Research Application Summary

The reaction of maize genotypes to maize streak virus disease in central Uganda

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Abstract

Documented evidence indicates that maize is production is constrained by a number of a biotic and biotic stresses including Maize streak virus disease (MSVD). Therefore, a study was conducted to assess the reaction of 3 maize genotypes to MSVD at Kyambogo University between 2008/2009. There were significant differences (P<0.05) in plant height, Leaf area index, disease incidence, severity and area under disease progress curve (AUDPC). Overall, MSVD had more effect on the local landrace compared to the improved genotypes.

Key words: Incidence and severity, maize genotypes, maize streak virus disease

Résumé

L'évidence documentée indique que la production du maïs est contrainte par un certain nombre des efforts biotiques comprenant la maladie du virus de strie de maïs (MSVD). Par conséquent, une étude a été entreprise pour évaluer la réaction de 3 génotypes de maïs face à MSVD à l'université de Kyambogo entre 2008/2009. Il y avait des différences significatives (P<0.05) dans la hauteur de la plante, l'index de la surface de feuille, l'incidence de la maladie, la sévérité et la partie sous la courbe de progression de la maladie (AUDPC). De façon générale, MSVD a eu plus d'effet sur la race locale comparé aux génotypes améliorés.

Mots clés: Incidence et severité, génotypes de maïs, maladie du virus de strie de maïs

Background

Maize (*Zea mays*) is an important food crop after rice and wheat in most of the tropical and sub-tropical countries including Uganda. Despite, its importance as a food and source of cash income in Uganda, maize production is threatened by a diversity of constraints notably pests and diseases, low inherent yielding varieties and low soil fertility among others. Among the diseases, maize streak virus disease (MSVD) caused by a gemini virus vectored by the leafhopper *Cicadulina mbila* is the most devastating and destructive disease of maize in Uganda. MSVD is characterized by a variety of symptoms including continuous longitudinal chlorotic streaks, mosaic, yellows, necrosis, vein clearing; vein banding, distortions or malformation. However, in Uganda there is a dearth of information on the reactions of maize to MSVD. Therefore, the objective of study was to assess the reaction of maize varieties to MSVD in central Uganda.

Literature Summary

In Uganda, information on MSVD is scanty. Maize streak virus disease (MSVD) is considered the most important viral disease of maize in the sub Saharan Africa. Initially, MSVD was recorded in South Africa as *Mealie variegation* in 1870s. Todate, maize streak virus disease has remained the most significant viral disease of maize in Africa resulting in the loss of revenue between US $ 120 and US $ 480 million, respectively (Bosque-Perez, 2000). Despite, considerable advances in control measures, poor farmers continue to suffer serious crop losses to MSVD. Maize streak virus disease is an obligate parasite transmitted by a leafhopper (Storey, 1924, 1925). In fact, the transmission cycle, latent periods in the vector and vectors' transmission ability is genetically determined (Storey, 1931). Maize streak virus disease is also known to infect a number of other host plants including sugar cane and other members of the grasses family.

Yield loss attributed to MSVD is variable but losses of up to 70% have been reported in susceptible maize varieties (Bosque-Perez *et al*., 1998). However, this depends on factors such as cultivars and stage of growth at the time of infection (Van Rensburg, 1981). Consequently, like other viral diseases, control of MSVD is difficult because it is impossible to kill the virus without killing the host plant. Nevertheless, a number of recommended control measures are available namely, disease avoidance practiced by only planting maize early when the viral inoculum load is lowest, insecticidal spraying of the leafhopper vectors, crop rotation, and destruction of infected plants. According to Rybicki, (1999), crop rotation is ineffective because the transmitting vector has a number of alternative hosts. Thus, use of host plant resistance remains the most economically viable and practical means of controlling MSVD epidemics. Accordingly, many naturally occurring maize lines tolerant to MSV possessing a single gene (msv-1) (Shepherd *et al*., 2010) were identified. Besides, the msv-1 other MSV resistance gene also exist and improved resistance has been achieved by concentrating these within individual maize genotypes.

Study Description

The study was conducted at Kyambogo University between October 2008 and August 2009 in a split plot design with maize genotype as the main plot and leafhopper as the subplot. Three maize varieties used for the study were artificially inoculated by confining the viruliferous leafhoppers into insect proof cages with maize seedlings 5 days after germination while the non inoculated plants served as the control. The leafhoppers *Cicadulina mbila* species were given a forty eight (48) hour acquisition access period on infected maize plants. The leafhoppers used for inoculation were obtained from the field maintained in insect proof cages in an insect proof mesh-screen house at the National Crop Resources Research Institute, Namulonge. To ensure uniform viral infection, the insects were disturbed every six hours. The inoculated plants were transferred to Kyambogo University and transplanted in the screen house. The inoculated plants were watered as and when necessary. Data collected included plant height, leaf area index, disease incidence and severity. Disease incidence and severity data were recorded from symptoms appearance on a weekly interval for 12 weeks. Disease incidence was based on the number of plants affected and expressed as a percentage of the total number of plants per plot. Meanwhile disease severity was visually scored as the percentage leaf area affected (PLAA) on a scale of 1-5 (Kyetere *et al*., 1999). Disease severity data were used to compute area under disease progress curve (AUDPC) as described by Campbell and Madden (1990). Reactions of the maize cultivars to MSV were analysed using analysis of variance (ANOVA) of the Genstat computer programme. Where ANOVA indicated significant differences, means were separated using the least significant differences at 5% probability level.

Findings

Maize streak virus disease (MSVD) manifested itself as streaking, mosaic, chlorosis and leaf malformations especially on the top young leaves. Disease incidence, severity and AUDPC significantly ($P<0.05$) varied with variety. Additionally, variety x treatment interactions was significant for both severity and AUDPC. Similarly, symptom appearance varied with variety. The highest and lowest MSVD severity was recorded on the local landrace and Longe 6H, respectively. In general, maize varieties with the highest severities had the highest AUDPC. The highest AUDPC was recorded 6 weeks after inoculation. Overall, the AUDPC followed a normal sigmoid curve characteristic of most diseases. Similarly, maize streak virus disease significantly reduced plant height and leaf area index, respectively (Table 1). Overall, MSVD had more effect on the local land race compared to the improved Longe 6H variety.

Table 1. Mean effect of maize streak virus disease on growth parameters of three maize genotypes assessed at Kyambogo University, 2008/2009.

Variety	Plant height (cm)	Leaf area index
Longe 4	35	77
Longe 6	87	82
Local landrace	34	77
Mean	36	79
LSD $_{(0.05)}$	2.3	7.6

Research Application

Maize streak virus disease significantly reduces the growth and yield of maize. However, the reduction in growth and yield is directly related to the time and stage of infection. In fact, the earlier the infection, the higher the yield loss but this varies with the level of resistance.

Recommendation

The study has shown that MSVD significantly reduces growth and yield of maize especially the local landraces compared to the improved varieties. However, despite the current success in breeding for resistance to MSVD, a number of challenges are encountered in producing conventionally bred maize genotypes with high degrees of resistance to MSV. Moreover, natural resistance may not be found on maize genotypes with good agronomic qualities. Additionally, most of the current sources of resistance to MSV are tropical varieties with maturation and flowering features that make them difficult to work with in the field. Thus, there is need for continuous search for more sources of resistance to MSV that combines resistance with good agronomic characteristics as well as high grain yield through screening and genetic improvement of both the local and introduced maize cultivars.

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