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Development and Evaluation of Recombinant Inbred Lines for Yield and Quality Traits in Tomato (*Solanum lycopersicum* L.)

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ABSTRACT: Tomato is the most important vegetable crop in the world and in India for its nutritional and industrial value. The production and productivity of tomato in India is less compare to world scenario due to plants basically succulent in nature so more prone to infestation by biotic and abiotic stresses. So there is need of new and improved tomato lines which were high yielded and resistant to biotic and abiotic stresses. In this experiment we have developed a total of 147 recombinant inbred lines from the cross Anagha and FBT-41, which are contrasting for the trait bacterial wilt disease resistance. Among 147 lines developed and evaluated for 18 yield and quality traits a total eight lines were identified as superior inbred lines *viz.*, TRIP2-8, TRIP2-17, TRIP2-18, TRIP2-20, TRIP2-22, TRIP2-24, TRIP2-35 and TRIP2-110, so these high yielding homozygous lines can be directly released as variety after necessary multi location trials or can be used as parent to develop hybrids.

Keywords: Tomato, *per se*, RILs and fruit yield.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is the most important vegetable crop grown all over the world due to its economic significance and prospective health benefits as it is good source of antioxidants, vitamins and minerals. It belongs to the family Solanaceae and having diploid chromosome number 2n= 24 (Jenkins, 1948). All the species of tomato are native to Western South America (Rick *et al.*, 1976), except the cultivated species *Solanum lycopersicum* (L.), which is native to the Peru-Ecuador region (Rick, 1969). It can be grown as an annual or short-lived perennial herbaceous plant with a taproot system andthe growth habits are determinate, semi-determinate and indeterminate.

Tomatoes are considered as protective food attributed to their special nutrition value and antioxidant properties like lycopene, flavonoids, ascorbic acid and ß-carotene, it is also valued for its flavour and colour. Lycopene is the major principal carotenoid responsible for the red hue characteristics of tomatoes used in curing various chronic human diseases like diabetes, osteoporosis, cancer and cardiovascular diseases (Bai and Lindhot 2007), for these characteristics tomato is considered as the most demanded and consumed vegetable across the World.

In the world scenario tomatoes are grown in an area of 5.51 million hectares with the 186 million tonnes production and 37.10 metric tons productivity (FAO, 2021). Globally the main producers included China, which alone produces alone about 63 million tons, ≈35 %, of the total production (181.00 million tons), followed by India (19.00 million tons), Turkey (12.80 million tons), the USA (10.90 million tons) and Egypt (6.90 million tons). In India, tomato occupies an area of 0.81 million hectares with a production of 21.17 million tons and productivity of 25.32 metric tons per hectare. Karnataka, occupies third place in the country with an area of 64.25 thousand hectares and production of 2081 thousand tons and productivity 32.40 metric tons per hectare (NHB, 2018).

Achievement of plant breeding depends upon the nature and magnitude of variability present in the genotypes. The production and productivity of tomato in India is far below compare to the global scenario. There is a need to develop superior hybrids or varieties suitable

for diverse agro-ecological conditions with specific end use. Before releasing any varieties or developing hybrids or commencement of any breeding programmes evaluation of germplasm or genotypes for per se performance followed by release of verities is scientifically valid and significant (Pidigam *et al*., 2019; Saidaiah *et al*., 2021; Rajasheka *et al*., 2017; Srivatsava *et al*., 2019; Tejaswini *et al.*, 2017; Triveni *et al.*, 2017). In light of the foregoing information, the current study was carried out to shed light on the *per se* performance of tomato for yield and its attributing traits and quality traits in the developed recombinant inbred lines.

MATERIAL AND METHOD

The study was undertaken at the Department of Vegetable Science field unit of Kittur Rani Channamma College of Horticulture, Arabhavi, which falls under northern dry zone of Karnataka, situated at an altitude of 612.03 meters above mean sea level. Geographically, it lies at 16°15' north latitude and 75°45' east longitude.

The parents Anagha and FBT-41 were crossed and used to develop F_1s. The seeds from F_1 hybrid derived from the cross involving the above parents were used as starting material to develop recombinant inbred line populations. The characteristics of parents were given in Table 1.

Each F_2 plants were advanced to develop recombinant inbred lines following single seed descent method. All the seeds from F_1 hybrids were sown in portrays and after four weeks, seedlings were transplanted with the 60 × 60 cm spacing in field with light irrigation. A total 147 individual families of RILs were derived from Anagha × FBT 41 cross and evaluated for total 18 yield and quality traits that includes plant height (cm), number of branches per plant, days to first flowering, days to 50 per cent flowering, number of clusters per plant , number of fruit per cluster, average fruit weight (g) , number of locules per fruit , fruit length (cm), fruit diameter (cm), number of fruits per plant, total yield per plant (kg),total soluble solids (^{o} Brix) and pH. The quality traits *viz.,* ascorbic acid (mg/100g) (Sadasivam and Manickam, 1996), lycopene content (mg/kg fresh wt.) (Darshan *et al*., 2013), fruit firmness (kg/cm^2) and pericarp thickness (mm) were recorded in the lines which were yielded more than 3 kg fruits per plant.

Table 1: Morphological characteristic of parents used to develop recombinant inbred lines.

Parents	Source	Morphological characteristics
Anagha	KAU, Thrissur	Determinate growth habit, bacterial wilt resistant variety with minimum average fruit weight 50-55g.
FBT- 41	CBR, CoH Bengaluru	Semi determinate, shape at blossom end is flat; bears small red colour fruits and carries *Ty*-1 and *Ty*-3 genes.

RESULT AND DISCUSSION

Recombinant inbred lines (RILs) are a collection of inbreds derived or developed from a cross and forwarded to F_2 generation and further though following single seed descent method. Parent strains are crossed to create recombinants that are then inbred to isogenic, resulting in a permanent resource for trait mapping and analysis and can be used to map quantitative trait loci (QTLs). Parents are selected based on the contrasting character for the bacterial wilt resistance and they were crossed to develop F_1 hybrid seeds and that material was used to develop further research material *i.e.,* RILs. Each F_2 plant obtained from F_1 crosses of Anagha × FBT-41, was advanced to develop RILs following the single seed descent method. All the plants were selfed and harvested fruit form the selfed flower. From that fruit, a single seed was sown and forwarded to further generation. Initially in F_2 generation, 170 plants from Anagha × FBT-41 cross. Similarly, in F_3 generation 165 plants from Anagha × FBT-41 cross. The reaming plants could not able to survive due to the death of plants due to transplanting shock. Likely in F_4 generation 160 plants from Anagha × FBT-41 cross. Correspondingly in F_5 generation 150 plants from Anagha × FBT-41 cross. Finally a set of total 147 recombinant inbred line populations were developed and evaluated for yield and yield attributing traits.

The mean performance of 147 tomato recombinant inbred lines studied for 14 yield and its attributing traits is presented in Table 2 and four quality traits in Table 3. Ample range of variability was observed in the lines derived from cross Anagha × FBT-41 for the trait plant height and it is ranged from 60.00 cm (TRIP2-79, TRIP2-125) to 105.00 cm (TRIP2-26, TRIP2-82) with a grand mean of 82.11 cm similarly for the trait number of branches per plant it ranged from 3.90 (TRIP2-140) to 8.60 (TRIP2-35, TRIP2-40) with a grand mean of 6.33. Higher variation was observed for number of cluster per plant and it ranged from 7.10 (TRIP2-105) to 26.30 (TRIP2-35) with a grand mean of 15.26, correspondingly for the number of fruits per cluster significant variation were observed and it ranged from 2.30 (TRIP2-12, TRIP2-78, TRIP2-134) to 7.50 (TRIP2-37) with a grand mean of 4.24. The plant height is as very important character as it directly influences the yield per plant through having effect though the branches per plant, clusters per plant. Number of locules per fruit a normal variation were observed and it

ranged from 1.83 to 4.15 with a grand mean of 2.88. Days to first flowering ranged from 22.00 days (TRIP2-26, TRIP2-145) to 32.00 days (TRIP2-118, TRIP2-132, TRIP2-136) with an average of 26.54 days. A wide range of variation was observed for the trait days to 50 per cent flowering and it ranged from 26.00 days (TRIP2-145) to 40 .00 days (TRIP2-118) with a grand mean of 31.85 days. The flowering traits implies earliness characters. Significant variations for the character plant height, number of branches per plant, days to first flowering and days to 50 per cent flowering were reported by Lekshmi and Celine (2017); Aralikatti *et al*. (2018); Tsagaye *et al*. (2020); Akhter *et al.* (2021); Debnath *et al*. (2021). Significant variation for the number of locules per fruit was reported by Kumari *et al*. (2020); Maurya *et al*. (2020); Sinha *et al.* (2020).

Higher variation was recorded for fruit length and it ranged from 2.50 cm (TRIP2-91) to 6.10 cm (TRIP2-12) with a grand mean of 4.41 cm. Fruit diameter varied from 3.10 cm (TRIP2-1) to 6.90 cm (TRIP2-12, TRIP2-25, TRIP2-105, TRIP2-138) with a grand mean of 5.46 cm. Higher variation was recorded for average fruit weight and it ranged from 23.50 g (TRIP2-87) to 68.52 g (TRIP2-66) with a grand mean of 40.66 g. For the number of fruits per plant a wider range of variation was observed and the mean value ranged from 18.98 (TRIP2-140) to 163.06 (TRIP2-35) with a grand mean of 64.67. Yield per plant ranged from 0.68 kg (TRIP2-140) to 6.05 kg (TRIP2-8) with a mean of 2.59 kg. A wide range of variation for the characters i.e., fruit yield per plant, average fruit weight, fruit diameter, number of fruits per cluster, number of clusters per plant, number of fruits per plant were also observed by Triveni *et al*. (2017); Bhandari *et al*. (2017); Aralikatti *et al*. (2018); Tsagaye *et al*. (2020); Venkadeswaran *et al*. (2020); Anuradha *et al*. (2021); Eppakayala *et al*. (2021), which confirms our findings. Thus, considerable amount of variability was present in the experimental material which can be exploited for improvement of fruit yield and yield attributes in tomato.

Quality traits such as total soluble solids it ranged from 4° Brix to 4.85° Brix with average of 4.23° Brix and pH ranged from 3.60 to 4.68 with a grand mean of 4.02.Pericarp thickness ranged from 1.90 to 5.90 mm (TRIP2-22) with a grand mean of 3.86 mm and for fruit firmness parameter it ranged from 2.09 to 7.38 kg/cm^2 (TRIP2-18) with a mean of 4.24 kg/cm^2. Similarly for ascorbic acid content values ranged from 9.00 to 16.3 mg/100g (TRIP2-18) with mean of 12.82 mg/100g. Correspondingly the lycopene (mg/kg fresh wt.) content ranged from 10.2 to 16.3 (TRIP2-8) with a mean of 13.72 (Table 3). As yield is an important character simultaneous consideration of quality traits is also important for overall improvement of variety this results were also corroborative with the findings of Triveni *et al*. (2017) in tomato where she reports the weightage of quality traits for selection of the improvement promising varieties.

Table 2: *Per se* performance for yield and its components and quality traits of Anagha × FBT-41 cross.

Sr. No.	Parents/ RILs	PHT	PB	NOCPP	NOFPC	FLO	DFF	D50F	FL	FD	AFW	NOF	YPP	TSS	PH
1	Anagha	68.00	7.00	15.00	5.00	3.40	26.00	30.00	3.60	3.50	52.35	75.00	3.93	4.50	3.95
2	FBT 41	71.00	5.80	13.80	6.10	2.60	29.00	34.00	4.10	4.50	39.50	84.18	3.33	4.10	3.60
3	TRIP2-1	86.00	6.10	14.25	2.40	4.00	29.00	34.00	5.80	3.10	55.25	34.20	1.89	4.20	4.08
4	TRIP2-2	70.00	4.60	12.20	3.90	3.00	27.00	33.00	5.10	4.60	46.12	47.58	2.19	4.20	4.12
5	TRIP2-3	85.00	7.30	16.35	4.80	4.00	28.00	33.00	4.80	4.10	36.20	78.48	2.84	4.30	4.18
6	TRIP2-4	65.00	4.35	10.25	5.60	3.00	28.00	32.00	4.10	5.10	35.65	57.40	2.05	4.10	3.98
7	TRIP2-5	72.00	4.60	11.35	3.70	2.00	27.00	32.00	5.20	5.40	48.65	42.00	2.04	4.25	4.13
8	TRIP2-6	81.00	6.10	14.90	3.10	2.00	26.00	32.00	5.40	4.10	52.35	46.19	2.42	4.32	4.20
9	TRIP2-7	75.00	5.20	11.35	4.80	2.00	28.00	33.00	4.10	4.30	38.32	54.48	2.09	4.25	4.13
10	TRIP2-8	86.00	7.60	19.10	5.90	3.00	25.00	29.00	4.10	5.30	53.65	112.69	6.05	4.60	4.48
11	TRIP2-9	64.00	4.30	8.10	5.60	3.50	27.00	32.00	4.90	6.10	36.12	45.36	1.64	4.12	4.00
12	TRIP2-10	78.00	6.20	14.30	7.30	2.50	28.00	34.00	4.10	3.50	25.62	104.39	2.67	4.35	4.23
13	TRIP2-11	74.00	5.30	13.50	3.80	3.00	27.00	31.00	5.80	5.10	48.25	51.30	2.48	4.25	4.13
14	TRIP2-12	88.00	7.60	19.50	2.30	3.00	26.00	31.00	6.10	6.90	59.25	44.85	2.66	4.25	4.13
15	TRIP2-13	87.00	7.60	20.10	2.60	3.00	25.00	31.00	5.40	5.10	44.65	52.26	2.33	4.60	4.48
16	TRIP2-14	63.00	4.10	8.30	3.70	3.00	28.00	32.00	4.20	5.50	48.62	30.71	1.49	4.20	4.08
17	TRIP2-15	67.00	4.70	10.50	3.90	3.00	27.00	32.00	5.10	4.10	38.62	40.95	1.58	4.50	4.38
18	TRIP2-16	70.00	4.10	10.30	5.10	3.00	31.00	37.00	4.40	5.60	36.21	52.53	1.90	4.10	3.98
19	TRIP2-17	91.00	8.20	22.30	5.90	4.00	24.00	29.00	4.10	5.20	38.62	131.57	5.08	4.20	4.08
20	TRIP2-18	102.00	8.20	20.50	3.90	2.00	23.00	27.00	5.50	6.80	46.21	79.95	3.69	4.50	4.38
21	TRIP2-19	79.00	6.20	11.50	4.50	3.00	25.00	30.00	4.60	5.50	40.25	51.75	2.08	4.80	4.68
22	TRIP2-20	99.00	8.30	20.50	4.80	2.00	24.00	30.00	5.20	6.50	38.62	98.40	3.80	4.10	3.98
23	TRIP2-21	98.00	8.00	19.60	5.60	3.00	24.00	28.00	4.10	4.20	36.25	109.76	3.98	4.20	4.08
24	TRIP2-22	100.00	8.40	24.60	6.20	2.00	23.00	28.00	4.10	5.40	38.56	152.52	5.88	4.00	3.88
25	TRIP2-23	68.00	4.20	8.30	4.80	3.00	30.00	34.00	4.20	5.70	39.25	39.84	1.56	4.00	3.88
26	TRIP2-24	94.00	8.10	21.50	5.90	4.00	25.00	30.00	4.20	6.20	35.65	126.85	4.52	4.30	4.18
27	TRIP2-25	68.52	4.60	11.65	3.70	2.00	29.00	36.00	5.30	6.90	44.25	43.11	1.91	4.10	3.98
28	TRIP2-26	105.00	8.30	21.60	3.90	3.00	22.00	29.00	4.70	4.10	38.62	84.24	3.25	4.20	4.08
29	TRIP2-27	75.00	5.10	13.60	5.10	3.00	24.00	28.00	4.60	5.90	53.65	69.36	3.72	4.00	3.88

Sr. No.	Parents/ RILs	PHT	PB	NOCPP	NOFPC	FLO	DFF	D50F	FL	FD	AFW	NOF	YPP	TSS	PH
30	TRIP2-28	91.54	8.10	21.30	3.10	2.00	25.00	30.00	5.10	6.10	56.60	66.03	3.74	4.00	3.88
31	TRIP2-29	95.00	8.10	20.60	4.50	4.00	24.00	30.00	4.10	6.20	52.35	92.70	4.85	4.50	4.38
32	TRIP2-30	86.00	7.60	16.50	4.10	4.00	28.00	33.00	4.40	5.60	44.25	67.65	2.99	4.10	3.98
33	TRIP2-31	83.00	7.30	15.60	5.60	2.00	25.00	29.00	4.60	5.20	44.25	87.36	3.87	4.20	4.08
34	TRIP2-32	71.58	4.60	11.60	3.10	3.00	26.00	31.00	5.40	6.20	48.65	35.96	1.75	4.30	4.18
35	TRIP2-33	92.00	8.10	20.10	3.20	3.00	25.00	31.00	5.50	6.10	54.58	64.32	3.51	4.10	3.98
36	TRIP2-34	77.00	6.10	14.60	4.10	3.00	27.00	32.00	3.50	6.10	35.60	59.86	2.13	4.20	4.08
37	TRIP2-35	94.00	8.60	26.30	6.20	2.00	24.00	28.00	3.90	4.90	36.10	163.06	5.89	4.50	4.38
38	TRIP2-36	63.00	4.10	7.60	7.30	4.00	29.00	34.00	4.10	5.30	26.87	55.48	1.49	4.30	4.18
39	TRIP2-37	86.00	7.30	15.60	7.50	2.00	23.00	29.00	3.50	6.80	39.54	117.00	4.63	4.00	3.88
40	TRIP2-38	84.98	7.10	14.20	5.90	3.00	24.00	31.00	4.60	5.50	44.25	83.78	3.71	4.10	3.98
41	TRIP2-39	71.00	4.10	12.30	5.10	4.00	29.00	36.00	4.40	5.80	38.62	62.73	2.42	4.20	4.08
42	TRIP2-40	93.00	8.60	22.30	6.10	2.00	24.00	30.00	4.20	5.20	35.65	136.03	4.85	4.30	3.98
43	TRIP2-41	98.32	8.10	20.40	2.40	3.00	28.00	33.00	5.70	6.50	48.60	48.96	2.38	4.20	3.88
44	TRIP2-42	102.00	8.40	24.90	4.50	2.00	23.00	27.00	4.50	5.60	40.25	112.05	4.51	4.60	4.28
45	TRIP2-43	82.74	7.10	15.60	4.80	3.00	25.00	31.00	3.90	4.60	36.54	74.88	2.74	4.10	3.78
46	TRIP2-44	67.00	4.20	11.30	5.10	2.00	27.00	32.00	5.10	6.10	29.65	57.63	1.71	4.20	3.88
47	TRIP2-45	63.52	4.00	8.20	5.60	3.00	29.00	35.00	4.70	5.10	39.54	45.92	1.82	4.30	3.98
48	TRIP2-46	89.00	7.60	19.20	3.50	4.00	28.00	33.00	5.40	6.30	48.32	67.20	3.25	4.20	3.88
49	TRIP2-47	88.00	7.20	18.30	4.50	2.00	24.00	29.00	4.50	6.50	44.25	82.35	3.64	4.10	3.78
50	TRIP2-48	72.65	5.60	13.60	3.20	3.00	26.00	32.00	5.20	6.10	48.25	43.52	2.10	4.20	3.88
51	TRIP2-49	103.00	8.50	22.50	3.80	4.00	24.00	29.00	4.90	5.50	40.25	85.50	3.44	4.00	3.68
52	TRIP2-50	72.00	5.40	13.50	4.50	3.00	27.00	33.00	5.10	5.60	25.35	60.75	1.54	4.60	4.28
53	TRIP2-51	82.00	6.60	15.40	5.10	2.00	23.00	28.00	5.40	4.10	55.60	78.54	4.37	4.10	3.78
54	TRIP2-52	96.85	8.50	21.60	6.20	4.00	24.00	30.00	3.90	6.20	40.25	133.92	5.39	4.10	3.78
55	TRIP2-53	90.00	7.50	18.60	2.80	2.00	28.00	33.00	5.60	6.10	52.32	52.08	2.72	4.30	3.98
56	TRIP2-54	103.71	8.50	23.40	3.20	3.00	28.00	34.00	5.30	6.50	44.25	74.88	3.31	4.50	4.18
57	TRIP2-55	74.10	5.20	11.80	4.20	2.00	27.00	32.00	4.60	4.90	46.85	49.56	2.32	4.80	4.48
58	TRIP2-56	82.30	5.90	12.30	5.10	4.00	29.00	35.00	5.50	6.10	44.25	62.73	2.78	4.10	3.78
59	TRIP2-57	75.90	6.00	15.30	5.90	2.00	23.00	28.00	5.30	6.50	52.35	90.27	4.73	4.20	3.88
60	TRIP2-58	75.00	6.10	15.30	4.50	2.00	25.00	31.00	3.50	4.80	40.25	68.85	2.77	4.20	3.88
61	TRIP2-59	76.00	5.80	13.80	5.60	4.00	26.00	31.00	4.10	4.60	28.65	77.28	2.21	4.00	3.68
62	TRIP2-60	82.00	7.10	16.90	5.90	2.00	29.00	35.00	3.30	4.10	26.51	99.71	2.64	4.00	3.68
63	TRIP2-61	64.00	4.10	8.10	6.60	3.00	26.00	31.00	3.90	5.60	31.25	53.46	1.67	4.00	3.68
64	TRIP2-62	97.00	8.30	21.30	3.50	2.00	24.00	30.00	5.50	6.50	35.62	74.55	2.66	4.30	3.98
65	TRIP2-63	90.00	8.20	22.80	3.90	4.00	24.00	29.00	4.10	6.20	38.65	88.92	3.44	4.10	3.78
66	TRIP2-64	68.00	4.60	12.60	4.50	2.00	28.00	34.00	5.10	6.20	30.56	56.70	1.73	4.20	3.88
67	TRIP2-65	87.00	7.60	18.10	3.30	3.00	28.00	33.00	4.10	5.60	35.62	59.73	2.13	4.30	3.98
68	TRIP2-66	67.80	4.10	8.00	4.10	2.00	27.00	31.00	4.50	6.50	68.52	32.80	2.25	4.20	3.88
69	TRIP2-67	65.00	4.25	10.00	3.80	4.00	28.00	35.00	4.10	5.60	65.25	38.00	2.48	4.10	3.78
70	TRIP2-68	84.90	7.30	17.60	3.10	2.00	31.00	36.00	4.20	5.60	35.62	54.56	1.94	4.50	4.18
71	TRIP2-69	103.00	8.10	21.80	3.50	3.00	24.00	28.00	5.10	5.60	48.35	76.30	3.69	4.60	4.28
72	TRIP2-70	78.50	6.30	15.70	3.10	2.00	29.00	36.00	5.40	6.20	50.25	48.67	2.45	4.10	3.78
73	TRIP2-71	81.00	6.30	14.60	4.20	3.00	28.00	32.00	4.80	5.60	39.25	61.32	2.41	4.10	3.78
74	TRIP2-72	75.60	6.50	15.60	4.10	2.00	27.00	34.00	4.70	5.50	35.60	63.96	2.28	4.20	3.88
75	TRIP2-73	79.00	6.30	16.10	4.80	3.00	28.00	33.00	5.10	5.60	36.54	77.28	2.82	4.20	3.88
76	TRIP2-74	102.80	8.10	21.90	5.10	4.00	23.00	27.00	4.10	5.60	35.25	111.69	3.94	4.20	3.88
77	TRIP2-75	78.00	5.10	12.40	5.40	2.00	27.00	33.00	4.10	5.40	35.65	66.96	2.39	4.30	3.98
78	TRIP2-76	72.60	5.20	13.10	7.10	3.00	28.00	33.00	3.90	5.20	29.35	93.01	2.73	4.10	3.78
79	TRIP2-77	82.60	7.10	14.80	5.60	4.00	29.00	33.00	4.10	5.40	32.25	82.88	2.67	4.00	3.68
80	TRIP2-78	75.80	6.30	12.90	2.30	2.00	28.00	35.00	5.80	6.50	35.50	29.67	1.05	4.00	3.68
81	TRIP2-79	60.00	4.00	7.90	3.70	3.00	27.00	31.00	5.10	5.60	36.25	29.23	1.06	4.00	3.68
82	TRIP2-80	68.00	4.10	8.50	2.60	2.00	29.00	35.00	4.30	5.90	36.51	22.10	0.81	4.50	4.18
83	TRIP2-81	62.80	4.30	9.10	3.50	4.00	30.00	37.00	3.50	4.60	35.85	31.85	1.14	4.30	3.98
84	TRIP2-82	105.00	8.40	21.50	3.10	2.00	25.00	29.00	4.10	4.90	32.56	66.65	2.17	4.10	3.78
85	TRIP2-83	103.00	8.50	22.60	4.10	3.00	24.00	30.00	4.50	5.20	36.51	92.66	3.38	4.00	3.79
86	TRIP2-84	87.60	7.60	17.60	5.40	2.00	26.00	33.00	3.50	5.90	35.51	95.04	3.37	4.00	3.79
87	TRIP2-85	80.00	7.30	17.50	5.10	3.00	24.00	28.00	3.10	5.20	31.25	89.25	2.79	4.00	3.79
88	TRIP2-86	103.80	7.50	16.50	2.60	2.00	31.00	37.00	4.20	5.90	36.51	42.90	1.57	4.00	3.79
89	TRIP2-87	99.00	8.00	21.60	3.10	3.00	28.00	34.00	3.10	4.50	23.50	66.96	1.57	4.60	4.39
90	TRIP2-88	83.00	7.00	15.60	3.20	4.00	28.00	32.00	4.10	5.60	35.85	49.92	1.79	4.40	4.19
91	TRIP2-89	64.80	4.00	8.10	4.10	3.00	30.00	37.00	2.60	4.50	32.25	33.21	1.07	4.00	3.79
92	TRIP2-90	84.00	7.30	17.20	3.50	4.00	28.00	34.00	3.90	4.80	35.21	60.20	2.12	4.00	3.79
93	TRIP2-91	98.00	8.30	24.00	2.90	3.00	26.00	33.00	2.50	5.40	36.54	69.60	2.54	4.00	3.79
94	TRIP2-92	85.00	7.10	15.60	3.10	4.00	24.00	31.00	3.50	4.90	51.25	48.36	2.48	4.30	4.09
95	TRIP2-93	96.80	8.10	21.20	4.10	3.00	25.00	32.00	2.60	4.20	36.25	86.92	3.15	4.20	3.99
96	TRIP2-94	65.00	4.10	8.30	3.70	4.00	29.00	35.00	5.10	5.90	56.21	30.71	1.73	4.50	4.29

Sr. No.	Parents/ RILs	PHT	PB	NOCPP	NOFPC	FLO	DFF	D50F	FL	FD	AFW	NOF	YPP	TSS	PH
97	TRIP2-95	100.00	8.00	21.20	4.20	3.00	23.00	27.00	4.10	5.20	46.32	89.04	4.12	4.10	3.89
98	TRIP2-96	98.10	7.80	19.20	5.10	2.00	24.00	31.00	4.10	5.60	44.54	97.92	4.36	4.50	4.29
99	TRIP2-97	80.00	5.90	13.50	3.20	4.00	28.00	34.00	3.10	3.90	32.50	43.20	1.40	4.10	3.89
100	TRIP2-98	73.00	4.90	13.60	3.50	2.00	26.00	32.00	4.10	4.90	44.52	47.60	2.12	4.20	3.99
101	TRIP2-99	80.00	6.10	15.90	4.80	3.00	24.00	28.00	5.10	5.50	46.32	76.32	3.54	4.60	4.39
102	TRIP2-100	77.30	5.10	10.10	3.90	4.00	29.00	36.00	4.10	5.80	35.61	39.39	1.40	4.12	3.91
103	TRIP2-101	65.00	4.00	7.60	4.10	2.00	27.00	33.00	4.20	5.60	46.32	31.16	1.44	4.20	3.99
104	TRIP2-102	103.00	7.60	21.50	4.80	3.00	23.00	27.00	4.10	5.60	41.25	103.20	4.26	4.12	3.91
105	TRIP2-103	68.60	4.00	12.50	5.40	4.00	28.00	32.00	4.20	5.80	32.50	67.50	2.19	4.30	4.09
106	TRIP2-104	92.00	7.10	15.80	5.20	2.00	24.00	31.00	3.50	4.60	36.65	82.16	3.01	4.10	3.89
107	TRIP2-105	69.00	4.00	7.10	2.80	3.00	25.00	29.00	5.70	6.90	56.65	19.88	1.13	4.30	4.09
108	TRIP2-106	62.50	4.10	8.20	3.70	2.00	26.00	32.00	4.40	5.60	48.32	30.34	1.47	4.60	4.39
109	TRIP2-107	103.00	7.20	16.90	3.10	4.00	26.00	32.00	5.40	6.20	54.32	52.39	2.85	4.10	3.89
110	TRIP2-108	103.00	6.50	15.40	3.90	2.00	24.00	28.00	4.70	5.90	50.65	60.06	3.04	4.10	3.89
111	TRIP2-109	79.00	4.50	11.60	3.10	3.00	31.00	37.00	4.10	5.50	35.65	35.96	1.28	4.20	3.99
112	TRIP2-110	103.00	7.90	21.50	4.50	2.00	28.00	33.00	2.60	5.20	36.51	96.75	3.53	4.30	4.09
113	TRIP2-111	103.00	7.80	19.80	5.20	4.00	25.00	29.00	3.10	4.50	26.65	102.96	2.74	4.10	3.89
114	TRIP2-112	62.00	4.20	8.20	3.20	2.00	26.00	33.00	4.90	5.30	48.32	26.24	1.27	4.20	3.99
115	TRIP2-113	80.00	7.10	15.10	2.60	3.00	30.00	35.00	5.40	6.20	36.25	39.26	1.42	4.60	4.39
116	TRIP2-114	64.00	4.10	12.50	3.10	2.00	28.00	32.00	3.60	4.90	35.65	38.75	1.38	4.10	3.89
117	TRIP2-115	68.00	4.20	13.50	5.20	4.00	29.00	34.00	3.50	6.20	30.25	70.20	2.12	4.20	3.99
118	TRIP2-116	94.00	8.20	20.50	3.50	3.00	24.00	29.00	4.10	5.60	39.25	71.75	2.82	4.50	4.29
119	TRIP2-117	85.00	7.30	15.40	3.50	2.00	30.00	36.00	3.50	6.10	32.25	53.90	1.74	4.60	4.39
120	TRIP2-118	80.00	5.50	13.50	2.50	4.00	32.00	40.00	2.60	4.80	36.54	33.75	1.23	4.10	3.89
121	TRIP2-119	101.00	7.50	16.90	3.10	2.00	28.00	35.00	2.60	6.10	26.52	52.39	1.39	4.50	4.29
122	TRIP2-120	89.00	7.60	15.90	3.50	3.00	28.00	33.00	3.50	4.50	36.20	55.65	2.01	4.85	4.64
123	TRIP2-121	62.00	4.10	8.30	5.40	2.00	24.00	30.00	4.10	4.60	40.25	44.82	1.80	4.14	3.93
124	TRIP2-122	89.00	7.10	14.20	6.70	4.00	28.00	32.00	3.60	4.50	36.54	95.14	3.48	4.26	4.05
125	TRIP2-123	96.00	8.00	21.20	5.20	2.00	23.00	28.00	5.20	6.10	35.51	110.24	3.91	4.10	3.89
126	TRIP2-124	84.00	7.00	14.60	3.50	3.00	28.00	34.00	4.10	4.60	25.25	51.10	1.29	4.16	3.95
127	TRIP2-125	60.00	4.00	8.10	3.50	4.00	29.00	34.00	4.20	5.60	36.25	28.35	1.03	4.19	3.98
128	TRIP2-126	79.00	6.20	14.30	4.50	2.00	25.00	29.00	3.50	6.20	31.25	64.35	2.01	4.59	4.38
129	TRIP2-127	100.00	8.00	21.20	3.50	3.00	26.00	32.00	2.90	4.50	36.52	74.20	2.71	4.30	4.09
130	TRIP2-128	71.00	4.10	8.20	5.10	3.00	24.00	28.00	4.20	5.30	44.21	41.82	1.85	4.50	4.29
131	TRIP2-129	104.00	7.50	18.30	3.20	2.00	24.00	29.00	4.70	5.90	46.23	58.56	2.71	4.10	3.89
132	TRIP2-130	65.00	4.30	10.30	5.60	4.00	25.00	29.00	4.30	5.10	38.65	57.68	2.23	4.10	3.89
133	TRIP2-131	94.00	7.10	14.30	3.10	4.00	31.00	36.00	4.90	6.10	36.25	44.33	1.61	4.20	3.99
134	TRIP2-132	71.00	4.10	8.30	3.10	2.00	32.00	38.00	4.10	4.50	26.50	25.73	0.68	4.20	3.99
135	TRIP2-133	66.00	4.25	10.20	2.60	3.00	31.00	36.00	5.70	6.30	48.65	26.52	1.29	4.50	4.29
136	TRIP2-134	88.00	7.60	15.60	2.30	2.00	30.00	35.00	3.10	5.50	36.52	35.88	1.31	4.10	3.89
137	TRIP2-135	72.00	5.20	12.50	3.10	3.00	32.00	37.00	4.20	6.30	39.65	38.75	1.54	4.10	3.89
138	TRIP2-136	97.30	8.30	25.30	3.10	2.00	23.00	27.00	4.80	5.60	46.25	78.43	3.63	4.10	3.89
139	TRIP2-137	89.00	7.00	15.30	3.70	3.00	26.00	30.00	5.10	4.60	44.21	56.61	2.50	4.00	3.79
140	TRIP2-138	78.00	6.10	14.20	5.40	2.00	24.00	29.00	5.50	6.90	55.65	76.68	4.27	4.00	3.79
141	TRIP2-139	81.60	6.10	12.30	3.90	2.00	24.00	30.00	4.40	5.60	42.32	47.97	2.03	4.00	3.89
142	TRIP2-140	62.00	3.90	7.30	2.60	3.00	31.00	37.00	5.50	6.10	45.62	18.98	0.87	4.30	4.19
143	TRIP2-141	69.00	6.30	15.30	3.20	2.00	24.00	28.00	4.70	6.20	38.65	48.96	1.89	4.20	4.09
144	TRIP2-142	67.20	4.10	8.20	5.10	4.00	26.00	30.00	4.70	5.30	44.25	41.82	1.85	4.10	3.99
145	TRIP2-143	80.00	7.00	15.20	3.70	2.00	26.00	33.00	4.20	5.60	40.32	56.24	2.27	4.30	4.19
146	TRIP2-144	71.60	5.00	12.30	4.20	3.00	26.00	30.00	4.70	5.10	36.32	51.66	1.88	4.60	4.49
147	TRIP2-145	94.00	8.00	18.30	3.90	4.00	22.00	26.00	4.90	5.90	48.65	71.37	3.47	4.10	3.99
148	TRIP2-146	99.00	7.60	15.80	3.20	2.00	25.00	30.00	5.30	5.90	44.65	50.56	2.26	4.00	3.89
149	TRIP2-147	70.00	4.60	12.50	2.80	3.00	28.00	34.00	4.10	5.60	35.25	35.00	1.23	4.20	4.09
	Minimum	60.00	3.90	7.10	2.30	2.00	22.00	26.00	2.50	3.10	23.50	18.98	0.68	4.23	3.60
	Maximum	105.00	8.60	26.30	7.50	4.00	32.00	40.00	6.10	6.90	68.52	163.06	6.05	4.85	4.68
	Mean	82.24	6.33	15.21	4.25	2.86	26.55	31.85	4.42	5.47	40.76	64.50	2.59	4.00	4.02
	SE±m	1.43	0.80	1.06	0.42	0.33	1.41	1.89	0.21	0.26	1.83	2.08	0.04	0.07	0.10
	CD @5 %	3.11	1.74	2.30	0.92	0.71	3.08	4.11	0.47	0.56	3.98	4.54	0.09	0.15	0.23
	CV @ 5 %	1.50	0.22	4.65	6.38	7.47	3.53	3.89	3.24	3.16	2.97	2.11	1.09	1.06	1.72

PHT-Plant height (cm)
PB-Number of branches per plant
NOFPC-Number of fruits per cluster
NOCPP-Number of cluster per plant
FLO-Number of locules per fruit
DFF-Days to first flowering
D50F-Days to 50 per cent flowering
FL-Fruit length (cm)
FD-Fruit diameter (cm)
AFW-Average fruit weight (g)
NOF-Number of fruits per plant
YPP-Total yield per plant (kg)
TSS: Total soluble solid

Table 3: Quality parameters of high yielding RILs derived from Anagha × FBT-41 cross.

Sr. No.	Parents/ RILs	Pericarp thickness (mm)	Firmness (kg/cm^2)	Ascorbic acid (mg/100g)	Lycopene (mg/kg)
1	Anagha	3.50	3.85	12.50	11.60
2	FBT- 41	3.40	3.74	10.20	12.50
3	TRIP2-8	3.90	4.29	11.30	16.30
4	TRIP2-17	4.20	5.25	15.30	13.20
5	TRIP2-18	5.90	7.38	16.30	14.30
6	TRIP2-20	4.10	4.51	14.00	15.30
7	TRIP2-21	4.90	5.39	13.00	14.30
8	TRIP2-22	5.90	6.49	12.30	15.30
9	TRIP2-24	5.30	5.57	15.30	16.10
10	TRIP2-26	3.50	3.68	12.20	14.20
11	TRIP2-27	3.60	3.78	15.30	13.23
12	TRIP2-28	4.10	4.31	11.00	14.20
13	TRIP2-29	3.50	3.68	10.10	13.20
14	TRIP2-31	4.20	4.41	11.30	15.20
15	TRIP2-33	3.80	3.99	14.30	14.20
16	TRIP2-35	3.80	3.99	12.60	13.20
17	TRIP2-37	3.50	3.68	12.80	14.20
18	TRIP2-38	3.60	3.78	12.50	13.20
19	TRIP2-40	3.50	3.68	14.30	15.23
20	TRIP2-42	4.20	4.62	13.20	14.30
21	TRIP2-46	4.10	4.51	11.20	11.20
22	TRIP2-47	3.90	4.29	13.50	10.30
23	TRIP2-49	2.10	2.31	14.60	13.20
24	TRIP2-51	1.90	2.09	16.20	10.20
25	TRIP2-52	2.60	2.86	14.20	15.30
26	TRIP2-54	3.50	3.85	13.00	12.30
27	TRIP2-57	3.70	4.07	15.30	14.20
28	TRIP2-63	2.80	3.08	11.30	13.20
29	TRIP2-69	4.20	4.62	11.20	14.20
30	TRIP2-74	3.60	3.96	10.20	14.30
31	TRIP2-83	3.70	4.07	10.80	14.10
32	TRIP2-84	4.20	4.62	11.90	14.20
33	TRIP2-93	5.10	5.61	12.10	14.60
34	TRIP2-95	4.10	4.51	11.20	14.30
35	TRIP2-96	4.60	5.06	11.00	15.30
36.	TRIP2-99	2.60	2.86	10.10	14.20
37	TRIP2-102	4.20	4.62	10.90	12.10
38	TRIP2-104	2.40	2.64	9.00	11.90
39	TRIP2-108	3.40	3.74	12.30	12.30
40	TRIP2-110	5.20	5.72	13.10	11.20
41	TRIP2-122	4.30	4.73	14.00	13.00
42	TRIP2-123	3.50	3.85	14.30	14.30
43	TRIP2-136	4.10	4.51	13.50	14.30
44	TRIP2-138	3.50	3.85	14.30	12.30
45	TRIP2-145	3.50	3.85	15.30	14.30

CONCLUSION

Considering all the yield and quality traits in the 147 RILs derived from the cross Anagha × FBT-41, eight lines were identified as superior inbred lines *viz*., TRIP2-8, TRIP2-17, TRIP2-18, TRIP2-20, TRIP2-22, TRIP2-24, TRIP2-35 and TRIP2-110. This lines homozygous stable lines can be used to developed hybrids which were high yielders or can be released as variety directly for cultivation.

FUTURE SCOPE

The present study aims at developing homozygous stable variety to increase the yield. So these lines can be used in future breeding programmes to develope newer novel lines.

Conflict of Interest. None

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