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MORPHOLOGICAL CHARACTERIZATION AND ASSESSMENT OF LIME GERMPLASM IN NARSINGDI DISTRICT

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Abstract

The experiment was conducted to evaluate lime germplasm at the research field of Regional Horticulture Research Station of Bangladesh Agricultural Research Institute, Shibpur, Narsingdi with five lime germplasm which all are two years old vegetative sapling. Significant variation was observed in case of growth, yield contributing characters, yield and fruit quality of the germplasm studied. The highest plant height (2.45 m), base girth (0.13 m) and canopy spreading (1.78 × 1.67 m^2) were noted from the germplasm CA Nar-001. On the other hand, the lowest plant height (1.18 m), base girth (0.10 m) and canopy spreading (1.32 × 1.37 m^2) was noted in CA Nar-003. Branching density was dense in CA Nar-001 and CA Nar-003 germplasm but sparse in CA Nar-002 and good in CA Nar-004 and CA Nar-005. Among the germplasm CA Nar-001 was found to free from disease whereas the other lines suffered from canker. Leaf miner was common in case of all the germplasm. Fruit size was the highest in CA Nar-001 (6.42 × 4.72 cm^2) followed by CA Nar-002 (5.31 × 4.67 cm^2). Irrespective of germplasm pulp color was found white. But juicy content high and strong fruit aroma was found in CA Nar-001. The highest edible portion (61.12%) recorded in CA Nar-001 and TSS (7.18%) was noticed from CA Nar-004.

Keywords: Pulp, fruit aroma, segregation, variability.

Introduction

Citrus fruit, which are ranked among the top fruit around the world, are widely cultivated in tropical and sub-tropical regions and are grown commercially in more than 50 countries around the world (Ladaniya 2008; Hvarleva *et al*., 2008). The rapid expansion of citrus fruit cultivation in recent years is due to the importance of nutrition and improved economic condition in consuming nations of the world and also the high demand for these crops because of the natural distinctive flavour of citrus (Kale and Adsule, 1995). Citrus fruits supply nutrients that are essential for a healthy life. They are the main source of ascorbic acid (Vitamin C) whose daily consumption is necessary for humans. There is considerable variation among *Citrus* species and cultivars which is due to pollination adaptation in the genus, frequent bud mutations, inter and intra specific hybridization, seed propagation and human selection (Shahsavar *et al.*, 2007; Hvarleva *et al*. 2008). Lime is an important citrus cultivated in many countries whose fruits are consumed daily and used for producing juice and are important components of the cosmetic and pharmaceutical industries (Prasad *et al*., 1989). Morphological characterization is the first and a basic step in the description and classification of germplasm and serves as the foundation in plant breeding to select and evaluate trait of interest (i.e. superior traits) among genetic resource. Due to climatic and soil type mutation and segregation is always conducted. Nonetheless different genotype has a significant characteristic which is also needed to characterize. But there is only one recommended variety of lime. It is essential to find out significant variation so that there can be released as a wonderful variety. For this the above mentioned research work was conducted.

Materials and Methods

The experiment was conducted at Regional Horticulture Research Station of Bangladesh Agricultural Research Institute, Shibpur, Narsingdi since May 2016. Five lime germplasm which all are two years of aged and vegetative propagated sapling was collected from different locations of Narsingdi district. The plants were planted in a single row system giving the spacing 4 × 4 m accommodating 4 plants in each row. After pit preparation 15 days before planting of sapling, 12 kg cowdung, 90 g P and 25 g S were applied in pit as basal dose and mixed thoroughly with the soil followed by irrigation. After planting each plant was fertilized in three equal splits, during February, April-May and September-October and the dose was 20 kg cowdung, 180 g N, 135 g P, 150 g K, 20 g S, 60 g Zn, 2.0 g B, 4.0 g Zn and 1.0 g B (Fertilizer

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Recommendation Guide, 2012). Weeding was done in rainy season before applying fertilizer. Data of different growth characteristics were analyzed and means were separated by STAR computer program.

Results and Discussion

A wide variation was observed in growth, yield and fruit quality of the germplasm (Table 1). The highest plant height (2.45 m) was recorded from CA Nar-001 while the lowest value (1.18 m) was found from CA Nar-003. Base girth was noted the highest (0.13 m) in CA Nar-001 and the lowest (0.10 m) from CA Nar-003. Maximum canopy (1.78 × 1.67 m^2) was found in CA Nar-001 and minimum (1.32× 1.37 m^2) in CA Nar-003. Maximum leaf size was found in germplasm CA Nar-001. Good branching with good growth condition was found in CA Nar-005 germplasm and the other germplasm occupied sparse and dense branching with good growth condition (Table 1).

Morphological characterization and assessment of Lime Germplasm

Table 1. Growth characteristics, flowering and harvesting time of different lime germplasm

Accession	Plant height (m)	Base Girth (m)	Canopy (m)		Leaf size (cm)		
			E-W	N-S	Laminah length	Lamina width	Petiole length
CA Nar-001	2.45a	0.13a	1.78a	1.67a	8.41	5.63	2.38a
CA Nar-002	1.23d	0.10d	1.47c	1.43d	7.42	5.10	2.15d
CA Nar-003	1.18e	0.10d	1.32d	1.37e	7.03	5.04	2.27b
CA Nar-004	1.21d	0.11c	1.46c	1.48d	7.14	5.23	2.20c
CA Nar-005	1.31b	0.11c	1.45c	1.41d	7.12	5.20	2.18c
Level of sig.	*	*	*	*	NS	NS	*
CV (%)	7.21	5.45	7.01	10.13	7.61	8.65	10.32

* indicate significant at 5% level of probability; NS: Not Significant

Table 1. (contd.) Growth characteristics, flowering and harvesting time of different lime germplasm

Accession	Flowering time	Branching density	Growth condition	Harvesting time
CA Nar-001	Jan.-Feb. and May-Jun.	Dense	Good	April-May and Aug.-Sep.
CA Nar-002	Jan.-Feb. and May-Jun.	Sparse	Good	April-May and Aug.-Sep.
CA Nar-003	Jan.-Feb. and May-Jun.	Dense	Good	April-May and Aug.-Sep.
CA Nar-004	Jan.-Feb. and May-Jun.	Sparse	Good	April-May and Aug.-Sep.
CA Nar-005	Jan.-Feb. and May-Jun.	Good	Good	April-May and Aug.-Sep.
Level of Sig.	-	-	-	-

Most of the germplasm varied significantly in respect of number of fruits $plant^{-1}$and fruit size (Table 2). The highest number of fruits $plant^{-1}$ (225.23) was obtained from CA Nar-001 compared to the lowest (95.17) in CA Nar-004. Fruit size was observed maximum in CA Nar-001 (6.42 × 4.72 cm^2). Individual fruit weight ranged from 55.63 to 38.12 g. Among them CA Nar-001 produced the heaviest fruit (55.63 g) and CA Nar-004 produced the lightest fruit (38.12 g). Rind weight and rind thickness were measured maximum in CA Nar-001 (12.42 g and 0.43 cm, respectively) but rind weight was minimum (8.07 g) in CA Nar-004 and rind thickness was minimum (0.37 cm) in CA Nar-002. Pulp weight was found the highest (43.21 g) in CA Nar-001, while it was the lowest (30.05 g) in CA Nar-004. Number of seeds $fruit^{-1}$ and seed weight $fruit^{-1}$ measured maximum (21.11 and 4.40 g, respectively) in CA Nar-004 but minimum (15.17 and 3.48g, respectively) in germplasm CA Nar-002. Percent edible portion is one of the most important features of any fruit. Maximum edible portion (61.12%) was recorded from CA Nar-001 as compared to minimum (58.24%) in CA Nar-003. The highest TSS content (7.18%) was recorded in CA Nar-004, while the lowest (5.75%) was noted in CA Nar-001. The highest yield (13.12 t ha^{-1}) was recorded in CA Nar-001 followed by CA Nar-003 (12.73 t ha^{-1}) and the lowest (11.43 t ha^{-1}) was in CA Nar-004.

Table 2. Quantitative characteristics of fruit of different lime germplasm

Accession	No. of fruit plant^{-1}	Fruit size (cm)		Individual fruit weight (g)	Rind weight (g)	Rind thickness (cm)	Pulp weight (g)	No. of segment fruit^{-1}
		Length	Diameter					
CA Nar-001	225.23a	6.42a	4.72	55.63a	12.42a	0.43a	43.21a	10.12b
CA Nar-002	115.15b	5.31b	4.67	42.03b	8.86b	0.37c	33.17b	9.05c
CA Nar-003	108.08c	4.83c	4.65	39.35c	8.72c	0.41b	30.63c	10.45ab
CA Nar-004	95.17d	4.78d	4.57	38.12d	8.07d	0.41b	30.05c	10.63a
CA Nar-005	103.32c	4.81c	4.60	40.04c	8.10d	0.41b	32.15b	10.14b
Level of Sig.	*	*	NS	*	*	*	*	*
CV (%)	8.34	7.67	6.65	10.02	11.23	7.53	9.15	7.23

* indicate significant at 5% level of probability; NS: Not significant

Table 2. Continued

Accession	No. of seeds fruit^{-1}	Seed weight fruit^{-1} (g)	Yield (t ha^{-1})	Edible portion (%)	TSS (%)
CA Nar-001	17.24d	4.14b	13.12a	61.12a	5.75e
CA Nar-002	15.17e	3.48e	11.57c	59.84c	6.97c
CA Nar-003	20.03b	4.34c	12.73b	58.24d	7.14b
CA Nar-004	21.11a	4.40a	11.43e	60.09b	7.18a
CA Nar-005	18.23c	3.73d	11.47d	59.23c	6.78d
Level of Sig.	*	NS	*	*	*
CV(%)	7.15	8.26	7.84	10.12	5.17

* indicate significant at 5% level of probability; NS: Not significant

Qualitative characteristics of the lime germplasm are shown in Table 3. In respect of shape and skin color of fruit, all the germplasm showed ellipsoid shape except CA Nar-002 which is spheroid and color is deep green to green of all germplasm but CA Nar-001 is green-yellow in color. Among the germplasm surface texture of all the fruit was smooth. Pulp consistency was soft and sticky. Juice content in juice vesicles (liths) reflects all the germplasm was medium to high. Juice taste evaluation was very good only for CA Nar-001 and in rest of the germplasm was pleasant. Fruit aroma and juice aroma were strong only in CA Nar-001 and in the rest of the germplasm was average.

Table 3. Qualitative characters of fruit of different lime germplasm

Accession No.	Fruit shape	Skin color	Surface texture	Pulp consistency
CA Nar-001	Ellipsoid	Green-yellow	Smooth	Soft and Sticky
CA Nar-002	Spheroid	Deep green	Smooth	Soft and Sticky
CA Nar-003	Ellipsoid	Green	Smooth	Soft and Sticky
CA Nar-004	Ellipsoid	Green	Smooth	Soft and Sticky
CA Nar-005	Spheroid	Green	Smooth	Soft and Sticky

Fig 1. Comparative images of both transverse and longitudinal sections as well as fruit shape of different line of lime germplasm. Fig. 1 (A) represents line CA Nar-001; Fig. 1 (B) represents line CA Nar-002; Fig. 1 (C) represents line CA Nar-003; Fig. 1 (D) represents line CA Nar-004; Fig. (E) represents line CA Nar-005

Table 3. Continued

Accession No.	Juice content in endocarp	Juice taste	Juice taste evaluation	Fruit Aroma	Juice Aroma
CA Nar-001	High	Acidic	Very good	Strong	Strong
CA Nar-002	Medium	Acidic	Pleasant	Average	Average
CA Nar-003	High	Acidic	Pleasant	Average	Average
CA Nar-004	Medium	Acidic	Pleasant	Average	Average
CA Nar-005	Medium	Acidic	Pleasant	Average	Average

No disease infection was observed in CA Nar-001 whereas the others suffered from canker. Leaf miner was common in all of the germplasm.

Table 4. Disease and insect pests of different lime germplasm

Accession	Disease incidence	Insect pest infestation
CA Nar-001	Nil	Leaf miner
CA Nar-002	Canker	Leaf miner, leaf roler
CA Nar-003	Canker	Leaf miner, leaf roler
CA Nar-004	Canker	Leaf miner
CA Nar-005	Canker	Leaf miner

Conclusion

Contemplating yield, edible portion, TSS, disease and insect infestation the germplasm CA Nar-001 showed the best characteristics among all of the other germplasm.

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