MANAGEMENT OF *SEPTORIA* LEAF SPOT DISEASE IN TOMATO AT BHAKTAPUR

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Abstract

A farmers' field survey was conducted during 2014 in Bhaktapur district to study socioeconomic status, agricultural practices and occurrence of Septoria Leaf Spot (*Septoria lycopersici* Mill.) of tomato and its management practices using random sampling of 25 respondents. Field experiment on management of Septoria Leaf Spot was conducted in a completely randomized design (CRD) with six treatments and four replications. The six treatments were i) Astha Killer 15 (*Azadirachta indica*) 1500ppm, ii) Cow Urine (@ 5% concentration of cow urine; solar activation for 48 hours), iii) *Neem (2ml/l water)* + cow urine (5%) (1:1 ratio; final solution of 2ml/l water), iv) Chlorothalonil @ 2.5gm/lt water, v) Mancozeb (@ 2.5gm/lt water), and vi) control (water). Majority of farmers (70%) raised seedlings by themselves. Septoria Leaf Spot disease was the third important disease after Late Blight and viral disease. Septoria Leaf Spot disease was found in farms of 84% respondents. Septoria Leaf Spot symptom was found in leaf and both in leaf and stem in 47.62% and 52.38% respondents respectively. The disease incidence in field of 85.71% respondents was since 1-2 years. Higher relative humidity, higher precipitation and higher temperature were congenial for disease development. 80% of the respondents used synthetic fungicides for controlling the disease, where Mancozeb and Chlorothalonil were used by 44% and 20% respectively. Mancozeb was found most effective in controlling disease, followed by Chlorothalonil. Among the botanical treatments, *Neem (2ml/l* water*)* + Cow urine (5%) was found effective in disease control than other two botanical treatments.

Key words: Septoria Leaf Spot, Neem, Mancozeb, Cow urine, botanical treatment

1. INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is the most important vegetable grown in the world (Saravanan et al., 2003). It is one of the major commercial vegetable crops and widely grown both in the plains and hills of Nepal. In Nepal, the area under tomato is about 19,728 ha with a production of 2,98,594 MT and productivity of 15.1 MT/ha (Year Book, 2013). Conventionally, tomato is grown popularly as winter crop in plains and summer crop in the hills. In the plains, tomato can be produced successfully as winter to spring season crop and as off-season in two growing seasons, spring (slightly later) and rainy to autumn (slightly earlier). It can be produced year round in protected conditions. Ripened fruits are good source of Ascorbic acid, organic acids and minerals. The gradual and ever increasing year round demand of tomato for fresh consumption and processing is due to increasing urbanization, hotels, tourism, nutritional awareness of the people, etc. "Srijana" is an indigenous popular hybrid variety of tomato in Nepal. It has average fruit weight of 50-60gm.

Among various diseases Septoria leaf spot caused by *Septoria lycopersici* Speg., (Mycosphaerellaceae) is one of the economically important foliar diseases. Under humid regions, particularly during the periods of rainfall, it incurs loss both at pre- and post-harvest stages in tomato. The causal fungus grows on potato dextrose agar (PDA) produced dull white mycelium with flexuous and filiform hyaline conidia, with l-9 septations. Under computerized predictive system, TOMCAST software is being used for forcasting of the disease (Agrios, 2005).

Septoria leaf spot is an important disease on cultivated tomato around the world (Stevenson, 1991). It was first reported in Argentina in 1882 and later in the United States in 1896 (Sutton & Waterston, 1966). The importance of this disease depends on weather conditions, being

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favored by high moisture and temperatures. In these conditions it can cause severe defoliation and consequently significant yield losses due to sun-scald of the fruits (Stevenson, 1991; Ferrandino and Elmer, 1992). Lincoln and Cummins (1949) in the USA, reported 80% defoliation and Sohi andSokhi (1974) in India reported almost 100% defoliation, due to this disease. Erinleet al. (1986) reported that in Northern Nigeria *S. lycopersici* was the only serious problem, during three consecutive years, in unprotected tomato cultivars.

A two-year (2007-2008) survey of nine tomato farms in three local government areas of Edo State (Esan central, Esan West and Esan North East) which are the main tomato growing areas of Edo State, revealed that Septoria leaf spot disease of tomato was of major concern, affecting 14.9 – 24.3% of the crops in the farms. Mature leaves were found to be more susceptible to the disease than younger ones. Resistant cultivars maintained their leaves even under severe infection and hence protected the fruits from sunscald while susceptible cultivars lost their leaves under moderate infestation by the Septoria. (Mensah *et al*., 2008)

Septoria leaf spot disease in Nepal

Septoria leaf spot has been observed in Nepal since many years. The disease is widespread in tomato growing areas. In severe conditions, it causes severe premature defoliations as well as drying of the entire plant and may cause severe yield loss. It has potentiality of being havoc in future if necessary management measures are not adopted. (Personal communication, Ramesh Baidya, Thimi, Bhaktapur)

2. MATERIALS AND METHODS

The study consisted of three parts: farmers' survey, laboratory study and a field experiment.

2.1. Farmers' survey

A survey was conducted to find out the incidence, severity and management of *Septoria* leaf spot in tomato in farmers' fields from six municipalities of Bhaktapur district. Twenty five tomato growers were taken under observation. Necessary households were used for pretest survey and necessary changes were made. Survey questionnaire (semi–structured) was prepared and necessary information were collected. Respondents were from Mahamanjushree Nagarkot Municipality, Madhyepur Municipality, Suryabinayak Municipality, Changunarayan Municipality, Anantalingeswor Municipality and Bhaktapur Municipality. The more number of selections of farmers from Mahamanjushree Nagarkot Municipality is due to more number of tomato growers present. Questionnaire was asked with the head of the family. In absence of household head, next senior of the household was taken as the respondent. Collected information was tabulated, analyzed and interpreted with the help of relevant literatures.

2.2. Laboratory study

For laboratory test of the Septoria leaf spot disease, affected plant parts were collected from each respondent. Clean scissor was used for taking samples and were put in clean plastic bag. Both affected stems and leaves were collected. The samples were taken and observed in laboratory of Plant Pathology Division, National Agriculture Research Council (NARC), Khumaltar and Department of Agriculture, Hariharbhawan, Lalitpur.

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2.3. Field experiment

2.3.1. Experimental site

The field experiment and design was conducted in a plastic house in Jhaukhel, Changunarayan municipality at the northern part of the Bhaktapur district (Figure 5). The site was 14 km away from Kathmandu district. The latitude and longitude of the site was 27°41' N and 85°25' E respectively, with an elevation of 1319 m from sea level. The study was carried out in Completely Randomized Design (CRD) with six treatments and four replications.

Astha Killer 15 (Neem pesticide, *Lila* Agrotech, Rajibpur, North 24 Parganas, WB, India a.i. Azadirachtin 1500ppm) @ 2ml l^{-1} water, cow urine (urine of improved cow, solar activated for 48 hours in direct sunlight) @ 5%, Neem + cow urine (1ml of Astha Killer 15 @ 2ml l^{-1}water + 1ml of cow urine @ 5% water; final solution of 2ml l^{-1} water) , Chlorothalonil @ 2gm l^{-1} water, Mancozeb @ 2gm l^{-1} water and control (water spray).

One liter of the treatment solution was applied in four plots. Fungicides were applied in afternoon. 2 liter sprayer was used to spray the fungicides. Foliar spray was implied to wet all aerial parts of plants. Interval of application of treatments was 7 days.

2.3.2. Selection of plants for disease assessment

In each plot numbering of the plants was done in Serpentine method. Four plants were selected randomly per plot for recording data.

$$\text{Percentage Incidence of the Disease} = \frac{\text{Number of Plants infected}}{\text{Total number of plants(infected and uninfected)}} \times 100\%$$

$$\text{Disease Severity Percent} = \frac{\text{Sum of all disease rating}}{\text{Total number of plants observed} \times \text{Maxm. disease rating grade}} \times 100\%$$

2.3.3. Disease Sample collection

The Septorial disease plants parts were collected from the experiment field, i. e. Changunarayan Municipality. It was taken in plastic bags and brought to the laboratory for isolating the disease-causing fungi.

2.3.4. Isolation and identification of pathogen

Diseased portion of the tomato plants were segmented with the aid of scalpel and needle. Under laminar flow, the segments were placed on petri-dishes containing PDA. Inoculated petri-dishes were incubated at room temperature and observed daily. The fresh growth of the fungi was transferred to freshly prepared potato-dextrose agar medium for sub-culturing. Based on morphology, the fungi isolated was identified under microscope by studying their typical conidia growth and septated elongated pycniospores produced on the potato dextrose agar medium.

2.3.5. Laboratory work

Laboratory testings were conducted in laboratories of National Agricultural Research Council (Plant Pathology Division, NARC), Khumaltar and Department of Agriculture (DOA), Hariharbhawan, Lalitpur. Infected plant parts preservation was done in incubator at room temperature. Preparation of PDA medium, transfer of infected samples in petri-dishes, disease

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slide preparation was done in UV laminar flow under sterilized condition. Conidia, pycnidia and other parts of Septoria were studied under under microscope.

2.3.6. Disease Scoring

The disease intensity was scored after McKinney's scale (0-4) as applied by Horsfall and Heuberger (1942) with slight modification as follows:

0 = infection free

1 = trace to 20% of leaf areas affected,

2 = 21-40% leaf areas affected,

3 = 41-60% leaf areas affected, and

4 = more than 60% of the leaf areas affected.

2.3.7. Statistical analysis

Data entry was done in MS-EXCEL and SPSS. Data were analysed using SPSS. 'R' software (2014, Warm Puppy) was used for analysis of variance and mean comparisons. Graph and figures were generated using SPSS software and MS-EXCEL.

3. RESULTS AND DISCUSSION

3.1. Farmers' survey

3.1.1. Farmers' profile

While studying the educational status of the sampled households, 4% of the tomato growers were found illiterate. 40% were found literate. 28%, 4% and 24% households had completed SLC, Intermediate, Bachelor and Graduate and above level education respectively.

The data regarding household survey of the respondents, 20% had equals to or less than 5 members (80%) and 5 respondents had 6-10 members.

All the respondents of the survey area were tomato growers. The land coverage of tomato farm range from 0.5 ropani to 27 ropani.

3.2. Field survey

Among selected farmers, seventy percent raised tomato seedlings themselves, twelve percent buy from market while sixteen percent do both.

Survey showed that hundred percent of the farmers observed their tomato farm with the presence of disease. They also observed for the performance of the fungicides used in their farms. This is a good indication of farmers' awareness. The survey showed thirty two percent, thirty two percent and thirty six percent farmers observed field monthly, weekly and daily respectively. This shows farmers are conscious on disease occurrence in their field.

3.3. Diseases prevalent in Bhaktapur

Among the tomato growers 60% farmers had the problem of late blight. Viral disease, Septoria leaf spot disease and bacterial wilt comprised of 20%, 12% and 8% respectively (Table 9). The data indicated Septoria leaf spot as the third major disease. It could be more havoc in near future if proper care is not taken on time.

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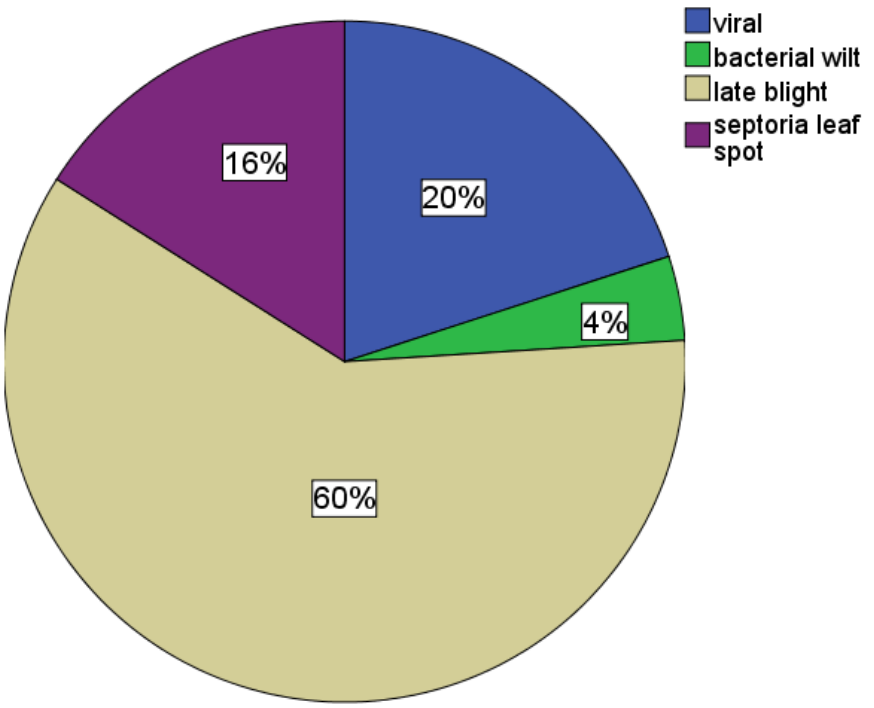

Figure 1 Diseases prevalent in Bhaktapur

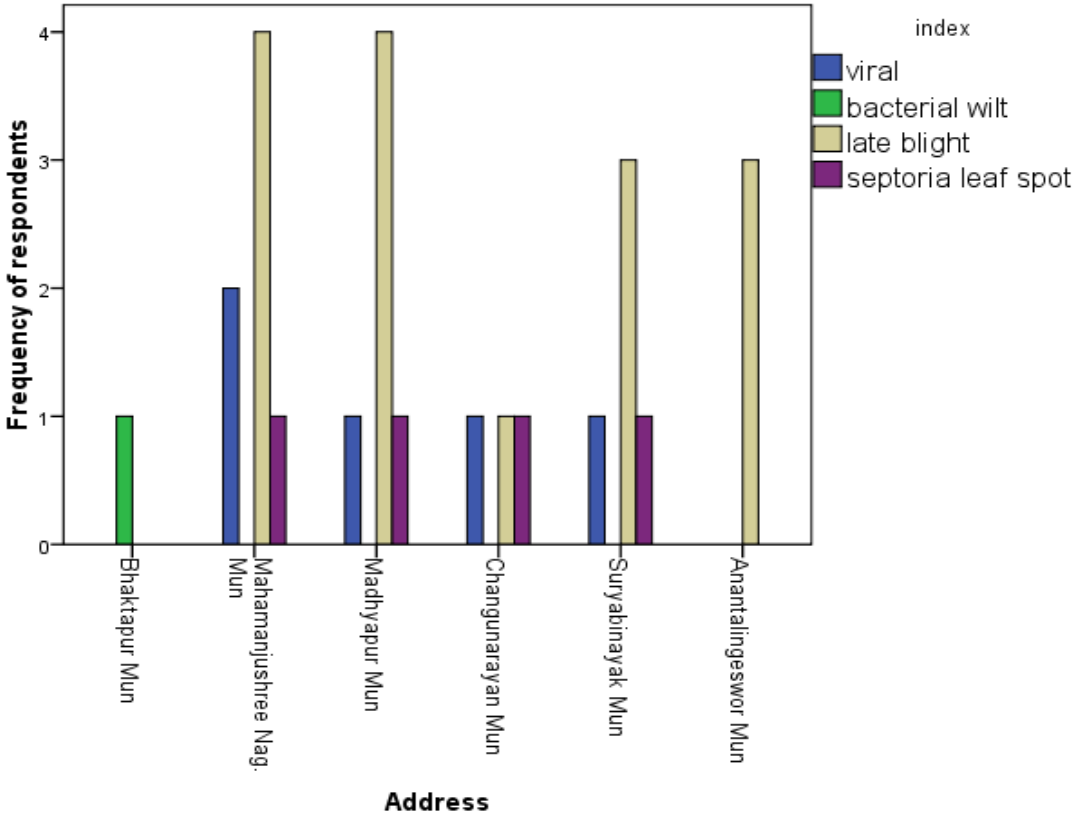

Figure 2: Diseases presence and farmers' response

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3.4. Presence of Septoria leaf spot

Septoria leaf spot was found in 84% farmers while remaining had no any disease (Table 11). The samples were collected in plastic sheet and tested in laboratory of Plant Pathology division, NARC. This could be because of conducive environmental conditions for spore release and dissemination during the cropping period. Environmental factors, such as, wind and leaf wetness period and intercultural operations could also enhance spore dissemination. Structure of the tunnel can also affect the disease spread.

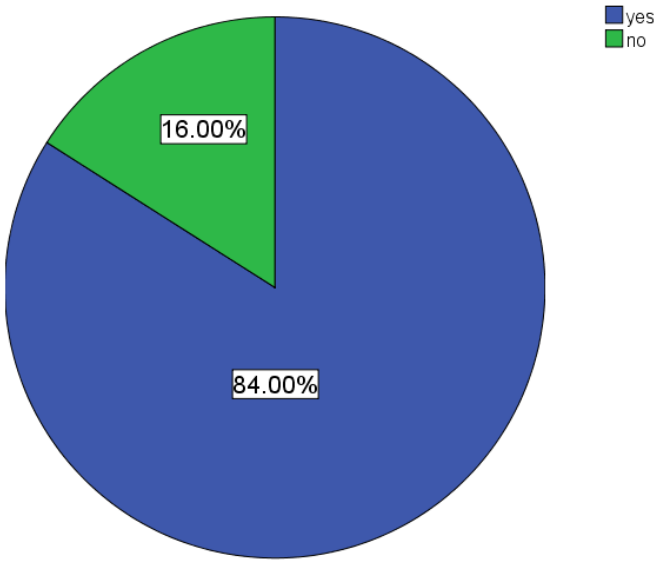

Figure 3: Presence of Septoria disease and farmers' response

Table 1. Presence of Septoria leaf spot

Presence of Septoria	Frequency	Percent
Yes	21	84
No	4	16
Total	25	100

Table 2. Presence of Septoria based on location

	Presence of Septoria	
Address	Yes	No
Mahamanjushree Nagarkot Municipality	6	1
Suryabinayak Municipality	5	0
Anantalingeswor Municipality	3	0
Changunarayan Municipality	3	0
Madhyapur Municipality	3	3
Bhaktapur Municipality	1	0
Total	21	4

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3.5. Plant parts affected

The study showed that 40% respondents replied leaf of the plants had symptoms of Septoria leaf spot, 44% had both on leaf and stem and 16% had no any disease symptoms on the plants. No symptoms were observed on fruits.

Table 32. Plant parts affected by the disease

Plant parts	Frequency	Percent
Leaf	10	40
Leaf and stem	11	44
No symptoms	4	16
Total	25	100

3.6. Prevalence of the disease

Seventy two percent farmers reported that Septoria Leaf Spot appeared since 1-2 years, while twelve mentioned since 3-5 years in their tomato field. Sixteen percent farmers did not notice the disease. (Table 14)

Table 3. History of disease prevalance

Year	Frequency	Percent
1-2	18	72
3-5	3	12
No disease	4	16
Total	25	100

3.7. Incidence of disease

Twenty four percent farmers had their farm with 41-50% disease incidence. Sixteen percent of the farmers' farm had 11-20% disease incidence. The weighted mean incidence of disease is 42.61% farm. The reason behind the disease spread might due to improper cultivation practices.

Table 4. Disease incidence (n=25)

Disease incidence	Frequency	Percent
0-10%	1	4
11-20%	4	16
21-30%	2	8
31-40%	2	8
41-50%	6	24
51-60%	2	8
61-70%	1	4
71-80%	1	4
81-90%	2	8
91-100%	4	16
Total	25	100

3.8. Role of environmental factors on disease development

Majority of farmers (60%) considered high temperature was responsible for Septoria leaf spot disease development. Thirty six percent and four percent farmers considered for medium and low temperature respectively. Sixty percent of the farmers considered high humidity responsible for the disease development while 40% considered the medium humidity for disease

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development. Seventy two percent of the farmers considered high rainfall responsible for the disease development and only 28% farmers considered medium rainfall for disease development.

Farmer's knowledge on environmental factor affecting the Septoria Leaf Spot is shown in table below.

Table 5. Farmer's response on environmental factor affecting Septoria Leaf Spot disease infestation (n=25)

Environmental factor	Frequency	Percent
Temperature		
High	15	60
Medium	9	36
Low	1	4
Humidity		
High	15	60
Medium	10	40
Low	0	0
Rainfall		
High	18	72
Medium	7	28
Low	0	0

3.9. Disease severity

Each forty percent of farmers farm had disease severity of <10% and 10-25%. Only 4% farmers' farm had 26-50% disease severity. The weighted mean of disease severity is 12.5%. This indicates the disease has become a problem.

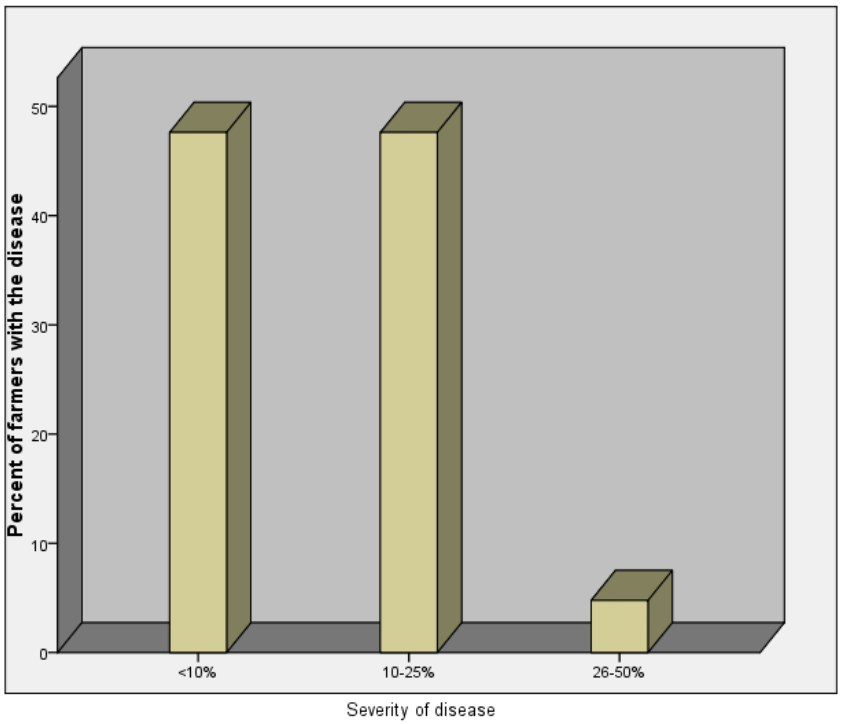

Figure 4 Disease severity of Septoria disease in farm of respondents

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3.10. Septoria disease problem

Septoria leaf spot is problem to around fifty two (52%) of farmers. This indicates the disease spread in Bhaktapur has become havoc.

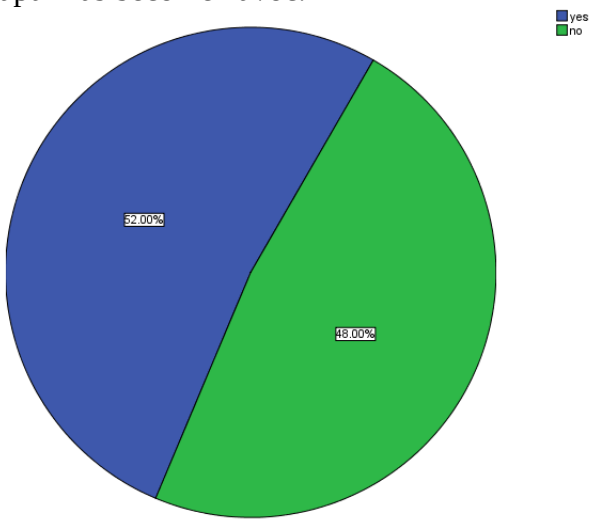

Figure 5. Septoria disease as problem in farms of respondents

3.11. Use of fungicides to control the disease

Based on survey, eighty percentages of the respondents used synthetic fungicides for controlling Septoria leaf spot. Among them Mancozeb, Chlorothalonil, Bavistin and no use of fungicides were forty four percentages, twenty percentages, sixteen percentages and twenty percentages respectively. The cause behind the use of Mancozeb could be the better efficacy of it in controlling fungal disease as board spectrum nature.

Use of fungicides to control the Septoria Leaf Spot in tomato in Bhaktapur

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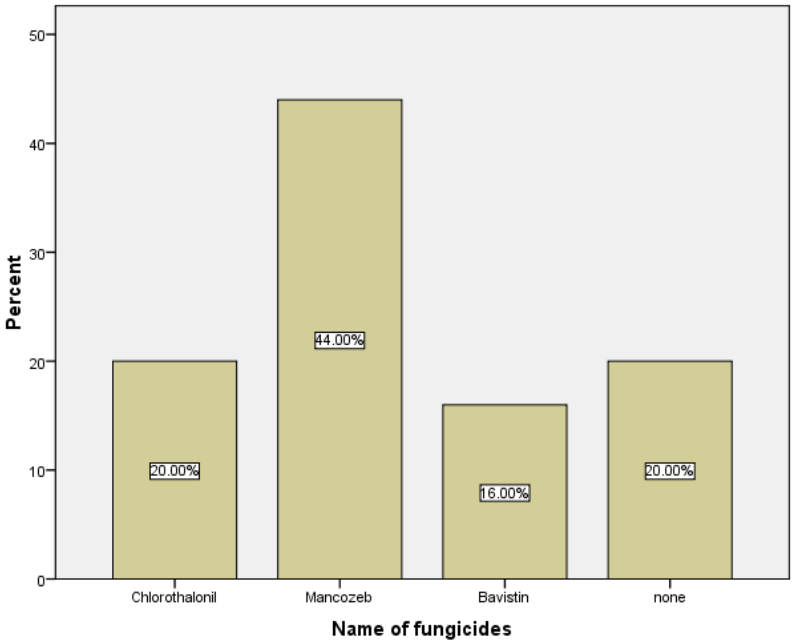

Figure 6. Synthetic fungicides used in tomato farms by respondents to control Septoria leaf spot

3.12. Crop rotation as measure to management of the disease

Among twenty five tomato growers sixty percent had practice of crop rotation while rest does not. Farmers used crucifers like cabbage, cauliflower etc. This indicates still there is a favorable environmental condition for Septoria fungus to persist year after year in their farm.

Frequency of crop rotation done by twenty five tomato growers is shown in following pie-chart:

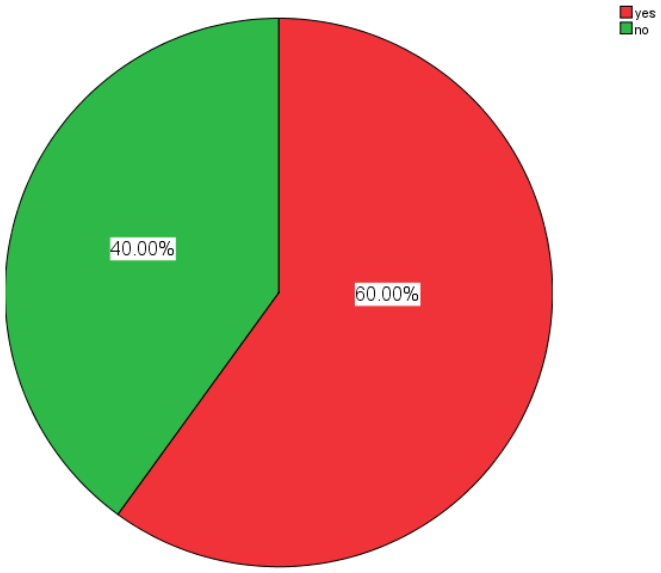

Figure 7. Crop rotation done in farm by respondents

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3.13. Yield loss

Seventy two percent of the farmers responds the loss incurred due to the Septoria disease was less than 10%. Eight percent had 10-20% yield loss, four percent had 41-60% yield loss. Sixteen percent had no disease symptoms.

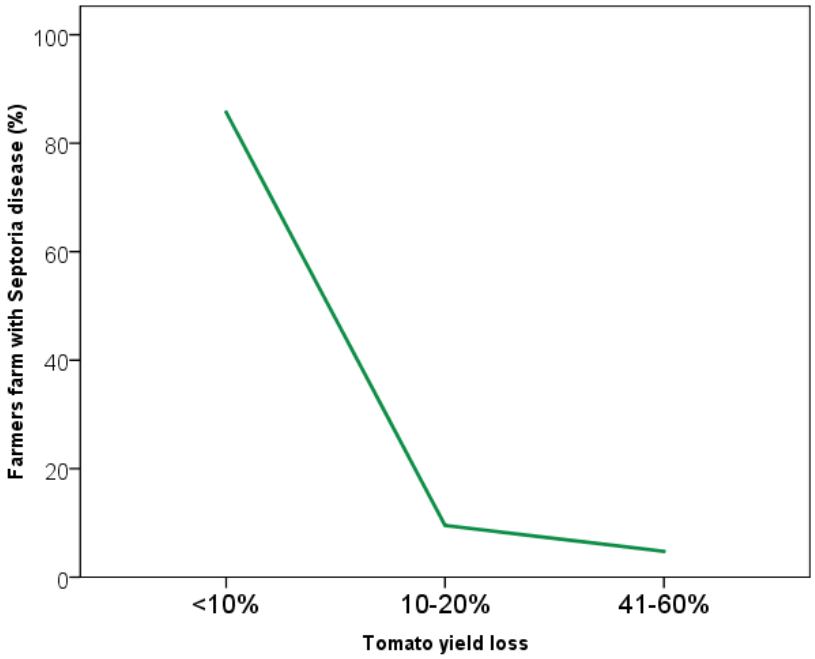

Figure 8. Yield loss due to Septoria leaf spot disease

3.14. Plastic House Study

The difference in disease severity in application of the treatments at 45 DAT is non-significant. Mancozeb @ 2.5gm/lt was found to be significant in disease control at 55 DAT. It was followed by Chlorothalonil @ 2.5gm/lt water. Disease severity was highest in control.

Disease severity was lowest equally on application of Mancozeb @ 2.5gm/lt and Chlorothalonil @ 2.5gm/lt water at 65 DAT. Disease severity was highest in control.

On forth application (75DAT) of treatments, Mancozeb found to be the best in controlling the disease, followed by Chlorothalonil. Control was found to be the worst in disease severity, followed by cow urine @ 5% concentration and mixed application of Neem (2ml/lt) + cow urine (5%) with proportion of 1:1 @ 2ml/lt water.

In comparing the efficacy in controlling the disease between the synthetic fungicide and bio-products; synthetic fungicides i.e. Mancozeb and Chlorothalonil had better efficacy than bio-products i.e. cow urine, Neem and combination of cow urine and Neem. Between the two synthetic fungicides Mancozeb had better efficacy in disease control.

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Table 6 Efficacy of treatments to control Septoria leaf spot disease in plastic house during June to October, 2014 at Bhaktapur

Treatments	Concentration and dose	Mean disease severity index (0-4, scale)			
		45DAT	55 DAT	65 DAT	75 DAT
Killer 15	1500 ppm in liquid form used @ 2ml/l water	2.5	2.25^{abc}	2.75^{b}	3.25^{ab}
Cow urine	5% conc. of urine	2.5	2.75^{a}	2.75^{b}	2.75^{b}
Neem + cow urine	1:1 ratio; final conc. 2ml/l water	2	2.50^{ab}	2.5^{b}	2.75^{b}
Chlorothalonil	2.5gm/l water	2	1.5^{bc}	1.5^{c}	1.5^{c}
Mancozeb	2.5gm/l water	1.5	1.25^{c}	1.25^{c}	0.5^{d}
Control	-	2	3^{a}	3.75^{a}	4^{a}
Mean		2.08	2.21	2.42	2.46
LSD		NS	1	0.78	0.87
CV (%)		**25.29**	**30.65**	**21.81**	**23.97**

CV:Coefficient of variation; LSD:Least Significant Difference; SEm: standard error

3.15. Plant height

Difference between the treatments in plant height is non-significant. It is also non-significant with the number of times of treatment applied.

Table 7. Efficacy of treatments in plant height by controlling Septoria leaf spot disease in plastic house during June to October, 2014 at Bhaktapur

Treatments	Concentration and dose	Plant height (in cm)		
		45DAS	55 DAS	65 DAS
Killer 15	1500 ppm in liquid form used @ 2ml/lt water	44.563^{a}	59.688^{a}	68.938^{a}
Cow urine	5% conc. of urine	46.563^{a}	67.375^{a}	78.750^{a}
Neem + cow-urine	1:1 ratio; final conc. 2ml/l water	49.188^{a}	62.125^{a}	75.646^{a}
Chlorothalonil	2.5gm/l water	48.500^{a}	60.938^{a}	69.813^{a}
Mancozeb	2.5gm/l water	50.438^{a}	67.125^{a}	78.000^{a}
Control	Water spray	49.313^{a}	61.563^{a}	69.375^{a}
Mean		48.09	63.14	73.40
LSD		11.29	17.75	20.20
CV(%)		15.81	18.93	18.52

CV:Coefficient of variation; LSD:Least Square Difference

4. SUMMARY AND CONCLUSION

Septoria Leaf Spot is one of the important disease of tomato in Bhaktapur with direct yield loss of fourteen percent. But, the disease was not taken seriously. So, detail study on the disease along with disease control measure is done.

Field survey was done representing the whole Bhaktapur district. It was done to study prevalence of Septoria leaf spot in Tomato at field condition. Disease was more prevalent at the

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field of commercial tomato growers. It is the third main disease to the tomato growers. It covers farms of eighty four percent of farmers.

The symptom of the disease is primarily found in leaf and stem. Nearly eighty six percent of farmer's farms have the disease since 1-2 years only. So, the disease is new in Bhaktapur. But it is prevalent throughout the district. Incidence of the disease in tomato plant is observed for around forty two percent.

Environmental conditions of high temperature, relative humidity and precipitation have positive correlation with the disease development.

The disease severity on tomato plants is observed to be fifty two percent.

Synthetic fungicides i.e. Mancozeb and Chlorothalonil were observed as the major disease control measures. These were more effective and fast controlling fungicides than bio-products. Mancozeb was the best one among all the synthetic and bio-products. In bio-products, combination of neem (2ml/l) + cowurine (5%); 1:1 ratio; final solution 2ml/l water has better efficacy followed by cow urine; 5% conc. of urine.

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