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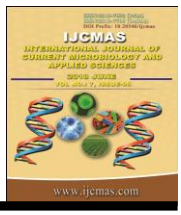

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Frequency of Pickings and Yield Characteristics as Influenced by Fertigation at Varied Planting Densities in Processing Tomato Varieties

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A B S T R A C T

The highest number of fruit pickings (10.32) and fruit yield per plant (26.56 kg) till 120 DAT was recorded by the var. Abhinav. Planting density at 60 cm x 60 cm (S_2) recorded significantly the highest number of fruit pickings (11.03) followed by 75 cm x 40 cm (S_3) (10.73). The lowest number of fruit pickings was recorded by the planting density at 120 cm x 40 cm (S_1) (9.16). Application of 180N: 90P: 90K kg per ha (F_3) recorded the highest fruit pickings (11.51) and fruit yield per plant (29.70 kg) followed by 150N: 75P: 75K kg per ha (F_2). The lowest fruit pickings (8.97) and fruit yield per plant (21.01 kg) was recorded by the application of 120N: 60P: 60K kg per ha (F_1). Among three way interactions, the highest number of fruit pickings was recorded by the combination of variety Abhinav + 60 cm x 60 cm (S_2) + 180N: 90P: 90K kg per ha (12.66).

Introduction

Tomato is the most important vegetables grown for their edible fruits. It belongs to the family Solanance and is a self-crossing annual crop. It is a good source of vitamins (A and C) and minerals (Kalloo, 1991) and antioxidants which help to control cancer, health diseases. Tomato ranks first among vegetables as a processing crop. It is used as salad crop and also processed in many forms such as soup, sauce, ketch-up and preservative *etc*. The high market price is attributed to the heavy demand for local and export purpose. The export market needs fruits with longer shelf life, attractive colour with good taste. However, the supply of such processing type tomatoes is inadequate due to the low productivity of the crop. Yield variation may be occurred due to variation in cultural practices. The objective of this article is to study the effect of different planting density and fertigation levels on frequency of pickings and yield of tomato.

Materials and Methods

The present experiment was conducted to find out the most suitable variety, planting density and fertigation level to grow processing tomato during *rabi* season of the year 2016-17 at Chittoor. It is situated at 334 metres above mean sea level and geographically situated at latitude of $12^0.37^1$ N and longitude of $78^0.33^1$ E. This place falls under Scarce Rain Fall Agro-Climatic Zone of Andhra Pradesh. This location has moderate rainy season, mild

winter, comparatively hot and dry summer. The results obtained along with relevant discussion are presented in this paper.

Results and Discussion

Days to first picking

Significant variations were observed in days to first picking due to variety, planting density, fertigation level and their interactions (Table 1) in (Fig. 1). Among the varieties, Abhinav recorded the highest number of days to first picking (80.93 days). Planting density at 120 cm x 40 cm (S_1) recorded significantly the longest duration to first picking (81.12 days) which was on par with 60 cm x 60 cm (S_2) (80.70 days). The lowest number of days taken for first picking was recorded by the planting density at 75 cm x 40 cm single row (S_1) (79.57 days). Application of 180N: 90P: 90K kg per ha (F_3) recorded the highest number of days taken for first picking (84.63 days) whereas the least number of days taken for first picking (78.56 days) was recorded by the application of 150N: 75P: 75K kg per ha (F_2) which was on par with 120N: 60P: 60K kg per ha (F_1) (78.21 days). The interaction effects of planting density x fertigation level and variety x planting density x fertigation level was found significant. Early fruit setting coupled with exposure of fruits to sunlight and better aeration could be the reasons for early picking at the orientations of 60 cm x 60 cm and 75 cm x 40 cm. Singh (2004) also reported similar findings.

Interval between pickings

The differences observed in the interval between pickings due to variety, planting density, fertigation combinations and some of their interactions were found to be significant (Table 2) in (Fig. 1). Among the varieties, Abhinav recorded the highest interval between pickings (4.48 days). Planting density at 60 cm x 60 cm (S_2) recorded significantly the longest interval between pickings (4.78 days) followed by 75 cm x 40 cm (S_3) (4.36 days). The lowest interval between pickings was recorded by the planting density at 120 cm x 40 cm (S_1) (3.98 days). This might be due to the reason that plants spaced widely would have received nutrients sufficiently without much competition as compared to the plants spaced closely. They took much time in vegetative growth and delayed flower initiation. Similar delays were also extended as regards to the interval between successive pickings in the widest spacing of 120 cm x 40 cm. Application of 180N: 90P: 90K kg per ha (F_3) recorded the lowest interval between pickings (3.80 days) which was followed by 150N: 75P: 75K kg per ha (F_2) (4.22 days) whereas the highest interval between pickings (5.10 days) was recorded by the application of 120N: 60P: 60K kg per ha (F_1). The interaction effects of planting density x fertigation level, variety x fertigation and Variety x planting density x fertigation level was found significant.

Number of pickings

Significant variations were observed in number of pickings due to planting density, fertigation levels and some of their interactions (Table 3) in (Fig. 1). Among the varieties Alankar and Abhinav there was no significance difference. Planting density at 60 cm x 60 cm (S_2) recorded significantly the highest number of pickings (11.03) followed by 75 cm x 40 cm (S_3) (10.73). The lowest number of pickings was recorded by the planting density at 120 cm x 40 cm (S_1) (9.16). Application of 180N: 90P: 90K kg per ha (F_3) recorded the highest number of pickings (11.51) which was followed by 150N: 75P: 75K kg per ha (F_2) (10.44) whereas the least number of pickings (8.97) was recorded by the application of 120N: 60P: 60K kg per ha (F_1).

Table.1 Days to first picking influenced as by variety, planting density and fertigation in processing tomato

Planting density (B)	Fertigation (C)	Variety (A)		
		Alankar	Abhinav	***Mean***
S_1(120cm x 40 cm) (2.08 plants per m^2)	F_1 (120N:60P:60K)	78.33	76.80	**77.56**
	F_2 (150N:75P:75K)	79.26	78.20	**78.73**
	F_3 (180N:90P:90K)	82.40	91.73	**87.06**
	Mean	**80.00**	**82.24**	***81.12***
S_2(60 cm x 60 cm) (2.78 plants per m^2)	F_1 (120N:60P:60K)	79.33	79.20	**79.26**
	F_2 (150N:75P:75K)	78.86	77.80	**78.33**
	F_3 (180N:90P:90K)	82.66	86.33	**84.50**
	Mean	**80.29**	**81.11**	***80.70***
S_3(75 cm x 40 cm) (3.33 plants per m^2)	F_1 (120N:60P:60K)	77.33	78.26	**77.80**
	F_2 (150N:75P:75K)	78.93	78.26	**78.60**
	F_3 (180N:90P:90K)	82.33	82.33	**82.33**
	Mean	**79.53**	**79.62**	***79.57***
For Comparing varieties (A) and Fertigation (C)				
F_1 (120N:60P:60K)		78.33	78.08	***78.21***
F_2 (150N:75P:75K)		79.02	78.08	***78.56***
F_3 (180N:90P:90K)		82.46	86.80	***84.63***
Mean		***79.94***	***80.93***	***80.46***

Factors	***S Em±***	**CD** at 5%
Variety (A)	0.12	0.34
Planting density (B)	0.14	0.42
Fertigation (C)	0.14	0.42
A x B	0.20	0.60
B x C	0.25	0.73
A x C	0.20	0.60
A x B x C	0.36	1.04

Table.2 Interval between pickings (days) as influenced by variety, planting density and fertigation in processing tomato

Planting density (B)	Fertigation (C)	Variety (A)		
		Alankar	Abhinav	***Mean***
S_1 (120cm x 40 cm) (2.08 plants perm^2)	F_1 (120N:60P:60K)	4.63	4.73	**4.68**
	F_2 (150N:75P:75K)	3.66	3.60	**3.63**
	F_3 (180N:90P:90K)	3.56	3.70	**3.44**
	Mean	**3.95**	**4.01**	***3.98***
S_2 (60 cm x 60 cm) (2.78 plants per m^2)	F_1 (120N:60P:60K)	5.43	5.66	**5.55**
	F_2 (150N:75P:75K)	4.53	4.40	**4.46**
	F_3 (180N:90P:90K)	4.16	4.50	**4.33**
	Mean	**4.71**	**4.85**	***4.78***
S_3 (75 cm x 40 cm) (3.33 plants per m^2)	F_1 (120N:60P:60K)	4.46	5.66	**5.06**
	F_2 (150N:75P:75K)	4.53	4.63	**4.58**
	F_3 (180N:90P:90K)	3.43	3.45	**3.44**
	Mean	**4.14**	**4.58**	***4.36***
For Comparing varieties (A) and Fertigation (C)				
F_1 (120N:60P:60K)		4.84	5.35	***5.10***
F_2 (150N:75P:75K)		4.24	4.21	***4.22***
F_3 (180N:90P:90K)		3.72	3.88	***3.80***
Mean		***4.27***	***4.48***	***4.37***

Factors	***S Em±***	**CD** at 5%
Variety (A)	0.04	0.13
Planting density (B)	0.05	0.16
Fertigation (C)	0.05	0.16
A x B	-	***NS***
B x C	0.10	0.29
A x C	0.08	0.23
A x B x C	0.14	0.41

Table.3 Number of Pickings as influenced by variety, planting density and fertigation in processing tomato

Planting density (B)	Fertigation (C)	Variety (A)		
		Alankar	Abhinav	***Mean***
S_1 (120cm x 40 cm) (2.08 plants per m^2)	F_1 (120N:60P:60K)	8.40	7.60	**8.00**
	F_2 (150N:75P:75K)	9.60	9.40	**9.50**
	F_3 (180N:90P:90K)	9.53	10.46	**10.00**
	Mean	**9.17**	**9.15**	***9.16***
S_2 (60 cm x 60 cm) (2.78 plants per m^2)	F_1 (120N:60P:60K)	10.26	9.53	**9.90**
	F_2 (150N:75P:75K)	10.60	10.60	**10.60**
	F_3 (180N:90P:90K)	12.53	12.66	**12.60**
	Mean	**11.13**	**10.93**	***11.03***
S_3 (75 cm x 40 cm) (3.33 plants per m^2)	F_1 (120N:60P:60K)	8.46	9.60	**9.03**
	F_2 (150N:75P:75K)	10.80	10.66	**10.73**
	F_3 (180N:90P:90K)	12.46	12.40	**12.43**
	Mean	**10.57**	**10.89**	***10.73***
For Comparing varieties (A) and Fertigation (C)				
F_1 (120N:60P:60K)		9.04	8.91	***8.97***
F_2 (150N:75P:75K)		10.31	10.57	***10.44***
F_3 (180N:90P:90K)		11.53	11.48	***11.51***
Mean		***10.29***	***10.32***	***10.31***

Factors	***S Em±***	**CD** at 5%
Variety (A)	-	***NS***
Planting density (B)	0.06	0.18
Fertigation (C)	0.06	0.18
A x B	0.08	0.25
B x C	0.11	0.31
A x C	-	***NS***
A x B x C	0.15	0.44

Table.4 Days from first picking to final picking as influenced by variety, planting density and fertigation in processing tomato

Planting density (B)	Fertigation (C)	Variety (A)		
		Alankar	Abhinav	***Mean***
S_1(120cm x 40 cm) (2.08 plants per m^2)	F_1 (120N:60P:60K)	35.18	39.73	**37.45**
	F_2 (150N:75P:75K)	34.40	34.56	**34.98**
	F_3 (180N:90P:90K)	37.23	35.26	**36.24**
	Mean	**35.60**	**36.51**	***36.05***
S_2(60 cm x 60 cm) (2.78 plants per m^2)	F_1 (120N:60P:60K)	51.74	58.07	**54.90**
	F_2 (150N:75P:75K)	48.01	46.64	**47.32**
	F_3 (180N:90P:90K)	52.66	56.38	**54.50**
	Mean	**50.80**	**53.69**	***52.24***
S_3(75 cm x 40 cm) (3.33 plants per m^2)	F_1 (120N:60P:60K)	42.81	47.88	**45.34**
	F_2 (150N:75P:75K)	48.28	50.00	**49.14**
	F_3 (180N:90P:90K)	42.53	42.98	**42.75**
	Mean	**44.54**	**46.95**	***46.24***
For Comparing varieties (A) and Fertigation (C)				
F_1 (120N:60P:60K)		42.70	44.73	***43.71***
F_2 (150N:75P:75K)		44.81	43.40	***44.10***
F_3 (180N:90P:90K)		43.12	48.36	***45.74***
Mean		***43.54***	***45.49***	***44.51***

Factors	***S Em±***	**CD** at 5%
Variety (A)	0.11	0.32
Planting density (B)	0.14	0.40
Fertigation (C)	0.14	0.40
A x B	-	***NS***
B x C	0.24	0.69
A x C	-	***NS***
A x B x C	-	***NS***

Table.5 Fruit Yield per plant (kg) as influenced by variety, planting density and fertigation in processing tomato

Planting density (B)	Fertigation (C)	Variety (A)		
		Alankar	Abhinav	***Mean***
S_1 (120cm x 40 cm) (2.08 plants per m^2)	F_1 (120N:60P:60K)	16.36	25.12	**20.74**
	F_2 (150N:75P:75K)	24.56	26.33	**25.44**
	F_3 (180N:90P:90K)	21.68	27.27	**24.48**
	Mean	**20.87**	**26.24**	***23.55***
S_2 (60 cm x 60 cm) (2.78 plants per m^2)	F_1 (120N:60P:60K)	21.57	19.70	**20.63**
	F_2 (150N:75P:75K)	24.23	30.47	**27.35**
	F_3 (180N:90P:90K)	40.02	23.88	**31.95**
	Mean	**28.60**	**24.68**	***26.64***
S_3 (75 cm x 40 cm) (3.33 plants per m^2)	F_1 (120N:60P:60K)	17.15	26.19	**21.67**
	F_2 (150N:75P:75K)	23.05	19.00	**21.02**
	F_3 (180N:90P:90K)	24.30	41.07	**32.68**
	Mean	**21.50**	**28.75**	***25.12***
For Comparing varieties (A) and Fertigation (C)				
F_1 (120N:60P:60K)		18.36	23.67	***21.01***
F_2 (150N:75P:75K)		23.95	25.26	***24.60***
F_3 (180N:90P:90K)		28.67	30.74	***29.70***
Mean		***23.66***	***26.56***	***25.11***

Factors	***S Em±***	**C.D** at 5%
Variety (A)	0.39	1.13
Planting density (B)	0.48	1.39
Fertigation (C)	0.48	1.39
A x B	0.68	1.96
B x C	0.83	2.41
A x C	0.68	1.96
A x B x C	1.18	3.41

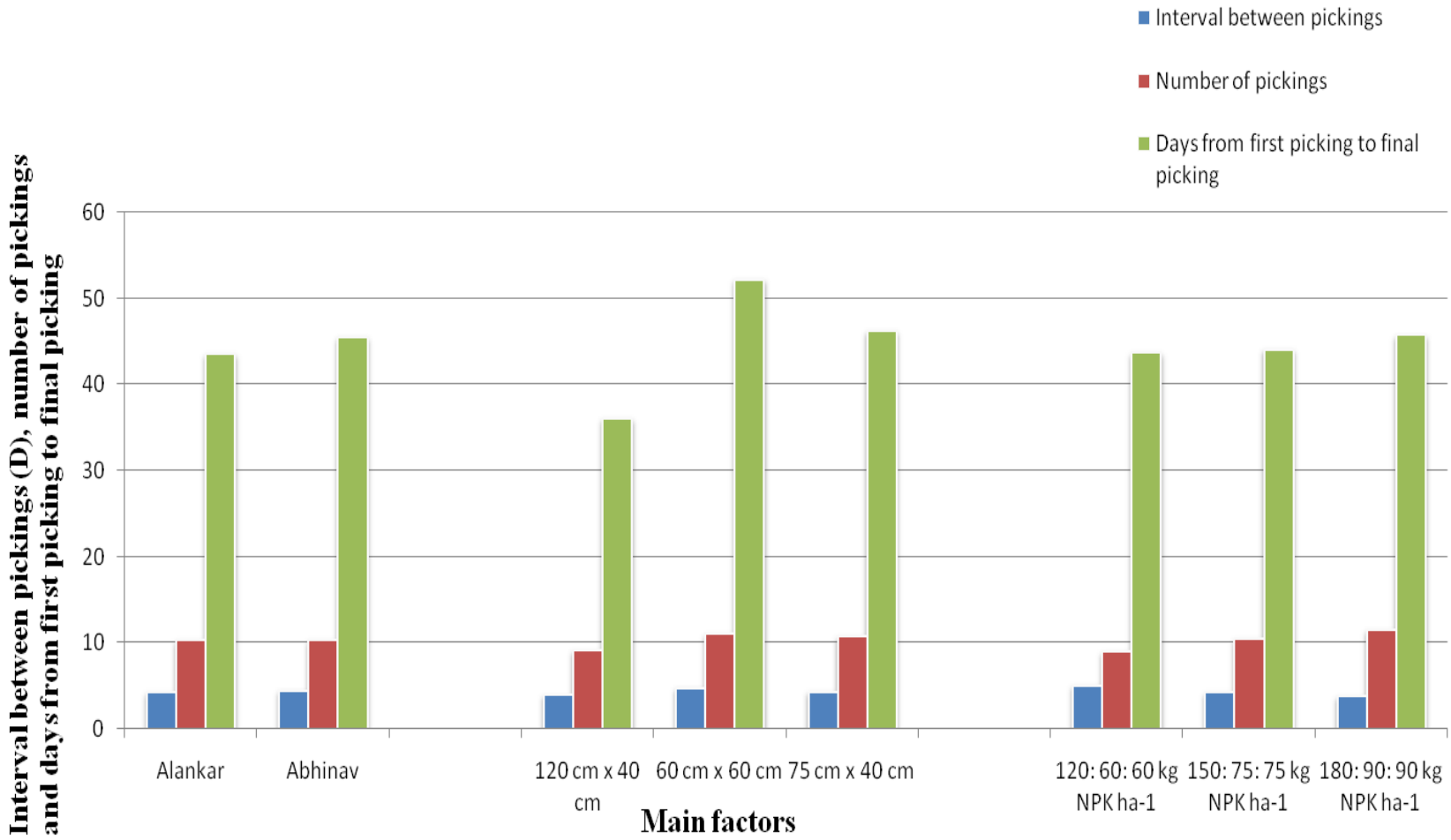

Fig. 1. Effect of variety, planting density and fertigation level on the interval between pickings, number of pickings and days from first picking to final picking

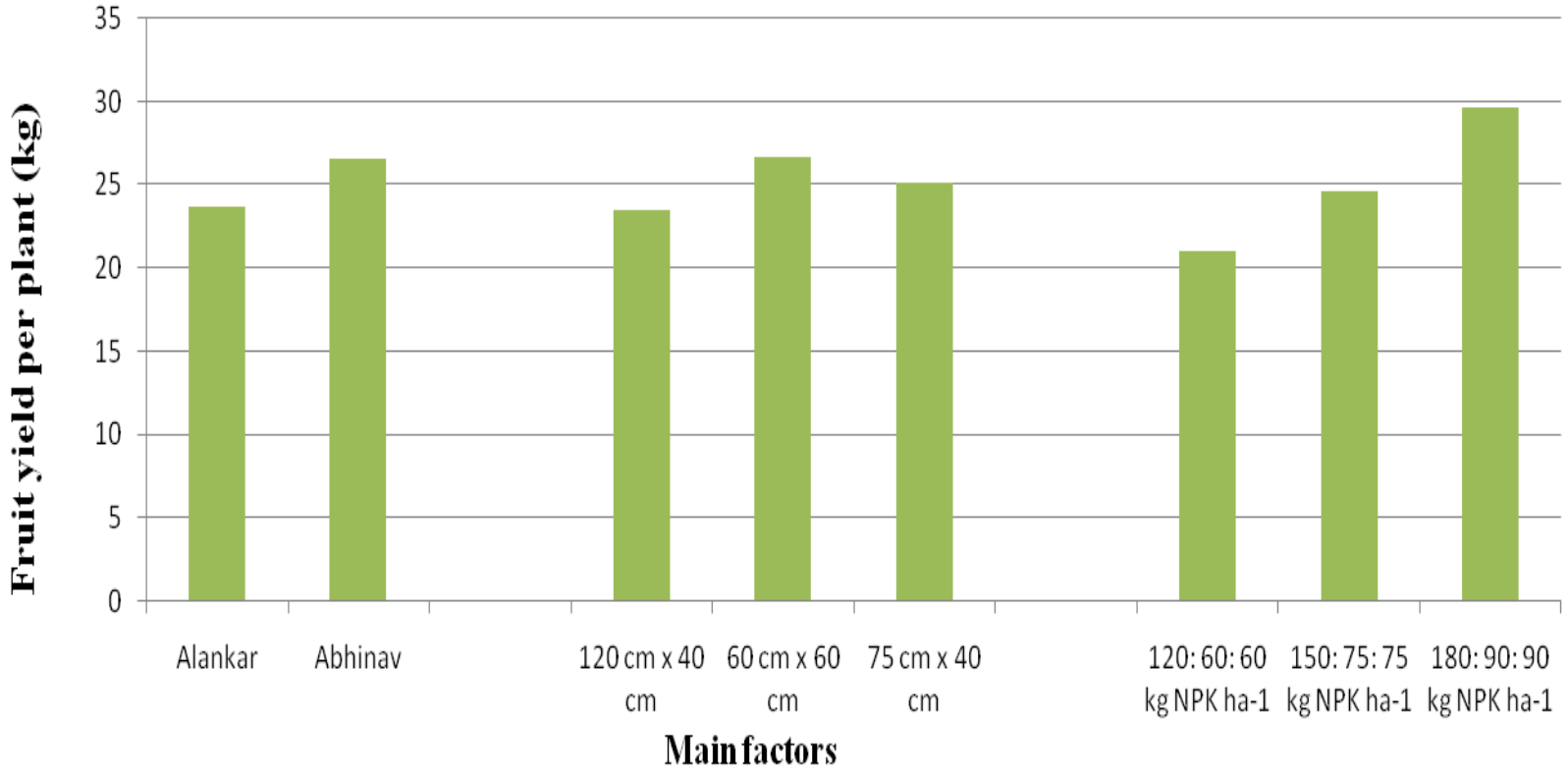

Fig. 2. Effect of variety, planting density and fertigation level on the fruit yield per plant (kg) in processing tomato

The interaction effects of planting density x fertigation level, variety x planting density and variety x planting density x fertigation level were found significant. The number of pickings reflected the capacity of the treatment in terms of yielding ability. It was evident from the data on fruit parameters that the treatment factors that excelled in the number of pickings also proved better in terms of total fruit number and / or fruit weight produced per plant.

Days from first picking to final picking

Significant variations were observed days from first picking to final picking due to variety, planting density, fertigation levels and their interactions (Table 4) in (Fig. 1). Among the varieties, Abhinav recorded the highest number days from first picking to final picking (45.49 days). Planting density at 60 cm x 60 cm (S_2) recorded significantly the longest duration from first picking to final picking (52.24 days) which was followed by 75 cm x 40 cm (S_3) (46.24 days). The lowest number of days taken from first picking to final picking was recorded by the planting density at 120 cm x 40 cm (S_1) (36.05 days). Application of 180N: 90P: 90K kg per ha (F_3) recorded the highest number of days from first picking to final picking (45.74 days) which was followed by150N: 75P: 75K kg per ha (F_2) (44.10 days). The lowest number of days from first picking to final picking (43.71 days) was recorded by the application of 120N: 60P: 60K kg per ha (F_1). Superior treatmental factors like Abhinav variety, planting density of 60 cm x 60 cm as well as application of F_3: 180N: 90P: 90K kg per ha registered a long bearing period from first picking to final picking, which might support in favour of recording the highest fruit yield per plant even though they took more interval between successive pickings and more days from fruit set to maturity. The results on these parameters are in conformity with the same.

Fruit yield per plant (kg)

Significant differences were observed in the fruit yield per plant (Table 5), (Fig. 2) due to variety, planting density, fertigation combinations and their interactions. The highest fruit yield per plant (26.56 kg) was recorded by variety Abhinav. Planting density at 60 cm x 60 cm (S_2) recorded significantly the highest fruit yield per plant (26.64 kg) followed by 75 cm x 40 cm (S_3) (25.12 kg). The lowest fruit yield per plant was recorded by the planting density at 120 cm x 40 cm (S_1) (23.55 kg). Planting density of 60 cm x 60 cm has equal distance between row to row and plant to plant which maintained equal growth of branches on both the sides ultimately which increases number of branches, no of flower truss per plant. Application of 180N: 90P: 90K kg per ha (F_3) recorded the highest fruit yield per plant (29.70 kg) followed by 150N: 75P: 75K kg per ha (F_2) (24.60 kg). The lowest fruit yield per plant (21.01 kg) was recorded by the application of 120N: 60P: 60K kg per ha (F_1). Similar findings were also reported by Mishra *et al.,* (2004). Similar observations were observed by Bhattarai, *et al.,* (2015) who reported that at high NPK levels, the number of fruits per plant was recorded highest due to more clusters per plant and more flowers per cluster.

The result revealed that the highest dose of 180N: 90P: 90K resulted in the late picking and also took more days from fruit set to maturity as compared to lower nutritional doses. The variety Abhinav coupled with population density at 120 cm x 40 cm and the highest fertigation level at 180N: 90P: 90K exhibited highest number of days to first picking which might be clearly due to the enlarged duration of time spent in fruit maturity and also the highest dose of 180N: 90P: 90K resulted in the reduction of time interval between pickings it may be due to the

availability of more nutrients reduces the competitions which leads to early ripening. The variety Abhinav coupled with population density at 120 cm x 40 cm and the lowest fertigation level at 120N: 60P: 60K per ha exhibited highest interval between every pickings which might be clearly due to least availability of nutrients to the plants for fruit ripening.

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