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Resistance of sweetpotato genotypes to sweetpotato virus disease in coastal Kenya

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Abstract: Sweet potato is a food and cash crop in the coastal region of Kenya but the sweetpotato virus disease is also prevalent in the area. Selection of sweetpotato varieties resistant to SPVD and with desirable consumer traits is an economically feasible strategy that can sustain sweetpotato production. Seventeen sweetpotato varieties were screened for resistance/tolerance against sweetpotato virus disease in three sites in Coastal Kenya. The experimental design was complete randomised block design replicated three times in the three sites. Disease incidence and vector populations were assessed using standard procedures. The sweetpotato virus disease (SPVD) was present in the three sites and varied across sites and among sweetpotato varieties. In the first season disease pressure (%) was highest in Lukore and lowest in Mtwapa while in the second season it was highest in Mtwapa and Lowest in Mwaluvanga.Varieties, jewel and 440015 were the most susceptible across the three sites while Jonathan, Zapallo and Japonese proved to be resistant across the three sites in both seasons. The disease incidence (%) was lower in the first season than in the second season and the most susceptible cultivars were the most affected. There was a negative relationship between disease incidence and tuber yield and as well between harvest index and the root dry matter (%). The number of whiteflies varied across the sites with Lukore recording the highest number and Mtwapa the lowest in the first season with no significant difference in the second season. No aphids were observed in the three sites in both seasons. A breeding program should be put in place to breed for sweetpotato virus disease (SPVD) resistance varieties with consumer preferable traits in the region. There is need to establish the physiological basis of resistance in the resistant sweetpotato varieties.
Key words: Sweet potato, SPVD, vector population, yield, breeding, physiological.

Introduction

Sweetpotato is among the most important food crops in the world and is ranked seventh based on total production and the fifth most important crop in developing countries (FAO, 1996). It is produced in both high and low technology input agricultural systems. The main sweetpotato production areas in Kenya include nyanza (53%), western (24%), central (11%), eastern (9%) and coast (3%) provinces (M.O.A, 1992) with about 75% of total production being concentrated at mid-altitudes (1000-1600m) (Ndolo *et al.,* 1997). The crop is grown largely by smallholder farmers (Horton, 1988, Carey, 1996). It is propagated by vines hence this may contribute to build up of seed-borne diseases. Adverse weather rarely causes a total crop failure. Many farmers plant sweetpotato as an insurance crop (Woolfe, 1996). Sweetpotato establishment is rapid hence weeding cost is minimized and it has high rate of production per unit area per unit time, making it attractive to farmers with little land (Woolfe, 1996). The major biotic production constraints are the sweetpotato weevil and the sweetpotato virus disease (SPVD). Abiotic stresses include low soil fertility and drought.

Sweetpotato is a major food and commercial crop in Kirinyaga and Kwale districts, which are among the major sweetpotato growing areas in Kenya. In Kirinyaga, the crop is intensively grown under irrigation whereas it is extensively grown under rainfed conditions in Kwale. Production of sweetpotato is threatened by the prevalence of sweetpotato virus disease (SPVD) the two regions (Ateka *et al*., 2004). Sweetpotato virus disease is the most devastating disease of the crop (Geddes, 1990) and it reduces yield significantly (Mukasa *et al.,* 2003) and has been reported in all areas where the crop is grown (Carey, 1996). It is caused by co-infection with aphid-borne sweetpotato feathery mottle and whitefly-borne sweetpotato chlorotic stunt viruses (Schaefers and Terry, 1976). Use of tolerant varieties seems to be the most economically feasible way of controlling the disease (Bashaasha *et al*., 1995; Kapinga *et al.,* 1995). Use of infected planting materials and susceptible cultivars has contributed to the persistence of the disease in farmers' fields. Yield losses of 56-98 % due to the disease have been reported (Mukasa *et al*., 2003). Aspects of farming systems such as cropping pattern and management practices influence the incidence of sweetpotato virus disease.

The farmers have a role in the process of problem identification and evaluation of possible solutions for fast adoption and continued practice of new innovations hence they should be the key in any research geared towards poverty alleviation. Consequently understanding of the present farmers' management practices, identifying production problems and their causes, solutions and embarking on setting priorities for future research work to

solve the problems is essential for effective sweetpotato virus disease (SPVD) control and this entails the assessment and diagnosis phase. An approach for developing technological innovations towards improving agriculture through purposeful and creative interaction between rural people and researchers need to be adopted. This would enable projects to effectively link technology options to potentials for contributing to overall livelihood improvement by corresponding to local needs and problems (Campilan, 1999). A participatory rural appraisal was therefore conducted in Kirinyaga and Kwale to identify the resource availability and utilization in crop production, role of sweetpotato in agricultural system, sweetpotato production constraints and utilization patterns and to create awareness about sweetpotato virus disease (SPVD). This aimed at building an initial framework for inter-institutional participatory agricultural research and development research.

Materials and methods

The experiment was conducted during 2006/2007 long and short rain seasons. The onset of the rain seasons was in May 2006 and October 2006 respectively. Three sites in coastal Kenya and 17 sweetpotato genotypes were considered in the experiment. The 17 genotypes were planted in the three sites arranged in a Randomised Complete Block Design (RCBD) with three replicates and were sampled after every two weeks one and half months after planting after establishment in the field. Sub-set trials at Lukore and Mwaluvanga sites were also incorporated with the aim of enhancing full participation of farmers both at subset and main trial levels. Each of the participating farmers planted 4 varieties under their management practices. The main trials were researcher managed while the subsets were farmer managed**.** Disease incidence (%), vector population (aphids and whiteflies), disease severity and ground cover (%) were monitored or measured over the growing period; and the fresh weight and dry matter of vines and roots were determined at harvest. Data was subjected to analysis of variance by use of Genstat software and means separated by LSD. Curves were generated using Microsoft Excel data processing.

Results and discussion

The sweetpotato virus disease was present in the three sites and varied across sites and among sweetpotato varieties. In the first season disease pressure was highest in Lukore and lowest in Mtwapa. However in the second season disease incidence (%) on average was highest in Mtwapa and Lowest in Mwaluvanga. Among the varieties, jewel and 440015 were the most susceptible across the three sites. Varieties Jonathan, Zapallo and Japonese had low disease incidence across the three sites in both seasons (Table 1). In the first 12 weeks after planting in season 2 varieties Japonese, Zapallo and Jonathan were free from the sweetpotato virus disease across the 3 sites. Varieties Ex-shimba, Bungoma, Salyboro and SPK004 were moderately susceptible across the three sites in both seasons to the sweetpotato virus disease (table 1).

The disease incidence (%) was lower in the first season than in the second season and the most susceptible cultivars were the most affected. Varieties Ejumula, Jubilee and Mugande succumbed to the sweetpotato virus disease more in the second season than in the first season. Common disease symptoms in the three sites were, purpling of leaves, leaf chlorosis and or yellowing and stunted growth.

Tere wasignificant difference ($P<0.05$) among varieties in their response to the sweetpotato virus disease (SPVD) in the three sites and was highest in Lukore and lowest in Mtwapa (table 1) in the first season. The high disease incidence (%) in Lukore can be attributed to the all year round cultivation of sweetpotato, which provide ready source of disease inoculum (Alicai *et al*., 1999) contrary to Mtwapa Research Station where the crop is not widely grown. In the second season, the disease incidence (%) was highest in Mtwapa and lowest in Mwaluvanga and this variation can be attributed to the incorporation of spreader rows in the trial at Mtwapa. Generally disease incidence (%) was high in the second season than the first season and this supports earlier reports that the chronic sweetpotato virus disease situation in Africa is due to the continuous cycle of vegetatively propagated planting materials which act as new sources of inoculum in newly established sweetpotato fields (Terry, 1982).

The high disease incidence and severity in the second season can also be associated with the dry spell that was encountered two and half months after planting up to the end of the growth period and this supports earlier reports that temperature and other seasonal factors influence plant growth, virus content and virus symptom expression (Thresh et al., 1994). The disease incidence (%) also varied with the age of the crop whereby it was highest from the third month after planting and this agrees with reports by Aldrich (1963) and Gibson et al., (2000) that higher incidences were associated with older crops than the young ones.

Conclusion and recommendations

There is need to incorporate the genes of resistance to sweetpotato virus disease (SPVD) into susceptible but high yielding genotypes. Since Varieties Jonathan, Japonese and Zapallo possess good levels of resistance, they can be used as sources of resistance to improve the popular susceptible and high yielding varieties in the region. This is by making crosses with the popular varieties such as Ex-shimba, SPK004, Bungoma and Kemb10, which are highly preferred by farmers. This would maintain sustainable production and boost the importance of sweetpotato in enhancing food security. Since SPVD still remains the most devastating disease in Africa, SPVD resistance should be focused in breeding programs to invent new varieties since the moderate susceptibility of local landraces and popular improved varieties to the disease is threatening and with increase in SPVD inoculum, tuber yield would be a nightmare hence need for varieties that are stable in diverse environments. This strategy would be even economically feasible than introducing the technology for provision of healthy planting materials because the susceptible crop will still be infected while in the field. Varieties Jewel and 440015 being the most susceptible can be used as checks in screening for the sweetpotato virus disease (SPVD).

Table 1: Disease incidence (%) among varieties across the three sites over the growing season

	Period after planting															
	10wks				12 wks				14 wks				16wks			
Variety	LKR	MTW	MWLV	MEAN	LKR	MTW	MWLVG	MEAN	LKR	MTW	MWLV	MEAN	LKR	MTW	MWLV	MEAN
Japonese	0	0	0	0	0	0	0	0	3.6	1.2	1.2	2	3.6	1.2	2.4	2.4
Zapallo	0	0	0	0	0	0	0	0	3.6	1.2	1.2	2	3.6	1.2	3.6	2.8
Jonathan	0	0	0	0	0	0	0	0	1.2	1.2	2.4	1.6	2.4	2.4	2.4	2.4
Kemb10	9.52	3.57	5.95	6.3467	10.71	9.5	10.71	10.307	10.7	19	19	16.233	14.3	21.43	21.4	19.04333
SPK004	8.33	0	4.76	4.3633	10.71	10.7	13.1	11.503	15.5	22.6	20.2	19.433	19	25	20.2	21.4
Bungoma	4.76	4.76	2.38	3.9667	8.33	13.1	8.33	9.92	9.5	17.9	13.1	13.5	11.9	30.95	15.5	19.45
K135	14.298	2.38	8.33	8.336	17.86	10.7	10.79	13.117	20.2	15.5	10.7	15.467	32.1	28.57	19	26.55667
Salyboro	7.14	0	3.57	3.57	8.33	11.9	5.95	8.7267	8.33	11.9	9.5	9.91	21.4	29.76	21.4	24.18667
Sponge	14.29	7.14	11.9	11.11	16.67	20.2	11.9	16.257	22.4	26.2	15.5	21.367	34.5	33.33	17.9	28.57667
Jubilee	2.38	3.57	3.57	3.1733	8.33	14.3	8.33	10.32	7.1	25	16.7	16.267	25	38.09	20.2	27.76333
Ex-shimba	7.14	8.33	7.14	7.5367	9.52	15.5	13.1	12.707	9.5	26.2	23.8	19.833	13.1	35.71	23.8	24.20333
Marooko	11.9	9.52	7.14	9.52	21.43	14.3	9.52	15.083	25	33.3	15.5	24.6	35.7	40.48	21.4	32.52667
Muibai	16.57	19.05	9.52	15.047	20.24	26.2	14.29	20.243	22.1	38.1	20.2	26.8	14.3	42.86	21.4	26.18667
Ejumula	2.38	7.14	5.95	5.1567	9.52	17.9	14.29	13.903	15.5	31	26.2	24.233	32.1	35.71	31	32.93667
440015	28.57	19.05	13.1	20.24	29.76	35.5	15.48	26.913	30.9	45.2	23.8	33.3	48.8	59.53	47.6	51.97667
Mugande	19.05	21.43	14.28	18.253	38.1	9.5	16.67	21.423	48.8	48.3	26.2	41.1	66.7	65.48	51.1	61.09333
Jewel	28.57	36.9	30.95	32.14	45.24	36.9	33.33	38.49	61.9	67.8	50	59.9	79.8	70.24	63.1	71.04667
MEAN	9.1455	7.7369	7.215	8.0325	14.062	13.169	10.644	12.625	18.578	25.388	17.365	20.444	26.958	33.055	23.729	27.91451
P=0.05	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	
LSD	9.693	9.721	11.1		9.375	5.65	10.375		12.06	15.12	14.48		12.09	11.271	13.15	
CV (%)	26.7	12.1	12.5		7.1	12.6	6.6		19.6	20.2	16.8		10	15.9	14.7	

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