitamin (A, C & E); the minerals (magnesium and potassium), vitamin B, good source of carbohydrate, protein, fiber, iron and calcium. The plant is native to tropical America and was introduced to India in 16th century. It is grown in tropical and sub-tropical region of the countries like Australia, Hawaii, Taiwan, Puerto Rico, Peru and Florida, Texas, California in U.S.A., Gold Coast, various part of Central and South Africa, Pakistan, Bangladesh and India. It is the fourth most important fruit in India, it is cultivated in different state, Madhya Pradesh, Uttar Pradesh, Karnataka, Bihar, Gujarat, West Bengal, Tamil Nadu, Andhra Pradesh, Rajasthan and Assam. Maharashtra is a leading state to produce papaya mainly for papain. The total area under papaya cultivation was 144 (000 hectare) and total was production 6086 (000 MT) 4th rank in fruits crop production after banana, mango and mandarin crop (Horticultural Statistics at a Glance, 2019-20 4th Estimation). Papaya tree is basically an evergreen short lived plant. The plant is hollow soft wooded, erect and usually unbranched can grow up to 20 m tall, regular bearer flower and fruits and good yielding fruit crop. Mature fruit contain proteolytic enzyme called papain. Traditionally leaves have been used for treatment of a wide range of ailments, like in treatment of malaria, dengue, jaundice, immunomodulatory and antiviral activity. Young leaves are rich in flavonoids (kaempferol and myricetin), alkaloids (carpaine, pseudocarpaine, dehydrocarpaine I and II), phenolic compounds (ferulic acid, caffeic acid, chlorogenic acid), the cynogenetic compounds (benzyl glucosinolate) found in leaves.

Method and Materials

The present investigation entitled "Effect of integrated nutrient management on growth and yield of papaya (*Carica papaya* L.) cv. Pusa Delicious" was carried out at Vegetable research

Farm and the laboratory of Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University Varanasi (U.P.).

Experiment conducted in Randomized Block Design (RBD), the experiment comprising fifteen treatments and three replications. Farmyard manure used as organic manure, thoroughly mixed with the top soil of pit, fortnight before the time of transplanting. Essential fertilizer are nitrogen, phosphorus and potassium (250:250:250 gm NPK /plant) were mixed just before transplanting. Biofertilizers are *Azotobacter*, *Azospirillum* and phosphate solubilizing bacteria (PSB) in powder form used pit as per technical programme. Treatment detail: T₁ Control (Without Nutrient), T₂ FYM + NPK (100%) 250:250:500 g/plant recommended dose, T₃ FYM + NPK (75%) + *Azotobacter*, T₄ FYM + NPK (75%) + *Azospirillum*, T₅ FYM + NPK (75%) + *Azotobacter*+PSB, T₆ FYM + NPK (75%) + *Azospirillum* + PSB, T₇ FYM + NPK (50%) + *Azotobacter*, T₈ FYM + NPK (50%) + *Azospirillum*, T₉ FYM + NPK (50%) + *Azotobacter* + PSB, T₁₀ FYM + NPK (50%) + *Azospirillum* + PSB, T₁₁ FYM + NPK (100%) + *Azotobacter*, T₁₂ FYM + NPK (100%) + *Azospirillum*, T₁₃ FYM + NPK (100%) + *Azotobacter* + PSB, T₁₄ FYM + NPK (100%) + *Azospirillum* + PSB, T₁₅ FYM (20 Kg). Seedlings attend height of 15 to 20 cm are ready to transplant in main field at a distance of 2 x 2 meter plant to plant and row to row. Data recoded on growth and yield according to technical programme and the data analysed by statically variance (ANOVA) of the data was carried out by the statistical techniques of Raghuramula *et al.* (1983).

Result and discussion

The present investigation entitled “Effect of integrated nutrient management on growth and yield of papaya (*Carica papaya* L.) cv. Pusa Delicious” the result of investigation, to assess the relative influence of different treatment combination of inorganic fertilizer, biofertilizers and FYM results the pronounced effect on growth characters of papaya. On the basis of present investigation it is reported that the plant height, circumference of plant, and number of leaves per plant, fruit length, diameter and weight were increased significantly, on other side height of plant at first flower initiation are decreases with the use of biofertilizers and inorganic fertilizer at different treatment combinations. Growth parameter is clearly evident from the data given in

Table.1 showed significant difference for height of plant, circumference of plant and height first flower initiation. The maximum plant height 214.04 cm was obtained in T₅ FYM + NPK (75%) + *Azotobacter* + PSB treated plants found to be best and minimum plant height recorded in T₁ control 183.76 cm. The maximum circumference (32.73 cm) of plant was recorded with T₁₃ FYM + NPK (100%) + *Azotobacter* + PSB treated plants found to be best and minimum circumference recorded in T₁ control 27.40 cm. The Height of plant at first flower initiation (99.87) cm was produced in the plant treated with T₈ FYM + NPK (50%) + *Azospirillum* and the minimum height of plant at first flower initiation was recorded with T₁ Control (86.53) cm without nutrient. Finding get the support of Yadav *et al.* (2011)^[7], Srivastava *et al.* (2014)^[6], Srinu *et al.* (2017) and Sethy *et al.* (2019).

Findings of number of leaves per plant, number of flower per plant and number of fruit per plant as influenced by different treatment combinations and the relevant data are presented in table. 2 The maximum number of leaves (53.67) was recorded with application of T₁₄ FYM + NPK (100%) + *Azospirillum* +PSB and the minimum number of leaf was recorded with T₁ Control (42.92) without nutrient, similar results were reported by earlier research workers Duragannavae *et al.* (2010), Srivastava *et al.* (2014)^[6], Srinu *et al.* (2017) and Sethy *et al.* (2019).

The maximum number of flowers (50.94) and fruits (42.28) per plant was recorded in T₅ FYM + NPK (75%) + *Azotobacter* + PSB treated plants, whereas the minimum number of flowers (33.67) and fruits per plant was observed in the untreated plant T₁(control) similar observations were also reported by Adjet *et al.*, (2007) and Srinu *et al.*, (2017) in papaya.

Relevant data pertaining to fruit weight (kg), fruit length (cm), fruit diameter (cm) and fruit yield per plant (kg) of different treatment combinations presented in table 3. The maximum weight 0.986 Kg, maximum fruit size length 159.43 cm, maximum fruit diameter 131.27 cm and maximum yield 38.42 Kg was recorded in the plants treated with T₁₃ FYM + NPK (100%) + *Azotobacter* +PSB and minimum fruit weight 0.571 Kg, minimum fruit size length 130.46 cm, minimum fruit diameter 120.39 cm and minimum yield per plant 15.29 Kg was observed in the untreated plant T₁ (control). Similar results were obtained by Alila *et al.*, (2003), Prakash *et al.*, (2010)^[4] and Sethy *et al.*, (2019) in papaya.

Table 1: Growth and yield parameters of papaya (*Carica papaya* L.) cv. Pusa Delicious influenced by integrated nutrient management

Treatments	Height first flower initiation (cm)	Height of plant (cm)	Circumference of plant (cm)	Number of leaves	Number of flower per plant	Number of fruit per plant	Average weight of fruit (kg)	Average length of fruit (cm)	Average diameter of fruit (cm)	Fruit yield per plant (kg)
T ₁ - Control (Without Nutrient)	86.53	183.76	27.40	42.94	33.67	26.78	0.571	13.05	12.04	15.29
T ₂ FYM + NPK (100%)	96.67	212.78	32.03	49.83	44.83	37.78	0.772	14.46	12.26	29.20
T ₃ FYM + NPK (75%) + <i>Azotobacter</i>	97.51	214.01	32.74	48.22	47.06	39.78	0.821	14.07	12.10	32.61
T ₄ FYM + NPK (75%) + <i>Azospirillum</i>	96.72	209.83	31.39	46.06	45.89	38.56	0.791	13.90	12.23	30.46
T ₅ FYM + NPK (75%) + <i>Azotobacter</i> + PSB	94.66	214.04	30.63	48.61	50.94	42.28	0.909	14.09	12.57	38.42
T ₆ FYM + NPK (75%) + <i>Azospirillum</i> + PSB	94.24	213.19	31.42	49.83	48.83	40.61	0.862	13.98	12.33	35.01
T ₇ FYM + NPK (50%) + <i>Azotobacter</i>	98.35	200.96	29.57	44.50	36.72	30.11	0.707	13.34	12.09	21.30
T ₈ FYM + NPK (50%) + <i>Azospirillum</i>	99.87	205.53	29.75	47.83	36.06	29.83	0.715	13.24	12.08	21.33
T ₉ FYM + NPK (50%) + <i>Azotobacter</i> + PSB	97.14	202.64	30.95	44.78	39.33	32.72	0.738	13.32	12.31	24.14
T ₁₀ FYM + NPK (50%) + <i>Azospirillum</i> + PSB	96.29	206.51	31.15	48.94	40.06	33.28	0.728	13.60	12.17	24.22
T ₁₁ FYM + NPK (100%) + <i>Azotobacter</i>	95.71	209.87	32.48	49.72	41.72	35.44	0.782	14.32	11.79	27.75

T ₁₂ FYM + NPK (100%) + <i>Azospirillum</i>	97.43	212.82	32.26	50.83	43.33	35.56	0.797	14.76	12.45	28.35
T ₁₃ FYM + NPK (100%) + <i>Azotobacter</i> + PSB	95.14	212.91	32.73	53.11	43.44	35.67	0.986	15.94	13.13	35.15
T ₁₄ FYM + NPK (100%) + <i>Azospirillum</i> + PSB	95.39	213.45	32.16	53.67	42.50	35.39	0.946	15.62	12.65	33.47
T ₁₅ FYM (20 kg)	97.78	202.78	31.56	45.72	37.50	30.78	0.710	13.17	12.05	21.86
S.Em. \pm	0.18	0.85	0.42	0.48	0.70	0.68	0.02	0.07	0.047	0.90
LSD (p=0.05)	0.52	2.45	1.22	1.39	2.03	1.96	0.06	0.52	0.13	2.60

Conclusions

On the basis of study following conclusions may be drawn;

- Among the integrated nutrient management treatments, FYM + NPK (100%) + *Azospirillum* + PSB resulted highest improvement in growth and floral characters of papaya.
- Among the integrated nutrient management treatments, FYM + NPK (75%) + *Azotobacter* + PSB resulted in higher yield attributes and yield of papaya.

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