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S Saha
Department of Vegetable Crops,
Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur,
West Bengal, India

S Dutta
Department of Vegetable Crops,
Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur,
West Bengal, India

P Biswas
Department of Vegetable Crops,
Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur,
West Bengal, India

R Mandal
Department of Vegetable Crops,
Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur,
West Bengal, India

A Chattopadhyay
Department of Vegetable Crops,
Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur,
West Bengal, India

P Hazra
Department of Vegetable Crops,
Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur,
West Bengal, India

Exploring the possibility of developing commercially exploitable hybrids of ripening inhibitor (*rin*) mutant

S Saha, S Dutta, P Biswas, R Mandal, A Chattopadhyay and P Hazra

Abstract

Many ripening inhibiting mutants which lengthen the shelf life of the fruits have been investigated not only to understand fruit ripening but also to develop hybrids possessing increased keeping quality. The present investigation was outlined to characterize the ripening inhibitor (*rin*) mutant and its hybrids to explore the possibility of its commercial utilization.

The genotype possessing the *rin* gene (BCT-111*rin*) was semi-determinate in growth habit with normal green leaf containing 164.27mg/ 100g fresh weight total chlorophyll content. Immature fruits with increased size of sepals were uniformly light green in colour containing 10.16mg/ 100g fresh weight chlorophyll as against the average of 11.03mg/ 100g in three normal genotypes. Fruits of the *rin* genotype had the lowest of 1.61% total sugar content and 0.36% titratable acidity in the fruit pulp. The fruits did not ripe and remained bright yellow till the end and lycopene content in the fruits was very low of 0.38 mg/ 100g fresh as against the average of 3.56mg/ 100g fresh weight in three normal genotypes due to highly down-regulated ripening related ethylene biosynthesis. Appreciable ascorbic acid content in the fruits (25.66mg/ 100g fresh weight) suggested that ascorbic acid synthesis in the fruits and fruit ripening event were uncorrelated physiological processes.

The hybrids between the genotypes with *rin/rin* gene and the genotypes possessing either *dg/dg* or *Aft/Aft* gene significantly enhanced all fruit morphological characters. The *dg/Dg rin/Rin* hybrid was the highest yielder (4.72kg fruit/ plant). Average of 3.50mg lycopene content/ 100g fresh of the 4 *rin/Rin* - - hybrids (*Aft/aft rin/Rin*, *dg/Dg rin/Rin*, *og^c/Og^c rin/Rin* and *hp-1/Hp-1 rin/Rin*) was slightly lesser than the average of the three normal tomato lines indicating negative effect of the “*rin*” gene even in heterozygous condition on the carotenoid biosynthesis although such depressive effect was too inconspicuous to their use in commercial hybrid breeding programme.

Keywords: *rin* gene, ripening inhibition, hybrid, tomato

Introduction

Many ripening inhibiting mutants which lengthen the shelf life of the fruits have been investigated not only to understand fruit ripening but also to develop hybrids possessing increased keeping quality. Of the several single-gene mutations causing reduction or almost complete elimination of fruit ripening, *rin* was most widely studied for use in breeding. The present investigation was outlined to characterize the ripening inhibitor (*rin*) mutant and its hybrids to explore the possibility of its commercial utilization.

Materials and methods

A line possessing *rin* (*ripening inhibitor*) gene and maintained in homozygous condition (BCT-111*rin*) were crossed with 3 genotypes possessing carotenoid enhancing mutant genes viz., *dg*, *hp-1* and *og^c* (BCT-115 *dg*, Alisa Craig *hp-1* and Alisa Craig *og^c*) and one genotype possessing *Anthocyanin fruit* (*Aft*) gene (Alisa Craig *Aft*). The parental lines and hybrids were evaluated in randomized block design with 3 replications under autumn - winter season (planting in mid of October) consecutively in two years keeping 20 plants in each replication in 60 x 60 spacing in both ways to study the manifestation of different characters in them. Five random plants per replication in each genotype were selected for recording the data on different characters.

Results and discussion

The genotype possessing the *rin* gene (BCT-111*rin*) was semi-determinate in growth habit with normal green leaf containing 164.27mg/ 100g fresh weight total chlorophyll content. Immature fruits with increased size of sepals were uniformly light green in colour containing 10.16mg/ 100g fresh weight chlorophyll as against the average of 11.03mg/ 100g in three normal genotypes. Fruits of the *rin* genotype had the lowest of 1.61% total sugar content and 0.36% titratable acidity in the fruit pulp.

Correspondence

S Saha
Department of Vegetable Crops,
Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur,
West Bengal, India

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All the 4 hybrids were heterozygous for two specific genes in all possible combinations (*dg/Dg rin/Rin*, *Aft/aft rin/Rin*, *og^c/Og^c rin/Rin* and *hp-1/Hp-1 rin/Rin*). The hybrids between the genotypes with *rin/rin* gene and the genotypes possessing either *dg/dg* or *Aft/Aft* gene significantly enhanced all fruit morphological characters. Concomitance of *dg/Dg rin/Rin* genes significantly enhanced all fruit morphological

characters, having been more pronounced in *dg/Dg Aft/aft* hybrid which produced the heaviest fruit (83.70 g) with thickest pericarp (6.78mm). The *dg/Dg rin/Rin* hybrid was the highest yielder (4.72kg fruit/ plant). Average of 3.50mg lycopene content/ 100g fresh of the 4 *rin/Rin* - - hybrids (*Aft/aft rin/Rin*, *dg/Dg rin/Rin*, *og^c/Og^c rin/Rin* and *hp-1/Hp-1 rin/Rin*) was slightly lesser than the average of the three normal tomato lines indicating negative effect of the "rin" gene even in heterozygous condition on the carotenoid biosynthesis which was also recorded earlier (Giovannoni *et al.*, 2004; Leseberg *et al.*, 2008)^[1, 2]. However, the present investigation clearly indicated that such depressive effect of "rin" gene on the carotenoid biosynthesis was too inconspicuous to their use in commercial hybrid breeding programme.

Table 1: Mean of important fruit characters in the parental lines and hybrids

Genotypes	Fruits per plant	Fruit weight (g)	Pericarp thickness (mm)	Fruit yield per plant (kg)	TSS (°Brix)	Anthocyanin (mg/100g)	Reducing sugar (%)	Ascorbic acid (mg/100g)	Acidity (%)	Lycopene (mg/100g)	β-carotene (mg/100g)
<i>dg/dg</i>	34.12	103.42	6.47	3.60	4.58	0.00	2.04	37.30	0.60	6.42	0.61
<i>Aft/Aft</i>	42.94	85.25	6.22	3.46	4.14	14.29	1.53	24.78	0.47	4.09	0.59
<i>og^c/og^c</i>	71.20	53.13	5.36	3.27	5.16	0.00	2.34	33.36	0.68	5.91	0.43
<i>hp-1/hp-1</i>	76.75	39.87	4.77	2.75	4.95	0.00	1.86	47.75	0.54	7.18	0.60
<i>rin/rin</i>	49.22	97.50	6.84	4.07	3.95	0.00	1.46	25.66	0.36	0.38	0.24
<i>dg x rin</i>	59.17	83.70	6.78	4.72	4.28	0.00	1.69	26.98	0.53	3.45	0.64
<i>Aft x rin</i>	64.02	83.92	7.56	3.88	3.92	8.66	1.47	25.17	0.42	3.39	0.67
<i>og^c x rin</i>	62.76	64.09	6.74	3.35	4.08	0.00	1.83	28.27	0.56	3.55	0.67
<i>hp-1 x rin</i>	58.28	49.44	6.01	3.17	4.09	0.00	1.81	25.57	0.65	3.62	0.55
S.E.	5.56	2.27	0.18	0.28	0.11	0.32	0.12	1.53	0.02	0.13	0.04
C.D.(P=0.05)	16.10	6.58	0.54	0.83	0.32	0.96	0.37	4.44	0.07	0.39	0.12



BCT-111 *rin* Best hybrid: BCT- 115 *dg* x BCT- 111 *rin*



Ripe fruit of BCT-111 *rin* (no pigmentation)



Normal pigmentation in the fruit of the hybrid

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