Assessment of Hot Pepper (*Capsicum* species) Diseases in Southern Ethiopia

Shiferaw Mekonen[1], Alemayehu Chala[2]

[1]Hawassa Agricultural Research Center, P.O. box 06, Hawassa, Ethiopia

[2]Hawassa University, P. O. Box 05, Hawassa, Ethiopia

Abstract: ***Production and productivity of hot pepper is highly threatened by different diseases in Southern Ethiopia. However, the relative importance of each disease across locations has not been assessed and well profiled to sound management strategy. To determine the occurrence, distribution and the status of hot pepper diseases in the region, survey was carried out in seven districts i.e. Meskan, Mareko and Abeshge districts (in Gurage administrative zone), Dallocha and Lanfro (in Silte zone), Hawasa zuria (in Sidama zone) and Halaba special district in 2010 and 2011 cropping seasons. Results indicated that 55% of seed beds were infected by seedling diseases. The highest seedling infection (73%) was recorded at Hawassa zuria district followed by Halaba, Lanfro and Dalocha districts (60, 56 and 54%, respectively). Similarly survey results made after transplanting showed that 229 (75 %) of samples were infected at least by one disease. The frequency of pathogen growth depicted that 30% of the associated pathogens were different bacteria, while 21, 12, 9 and 3.0% belong to the fungal genera Fusarium, Colletotrichum, Cercospora and Alternaria spp respectively. Adoption analysis of previously recommended cultural practices showed 100%, 42%, 31%, 30% and 19% for fertilizer application, engagement in two year rotation, row planting, use of pesticides and improved seed, respectively. The current study indicated that a complex of diseases exist at each growth stage of hot pepper and the occurrence across districts is highly variable despite introduction and promotion of different management practices. Therefore holistic and cumulative integrated approach is required to manage the complex diseases in the region.***

Keywords: pepper, seedling infection, disease complex

1. Introduction

Hot pepper *(Capsicums* spp.*)* is the most important vegetable crop belonging to the family *Solanaceae* and grown as spice crop in different parts of the world (Berke, 2002). It is the most common type of *Capsicum* spp. grown in Ethiopia, since its introduction in the early 17th century by the Portuguese (Huffnaga, 1961). Hot pepper covers 67.98% of all the area under vegetables in Ethiopia (CSA, 2011/2012).

It is the main part in the daily diet of most Ethiopian societies. The average daily consumption of hot pepper by Ethiopian adult is estimated at 15 g, which is higher than tomatoes and most other vegetables (MARC, 2004). Hot pepper is a popular vegetable and plays an important role in the national economy of the country. It serves as row material for the processing industries, important cash crop to farmers, and a source of employment to urban and rural populations. However, hot pepper production for dry pod has been low with a national average yields of 0.4 t/ha (Fekadu and Dandena, 2006) and declining with time. South Nations, Nationalities and Peoples Regional State (SNNPRS) contribute a significant portion to the country's total pepper production. In the region, Mareko, Meskan, Abeshge, Lanfro, Dallocha, Silte, Gimbo, Gibe, Gojeb, Shashego, Halaba, Meirab-Abaya and Hawassa Zuria are higher pepper producing districts. However, the productivity and production of the crop is low in the region. This might be attributed to the use of low yielding varieties, drought, insect pest, diseases, poor cultural practices etc. (Fekadu and Dandena, 2006). Among these, diseases caused by different fungi, bacteria and viruses are the major ones (Green, 1991**).** Virus caused 60 to 100 % losses of marketable fruit, while up to 100% loss was recorded from pepper anthracnose (Melanie and Sally, 2004). 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 (Sun *et al*., 2002). Total crop failure due to diseases has been common in the region and farmers are sometimes forced to abandon their production due to excessive infection pressure in the field (Tameru *et al*., 2003). Despite this fact the identity and relative importance of each disease across locations has not been well profiled.

Therefore, this study was initiated to determine the relative occurrence, distribution and frequency of diseases across locations; and to document information which can be used in developing integrated management strategy against hot pepper diseases.

2. Material and Methods

2.1 Survey and Sample Collection

Study area: Survey was conducted in Gurage administrative zone (Meskan, Mareko and Abeshge districts), Silte zone (Dallocha and Lanfro districts), Sidama zone (Hawasa zuria districts) and Halaba special district of SNNPRS of Ethiopia, ranging from an elevation of 1537 to 2010 masl, in 2010 and 2011 cropping season. The surveyed zones were purposively selected to represent the major hot pepper growing areas of the region.

2.2 Prevalence of seed bed diseases

Assessment of seedling disease was made in six seedling rising districts (Meskan, Mareko, Lanfro Dallocha, Halaba and Hawassa zuria) and in Abeshge district where farmers traditionally grow hot pepper by directly sowing in the main field. A total of 90 seed beds (15 per district) were assessed.

The assessment was carried out from April to June in each year. The numbers of diseased seed beds per district were documented. Finally percentages of infected seed beds in relation to total inspected fields were computed to determine disease prevalence.

2.3 Prevalence and Incidence of disease after transplanting

Prevalence of the disease: 152 hot pepper farms were visually assessed before and after flowering on permanent field. The distance between two nearby randomly surveyed fields was 4 km.

Plant incidence: Farms were visited diagonally, and the disease incidence was estimated by using 3 m x 3 m quadrant. The number of diseased plants and the total number in each quadrant were recorded. Disease incidence was calculated as the percentage of infected plants in each field at each location.

2.4. Production practices of the farmer

Field inspection formats were developed to get additional information related to farmers' agronomic practices (planting methods, planting time, seed source, fertilizer application, pesticide usage and crop rotation system), and these data were recorded during field visits. A total of 84 hot pepper farmers were interviewed and their fields were observed to investigate their current cultural practice in the selected districts.

Sample collection: During the survey period naturally infected plants of different parts (root, stem, leaf and pod) which showed suspected typical symptoms of different diseases were collected. A total of 306 samples were collected and brought to Hawassa Agricultural Research Center and Hawassa University plant protection laboratories for isolation and identification of the pathogen.

Sample isolation: Each samples having suspected disease symptom were cut in to smaller pieces from the edge of the diseased part and surface sterilized for 3 min in 10% sodium hypochlorite solution and rinsed 5 times by changing sterile water. The sterilized pieces were put in potato dextrose agar (PDA) and Yeast Potato Sucrose Agar (YPSA) Media for isolation of fungal and bacterial pathogens, respectively. After few days of growth, each pathogen was purified by transferring cultures to new media. Identification at species level was made using the colour of the mycelium and the morphology of the conidia. Finally each isolated pathogen has been transferred in to the PDA and YPSA slant media, labelled and preserved at 4^{o}C for further work.

3. Results and Discussions

3.1 Seedling diseases

Out of the 90 seedbeds assessed during the current survey, 55% were infected with different diseases (Table 1). Two seedling diseases causing pathogens namely *Phytophthora* spp. and Fusarium spp., as well as the combination of the two pathogens were found in seed beds. *Phytophthora* spp. accounted for 22.0% of the isolated pathogens while *Fusarium* spp. was responsible for 20% of field infection. A combination of the two pathogens was recorded in 13% of assessed fields. Sharma (2001) explained that seedling diseases are caused by a range of pathogens including *Fusarium oxysporum, Phytophthora* spp. and others. The highest hot pepper seedling disease (73%) was recorded in Hawassa zuria district. It was followed by Halaba. Lanfro, and Dallocha, which had 60, 56 and 54% average disease prevalence, respectively. The lowest seedling disease occurrence was observed in Meskan (40%) and Mareko (47%).

Table 1: Prevalence of seed bed diseases across location

District	*No. of seed bed*	*Frequency and type of pathogen*			*TISB (%)*
		Ph.s (%)	*Fu.s (%)*	*Ph.s+FuS (%)*	
Meskan	15	14	18	8	40
Mareko	15	18	17	12	47
Halaba	15	22	23	15	60
Hawassa zuria	15	33	27	13	73
Lanfro	15	22	19	15	56
Dallocha	15	23	16	15	54
Mean infection		22	20	13	55

Ph.s = Phytophthora spp, Fu.s = Fusarium spp.
Ph.s+Fu.s=Phytophthora+Fusarium spp
TISB= Total infected seed bed

3.2 Prevalence and incidence after transplanting

3.2.1 Prevalence of disease

The diseases found infecting hot peppers after transplanting in the inspected area were bacterial leaf spot (*Xanthomonas campestris* pv. *vesicatoria,*), bacterial soft rot (*Erwina cartovora*), fusarium wilt (*Fusarium* spp), Powdery mildew (*Leveillula taurica,),* anthracnose (*Colletotrichum* spp), cercospora leaf spot (*Cercospora capsici),* and viral diseases.

In the previous study, Mohamed and Getachew (1995) reported that pepper can be affected by a number of diseases after transplanting in addition to damping-off. Mengistu (1994) and Temam (2006) also reported powdery mildew *(Leveillula taurica)* and Fusarium wilt (*Fusarium oxysporum*) as being the most widespread fungal diseases of hot pepper in Ethiopia

The mean frequency of each disease symptom across the surveyed area was different among all pathogens. About 39% of assessed farms had bacterial leaf spot. Viral diseases, Fusarium wilt and powdery mildew diseases occurred in 29%, 30% and 23% of the farms, respectively. As compared to other diseases, bacterial soft rot, anthracnose, cercospora leaf spot-diseases occurred at very low frequencies of 14%, 12 % and 11%, respectively (Table 2). Virus, bacterial leaf spot, Fusarium wilt and Cercospora leaf spot diseases were observed at all growth stages of the crop, while powdery mildew, anthracnose and bacterial soft rot were observed at and after flowering, and fruiting stage of the crop.

The relative occurrence of each disease varied across surveyed districts. High prevalence of bacterial leaf spot (55%), powdery mildew (37%), and viruses (73%) were recorded at Meskan, Mareko and Hawassa zuria districts, respectively. Occurrence of fusarium wilt was the highest at Abeshge (55%) followed by Halaba (41%), Hawassa zuria (36%), Dalocha (32%) and Lanfro (30%). In the remaining districts 9- 23% of inspected farms were infected by *Fsarium* spp. (Table 2).

Table 2: Prevalence of hot pepper diseases after transplanting across locations in selected district of SNNPRS

Districts	*No of fields*	*Type and prevalence of pathogens*						
		Vi	*BLS(%)*	*FW (%)*	*PM (%)*	*Ant (%)*	*BSR (%)*	*CLS (%)*
Meskan	22	23	55	18	37	14	32	5
Mareko	22	29	52	9	32	9	27	4
Abeshge	22	9	37	55	27	0	22	4
Lanfro	22	30	30	30	15	30	0	9
Dallocha	22	18	32	23	15	8	13	14
Hawassa zuria	22	73	23	36	14	9	0	18
Halaba	22	18	41	41	22	14	4	23
Total	**152**	**29**	**39**	**30**	**23**	**12**	**14**	**11**

Vi= Virus, BLS= Bacterial leaf spot, FW= Fusrium wilt, PM= Powdery mildew, Ant= Anthracnose, BSR= Bacterial soft rot, CLS= Cercospora leaf spot,

3.2.2 Disease incidence

The highest mean infection of viruses (75%), Bacterial leaf spot (37.5%), Powdery mildew (60%), Bacterial soft rot (52.5%) and *Fusarium* wilt (45%), were recorded in Hawassa zuria, Meskan, Mareko and Meskan, Mareko and Abeshge, respectively,(Fig.1).On the other hand, anthracnose and cercospora leaf spots were recorded on the main field as minor diseases as compared to other hot pepper diseases in the inspected districts. The highest mean incidence of anthracnose was 12.5% and it was similar for Meskan, Mareko, Dallocha and Lanfro districts. The highest incidence (12.5%) of cercospora leaf spot was recorded at Halaba special district. In the remaining districts, the infection was only 0-5%.

Virus disease: Multiple virus infection symptoms such as mosaic, mottle, and plant stunting, malformation, leaf curling, and fruit distortion were observed in the field. Virus disease incidence was recorded in all surveyed districts. The highest disease incidence was 75% at Hawassa zuria district whereas the lowest disease recorded at Abeshge district (Fig. 1). Similar works have been reported by Tameru (2004) in which the highest (89%) and the lowest (15%) viral disease incidences were recorded at Awassa and Meki area, respectively. Similarly Hikias *et al.* (2008) reported the presence of different virus of hot pepper in Ethiopia and detected the Potato virus Y (PVY), Ethiopian pepper mottle virus (*EPMV*), pepper mottle virus (PVMV) and tomato mosaic virus (*ToMV*) from hot pepper samples collected in the region. The present study also confirmed the prevalence of viruses at the study areas, even though the relative occurrence of virus across locations is variable. Therefore care should be taken during exchange of seed and seedling of hot pepper from some districts having high virus incidence.

Powdery mildew: This disease was one of the major diseases found in hot pepper production, beginning from fruit setting stage of the crop. Tameru and Alemayehu (2006) have also confirmed the presence of fungal diseases of hot pepper such as powdery mildew during the dry season, when farmers are using irrigation. The disease was severe in Meskan, Mareko, Abeshge and Lanfro district with disease incidence of 55, 60 and 37.5 and 32.5 %, respectively.

Bacterial leaf spot: Bacterial leaf spot was found in all inspected areas of the region. It affects leaves, fruits, and stems of the crop. Symptoms begin on leaves as small, water-soaked spots and turn dark brown. The highest bacterial leaf spot incidence recorded was 45% and 35% in Meskan and Mareko, respectively. The lowest bacterial leaf spots incidence (20%) was recorded at Hawassa zuria district (Fig. 1).

Bacterial soft rot: Bacterial soft rot was found to be a devastating disease at fruiting stage of the crop, when the rain fall is continuous and very intensive in the area. The disease incidence was 52.5% at Meskan25% at Mareko, Abeshge, Lanfro and Dallocha (Fig. 1). Beth (1989) reported that soft rot caused by *Erwinia carotovora* is favoured by unfavourable soil conditions such as heavy and poorly-drained soils

Fusariumwilt: This disease is a major disease of the surveyed districts having soils of high water-holding capacity and poor drainage. Symptoms of this disease include wilting of the foliage and internal necrosis of the vascular tissue in the stem of the plant. The highest fusarium wilt incidence was observed at Abeshenge (45%), Halaba special district (32.5%) and Hawasa zuria (26.0%). Whereas the incidence was lower at Meskan (7.5%), Mareko (10%), Lanfro (7.5%) and Dallocha (12.5%) (Fig.1). The variability in the occurrence of the diseases might be related to the environmental condition and soil type of the specific areas that tended to favour the growth of the pathogens. This is evidenced by the higher water holding capacity of the vertisoil of Abeshge and the repeated occurrence of flooding at Hawassa Zuria, which favours the growth of fusarium in the area. This result is in line with Ristaino (1991), who confirmed that the number of days with heavy rainfall and surface water accumulation is very important for diseases like fusarium wilt. This also has important implications for disease management in the region

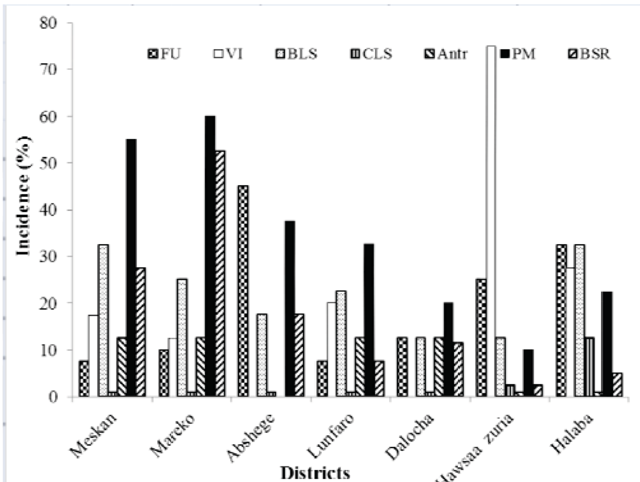

Fig 1. Average hotppppper disease insidence in selected districts of SNNPRS

3.2. 2 Pathogen Isolation

Out of the 306 samples of root, stem, and leaf of hot pepper collected during the current survey, 75% were infected by different fungal and bacterial pathogens (Table 3). The remaining 25% samples were free from any pathogen.

Bacterial and *Fusarium* spp. were the most frequently isolated pathogens in the samples. They were followed by *Colletotrichum*, *Cercospora* and *Alternaria* spp. in that order (Table 3). The frequency of pathogen growth depicted that 30% of the associated pathogens were different bacteria, while 21 12, 9 and 3% belong to the fungal genera *Fusarium Colletotrichum* spp, *Cercospora* and *Alternaria,* respectively.

Table 3: Isolated from the collections of different districts of SNSNPR

Districts	*No. of samples*	*Percentage of isolated pathogen*					
		FS (%)	*B (%)*	*CS (%)*	*CPS (%)*	*AS (%)*	*Free (%)*
Meskan	44	11	37	7	9	0	36
Mareko	44	12	34	9	10	0	35
Abeshge	44	45	30	10	0	0	15
Lanfro	44	20	25	16	7	0	29
Dallocha	43	18	30	16	7	0	27
Hawasazuria	43	21	21	8	16	21	13
Halaba	44	18	30	18	14	0	17
Mean	306	21	30	12	9	3	25

FS=*Fusarim* spp, B=Bacterial, CPS= *Cercospora* spp,
CS = *Colletotrichum* spp, AS=*Alternaria* spp.

3.3. Cultural practice of hot pepper grower farmers

Most of the diseases observed on hot pepper farms can be controlled by using recommended cultural practice like optimum rate of fertilizer, row planting, appropriate spacing, crop rotation and use of clean seed of improved varieties. However, in surveyed districts farmers' practices were variable and only few farmers apply recommended cultural practice. For example at Abeshge district, seed bed preparation and rising of hot pepper seedling was not practiced by farmers at all. The farmers plant directly using broadcast method of sowing on the main field. Of all inspected farms of hot pepper growers, 69% used broadcast method of planting. The remaining farmers (31%) used raw planting. Even those who used raw planting were using spacing below recommendation (Table 4).

The recommended inter and intra-raw spacing for pepper is 70 and 30 cm, respectively, but the farmers were using 35 and 20 cm, respectively. This indicates that farmers in the region still lack know how on the advantage of spacing in suppressing disease incidence. The entire farmers in the inspected areas used fertilizer during planting but the amount of fertilizer used were variable from farmer to farmer. Regarding fungicide usage, only 21% of the farmers used fungicides for seed treatment, spraying at seed bed and after transplanting, whereas 69% of the farmers did not use chemicals against hot pepper diseases. It has been known that some improved nursery managements including pepper seed treatment, use of recommended seed rate, sowing seeds in row and planting seedlings in row have shown better results in improving production and productivity (Girma, 2009).

All of the interviewed farmers used rotation after producing hot pepper; however the year interval and the type of crop used for rotation varied from farmers to farmers. Sixty percent of the farmers used rotation only for one year and plant maize after hot pepper. Forty percent of the farmers used rotation for two years and plant maize and haricot bean after hot pepper production (Table 4). But most of hot pepper diseases causing fugal and bacterial pathogens once occurred in the area can survive at least for three years in the soil debris

Table 4: Response of farmers on cultural practices of hot pepper, 2010 and 2011 cropping season

Districts	*NF*	*MP (%)*		*FR (%)*		*Fnu (%)*		*Rotation (%)*	
		BC	*RP*	*Yes*	*No*	*Yes*	*No*	*OYM*	*T Y*
Meskan	12	58	42	100	0	42	58	33	66
Mareko	12	67	33	100	0	50	50	42	58
Abeshge	12	100	0	100	0	0	100	75	25
Lanfro	12	66	34	100	0	20	80	42	58
Dallocha	12	84	16	100	0	25	75	50	50
Hawsaa zuria	12	25	75	100	0	42	58	83	17
Halaba	12	84	16	100	0	33	67	50	50
Mean		69	31	100	0	30	70	58	42

NF= Number of farmers, MP= Method of planting,
FRU= Fertilizer used, FNU= Fungicide used, BC = Broad cast, RP= Raw planting, R= Rotation, OYM= One year maize, TYMAH= Two year (maize and haricot bean)

Farmers in the study area use hot pepper seed from various sources. Of the interviewed farmers, 43% used their own seed, 38% used seeds purchased from local market, whereas 19% of the farmers used improved seed obtained from governmental and nongovernmental organizations (Fig. 2). However, it is known that both purchased seeds from the local market and traditionally extracted seeds are unreliable and more likely attacked by seed borne pathogens and play a role in transmitting diseases in the nursery. It was reported that contaminated seeds and soils are sources of inoculums that affect seedlings before or after emergence. In order to avoid such problems, Sharma (2001) stated that cultural control measures in the field are key components for disease control, but it all starts with the seed.

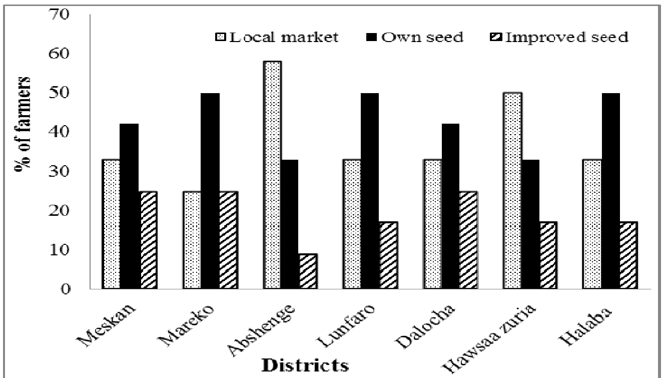

Fig 2. Percent of pepper seed sources in selected districts of SNNPR

4. Conclusion and Recommendation

Even though the yield loss caused by each pathogen is not clearly studied and quantified in Ethiopia, this study indicated the presence of complex diseases at seedling and subsequent growth stages of the hot pepper. In this study, more than eight types of pathogens attacking hot pepper were observed across surveyed districts. Among all diseases, fungal diseases (fusarium wilt and powdery mildew), Bacterial diseases (bacterial leaf spot and bacterial soft rot) and virus diseases are the most frequently encountered diseases in hot pepper producing areas. In addition, *Phytophthora* spp. and *Fusarium* spp. are the main pathogens affecting hot pepper seedlings on seed beds.

Many efforts were made in the region to manage the diseases through training and demonstration on improved agronomical practice and other recommended disease management packages from seedling rising till post-harvest handling. However, farmers' adoption study indicated application of recommended improved cultural practice on hot pepper production in the region is very low. Farmers in the region are still using poor cultural practices to produce hot pepper.

Adoption analysis of previously recommended cultural practices showed 100%, 42%, 31%, 30% and 19 % for fertilizer application, engagement in two year rotation, row planting, use of pesticides and improved seed, respectively. Therefore, efforts should be made towards the integration of multiple control options. These are development of resistance varieties, implementation of improved agronomic practices, awareness creation of farmers and experts from site selection up to post harvest handling on the importance of diseases and their management. In general, holistic cumulative integrated approach is required in all urgency to manage the complex diseases developed in the region.

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References

[1] Berke, T. 2002. The\VB KL Asian Vegetable Research Development Canter Pepper Project.
[2] Beth, L.T. 1989. Effect of irrigation management on sour skin of onion. Plant diseases 73: 819-822.
[3] Central Statistical Agency Agricultural sample survey. 2012. The federal democratic republic of Ethiopia.(September-December,2011/2012.
[4] Fekadu, M. and Dandena, G. 2006. Status of Vegetabl CropsinEthiopia.http//scribd.asterpix.com/cy/2437661/= Accessed on 12/29/2009. Ugandan Journal of Agriculture, 2006, 12(2): 26-30
[5] GirmaTegegneand Yusof Keder. 2009. Enhancing and Demonstrating appropriateVegetable production practices in the Central Rift Valley of Ethiopia
[6] Green, S.K. and Kim, J.S. 1991. Características and control of viruses infecting peppers: a Literatura review asian Vegetable Research and Development Centre. Technical Bulletin No. 18. 60pp
[7] Hiskias. YD. E. Lesemann and H. J. Vetted. 2008. Occurrence, Distribution and Relative Importance of Viruses Infecting Hot Pepper and Tomato in the Major Growing Areas of Ethiopia. Crop protection 28: 443-448. Published online: 28 JUN 2008 Journal of Phytopathology
[8] Huffnagel, H.P. 1961. Agriculture in Ethiopia. Food and Agriculture Organization (FAO), Rome, 24, Kaiser, W. J. and R. Hannan, 1987. Seed-treatment fungicides for control of seed borne Ascochyta lentils on lentil. Plant Disease. 71:58-62.
[9] Melanie L.L.I. and Sally A.M. 2004. Anthracnose Fruit Rot of Pepper [Internet]. Extension Fact sheet, Ohio State University [Online].Available from: http://ohioline.osu.edu (Accessed: 8/12/2010)
[10] Melkasa Agricultural Research Center. 2004. Progress Report Addis Ababa. Miller JJ.1946.Taxonomy Fusarium with particular reference to section Elegans.
[11] Mengistu Hululuka, 1994, Research on vegetable diseases in Ethiopia.pp.209-216 In E. Herath. Lemma. D. (Eds). Horticultural The Proceeding of second National international Horticultural Work Shop Of Ethiopia,1-3 December 1992, Addi Ababa, IAR/FAO.
[12] Mohamed Yesufe and Getahew Ayana. 1995. A Review of Vegetable and Fruit Crop Diseases: Research:\ Achievements and Prospects. In: 25 Years of Research Experience in Lowland Crops.
[13] Ristaino, J.B. 1991. Influence of rainfall, drip irrigation, and inoculum density and the development of Phytophthora root and crown rot epidemic dsease and yield in bell pepper. Psychopathology, 81: 132-137.
[14] Sharma, P.D. 2001. (ed.). Plant Pathology a text book for University students. Rastogi Publications, India. Pp.224-263.
[15] Sun, X., Nielsen, M.C. and Miller, J.W. 2002. Bacterial Spot of Tomato and Pepper. Plant Pathology Circular No. 129] (Revised) April/ May; Fl. Dept. Agriculture and Cons. Svcs. Division of Plant Industry
[16] Tameru Alemu and Alemayehu Challa. 2006. The efficacy of some fungicides against pepper powdery mildew (Leveillula taurcia) in the rift valley parts of Ethiopia.Unpublished report PP.16
[17] Tameru Alemu. 2004. Characterizition of pepper (Capsicum spp) and sweet potato (Eabatatas) from Ethiopia .Ph.D Thesis. University of Bonn, Germany
[18] Tameru, Alemu: Hamacher, J. and Dehne, H.W. 2003. The increase in importance of Ethiopian Pepper mottle Virus (EPMV) in the rift valley part of Ethiopia; time to create Awareness among researchers an extension workers, Paper presented at Deutsches Tropentage, October 18-2 1-2003. Gottingen, Germany.
[19] Temam Hussen. 2006. Disease of vegetable crops and their Importance in Hararghe, eastern, Ethiopia. Pepper Presented at the Inaugural Conference and 3rd National Horticultural Workshopm 27-30 March 2006, Addis Ababa, Ethiopia. p_p.National Horticultural Workshopm 27-30 March 2006,Addis Ababa, Ethiopia.http://nl1.vnunet.com/news/1116995. [Accessed: Sept. 12, 2004]. (General Internet site

Author Profile

Shiferaw Mekonen received his B.Sc. degree in Plant Production and Dry land Farming; in 2004 from Hawassa University, Ethiopia. He got his M. Sc in Plant Pathology from the same University in 2008. Since, 2005 he has been working as researcher at Hawassa Agricultural Research Center, Crop Science Department, and Crop protection section