RESEARCH ARTICLE

COMPARATIVE STUDY OF MAJOR DISEASES OF MAJOR SUMMER VEGETABLES AND THEIR MANAGEMENT PRACTICES IN SYANGJA, NEPAL

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ABSTRACT

Plant diseases are one of the major factors of crop yield loss during production process. Different disease management methods have been innovated including chemical to biological methods. Different types of cultural methods for the disease control are also evolving. In this study, we found out the different plant diseases occurring in summer vegetables in syangja district and compare the management practices, which are being used by conventional and commercial farmers. For this, farmers were asked questions related to the symptoms of diseases and the management practices which they are using for the control of disease. 72.9% of farmers pointed out disease as the major problem in summer vegetable. More number of Commercial farmers (75%) were found to use both chemicals and non-chemical disease management methods than conventional farmers. Botanical pesticides was in more use in commercial farms than in conventional farms. Not only botanical pesticides, chemical pesticides were also more in use in commercial farms. Commercial farms were found to use both chemical and botanical pesticides according to severity of disease. Conventional farmers were found to use a greater number of chemical pesticides as compare to botanical pesticides because of lack of knowledge and quick action of chemical pesticides.

KEYWORDS

Commercial farmers, conventional farmers, Disease management, Botanical pesticides, chemical pesticides.

1. INTRODUCTION

Vegetables plays major role in our diet. They are the vital for human nutrition. (JJ, 2016) Vegetable are one of the major crops grown in Nepal. Vegetable is grown in 84000 hectares of land (CBS, 2011). In Syangja vegetables are grown in 844.6 hectare of land. In syangja vegetable are grown by 43803 households (CBS, 2011). Vegetable is important agriculture commodity for poverty alleviation and income generation as identified by different periodic plans of Nepal. Vegetable including potato and spices has contributed 5% to the GDP and 19.44% to AGDP. In Nepal the production and area are increasing year by year. Present data reveals from the year 1991/92 area have been increased by 208% and productivity by 175% within 26 years period (MOAD, 2018). Vegetables suffer from many problems; among them diseases are the most important. Diseases might cause the loss from 50%-complete loss (Government of Sudan, 2008).

Plant diseases are one of the main constraints for the production of the vegetable in Nepal. The major diseases are Fungal, Bacterial and viral diseases. From 2001-2003 total of the 10-15% loss in the vegetable due to fungi and bacteria worldwide (Shrestha et al., 2014). According to the major crucifer's diseases are alternaria leaf spot, club root, downy mildew, sclerotia stalk root, black rot and damping off (Timila and Manandhar,

2011). Late blight, septoria blight, bacterial stem rot, bacterial wilt are the major diseases of the tomato. The major diseases of the cucurbits are downy mildew and powdery mildew. Similarly, viral diseases are the major diseases which cause the complete crop failure. According to tomato leaf curl virus and tomato mosaic virus are causing a drastic production loss in tomato (PPD, 2012). Because of the new varieties of the vegetables which are more prone to the diseases we are forced to use the chemicals pesticides (JJ, 2016). Chandrasekhar et al reported that good control of the plant diseases needs to have good quality and abundance off food and feed by farmers around the world (KN, and Manivaman, 2012).

Plant disease is an impairment of the normal state of a plant that interrupts or modifies its vital functions. All species of plants, wild and cultivated alike, are subject to disease. Although each species is susceptible to characteristics diseases, these are, in each case, relatively few in numbers. The occurrence of plant disease varies from season to season depending on the availability of the pathogen, host and environmental condition (Shurtleff et al., 2020). In general, a plant becomes diseased when it is continuously disturbed by some causal agent that results in an abnormal physiological process that disrupts the plant's normal structure, growth, function, or other activities. This interference with one or more of a plant's essential physiological or biochemical systems elicits characteristic pathological conditions or symptoms.

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Plant diseases can be broadly classified according to the nature of their primary causal agent, either infectious or noninfectious. Infectious plant diseases are caused by a pathogenic organism such as a fungus bacterium mycoplasma, virus, viroid, nematode, or parasitic flowering plant. An infectious agent is capable of reproducing within or on its host and spreading from one susceptible host to another. Noninfectious plant diseases are caused by unfavorable growing conditions, including extremes of temperature, disadvantageous relationships between moisture and oxygentoxic substances in the soil or atmosphere and an excess or deficiency of an essential mineral. Because noninfectious causal agents are not organisms capable of reproducing within a host, they are not transmissible (Shurtleff et al., 2020). There is various type of plant disease. The plant disease based on the pathogen are given below:

Bacterial diseases: The major bacterial diseases of the crops are, Bacterial blight, Bacterial sheath brown rot, Bacterial stalk rot of maize, bacterial leaf strip, Bacterial sheath rot, Citrus canker, Citrus greening, Bacterial wilt of tomato, Bacterial speck of tomato, Bacterial wilt of potato, Potato scub, Black rot of curcifers (Sharma and Neupane, 2018). By the use of the method like face-to-face interview and key informant interview Sachin et al found that disease is the major constraints for the production of the cabbage in Dhankuta, among them club root is the major one (Ghatraj et al., 2019).

Viral diseases: Plant viruses are grouped into 73 genera and 49 families. This is in case of the only cultivated species. This represents only the small fraction of the total no of virus species. The virus in the wild is less studied. These viral diseases are mostly transferred through the vectors (Mj and Roossinck, 2011). Mechanism for transporting mRNAs through plasmodesmata is the preferred path for the plant virions to be transferred. The Mechanism of using the plasmodesmata for the transfers of the virus from the one plant to the other is followed mainly by the RNAs virus (Gr and Kj, 2001).

Fungal diseases: Fungi consist of wide range of the plant pathogens and are the serious problem for the plant production. The major fungal diseases of the plants are white blisters of Brassica, Downy mildew of onion, peas, lettuce, celery, spinach, kale, herbs, cucurbits brassicas, etc, Club root of Brassicas, pythium species diseases pf cucurbits, brassicas and lettuce. Sclerotium root rot, Fusarium wilts, botrytis rots, Anthracnose, Rhizoctonia rots, Damping off, Cavity spot, Tuber diseases, rust, Black rot (Hal, 2012).

Nematode disease: Nematodes parasitic on plants are active, slender, unsegmented roundworms. The great majority cannot be seen with unaided eye because they are very small and translucent. Practically they are 0.25 to 2 mm in length. About 12000 species cause the disease in plants. They live in the soil and attack the small roots. The common symptoms of nematodes are stunting, yellowing and loss of green color. Common nematodes are, Root knot nematode, root-lesion nematode, the golden nematode, the citrus nematode etc (Shurtleff et al., 2020).

The goal of plant disease management is to reduce the economic and aesthetic damage caused by disease. Disease management approach have been changed from past. Today severe measures like pesticide application, soil fumigation or burning are no longer in common use. Plant disease management practices relay on anticipating occurrence of disease and attacking vulnerable points in the disease cycle. Therefore, correct diagnosis of plant disease is necessary to identify the pathogen. A thorough understanding of the disease cycle, and cultural requirements of host plants is required for the effective management of any disease.

The understanding of the climate change related issues helps in the understanding and management of the plant diseases by combating with the present and future climate changes (Coakley et al., 1999). Bitter gourd is the most important vegetable in Kerela which is mostly attacked by BGDMV. Coconut vinegar one percent could reduce the severity of the disease. The treatment with the *Apismelliphica*30 potency and *Arsenicum album* 30 potency showed the reduction in the viral infection and increase in the production. Forenoon has shown the positive correlation with the

disease incidence and hence is the most important in the BGDMV infection (Zacharia and Mathew, 2016).

BINA biofertilizer and BAU biofungicide are compatible and have combined effect in the controlling of the fungus *Fusariumoxysporium* and *Sclerotiumrolfsii* which cause root rot of lentil. Cowdung mixed with soil @ of 5t/ha and seed coting with the BINA-biofertilizer and BAU-biofungicide @2.5% seed weight before sowing recorded 81.5% of the field emergence of lentil which is 19.5% more than the previous results. The post emergence death of the seedling due to the root rot is greatly reduced. Similarly, the use of BINA-biofertilizer and BAU-biofungicide has result in the higher root and shoot length. The biomass has increased upto 75.56% over the control (Hanan, et al., 2012).

The compost tea, a product of compost has been shown to suppress the soil-borne diseases like *Pythiummultimum*, *Rhizoctoniasolani*, *Phytophthoraspp* and wilts like *Fusariumoxysporium*. As the sterilization of the compost results in the loss of supresiveness to the disease this proved that the mechanism of suppression is often or predominately biological but sometime chemical and physical factor has also been implicated (Martin and Brathwaite, 2012).

2. MATERIALS AND METHODS

The study site is the vegetable block of Syangja i.e. Tirashi. It is located in the western side of the Syangja at an altitude of 1100 m. its co-ordinates are 27°59'20"N 83°46'3"E. It is located in Gandaki province. The total area of the study site is 2300ropani.

Figure 1: Map of Syangja District (showing the study site)

2.1 Data types

2.1.1 Primary data

Primary data was collected by developing questionnaire, farm visit, and personal communication. Because of the covid-19, farm visit was not possible, so data were taken through phone calls.

2.1.2 Secondary data

The secondary sources of information were gathered from the municipality, district agriculture information centre, agriculture service centre, websites of different reputed national and international agencies, reports and publications of reputed NGOs and INGOs etc. and reviewed during study for gaining relevant information.

2.2 Sample and sampling technique

The sample was taken from the total no of the members of the block. The data about the members was taken from the block management committee. Out of the total members only 40 of the members 20 conventional and 20 commercials were selected through purposive random sampling. They were interviewed through the phone calls. Secondary data is collected from agriculture information center Syangja and related articles.

2.3 Research instrument

The different instruments which are used are describe below:

2.3.1 Questionnaire survey

Questions focusing the types of vegetable diseases and the management practices used by the farmers were prepared and the household survey was done. The selected farmers were asked the questions and the information's were taken from them.

2.3.2 Key informant interview

For checking the validity of the information from the farmers the key informant was interviewed. Key informant are head of each seven co-operatives. They were interviewed to check whether the information provided by the farmers is correct or not.

2.3.3 Focus group discussion

Farmers practicing vegetable cultivation were gathered and discussions about vegetable plantation was carried out. A group of 15-30 farmer were formed. Focus group discussions was conducted after questionnaire with the help of checklist to verify the result obtained from questionnaire survey.in FGD, participants were local vegetable growing farmers.

2.4 Data analysis technique

The data collected during the field works is identified into different variables as required by the study objectives. Data is analyzed both qualitatively and quantitatively. The data is logically interpreted using simple tables, charts, and graphs. The simple statistical tools like percentage, mean, and also appropriate statistical computer software like SPSS is used in this regard. The information which is collected from farmers is entered in SPSS. SPSS is the most popular software for the analysis of survey data. Data entry is done in SPSS in initial stage. After the data entry is done analysis of data is done. Different statistical tools like Mean, frequency, percentage, Chi-square test and fisher's exact test are used for the proper analysis of data.

- Frequency: It is the no of time the event occurs in the study
- Mean: It is an average score often denoted by X
- Percentage: A number or ratio expressed as a fraction or number.

2.4.1 Chi-square test

The Chi Square statistic is commonly used for testing relationships between categorical variables. The null hypothesis of the Chi-Square test is that no relationship exists on the categorical variables in the population; they are independent. An example research question that could be answered using a Chi-Square analysis would be:

Is there a significant relationship between voter intent and political party membership?

There are a number of important considerations when using the Chi-Square statistic to evaluate a crosstabulation. Because of how the Chi-Square value is calculated, it is extremely sensitive to sample size – when the sample size is too large (~500), almost any small difference will appear statistically significant. It is also sensitive to the distribution within the cells, and SPSS gives a warning message if cells have fewer than 5 cases. This can be addressed by always using categorical variables with a limited number of categories (e.g., by combining categories if necessary, to produce a smaller table). In this case chi-square test is conducted at 5% level of significance.

2.4.2 Fishers exact test

Fisher's Exact Test of Independence is a statistical test used when you have two nominal variables and want to find out if proportions for one nominal variable are different among values of the other nominal variable. For experiments with small numbers of participants (under around 1,000), Fisher's is more accurate than the chi-square test or G-test.

3. RESULTS AND DISCUSSIONS

3.1 Major vegetable grown by farmers

The major summer vegetable which are grown by farmers are sponge gourd, bottle gourd, cucumber, bitter gourd and pumpkin. Beside this some farmers were found to grow beans and pointed gourd. The average productivity in quintal of the vegetable are given in table below.

Table 1: Average productivity (quintal/ropani) of major summer vegetables by conventional and commercial farmers.				
Types of farmers	Tomato	Cucumber	Sponge gourd	Pumpkin
conventional	5.67	3.90	6.071	10
commercial	13.20	12.08	5.598	0.55

As seen in the above table the productivity of vegetable in the conventional farm is lesser as compare to commercial farm in every aspect. It was found that only 20% of the conventional farmer use sprinkler irrigation as the method of irrigation where as 45% of commercial farmers were found to use sprinkler irrigation. None of the conventional farmers were found to use drip irrigation while 20% of commercial farmers were found to use drip irrigation. Similarly, only 38.46% of conventional farmers were found to use plastic house while 100% of the commercial farmers were using plastic house. This data clearly shows why the production of vegetable is low in case of conventional farmers. Only 15% of conventional farmers were using resistant variety, where as 45% of commercial farmers were found to use resistant variety. Hence the production of every summer vegetable is less in conventional farm.

3.2 Major Vegetable diseases

Different kind of diseases are seen in the major vegetable which are grown by farmers. 72.9 % of the farmers said disease as the major problem of summer vegetable. In tomato viral disease, late blight and bacterial wilt were the most prominent one. Similarly, downy mildew, powdery mildew and cucumber mosaic were major disease which were seen in cucumber. Disease which was more prominent in pumpkin were powdery mildew, downy mildew and viral diseases. It was found that the occurrence of late blight is highest then the other disease. Late blight had affected in most of the farmer's field. This disease was found to occur in 75% of the farmer field. Major Diseases of Major Summer Vegetable and their occurrence in percentage is given below:

Table 2: Major Diseases of Major Summer Vegetables and the percentage of their occurrence in farmer's field			
Crop	Disease	Causal Pathogen	Disease Occurrence %
Tomato	Late Blight	<i>Phytophthora infestans</i>	75
	Viral disease	Viruses	45
	Bacterial Wilt	<i>Pseudomonas solanacearum</i>	35
	Root Knot nematode	<i>Meloidogynespp</i>	10
Cucumber	Cucumber Mosaic	Viruses	25
	Powdery Mildew	<i>Erysiphe spp</i>	10
	Downy Mildew	<i>Pseudoperonosporavcubensis</i>	15
Pumpkin	Powdery Mildew	<i>Erysiphe spp</i>	10
	Downy Mildew	<i>Pseudoperonosporavcubensis</i>	5
	Viral disease	Viruses	20

3.3 Management Technique

Different types of management technique were followed by both commercial and conventional farmers. Most of the conventional farmers were dependent on chemical methods. 65% of conventional farmers were dependent on chemical methods of management technique. Similarly, 20 % of commercial farmers were dependent on chemical methods. Speaking of non-chemical methods 5% of conventional farmers were using it while 5% of commercial farmers were using it. Commercial farmers were using both chemical and non-chemical method side by side. 75% of commercial farmers were found to use both the chemicals and non-chemical methods. The detail about the use of chemical and non-chemical methods by both conventional and commercial farms in percentage is given below:

Table 3: Use of chemical and non-chemical methods by conventional and commercial farms (in percentage)		
Management Technique	Conventional farmers (%)	Commercial farmers (%)
Chemical	65	20
Non Chemical	5	5
Both	30	75

By computing the fishers exact test value of p was found to be 0.006 which is less than the significant value (0.05) hence there is relationship between the management technique and types of farmers. The reason for the more use of chemical methods by farmers is lack of knowledge about the adverse effect of chemicals on human health and environment. The government should focus the small-scale farmers. Most of the program which are conducted by agriculture knowledge center are focused on commercial farmers. They should focus their program to small scale farmers and help them understand the side effect of chemicals.

3.4 Non-Chemical Disease Management

Different types of non-chemical methods were being used by farmers. The methods include management of disease plant, management of weed, management of crop residue and different types of cultural methods. During the study it was found that most of the commercial farmers were using the non-chemical methods of disease management. Regarding the management of disease plant 15% of conventional farmers were found to leave the disease plant as it is in field. 50% of conventional farmers were found to uproot the disease plant while 55% of the commercial were found to use that technique. 35% of conventional farmers were found to cut the disease plant parts while 45% of commercial farmers were found to cut the disease plant parts. Detail of the different types of nonchemical methods used by farmers and the percentage of conventional and commercial farmers which are using it in percentage is given in the table below:

Table 4: Different types of nonchemical methods used by commercial and conventional farmers (in percentage)		
Method	Conventional farmers (%)	Commercial farmers (%)
Management of disease plant		
Leave it	15	0
Uproot the disease plant	50	55
Cut the plant Part	35	45
Management of weed		
Uproot and burn	5	15
Uproot and manure	35	70
soiling	60	15
Management of crop residue		
Use to Prepare Manure	55	90
Throw away	45	10
Use as feed	0	0

By computing the fishers exact test for management of crop residue the value of p was found to be 0.031 which was less than the significance level (0.05) so there is relationship between types of farmers and management of crop residue. Similarly, fishers' exact test was done for management of

weed and types of farmers and the value of p was found to be 0.011 which is less than significance level (0.05) so there is relationship between types of farmers and management of weed. Similarly, chi square test was also done for management of disease plant and types of farmers and the value of p was found to be 0.22 which is greater than significance level (0.05) hence there was no relation between types of farmers and management of disease plant. Most of the conventional farmers have no idea about the disease and its effect on plants so they just leave the plants as it is. Some of the conventional farmers were found to use direct chemical methods when the disease appears on the field. This is causing the great effect on the health of human and environment.

3.5 Cultural methods of disease management

These are the methods which are aimed at either reducing the source of inoculum or reducing the exposure of plants to infection. Its primary target is to reduce the pest damage not the destruction of pest. (Humanity development library 2.0, n.d.) Different cultural methods were being followed by farmers. All of the farmers were concerned about the cleanliness, ploughing, time of sowing and irrigation. 70% of conventional farmers were following mixed cropping while 75% of commercial farmers were following mixed cropping. None of the conventional farmers were using resistant variety. 45% of commercial farmers were using resistant variety for protecting their crops from different types of disease. Less use of resistant variety in conventional farmers is due to high price of resistant variety and lack of knowledge among farmers. Because of no use of resistant variety more no of disease were raising on conventional farms. The detail about use of cultural method in percentage by both conventional and commercial farms is given in the table below:

Table 5: Use of cultural methods by conventional and commercial farmers (in percentage)		
Methods	Conventional farmers (%)	Commercial farmers (%)
Cleanliness	100	100
Ploughing	100	100
Time of sowing	100	100
Irrigation	100	100
Mixed Cropping	70	75
Resistant Variety	15	45

3.6 Use of Organic and Chemical Pesticide

Pesticides helps farmer by saving their crops. Although pesticides help farmers over use of chemical pesticide cause lots of environmental effects. The excess use of these decreases the general biodiversity of the soil. They also inversely effect the human health. There are two different types of pesticide. One is chemical and other is botanical pesticide. (Byju's the learning app, n.d.). From my study it was found that 45% of conventional farmers were using botanical pesticide while 85% of commercial farmers were using botanical pesticide. 85% of conventional farmers were using chemical pesticide while 100% of commercial farmers were using chemical fertilizers. The effect of chemical fertilizers is fast and show their result soon (Byju's the learning app, n.d.) So the farmers are more interested in chemical pesticide then botanical pesticides. The percentage of farmers which are using chemical and botanical pesticide is shown in the table below:

Table 6: Use of chemical and botanical pesticide by conventional and commercial farmers (in percentage)		
Pesticide	Conventional farmers (%)	Commercial farmers (%)
Botanical	45	85
Chemical	85	100

For the farmer using botanical pesticide chi -square test was done and the value of p was found to be 0.04 which is less than the significance level (0.05) hence there is relationship between conventional and commercial farmers using botanical pesticide. Similarly, For the farmer using chemical pesticide chi square test was done and the value of p was found to be 0.03 which is less than significance level (0.05) so there relationship between the farmers using chemical pesticide.

3.7 Synthetic Chemical Pesticides Used By farmers

Use of chemical pesticide is increasing the production and productivity. Not only the production and productivity is increasing it is also increasing the environmental and health risk. There is adverse effect on land fisheries fauna and flora. It is also destructing the beneficial insect of agriculture thereby increasing the virulence of many species of agriculture pest (Tisdell and Wilson, 2001). Despite these farmers are still using different types of chemical pesticide in their fields.

Table 7: Management technique used by farmers (in frequency and percentage)

Management technique	Frequency	Percent	Cumulative Percent
chemical	17	42.5	42.5
biological	2	5.0	47.5
both	21	52.5	100.0
Total	40	100.0	

In the above table 42.5 percentage were found to use the chemical methods of disease control. Out of total 40 farmers only 5 % were found to use biological method of disease control. However, 52.5% of farmers were found to use both methods of disease control. The major chemical pesticides which are being used by farmers to control the pest of summer vegetable are as follows:

Table 8: Major chemical pesticide used by farmers

Pesticide	Vegetable	Disease
Anti-Virus	All	Virus
Tabucanazole	Tomato, Cucurbits	Powdery Mildew
Copper oxy chloride	Tomato	Late blight
Bavistin	all	Fungal
Mancozeb	tomato	Early blight
Karathane	Cucumber	Powdery Mildew

3.8 Botanical and organic pesticide Used by farmers

Natural pesticide derived from plants are termed as botanical pesticide. Most of the ayurvedic plants also produce pesticides, which are being used from the long time. The use of botanical pesticide has been decreased since the arrival of synthetic pesticide. Unlike synthetic pesticides botanical and organic pesticide are not harmful to human health and environment (Neupane, 2004). Different types of botanical and organic pesticide were found which are being used by farmers. Following table shows the different types of botanical and organic pesticide which are used by farmers.

Table 9: Major botanical and organic pesticide used by farmers

English Name	Local Name	Scientific Name
Cattle urine	Gaut	
Ash	Kharani	
Cow milk	Dudh	
Mugwort	Titepati	<i>Artemisia vulgaris</i>
Stinging nettle	Sisno	<i>Urticadioica</i>
Soap	Sabun	
Malabar	Asuro	<i>Adhatodavasic</i>

45% of conventional farmers were found to use botanical and organic pesticide, while 85% of commercial farmers were found to use botanical and organic pesticide. Most of the farmers use cattle urine for almost all disease and insect. Cow milk was found to be more effective for the control of viral diseases.

4. CONCLUSION

Late blight in tomato and viral diseases seems to be major problem for summer vegetable cultivation in Syangja. In Syangja farmers are forced to

use chemical methods because of the lack of proper organic methods for disease management. Commercial farmers are using biological and chemical disease management methods side by side while conventional farmers are using chemical methods widely. Government should focus their program to conventional farmers and should encourage the use of organic methods of disease management. Availability and promotion of biological pesticide as curative method of disease management will certainly encourage for organic farming.

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