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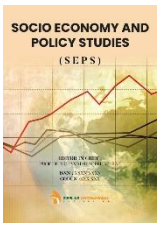


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*RESEARCH ARTICLE*

# FARMER'S PERCEPTION ON MANDARIN (*CITRUS RETICULATA* BLANCO) DISEASE IN GORKHA, NEPAL

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**ABSTRACT**

A study was carried out to examine the Farmer's perception on mandarin disease in Gorkha district of Nepal to assess mandarin growing farmers' knowledge towards mandarin attacking diseases and their prevailing management practices. Purposive random sampling techniques was used to select the household and interview with the semi-structured questionnaire was carried out Primary data were collected by the use of pre-tested questionnaire from 120 respondents selected to represent citrus growing farmers in Gorkha, Nepal. The data were processed and analyzed by using descriptive and inferential statistics through MS-excel and SPSS. The study revealed that majority of farmers had basic knowledge about mandarin attacking diseases and their major source of information was training. The major diseases ranked by the farmers were die-back (index 0.852), citrus greening (index 0.760), powdery mildew (index 0.730), root rot (index 0.670) sooty mold (index 0.440), pink disease (index 0.377), gummosis (index 0.335) and scab disease (index 0.330). On an average farmer had knowledge score of 1.53 and could name 2.17 diseases. The major expectations of the farmers from government for disease management were monitoring of orchard by specialists and recommendations for disease management (index 0.87 followed by providing healthy planting materials (index 0.65). Majority of the farmers adopted training pruning, application of Bordeaux mixture and paste (58.3%), weed control measures, intercropping, tillage and mulching (5%).

**KEYWORDS**

Mandarin, Disease, Incidence, Management, Perception.

## 1. INTRODUCTION

The contribution of horticulture sector amounts to 15% of Agriculture GDP, among which fruits contribute about 7% (Atreya and Manandhar, 2016; MoAD, 2016). Among sub-tropical fruits, citrus fruits occupy third position contributing 20.03% to global food production. Mandarin is a second leading citrus crop after sweet orange which constitutes 21.27% of world's citrus production. Globally citrus is cultivated in 114 countries among which 53 countries grow citrus commercially with a total production of more than 115 million tons (Liu et al., 2012). In Nepal, citrus contributes to 22.4% of total fruit production, of which mandarin shares 66.97% of total citrus production. Nepal ranks 20$^{th}$ position in the world's mandarin production (Rokaya, 2017). The three major citrus species grown commercially in Nepal are Mandarin (*Citrus reticulata*), Sweet Orange (*Citrus sinensis*) and Lime (*Citrus aurantifolia*).

Citrus cultivation is done in 62 districts covering 46502 ha of area with 58.3% as a productive area. In Fiscal Year 2073/74, production of citrus was 246643 mt (MoAD, 2016). Gorkha is the fourth largest district of Nepal where the mid hills popularly consist of citrus fruits like mandarin, sweet orange, lime, lemon, pumelo, etc. The area occupied by Citrus cultivation is 1,140 hectares but the productive area of citrus cultivation is only 840 hectares. The productivity of citrus in Gorkha is 12.45mt/ha with the production of 8632mt.ton. Among citrus, mandarin orange solely occupies an area of 988 hectares with the productive area of 829 hectares. The production of mandarin is 8521mt.ton with the productivity of 12mt/ha (DADO, 2016). Despite the fact that the area of citrus cultivation in Nepal is in increasing trend, the productivity is very low as compared to most citrus growing countries in the world. The decline or stagnation of citrus productivity is reported to be caused by various biotic and abiotic factors (ARSD, 2006; Subedi and Acharya, 2008).

One of the major problems for decreasing the productivity of citrus fruits in Nepal is citrus decline. Thus, it has a scope for increasing the production and productivity through adoption of disease control measures and orchard management practices. The major diseases are citrus greening, root and foot rot, powdery mildew, sooty mold, etc. that are causes of citrus decline in Nepal (Paudyal et al., 2002). The research focus shall be on major diseases of mandarin, various orchard management factors like fertilizers, irrigation, mulching, insect vectors, tillage, height and orientation of the orchard knowledge of farmers regarding mandarin affecting and disease management practices adopted by them. This study was conducted to find out the major diseases of mandarin and knowledge of farmers regarding mandarin affecting diseases and their management practices adopted by them.

## 2. METHODOLOGY

### 2.1 Study site

The study was carried out in Gorkha district of Gandaki province of Nepal. The research was carried purposively under the command area of Prime Minister Agriculture Modernization Project (PMAMP), Project Implementation Unit (PIU), Citrus Zone, Gorkha. This area was

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purposively selected as it is the pocket area of mandarin in which farmer are growing mandarin commercially.

### 2.2 Sampling procedure and sample size

First of all, a list of mandarin growing farmers was prepared and used as sampling frame to select the respondent farmers which was provided by PMAMP, PIU, citrus zone, Gorkha. The surveys of 120 households were done based on purposive random sampling. Farmers of different locations, having diverse disease management practices, orchard management practices were purposively chosen and field survey was conducted at major citrus producing areas of Sahidlakhan rural municipality.

### 2.3 Research Design

Both qualitative and quantitative information were collected using household survey. Primary data was obtained from preliminary survey, key informant interview, questionnaire survey and focus group discussion. Secondary data was obtained from different National and International organization working in that field.

### 2.4 Technique of data tabulation and analysis

The collected primary data were coded, entered, cleansed, and put forward for analysis on Statistical Package for the Social Science (SPSS) and MS-Excel. Descriptive statistics such as frequency and percentage were calculated to determine distribution of the study variables. Disease incidence % was calculated and preferential ranking was also carried out.

| Score | Knowledge level | Criteria |
|---|---|---|
| 0 | No | Farmer couldn't mention a mandarin disease by a name, its description or the type of damage |
| 1 | Low | Farmer named one disease, one feature and one type of damage caused by the disease. |
| 2 | Medium | Farmer named two diseases, describe at least one feature of each disease and one type of damage caused by each of the two diseases |
| 3 | High | Farmer named three or more diseases, describe at least one feature of each disease and one type of damage caused by each of the three diseases |

Adapted from (Midega et al., 2012)

## 3. Results and Discussion

### 3.1 Socio-Demographic Analysis

A total household of 120 were scheduled for interview, out of which 43.8% were male and 56.20% were female. The population distribution of sampled households in the study area was found to be similar to that of Municipality figure of male 44.76% and female 55.24% (CBS, 2018). The study revealed that 38.3% of the respondents were Janajati in the study area followed by Chhteri (31.7%), Brahmin (26.7%) and Dalits (3.3%) (Shrestha, 2010). Similarly, majority of the respondents were having educational status as less than SLC (45%) followed by literate (21.7%) and illiterate and above SLC both comprising 16.7% of the respondents' population. The distribution of family income revealed that majority of respondents (58%) had Agriculture only as the primary source of income followed by service (30%) and Business (10%). The distribution of landholding revealed that majority of the respondents (68.4%) owned medium size land holding, 18.3% owned small size land holding and 13.3% owned large size land. From the findings, it was observed that majority of the respondents had medium size land holding. The average land holding size of study area was 0.72 ha.

### 3.2 Adoption of orchard management practices

The study revealed that 63.3% of the respondents had sent their soil sample of the orchard for testing, 88.3% practiced training pruning, 100% used manure and fertilizers, 93.3% adopted irrigation practices, 70% adopted Bordeaux mixture and paste application, 28.3% applied micronutrient, 96.7% adopted weed management strategies, 41.7% adopted insect control measures, 96.7% practiced mulching, 15% had sent their samples for Citrus Greening test, 88.3% adopted tillage practices and 80% of the respondents practiced intercropping in their orchard as shown in table 1.

**Table 1:** Distribution of respondents based on adoption of orchard management practices

| Orchard management practices | Adopted (% of respondents) | Not adopted (% of respondents) |
|---|---|---|
| Soil testing | 63.3 | 36.7 |
| Training and pruning | 88.3 | 11.7 |
| Manures and fertilizer application | 100 | 0 |
| Irrigation | 6.7 | 93.3 |
| Bordeaux mixture and paste application | 70 | 30 |
| Micronutrient application | 28.3 | 71.7 |
| Weed management | 96.7 | 3.3 |
| Insect control | 41.7 | 58.3 |
| Mulching | 96.7 | 3.3 |
| Greening test | 15 | 85 |
| Tillage | 88.3 | 11.7 |
| Intercropping | 80 | 20 |

### 3.3 Knowledge and identification of mandarin affecting diseases

Overall, several diseases of mandarin were mentioned by farmers. These includes die-back, citrus greening, sooty mold, powdery mildew, root rot etc. Similar diseases were reported in mandarin in Northeast India having similar topography like study site (Singh and Singh, 2016). On an average farmer could name 2.17 diseases. However, it was found that farmer had knowledge score of 1.53 and 91.7% of the respondents had basic knowledge about diseases on mandarin. 65% of the respondents had basic idea about diseases from trainings and seminars conducted by different agencies, 23.3% of respondents had basic idea of diseases from community people, 8.3% of respondents had no knowledge on disease of mandarin, and lastly 3.3% of respondents got the basic knowledge of diseases from different media as shown in the Table 2.

**Table 2:** Knowledge score and identification of disease

| **Parameters** | **Score** | **Frequency** | **Percentage** |
|---|---|---|---|
| No Knowledge of Disease | 0 | 10 | 8.33 |
| Low | 1 | 46 | 38.33 |
| Medium | 2 | 38 | 31.67 |
| High | 3 | 26 | 21.67 |
| Know about disease | | | 91.7 |
| Media: T.V, radio, newspaper | | | 3.3 |
| Community people | | | 23.3 |
| Trainings and seminars | | | 65 |

Source: Field Survey, 2019

### 3.4 Appearance of diseases

The study reveals that sooty mold, powdery mildew, root rot and dieback was reported by 66.7%, 71.7%, 68.3 % and 41.7% of the respondents reported to appear in their orchard 3-9 years ago but citrus greening (or greening like symptoms) was reported by 58.3% of respondent to appear on their orchard less than 3 years ago, From the table below, it can be concluded that majority of the major diseases of mandarin appeared in the respondent's orchard 3-9 years ago.

Ghosh and Singh reported that general neglect, mixed planting and undesirable intercropping, improper spacing, vigorous weed growth, inadequate nutrition (particularly Zn and Ca), infection of Phytophthora root rot, gummosis, powdery mildew, canker, scab diseases and attack of insects and pests are common in mandarin oranges, which leads to severe decline in the region (Ghosh and Singh, 1978). These diseases are common in citrus orchard of high altitude(>1600m) (Dhakal et al., 2002). Citrus greening was first reported in pokhara in 1968 A.D and the disease has spread all over the country but farmer of this region only identified 3 years ago due to lack of knowledge about citrus greening (Timilsina, 2019). But after establishment of Citrus, Zone, farmer of this region was able to identify different diseases along with citrus greening.

**Table 3:** Response to first appearance of disease

| Diseases | Response to year of first appearance of disease (%) | | |
|---|---|---|---|
| | Less than 3 years ago | 3-9 years ago, | More than 9 years ago |
| Sooty mold | 15 | 66.7 | 18.3 |
| Powdery mildew | 8.3 | 71.7 | 20 |
| Root rot | 15 | 68.3 | 16.7 |
| Citrus greening | 58.3 | 30 | 11.7 |
| Dieback | 26.7 | 41.7 | 31.6 |

Source: Field Survey, 2019

### 3.5 Ranking of major diseases

After focus group discussion and field visit of the mandarin orchard of the sites, eight diseases were listed as major diseases prevalent in mandarin orchards. That includes Dieback, powdery mildew, sooty mold, root and foot rot, citrus greening, pink disease, gummosis and scab disease (FAO, 2011). These eight major diseases were ranked by individual respondents of household survey with 8 as highest rank and 1 as a lowest rank. Weightage was given for the ranked position as 1, 0.875, 0.75, 0.625, 0.5, 0.375, 0.25 and 0.125 for first, second, third, fourth, fifth, sixth, seventh and eighth position respectively. Respondent farmers of the study site were asked to rank the major diseases in their orchard. Table 4 revealed that Dieback was ranked first (index 0.852), followed by citrus greening (index 0.760) at second followed. Similarly, powdery mildew (index 0.730), Root and foot rot (index 0.670), sooty mold (index 0.440), pink disease (index 0.377), gummosis (index 0.335) and scab disease (index 0.330) ranked at third, fourth, fifth, sixth, seventh and eighth rank respectively in the study area.

Despite many diseases reported to attack citrus crop in Nepal. HLB disease is very severe and Root and foot rot disease is very common in Dhading, Gorkha and Tanahu areas (DOA, 2011). Huanglongbing (greening) disease is the number one threat to the citrus industry followed by Phytophthora inducing diseases and is the major reason for citrus declining (Knorr, 1971; Reddy and Murti, 1972). Root rot disease was categorized under serious disease in Dailekh (Acharya et al., 2011). Other diseases associated with citrus decline in Nepal are Tristeza, canker, twig blight, powdery mildew disease, Anthracnose, Sooty mould, Pink diseases, gummosis and scab diseases are the diseases for declining citrus production and its quality (Adhikari, 2016; Lakshmi et al., 2014).

**Table 4:** Ranking of mandarin affecting diseases in Gorkha, 2019

| Major diseases | Index | Rank |
|---|---|---|
| Dieback | 0.852 | I |
| Citrus Greening | 0.760 | II |
| Powdery mildew | 0.730 | III |
| Root and foot rot | 0.670 | IV |
| Sooty mold | 0.440 | V |
| Pink disease | 0.377 | VI |
| Gummosis | 0.335 | VII |
| Scab disease | 0.330 | VIII |

Source: Field Survey, 2019

### 3.6 Disease management strategies

The respondents were asked about the disease management strategies adopted by them and it was found that 80% of the respondents adopted different strategies to control different diseases in their mandarin orchard while 20% didn't use any control measures (APMBD, 2014/15). It is due to the lack of knowledge and their management strategies. Among 80% of the respondents who adopted disease control measures, 58.3% adopted mechanical and chemical method, majority of which included training pruning, application of Bordeaux mixture and paste properly, followed by mechanical control only and 5% applying local practices to control diseases (Abbas, 2016). The recommended practice is use of grafted sapling as a planting material and pruning of the infected parts and drenching 1% Bordeaux mixture and removal of diseased parts, spray of Sulphur dust 2g/l and spray of cow urine 1:5(1part urine and 5 parts of water) act as antifungal agent (Jandaik et al., 2015; Adhikari, 2016). This lag in management practices is due to lack of knowledge, less involvement in trainings and seminars regarding citrus orchard management (Khanchouch et al., 2017).

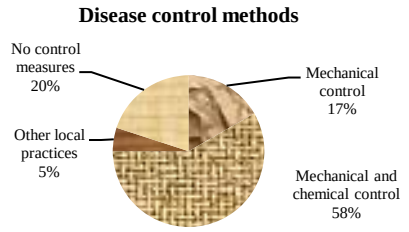


**Figure 1:** Disease control methods adopted by respondents

### 3.7 Ranking of respondents' expectations from government for disease management

The four major categories include monitoring of orchard by specialist and recommendations; provide healthy planting material, subsidies on mechanical and chemical disease control and model farm establishment. The table shows that majority of the respondents expect specialist, plant pathologist or horticulturists to visit their orchard and recommend them suitable management strategies for disease management. Technical information should be disseminated among farmers through scheduled training, observational visit and demonstration programs (Panth and Dhakal, 2019). Use of disease resistant high yielding variety grafted with trifoliate rootstock result in proper management of disease (Pant et al., 2019). Similarly, proper management of orchard, proper planting material and desirable intercropping also result in management of disease (Ghosh and Singh, 1993).

**Table 5:** Ranking of Respondents expectations on management strategy

| Expectations | Index | Rank |
|---|---|---|
| Monitoring of your orchard by specialists and recommendations | 0.87 | I |
| Provide healthy planting material | 0.65 | II |
| Subsidies on disease control | 0.50 | III |
| Model farm establishment | 0.49 | IV |

Source: Field Survey, 2019

## 4. Conclusion

After the end of the survey, it was found that farmers had moderate disease incidence in their orchard, with majority of them reporting high damage from diseases. Mechanical and chemical control was major prevailing disease management practices in Sahidlakhan rural municipality. Majority of the respondents reported adopting orchard management practices like training, pruning, irrigation, intercropping, fertilizer application, tillage, mulching, Bordeaux mixture and paste application. The major diseases in mandarin were Dieback, citrus greening, powdery mildew and root and foot rot. The major constraint to disease management was reported to be lack of accessibility to chemicals and other management practices. The majority of the respondents expect monitoring of their orchard by Horticulturists and plant pathologists and recommendations for disease management on their orchard.

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## Author's Contributions

BD and RK conducted the survey, recorded data, analyzed and prepared the final manuscript. NB supervised the survey. CP prepared of the version of manuscript to be published. RN helped during data entry and analysis.

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