

PRESENT STATUS OF CITRUS NURSERY BUSINESS IN DHANKUTA DISTRICT

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ABSTRACT

Studies were conducted in Dhankuta district to find the real situation of citrus nursery business in the district during March-April, 2012. During the studies, five nurseries were selected and similar sets of questionnaires were prepared and given to fill to the nursery owners. Direct field observation, measurement, personnel communication and secondary data were used during the study. From the study it was revealed that 11 nurseries were producing saplings in Dhankuta, out of which six nurseries were legally operated. Most of them were producing grafted saplings while others producing both grafted sapling and seedling. All the nurseries were found to be located above 1000 meter above mean sea level. The shoot-tip method of grafting was found to be the most common method of grafting onto trifoliolate orange seedling rootstock at very low height ranging from 6 cm to 15 cm due to the poor growth of the seedling. Most of the nurseries were maintaining the mother stock inside the screen house but scions were taken from the open field mother plant. Major problems of raising mother stock inside the screen house were high occurrence of citrus scales, aphids, white flies and sooty mould. The age of sapling during selling time was found to be 6 month in most of the nurseries indicating high demand of the sapling. Hardly, some saplings remained for the next year to sell. The income of the citrus nurseries ranged from NRs. 300,000 to 660,575 per annum. Leaf miner, scale insect, lemon dog, twig borers were the important insect pests while damping-off, powdery mildew, root rot, sooty mold and twig blight were the major diseases of the nurseries.

Key words: Sapling, trifoliolate orange, mother stock, shoot-tip grafting, nursery business.

INTRODUCTION

Citrus occupy an important place in the horticultural wealth and economy of the world and ranks first in international fruit trade in terms of value. Larger part of the revenue of the major citrus producing countries is being earned through its fresh fruit market followed by its processed products and by-products. Almost, 140 countries of the world produce about 104,916,410 mt citrus fruits. Brazil, China, United States of America, Mexico, India, Spain, Iran, Italy, Nigeria and Turkey are the top ten citrus producing countries of the world. Based on magnitude of production, oranges occupy the first position, mandarins the second, limes and lemons the third in the world (FAO, 2007).

Citrus is the major fruit crop which occupies 35,576 ha area and is the major fruit for mid hills running from Eastern to the Far-western Development Region of Nepal. Its total production and productivity is 263,710 mt and 11.2 mt/ha respectively (MOAC, 2011). APP (1995) has given citrus as the number one priority crop for mid-hills of Nepal. Citrus is highly profitable commodity for the peoples of mid-hill of the country which gives about five times greater profit as compared to the agronomical crops.

Dhankuta is a major citrus producing district of Nepal. The major citrus producing areas of Dhankuta are Khoku, Chhintang, Maunabudhuk, Budi Morang, Belhara, Syaule, Fakchamara *etc.* Total area, production and productivity of citrus in Dhankuta is 1391 ha, 10515.4 mt and 11.90 mt/ha respectively. Among the citrus crop mandarin, sweet orange, acid lime and lemon covers about 698 ha, 231 ha, 461 ha and 1 ha with their total production of 6230.4 mt, 2305.8 mt 1974.9 mt and 4.3 mt and productivity 13.2 mt/ha, 12.6 mt/ha, 8.7 mt/ha and 4.3 mt/ha respectively (MOAC, 2011).

Citrus nursery enterprise is one of the emerging enterprises of Nepal and highly profitable. As compared to the citrus orchard, it is profitable and generates income to the owners earlier. However, some practical techniques should be adopted by the owner of the enterprise. This study is intended to find the actual situation of the citrus nursery and identify the major production constraints of the nursery business in Dhankuta district.

MATERIALS AND METHODS

Five nurseries namely, Ghimire Niji Nursery, Dhankuta Municipality-2, Kagate; Om Shiva Falful Niji Nursery, Dhankuta Municipality-7, Madanchok; Ganesh Falful Nursery, Belhara-1, Chaudharigaon, Dhankuta; Karki Suntalajat Falful Biruwa Utpadan Kendra, Dhankuta Municipality-2, Kagate and National Citrus Research Program, Citrus Nursery, Belhara-1, Paripatle were selected for the study. The study involved the combination of methodologies resembling direct observation of the nurseries, measurement of the sapling (sapling height, height of the graft union), observation for the occurrence of disease and insect pests, personal communication with the nursery owners, sapling buyer, filling of the written sets of questionnaire and use of secondary data from the District Agriculture Development Office. The visit team comprised of pomologist, soil scientist and entomologist.

RESULTS AND DISCUSSION

Existing nursery practices and technological gaps

Location of the nursery

Citrus green disease is a major bacterial disease of citrus and is commonly transmitted by citrus psylla (*Diaphorina citri*) as a vector (Bove et al., 1974). It is believed that the activities of citrus psylla are not observed above the 1000 meter above mean sea level. All the observed nurseries were located at an altitude ranging from 1,060 to 1,450 meter above mean sea level. However, the distance between the commercial citrus orchard and the nursery was found closer than the recommended distance in some nurseries. The recommended distance of citrus nursery is 1,000 to 2,000 meter from the commercial orchard. It is said that the distance should be maintained to protect the spread of the disease of citrus.

Nursery bed preparation

The preparation of nursery bed consisted of plowing the field about three times with plough, breaking the clods, removing of stones and other materials from the bed. In most of the nurseries, the size of the bed varied from 50 cm to 75 cm in their breadth and the length was made according to the length of the terrace, but the most common length was 5-6 meter. The raised bed was prepared using bamboo splits and piece of plastic sheet to protect the bed from soil loss, leaching of irrigation water and nutrients at NCRP. But in other nurseries the side support was not found because it would create difficulties during the tillage for next bed preparation at the same place.

In the entire observed nurseries, there was no practice of nursery bed treatment. Vapum (sodium N-methyldithiocarbamate dihydrate), methyl bromide, formalin, etc. are the chemicals used in the treatment of citrus nursery bed in developed countries. There is also a cheap technique of nursery bed treatment using solar radiation commonly called as soil solarization. In this technique the use of a 70-micron thick ethyl acetate vinyl plastic is recommended. After preparing the beds, the soil surface is punctured with a board creating about 1.5 cm wide and 5 cm deep holes. The punctures help diffuse the solar heat into the soil. The planting can be initiated after 2.5 to 3 months of solar exposure. This treatment helps to control damping-off disease and various types of weeds and nematodes. The growth was also found vigor on solarized soil than methyl bromide treated soil (Continella and Cartia, 1993).

The amount of manure application was found varied from 20 kg to 50 kg compost for 75 cm×500 cm bed. Some nursery owners were using urea for top-dressing but without calculating any dose of fertilizer. The recommended dose of manure is 80 ton/ha and fertilizer is 0.4 ton of triple super phosphate (45% P₂O₅) for slightly acidic soil and 0.5 ton of potassium sulfate (50% K₂O) for an optimum fertile soil (Aubert and Vullin, 1998).

Internationally, the grafts are planted in the polythene bags containing the propagation media compost and soil at the ratio of 1:1. The benefit from planting sapling in polythene bag is it is easy to uproot and establishment to the permanent field after planting. In directly planted grafts, the damage of root system is higher and mortality rate also is higher in field after transplanting.

Use of rootstocks

Selection of an appropriate rootstock is the fundamental and prime step in citriculture for long productive life of a tree and its final selection should be after considering the rootstock and scion compatibility for desired horticultural trait and other prevalent citrus diseases of the region.

Trifoliolate orange was found to be the principal rootstock for all the citrus species for propagation in Nepal. All the visited nursery owners were using trifoliolate orange rootstock but some farmers are also using citrange rootstock. Trifoliolate orange and citrange have been used as rootstock for almost all the citrus species cultivated from Terai to mid-hills of Nepal. Internationally, different citrus species are grafted onto different rootstock. In India more than 80% citrus plants are being raised on rough lemon and the rest on other rootstocks like Rangpur lime and others (Singh, 2001). Some reports showed that combination of trifoliolate orange and acid lime manifests the occurrence of citrus canker disease (Aubert and Vullin, 1998).

The age of seedling rootstock used in propagation was found to be of one year old. Growth of trifoliolate orange is sluggish in subtropical regions. Therefore, one year of age at open field production of rootstock results unsuitable size of the rootstock for grafting. To obtain the optimum size of grafting, therefore, grafters should go at lower height on the rootstock for grafting. Low grafting height results in high occurrence of *Phytophthora* disease after planting in orchard. Most of the nurseries owners were grafting at 6-8 cm height of the rootstock while some others at 12 to 15 cm height. In general, average nursery owners were grafting at 8-10 cm height of the rootstock. Chalise et al. (2011) suggested that the appropriate grafting height of acid lime scion onto trifoliolate rootstock is 16 cm for optimum growth of the sapling.

Method of propagation

The internationally accepted method of propagating citrus tree is budding, especially T-budding. In Nepal, the shoot tip method of grafting is employed in propagation though veneer method produces the higher bud take. The reason for the popularity of shoot tip is due to preparation of higher number of grafts within a short time. The veneer method is time consuming but the success rate is higher as compared to shoot tip (Chalise, 2010).

Nursery owners were using scions from outside the screen house though they had screen house. In most of the nurseries, the size of the mother stock was found too small, so not ready for scion. Therefore, nursery owners were using unhealthy scion from the orchard trees. These were not tested for the greening disease. Some nurseries were using scion from NCRP, Paripatle which was located nearer to it. NCRP has been producing healthy saplings using scions inside the screen house (NCRP, 2010).

It is recommended that the scion for grafting should be round shaped with longitudinal lines. Too small and very angular scion when used for grafting results into low rate of graft success, so not recommended for grafting. The age of scion to be used for grafting should be more than 6 month of age. However, the size of scions used by the nursery owners was too small, green, angular and containing one or two buds. The rate of success of the grafting varied from 60% to 95% according to the nursery owners. The rate of success differed from grafters to grafters, time to time and methods to methods.

Planting of the grafts

Immediately after grafting, the grafts were planted inside the tunnel at the spacing of 5-6 cm by creating a hole with a stick. The tunnels were prepared by the bamboo splits and covered inside by the jute sheet and plastic sheet from outside. After the planting of the grafts, heavy irrigation was given from outside the jute sheet. Most of the nursery owners planted the grafts at closer spacing of 5-6 cm distance. The recommended spacing for sapling planting is 10×10 cm (NCRP, 2010). Closer planting of sapling results into poor growth of sapling due to more competition of the root for nutrient and soil moisture. The spacing adopted for planting the saplings was found to be more or less equal among all the visited nurseries.

Care and management of the sapling

After the planting, the immediate irrigation was given to establish the root. In the initial days of planting the irrigation was given daily for the first about 10 days and then once in 2-3 days for about one month and 2 times per week for about next one months and then as required by the plant. The attack of insect pests and diseases were found after removing the plastic sheet in April/May. Disease attack started after the onset of rainy season in June/July. Regular spray of insecticide and fungicide could control the insect pests and diseases. Nursery owners were found using Malathion and Rogor @ 2 ml/liter of water for the control of insect pests and Sulfex @ 2 g/ liter of water to control powdery mildew disease and Bavistin/ Dithane M-45/ Dithane Z-78 for controlling other fungal diseases like leaf and twig blight, etc.

Uprooting and packaging of sapling

According to the nursery owners, grafts were directly planted on nursery bed without any plastic bag. Difficulties existed in direct planted saplings on soil during uprooting. There would certainly be damage in root systems in directly planted grafts as compared to sapling planted in polythene bags. Uprooting was done with

the help of spade. Uprouted grafts were packed in sphagnum moss covering the whole root system. The external material used in wrapping the moss was jute sheet according to the nursery owners.

Quality of sapling

Different criteria are set for determination of quality of saplings of citrus. Among them age and height of the sapling is major criteria. Almost all citrus nursery owners used to sell saplings within six month of age because of high demand of saplings. The recommended age of sapling for sale is one and half year. At that age the height is 45 cm-75 cm (Shah, 1992). But the saplings were being sold without any quality testing, there by resulting into death of saplings in the field. Except height and age, other quality criteria were met by the saplings observed during the visit.

Marketing

Marketing is the selling of the saplings in the market. According to the nursery owners, there was no difficulty for selling the saplings. Most of the nursery owners said there was also booking system for citrus saplings. However, many buyers used to come to the nursery without any pre-information. The demand of acid lime saplings was found rising during later period of the time because it could be cultivated in Terai regions as well as mid-hills. Mandarin's demand was found higher as compared to sweet orange varieties. About 4-5 years earlier, nursery owners used to transport the saplings to Kathmandu for sale. But now a day, the trend has been changing which made some benefit to the nursery owners.

Benefit/Cost analysis of sapling production

The major investment for citrus sapling production was on the labor. About 40% of the total investment for sapling production was found to be occupied by the labor cost (Table 1). If family labors were available throughout the year then the amount of net benefit would certainly become high. Similarly, if the nursery man was skilled grafter, then the investment on grafter also would be minimized and net benefit would become still higher.

Table 1. Estimation of benefit cost ratio of citrus sapling production of Ganesh Falful Nursery, Dhankuta

Cost (Rs.)		
S.N.	Particulars	Cost
1.	Labor	140,000.00
2.	Grafters	45,000.00
3.	Manure and fertilizers	10,000.00
4.	Pesticides	10,000.00
5.	Jute sheets	20,000.00
6.	Plastic sheets	50,000.00
7.	Equipments required for land and nursery bed preparation	25,000.00
8.	Investment on rootstock raising	50,000.00
	Total	350,000.00
	Cost per sapling	14.00
Income (Rs.)		
1.	Number of sapling produced	25,000
2.	Price of individual sapling	25
3.	Income from selling of saplings	625,000
	Net benefit	275,000

Key problems of the nursery business

Availability of seeds for raising sapling

The major constraint of citrus sapling production is the availability of the seeds for rootstock. The principal rootstock of citrus in Nepal is trifoliate orange and citrange but the availability is limited. The demand of seed is increasing while the production of rootstock seedling is decreasing. Major trifoliate orange/ citrange producing farms are Central Horticultural Station, Kirtipur; National Citrus Research Program, Dhankuta and Agricultural Research Station, Dailekh etc. During the fiscal year 2068/69 the total production of seed was about 33 kg. One kg of seed gives about 3,000 seedlings and thus total seedling production by 33 kg seed will be 99,000 seedlings

if germination rate is high. The demand of seed for rootstock production was not met by the present total production.

Availability of scion

Scion and rootstock seedling are the two major components for preparing the sapling. The quality of sapling is basically dependent on the quality of scion and rootstock used. The scion used in grafting process should be of true to type and appropriate age. It must be taken from the mother stock maintained in disease free condition inside the screen house. During the visit, it was found that all of the nursery owners had screen house in their own farm but not using properly. The saplings planted for scion had poor growth and high incidence of scales and aphid infestation. Scion used by the nursery owner was from outside the screen house because of the young plant and high incidence of disease and insect pests. Some farmers in the vicinity of NCRP, Dhankuta were using scion from orchard tree of the research station. The cost invested per piece of scion was Rs. 1 per piece of bud-wood. Some orchard trees at NCRP, Dhankuta was found positive to the Huanglongbing (HLB) disease of citrus, so it is not safe to use scion from such orchard tree.

Availability of skilled grafters

The most suitable time of grafting citrus fruit tree is between second week to final week of January. Therefore, the demand of grafters was found higher during that time. The number of experienced grafters is limited in Dhankuta districts. The same grafters are mobilized in the entire nurseries for grafting purpose. Thus, it was found difficult to get the grafters at peak period of the grafting. So, this was major constraint for the nursery business.

Availability of labor

The most costly input for the nursery business is the labor. About 40% of the total investment was found invested on labor. The main benefit for the nursery owner lies here if they use family labor on it. The daily investment for a single labor is about 200 rupees. For skilled labor, the daily wage was found about 500 to 600 rupees but grafters prefer payment on the basis of per grafts prepared. The investment on per graft preparation was found Rs. 1 to 1.5 per graft. Most of the nursery owners are found to be a skilled grafter too.

Problems of raising mother stock

There is no appropriate technique for raising mother stock inside the screen house at all. The major problem of raising mother stock inside the screen house is the high attack of citrus scales, aphids and whitefly. As a result, there is high growth of sooty mould fungus on the whole plant. Moreover, mother stocks are usually infected by the root rot disease. The twigs infested by insect and disease are unsuitable for grafting purpose. Therefore, grafters prefer open field scion over the mother stocks of screen house. It is, therefore, necessary to develop appropriate mother plant raising technique inside the screen house.

Marketing

Marketing of citrus sapling was not found to be a great problem but the demand for saplings is not constant all the years. In some years, there were lesser saplings than the demand and in some year there were more than the demand. Information should be given to the nursery owners by the buyer prior to the grafting season so that they can estimate the amount of saplings to be produced. The unmarked saplings require extra investment to maintain in the nursery.

CONCLUSION

The citrus nursery business was found to be one of the emerging and profitable businesses for nursery owners in Dhankuta district. It has been generating employment opportunity for family labor in all of the observed nurseries. Benefit: cost ratio was calculated during the study which was found to be 1:1.78 and found to be increasing when the magnitude of sapling production increased with decreasing the production cost.

RECOMMENDATIONS

- The sapling production system should be controlled by the legal authority of the Government.
- Nursery must be registered and timely supervision must be done by the authority for quality sapling production and marketing as done in seed certification in agronomical crops.

- Research works should be conducted by National Citrus Research Program, Paripatle and Dhankuta for screening the suitable citrus rootstocks for mid-hill and Terai regions of Nepal.
- Mother stock should be maintained by every nursery owner inside the insect proof screen houses with proper management.
- Appropriate mother stock production and management techniques should be developed for the screen house.
- The grafting height is very low. Therefore, nursery owners should follow the suitable rootstock production technique inside the plastic house/ or tunnel.
- Government should bring the plan and policy for crop insurance.
- The demand of rootstock seed is higher; therefore, government farm should be encouraged for plantation and management of the rootstock mother plants.
- Nursery owner should be provided with incentives by the government.
- Nursery located below 1000 meters altitude should be sealed by the government authority and control the production of sapling.

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Annex 1. Summary of the observation of citrus nurseries at Dhankuta district

S.N.	Description	Ghimire Niji Nursery, Dhankuta Municipality-2, Kagate	Om Shiva Falful Niji Nursery, Dhankuta Municipality-7, Madanchok	Ganesh Falful Nursery, Belhara-1, Chaudharigaon, Dhankuta	Karki Suntalajat Falful Biruwa Utpadan Kendra, Dhankuta Municipality-2, Kagate	National Citrus Research Program Citrus Nursery, Belhara-1, Paripatle, Dhankuta
1	Proprietor	Madan Bahadur Ghimire	Bimala Rai	Ganesh Bahadur Karki	Min Bahadur Karki	NCRP, Dhankuta
2	Establishment (B.S.)	2047	2064	2045	2048	2018
3	Altitude (meter)	1200	1060	1450	1400	1350
4	Area (Ropani)	5	4	8	1.5	7
5	Method of propagation	Shoot-tip grafting and seed	Shoot-tip grafting and seed	Shoot-tip grafting and seed	Shoot-tip grafting and seed	Shoot-tip grafting and seed
6	Major species	Mandarin, kumquat and acid lime	Mandarin and acid lime	Mandarin, acid lime, sweet orange and kumquat	Mandarin, acid lime and kumquat	Mandarin, acid lime and sweet orange
7	Amount of sapling production (2068/69)	25,000 grafted and 20,000 seedling	15,000 grafted and 20,000 seedling	22,500 grafted	22,000 grafted and 20,000 seedling	17,370 grafted
8	Mother plants	Yes, under screen house	Yes, open	Yes, under screen house	Yes, under screen house	Yes, under screen house
9	Mother stock for rootstock	Yes, trifoliolate orange growing	Yes, trifoliolate orange but young	Yes, trifoliolate and citrange growing	Yes, trifoliolate but young	Yes, producing fruits
10	Age of rootstock used	One year	One year	One year	One year	One year
11	Income of 2067/68 (NPR)	5,00,000.00	6,60,575.00	4,90,000.00	3,00,000.00	3,50,000.00
12	Height of the grafting (cm)	6-12	6-12	5-15	6-15	6-15
13	Cost per sapling production (NPR)	10	10	14	6	22
14	Age of sapling during sale (month)	6-18	6-18	6-18	6-18	6-18
15	Problems	Irrigation, manure and fertilizer	Irrigation and marketing	No problems	No problems	Disease and insect pests
16	Major diseases and insect pests	Root-rot, Powdery mildew, scale and leaf miner	Root-rot, powdery mildew, sooty mold, canker, scale and leaf miner	Sooty mold, powdery mildew, scale, aphid, leaf miner, lemon butterfly larva, borer and grubs	Powdery mildew, leaf and twig blight and leaf miner	Powdery mildew, leaf and twig blight, gummosis, damping off, leaf miner and lemon butterfly larva