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TOWARDS A SEEDLESS CULTIVAR OF KINNOW MANDARIN III.VARIABILITY OF DEVELOPED AND UNDEVELOPED SEED NUMBER IN SEEDLESS/LOW SEEDED FRUITS

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Abstract

Seedless trait is desirable and was selected on the basis of fruit stylar ring which has 5 – 20% probability of carrying seedless trait and narrow new emerging leaves of sprouts and shoots of branches bearing seedless/low seeded fruits. Fruit with stylar ring has notched narrow leaves at the apex of sprouts.

Introduction

Kinnow is the dominant cultivar in *Citrus* fruits and has variability in almost all fruit characteristics including seed number per fruit (Altaf & Iqbal, 2002). Seedlessness is a desirable trait in *Citrus* from consumer's view and for commercial purpose and variability in fruit characteristics itself has a negative economic impact added by variation in seed number. So an extensive screening was conducted for low seeded/seedless trait using stylar ring as marker (Iqbal *et al.*, 2001) and narrow new emerging leaves (Altaf *et al.*, 2002). The degree of narrowness in new emerging leaves was helpful for selection of low seeded trait and this was coupled with fruit holding potential to tree as kinnow orchards have fruit drop problem. The objective of research programme was to make desirable Kinnow clones from existing variability and selection of superior material for plant propagation. The present paper reports the variability in seed number per fruit observed in orchards of the Punjab province, Pakistan.

Materials and Methods

Low seeded/seedless fruits were screened on the basis of stylar ring and narrow new emerging leaves of the sprouts and shoots of orchard plants. Each fruit was studied for developed and underdeveloped or aborted seeds. The fruits were recorded according to the developed seed number 1, 2, 3, 4 and 5. The rest were considered to be seedy. Highly seeded fruits were recorded just to have an idea of extent of seedy nature of kinnow mandarin. Since kinnow has inherent potential of nucellar embryony, low seeded fruits were utilized in embryogenesis work which will be published separately.

Results

Fruits were selected on the basis of seedless markers like fruit stylar ring which has 5 –20% probability of having seedless trait and on the basis of narrow new emerging leaves of the orchard branches (Fig. 1A), in contrast to new emerging leaves of seedy branches (Fig. 1B). The marker fruit bearing branches have notched narrow (Fig. 1C) or wrinkled narrow leaves at the apex (Fig. 1D). The narrow new emerging leaves was a common factor in all kinds of seedless/low seeded fruit bearing branches. These have variation in length/breadth of new emerging leaves.

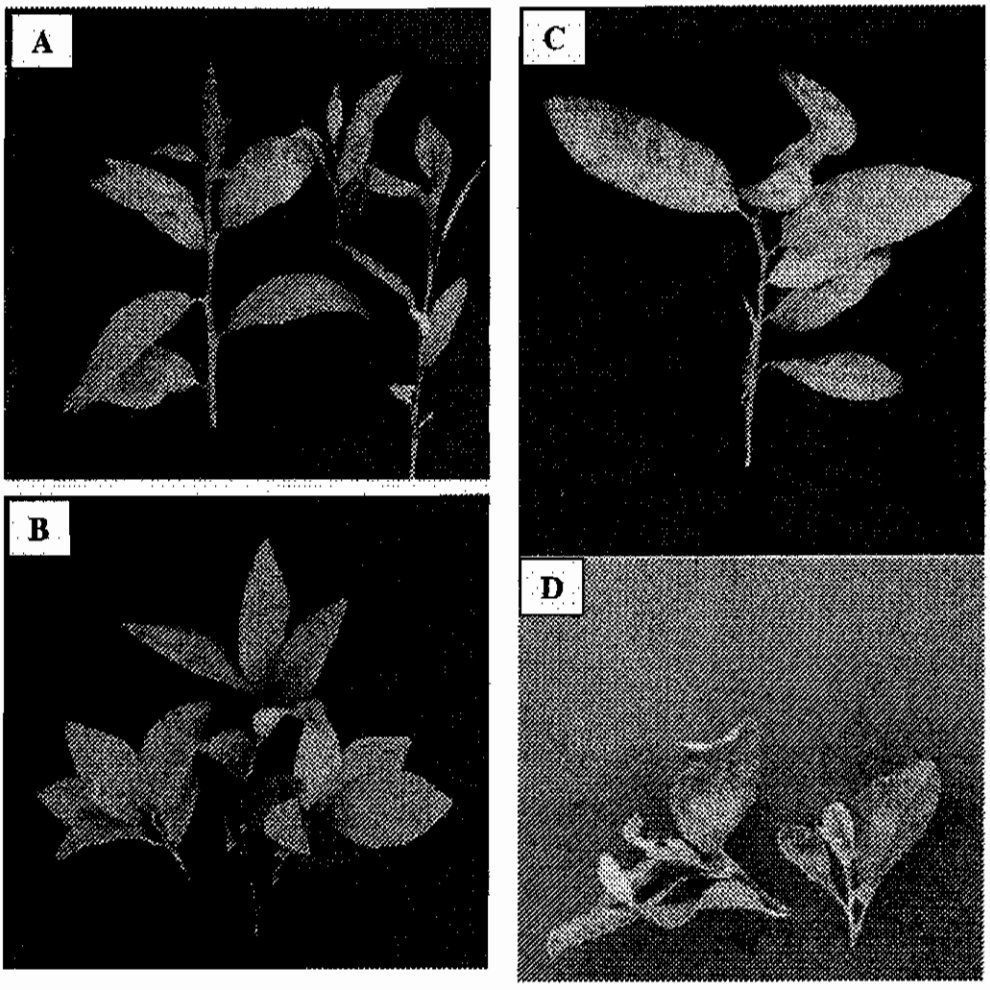

Fig. 1. New emerging leaves of fruit bearing branches.
A. Seedless, B. Seedy, C & D. of marker fruits

The seed number per fruit ranged between zero to 52. Out of 4,389 fruits selected with markers and tested, 17 were complete seedless with no developed seed and no aborted seed. Some ovules aborted at the stage that it was difficult to recognize between juice vesicle and ovule. Among the 0 – 5 developed seed per fruit which were 13.85% of the total fruits, four seeded fruits were highest (3.14%), the minimum were one seeded fruits (1.41%). The underdeveloped, shrunken, aborted or dead ovules were of different sizes. Fruits with 38 seeds and above are of rare occurrence. The developed seeds within a fruit are of different shapes and sizes.

Fruits also have variable characteristics in colour, shape, peel thickness with its tightness or loose nature, aroma, acidity, sweetness, juicy contents etc. The developed and underdeveloped, aborted seeds per fruit in low seeded/seedless branches of Kinnow mandarin is presented in Table 1.

Table 1. Undeveloped seeds in low seeded fruits.

Undeveloped seeds	Number of fruits with developed seeds					
	Nil	One	Two	Three	Four	Five
Zero	17	8	11	18	18	6
One	13	12	14	20	25	1
Two	13	9	6	25	29	17
Three	9	9	9	13	22	22
Four	13	2	5	15	17	9
Five	7	6	4	13	7	7
Six	9	5	7	14	9	9
Seven	2	5	7	4	4	4
Eight	4	4	3	6	3	3
Nine	5	2	5	3	3	3
Ten	1	-	4	-	-	1
Eleven	2	-	3	1	-	-
Twelve	3	-	2	-	-	1
Thirteen	-	-	1	-	1	1
Fourteen	1	-	3	-	-	1
Fifteen	-	-	-	-	-	-
Sixteen	1	-	-	-	-	-
Seventeen	-	-	-	-	-	-
Eighteen	1	-	-	-	-	-
Nineteen	-	-	-	-	-	-
Twenty	2	-	-	-	-	-
Twenty one	1	-	1	-	-	1
Twenty two	-	-	-	-	-	-
Twenty three	-	-	-	-	-	-
Twenty four	-	-	-	-	-	-
Twenty five	2	-	-	-	-	-
Low seeded fruits/their % in total fruits	105/2.39	62/1.413	85/1.936	132/3.008	138/3.14	86/1.96
Normal/marker fruits	37/68	16/46	31/54	19/113	16/122	14/72

Discussion

Because of hybrid nature, heterogeneity, presence of nucellar polyembryony and juvenile period, the improvement of kinnow through breeding methods is extremely difficult. Kinnow mandarin has clonal variability in almost all characteristics including seed number per fruit. Seedless trait may be due to: i) Triploidy, ii) Chromosome or DNA segment deletion, addition, substitution, iii) Mutations in various tissues of gamete or seed development, seed development lethal sequences etc. iv) Ovule, pollen sterility, v) Incompatibility, vi) Parthenocarpy. We are interested in natural existing variability because: i) Gene Pool is limited, ii) Hybridization does not offer this possibility because desirable genes take part in recombinations alongwith undesirable ones, iii) Induced mutations too are less satisfactory because of their random and unpredictable occurrence, iv) Gene transfer is directed mutagenesis but require efficient vectors and a better understanding of genetic and molecular structure of plant genome, v) Practical gains will be made using nucellar embryogenesis and shoot apical meristem cloning to enhance and release somatic variability within seedless trait background. The broad aims are

production of seedless fruits with optimal size and shape, easily removable peel, new and original organoleptic characteristics, early ripening, plants with improved resistance against stress and which have high productivity.

Citrus has natural mutations (Singh & Singh, 2001) and seedless clones can be obtained with improved tolerance to biotic stresses (Calabrese *et al.*, 2001). The natural changes in Kinnow seedless trait like narrow new emerging leaves at the tip of sprout or branches is of direct help in seedless trait selection. The fruits with stylar ring have 5 – 20% probability of carrying seedless trait which is another marker for selection. Since kinnow has chromosomes of 3 cultivars with a process of bud wood grafting over a long time for large scale propagation has developed changes in seedless/low seeded fruits for fully developed, under developed, aborted seeds, also variability in fruit shape and other characteristics.

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