

# A Journey of Acid Lime from Hills to Terai: The Woes and Gains

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## Abstract

The migration of people from hills brought citrus fruit seeds and seedlings to flat plain (the Terai) some 50 years ago. Otherwise, citrus especially acid lime and mandarin, were supposed to be the fruit crops suitable to cultivate in the mid-hills. Ten years after the establishment of National Citrus Research Program in the year 1997 AD. Citrus researchers believed that acid lime could be commercially cultivated in Terai areas else it was cultivated at homestead level for self-consumption both in the hills and the Terai areas. It took nearly 15 years to carry systematic research and release two commercial acid lime varieties (Sunkagati 1 and Sunkagati 2) for the Terai area. A number of researchers contributed from collection, field trials and even molecular study of this crop. Now a days, there is a rush for cultivation of acid lime even by wiping out paddy fields (inundated land in rainy season). When acid lime descended from hill to the Terai it showed a true form of off-season and year-round production capacity. Along with that trait it became susceptible to a number of biotic stresses namely; root rot, citrus canker and leaf minor. Recent import shows that NRs.72 Crores worth of acid lime was imported in the 2019. There is tremendous potentiality of commercially growing acid lime from hills to plain areas with the adoption of modern farming technologies which could be done by joint effort of all the stakeholders of fruit farming in Nepal.

**Keywords:** Acid lime, Off-season production, Year-round

## Introduction

Acid lime (*Citrus aurantifolia* Swingle) is an important fruit crop of commercial value, ranking third after mandarin and sweet orange in Nepal (Fig. 1). Traditionally, acid lime cultivation is being limited to a range of 800 m to 1400 m amsl in the mid hill districts, producing a very small volume during September to November. Since the in-

country fresh lime fruit production is far below the domestic demand Nepal imports more than 90 % of the internal demand in the country every year (MoALD, 2020). Moreover, the cultivation practice is mainly limited to marginal lands with poor yielding varieties. Similarly, the potential of cultivating range could be much wider from 125 masl to 1400 masl in Nepal (NCRP, 2020). After the release of two acid lime varieties viz.

Sunkagati-1 and Sunkagati-2 for Terai region in 2015 AD, the cultivation area of acid lime has increased significantly. These two varieties are becoming popular among acid lime cultivating farmers in Terai region of Nepal. Further there is one more accession NCRP-53 which will be registered for commercial production both for Terai and mid hills in near future (NCRP, 2017).

### Methodology

A desk work has been conducted on literatures of acid lime research and development activities carried out by National Citrus Research Program and other government agencies over the period of last 12 years. Further the authors' own experience from field visit and that of several co-workers and the farmers involved in acid lime farming in Terai have been incorporated while preparing this paper.

### Situation analysis

Acid lime is the second important citrus crop in Nepal in terms of area and the third in terms of production (Fig. 1). It occupies 21% (9746 ha) of current citrus production area (46411 ha) with production of 39579 mt fresh fruit (MoALD, 2020). Although, the productivity of acid lime is the least among citrus commodities (Fig. 2) farmers' interest to grow this commodity is rising day by day. The acid lime farming is concentrated mostly in hill districts till date

(Fig 3 and 4) and fresh fruits marketed to other areas (DoC 2020). The commercial acid lime farming is new to Terai (flat plain) districts. With the recommendation of two off-season acid lime varieties viz. Sunkagati 1 and Sunkagati 2 in the year 2015, there has been sudden surge in acid lime cultivation in 16 Terai districts and the area almost doubled from 849 ha in 2013 to 1397 ha in 2019 (Fig 6). The promising acid lime producing districts are Jhapa, Morang, Sunsari, Saptari, Siraha, Rautahat, Bara, Chitwana, Nawalparasi East and West, Dang, Kapilvastu, Banke, Bardiya, Kailai and Kanchanpur. The recently established acid lime orchards in these areas are yet to come into full bearing stage. The initial field observation on productivity of these orchards is about 15 t/ha which is double than the national yield of acid lime (NCRP 2020). In the past, effort was made to induce acid lime production with implementation of Mission Kagati Production in the year 2007 and later dropped due to lack of budget and faulty implementation plan (Acharya and Pandey, 2013). With a plan to produce more acid lime in the country (Table 1) the government of Nepal has given emphasis on establishment of new orchards for off-season lime fruit production with a view of import substitution. Currently, Nepal imports NRs. 72 Crores worth of fresh acid lime fruit from India annually (DoC, 2020).

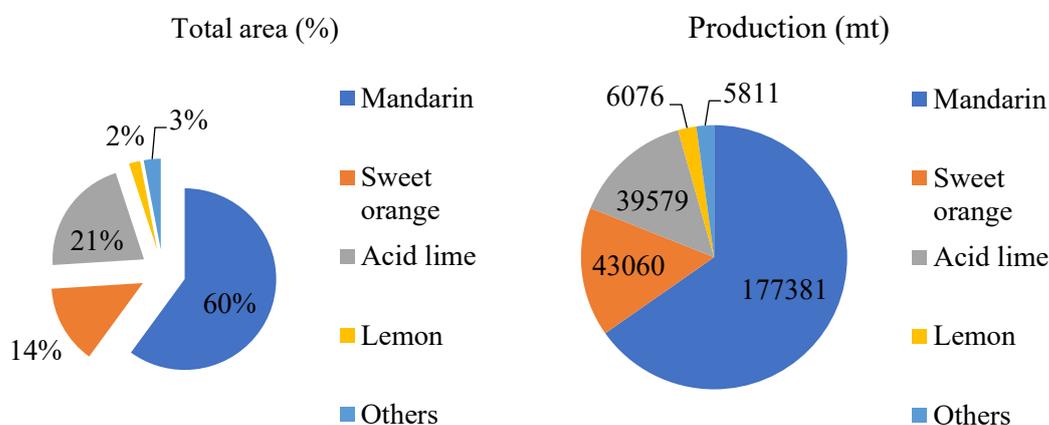


Fig 1. Total area and production of citrus fruits in Nepal, 2018/19 (Source: MoALD, 2020)

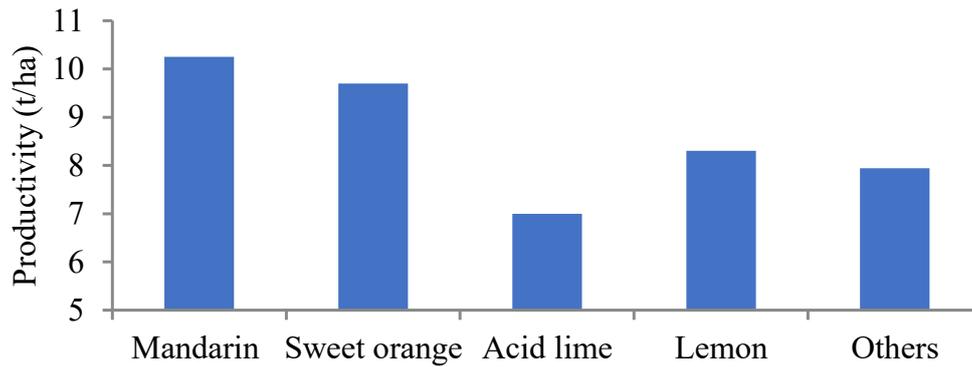


Fig 2. The average productivity (t/ha) of different citrus fruit in Nepal 2018/19 (Source:MoALD, 2020)

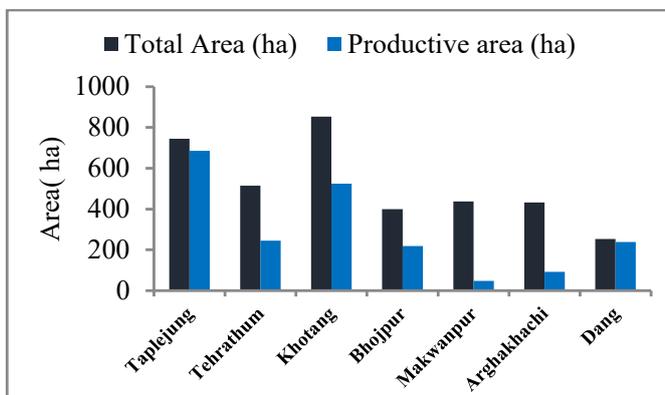


Fig 3. Total and productive area of acid lime in major districts

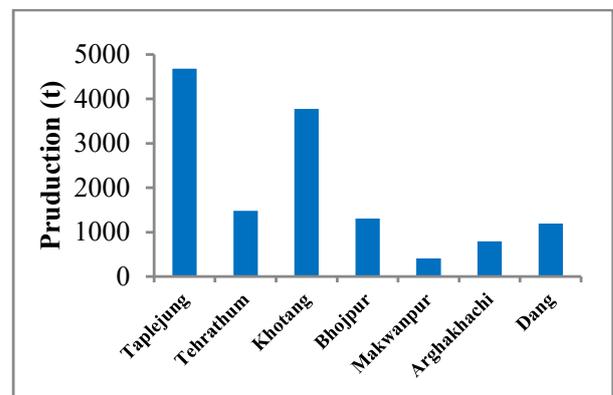


Fig 4. Production of acid lime in major districts

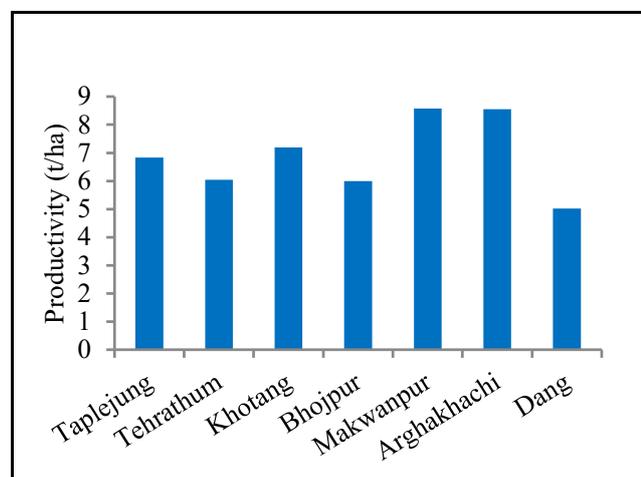


Fig 5. Productivity (t/ha) of acid lime in major hill districts

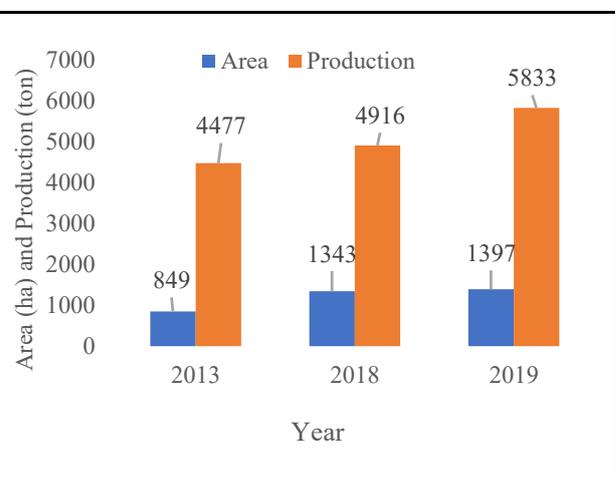


Fig 6. Increase in acid lime area (ha) and production (mt) in 16 terai districts

Citrus fruit workshop organized at the Institute of Agriculture and Animal Science (IAAS), Rampur, Chitwan, Nepal in 2001 and a study team led by the former Dean, Prof Dr. Durga Datta Dhakal, reported import of nine crore Nepali rupee worth of fresh lime fruit from India (NCRP 2001). This led to inception of idea on

search of Nepali acid lime germplasm which could be used for off-season production in hill region. Some of the germplasm were collected with the help of Hill Agriculture Research Project and an orchard was established within IAAS, Rampur premises. From this orchard two students did their post graduate study

on characterization of germplasm. Later, few outstanding lines were donated to National Citrus Research Program, Paripatle, Dhankuta. The then Citrus Coordinator, Dr. Krishna Prasad Paudel later collected other promising lines from Terai and hill region of Nepal and applied for grant proposal to National Agricultural Research and Development Fund (NARDF). Unfortunately, the project was declined due to unknown reason and Dr. Paudel started this quest of searching off-season lime variety using limited Nepal Agricultural Research Council (NARC) fund. The suitable acid lime genotypes were then evaluated under farmer’s field across the Terai region from east to west. It took nearly

12 years to come up with recommendation of two acid lime varieties for commercial cultivation under Terai condition as off-season production. With the plan to produce and supply year-round acid lime fruits NCRP Dhankuta has proposed a plan of utilizing genetic resources as described in Table 1 below. Further, it has searched more indigenous and exotic genetic materials which could produce off-season lime fruits both in hills and Terai region. From the past few years an introduced acid lime genotype NCRP-53 is performing very well in both hills and Terai as off-season variety. It bears bigger sized (average 100 g) yellowish round seedless fruit with more than 50% juice in it (NCRP 2020).

**Table 1:** Plan of acid lime production season expansion using various techniques in Nepal

	Baisakh	Jeshta	Ashar	Sawan	Bhardar	Ashoj	Kartik	Mansir	Paush	Magh	Falgun	Chaitra
Terai (NCRP 53)	■	■	■	■	■	■	■	■	■	■	■	■
Terai and inner terai (Sunkagati 1 &2)			■	■	■	■	■	■	■			
Mid-hills (NCRP 53)				■	■	■						
Mid hills (Sunkagati-2)					■	■	■	■				
Mid hills (Local selection)							■	■	■			
Storage (mid hills)										■	■	■

(Source Acharya et al. 2020)

A lot of misinformation regarding acid lime cultivation in the Terai exist especially in social media. One Facebook group exists in the name of acid lime production group which has more than 4.3 thousand members and dozens of you-tube channels selling ideas about lime cultivation in the Terai as hot cake. The farmers unaware of suitability of their land for lime cultivation are transforming water logging low land into lime orchard. Further, others are planting

sub-standard planting materials of unknown varieties at the high density (shorter planting distance). It needs placement of graft union well above the ground level while planting saplings and removal of sprouts developed below the union. Due to such small mistakes mortality of saplings is very high. The need for after care of very vigorously growing acid lime trees in tropics is very high. Especially it needs early-stage training and heavy pruning each year

during winter season. Further, the symptom of various nutrient deficiencies is seen in several orchards due to lower level of external fertilizer use. With the introduction of acid lime from hill to Terai the issues of canker and gummosis or root rot is very high. Further, use of HLB infected planting materials and transmission of citrus tristeza virus through aphid infestation is obvious. Additionally, lemon butterfly at early stage of growth and leaf minor insect problem during flushing time are very likely to hinder the commercial cultivation of lime in the Terai. Most of the farmers are unaware of such abiotic and biotic stress management techniques. A few farmers who have mastered to manage these problems (nuances) are now facing market penetration problem due to limited volume of supply to wholesale market, however; selling small quantity of fresh lime fruit in local market is still a lucrative business.

From the previously recommended lime varieties the farmers are getting bumper yield from 5-6 year's of planting. For example, Mr Lekh Nath Subedi, from Buddhasanti Municipality, Jhapa is earning more than NRs. 10 Lakh from his mere 275 trees. Similarly, Mr Narendra KC from Choramara, Nawalparashi has produced 45 quintals of fresh lime fruit from 5 years old orchard planted at 1000 m<sup>2</sup> area in the year

2020. Looking at such encouraging results from several farmers across the Terai region farmers and government organizations are demanding more and more grafted saplings of acid lime. Each year NCRP receives demand for more than 50000 saplings both from the government and farmers' level. However, at present, NCRP produces 20000 saplings of Sunkagati 1 and Sunkagati 2 and other government farms produce only 5000 grafted saplings. To fulfil this demand gap NCRP has partnered with several nursery owners from east to western part of the county and in the year 2021 nearly 100000 saplings are (will be) produced at community level. The estimated demand of acid lime planting materials across the country is roughly 500000 and the demand is rising each year. Due to this shortage in sapling supply many foul nursery players are producing seedlings of unknown genotypes collecting any yellow skinned fruits from markets and selling them with wrong name as golden lime (Sunkagati). Even sometimes, they sell seedlings from tissue culture and air-layered materials with hefty price. Other farmers who are unaware of recommendation domain are planting Sunkagati-1 as off-season variety in mid hills where the performance of this variety is poorer than Sunkagati-2 and NCRP-53 (Table 2).

**Table 2:** Some of fruit quality and yield parameters of selected acid lime genotypes at NCRP Dhankuta, 1250 m amsl in 2017/18

Genotype	Fruit Wt (g)	Juice %	Rind thickness (mm)	Fruit Dia (mm)	Av TA (%)	# Fruit / tree	Productivity (t/ha)
NCRP 60	65	26	3.94	46	6.8	300	23.14
NCRP 51	38	40	1.71	40	8.7	396	15.52
NCRP 52	31	44	1.74	38	8.7	350	12.31
NCRP 48	45	36	1.6	41	8.9	190	9.47
Sunkagati-2	41	36.	1.66	39	7.3	249.	9.26
NCRP 53	81	21	3.59	54	7.2	108	8.7
Sunkagati-1	45	30	2.14	40	8.3	95	4.72

(Source: NCRP 2018)

## Conclusion

The acid lime cultivation is technology demanding in hot tropics. However, farmers are establishing orchards in abandoned and neglected lands using traditional knowledge of fruit cultivation. Farmers in Terai need appropriate know-how of acid lime cultivation to get return of their investment as there is plethora of information in the web overwhelming the producers. Therefore, knowing the fact that there is tremendous potentiality of commercially growing acid lime from hills to plain areas with adoption of modern farming technologies, a joint effort is needed from all the stakeholders to flourish acid lime industry in Nepal.

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