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Original Research Article

Effect of Different Treatments and Pruning on Reproductive, Fruit and Quality Characters of Passion Fruit

Sangita Mehta[1*] and Birendra Prasad[2]

[1]Krishi Vigyan Kendra, Siris, Aurangabad, India
[2]Regional Research Station, Agwanpur, Saharsa, Bihar Agricultural University, Sabour (Bhagalpur) Bihar – 813210, India
**Corresponding author*

A B S T R A C T

The passion fruit is a high value, nutritious, export oriented and prolific bearer fruits crop. The crop has considered great importance recently in respect to high value and medicinal properties. Present investigation was carried out to study the effect of different treatments of major and minor elements with pruning of plants in such expectation that they play major role to improve its many characters. NPK (250: 125:125 gm/ vine) + boron 1.2 gm/vine appeared to be the best treatment in reproductive characters, fruit characters and quality characters followed by NPK (250:125:125 gm/ vine) + sulphur 24 gm/vine.

Keywords

Treatments, Pruning, Reproductive, Fruit, Quality

Introduction

The passion fruit is a high value and export oriented crop. It belongs to the family *Passifloracea*, which is represented by 14 genera. The genus *Passiflora* is the principal representative of the family and comprises of nearly 580 species, distributed throughout the tropical and subtropical regions of the world (Silva and San Jose 1994). More than 150 species are native to Brazil, out of which 60 bear edible fruit but only a few are of commercial importance. Martine and Nakesone (1970) suggested the term passion fruit exclusively to represent the species, *Passiflora edulis* Sins, which contains two forms-purple fruited (*Passiflora edulis* Sins) and yellow fruited (*Passiflora edulis Sins f. flavicarpa* Degener). The purple passion fruit is also known as red or black grandilla or mountain sweety cup and in other language as Lilikai in Hawaii and Linmangkan in Indonesia, while the yellow form is known as yellow grandilla, golden passion fruit, yellow lilikai in Hawaii and parena amarilla in Venezwella. Passion fruit is a native of Brazil and widely cultivated in South Africa, Australia, Newzealand and Indonesia. In India, it grows widely in Nilgiri hills, Kodaikanal, Coorg, Malabar, Kerala and Himachal Pradesh. It occupies an important place among the fruits grown in India. North Eastern parts of India have greater potential for establishing passion fruit globe on commercial scale. Recently, this fruit has come into prominence among the people of north eastern states of India particularly in Meghalaya, Manipur,

Mizoram, Nagaland and Sikkim due to its pleasant aroma, rich flavor, prolific bearing habit and higher return even without much care

It is a vigorous woody perennial climber, 15 m long; tendrils auxiliary, robust, green longer than the leaves, spirally coiled. The fruit is as big as a tennis ball, about 6.0 cm long and 5.0 cm broad weighting 75.0 g. It flowers throughout the year; however main harvesting seasons are September-October and January- February, producing about 75 fruits/ vine/year.

Due to lack of knowledge of its nutritive value, its cultivation and standard methods to make processed products, this crop has not gained popularity in this region. It holds a great scope as a commercial crop for its juice.

Passion fruits are good source of vitamin-A, ascorbic acid, riboflavin and niacin and also contain fair amount of minerals sodium, magnesium, sulphur and chlorides. It is extensively used in confectionary and in preparation of cakes, pies, sherbet, ice cream and fruit nectar.

The passion juice and leaves are used in many countries as medicines. The flower of passion fruit has a mild sedative effect and can help to induce sleep. Passion flower has been used in the treatment of nervous disorder, bronchial asthma, insomnia and nervous disorders. Researchers at the University of Florida have found that yellow passion fruit extracts can kill cancer cells in vitro. The passion flower extracts is used in treating asthma, whooping cough, bronchitis and other tough coughs.

Passion fruit is getting popularity and its cultivation is gradually increasing in India. Research works had been initiated in many passion fruit growing areas. But till now farmers are unable to fetch good income by this crop.

Therefore it is necessary to improve fruiting and quality of this fruit. So, keeping the above points in view, the present investigation was formulated.

Materials and Methods

An investigation was conducted in the poly-houses of Horticultural research farm of Birsa Agricultural University Kanke, Ranchi (Jharkhand).

Details of Treatments

T_1 - NPK (300:150:150 g^{-1}vine)

T_2 - NPK (250:125:125 g^{-1}vine)

T_3 - Boron (1.2 g^{-1} vine)

T_4 - Sulphur (24 g^{-1} vine)

T_5 - NPK (300:150:150 g^{-1}vine) + Boron (1.2 g^{-1} vine)

T_6 - NPK (250:125:125 g^{-1}vine) + Boron (1.2 g^{-1} vine)

T_7 - NPK (300:150:150 g^{-1}vine) + Sulphur (24 g^{-1} vine)

T_8 - NPK (250:125:125 g^{-1}vine) + Sulphur (24 g^{-1} vine)

T_9 - Control

T_{10} - Absolute control (without vermicompost)

(Note:- A uniform dose of 2 kg vermicompost + 500 g lime per pit during planting).

Design, Plot size and Layout

Experimental Design - RBD
Treatments - 10
Replications - 3
Spacing - 3 x 2m
Plot size - 4 pits/ line/ treatment

Total no. of plots - 30 lines with four plants in each line

Number of plants per line - 4

Number of plants per treatment - 4x3=12

Observation of flowering and fruiting characters were recorded on five randomly tagged shoots.

Days to flowering (days)

The date of the flower initiation was recorded for each treatment and the time taken from the transplanting to first flowering was calculated.

Days to fruit set (days)

The date of the first set was recorded in each treatment and the time taken from the transplanting to first fruit set was calculated.

Days to maturity (days)

The date of the first fruit harvesting was recorded in each treatment and the time taken from the fruit set was calculated.

Fruit characters

Fruit length and fruit breadth (cm)

Only fully matured fruit from each tagged plant was selected at random from each treatment and the length and breadth of five fruits were measured in cm with the help of slide callipers and then the average length and breadth was calculated.

Volume of fruit (cc)

The volume of individual fruit was taken by water displacement method. The same fruits which were used for measuring size and weight were also used for estimation of volume.

Weight of fruit (g)

The weight of individual fruit was taken with the help of physical balance. In this way total weight of all five individual fruits was obtained and then its average weight per fruit was calculated.

Quality characters

Estimation of pulp

The weighed fruits were peeled and the pulp was kept separately in each case. Each lot was weighed in each case. Each lot was weighed in quickest possible time on a physical balance. The percentage of pulp was determined as follows:

$$\text{Pulp per cent} = \frac{\text{weight of pulp (g.)}}{\text{weight of fruit (g.)}} X100$$

Estimation of juice

Juice percentage of fruits was recorded by adopting following formula.

$$\text{Juice per cent} = \frac{\text{weight of juice (g.)}}{\text{weight of fruit (g.)}} X100$$

Estimation of Total Soluble Solids

Total Soluble Solids (TSS) of the samples were estimated by Erma Hand Reftractometer (0-32^{o}B) and the result was

expressed in Degree Brix (^{o}B). The observed reading was corrected using temperature correction chart to obtain TSS value at 20^{o}C.

Estimation of Acidity

The titrable acidity was determined by titrating the juice against standard alkali solution (0.1N NaOH). 10 ml of juice was taken by means of pipette and transferred into 100 ml volumetric flack and finally distilled water was added to make 100 ml volume. 10 ml aliquot of diluted juice was pipetted out and transferred in the 250 ml beaker.

1-2 drops of phenolphthalein indicator was added to the solution. The juice of conical flask was titrated against 0.1N NaOH solution. The alkali was added drop by drop to the conical flask with constant stirring until the end point was reached with disappearance of pink colour. The percentage of acidity was calculated using following formula.

$$\text{Acidity per cent} = \frac{\text{Normality of NaOH solution X volume of 0.1 (N) NaOH consumed}}{\text{Volume of juice taken}} X \frac{65}{1000} X100$$

Total Sugar

10 ml juice was hydrolyzed by adding 2 ml. of conc. HC1 and left for 24 hours. After that, it was neutralized by adding 40% NaOH solution. To ensure complete neutralization, blue and red litmus papers were used. This solution was then titrated against Fehling's A and B as reducing sugar titration and the percentage of total sugar was worked out. Total sugar as invert sugar was calculated as in per cent Reducing sugar making use of the titre value obtained in determination of total sugar after inversion per cent non-reducing sugar = (% Total invert sugar - % Reducing sugar originally present) x 0.95%.

Total Sugar = (% Reducing Sugar + % non-reducing sugar)

* (10 ml of Fehling solution = 0.95 gm of sugar)

Reducing Sugar

10 ml of filtered juice was taken in a conical flask. 2 ml of lead acetate was added to it. It was made to shake and allowed to stand for 10 minutes and 2 ml of potassium oxalate was added. Then distilled water was added and volume was made up to 100 ml. the solution was filtered through Whatsman paper No.4 and the filtrate was collected in a conical flask. 5 ml of each Fehling's solution A and B was taken in a conical flask to which 25 ml of distilled water was added. This was kept on electric heater for boiling. 2-3 drops of methy1 blue indicator were dropped. The Fehling's solution was also be titrated by filtered fruit juice. The appearance of brick red colour determined the end point. Reducing sugar was calculated by the following formula.

$$\text{Reducing Sugar (per cent)} = \frac{\text{mg of invert sugar x Dilution}}{\text{Titre x Water volume of the sample}} X100$$

Non - Reducing sugar

The non-reducing sugar was calculated by deducting the reducing sugar from total sugar and subsequently multiplying with the factor (0.95). The amount of non-reducing sugar estimated, was expressed in g/ 100g of juice.

Estimation of Ascorbic Acid Content (mg/100g)

Standardization of Dye

5ml of ascorbic acid solution was taken and 5ml of HPO_3 was added in a conical flask. A

microburette was filled with the dye solution and then the dye solution was titrated and the end point was reached with appearance of pink colour which persisted for 15 seconds. The dye factor was determined i.e. mg of ascorbic acid per ml of dye, using following formula

$$\text{Dye factor} = \frac{0.5}{\text{Titre (burette reading)}}$$

2 ml of juice was taken in a conical flask and 8ml of 3% HPO_3 solution was added. This solution was titrated with standard dye 2, 6-Dichiorophenol-indophenol to a pink end point appearance. Titrated rapidly and made a preliminary determination of the titre. The ascorbic acid content of the sample calculated by the following formula

$$\text{Ascorbic acid per 100 ml of juice} = \frac{\text{Titre x Dye factor x Volume make up}}{\text{Aliquote x Vol.of juice taken forestimation}} \text{X100}$$

Results and Discussion

Effect of different treatments on reproductive character

Days taken for flower initiation, Days taken for 50% flower initiation, Days taken to fruit set, Days taken to fruit maturity have been affected by the application of different nutrient. The minimum days taken for flower initiation (190.90 days), 50% flower initiation (211.45 days) Days taken to fruit set (233.63 days) and Days taken to fruit maturity (295.05 days) were recorded with T_6 (application 250:125:125g NPK+ 1.2g Boron) which was closely followed and at par with different treatments but the maximum days taken for flower initiation (217.10 days), 50% flower initiation (242.73 days) Days taken to fruit set (255.48 days) and Days taken to fruit maturity (323.93 days) were observed in (T_{10}) absolute control. In general application of NPKB slightly induced earliness, the 50% flowering also followed the same trend.

The process of flowering and fruiting involve cell division, cell elongation and cell enlargement. The earliness of flowering and fruit setting may be explained in the light of the hypothesis advanced by Witter and Bukovac (1962), who suggested that practically every chemical or group of chemicals which enhance cell-division and cell-enlargement would likewise accelerate floral initiation and fruit setting. Early flower bud differentiation and fruit set with application of nitrogen alone and in presence of phosphorus, potash and boron might be due to accumulation of optimum quantity of carbohydrate reserves. As we know, boron governs many physiological and bio-chemical plant processes. Application of boron resulted in promotion of flower, all possibly due to the promoting effect of boron on cell division and elongation process Dutta, (2004).

Effect of different treatments on fruit character of passion fruit

The treatment effects on fruit length, fruit breadth, fruit, weight and fruit volume were significant. The maximum fruit length (7.30 cm), fruit breath (6.43 cm), fruit weight (72.63 g) and fruit volume (138 cc) were recorded in case of T_6 (application 250:125:120g NPK+ 1.2g Boron) which were closely followed by T_8 (6.40 cm), (5.88 cm), (70.85 g) and (136.93 cc) respectively. Whereas the minimum fruit length (4.75 cm), fruit breadth (4.18 cm), fruit weight (54.68 g) and fruit volume (101.28 cc) were observed in case of absolute control. Vine treated with NPKB (250:125:125:1.2 g/vine/year) showed the earliness in reproductive character and yield. Similar findings was observed by Natal *et al.*, (2004) and Russel, 1957).

Table.1 Effect of different nutrient on reproductive characters (days) after pruning

Treatment		Days to flower	Days to 50 % flowering	Days to fruit set	Days to maturity
T_1	300:150:150 g NPK vine^{-1}	205.93	226.33	248.18	310.08
T_2	250:125:125 g NPK vine^{-1}	203.80	224.05	245.30	306.55
T_3	1.2 Boron g vine^{-1}	208.55	229.68	241.13	313.18
T_4	24 Sulphur g vine^{-1}	209.80	231.68	252.88	316.13
T_5	300:150:150:1.2 NPKB g vine^{-1}	198.33	221.33	243.85	306.18
T_6	250:125:125:1.2 NPKB vine^{-1}	190.90	211.45	233.63	295.05
T_7	300:150:150:24 g NPKS vine	195.63	217.88	239.15	308.18
T_8	250:125:125:24 g NPKS vine^{-1}	192.85	214.18	235.95	299.75
T_9	Control	214.53	237.50	250.98	320.10
T_{10}	Absolute Control	217.10	242.73	255.48	323.93
SE(m)		0.27	9.22	0.66	7.06
CD 5%		0.78	26.89	1.66	20.28
CV %		0.26	8.05	7.07	6.08

Table.2 Effect of different nutrient on fruit character after pruning

Treatment		Fruit length (cm)	Fruit breath (cm)	Fruit weight (g)	Fruit volume (cc)
T_1	300:150:150 g NPK vine^{-1}	5.80	5.25	63.50	113.70
T_2	250:125:125 g NPK vine^{-1}	5.95	5.55	65.30	124.05
T_3	1.2 Boron g vine^{-1}	5.33	5.17	61.75	109.50
T_4	24 Sulphur g vine^{-1}	5.08	4.75	59.10	106.73
T_5	300:150:150:1.2 NPKB g vine^{-1}	6.10	5.55	67.95	126.45
T_6	250:125:125:1.2 NPKB vine^{-1}	7.30	6.43	72.63	138.33
T_7	300:150:150:24 g NPKS vine	6.03	5.63	69.18	132.88
T_8	250:125:125:24 g NPKS vine^{-1}	6.40	5.88	70.85	136.93
T_9	Control	5.25	4.73	56.63	102.55
T_{10}	Absolute Control	4.75	4.18	54.68	101.28
SE(m)		0.13	0.10	0.27	0.37
CD 5%		0.37	0.28	0.79	1.08
CV %		4.32	3.57	0.84	0.62

Table.3 Effect of different nutrient on quality character after transplanting

Treatment		Pulp (%)	Juice (%)	TSS (°Brix)	Acidity (%)	Total sugar (%)	Reducing (%)	Non reducing (%)	Ascorbic acid (mg/100g)
T_1	300:150:150 g NPK vine^{-1}	19.33	22.75	10.36	4.94	7.43	3.56	3.87	12.60
T_2	250:125:125 g NPK vine^{-1}	20.75	23.33	11.81	4.83	7.56	3.43	4.55	12.43
T_3	1.2 Boron g vine^{-1}	18.70	21.65	8.43	5.47	6.69	2.71	4.08	11.50
T_4	24 Sulphur g vine^{-1}	18.40	20.60	7.08	5.68	6.88	2.43	4.39	10.67
T_5	300:150:150:1.2 NPKB g vine^{-1}	22.53	25.60	15.74	2.72	10.91	4.28	6.56	14.89
T_6	250:125:125:1.2 NPKB vine^{-1}	28.45	30.18	17.89	2.53	11.05	5.20	6.75	15.32
T_7	300:150:150:24 g NPKS vine	24.35	26.50	12.66	3.65	8.26	3.67	4.28	13.41
T_8	250:125:125:24 g NPKS vine^{-1}	27.90	29.38	13.54	4.57	9.53	4.84	5.52	13.48
T_9	Control	15.55	18.30	7.78	5.44	6.14	1.13	4.30	10.33
T_{10}	Absolute Control	14.30	16.45	6.97	6.85	5.28	1.67	3.43	9.29
SE(m)		0.19	0.24	1.04	0.03	0.47	0.16	0.70	0.57
CD 5%		0.56	0.69	2.97	0.09	1.41	0.48	2.06	1.77
CV %		1.82	2.03	5.71	2.33	3.19	5.31	9.68	2.49

The application of different levels of NPKB was effective in increasing maximum fruit character and yield. It was observed that lower level of NPK induced more fruit length, fruit breath, fruit weight, fruit volume and yield than higher dose. Fruit weight is very important with respect to fruit quality as it adds towards fruit yield. Fruit weight follows yield trends. Like fruit size, significant increase in fruit weight, was also obtained with boron treatment. These observations are in consonance with Brahamchari *et al.,* (1997) and Haque and Ibrago (1994) in guava. The possible reason behind increasing fruit weight might be due to hormonal mediated direct transport, accumulation and ensure balanced partitioning of photosynthetic assimilates to the developing fruit than by enabling the shoot to meet the nutritional requirement of fruits throughout their development.

Effect of different treatments on quality character of passion fruit

Data on effect of nutrient management on pulp percentage of passion fruit have been indicated significant effects of different treatments. After fruit ripening, the maximum content of fruit pulp percentage (28.45 %), fruit juice percentage (30.18%), reducing sugar (5.20%), non-reducing sugar (6.75%) were obtained in case of T_6 (application 250:125:120g NPK+ 1.2g Boron) and which were at par with T_8 (27.90%), (29.38%), (4.84%) and (5.52) respectively. Whereas maximum TSS (17.89 ^{0}B), acidity (6.85%), total sugar (11.05%), and ascorbic acid (15.32 mg/100gm) were obtained also with the treatment T_6 which were at par with T_5 (15.74^{0}B), (2.72%), (10.91%) and (14.89 mg/100gm) respectively. The minimum percentage in all the treatments were recorded in (T_{10}) absolute control. The probable cause may be due to medium dose of NPKB contributed to synthesis of essential constituent of protein and other compounds of great physiological process in plant metabolism resulting in increased TSS, acidity percentage, total sugar, reducing sugar, non-reducing sugar and ascorbic acid.

The increase in content of total soluble solids and total sugar might be due to quick metabolic transformation of starch and pectin into soluble sugars and rapid mobilization of photosynthetic metabolites and minerals from other parts of the plant to developing fruits. The increase in TSS content might have also diverted more solids towards developing fruits and also enhanced the conversion of complex polysaccharides into simple sugars. Similarly, increase in total sugar can also be attributed to the accumulation of oligosaccharides and polysaccharides in higher amount in these treatments.

Similarly, higher ascorbic acid (Vitamin-C) content was recorded with the addition of boron in soil. The perspective increase in ascorbic acid might be due to catalytic activity on its biosynthesis from its precursor glucose-6-phosphate or inhibition of its conversion into dehydroascorbic acid by enzyme ascorbic acid oxidize or both 2. Apart from this, boron facilitated sugar transport within the plant and it was also reported that borate reacted with sugar to form sugar borate complex which was more easily able to transverse (Gauch and Dugger, 1953).

Application of NPKB (250:150:150:1.2 g/vine/year), might have stimulated synthesis of enzymes affecting the physiological process, which in turn hydrolysed starch and helped in metabolic level in regulating vital physiological and biochemical processes which ultimately increased quality characters in fruits. The

results are in agreement with finding of Rath *et al.*, (1980) in mango, Rajput and Chand, (1975), Singh and Chonkar, (1983) and Pathak and Pandey (1988) in guava.

References

Brahamchari, V.S. and Shreshtha, A.K. (1997). Effect of nutrient and growth studies on fruit retention. Physico-chemical composition and shelf life of mango c.v. Langra. M.Sc. (Ag.) thesis submitted to R.A.C. Pusa, Bihar.

Dutta, P. (2004). Effect of foliar application of boron on panicle growth, fruit retention and physic-chemical parameter of mange cv. Hemsagar. *Indian Journal of Horticulture*. 61(3): 265-266.

Gauch, H.G and Duggar, W.M. (1954). The role of B in the translocation of sucrose. *Plant Physiology*. 28: 457-466.

Haque, M.H and Ibrago, J.A. (1994). Fruit size and economic performance of guava cv Guapple as affected by fruit thining and boric acid. *South Indian Hort.* 42:289-292.

Martin, F.G. and Nakesone, H.Y. (1970). The edible spices of passiflora. *Economic Botany*. 24 (3): 333-343.

Natal, W; Prado,-R-de-M; Leal, -R-M, Franco, -C-F. (2004). Effect of boron application on the development nutritional status and production of passion fruit cuttings. *Revista-Brasileira-de-fruiticultura.* 26(2):310-314.

Pathak, R.A and D.K. Pandey. (1988). Effect of foliar application of nutrients and plant growth regulators in Sardar guava. Fruits pres. Workshop may 23-25, 1988 at Pusa.

Rajput, C.B.S and Chand, S. (1975) Effect of boron and zinc on the physico-chemical composition of guava. *J. National Agric. Soc. Cylone*.13: 49-54.

Rath, S., Singh R.L, Singh, B. and Singh, D.B. (1980). Effect of boron and zinc sprays on the physic-chemical composition of mango fruits. *Punjab. J. Hort*. 203(1-2): 33-35.

Russel, D.A. (1957). Boron and soil fertility. In the yearbook of Agriculture, USDA, Washington, D.C.

Silva, A.C and San Jose, A.R. (1994). Classificacao Botanica de Maracujazeiro. In San Jose.A.R(ed), Maracuja : Produceo e Mercado. Universidade Estadual do sudoeste da Bhaia, Depamento de Fitolecnia e Zootecnia,Vitoria da Conquista Ba, Brazil.

Singh, N.P and Chhonkar, V.S. (1983). Effect of zinc, boron and molybdenum as foliar spray on chemical composition of guava fruits. *Punjab J. Hort*. 23(M_2): 34-37.

Witter, S.H and Bukovac, M.J. (1962). Manurial requirement of vegetable crops. ICAR. New Delhi.