

RESEARCH ARTICLE

FARMERS' PERCEPTION ON ORCHARD MANAGEMENT IN MANDARIN ORANGE (*CITRUS RETICULATA* BLANCO.) IN GULMI DISTRICT, NEPAL

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ABSTRACT

The study aimed to understand farmers' perceptions of mandarin orchard management in Gulmi district, Nepal. A total of 100 respondents were selected through simple random sampling and interviewed using a semi-structured questionnaire. The collected data were then entered in Ms. Excel and then analyzed using STATA. On an average, each household allocated 0.48 hectares for mandarin cultivation, with 2.45 family members engaged in farming and an average of 17.21 years of experience in mandarin production. Findings revealed that 68% of farmers relied solely on rainfall for irrigation, while only 31% stored water. Organic farming practices dominated, with 78% using only farmyard manure (FYM) and 9% combining FYM with chemical fertilizers on a regular basis. Training on orchard management was received by 58% of farmers, while subsidies were accessed by only 15%. Pruning was practiced by 92% of farmers, but only 40% had received proper training, and merely 2% performed training. Post-pruning, 32% applied Bordeaux mix. Most farmers were aware of common mandarin pests and diseases, yet few used chemical insecticides or fungicides, favoring organic methods instead. Farmers were gradually adopting scientific practices like pit preparation, pruning, mulching, and Bordeaux mix application. However, challenges such as inadequate irrigation, prevalence of pests and diseases, and limited knowledge of proper orchard management remained significant constraints in mandarin production.

KEYWORDS

Mandarin orange, orchard management, farmers' perception

1. INTRODUCTION

In context of Nepal, Agriculture is an important source of economy that contribute to 24.12% of GDP. Horticultural crops contribute to about 15% to AGDP of which, Mandarin contribute to 0.9648% of AGDP (MOALD, 2023). Citrus crops contributes about 27% of the total fruit area of Nepal out of which 64.0% is covered by mandarin. Although the area and production is highest in Gandaki province, the productivity (11.45 Mt/ha) is highest in Lumbini province (NCRP, 2023). They can be grown in sub-tropical climates of mid hills and terai with altitude ranging from 800 to 1400 masl. Deep sandy loam soil with pH range of 5.0 is best for its cultivation. Citrus is being grown commercially in 64 districts of Nepal with 48 district of hills and 16 district of terai (NCRP, 2023).

Gulmi has a flair for becoming successful in cultivation of Mandarin. It has got suitable geographical and climatic condition. Gulmi has an altitude favorable for mandarin cultivation. For successful cultivation of mandarin, different factors need to be considered. Among them orchard management is the most important among all. Management practices conducted at right time and in appropriate manner promotes physiological functions of plants which ultimately leads to resource utilization in an economically efficient way (Dorji et al., 2016). The productivity of mandarin decreases with the age. However, Lower productivity and decline of mandarin has been mainly caused by poor management practices (Panth and Dhakal, 2019). The production of Mandarin has dropped this year due to traditional methods of cultivation and more than 95% of the farmers' use of seedling from seed. Further, lack of nutrients and fertilizers in mandarin orchard has resulted yellowing of leaves, shriveling, drying of branches and plants from the tip,

falling and small fruits, lack of juicy fruits and thickening of the bark of fruits has decreased the production compared to the previous year (Ghimire, 2080).

Most of the farmers of Gulmi district are involved in Mandarin farming for their economic upliftment. Most of the farmers are using seedling from seed for orchard establishment. As per the farmers, the main constraints for mandarin production is lack of irrigation facility. Similarly, unavailability of fertilizer at proper time, lack of training to farmers about good agricultural practices, prevalence of diseases like dieback, citrus greening and pest like Chinese fruit fly and stink bug were also causing severe loss to the production (Adhikari et al., 2021). Inappropriate spacing between plants, dense planting, inappropriate training and pruning, absence of proper storage facility like cold storage or cellar storage, letting fruit to stay in tree and late harvesting are the major prevalent in this area. Further stress shows symptoms of yellowing of leaves, dieback, defoliation and nutrient deficiency.

Mandarin is one of the most grown indigenous fruit of Nepal. Though indigenous, it is regarded as high value commodity with high potentiality of production and marketing as climate and ecology required for its cultivation is prevalent in most of the districts of Nepal. Even though the demand of mandarin is high, but due to lack of knowledge about good orchard management, cultivation practices and prevalence of various diseases and pests, the farmers are unable to meet the supply of mandarin as demanded. So, this study will help to find out the farmer's knowledge about orchard management, practices implemented by farmers for production of mandarin and also helps to access the status of orchard management and thus facilitate farmers with the better practices for

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orchard management.

Further, this study also helps to identify constraints in management practices adopted by farmers and will give significant recommendations for farmers for adopting better management practices to minimize attack of disease and pest, proper spacing, clean cultivation. It also assists in implementing different program and policies by various governmental and non-governmental organizations for better orchard management and increasing the quality, productivity and finally demand of mandarin.

1.1 Program and Policies related to Mandarin orange

Agriculture Perspective Plan (APP) has been formulated with a goal of setting the agricultural sector into a sustainable path. It was initiated in late 1992 and then implemented since 1995/96. APP has given priority output to high value crops and expected to triple during this course. APP has prioritized high value crops like apples in inner Himalayan zone, Citrus throughout the mid-hills, off-season vegetables in hills as well as terai, beekeeping products in hills and mountains and raw silk in hills (APP, 1995). ADS has also set target to increase the volume of food production, increasing Agricultural Trade Competitiveness thus reducing the vulnerability of farmer through improved seed and improved agricultural practices, improved access to market and post-harvest losses.

The 15th periodic plan has also set the strategies to improve production and productivity of Agricultural commodity through mechanization, modernization, commercialization and industrialization (Gaihre and Dhakal, 2022). The 15th periodic plan has set a goal to increase productivity of fruits from 9.8 metric ton per hectare in FY 2.75/76 to 12 metric ton per hectare in FY 2080/81. (National Planning Commission, 2020)

Gulmi district is identified as potent for citrus cultivation. PMAMP has listed Gulmi as a Citrus Zone which is working by creating pockets and block of Citrus. PMAMP Program Implementation Unit, Gulmi aims in developing a commercial, sustainable, ensuring nutrient security and self-sufficient agricultural sector oriented towards agricultural industrialization. It has also provided various programs and trainings and equipment to the farmers for commercialization and increasing the area and production of Mandarin.

1.2 Status of Mandarin production in Nepal

The trend of mandarin farming is increasing from past 30 years. In 2068 B.S., there was production area from 6000 hectare which is increasing in

yearly basis. There are around 363,359 farmers involved in mandarin farming. Area of 6,545.3 ha is used for compact plantation of mandarin (National Statistics Office, 2023).

In the context of Nepal, there is gradual increase in total area and productive area. However, the trend of production is fluctuating. In the fiscal year 2021/22, though there is increase in production area, there is subsequent decrease in production than previous year which ultimately decreased the yield of mandarin.

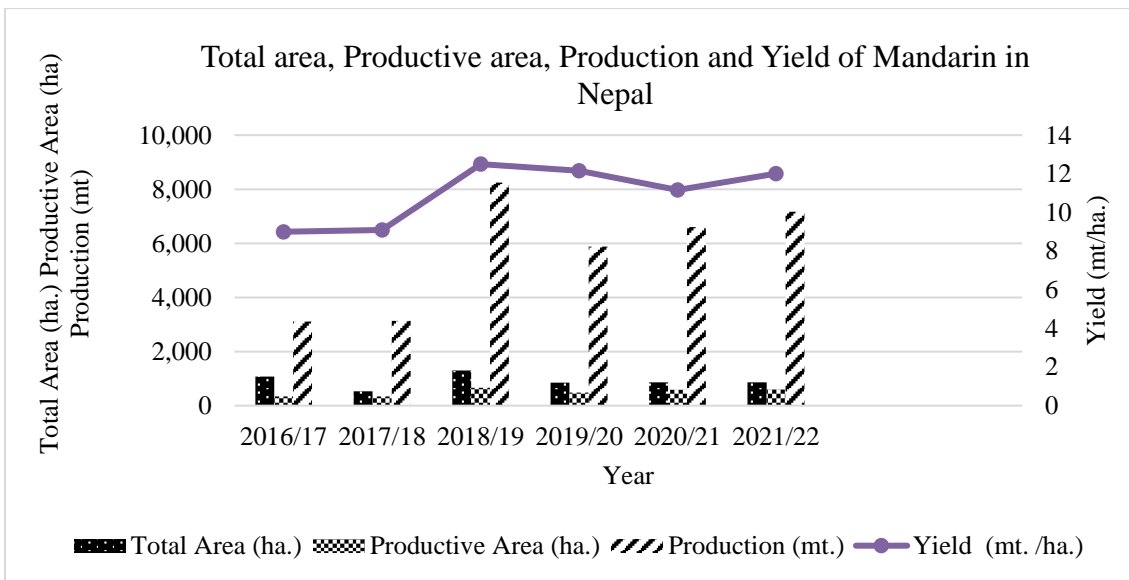
Table 1: Table showing Total area, Productive area, Production and Yield of Mandarin in Nepal

Year	Total Area (ha.)	Productive Area (ha)	Production (mt)	Yield (mt/ha.)
2013/14	25407.9	16527.5	149315.5	9.0
2014/15	25123	16224	149212	9.2
2015/16	26,282	16,248	146,690	9
2016/17	28,760	17,457	164,593	9
2018/19	27,951	17,220	177,381	10.30
2019/20	6,591.18	4,550.32	156,179.68	10.73
2020/21	27,002	18,369	198,406	10.80
2021/22	27,982	19,481	185,346	9.51

Source: (MOALD, 2023)

1.3 Status of Mandarin production in Gulmi district

In the context of Gulmi district, there was sudden decrease in productive area in 2019/20 than the previous year. However, there is gradual increase in productive area and production. The productivity of mandarin in FY 2021/22 was 12 metric ton per hectare.



Source: (MOALD, 2023)

Figure 1: Graph showing Total area, Productive area, Production and Yield of Mandarin in Gulmi District

1.4 Orchard management in Mandarin

Orchard is the area which is oriented particularly towards the cultivation of fruits. Orchard management begins right from the planning of orchard and goes through various intercultural operations till the harvest with an objective to increase the production and achieve best marketable yield. Orchard management includes all the activities like orchard establishment, irrigation, nutrition, canopy management, regular monitoring and orchard protection from diseases and pest.

2.1 Selection of research site

The study was carried out in ward no 3 of Resunga Municipality and ward no 1 of Dhurkot rural municipality of Gulmi district where most of the farmers are involved in mandarin farming. The reasons for selection these areas are:-

- These areas are listed under citrus zone by PMAMP.
- Most of the farmers in these area are involved in Mandarin cultivation

2. MATERIALS AND METHODS



Figure 2: Map of Gulmi district showing research site

2.2 Sample and Sampling techniques

The sample was taken from Resunga municipality and Dhurkot rural municipality. There are total of 5773 farmers growing mandarin in Resunga municipality and Dhurkot rural municipality. Among them, 100 mandarin farmers was selected by using Yamane's Formula. 50% of the respondents were from Resunga municipality and remaining were from Dhurkot rural municipality based on simple random sampling.

At 90% confidence level and $e = 0.1$, size of the sample is determined by using following formula (Yamane, 1967)

$$n = \frac{N}{1 + Ne^2}$$

Where,

N is the population size

e is the level of precision

n is the required sample size

2.3 Research Design

First of all, the study area was selected. Personal interviews were done in order to collect the primary data by asking the pretested questionnaire. In addition to this Key Informant Interviews was also carried out to cross-check and validate the responses gathered from the interview.

2.4 Data and Data Types

2.4.1 Primary Data

Primary data was collected from household survey, Key Informant Interview (KII) and field observation.

2.4.1.1 Household Survey

A semi structured questionnaire including open ended and close ended questionnaire was prepared. These questionnaires were pretested and finalized. Finally household survey was conducted in the selected site to gather the information.

2.4.1.2 Key Informant Interview (KII)

KII was carried out among progressive farmers, Cooperative staffs, village elders and staffs of citrus zone of PMAMP. The interview was intended on gathering the information on how the farmers manage their orchard, major problems of the orchard management, disease and pest prevalent in the area and their management practices adopted by farmers of the selected area.

2.4.1.3 Field Observation

The farmer's orchard was also visited in order to review the responses of the respondents. Field observation help to assess the orchard management and the diseases and pest mitigation measures adopted by farmers.

2.4.2 Secondary Data

Secondary data was gathered from journals and articles publications, Central Bureau of Statistics, newspapers, Agriculture Knowledge Center (AKC) and reports from PMAMP Gulmi.

2.5 Data Analysis

The collected information were entered in MS- Excel. These data are thoroughly checked, coded and then analyzed using Stata. Descriptive

statistics were computed to ascertain the distribution of the research variables, including frequency and percentage. Problem ranking was also assessed to determine the major challenges faced by farmers during the orchard management.

2.5.1 Problem ranking

Major challenges faced by the farmers during the orchard management were identified and listed. Forced ranking scales were used by giving a score of 1 to the most severe problem and assigning 2, 3, 4 and 5 to the less serious problems simultaneously.

Farmers were asked to rank these problems based on their severity and weight of each problems was calculated and index was finally obtained. Based on these index, ranking of the problems was done. Formula used for problem indexing is given below;

$$I = \frac{\sum SiFi}{N}$$

Where,

I = Index Value

Si = i^{th} scale value (1=1, 0.8, 0.6, 0.4, 0.2)

Fi = frequency of i^{th} importance given by the respondents

N = Total number of respondents

The challenges with highest index value was ranked as first followed by second, third and so on.

3. RESULTS AND DISCUSSION

3.1 Household Characteristics

The survey was conducted among the respondents having wide range of age. The youngest respondent was only 25 years while the eldest respondents was 82 years old with average age of the household head as 53.31 years (SD=12.62).

The respondents has an average of 5.73 family members (SD=3.33), with minimum of 2 and maximum of 22 family members. Among them the mean number of family members involved in mandarin farming is 2.45 (SD=1.23), where lowest number of family member involved being 1 and highest reaching 8.

On an average, household has been farming mandarin since 17.21 years (SD=13.13) having the experience level of farming ranging from 2 to 60 years. This significant variance suggests a significant difference in experience as some household has a rich history of involvement in farming while others are very new to it. The mean total area of the land per family was 0.81 ha. Out of the total area, Mandarin is being planted in 0.48 ha (59.26%), while other crops were grown on 0.33ha (40.74%). The population of mandarin tree ranged from 35 to 1200 trees, with an average household possessing 219.04 trees.

Out of the total respondents, 99% of the household have Mandarin trees that bear fruit. The least number of bearing tree is 2 while one of the respondents have 400 bearing Mandarin trees. The average number of Mandarin tree that bear fruits is 95.52 (SD = 86.08). In contrast to the bearing trees, 98% of the household have non-bearing trees. The non-bearing trees were in between 5 and 1100 with an average of 127.02 (SD = 194.92). This signifies that almost all the families have made significant investments in orchard establishment

Table 2: Household characteristics of the respondents					
Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Age	100	53.31	12.62	25	82
Family size	100	5.73	3.33	2	22
Member involved in Mandarin cultivation	100	2.45	1.23	1	8
Year of mandarin Cultivation	100	17.21	13.13	2	60
Total area(Ha)	100	0.81	0.59	0.15	3.05
Mandarin population	100	219.04	218.57	35	1200
Bearing	99	95.51	86.08	2	400
Non-Bearing	98	127.02	194.92	5	1100

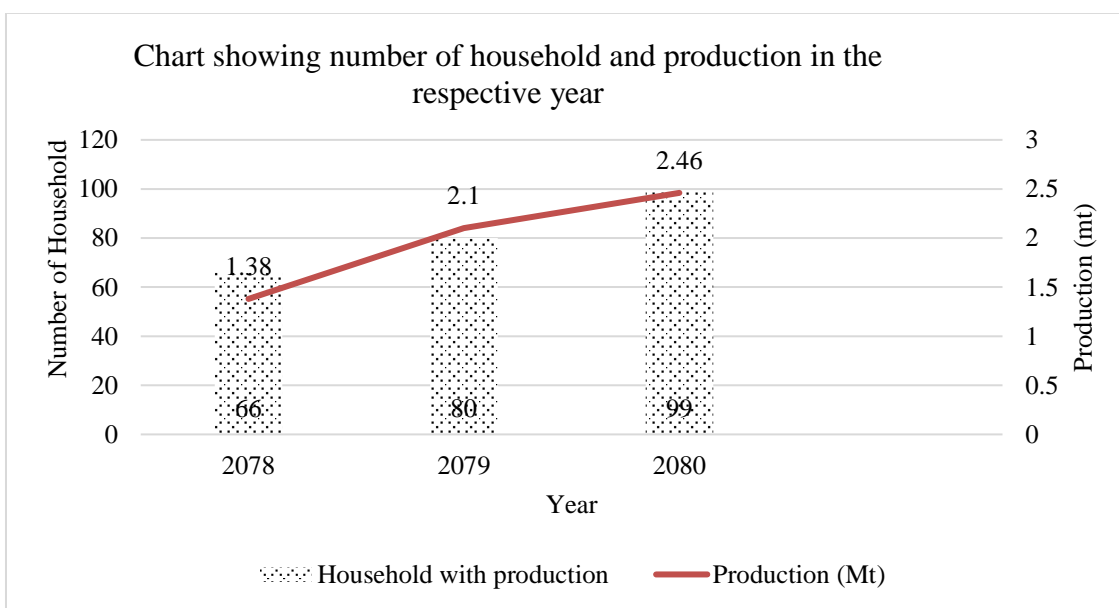
Source: Field Survey, 2024

3.2 Support mechanisms for the farmers

Among total respondents only 58% has received the training related to mandarin facilities. Similarly only 15% of the total respondents have got subsidies in constructing pond, tank, and for the planting materials. However 70% of the respondents have access to credit facility through the cooperatives and farmers group.

3.3 Trend of Mandarin production

The chart demonstrates that the number of household that are involved in production in 2078 was 66. The number increased to 80 in 2079. This number increased to 96 in 2080. This represents that the number of household involved in mandarin cultivation is increasing.



Source: Field Survey, 2024

Figure 3: Chart showing number of household and production in the respective year

Similarly, during the course of three years, there was a significant increase in production from 1.38 metric ton in 2078 to 2.46 mt in 2080.

3.4 Reason for increase/decrease in production

As per the responses, 60 of the respondents reported that there is increase in the production of Mandarin in this year. Among them 36.67% of the people admitted that the reason for the increase in production was due to better management of orchard while 63.33% of the household responded the reason was due to increase in number of bearing trees.

However, there was decrease in production in this current year among 19 respondents. Among them most of the respondents (57.89%) believe that the reason for decrease in production was due to off season followed by lack of irrigation (26.32%), fruit drop (10.53%) and landslide (5.26%) respectively.

Furthermore, 20 out of total respondents were on first sales and 1 respondents have new orchard without the production of mandarin.

3.5 Drivers encouraging farmers towards Mandarin production

Figure reveals that around 36% of the household were involved in mandarin as it was easy to practice mandarin farming, 32% were involved due to its high return followed by factors like influence from neighbor, tradition (13%). 5% of the respondents were involved in mandarin farming due to all the above mentioned factors.

3.6 Direction of Orchard

The study revealed that 68% of the household orchard are facing towards the north while 15% is facing towards the north east followed by East (7%), West (4%), South (3%) and North West (3%).

3.7 Soil test

In the study area, only 14% of the farmers have performed soil test while majority of the farmers haven't performed soil test.

3.8 System of plantation

3.8.1 Layout of orchard

The study revealed that majority of respondents (81%) adopted irregular system of plantation followed by square (9%) and rectangular system of plantation (7%). Only 3% of the respondents has been practicing rectangular system for plantation for recently planted mandarins and irregular system was practiced for older trees.

3.8.2 Pit preparation

Out of the total respondents, only 45% of the household prepare pit before planting of the Mandarin. Among them, 55.56% of the household prepares the pit of size 1m*1m*1m followed by random size of the pit (40%) and pit size of 0.5m*0.5m*0.5m (4.44%).

In case of the fertilizers application in the pit, almost all those household who are digging pit for the plantation of mandarin (95.59%) has been using fertilizers.

Regarding the fertilizers, among those household who apply fertilizers in the pit, the vast majority (88.37%) of the respondents prefers to use only FYM while others (11.63%) prefer to use vermi-compost along with the FYM. None of the respondents has been using chemical fertilizers which reflect traditional, organic method of mandarin cultivation.

3.8.3 Closeness between plants

The study showed that majority of the household (40%) has been growing mandarin at sparse followed by 28% planted at normal distance, 23% being planted densely and 6% of the household has been planting mandarin at very far distance and 3% of them were planting them very closely.

3.8.4 Farmer's awareness on planting season and disease-free planting materials

The study showed that 98% of the farmers opt for planting during the rainy season demonstrating a great understanding of when it is best to grow mandarin where there is abundance of water. Just 2% of the farmers plant mandarin in the winter season.

However there is a notable gap among farmers related to disease free planting materials. Only 38% of the farmers are acknowledged that the planting materials they are using is disease-free. In contrast 68% of the farmers are unaware if the planting materials which they are using are free from disease or not.

3.9 Varieties

Almost all of the farmers (93%) use local variety followed by Palpa sthaniya variety (2%). A small portion of the farmers (4%) uses both local and Palpa sthaniya variety in their orchard. Among all the respondents, there was one progressive farmers who have been using local varieties along with other varieties like Palpa sthaniya, Unsu, Yasoda Pumkan and Ota Pumkan.

3.10 Farmer's perception on suitable age for planting Mandarin

In case of grafted plants, 51% of the farmers perceive that the best age of grafted plant to be planted in orchard is between 1 to 1.5 years followed by 2 years old plants (40%). A minority of respondents (5%) believe that grafted plants should be planted within a year while 4% of them consider to plant grafted materials of age more than 2 years.

However, the scenario of seedling from seed is just opposite than that of the grafted plants. Majority of the farmers (61%) reported that they prefers to use seedling from seed having the age of more than 2 years. Only 24% of the farmers uses 2 years old seedling followed by seedling of aged 1 to 1.5 years (15%).

3.10.1 Method of planting Grafted plants

The study revealed that 85% of the farmers are aware about the planting method of the grafted plants. They perceive planting grafted plants with the union of graft above the ground level. In contrast 1% of the farmer perceives that grafted plant should be planted with the union below the ground. However 14% of the farmers are unaware about the method of planting grafted plants.

3.11 Bee hive

The study showed that only 46% of the respondents have reared bee with an average of 3.54 bee hive. The minimum number of bee hive is 1 and maximum reaching up to 28 bee hive.

3.12 Irrigation

Majority of the household (68%) relies on the rain as the source of irrigation while only small portion of the household (32%) are using irrigated system. For the irrigation of the mandarin only 31% of the respondent have water storing facilities while 69% of the total respondents do not have such storage facilities.

Among those household who have been irrigating the mandarin plants, 65.62% of them have built the tank followed by pond (18.75%), 3.13% of the household has been using both source of irrigation. Lifting has been used by 9.37% of the household while 3.13% of the household irrigate the orchard through pipe directly from the water source.

3.12.1 Farmer's perception effect of lack of irrigation on the mandarin

The study showed that the most common effect is increase in flower and fruit drop which was reported by 30% of the respondents followed by yellowing of the plants (24%), reduced fruit size (14%), reduced fruit quality (14%) and reduced fruit size (10%). 20% of the respondent responds on both reduced fruit size and increase in flower and fruit drop

while 2% believe that lack of irrigation causes mold to develop around the plants.

3.13 Nutrition

3.13.1 Types of Fertilizer with their application

From the study, it was found that 91% of the farmers involved in mandarin farming applies the FYM only while only 9% of the farmers uses both FYM and chemical fertilizers.

Among the farmers who uses FYM, 78 farmers were classified as regular applicator while only 13 of them were irregular applicator of FYM. Whereas all those farmers who apply both FYM and chemical fertilizers apply fertilizers at a regular interval.

3.13.2 Source of Chemical fertilizers

Among the farmers who are using the chemical fertilizers, 44.44% of the farmers buy fertilizers from cooperatives followed by 11.12% of the farmers buy the fertilizers from agro-vet. However 44.44% of the farmers buy fertilizers from the both cooperatives and agro-vet.

3.13.3 Method of fertilizers application

Out of the total respondents, 65% of the farmers apply fertilizers through ring placement whereas 35% of the farmers broadcast the fertilizers in the field.

3.13.4 Fertilizer application according to size of plants

The average amount of fertilizers applied for the smaller plants is 11.45 kg (SD = 3.50) per plants whereas that for larger plants is 31.41 kg (SD = 31.41) per plants

3.14 Training and Pruning

3.14.1 Training

The study revealed that only 2% of the farmers are involved in training of Mandarin where they practice center leader system where as 98% of the farmers don't practice pruning.

3.14.2 Pruning

The study revealed that only 58 of the farmers have received training about pruning in mandarin. Among them, 55 of the respondent practices regular pruning whereas 3 farmers do not perform pruning. In contrast, of the 42 farmers who haven't received training about pruning 37 farmers have been performing pruning whereas 5 of the farmers haven't performed pruning

Out of the farmers who are involved in regular pruning (92), 7.61% of them prune only loranthus followed by dead shoots (6.52%), suckers (4.35%) and laterals up to 45 cm (1.09%). However 80.43% of the farmers prune all the above mentioned parts.

3.14.3 Equipment used in pruning

The study revealed that most of the farmers are conscious about the importance and has been using various equipment for pruning. 31.52% of the farmers uses secateurs followed by sickle (7.61%) and saw (2.17%). 54.35% of the farmers have both saw and secateurs and has been using them for the purpose of pruning while 4.35% of the farmers don't have any equipment and has been doing pruning by hand.

3.14.4 Farmer's perception on Bordeaux mix

Of the total respondents, 80% of the farmers have knowledge on preparation of Bordeaux mixture and its application. 55% of them got to know about it from the training followed by Neighbor (28.75%) and through Mobile or internet (16.25%).

The survey also showed that only 32% of the farmers who have knowledge about the Bordeaux mix has been applying Bordeaux mix after pruning where as 68% of the farmers don't apply it after pruning.

3.15 Intercropping

The study revealed that all of the respondents has been practicing intercropping. Majority of the respondents (78%) are growing cereals like maize, wheat and barley. 6% of them are growing vegetables like beans, cowpea, leafy vegetables etc. 14% of the respondents were growing both cereals and vegetables while only 2% of them were growing coffee.

3.16 Weeding

3.16.1 Farmer's perception on importance of weeding

The study revealed that all of the respondents are aware about the importance of weeding. 69% of the farmers perceives that weeding

promotes better nutrient and water uptake followed by control of disease and pest infestation (17%), increased yield (12%) and better fruiting and increased quality of fruits (2%).

3.16.2 Method of weeding

The result demonstrate that though the farmers are aware about the effect of weeding however, weeding is practiced in 98 out of the 100 household. Out of them 78.57% of the farmers are manually weeding followed by use of mechanicals (6.12%) like mini tillers and plough. 15.31% of them are using both manual and mechanical method of weeding.

3.17 Mulching

In the study area, 95% of the farmers haven't performed mulching while only 5% of them have practiced mulching in mandarin. Though majority of the household haven't performed mulching but 24.21% are positive about the importance of mulching whereas 75.79% of them don't consider mulching as integral part of Mandarin orchard.

3.18 Diseases

3.18.1 Farmer's perception on Disease severity

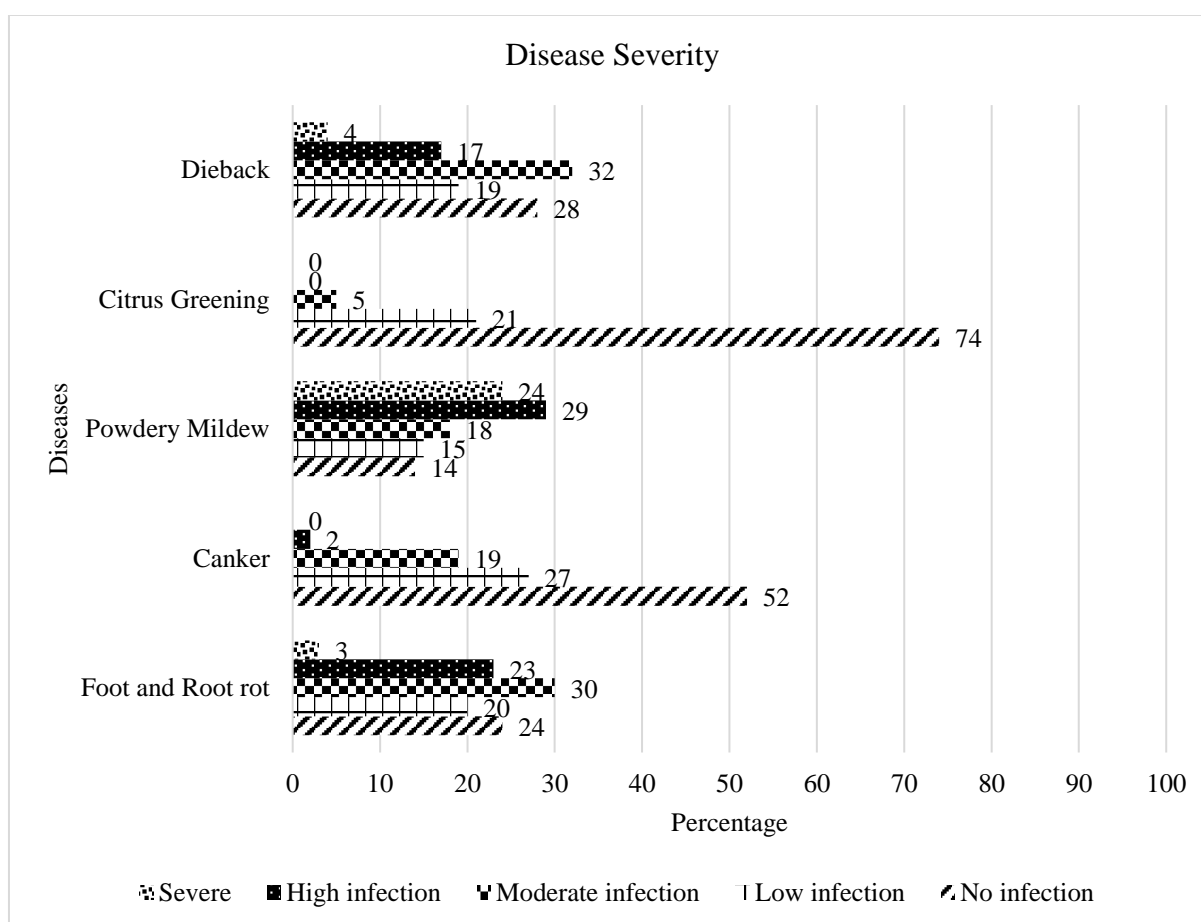
The bar graph illustrates the farmer's perception on disease severity on their orchard. As per the responses the major five diseases present in the study area are powdery mildew, foot and root rot, dieback and citrus greening.

Dieback was reported to be severe among 4% of the household while there high infection among 17% of the farmers. 32% of the farmers have reported moderate infection followed by low infection (19%) and 28% of the household has reported no infection of dieback. In contrast none of the farmers reported severe or high infection of citrus greening in their orchard. 5% of them have faced moderate infection while 21% has reported low infection whereas majority of the respondent (74%) has reported no infection of citrus greening in their orchard.

Powdery mildew has been reported to be severe problem of the orchard among 24% of the household while there is high infection among 29% of the farmers. 18% of the farmers have reported moderate infection of this disease followed by low infection (15%) and 14% of the household has reported no infection of dieback in their orchard.

Most of the farmers (52%) reported there is no infection of the citrus canker in their orchard, 27% of them reported there is low infection of canker in the orchard followed by moderate infection (19%) and high infection (2%). None of the respondents have reported severe infection of canker in their orchard.

After powdery mildew, foot and root rot is reported to be causing severe and high infection by 3% and 23% of the household respectively. 30% of them reported moderate infection followed by low infection (20%) and no infection was reported by 24% of the household.



Source: Field Survey, 2024

Figure 4: Disease severity in orchard of the respondents

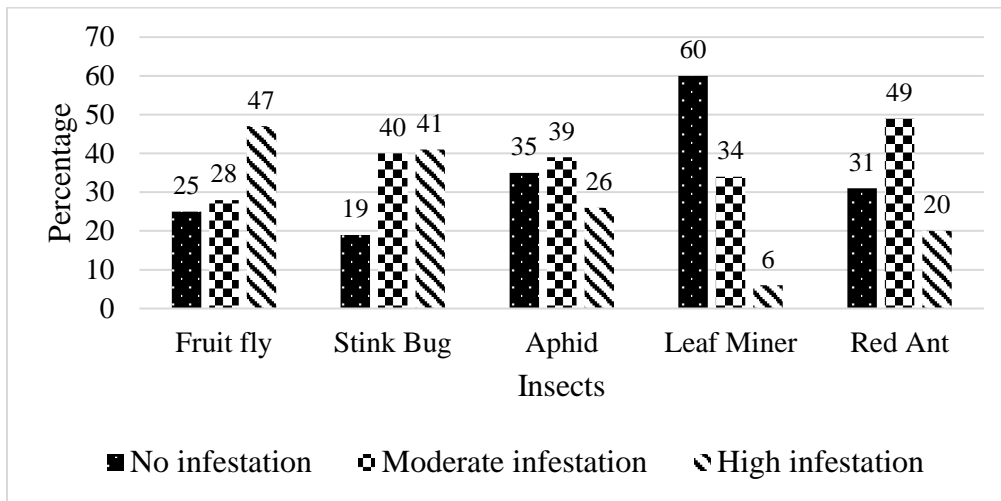
3.18.2 Practices to control diseases

Almost half of the respondents (49%) don't practice any measures for the control of the disease whereas 16% of the respondents believe proper management of the orchard can minimize and control the disease. 14% of them apply Bordeaux mix in their orchard to prevent the disease. 2% of the farmers apply cow urine and water in the disease infected parts while 10% of them apply both Bordeaux mix and cow urine in their orchard. Most of the farmers avoid using chemicals for controlling the disease while only 5% of the farmers are using fungicides as prescribed by the agro-vet and 4% of them are spraying micronutrients to prevent diseases.

3.19 Insects

3.19.1 Farmer's perception on insect infestation

The study revealed that 47% of the farmers believe that there is high infestation of the fruit fly followed by moderate infestation (28%) and no infestation was reported by 25% of the farmers. In case of Stink bug, 19% of the farmers reported no infection in their orchard, while 40% reported moderate infestation followed by 41% of the farmers with high infestation. Aphid has been reported to be of high infestation by 26% of the respondents while 39% of them reported moderate infestation followed by no infestation (35%). Most of the farmers (60%) reported there is no infestation of the leaf miner in their orchard, 34% of them reported there is moderate infestation in the orchard followed by high infestation (6%). However, about half of the respondents (49%) has reported moderate infestation of the Red ants with 20% of them facing severe infestation followed by no infestation (31%).



Source: Field Survey, 2024

Figure 5: Insect infestation in orchard of the respondents

3.19.2 Practices to control diseases

For the control of the insects, only 14% of the farmers use the insecticides. These insecticides are prescribed by the agro-vet. Similarly, 2% of the respondents use cow urine, ash and water for controlling the insects. 14% of the farmers apply Bordeaux mix around the plant canopy for preventing the incidence of the diseases. While 70% of the farmers don't practice any measures to control diseases.

3.20 Major orchard management problems

Based on the KII, major problems associated with Orchard management in mandarin farming in the district were identified and included in the questionnaire. The major five problems were incidence of disease and pest, lack of irrigation facility, High cost of inputs like fertilizers and saplings, Lack of training and knowledge about package of practices and flower/fruit drop. Then the farmers were asked to rank the problems on the scale of 1 to 5 under forced ranking by giving score of 1 to the most severe problems and ascending the values as the severity decreases. Finally the index value was obtained and ranking was done based on the index value.

Lack of irrigation facility was the most significant problems with the highest index value of 0.774. The second major problems associated with mandarin farming was diseases like Powdery mildew, Foot and root rot, Dieback, Canker and Citrus greening. And insects like fruit fly, Red ant, stink bug, aphids and leaf miners.

The third, fourth and fifth problems ranked were lack of training and knowledge about package of practices and orchard management, flower or fruit drop and high cost of inputs.

Table 3: Ranking of the major problems in orchard management

Major problems	SiFi	Index value	Rank
Disease/Pest	73	0.730	II
Lack of Irrigation Facility	77.4	0.774	I
High cost of inputs	39.2	0.392	V
Lack of training and Knowledge	62.6	0.626	III
Flower/Fruit drop	48.4	0.484	IV

4. DISCUSSION

The study highlights the prevalent practices that are being adopted in orchard management by the farmers of the area. The study revealed that the primary method of planting the sapling is traditional method (55%) using the local varieties by 93% of the farmers which indicates that the farmers rely in indigenous practices. The majority of Mandarin growers in the midhills are male, middle-aged, with medium-sized families and farms, mainly literate, and relied on agriculture as their principal source of income (Belbase et al., 2020).

There is more number of non-bearing plants than the bearing plants in the orchard with the mean of 127.02 and 95.51 respectively. Similarly there are more number of plants having the age of less than 5 than that of the plants having the age of 15 or more. There is potentiality of increase in the production of mandarin as the number of plants having the age of 5 or more

is increasing and the production is maximum until the age of 25 (Rattan et al., 2020). The production of mandarin was increased from 2.1 tons per hectare in 2079 to 2.46 tons per hectares in 2080. 36.67% of the farmers believe the main reason for increase in production is due to the better management of the orchard while 63.33% of the farmers believe that increase in the number of fruiting plants is the main reason for the increase in production. The majority were members of farmers' groups but had limited access to training (Poudel et al., 2020).

Soil test was performed by only 14% of the farmers. 81% of the farmers are planting saplings at an irregular distance. 40% of the farmers perceive that the best time for planting grafted plants is 2 years while 61% of them plants at the age of 2 or more. 14% of the farmers are rearing bee that plays crucial role in pollination and increased fruit set of the mandarin (Ramon et al., 2021).

A large fraction of farmers (68%) are relying on rain-fed method of irrigation while only 31% of the farmers store water out of which 62% of the farmers are storing water in the tank. 71% of the farmers apply FYM only whereas 9% of the farmers apply chemical fertilizers along with FYM. Ring placement of fertilizers application has been in practice by 65% of the farmers. All of the farmers have been practicing weeding where 78.57% of them are practicing weeding manually. Out of the farmers 40% the farmers who got training in pruning of plants, 92% of them are practicing pruning where more than half (54.35%) of farmers use saw and secateurs. 32% of the farmers apply Bordeaux mix after pruning. Only 5% of the farmers are adopting mulching that encourage fruit production as it checks water loss and suppress the growth of weed in mandarin (Bons et al., 2018).

The major insect pests of Mandarin in Nepal were fruit flies, citrus psylla stink bugs, aphids, and red ants (Magar et al., 2024). However, citrus psylla was not recorded by any of the respondents in the study area. There is moderate to high infection of powdery mildew, foot and root rot and dieback however none of the farmers reported high and severe citrus greening. In contrast, 35% of the 51 orchard of the same area was detected positive for citrus greening (Poudel et al., 2024). However only 15% of the respondents were applying insecticide whereas only 5% of the farmers were using fungicides. Majority of the population in the western midhills has ranked lack of irrigation as the major problems followed by disease and insects and lack of knowledge and training on package of practices (Neupane and Regmi , 2020).

5. CONCLUSION

Most of the farmers were still relying on traditional practices of Mandarin production like planting without digging pits, rain-fed irrigation. However, farmers are gradually shifting towards scientific cultivation practices like pit method of planting, training, pruning, application of Bordeaux mix. They relied mostly on the local variety that are best suited in the area with almost all of the farmers preferring FYM as a nutrient supplements. Though the mulching is not in practice but majority of the farmers are positive and are willing to adopt mulching in the orchard. Most of the farmers prefer organic farming so they avoid use of any chemicals in their field in the form of fertilizers or as an insecticides or pesticides. The major problem reported in the study area are lack of irrigation, prevalence of disease and insect, lack of training and knowledge about PoPs. Though most of the farmers are aware about the disease and insects prevalent in their orchard however most of them prefer to use organic method of disease and pest

management rather than use of insecticides and fungicides. Thus, programs related to better irrigation facility, disease and insect management and training related to orchard management are highly recommended to the study area for better management of orchard.

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