

Assessments of Distribution and Status of Major Disease of Hot Pepper (*Capsicum annuum* L.) in West Shoa and East Wollega Zones, Ethiopia

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Abstract: Hot pepper crop is native to Latin America and belongs to the family Solanaceae. The exact time for the introduction of pepper to Africa in general and Ethiopia in particular is not known. In Ethiopia hot pepper (*Capsicum annuum*) is an economically and traditionally vital crop, and for most Ethiopians food is tasteless without hot pepper. Despite the importance of hot pepper in Ethiopia, total crop failure due to diseases has been common and sometimes farmers are forced to abandon their production due to excessive disease pressure in the field. This activity was initiated to determine the relative occurrence, distribution and status of hot pepper disease across study area. The disease Survey was conducted to assess the prevalence, incidence and severity of major disease of Hot pepper. The survey was conducted in 32 Kebeles and 46 farms in the four Districts of the two Zones. Kebele were randomly selected from each District and based on the representativeness of hot pepper production of the area. The disease survey was done along the two diagonals (in an “X” fashion) of the field from five points using 1m x 1m (1 m²) quadrates. The assessment was done for disease prevalence, incidence and severity hot pepper. The data collected from the survey was checked completeness and analyzed using SPSS software used to summarize. Six diseases of hot pepper, Fusarium wilt, Cercospora leaf spot, Bacterial leaf spot, Bacteria soft rot, and Anthracnose diseases were assessed in the farms field. The importance of each disease was determined by calculating the prevalence, incidence and severity values. The incidence of individual disease of hot pepper fusarium, cercospora leaf spot, Bacterial leaf spot and anthracnose highest scored 65%, 90.31%, 76.33% and 39.5 while the severity value 65%, 43.65%, 32% and 24 respectively. Thus, when developing a hot pepper disease control strategy in the future, different disease management options required.

Keywords: Assessments, Distribution, Status, Disease, Hot Pepper

1. Introduction

Hot pepper (*Capsicum annuum* L.) is an important crop grown as vegetable and spice in all the continents of the world [1]. This crop is native to Latin America and belongs to the family Solanaceae [2]. The exact time for the introduction of pepper to Africa in general and Ethiopia in particular is not known. Probably Portuguese had introduced hot pepper to Ethiopia in early 17th century [3]. In Ethiopia, the production history and use of pepper is perhaps more ancient than the history of any other vegetable crop except tomato [4].

Hot pepper is the most important vegetable, which can be

found on the daily dish of every Ethiopians [5]. According to [6] in Ethiopia hot pepper (*Capsicum annuum*) is an economically and traditionally vital crop, and for most Ethiopians food is tasteless without hot pepper. The fine powdered pungent product is an important flavoring and coloring component in the common traditional sauce “Wot”, (stew). In addition to dietary benefits, capsicums are also high value crops in both domestic and export markets. Since it is an industrial Crop, it generates employment to urban and rural workers. The deep red colored cultivars have a very high processing demand in the country [7].

The national production of green and dry hot pepper was 632,404.53 and 2,647,225.30 tones with average productivity

of 61.96 and 17.33 tones ha respectively [8]. Thus, *Capsicum* productivity in Ethiopia is far below the world average that strongly demands immediate productivity improvement. People consume pepper for intake enhancement as well as to supplement the dietary needs. It is also one of the major income generating crops for most households of the pepper producing areas and plays a vital role in food security in Ethiopia [9].

Despite the importance of hot pepper in Ethiopia, total crop failure due to diseases has been common and sometimes farmers are forced to abandon their production due to excessive disease pressure in the field [10]. Among hot pepper diseases, Powdery mildew, Leaf blight, Wilt and Pepper mottle virus [11-13] have been reported in Ethiopia. Recently, wilt causing pathogens are becoming the leading problems reported by causing 86.4% wilt incidence due to *fusarium* wilt in Ethiopia [14]. Virus caused 60 to 100% losses of marketable fruit, while up to 100% loss was recorded from pepper anthracnose [15]. Bacterial spots caused by a seed borne bacterial pathogen (*Xanthomonas campestris* pv. *vesicatoria*) is also capable of causing severe defoliation of plants, resulting in reduced yield and loss of quality of harvested fruit when severe damage occurs on enlarging fruits [16].

Even though the study areas have a great potential in terms of physical environment and market opportunities, the production and productivity of pepper is becoming

decreasing due to disease. So, it was very important to assess and identifying the cause pathogen. Therefore, this activity was initiated to determine the relative occurrence, distribution and status of hot pepper disease across study area.

2. Materials and Methods

2.1. Description of the Study Area

The Field survey was conducted in part of Western Oromia in West Shoa and East Wollega Zones during 2020 main cropping season. The disease assessment survey was conducted in two districts of West Shoa Zone Ilu galan and Bako Tibe, in two districts of East Wollega Zone namely Sibu sire and Bilo Boshe Districts (Table 1). The disease Survey was conducted to assess the prevalence, incidence and severity of major disease of Hot pepper. In most of the areas, the survey was conducted after fruit set to maturity growth stages of the crop. The survey was conducted from 20th to 30th November 2020 cropping season. The annual mean minimum and maximum temperature of the area is 14.5°C and 29.3°C, respectively, while the annual rainfall is 1605.7mm. The geographical locations of the surveyed areas were located in a range of latitude and longitude of 08°55'10.89"- 09°05'04.87"N and 036°44'35.44"- 037°60'22.73"E, respectively.

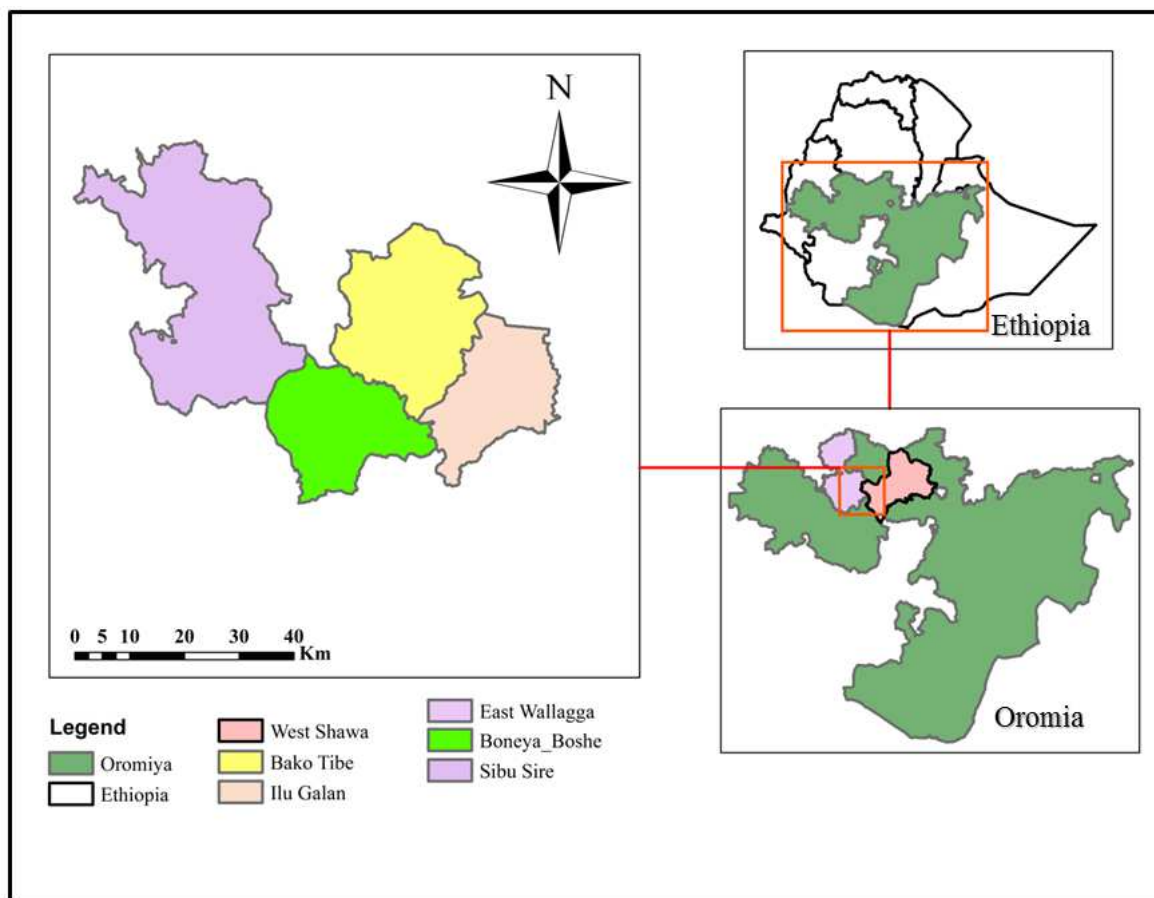


Figure 1. Map of survey site.

Table 1. Characteristic features of surveyed hot pepper fields in two Zones, Western Oromia.

Zones	Districts	Altitude (m.a.s.l.)	No. field assessed
West Shoa	Ilu Galan	1705-1793	5
	Bako Tibe	1610-1768	14
	Mean	1610-1793	19
East Wollega	Sibu Sire	1711-2083	18
	Boneya Boshe	1655-1778	8
	Mean	1655-2083	26
	Over all mean	1610-2083	45

m.a.s.l. = meters above sea level.

Table 2. Meteorology data last ten years (annual temperature and annual rain fall).

year	annual mean minimum temperature	annual mean maximum temperature	annual mean rain fall
2011	13.5	27.3	1425.5
2012	13.7	28.7	889.8
2013	12.9	29	1432.6
2014	13.4	28.4	1066.4
2015	12.4	29.9	931.4
2016	14.1	29.7	1330.7
2017	12.7	29.1	1599.5
2018	14	30	1267.1
2019	14.2	29	1342.3
2020	14.5	29.3	1605.7

Source: Bako Meteorology station.

2.2. Hot Pepper Field Survey

The hot pepper disease assessment was done in four Districts of the two zones during main season of 2020 in all surveyed districts of two zones. The survey was conducted in 32 Kebeles and 46 farms in the four Districts of the two Zones. Random sampling technique was applied in the study assessment. Kebele were randomly selected from each District and based on the representativeness of hot pepper production of the area. The locations were at least 4-7 km apart and the distance locations depended on the topography and the relative importance of crop production within each location. The disease survey was done along the two diagonals (in an “X” fashion) of the field from five points using 1m x 1m (1 m²) quadrates and some questioner rise to farmers.

The hot pepper management practices; like variety grown whether local or improved, previous crop (cereals, pulses or

vegetables), planting date (sowing) crop density, altitude, weed density per meter square, fertilizer type and rate, soil type, growth stage, disease type observed and fungicide used were collected as to the survey format. Most of hot pepper local cultivars assessed during the survey time and recorded. In each field, plants within the quadrates were counted and recorded as diseased/infected plants part.

2.3. Disease Scoring

Visual identification of the disease was used on all visited fields. The survey was conducted for disease prevalence, incidence and severity hot pepper in reported locations.

2.3.1. Disease Prevalence

Disease prevalence refers percentage of sampling areas in which disease was presented. The formula the determination of prevalence is:

$$\text{Disease prevalence (\%)} = \frac{\text{number of locations showing plant disease}}{\text{total no. of location /field}} \times 100$$

2.3.2. Disease Incidence

Disease incidence was determined in each field on the basis of visual symptoms and by counting the number of symptomatic or infected plants in a sample of total plants in

randomly selected in the fields. An overall disease incidence value was obtained by averaging the incidence among all the fields (including the fields which has no disease). The formula for determination of incidence is;

$$\text{Disease Incidence (\%)} = \frac{\text{number of Diseases plant in the quardate/field}}{\text{total number of plant in quardate/field}} \times 100$$

2.3.3. Disease Severity

The proportion of the area of a plant or plant organ (e.g.

leaf, stem, branch, and fruit) that was affected. It measures percentage of disease damage and yield loss on each plant. The level of disease severity for each field was determined

by using visual by [17].

$$\text{Disease Severity(\%)} = \frac{\text{Area of plants tissue affected}}{\text{total number of plants affected}} \times 100$$

Table 3. Disease rating scales used in scoring observed diseases in the field.

Disease	Scale	Description	Reference
Fusarium wilt	0	0% healthy,	[18]
	1	1 - 10% one leaf yellowing,	
	2	11-20% more than one leaf yellowing,	
	3	21-30% one wilted leaf,	
	4	31-50% more than one leaf wilted, and	
Cercospora leaf spot	5	> 50% completely dead/ wilted plants.	[19]
	0	No disease symptom	
	1	10% of canopy showing diseased symptoms	
	3	10-20% of canopy showing disease symptoms	
	5	25-50% of the canopy showing disease symptoms	
Bacteria leaf spot	7	50-75% of canopy showing disease symptoms	[20]
	9	>75% of canopy showing disease symptoms	
	0	0 no symptom,	
	1	symptomless,	
	2	a few necrotic spots on a few leaflets,	
Bacteria soft rot	3	a few necrotic spots on many leaflets,	[21]
	4	many spots with coalescence on few leaf,	
	5	many spots with coalescence on many leaflets,	
	6	severe disease, and leaf defoliation, and	
	7	a dead plant.	
Anthracnose	0	Healthy fruit on entire plant	[22]
	1	Sunken, light-coloured lesions on exposed fruits lesion can enlarge that may extend to sides	
	2	Dark leathery spot on blossom-end Raised, wart-like brown lesion + Small pale halos- "ghost spots"	
	3	Water-soaked, dull green spots covered with cream mould growth	
	4	Water-soaked sunken lesions that expand Cloudy, yellow blotches directly below skin	
	5	Pods soften and quickly collapse	
	0	Healthy	
	1	1-5% of mature leaves with necrotic and chlorotic symptoms	
	2	6-15% of mature leaves with necrotic and chlorotic symptoms	
	3	15-50% of young shoots and stems water soaked lesions and minor die back	
	4	51-95% of water-soaked lesions with abundance mycelia growth and fructification, and extensive shoot dieback	
	5	Dead plant	

2.4. Statistical Data Analysis

The data collected from the survey was checked completeness and analyzed using SPSS software used to summarized. Analysis was conducted by disaggregating important relevant information by Districts and Zones so that comparison could be made.

3. Result and Discussion

3.1. Status and Distribution of Hot Pepper Diseases

A total of 46 fields were surveyed in four Districts of West Shoa and East Wollega Zones during 2020 main crop season. The four districts had almost near to midland and highland agro-ecologies. It lies at an altitude of 1610-2083m.a.s.l. in two Administrative Zones (Table 1). In this area most farms fields covered by hot pepper from vegetables next to cereal crops. The survey was conducted in 32 Kebeles and 46 fields in the six districts of the two zones.

Six diseases of hot pepper, Fusarium wilt (*Fusarium oxysporum*), Cercospora leaf spot (*Cercospora capsici*),

Bacterial leaf spot (*Xanthomonas campestris pv vesicatoria*), Bacteria soft rot (*Erwinia cartovora*) and Anthracnose (*Colletotrichum gloeosporioides*) diseases were assessed in the farms field. Prevalence of most leaf diseases varies from field to field, depending on environmental conditions, tillage practices, cropping sequence, and hybrid susceptibility. Moderate temperatures and moisture in the form of rain and heavy dew usually favor development of foliar diseases and more than one type can be present on the individual plant. Disease incidence of hot pepper in the farms were computed for Kebeles, Districts and in the study areas.

3.2. Hot Pepper Disease Prevalence

Hot pepper Fusarium wilt, was prevalent in all hot pepper producing districts of West Shoa and East Wollega Zones in this Assessments. The disease prevalence of Hot pepper Fusarium Wilt ranged from (70.59%-100%) (Table 4). This indicated the disease was the most destructive diseases during the season. The highest prevalence of Fusarium wilt 100% was recorded in Boneya Boshe district followed by Ilu Galan and Bako Tibe which had 83% and 74.62% disease prevalence,

respectively, while the lowest prevalence of Fusarium wilt 70.59% was recorded in Sibu Sire district (Table 4).

Prevalence of hot pepper Cercospora leaf spot was 100% in all surveyed districts and the disease was commonly found in all assessed hot pepper fields. Next to Cercospora leaf spot, Bacteril leaf spot disease recorded 87% in Ilu Galan, 76.47% in Sibu Sire, 75% in Boneya Boshe and in Bako Tibe 69.23% the disease covered in assessed area (Table 4). The prevalence of Bacteria soft rot hot pepper disease was recorded 58.82% in Sibu Sire and 23.08% in Bako Tibe Districts. Hot pepper Anthracnose disease prevalence in Bako Tibe 30.77%, in Sibu Sire 23.53% and in Boneya Boshe 26% was recorded.

3.3. Hot Pepper Disease Incidence

Fusarium wilt of hot pepper was observed in all surveyed fields of the two Districtes of West Shoa and two Districts of East Wollega Zone in all producing farmers. There was not similar status among hot pepper fusarium wilt disease between Districts and Zones. Regarding the variation of hot pepper fusarium wilt disease, within and across Districts, relatively higher incidence Bako Tibe 54.8% whereas followed by Ilu Galan 47% (Table 4). The minimum of mean incidence was 40.5% and 43.33% recorded in Sibu Sire and Boneya Boshe District, respectively. The result almost nearly similar to [23]. In western Ethiopia fusarium wilt incidence recorded up to 86.4% [14]. This report indicates that there is variation in level of infection and wilt causing pathogens in different locations in Ethiopia.

Cercospora leaf spot of hot pepper observed in all surveyed fields Districts. There dissemination variable from farms field to field along the study area. The highest cercospora leaf spot of hot pepper was 90.31% recorded in Bako Tibe and followed in Ilu Galan 85%. The minimum mean incidence of cercospora leaf spot was 36.33% and 66.53% recorded in Boneya Boshe and Sibu sire District, respectively (Table 4).

Bacteria leaf spot disease of hot pepper found in all surveyed fields Districts. It devastated on fruit, leaf and steam of the hot pepper. The highest Bacteria leaf spot was 76.33% and 73% observed in Bako Tibe and Ilu Galan District, respectively (Table 4) whereas the minimum mean incidence average incidence of bacteria leaf spot was 57.33% and 56% in Boneya Boshe and Sibu Sire District, respectively (Table 4).

Bacteria soft rot disease of hot pepper was found in Bako Tibe and Sibu Sire Districts. The disease to be a devastating at fruiting stage of hot pepper, when the rain fall is continuous and very intensive. The maximum mean incidence was recorded 42.4% in Sibu Sire while minimum disease mean was 27.5% observed in Bako Tibe District (Table 4).

Hot pepper Anthracnose disease was observed in Bako Tibe, Sibu Sire and Boneya Boshe Districts at different levels of disease incidence. The maximum mean incidence was recorded 39.5% in Bako Tibe and followed in Boneya Boshe 28%. The minimum mean incidence average of anthracnose was recorded in Sibu Sire District 22.75% (Table 4).

Table 4. Percentage of Prevalence, Incidence and Severity Index of Hot pepper disease.

Zone	Districts	Types of disease	Prevalence %	Incidence %	Severity %
West Shoa	Bako Tibe	Fusarium wilt	74.62	54.8	54.8
		Cercospra leaf spot	100	90.31	43.69
		bacteril leaf spot	69.23	76.33	30.67
		Bacteria soft rot	23.08	27.5	23
		Anthracnose	30.77	39.5	24
	Ilu Galan	Fusarium wilt	83	47	47
		Cercospra leaf spot	100	85	26
		Bacterial leaf spot	87	73	32
		Fusarium wilt	70.59	40.5	40.5
		Cercospra leaf spot	100	66.53	27.94
East wollega	Sibu Sire	Bacterial leaf spot	76.47	56	23.22
		Bacteria soft rot	58.82	42.4	21.8
		Anthracnose	23.53	22.75	11
		Fusarium wilt	100	43.33	43.33
		Cercospra leaf spot	100	33.36	36.75
	Boneya Boshe	Bacterial leaf spot	75	57.33	24.67
		Anthracnose	26	28	17

3.4. Hot Pepper Disease Severity

Survey of farmers' fields in major hot pepper farms in Bako Tibe, Ilu Galan, Sibu Sire and Boneya Boshe Districts revealed that, highest disease severity of fusarium wilt disease in all studies area. The most influenced areas were found in Bako Tibe with 54.8% disease severity, followed by Boneya Boshe 47% severity, but the minimum disease severity was recorded in Ilu Galan Districts were 40.5%

(Table 4). This result almost similar with results studied by [24] indicated that the occurrence of fusarium wilt was the highest at Abeshge (55%) followed by Halaba (41%), Hawassa zuria (36%), Dalocha (32%) and Lanfro (30%) and in other location mainly western Ethiopia.

Cercospra leaf spot disease severity of hot pepper varied significant across the studies area. This revealed that the importance of the disease in all hot pepper growing farms of two Zones were a major challenge curtailing its productivity.

The highest severity of cercospora leaf spot of hot pepper was 43.69% recorded in Bako Tibe District and followed Boneya Boshe District 36.75%. The minimum mean disease severity of cercospora leaf spot of hot pepper was 26% assessed in Ilu Galan District (Figure 2).

Bacteria leaf spot disease severity of hot pepper varied significant across Bako Tibe, Ilu Galan, Sibu Sire and Boneya Boshe Districts. The highest severity of Bacteria leaf spot of hot pepper was 32% recorded in Ilu Galan and followed in Bako Tibe 30.67%. the minimum mean severity of bacteria leaf spot was 21.8% and 24.67% assessed in Sibu Sire and Boneya Boshe Districts, respectively (Table 2). This result is higher than the result studied by [25]. The occurrence of bacterial leaf spot was observed in all surveyed districts with low infestation level ranging from 7.6 up to 18.5% of severity index.

Bacteria soft rot disease of hot pepper was widely distributed throughout the major hot pepper growing of Bako Tibe and Sibu Sire Districts. The disease to be a devastating at fruiting stage of hot pepper, when the rain fall is continuous and very intensive. The mean average disease severity bacteria soft rot was nearly similar in both 23% and 21.8 in Bako Tibe and Sibu Sire Districts, respectively (Table 2).

The survey results indicated that, the Hot Pepper Anthracnose disease severity devastated in Bako Tibe, Sibu Sire and Boneya boshe Districts farmers field. The highest severity of anthracnose of hot pepper was 24% recorded in Bako Tibe and followed by Boneya Boshe 17% severity, but the minimum disease severity was recorded in Sibu Sire Districts (Figure 2).

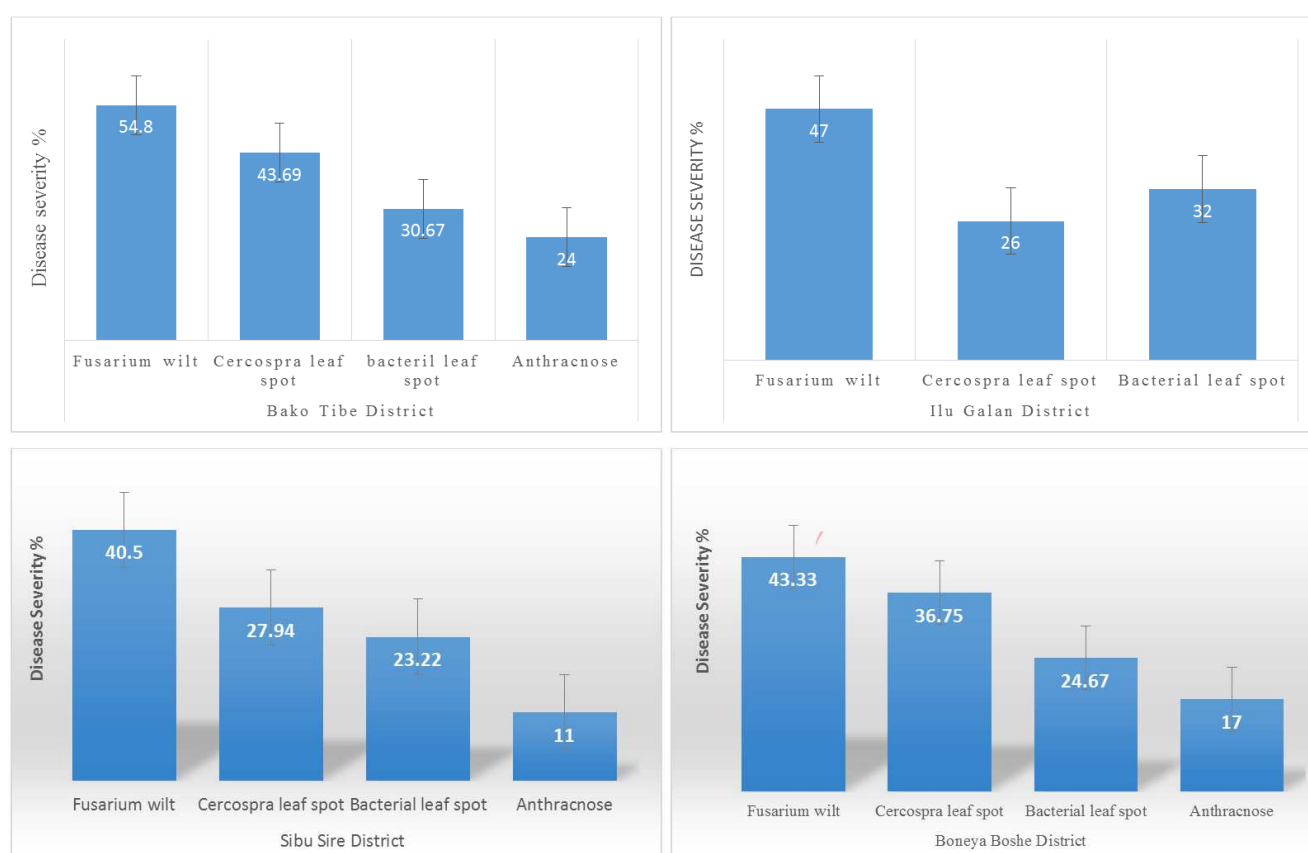


Figure 2. Disease severity of Hot pepper in each District.

4. Conclusion

Based on the study, the total of 45 hot pepper fields were assessed and different disease were identified. The importance of each disease was determined by calculating the prevalence, incidence and severity values. Major hot pepper, fields were assessed and different disease was identified and summarized. The severity and incidence of individual disease of hot pepper field such Fusarium wilt, Cercospora leaf spot, Bacterial soft rot, Bacterial leaf spot and Anthracnose. The incidence of individual disease of hot

pepper Fusarium, Cercospora leaf spot, Bacteria leaf spot and Anthracnose highest scored 65%, 90.31%, 76.33% and 39.5 while the severity value 65%, 43.65%, 32% and 24 respectively. Thus. When developing a hot pepper disease control strategy in the future, different disease management options required.

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