WHAT CAN BE DONE TO IMPROVE CITRUS PRODUCTION IN DAILEKH DISTRICT OF NEPAL?

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ABSTRACT

In the Dailekh district, despite steady increase in area devoted to citrus production productivity was not increased as anticipated. Therefore, this study was conducted to establish the present state of citrus cultivation and associated problems. The study was conducted during September 2008 in three citrus production villages of Dailekh district: Goganpani, Lankuri and Dullu. Sixty citrus growers were selected randomly from the a list of total that is twenty in each of three villages and participated in semi-structured questionnaire, focus group discussions and orchard visits. Eighty percent farmers used seedling plants and only five percent of farmers used chemical fertilizer. Further, only 10 % of farmers had assured irrigation so rest had adopted rain-fed system. Growers were in false belief that intercropping cereals increases citrus production due to better aeration at root zone by plowing. All orchards were affected by pests and diseases because of a limited access to chemical control measure and a lack of knowledge meant that proper control measures were not employed. Further, improper post-harvest handling caused farmers to receive lower prices for their product. Integrated plant nutrient and pest management programs need to be adopted by R &D partners for these production areas. Farmers have to be encouraged to plant grafted sapling because these are free from bacterial and viral diseases and can better withstand water stress. It is suggested that R and D partners organize training and awareness programs on proper orchard and nursery management, and post-harvest handling and marketing processes.

INTRODUCTION

Citrus are the main cultivated fruit in Nepal occupying 49% (27890 ha) of the total fruit growing area (MoAC, 2009). In total, the productive citrus orchard in Nepal covers 15832 ha with a productivity of 11.37 mt. Annual exports of fruit and juice are worth of USD 14.37 million (MOAC, 2008). Because of major share in cultivation area, production and export potential the guiding agricultural strategic document of Nepal, the Agricultural Prospective Plan (1995), has given higher emphasis and recognized citrus as cash crops.

Citrus growing in Nepal is mainly confined between 26^0 45' and 29^0 40' North latitude, 80^0 15' and 88^0 12' East longitude and 900-1400 msl in mid-hill. Mandarin orange, sweet orange, lime and lemon are main crops and are grown semi-commercial to commercial scale on hilly terraces in 58 districts. However, there are 34 priority citrus production districts and Dailekh is one of them (ICIMOD, 2003). Between 2005 and 2008, the citrus growing area in Dailekh district increased from 382 ha to 800 ha, but productivity has been disappointing. Whereas, the national average productivity is 11.37 mt/ha, Dailekh's productivity is only 10.15 mt/ha. Moreover, Dailekh is also representative of the surrounding seven districts of mid-western region of Nepal, with a combined citrus area of 3926 ha, all of which have below average productivity (MoAC, 2009).

Failure to improve citrus productivity may lie with various biotic and abiotic factors (ARSD, 2006; Paudyal *et al.*, 2002; Subedi and Jacobsen, 2000, Subedi *et al.* 2008), such as unsuitable soils, drought, lack of systematic manuring, use of poor quality planting materials, improper orchard management and various diseases and insects. This study was conducted to discover the present state of citrus cultivation and associated problems in Dailekh district, and to identify possible remedies.

MATERIALS AND METHODS

This study was conducted during September 2008 in Dailekh district of Nepal. Dailekh district was chosen because it is representative of seven priority citrus production districts of mid-western region of Nepal. Three production pocket villages in the Dailekh district, viz; Goganpani, Lankuri and Dullu, were selected for the study. All the citrus growers in the selected villages were enlisted with the help of key-informants and the District Agriculture Development Office. Altogether 60 respondents (20 from each of three village) were selected randomly from the list and participated in the study via a semi-structured questionnaire, focus group discussion and an orchard visit. The data were analyzed using Microsoft Excel and Statistical Package for Social Sciences (SPSS).

RESULTS

Characteristics of Citrus Orchard:

The surveyed orchards were 35% of larger size (> 150 trees) and 65% of medium size (50-150 trees). Their location ranged from 1000 m to 1400 m, with sizes ranging from 500-15000 m^2 and averaging 2610 m^2. Further, most were north and east facing (Fig. 1) and on loamy soil (Fig. 2) which is ideal for citrus cultivation.

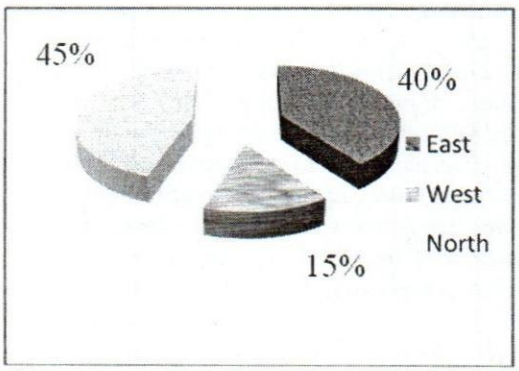

Fig1: Aspect of the surveyed orchards

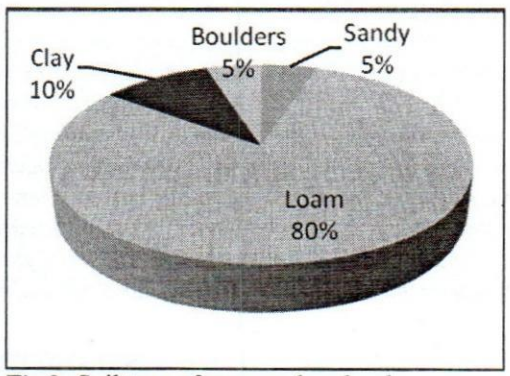

Fig 2: Soil type of surveyed orchards

Use of planting materials:

Seedlings are still the preferred source of planting material with 60% farmers relaying on the seedling (Fig. 3). For the future use, however, 20% of respondents preferred grafted planting materials. Of these respondents, 15% were from Lankuri and 5% were from Goganpani village (Fig. 4). The other 80% of respondents wanted to continue using seedling plants. They stated that the average yield from seedling plants is 170, 90 and 110 kg per tree in Lankuri, Goganpani and Dullu villages, respectively. No corresponding data for grafted plants is available because what grafted plants have been planted are yet to be ready for maturity.

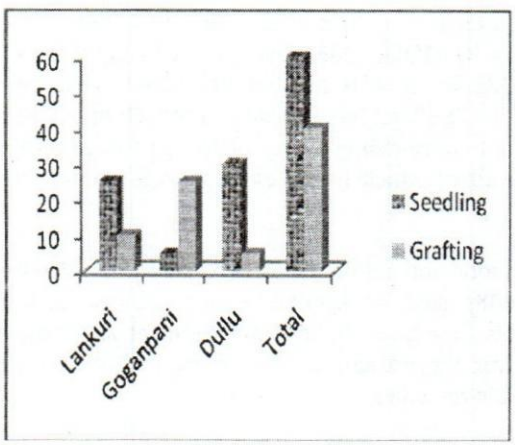

Fig 3: Seedling plants are extensively used in the surveyed area

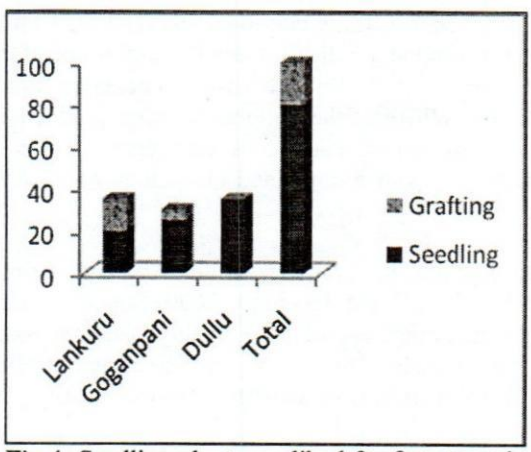

Fig 4: Seedling plants are liked for future use in survey area

Propagation materials:

Only 15% of the respondents had a nursery and they performed grafting in December with splice and cleft method. The common rootstocks were Kali Jyamir (*Citurs jambiri*) and Trifoliate (*Poncirus trifoliate*), with trifoliate being obtained from Agricultural Research Station (ARS), Dailekh. However, the scion source is their own. Further, the nursery owners sell their product directly from their nursery. Private nurseries are the prime source (50%) of seedlings followed by ARS, Dailekh (20%) and mixed (ARS, Dailekh and Private) source (20%). For grafted plants, ARS, Dailekh and Private Nurseries were the two main sources.

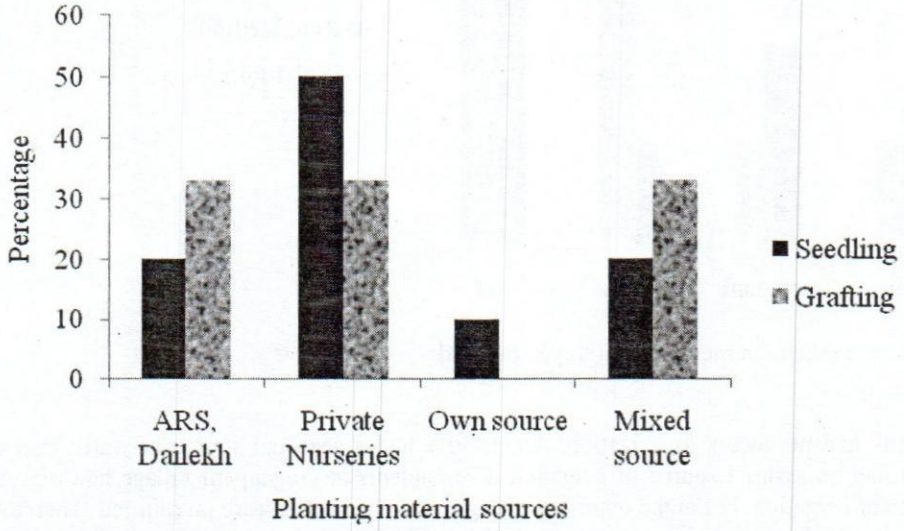

Fig 4: Private nurseries are the principal source for seedlings

Use of fertilizer:

About 90% of respondents stated that they use compost fertilizer in their orchards. The 10% who were not applying compost fertilizer were all from Lankuri village. Of the total respondents, application of compost with the ring method in January was higher in Goganpani (20%) followed by Lankuri (15%) village. However, 25% of farmers from Dullu prefer to apply compost in April for intercropped maize and only 10% of respondents apply compost with ring method in January to citrus crops (Fig 6 & 7). An equal number of farmers applied compost in January and April and the figures are similar for method of application. Only 5% of respondents use chemical fertilizer and all of those were from Goganpani village.

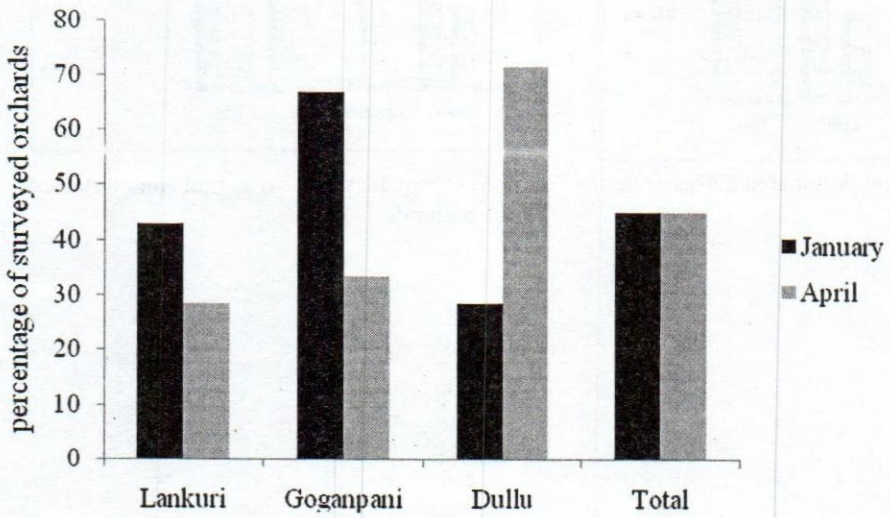

Fig 5: Compost fertilizer application time in surveyed orchard

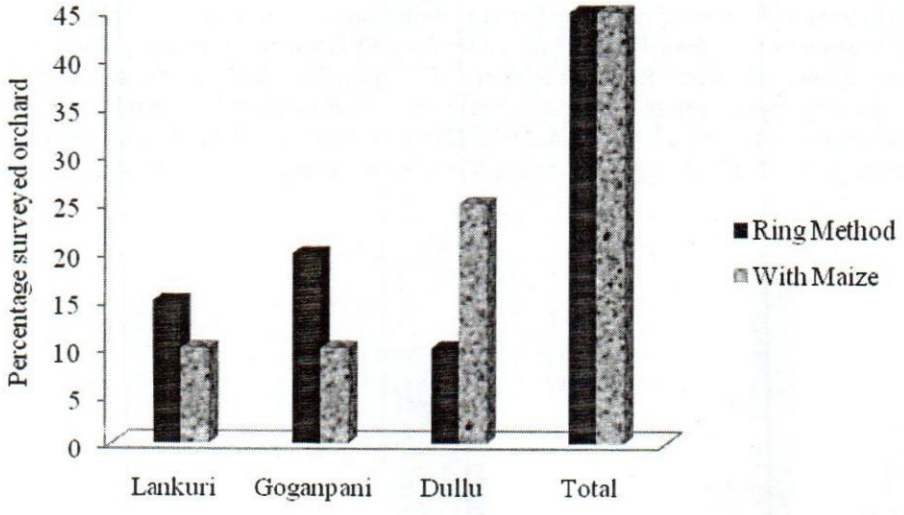

Fig 6: Compost fertilizer application method in surveyed orchard

Irrigation use:

Half of the respondents had no access to irrigation. About 30% had a seasonal source of water, and the remaining 20 percent had an assured source of irrigation. Respondents at Goganpani village had seasonal and year round sources of irrigation, but in the other two villages, most orchards were on rain-fed. Therefore, half of orchardists had no irrigation water, 10% applied water when needed and 40% applied water only during drought .

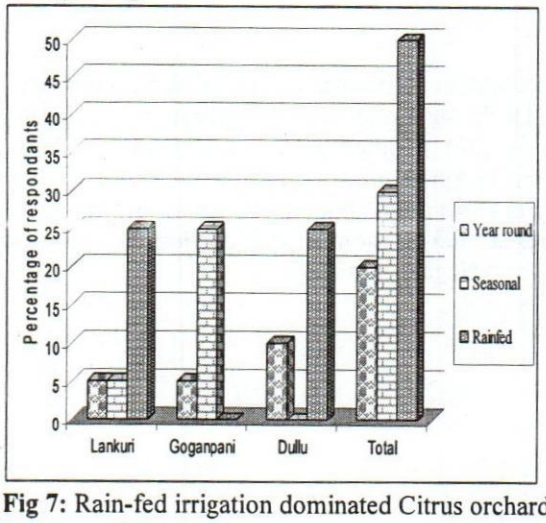

Fig 7: Rain-fed irrigation dominated Citrus orchards in surveyed area

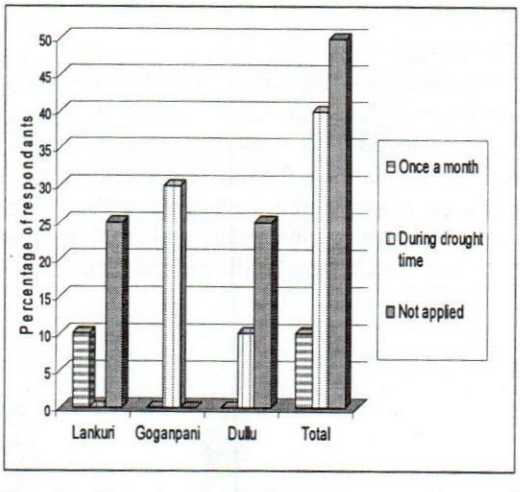

Fig 8: Frequency of irrigation on surveyed Citrus orchards

Tree planting pattern:

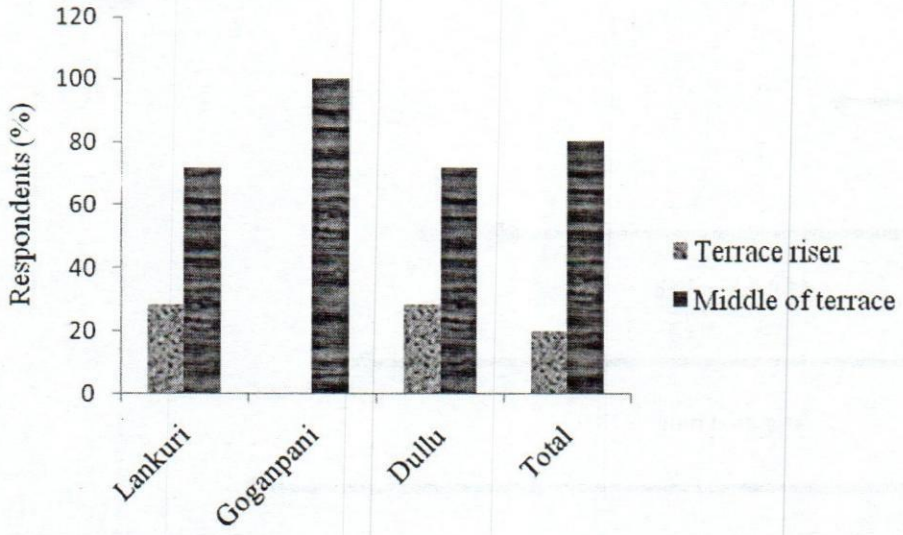

Fig 9: Citrus tree planting pattern in surveyed area

In all surveyed areas, the trees were planted mostly on middle of terrace (Fig. 9). In Goganpani, all farmers had reported planting citrus on the middle of terrace, whereas 29% respondents in each of Lankuri and Dullu reported planting trees on the terrace riser.

Intercropping:

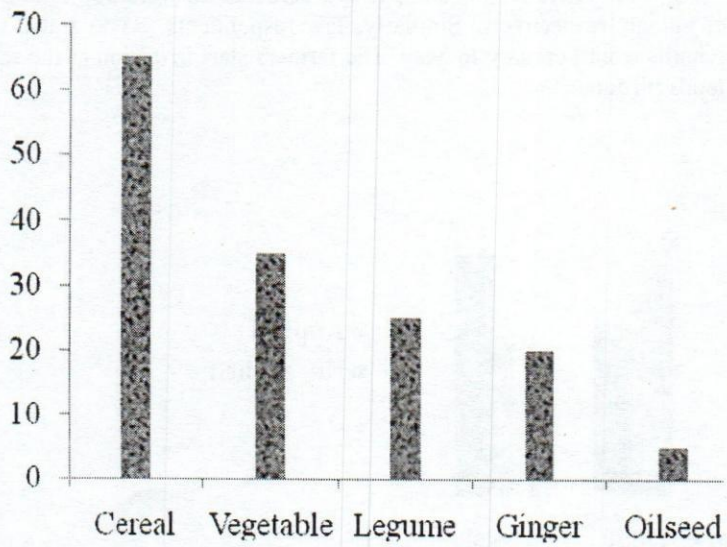

Fig 10: Cereal is the dominating intercropping system in surveyed area

All respondents reported intercropping is general practice in their citrus orchards. They intercrop cereals (65%), vegetables (35%), legume (25%), ginger (20%) and oilseed crops (5%) in their citrus orchards (Fig .10). They cultivate maize and upland rice as a summer-rainy season crop and wheat as a winter crops inside the citrus orchard. Further, they intercrop leguminous crops (Asparagus bean, Phaseolus bean, chickpea, Black gram, etc) and various kinds of vegetable crops (potato, cauliflower, cabbage, tomato, etc) year round.

Citrus orchard cultivation pattern

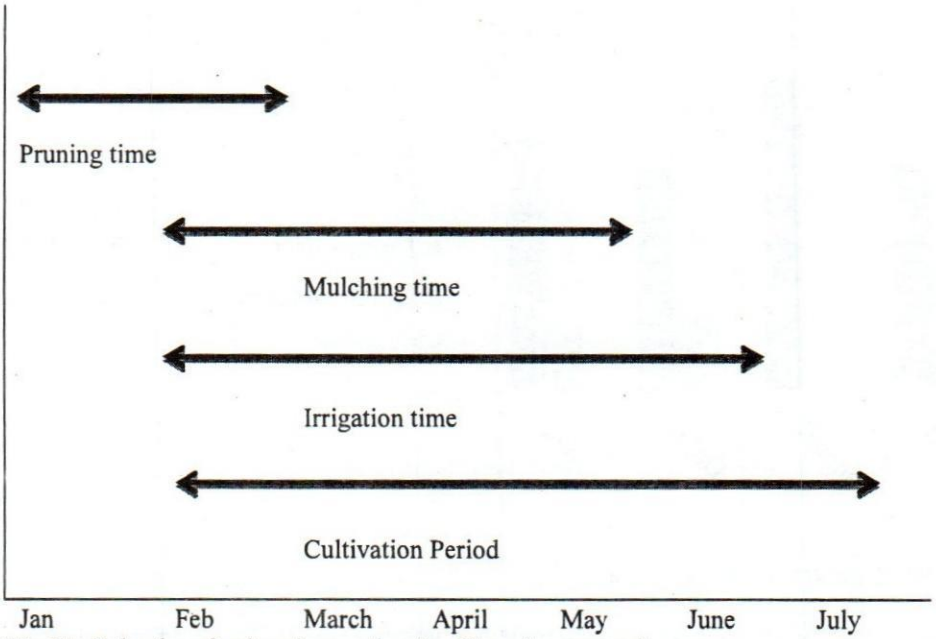

Fig 11: Calendar of cultural operation for Citrus in surveyed area

The period from February to July is cultivation time for Citrus orchard in the Dailekh district (Fig. 11). Few orchardists (< 5%) prune their orchard during January and only 40% of these respondents replied that they applied Bordeaux paste after pruning (Fig. 12). These Bordeaux applying percentages were 58, 43 and 17 within Dullu, Lankuri and Goganpani village, respectively. Similarly, few respondents (<5%) stated that they apply mulch materials to their orchards from February to May. The farmers start irrigation at the same time as mulching but the irrigation extends till June.

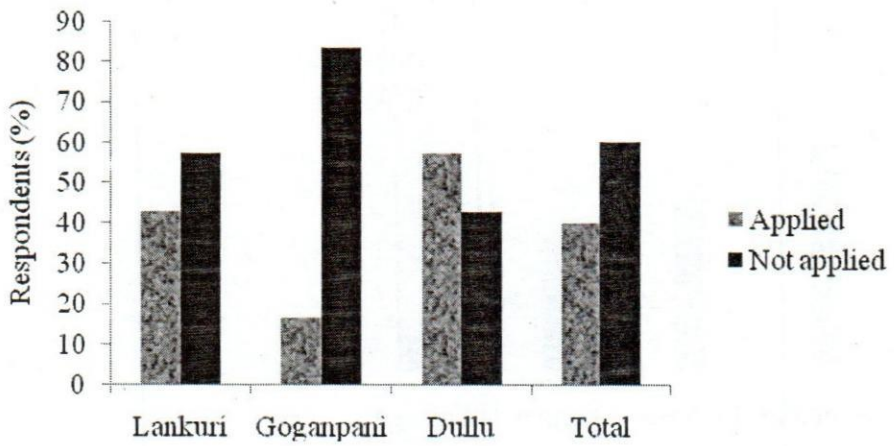

Fig 12: Application of Bordeaux paste after tree pruning

Harvesting and storage:

Farmers hand pick citrus from January to mid-February, as all orchards have mid-season local cultivars. While harvesting, 75% of respondents reported that they don't retain stalk on fruits (100%, 70% and 57% within Goganpani, Lankuri and Dullu VDCs, respectively Fig. 13). After harvesting, only 45% of the respondent stored fruit for a few months (Dullu 86%, Lankuri 29% and Goganpani 17%, Fig. 14). The usual storage pattern is spreading or heaping on the house floor because there is only one cellar storage in both Dullu and Lankuri. Product is sent to local market piled in traditional bamboo basket (Doko) as a back-pack of 20-30 kg capacity as backpack by 75% of total respondents (86%, 83% and 57% Dullu, Goganpani and

Lankuri, respectively) (Fig. 15). Eighty percent of respondents were not aware of post-harvest handling of fruits but 53% of the respondents within Dullu claimed some knowledge of post-harvest handling (Fig. 16).

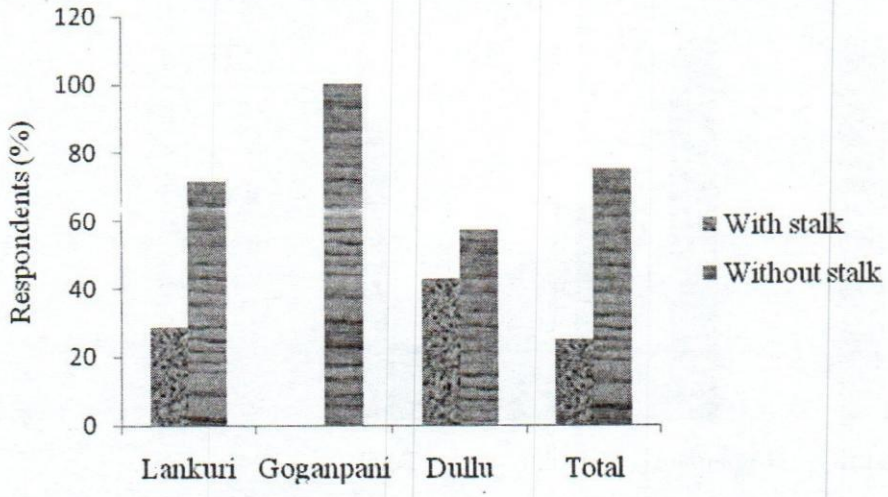

Fig 13: Fruit picking without stalk is common.

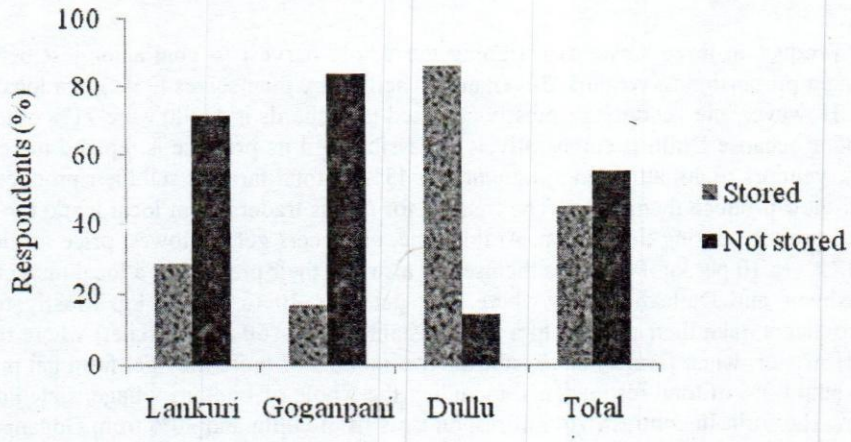

Fig 14: Pattern of citrus fruit storage in surveyed VDCs

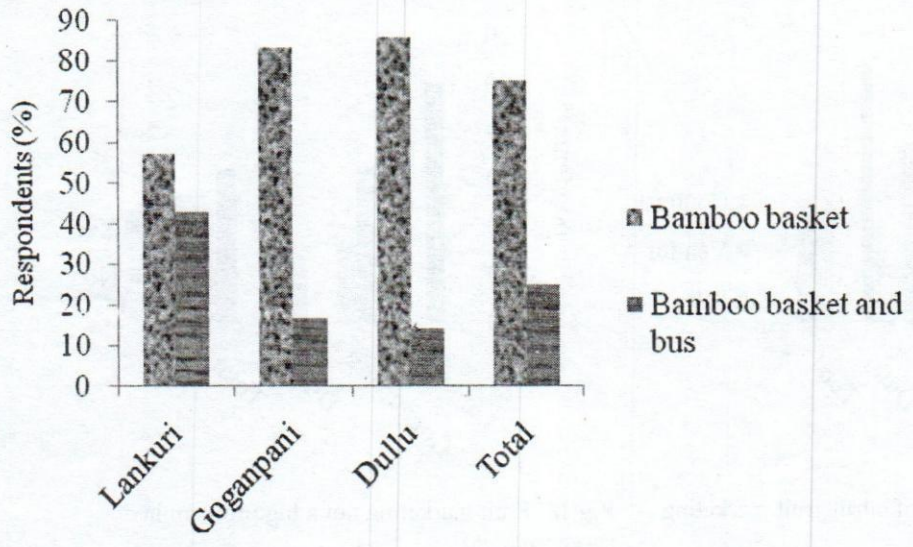

Fig 15: Means of transporting Citrus product

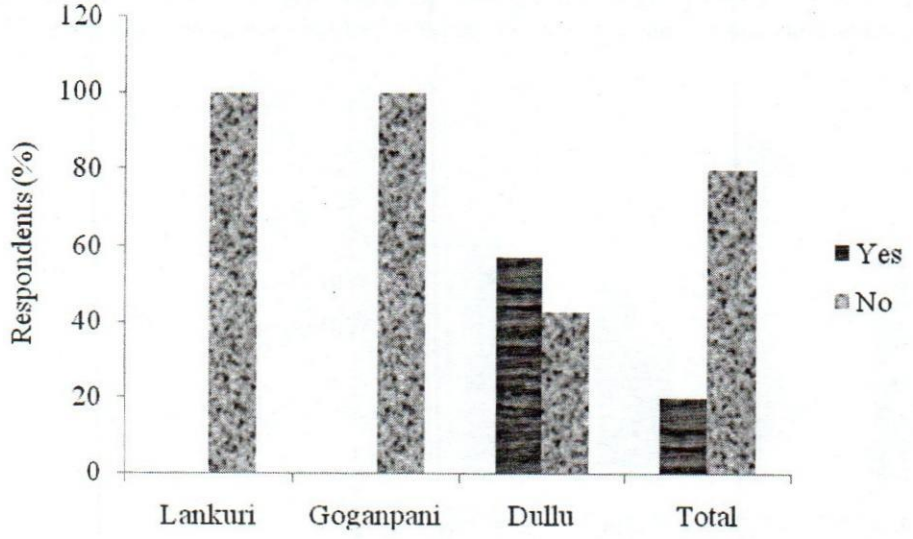

Fig 16: Most respondents were unaware of post-harvest technology

Marketing of produce:

The orchardists sell their product in three ways: a) assigning the whole harvest to contractor just before harvesting (35%); b) selling a proportion to vendors (30%); and c) selling by themselves (35%) in a local or a distant market (Fig. 17). However, the vendors are mostly attracted to orchards in Dullu were 71% of total respondents sell via a vendor because Dullu is comparatively accessible and its produce is reputed to be of higher quality. Conversely, vendors re not attracted to Lankuri, so 43% of total farmers sell their produce to contractor and the rest sell their produce themselves. The trend is for Citrus traders from local market to go to the orchard to collect the produce during the harvest. At this time, producers get the lowest price for their commodity i.e. between NRs 5 to 10 per kg. Producers themselves also sell their produce at a local market (5 to10 km; Chupra, Dungeshwor and Dailekh Bazar) where they get NRs 10 to 15 per kg. Mostly fruit collectors, but also few producers, take their product to a more distant market (60 km; Surkhet) where they get NRs 12 to 25 per kg. However, when farmers store fruit for two months or more they get farm get price of NRs 20 to 30 per kg. About 60% of total respondents, including the whole of Lankuri village, stated that they had problems in selling the fruit. In contrast, 70% of respondents from Dullu and 30% from Goganpani stated that they had no such problem (Fig. 18).

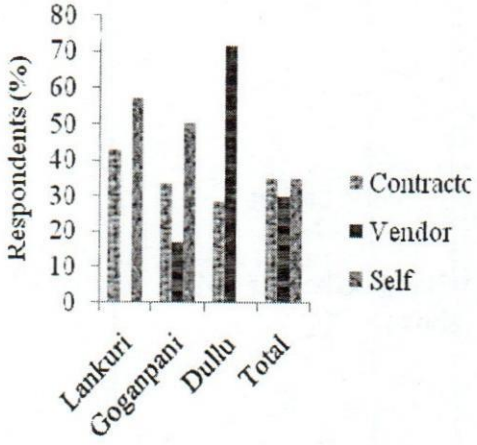

Fig 17: Three ways of citrus fruit marketing in surveyed areas

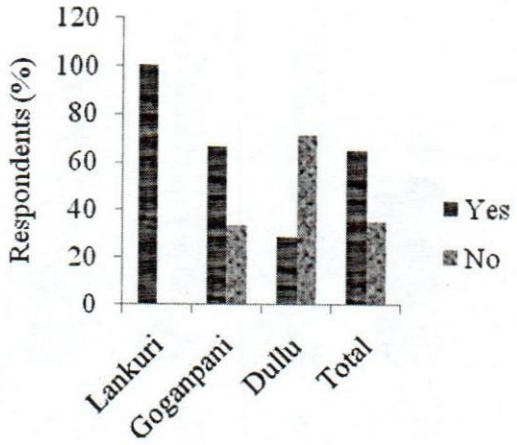

Fig 18: Fruit marketing not a big problem in surveyed areas

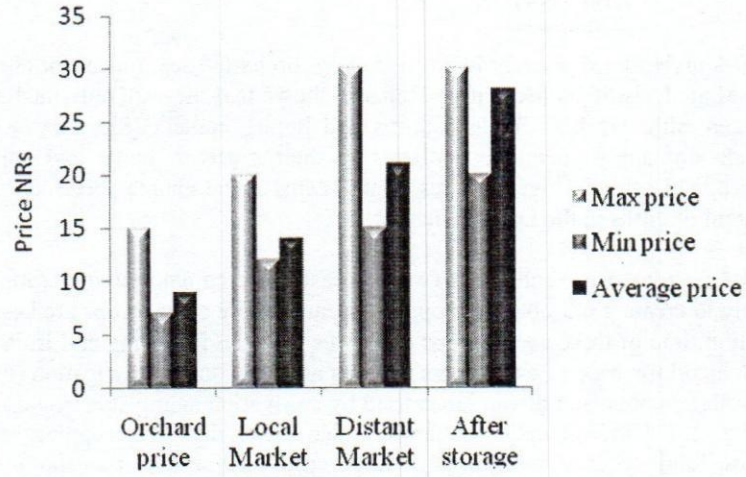

Fig 19: Mandarin orange market price fluctuates over time and locaton

Problem prioritization

Based on Citrus orchardists' statement, their problems were ranked using problem priority index and it was found that their priority problems were a) unavailability of irrigation, b) fruit drop, c) tip drying of citrus plants, d) green stink bug and e) unavailability of pesticide (Fig. 11). Further, some of the important diseases and pest farmers have recorded in their orchards are Citrus greening, Powdery mildew, Sooty mold, green stink bug and parasitic plant (Table 1).

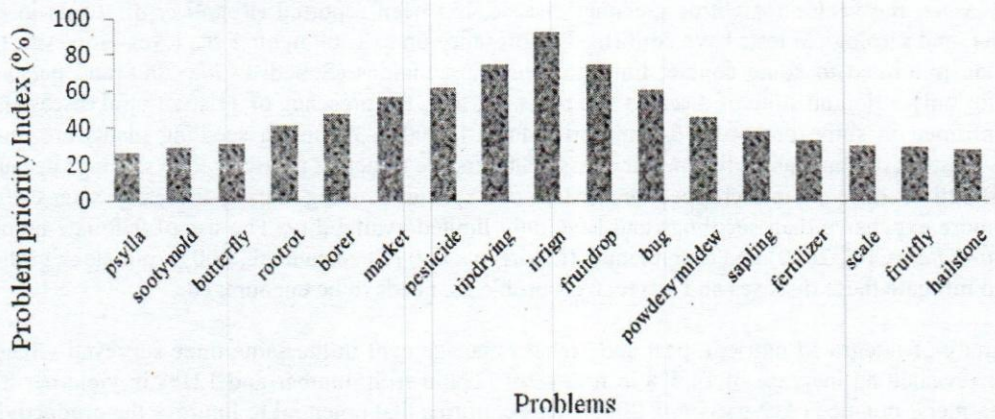

Fig 20: Citrus problem prioritization

Table 1: Farmers' perception on presence of important diseases and pests in surveyed orchards

Problem	Presence (%)	Absence (%)
Tip drying (Citrus greening)	85	15
Powdery mildew	65	35
Sooty mold	65	35
Parasitic plant (*Loranthus spp*)	45	55
Green stink bug	100	0

(Source: Survey, 2008)

DISCUSSION

Although the north-facing slopes (50% orchards) and sandy loam soils (80% orchards) seem ideal for citrus cultivation (Fig. 1 and 2), soil and leaf analysis of Dailekh citrus orchards shows that they are only medium to low in organic matter and Nitrogen, although high in Phosphorus and Potash content (Shrestha *et al.* 2008). Moreover, farmers usually do not apply chemical fertilizers to their citrus orchards and apply compost fertilizer only to the intercropped cereals (Fig. 5). Thus, there seems to be appreciable scope to improve nutritional management system of citrus in the Dailekh district.

As already noted, upland rice or maize (rainy season) and wheat (winter season) are commonly intercropped in the orchards (Fig. 10). This is likely to create a sub-optimal cropping because these cereal crops are heavy nutrient feeders. Further, the cultivation time of these cereal crops coincides with the flowering and fruiting stage of citrus when there is heavy demand for water. Few farmers have an assured source of irrigation (Fig. 7 & 8) and the combination of high water demand and disruption caused by cultivation aggravates fruit drop, a fact confirmed by the farmers (Fig. 20). Unfortunately, the farmers also belief that intercropping both increases citrus yield and improves food security by growing other crops. A similar perception of intercropping is held by farmers of the Eastern mid-hills of Nepal who state that intercropping increases citrus production because of better aeration of the root zone due to plowing and greater cleanness of the orchard (CADP, 2008). To the extent that a better citrus yield is associated with intercropping it is likely to be due to addition of nutrients by the a short-duration leguminous vegetable crops. As most semi-commercial farmers seek a trade-off between cash income and food security, a legume based intercropping solution should be developed by R and D partners so that citrus production is not impaired by intercropping.

All citrus orchards host by various diseases (Powdery mildew, Sooty mold, Greening disease) and pests (Scale, *Citrus phylla*, Lemon butterfly, green stink bug and borer) (Fig. 20 and Table 1). The presence of *Citrus psylla* insect, the vector for Citrus greening disease, has been reported (Regmi *et al.* 2001) in the Dailekh district, and serological tests have confirmed its presence up to 1300 m after sea level. However, the use of pesticide is limited to some contact fungicides and insecticides (Subedi *et al.*, 2008 and personal observation) for only a limited suite of diseases and pests. Further, the presence of Tristeza viral disease has also been confirmed in some orchards (Regmi and Adhikari, 2000). Although seedling plants are more susceptible to Tristeza disease (as well as water stress), farmers are reluctant to use grafted saplings because grafts are difficult to raise in intercropped orchards, need special pruning during the early stages after planting, are more expensive than seedlings and have only limited availability. The use of trifoliate orange (*Poncirous trifoliate*) (CFE, 2000) and rough lemon (*Citrus jambiri*) (Cheema et al., 2003) root-stock grafted sapling help to mitigate these diseases and water stress problems, needs to be encouraged.

An on-farm study of integrated nutrient, pest and orchard management in the same three surveyed villages by this author revealed an increase of 14.5% in fruit size, 72% in fruit number and 121% in yield per tree compared to farmers' practice (Acharya *et al.* 2009). This confirms that potential to improve the productivity of citrus orchards with improved cultural practices.

Further, improper harvesting and transportation (Fig. 13 & 15) arise from the farmer's lack of knowledge about post-harvest technology (Fig. 16) and, because of this; farmers receive lower prices for their product. Moreover, lack of knowledge about marketing leads them to sell fruit to middle-men rather than wholesalers (Fig. 17 and 19) and, thus receive lower prices. Hence, a better knowledge of market demand and marketing channels could raise their aspiration to produce both better quality and quantity of citrus.

CONCLUSION

Integrated plant nutrient and pest management programs need to be adopted by R &D partners for these production areas. In addition, farmers need to be encouraged to plant grafted saplings because they are free of bacterial and viral diseases and can better withstand water stress. Lastly, it is suggested that R and D partners organize training and awareness programs on proper orchard and nursery management, and post-harvest handling and marketing processes.

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