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Research Article

Evaluation of Growth and Yield Characteristics of Acid Lime Genotypes in Different Locations of Nepal

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Abstract

Nepal has a rich diversity of acid lime, having commercial importance in terms of fruit maturing time and quality. The study on the variety selection and evaluation of local acid lime genotypes has been conducted in the eastern region of Nepal since 2005. Ten local genotypes were evaluated for their morphological and fruit yield characteristics. The research results revealed that genotypes: NCRP-49 and NCRP-55 were found superior among the genotypes with higher yield potential for upland Terai condition. The genotype NCRP-55 produced 947 fruits/plant having 383.0 cm tree height with average fruit weight of 55.2 g and yield of 66.8 kg/plant, while genotype NCRP-49 had 284.2 cm tree height, producing 793 fruits/plant per annum with average fruit weight of 53.1 g and fruit yield of 50.9 kg/plant. However, other genotypes NCRP-53, NCRP-56 and NCRP-47 were also promising for the higher yield. Thus, these genotypes should be proposed for the variety release in the future.

Keywords: acid lime; genotypes; variety diversity; fruit characteristic; evaluation.

Introduction

Acid lime (*Citrus aurantifolia* Swingle) is one of the commercially important citrus crops of Nepal (NCRP, 2017; NCDP, 2016; Dhakal et al., 2005). The current production of this crop is reported to be 27, 017 t under 7, 296 ha acreage with productivity of 7.0 t/ha (MoAD, 2016). Nepal has appropriate geography and climate for producing acid lime from mid hills to upland Terai areas (Shrestha et al., 2012; Chalise et al., 2012; Lama et al., 1984). However, its cultivation is limited to a range of 800 m to 1400 m asl in the mid hills, producing a very small volume during normal season on September to November (Shrestha et al., 2012; Paudyal and Shrestha, 2004; Dhakal et al., 2002). But, the potential of cultivating range could be much wider from 125 m asl Terai to 1800 m asl high hills in Nepal (Shrestha *et al*., 2012). Moreover, the eastern hills have rich diversity of acid lime (Munankarmi et al., 2014; Paudyal and Shrestha, 2004; Budathoki et al., 2004). Nepal has enormous scope of increasing production and productivity by adopting better varieties. However, the existing local cultivars are attributed to poor yield potential and similar fruit maturing (NCRP, 2017; Chaudhary, 1999). Thus, the study on variety selection and evaluation of acid lime has been carried out in order to determining the appropriate varieties of diverse fruit maturing times and yield potentials.

Materials and Method

The study on varietal evaluation and selection of acid lime genotypes has been conducted at National Citrus Research Program (NCRP), Paripatle, Dhankuta since 2005. Ten acid lime genotypes collected from the eastern hills of Nepal were evaluated for their morphological and agronomic characteristics. Eight plants of each genotype were planted in Chitwan, Sunsari, Morang, and Jhapa districts. The experiment was designed at RCBD with four replications. The plants grafted with *Trifoliate* rootstock aged 1½ years were transplanted at 4 m x 3 m spacing. The crop husbandry, manure and fertilizer, and disease and pest

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management were carried out as per the recommendation. The fruit characteristics viz. fruit weight, fruit number and total fruit yield were observed during 2012 and 2013, when trees were seven and eight-years old. The samples were taken from randomly selected four trees as replications of each genotype. The tree height was measured by following the descriptor as mentioned in IPGRI (1999). The fruit weight, fruit juice content and total acidity (TA%) were measured from 10 fruits per replication, using micro-balance and titrating 2 ml fruit juice with 0.1 M NaOH as mentioned by Hardy and Sanderson (2010). The data were statistically analyzed using GENSTAT and mean comparison with DMRT.

Results and Discussion

Tree Height

The tree height was significantly ($P \leq 0.001$ and $P \leq 0.01$) differed among the tested genotypes (Table 1). The genotype NCRP-55 had the highest tree height (383.0 cm) followed by NCRP-53 (317.4 cm) and NCRP-50 (305.0 cm), while the lowest tree height was measured at NCRP-52 (190.0 cm). The result revealed that the genotype NCRP-55 was significantly tallest among tested genotypes across all locations except Sunsari and the genotype NCRP-52 was appeared lowest tree height at all locations except Jhapa. The intermediate tree height was found at par among NCRP- 46, NCRP- 47, NCRP- 48, NCRP- 49, NCRP- 50, and NCRP-53. The average tree height at Sunsari was found higher than other location and the least height was measured at Chitwan. Thus, it seemed to be associated with the soil factor including agro-ecological condition and the eastern Terai districts is looking appropriate for the tree growth as compared to Chitwan.

Fruit Yield Characteristics

Fruit Number

There was a significant variation on the number of fruits/plant among the tested genotypes across all the locations (Table 2). A large variation on the numbers of fruits/plant ranging from 340 to 947 was observed among the genotypes. The maximum fruit number was found at genotype NCRP-55 (947 nos) followed by NCRP- 49 (793 nos), while genotype NCRP-51 produced the lowest number of fruit (340 nos). The genotype NCRP-55 produced the higher fruits/plant at all locations except Sunsari, where genotype NCRP-48 gave the highest fruit number. The maximum fruit number of all genotypes was found at Sunsari followed by Morang and Jhapa and the least fruit number was observed at Chitwan.

Table 1: Tree height of 7-8 years old acid lime genotypes tested at different districts during 2012 and 2013

Genotypes	Tree height (cm)				Mean
	Chitwan	Sunsari	Morang	Jhapa	
1. NCRP-46	321.2	339.5	315.1	211.0	296.7 b
2. NCRP-47	306.3	397.4	279.9	221.2	301.2 b
3. NCRP-48	265.9	388.0	278.5	219.2	287.9 b
4. NCRP-49	232.5	381.7	297.5	225.1	284.2 b
5. NCRP-50	337.4	372.5	280.2	229.9	305.0 b
6. NCRP-51	182.5	263.2	213.0	141.4	200.0 c
7. NCRP-52	178.3	196.4	192.0	193.1	190.0 c
8. NCRP-53	289.9	399.2	312.4	267.9	317.4 b
9. NCRP-55	379.7	395.9	384.6	371.8	383.0 a
10. NCRP-56	290.5	302.0	298.9	288.0	294.9 b
P value	**	***	***	***	***
LSD (0.05)	69.8	89.6	46.5	20.2	56.53
CV %	20.6	16.6	14.21	3.1	13.63

Note: ** & *** indicate highly and very highly significant difference respectively at P≤0.01 and P≤0.001 level. Data were average of two consecutive years: 2012 and 2013.

Table 2: Number of fruits/plant of acid lime genotypes tested at different locations during 2012-2013

Genotypes	Number of fruit/plant				Mean
	Chitwan	Sunsari	Morang	Jhapa	
1. NCRP-46	277	1194	274	368	528 cd
2. NCRP-47	361	1386	601	461	702 b
3. NCRP-48	348	1662	368	409	697 bc
4. NCRP-49	441	1576	586	569	793 b
5. NCRP-50	342	1356	610	474	696 bc
6. NCRP-51	136	513	329	383	340 d
7. NCRP-52	143	602	316	307	342 d
8. NCRP-53	251	1025	489	411	544 cd
9. NCRP-55	988	1473	738	588	947 a
10. NCRP-56	681	1192	592	439	726 b
P value	***	***	**	**	***
LSD (0.05)	172	293.5	241	61.3	192.0
CV %	18.2	17.1	17.2	14.2	16.7

Note: ** & *** indicate highly and very highly significant difference respectively at P≤0.01 and P≤0.001 level. Data were average of two consecutive years: 2012 and 2013.

Table 3: Fruit yield characteristics of acid lime genotypes tested at different locations during 2012-2013

Genotypes	Fruit weight (g)				Mean	Fruit yield (kg/plant)				Mean
	Chitwan	Sunsari	Morang	Jhapa		Chitwan	Sunsari	Morang	Jhapa	
1. NCRP-46	49.5	50.9	52.1	50	50.6 d	22.4	70.7	21.3	24.6	34.8 c
2. NCRP-47	47.2	46.8	45.5	44.9	46.1 f	27.2	80.1	35.1	27.3	42.4 bc
3. NCRP-48	46.1	47.4	43.7	45.2	45.6 f	26.1	73.8	26.8	25.5	38.1 c
4. NCRP-49	54.6	51.1	53.8	52.7	53.1 c	35.5	91.8	39.5	36.7	50.9 b
5. NCRP-50	52.3	50.5	49.4	51.2	50.9 d	25.9	72.4	36.9	29.9	41.3 bc
6. NCRP-51	48.6	49	46.9	47.4	47.9 e	15.4	32.2	21.9	25.1	23.7 d
7. NCRP-52	47.1	44.8	46.2	45.1	45.8 f	15.2	21.1	18.4	21.2	19.0 d
8. NCRP-53	90.9	98.3	90.2	95.5	93.7 a	30.1	126.7	48.6	42.4	62.0 a
9. NCRP-55	54.8	55.3	54.6	56.2	55.2 b	65.7	75.9	65.8	59.9	66.8 a
10. NCRP-56	49.5	52.7	52.2	55.1	52.4 c	42.5	56.3	48.1	52.0	49.7 b
P value	***	***	***	***	***	***	***	***	***	***
LSD (0.05)	1.8	0.9	0.9	2.1	1.42	6.3	16	11.2	3	9.13
CV %	1.0	0.8	1.3	2.2	1.3	21.4	15.5	34.2	9.2	20.1

Note: *** indicates very highly significant difference at P≤0.001 level. Data were average of two consecutive years: 2012 and 2013.

Fruit Weight and Yield

The fruit weight and yield were found significantly different among the genotypes at all the locations. The genotype NCRP-53 produced the highest fruit weight (93.7 g) followed by genotype NCRP-55 (55.2 g) and NCRP-49 (53.1 g), while genotype NCRP-52 gave the lowest fruit weight (45.6 g) among the genotypes. The results showed that genotype NCRP-55 produced the highest fruit yield (66.8 kg/plant) among the tested genotypes. Similarly, the second higher yield was found at genotype NCRP-53 (62.0 kg/plant) and genotype NCRP-49 (50.9 kg/plant). Therefore, two acid lime genotypes: NCRP-55 and NCRP-49 were found promising for bearing higher fruit weight and number of fruits, and corresponding higher fruit yield (Table 3).

Fruit Juice Content and Titratable Acidity (TA)

The fruit juice content among the genotypes was not significantly varied (Fig.1). It was found at the range of 44.8 to 51.5% among the genotypes. The genotype NCRP-48 had the highest juice content (51.5%) followed by NCRP-49 (49.0%) and NCRP-46 (48.3%). The least juice content was observed at NCRP-53 (44.8%).

The data shown in Fig. 2 shows that the TA was found at the range of 6.3 to 6.9% among the genotypes that it was not varied significantly among the genotypes. However, the highest TA% was observed at NCRP-49 (6.9%), while the least TA% was recorded at NCRP-56 (6.3%).

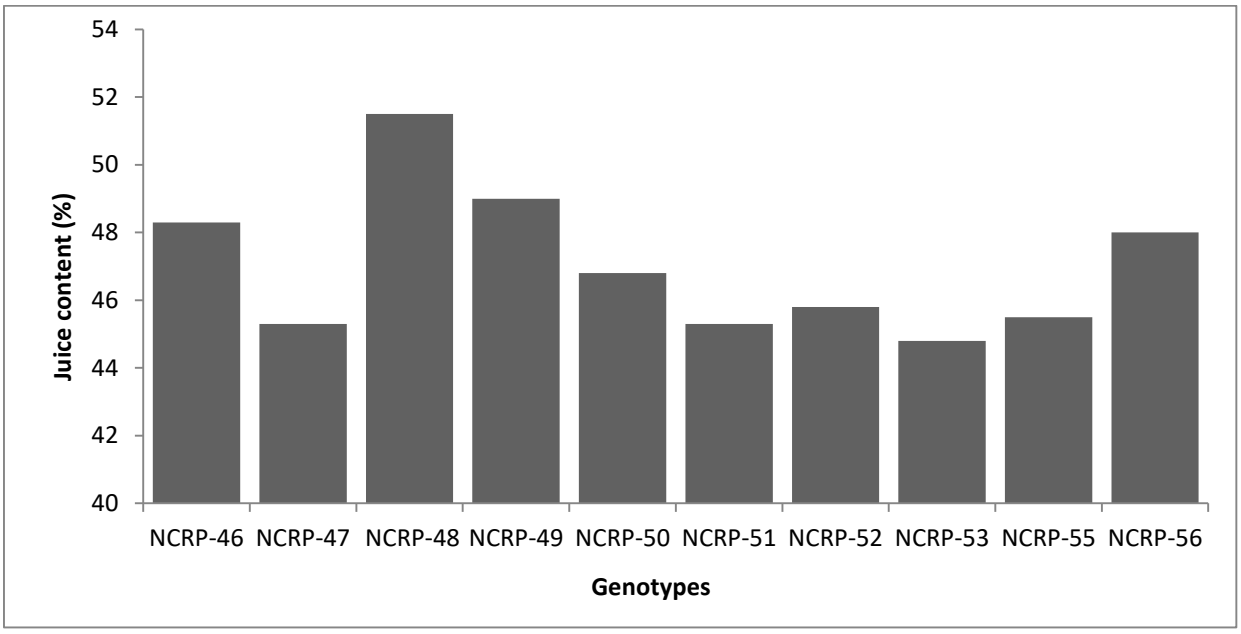

Fig. 1: Fruit juice content (%) of acid lime genotypes (n=10).

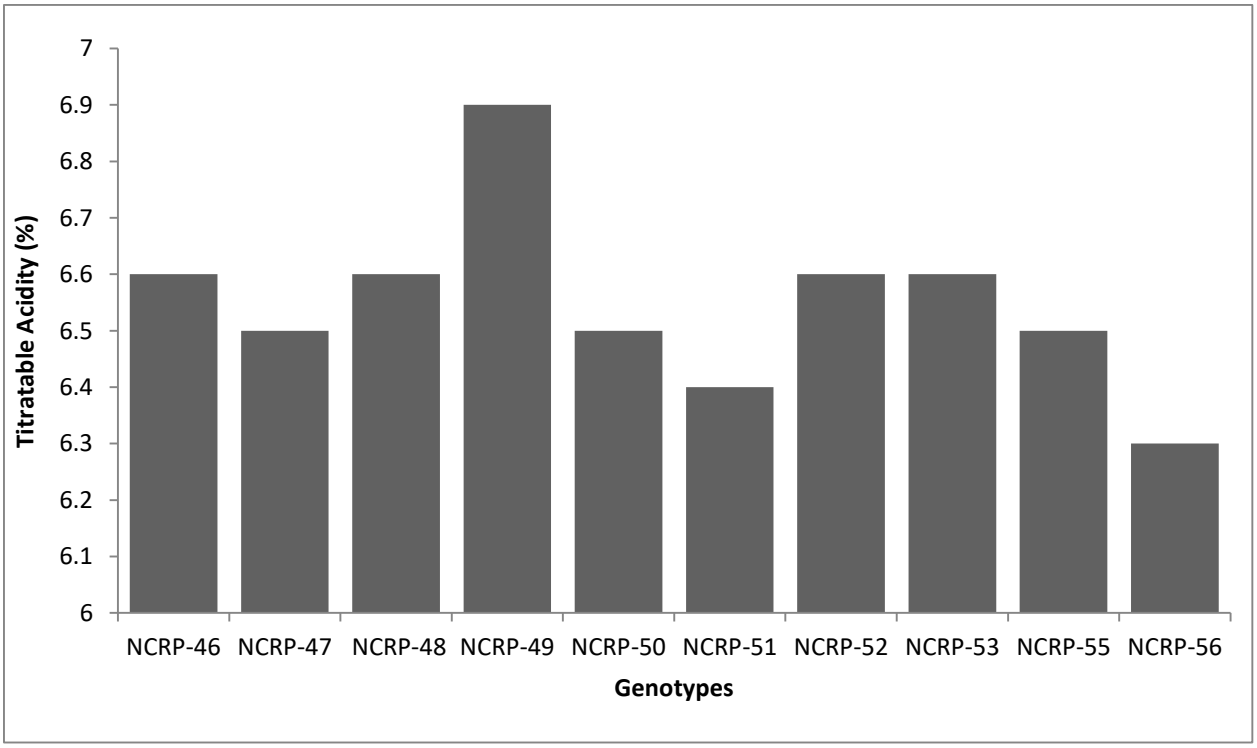

Fig. 2: TA% of acid lime genotypes (n=10).

Conclusion

Acid lime has commercial important in Nepal and the local genotypes have wide diversity for fruit maturing and fruit quality. The genotypes with diverse fruit maturing time are required for commercial production in the upland Terai condition. For this objective, variety selection and evaluation embracing indigenous genotypes has been underway at NCRP, Dhankuta. The two genotypes: NCRP-55 and NCRP-49 exhibited the excellent results in terms of fruit yield characteristics in the upland Terai condition among the genotypes. However, the other genotypes were equally promising. Therefore, these genotypes need to be promoted in the future.

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