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Reaction of sweet potato genotypes to sweet potato weevils (*Cylas puncticollis* (boheman) and *Alcidodes dentipes* (olivier), coleoptera: curculionidae) and viruses in Eastern Hararge, Oromiya, Ethiopia

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Nineteen sweet potato genotypes were screened for tolerance against sweet potato weevils and viruses at different locations of Eastern Hararge. Disease incidence and weevil population was assessed using standard procedures. Results of this study revealed that sweet potato weevils (SPW) and sweet potato virus diseases (SPVD) were present in studied area varied among sweet potato genotypes. Genotypes; Awassa-83, Bekale-A, Bekale-B, CN-1752-9, Cuba-2, Korojo, TIS-70357-5 and TIS-9465-2 had least load of SPW while, Bekale-A, TIS-8250-7 and TIS-9465-2 genotypes were free of virus diseases. Genotypes showing resistance to sweet potato can be used in varietal improvement program. The present studies concluded that the resistant sweet potato genotypes identified for SPW and SPVD could be utilized in integrated sweet potato production for the locations where the pests are major production bottleneck, like in Eastern Hararge.

Key words: Resistant, tolerance, Integrated pest management (IPM), sweet potato viruses, Oromiya, Hararge.

INTRODUCTION

Sweet potato (*Ipomoea batatas* (L) Lam.) is one of the world's most versatile crops and it is an important crop in East Africa (Stevenson et al., 2009). In eastern Ethiopia, sweet potato is mainly produced for human consumption,

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as income source and livestock feed (Tarekegn et al*.,* 2014a). Over the years the significance of sweet potato usage in Ethiopia, particularly east and southwestern, has shown increasing trend. However, the obtained yields are far below the average production. Many factors including both biotic and abiotic limits the production and productivity of sweet potato in Eastern Oromiya, in particular in East Hararge.

World-wide weevils are economically important pests in horticultural crops (Braimah and Emden, 2010; Karuppaiah, 2015). In sweet potato, among various production constraints, sweet potato weevil (SPW) (*Cylas puncticollis* Boheman) (Tarekegn et al*.,* 2014a), striped sweet potato weevil (*Alcidodes dentipes* (Olivier)) are also economical interest of this important crop in Ethiopia and virus-induced diseases are important issues for yield reduction.

C. puncticollis limit sweet potato production by damaging vines, tubers and occasionally the foliage, thereby reducing both the yield and quality of the crop. Yield losses of 73% in Uganda (Smit, 1997), 20% in Tanzania (Kapinga et al., 1996), 22.26 to 70% in Ethiopia (Tarekegn et al*.,* 2014b) and 60 to 70 % in East Africa (Kabi et al*.,* 2001) in sweet potato have been recorded due to *Cylas spp.* Due to the cryptic feeding nature of the pest, some control practices like chemical and biological controls were ineffective (Smit et al*.,* 2001). Though cultural management of sweet potato weevils are crucial like the use of insecticide combinations such as sweet potato stems treated with Diazinon or Chlorpyrifos + Endosulfan spray after 45 days of planting was effective in controlling *C. puncticollis* in Southern Ethiopia (Alehegne and Eyob, 2013).

Often producers rely on chemical control for *C. puncticollis* management, however in addition to its side effect on living things and the environment in general; farmers of eastern Hararge do not afford to buy pesticide. However, some cultural practices like earthing-up, prompt harvesting and intercropping were found to be more effective in the management of *C. puncticollis* (Emana, 1990). Likely, destroying crop residues in the field after harvesting (Jansson et al., 1989); flooding of the field to kill the weevil larvae present in the roots in the field (Otto et al., 2006), crop sanitation and the avoidance of adjacent planting of successive crops (Powell et al., 2001; Smit and Matengo, 1995), Intercropping with other crops (Stathhers et al., 2005; Rajasekhara et al., 2006), mulching the field (Talekar, 1987a) and early harvesting (Cisneros and Gregory, 1994; Cisneros et al., 1995; Stathers et al., 2005; Ebregt et al., 2005) was also as an important promising part of cultural sweet potato weevil management.

Other biological factor that limits sweet potato production is sweet potato virus diseases (SPVD), throughout the world, causing yield reduction (Aritua et al., 1998; Carey et al., 1999; Fuglie, 2007; Geleta, 2009). Worldwide, at least nineteen different viruses have been described in sweet potato, but only eleven (sweet potato feathery mottle, sweet potato mild mottle, SWEET potato chlorotic stunt, sweet potato chlorotic fleck virus, sweet potato caulimo like virus, sweet potato potyvirus G and sweet potato leave curl virus*)* (Tairo et al., 2004; Ateka et al., 2004; Mukasa et al., 2003) of these have been recognized by the International Committee on Taxonomy of Viruses (ICTV).

In Ethiopia, particularly Southern Ethiopia, several SPVD have been detected. These include sweet potato chlorotic stunt virus (SPCSV), sweet potato feathery mottle virus (SPFMV), sweet potato mild mottle virus (SPMMV), sweet potato chlorotic fleck virus (SPCFV), sweet potato caulimo-like virus (SPCaLV), sweet potato mild speckling virus (SPMSV), C-6 (flexious rod virus), sweet potato latent virus (SwPLV), sweet potato *virus G* (SPVG) and cucumber mosaic virus (CMV) with SPFMV followed by SPCSV, SPVG and SPCSV being the most prevalent (Abraham, 2010; Tewodros et al., 2011; Shiferaw et al., 2014). In East Africa, SPVD can cause yield reduction up to 98% (Gibson et al., 1997; Gutierrez et al., 2003; Mukasa et al., 2003; Ndunguru et al., 2007).

Use of resistant variety is of a major component of integrated pest management. It is environmentally friendly and economically feasible approach. To some extent, the use of resistant landraces of sweet potato has reduced the incidence of SPVD and improved the yields under field condition (Karyeija et al., 2000; Rwegasira et al., 2004) as a part of sweet potato virus management. In North America, there is strong evidence that dry-fleshed cultivars of sweet potato (Jackson and Bohac, 2007) are resistant to sweet potato weevil, as feeding and oviposition on such genotypes are highly minimized due to genetic make-up variation (Mao et al., 2004).

Further, chemical compositions of the roots also play a vital role in resistance through volatile chemicals which mediate behavior that led to resistance to the American SPW, *Cylas formicarius elegantulus* (Wang and Kays, 2002). Also, the root and vine latex has been shown to reduce feeding and oviposition by SPW when applied to the surface of root cores and its addition to the semi-artificial diets also reduced the number of feeding punctures (Data et al., 1996). Thus, the components in latex could be a source of chemical based resistance to SPW. Currently, there is little information on existing resistance of sweet potato genotypes against *Cylas* species and virus infections in Ethiopia. Thus, the objective of this research is to evaluate and select sweet potato genotypes resistant to sweet potato weevil and viral diseases in Eastern Hararge.

MATERIALS AND METHODS

Description of the study sites

Two sweet potato growing sites in Eastern Oromiya, Ethiopia were

Plate 1. Detached leaves showing virus-like and virus symptoms observed on sweet potato plants collected from Southern and Eastern part of Ethiopia. A. Purple spotted leaves of plants infected with SPCSV; B. Vein chlorosis leaves of plants infected with SPFMV; C. Chlorotic spotted leaves of plants infected with SPVG; D. Healthy sweet potato leaves; E. Purple and Chlorotic spotted leaves of plants infected with SPVG+SPCSV; J. Leaf from a healthy plant. (Tewodros et al., 2011).

chosen to evaluate the effect of sweet potato genotypes on the expression of sweet potato weevil resistance and virus diseases. The two sites locations are among potential places for sweet potato production in East Hararge Zone of Eastern Oromiya, regional state. The two trials were conducted at Haramaya University Research Stations, Babile and Fadis during the rainy season of 2010/2011 (June to November). Babile was found at an altitude of 1646 m.a.s.l and 9°13'19.147'' N and 42°19'47.538'' E and Fadis at an altitude of 1710 m.a.s.l, 9°8'20.272'' N and 42°4'39.783'' E. Both locations are found in the low-land agro ecological zones of East Hararge zone. During the six months of the cropping season (June to November 2011) rain fall was poorly distributed (523.4 mm).The maximum monthly rainfall was received in september (127.8 ml) whereas, the lowest in october (2 ml). The mean monthly maximum temperature is 27.81°C, while the mean monthly minimum temperature is 14.81°C (Source: Haramaya University–Babile research Station, 2011).

Treatments and experimental design

Treatments consisted of nineteen improved sweet potato genotypes at both locations, and the trials were laid out in a randomized complete block design (RCBD) with three replications. The plants were established on a single row in each plot. The plot size was 2 m × 6 m. Each row consisted of 20 plants spaced 0.3 m apart. The nineteen improved sweet potato genotypes evaluated at both sites were: Barkume (local check), TIS-8250-7, Cuba-1, CN-1753-17, Korojo-2, CN-1753-14, Korojo, Bekale-A, Bukariso, Bekale-B, TIS-9465-2, TIS-9068-8, TIS-8250-1, Awassa-83, TIS-70357-5, CN-1752-9, TIS-9065-1, TIS-8441-3 and TIS-82/0602-11. These genotypes were obtained from Dire Dawa (Haramaya University). The genotypes were tested and damage quantified against pests in both sites (Sweet potato weevil population and virus diseases incidence). The number of sweet potato weevils under natural infestation was recorded on three randomly selected plants from each row of sweet potato genotype at two weeks intervals starting from one month (30 days) after planting (DAP). At the end of harvesting time, the average number of weevils was taken for both locations. The incidences of virus diseases at both locations were evaluated using infection symptoms through visual assessment, on the leaves and other parts of the plants, from randomly selected three plants per plot. The development of purple color spots on the sample plants was used to identify virus-positive specimen (Gutierrez et al., 2003) as shown in Plate 1. The rooting characteristics of sweet potato are one of the main required parameter to evaluate the pest and drought resistance of this crop. This data was taken randomly from two plants per row using spring balance on 60 days after planting (DAP) to measure their root pulling resistance (kg) ability of each variety at both locations. The data for root pulling resistant were taken on the same day considering that soil preparation for planting was similar in both sites. The fresh root yield of sample plants were determined by size and weight of the storage roots. Medium sized and weevil free roots were considered as marketable roots. Small, oversized roots and weevil infected storage roots were considered as unmarketable roots following harvesting.

Data analysis

The collected data were subjected to analysis of variance and means were separated using least significant differences (LSD) at 0.05 probability level.

RESULTS

Cylas puncticollis and *Alcidodes dentipes* population on sweet potato

The results of pooled analysis of the effect of SPWs on the sweet potato are summarized in Table 1 and Plate 2A. The result indicates that a significant ($p<0.05$) difference was observed among genotypes on the number of sweet potato weevil population per plant. Higher *C. puncticollis* (0.5 weevils/plant) was recorded in genotype *Korojo-2.* No weevil (0.00 weevil/plant) infestation was recorded from *Awassa-83, Bekale-A, Bekale-B, CN-1752-9, Cuba-2*, *Korojo, TIS-70357-5* and *TIS-9465-2.* Other sweet potato insect pest species observed was *A. dentipes*, which was observed on sweet potato stem bases feeding and cause malformation at the feeding point (Plate 2). Maximum (1.83 weevils/plant) *A. dentipes* was recorded from the genotype *TIS-9465-2,* however, not significantly different from most of the genotypes. Minimum (0.33 weevils/plant) weevils were recorded from the genotypes *Awassa-83* and *TIS-70357-5,* but similar with most of the genotypes (Table 1). None of the genotypes tested in this experiment suffered from *A. dentipes* infestation, which are the predominant insect pests of sweet potato at Babile site known by causing

Table 1. Effects of sweet potato genotypes on the number of sweet potato weevils, root pulling resistance, percent root damage and total fresh root yield in East Hararge, Oromiya, Ethiopia, 2010/2011.

Genotype	Mean value of pooled analysis				
	C. puncticollis	*A. dentipes*	RPR (Km)	PRD (%)	FRY (t/hac)
Awassa-83	0.00^{b}	0.33^{c}	18.55^{a}	30.16^{a}	19.16^{bcd}
Barkume (Local check)	0.16^{ab}	1.33^{abc}	16.13^{abcd}	21.46^{ab}	28.75^{a}
Bekale-A	0.00^{b}	1.16^{abc}	17.71^{abc}	6.47^{d}	4.00^{hi}
Bekale-B	0.00^{b}	0.66^{abc}	16.16^{abcd}	6.04^{d}	10.58^{efgh}
Bukariso	0.16^{ab}	1.50^{abc}	13.91^{cde}	15.02^{bcd}	8.00^{fghi}
CN-1752-9	0.00^{b}	1.66^{ab}	15.91^{abcd}	11.42^{bcd}	10.16^{efgh}
CN-1753-14	0.16^{ab}	1.66^{ab}	18.35^{a}	19.07^{bc}	10.50^{efgh}
CN-1753-17	0.16^{ab}	0.66^{abc}	16.30^{abcd}	15.02^{bcd}	14.25^{def}
Cuba-2	0.00^{b}	0.66^{abc}	18.10^{ab}	13.73^{bcd}	15.08^{cde}
Korojo	0.00^{b}	1.33^{abc}	16.80^{abcd}	8.68^{cd}	3.80^{hi}
Korojo-2	0.50^{a}	$0.50b^{c}$	18.00^{ab}	4.40^{d}	2.50^{i}
TIS-70357-5	0.00^{b}	0.33^{c}	15.69^{abcd}	18.66^{bc}	22.00^{abc}
TIS-82/00607-11	0.16^{ab}	0.66^{abc}	16.00^{abcd}	10.47^{cd}	7.25^{ghi}
TIS-8250-1	0.33^{ab}	0.50^{abc}	18.41^{a}	13.69^{bcd}	22.33^{ab}
TIS-8250-7	0.33^{ab}	0.83^{abc}	11.41^{e}	10.25^{cd}	9.91^{efgh}
TIS-8441-3	0.33^{ab}	1.66^{ab}	16.10^{abcd}	13.37^{bcd}	7.33^{fghi}
TIS-9065-1	0.16^{ab}	0.83^{abc}	18.41^{a}	10.72^{bcd}	13.66^{defg}
TIS-9068-8	0.16^{ab}	1.00^{abc}	14.08^{bcde}	18.01^{bc}	9.16^{efghi}
TIS-9465-2	0.00^{b}	1.83^{a}	17.66^{abcd}	18.68^{bc}	20.25^{bcd}
Mean	0.14	1.00	16.26	13.96	12.56
LSD(0.05)	0.39	1.22	4.04	10.92	6.99
P-value	0.23.,	0.20	0.23	0.0058	0.20
Locations					
Babile	0.12^{a}	1.64^{a}	18.35^{a}	13.39^{a}	15.01^{a}
Fadis	0.15^{a}	0.36^{b}	14.16^{b}	14.54^{a}	10.11^{b}

Means with the same letter with in the same column are not significantly different at p<0.05, Fisher's Least Significant Difference test. RPR=Root Pulling Resistance. PRD = Percent root damage. FRD = Fresh root yield.

stem base malformation (Plate 2A and B). The comparative analysis of SPWs population at the two locations have shown the non-significant difference for *C. puncticollis* but *A. dentipes* with significantly more population of *A. dentipes* at Babile (1.64 weevils/plant) than Fadis (0.36 weevils/plant).

Root pulling resistance (RPR)

Significant differences (p<0.05) among genotypes in RPR were recorded (Table 1). Maximum (18.55 kg) root pulling resistance was obtained from *Awassa-83,* with statistically similar result with all the other genotypes except Bukariso, TIS8250-7, and TIS 9068-8*.* Minimum RPR (11.41 kg) was recorded from *TIS-8250*-7, but statistically similar with *TIS-9068-8* genotype and Bukariso.

Virus diseases incidence/symptom

Sweet potato genotypes showed variation in regarding their reaction to sweet potato virus diseases at both locations among genotypes (Table 2). Sweet potato Chlorotic stunt virus (SPCSV) symptoms were observed in many plants and some stunted plants were observed from plots planted with genotypes Korojo-2, Korojo, Bekale-B, Awassa-83, TIS-70357-5, TIS-9065-1, TIS-8441-3, TIS-82/0602-11 and on farmers variety Barkume (Local Check), indicating that they are relatively susceptible to this virus infections. The rest of genotypes have shown no viral infection symptom at Babile research station. Whereas, in Fadis the genotypes Korojo-2, Bekale-B, Awassa-83, TIS-8250-1, TIS-82/00607-11, CN-1752-9, TIS-9068-8, TIS-8250-1, CN-1753-14, Bukariso, Cuba-2, CN-1753-17 and Barkume (Local Check) have shown viral diseases infection. In both sites only three

Plate 2. Sever infestation and damage to sweet potato stem and storage roots. (A) Adult, pupa and larva of *A. dentipes* (Striped Sweet potato weevil) (at Babile) feeding up on crown; (B) Stem of sweet potato plants filled with frasses of *A. dentipes* and caused malformation (at Babile); (C) Adult of sweet potato weevil, *C. puncticollis* (at Fadis) feeding on sweet potato roots and (D) Necrotic lesions and cracks caused by *Scutellonema bradys* (roots damaged by nematode attacks) (at Babile), Eastern Hararge, Oromiya, Ethiopia, 2010/2011 cropping season.

Plate 3. Damage to different genotypes of sweet potato by different pests. (A) Damage by flea beetles; (B and C) Damage by *C. puncticollis*; (d) Damage by other soil insect pest of sweet potato.

genotypes (Bekale-A, TIS-8250-7 and TIS-9465-2) have shown no viral infection symptom.

Damaged storage roots (%)

There were significant variations ($p<0.05$) among the tested genotypes concerning storage root damage by sweet potato weevil (Table 1 and Plate 3). The highest damage (30.16%) due to sweet potato weevil was recorded on *Awassa-83,* but statistically similar with Barkume (local check) and the lowest damage (4.40%) was from Korojo-2, Bekale-A (6.47%) and Bekale-B (6.04%).

Fresh root yield (t/ha)

There were significant differences ($p<0.05$) among the genotypes about storage root yield (Table 1). The variety Barkume (Local check) had the highest (28.75 t/ha) fresh root yields, but statistically not different from TIS-70357-5 and TIS-8250-1 and on the contrary genotype Korojo-2 gave the lowest fresh root yield (2.50 t/ha).

Number of marketable and unmarketable storage roots per plot

A significant difference ($p<0.05$) was observed among genotypes about the number of storage roots per plots (marketable and unmarketable) (Table 2). The highest number of marketable storage roots (39.33 roots/plot) was recorded on genotype TIS-70357-5, but statistically not significantly different from Barkume, TIS-8250-1, TIS-9065-1 and TIS-9465-2. Lowest (4.66 roots/plot) was obtained from Korojo-2 which is statistically similar with Bekale-A, Bukariso, Korojo, TIS-8441-3 and TIS-9068-8. Concerning the number of unmarketable roots, maximum (19.50 roots/plot) was obtained from Barkume, but statistically not significantly different from Awassa-83, TIS-9465-2, TIS-70357-5 and CN-1753-14 and on the

Table 2. Effects of sweet potato genotypes on number of marketable and unmarketable roots per plot and virus incidence in East Hararge, Oromiya, Ethiopia, 2010/2011.

Genotype	Mean value of pooled analysis		Locations	
			Babile	Fadis
	No. M roots/plot	No. unM roots/plot	Virus incidence	
Awassa-83	20.50^{cde}	14.50^{abcd}	Diseases observed	Diseases observed
Barkume (Local check)	35.50^{ab}	19.50^{a}	Diseases observed	Diseases observed
Bekale-A	8.83^{gh}	2.00^{fg}	No symptoms	No symptoms
Bekale-B	20.83^{cde}	3.83^{efg}	Diseases observed	Diseases observed
Bukariso	14.16^{efgh}	7.16^{defg}	No symptoms	Diseases observed
CN-1752-9	25.66^{bcd}	6.83^{defg}	No symptoms	Diseases observed
CN-1753-14	20.66^{cde}	11.66^{abcde}	No symptoms	Diseases observed
CN-1753-17	22.00^{cde}	8.83^{bcdefg}	No symptoms	Diseases observed
Cuba-2	19.33^{cdef}	7.58^{defg}	No symptoms	Diseases observed
Korojo	9.16^{fgh}	3.50^{efg}	Diseases observed	No symptoms
Korojo-2	4.66^{h}	1.50^{g}	Diseases observed	Diseases observed
TIS-70357-5	39.33^{a}	17.33^{ab}	Diseases observed	No symptoms
TIS-82/00607-11	15.83^{defg}	6.50^{defg}	Diseases observed	Diseases observed
TIS-8250-1	29.50^{abc}	10.33^{bcdef}	No symptoms	Diseases observed
TIS-8250-7	22.33^{cde}	7.91^{cdefg}	No symptoms	No symptoms
TIS-8441-3	14.83^{efgh}	8.00^{cdefg}	Diseases observed	No symptoms
TIS-9065-1	29.33^{abc}	10.16^{bcdef}	Diseases observed	Diseases observed
TIS-9068-8	18.83^{defg}	9.66^{bcdefg}	No symptoms	Diseases observed
TIS-9465-2	34.33^{ab}	16.33^{abc}	No symptoms	No symptoms
Mean	21.35	9.11		
LSD(0.05)	10.38	8.51		
P-value	0.049	0.008		
Location				
Babile	26.08^{a}	8.89^{a}		
Fadis	16.61^{b}	9.33^{a}		

Means with the same letter with in the same column are not significantly different at p<0.05, Fisher's Least Significant Difference test. No.M roots/plot= Number of marketable roots per plot; No.unM roots/plot= Number of unmarketable roots per plot.

other hand, the lowest (1.50 roots/plot) was recorded from Koroo-2 which is similar with most of the genotypes tested in this experiment.

DISCUSSION

Sweet potato weevils, *C. puncticollis* and *A. dentipes*, are important pests of sweet potato in the study area. Among these, the former was the most prevalent and destructive insect pest known by direct feeding up on the harvestable storage roots of sweet potato genotypes. Whereas, *A. dentipes*, which is the most predominant insect pest at Babile, caused malformation on the crown (stem base) and rupture of vascular tissues and also, this insect were observed on all genotypes tested. However, variation in susceptibility to *C. puncticollis* and *A. dentipes* was found among genotypes.

In this experiment, no complete resistance was observed even though there is to some extent lower number of sweet potato weevils on some genotypes. For instance, *Awassa-83* was not infested with *C. puncticollis*, however, infested by *A. dentipes* which are the insect responsible for the high percent damaged roots recorded by this genotype. Mullen et al. (1980) reported the existence of moderate level resistance of sweet potato genotypes to an infestation of sweet potato weevil, *C. formicarius*. The report of Thompson et al. (2001) also confirms the presence of low resistance levels in different sweet potato genotypes. Rooting characteristics play a vital role against the attack of soil insects in sweet potato. Variation among genotypes was observed on rooting characteristics. In this experiment most genotypes have deep-rooting characteristics that lead to moderate levels of weevil population escaping the storage roots from severe damage since in deeply rooted genotypes there was reduced soil cracking around the root zone that limited the exposure of roots to weevils. Previous workers reported similar results (Muyinza et al., 2007). Not only the deeply rooted characteristics of sweet potato, but also the size of root had a vital role in influencing the damage by SPW. The report by Kabi et al. (2001) also claims that size of root tubers influenced their damage and hence yields loss due to *Cylas spp*. Some field trails suggests that physical traits that allow sweet potato to avoid damage such as rooting depth, arrangement, root size and shape, as played important roles in conferring resistance to *Cylas spp*. (Singh et al., 1987; Talekar, 1987b) and in other crops (Karuppaiah et al., 2017).

The documentation of maximum root damage of 30.16% due to weevil from the high yielding genotype *Awassa-83*, 21.46% from *Barkume* indicates the absence of resistance of this genotype in the present study. The low level of damage from Korojo-2 and the lower percentage of root damage in TIS-82/00607-11 genotypes might be due to the production of latex by these varieties, which can be used as a defense mechanism against the sweet potato weevil infestation. Previous reports also confirm that the latex production by sweet potato significantly reduced feeding and oviposition and the number of feeding puncture (Nottingham et al., 1988). Similarly Data et al. (1996) reported that sweet potato root latex could be a contributing factor in sweet potato resistance to *C. formicarius*. Stevenson et al. (2009) and Muyinza et al. (2012) also reported one East African genotype, New Kawogo, as a variety that has shown the promising source of resistance to pest infestation. Jackson and Bohac (2007) reported that in North America there is strong evidence for resistance among dry-fleshed cultivars.

The results of the current study revealed a high prevalence of virus diseases and variation in the incidence among genotypes in eastern Hararge, Oromiya, Ethiopia. Most of the invaded plants were characterized by leaf burning, general chlorosis, growth stunting, vein chlorosis and purpling. This is in agreement with Tewodros et al. (2011) who observed that the most common symptoms of sweet potato were general chlorosis, leaf clearing (leaf burning), leaf distortion, mosaic, purpling, stunting, and vein chlorosis. They further noted SPFMV followed by SPCSV are the two most widely spread, sweet potato viral diseases attacking sweet potato in East Africa.

Carey et al. (1999) also opined that sweet potato virus disease complex (SPVD), caused by dual infection with SPFMV and SPCSV, are the most important disease of sweet potato in Africa. These two viruses are the most common and damaging as reported in other East African countries (Mukasa et al., 2003; Ateka et al., 2004). The presence of high prevalence of sweet potato viral disease in the Eastern Hararge is an indicative for the high population of aphid and whitefly vectors due to the favorability of the environment for these insects. This result is in agreement with the finding of Aritua et al. (1998) who suggested that lower altitude, warmer and drier climate, which may favor a higher population of aphid and whitefly vectors of the viruses, result in higher disease incidences. However, previous reports by Tewodros et al. (2011) indicated that there is a low prevalence of sweet potato virus disease in Eastern Ethiopia when compared with southern Ethiopia.

Conclusion

The present study suggests that both sweet potato weevils and sweet potato virus are becoming a threat to sweet potato production in Eastern Oromiya, in particular, east Hararge. Genotypes; Awassa-83 and TIS-70357-5 had least load of sweet potato weevils (both) while, Bekale-A, TIS-8250-7 and TIS-9465-2 genotypes were free of virus diseases. Genotypes shown resistance to sweet potato pests can be used in varietal improvement program. Our studies concluded that, the resistant sweet potato genotypes identified for SPW and SPVD could be utilized in integrated sweet potato production for the locations where the pests are major production bottleneck, like in Eastern Hararge. The current study on viral diseases is only based on qualitative data, therefore any future management attempts or study should concentrate on quantitative studies and must give due emphasis for virus infection. Moreover, further investigation is needed with the promising genotypes showing tolerance to sweet potato pests in this experiment.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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