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Short Communication

Exploring seasonal barrier breaking novel genes: ever-bearing hill lemon, C*itrus pseudolimon* Tanaka

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ABSTRACT

Hill lemon, *Citrus pseudolimon* Tanaka commonly known as Galgal has rich biodiversity in hills and plains of northwestern Himalaya and the existing population comprising the plants of seedling origin exhibits tremendous variability thereby providing a platform for exploitation of vast gene pool. Meagre efforts have been made in the past for selection of superior genotypes from seedling population having heterozygous nature. An exhaustive exploration for the want of useful traits as well as to observe the extent of natural variability of hill lemon was carried out during 2012-2013 and some Galgal accessions of seedling origin were spotted possessing a very unique trait of ever-bearing like continuous flowering and fruiting simultaneously on the same plant at the same time. The exhibition of simultaneous flowering and fruiting on the same tree presents newer opportunities to horticulturists and biologists as well particularly with reference to year round production and insight into reproductive behavior of Galgal . This is the first ever report from India.

Keywords: Hill lemon; variability; genotypes; ever-bearing

INRODUCTION

Hill lemon, *Citrus pseudolimon* Tanaka commonly known as Galgal is very popular citrus fruit of north India. Galgal is indigenous to India and is found growing in semi-wild state in the northwestern Indian hill regions viz Himachal Pradesh, Jammu and Kashmir and Uttarakhand. Galgal is also cultivated to a limited extent especially in the foothills to high hills of sub-temperate Himalayas due to its wider adaptability, high yield potential, tolerance to canker and hardiness to both hot and cold climatic conditions (Singh 1992). Generally it bears flowers during March-April and fruits are harvested in November-December (Badge and Patil 1989, Badiyala et al 1992, Singh 1992, Singh et al 2009). Mature fruits in rural areas are utilised for

making pickle and juice-based drinks. The fruit juice is also converted to concentrate Chukh in some areas of the hill states by heating juice in traditional way in the households. The Chukh as well as juice of this fruit is also used as a souring agent in many north Indian food preparations. Fruits at industrial scale are used for the preparation of value added products like citric acid, pectin, juice powder, pickle, squash, candy etc.

There is rich biodiversity of this fruit in hills and plains of northwestern Himalaya and the existing population comprising the plants of seedling origin exhibits tremendous variability in growth, yield and quality attributes (Singh et al 2009) thereby providing a platform for exploitation of vast gene pool. Meagre efforts have been made in the past for selection of superior genotypes from seedling population having heterozygous nature. With the advent of high yielding varieties of fruit crops the diversity found in the neglected crops like Galgal is at the verge of oblivion due to uprooting of indigenous scattered growing citrus species for land reclamation purpose in the natural habitat.

Importance of survey, selection and conservation of elite germplasm in crop improvement is well recognized by several workers in the past and present (Badge and Patil 1989, Badiyala et al 1992, Singh et al 2009). Therefore it is of utmost importance to observe and document the range of variability for commercially important characters so as to identify superior strains of hill lemon having useful distinct traits.

MATERIAL and METHODS

In view of the above facts, an exhaustive exploration for the want of useful traits as well as to observe the extent of natural variability of hill lemon was carried out during 2012-2013 in Shimla, Sirmour and Solan districts of Himachal Pradesh. During the exploration some Galgal accessions of seedling origin were spotted from the above surveyed areas possessing a very unique trait of ever-bearing like continuous flowering and fruiting simultaneously on the same plant at the same time.

The fruits of these seedling hill lemon plants were harvested and analyzed for various fruit quality traits (Table 1). Six fruits per accession were collected to analyse various physico-chemical characters. Standard descriptors (Anon 1999) were followed for recording data on physical parameters. Juice content was estimated by extracting juice from the pulp by citrus juice extractor and juice percentage was worked out on fresh fruit weight basis. The extracted juice was strained through a muslin cloth and total soluble solids were noted with digital hand refractometer in terms of percentage. The estimates of biochemical characters were worked out as per Anon (1970).

Table 1. Physico-chemical characteristics of ever-bearing hill lemon identified at different locations

Trait	Location		
	Phagali (Shimla)	Amberkoti (Sirmour)	Kandaghat (Solan)
Fruit weight (g)	315.50	259.80	300.23
Fruit length (mm)	121.47	96.91	117.84
Fruit width (mm)	86.42	74.35	84.23
Fruit shape	Ellipsoid	Ellipsoid	Ellipsoid
Base	Concave	Concave	Concave
Apex	Mammiform	Mammiform	Mammiform
Skin colour	Yellow	Yellow	Yellow
Surface	Pitted	Pitted	Pitted
Adherence to epicarp	Moderate	Moderate	Moderate
Nature of oil glands	Conspicuous	Conspicuous	Conspicuous
Mesocarp colour	White	White	White
Fruit segments	10	10	10
Adherence of segments to each other	Moderate	Moderate	Moderate
Pulp colour	Light Yellow	Yellow	Yellow
Pulp texture	Firm	Firm	Firm
Juice colour	White	White	White
Juice taste	Good	Good	Good
Juice aroma	Moderate	Moderate	Moderate
Total # seeds	17	20	20
Average seed length (mm)	11.12	10.20	11.34
Seed width (mm)	3.34	3.32	3.38
Average seed weight (g)	0.37	0.10	0.33
Seed shape	Ovoid	Ovoid	Ovoid
Seed colour	Light brown	Brown	Light brown
TSS (%)	6.1	5.8	6.21
Acidity (%)	4.8	4.2	4.76
Total sugars (%)	2.1	2.35	2.54
Reducing sugar	1.5	1.45	1.55
Vitamin C content (mg/100 g)	23.18	24.38	24.02
Juice content (%)	38	47	45

RESULTS and DISCUSSION

During the field survey, three genotypes one each at Phagali (Shimla), Amberkoti (Sirmour) and Kandaghat (Solan) were spotted exhibiting a very rare trait of continuous flowering and fruiting through the development season. The marked trees at three locations were extensively studied for various morpho-physical and biochemical characters (Table 1).

Generally hill lemon reported so far in literature worldwide exhibited flowering and fruiting once in a year. Since the occurrence of ever-bearing hill lemon is a rare event it became all the more significant to analyse the fruiting characteristics of these elite genotypes.

The exhibition of simultaneous flowering and fruiting on the same tree presents newer opportunities to horticulturists and biologists as well particularly with reference to year round production and insight into reproductive behavior of Galgal respectively. This is the first ever report from India.

CONCLUSION

The above findings are of immense commercial value and there is absolute and immediate need to utilize this novel trait hitherto unknown for utilization in citrus improvement programmes.

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