Prevalence, Incidence and Distribution of Sweet Potato Virus: It's Effect on the Yield of Sweet Potato in Southern Region of Ethiopia

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Abstract: ***Sweet potato virus disease (SPVD) is one of the major constraints of sweet potato production in east and central African. However the problem has not been reported in Ethiopia until recently. Even if the first introduction of the virus was not clearly known, its devastation behavior was observed in 2005-2006 around Hawassa agricultural research center. In order to confirm this speculation a survey was conducted during 2007/08 cropping season in major sweet potato growing areas of southern Ethiopia. This survey was confirmed the presence of sweet potato virus both in farmers field and Research stations. Thus it was conclude that 75% of farmers field and 100% experimental stations were infected by the disease. Apart from virus, other diseases such as Cercospora leaf spot, Alternaria leaf spot, stem blight, leaf blight were also recorded on the crop and considered as minor problem. During the virus disease assessment, vector and non vector insect pests such as Sweet potato butter fly, sweet potato weevil, aphids, and white fly were documented. Among the insect pests aphid and white fly were already known vectors of SPVD. It was also observed that SPVD has affected negatively the number of roots (44.73%) and weight (32.44%) of per plant.***

Keywords: Virus, SNNPR, prevalence, distribution, incidence, aphids and white fly

1. Introduction

In SNNPR sweet potato diseases in particular virus problem has not been reported until recent years, although, it is one and the most important constraint of sweet potato growing countries of east and central Africa, where it has confined and remained endemic for several years. At current conditions, sweet potato is subjected to virus disease, a new threat to its production in the region. Sweet potato (Ipomea batatas L.) is one of the prominent root crops supporting a considerable portion of Ethiopian as a source of food. It has been cultivated as crop in Ethiopia for several years and over 95 % of the crop produced in the country is grown in the south, south western and eastern parts of the country, where it has remained for centuries as an important staple or co-staple for the community (Emanna, 1990). In area coverage and production, it is the third important root and tuber crop next to enset (Ensete ventricosum) and potato (Million, 2002). In 1999, 63% of the estimated 52,022 hectares of sweet potato cultivated in Ethiopia was in SNNPR, with Oromiya being the second region of importance with 34% of cultivated area. The economic impact of the crop in the region is considerable where it is basically cultivated by small-scale resource poor farmers (CACC, 2002).

In SNNPR, sweet potato is a subsistence and food security crop grown for family consumption by millions of people, although, it is used for many purposes in many parts of the world. Sweet potato starch is used for production of alcohol, manufacture of adhesives, textiles and paper sizing and in the confectionary and baking industries (Terefe, 2003). In SNNPR, it is extensively grown in Wolayta, Gamo Gofa, Dawro, Kembata and Tambaro, Hadiya zones. The national average yield of sweet potato is 10 tones per hectares (CACC, 2002), which is extremely low as compared with the average yield of other countries, due to various limiting factors. China increased its average production from 8 to 18 tons /ha (Horton, 1988 as cited by Woolf, 1992), and the average yield of sweet potato in Mozambique ranges from 13.6 tons to 16.1 tons per hectare (Andrade et al., 2002 as cited by Feliciano M. Mazuze, 2004).

Sweet potato production is constrained by biotic and abiotic factors, among biotic the most important of which are weevils and viruses (Msabaha, 1979 and Rwegasira, 2004). Virus diseases alone can cause yield reduction of 56 to 98 % (Mukasa, et al., 2003, Gibson et al., 1998, Karyeija, et al., 1998). In East Africa, severe sweet potato virus disease (SPVD), characterized by small, distorted leaves which are often narrow (strap-like) and wrinkled, with a chlorotic mosaic or vein clearing, stunting of plants and heavy yield losses, has been reported in Uganda since 1944 (Karyeija, et al., 1998 and Mukasa, et al., 2003) and later in Kenya, Tanzania, Rwanda, Burundi, and Malawi (Schaefer and Terry, 1976). Sweet potato virus disease (SPVD) is the most devastating diseases of sweet potato and caused by dual infection with the whitefly-transmitted sweet potato chlorotic stunt virus (SPCSV) and the aphid-transmitted sweet potato

feathery mottle virus (SPFMV).

According to Karyeija, et al (1998) SPFMV is the most important potyviruses infecting sweet potatoes in Africa and elsewhere in the world. Another severe disease is Chlorotic Dwarf (CD) caused by SPFMV, SPCSV and sweet potato mild speckling virus (SPMSV) which occur in numerous countries throughout the world (Tairo, 2006). According to Loebenstein et al. (2003) there are more than 20 viruses known to infect cultivated sweet potato worldwide. The use of SPVD resistance varieties and phytosanitation (selection of healthy vines, rouging of SPVD infected plants and isolation) were the principal management approaches (Rwegasira et al., 2004). Among the insect pests, sweet potato butterfly, Acraea accrata Haw. (Lepidoptera: Nymphalidae), and the sweet potato weevil, Cylas spp. (Coleoptera: Curculionidae) are the most important in the southern region. Although SPVD can be controlled by healthy stock programmes, phytosanitation and cultural measures, these are difficult to integrate with subsistence production systems used by resource-poor farmers. Selection by farmers of more resistant, better performing landraces for planting has reduced SPVD incidence in the field in east Africa, resulting improved yields (Mwanga et al., 2002), but no current cultivars grown in any part of the world is immune to SPVD (Tairo, 2006).

At present, various research projects are undergoing to improve sweet potato production and productivity. About 15 improved sweet potato varieties were released by Hawassa Research Center (HRC) of SARI, since 1996. The HRC also distributes sweet potato planting materials (cuttings of different varieties) within the region and to other newly expanding regions (Tigry, Amhara, etc.) as sweet potato is increasingly recognized as a crop that could improve food security. Apart from these, HRC introduces several sweet potato germplasms from east African countries especially from Uganda and tests for its desirable traits. In the research centers as well as in farmer fields, use of cuttings mode of propagation is usual procedure and this practice likely enhances accumulation, development and distribution of pests (disease and insect pest) over a period of time leading to eventually break down of new threats. Fungal, bacterial and viral diseases dissemination is nearly associated with vegetative propagation in the fields causing the production of poor quality of planting materials and crop yield reduction. So far, there is no data based information on the virus disease and vectors prevalence and distribution in the region. This paper reports on results of sweet potato virus disease incidence and distribution mainly on field observations in major sweet potato growing areas of SNNPR.

2. Materials and Methods

The Assessments of sweet potato growing areas of the southern region, Ethiopia were conducted during 2007/2008 cropping season, to determine the incidence and distribution of diseases in particular virus. A survey for sweet potato virus disease was covered the major sweet potato growing areas of Sidama, Gedeo, Amaro, Wolaita, Gamo Gofa and Kembata-Tembaro in SNNPR. A total of 166 farmers' fields were selected randomly and from each field 3-5 samples (depending on the size of fields) were collected and diseasand insect pests data were recorded by using check list at each location (Table 1).

Table 1: Sample size and locations assessed for virus diseases and associated insect pests

Location	*Sample Size*	*Altitude (masl) Range*	*No of sweet potato varieties examined*	
			On farm	*On station*
Sidama	31	1700-1920	2	16 (Hawassa)
Gedeo	14	1560-1745	2	No testing site
Amaro	11	1420-1610	1	9 (Kelle)
Wolaita	45	1540-2140	2	(Kokate) harvested at the time
Gamo Gofa	30	1200-1580	2	15 (Sawulla and C/Mille)
Kembata Tembaro	35	1550-1900	2	No testing site

Apart from farmer fields, assessment for virus disease was carried out at each experimental station of Hawassa, Kelle, Sawula and Chano Mille. During the assessment, The fresh specimens/samples of virus infected plants were collected from different locations and transported/sent to Ambo plant protection research centre (PPRC) for farther analysis and confirmation. The yield samples (about 10 from each location) were taken from apparently healthy as well as plants with virus symptoms to observe the virus effect on the production. Both healthy and virus infected plants were uprooted; number and weight of each plant were recorded accordingly for yield computation. Reduction (R) in root and weight were calculated as:

$$R\ (\%) = \frac{\text{Diseased}\ \ X\ 100}{\text{Healthy}}$$

3. Results and Discussion

Disease and insect pest

The disease and insect pest types and status observed on sweet potato during 2007/08 assessments at different locations of the region were presented in Table2. The major insect pests found to attack the crop were weevil, butter fly, white fly, and aphid. The insect pests recorded at the time of survey, were not new to cause crop damages in the region. In this report sweet potato virus disease is identified and recorded as a newly emerged major constraint of sweet potato production, while Alternaria leaf spot as intermediate, and Cercospora leaf spot, stem blight diseases were recognized as a minor problem of the crop.

Table 2: The status of diseases and insect pests recorded on sweet potato

Insect pest/Disease	*Species (spp.)*	*Status*	*Remark*
Weevil	Curculionidae	Major	
White fly	Bemisia	Major	Sporadic
Butter fly	Acraea accrata	Major	Sporadic
Aphid	Myzus	Intermediate	
Tortoise	Aspidomorpha	Intermediate	
Leaf miner	Bedellia	Minor	
Stem blight	Erwinia	Minor	
Alternaria leaf spot	Alternaria	Intermediate	
Virus	SPVD	Major	New for the region
Leaf spots/	Phomopsis	Minor	
Cercospora leaf spot	Cercospora	Minor	

SPVD prevalence and distribution

In SNNPR, up to this report there is no data based information on the sweet potato disease (SPVD) incidence and distribution. Until the recent years, the available documents report that sweet potato was free from the diseases in particular viruses constraint, though, SPVD has remained endemic for a several years and serious problem in other sweet potato growing countries of east Africa. However, prior to this report, virus disease symptoms were first noticed at Hawassa and Kokate stations of Hawassa research centre between 2004 and 2006 by researchers' team. During this survey, it was identified that the diseases especially SPVD has emerged as a new, major and serious problem, being distributed almost in all assessed location of SNNPR. It was also detected by laboratory testing in leaves (with young stem) samples that were collected and sent to the Ambo PPRC from the fields showing typical virus. ELISA kit was used to identify the presence of virus in the leaves symptoms (+). The prevalence and distribution of SPVD was highest in experimental stations than in farmers' fields. In this study the most affected locations are Hawassa station and Kembata Tembaro zone. The maximum SPVD incidence of 100% was observed in research station of Hawassa and it was 75% in Kembata (Tunto) areas, followed by Wolita (66.7%). At the course of survey, Amaro on farm the crop was free of SPVD incidence (Table 3).

Table 3: Sweet potato virus disease incidence and distribution in major sweet potato growing areas, SNNPR

Location	*Sweet potato virus disease incidence*			*Remark*
	On-farm (%)	*On-station (%)*	*Laboratory test*	
Sidama	37.30	100	+	
Gedeo	25.00	-	+	- No testing site
Amaro	0.00	62.20	+	
Wolaita	66.70	-	+	No crop at the time
Gamo Gofa	40.00	46.70	+	
Kembata Tembaro	75.00	-	+	- No testing site

Although, numerous sweet potato varieties were released by Hawassa Agricultural Research Centre, farmers use only few (maximum 2) varieties, because of various reasons. "Awassa 83" was widely distributed, the most popular and predominant sweet potato variety used by farmers in the southern region, although, some farmers often use their own local varieties. The incidence of SPVD was observed on both improved Awassa 83 variety and local cultivars. Similarly, SPVD incidence was observed on the numerous sweet potato germplasms planted at different research stations (Hawassa, Kelle, Chano Mille and Sawulla).

The movements of infected planting materials are the main mode for the long distance dissemination of plant pathogens, as locally spread mainly by cultural practices and vectors. This means led authors to suspect that SPVD is introduced into SNNPR through planting materials form east Africa, likely from Uganda; as this country is the main partner for the new germplasms/planting materials introduction. The subsequent dissemination of disease within the region is also mainly through cuttings (infected planting materials) distributions. This statement is in accordance with reports of Nichlon (1950) and Hillocks and Thresh (2000) mentioned that cassava brown streak disease (CBSD) was introduced from Tanzania (first observed) to other east African countries through distributions of varietal collection (infected planting materials). Similarly, Tushemereirwe et al., (2001) reported that enset BW pathogen reached to Uganda from Ethiopia, although, the means of transmission was not noticed likely by means of human activities.

Effect of virus disease on the yield

SPVD is became the Important and serious problem of sweet potato production causes considerable yield losses. At the time of diseases assessments, the yield samples (about 10 from each location) have been taken from apparently healthy and virus infected plants to observe the virus effect on the production. Data presented in the Table 4 reveal that virus disease has reduced the number of roots and weight of roots per plant. Due to the virus disease infection the average reduction in number of roots and weight (kg) of roots was ranged from 24.58 to 63.60 and 9.76 to 59.62 per cent per plant, respectively. Although, the systematic yield loss was not yet assessed adequately, the mean reduction in number of roots of 44.73% and weight (kg) of roots of 32.44% per plant was recorded. In accordance with these studies, the east African experiences show that virus diseases alone can cause yield reduction up to 98 % (Mukasa, et al., 2003, Gibson et al., 1998, Karyeija, et al., 1998).

Table 4: Effect of virus disease on the yield

Location	Healthy		Diseased		Reduction (%) in	
	Average No. of root/plant	Average weight of root/Plant (kg)	Average No. of root/plant	Average weight of root/Plant (kg)	Root	Weight
Sidama	4.6	0.45	2.24	0.13	48.5	28.9
Gedeo	5.1	0.36	1.85	0.17	36.3	47.2
Amaro	4.5	0.52	2.83	0.31	63.6	59.6
Wolaita	5.2	0.51	2.11	0.05	40.9	9.8
Gamo Gofa	4.8	0.55	2.62	0.27	54.6	49.1
Kembata	4.8	0.41	1.17	0.04	24.6	9.8
Mean	4.8	0.46	2.13	0.16	44.7	32.4

4. Conclusion and Recommendations

At present, it is distributed almost in all assessed location of SNNPR with varying level of incidences. Since SPVD is considered as a most important constraint of sweet potato production in the region, it can be minimized by application of control measures such as use of resistance/ tolerant varieties integrating with selection of healthy vines, timely removal of SPVD infected plants (to prevent further spread of virus by vectors) and establishment of isolated sites/nurseries (for virus free planting materials production) and control of vectors. Prevention of the virus from getting established in the areas where currently not affected and/ or little affected is also among the option of its management. Furthermore, awareness creation of development workers and farmers on the importance of SPVD is very essential.

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