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Occurrence and distribution of cassava pests and diseases in Rwanda

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ABSTRACT

A survey was conducted in 2007 to obtain information on the distribution, incidence and severity of cassava pests and diseases in Rwanda, and determine how these parameters relate with cassava varieties and intercropping. Local (unimproved) cultivars predominated in most farmers' fields (over 83%) and 78% of the fields were intercropped. Cassava green mite, *Mononychellus tanajoa* and cassava whitefly, *Bemisia tabaci*, were the most abundant pests. Within-field incidence of green mite averaged 42% but damage was mild (average score of 2.3 on a scale of 5). *Typhlodromalus aripo*, the mite predator of green mite, was found in 28% of the fields surveyed, with a mean incidence of 5.7% within fields. The mean number of *B. tabaci* whitefly adults on the apical five leaves was 0.92 whereas the mean number of whitefly nymphs on a middle leaf was 5.2. Incidence of cassava mosaic disease within sites averaged 33.2%. Cutting infection accounted for 66% of infected plants but the relative contribution of cutting and whitefly infection varied among the major varieties. Mite damage as well as mosaic disease incidence and severity were higher on local varieties. However, whitefly populations were higher on improved varieties. Intercropping was associated with lower pest populations and disease incidence and severity.

1. Introduction

Cassava is an important food crop in the tropics and subtropics, and in Rwanda it is the third most important food crop, after banana and sweet potato. Production of this crop is constrained by pests and diseases. In Africa, major pests are cassava green mite (CGM), *Mononychellus tanajoa*, cassava whitefly *Bemisia tabaci*, and cassava mealybug—*Phenacoccus manihoti* (Hahn et al., 1989; Otim et al., 2006). In the past two decades the predatory mite and biological control agent of green mite, *Typhlodromalus aripo*, has been released in different regions of Rwanda in an attempt to control the pest. There is no current information on distribution of green mite or the establishment and distribution of *T. aripo*. Cassava whitefly is the vector of the cassava mosaic geminiviruses that cause cassava mosaic disease (Hahn et al., 1979, 1989; Legg and Fauquet, 2004). Cassava mealybug has been subjected to biological control by *Anagyrus lopezi* in Rwanda (ISAR, 1991), but there is no information on the current distribution of this pest and its predator.

Cassava mosaic disease causes yield losses of up to 95% (Hahn et al., 1989) depending on variety and time of infection (Thresh et al., 1994). Transmission is through use of infected cuttings or whitefly feeding (Hahn et al., 1979; Thresh et al., 1998). The recommended method of managing the disease is to use resistant varieties and disease-free cuttings for planting. Following the spread of the pandemic, a number of improved mosaic disease-resistant varieties have been multiplied and disseminated to farmers in Rwanda. However, their current prevalence in farmers' fields has not been documented.

Cassava mosaic disease occurs in all cassava growing areas of sub-Saharan Africa and the Indian sub-continent (Thresh et al., 1998) and was first reported in 1894 in present day Tanzania and likely reached all cassava growing areas of Africa by the 1930s (Legg and Fauquet, 2004). The disease has become more important in recent years following the spread of the regional pandemic of unusually severe mosaic disease from Uganda to neighbouring countries including Rwanda (Legg et al., 2001, 2006). A comprehensive survey of mosaic disease in Rwanda was conducted in 2001 in the major cassava growing areas of the country (Sseruwagi et al., 2005). Data were taken on whitefly populations, and incidence and severity of mosaic disease. Gashaka et al. (2007) reported mosaic disease incidence and severity data from a survey conducted in 2006. The current study was conducted to update this information.

Cassava bacterial blight and cassava brown streak virus disease are also important diseases of cassava (Hahn et al., 1989). Bacterial blight can cause complete crop loss under heavy infection and

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outbreaks have been reported in several countries of East, Central and West Africa (Hahn, 1978). Brown streak disease, known for many years as a problem of coastal East Africa (Nichols, 1950), has recently been recorded as spreading rapidly in Uganda (Alicai et al., 2007), and therefore represents a new threat to Rwanda. The current incidence and severity of these diseases in the country is unknown.

Incidence and severity of pests and diseases of cassava have been shown to be influenced by environmental and agronomic characteristics. For instance, intercropping cassava with cowpea in Colombia reduced whitefly populations (Gold, 1994). Fondong et al. (2002) observed that intercropping cassava with maize or cowpea reduced incidence of mosaic disease in Cameroon. Wydra and Verdier (2002) reported from survey data that mosaic disease was positively correlated with increasing numbers of weeds and with variety mixtures; incidence and severity of bacterial blight were lower in intercrops or in variety mixtures.

This survey was conducted to determine the distribution, incidence and severity of pests and diseases of cassava in Rwanda. Data on cultivar types and cropping systems were collected to determine how these factors relate with pest and disease incidence and severity in cassava fields.

2. Methods

The survey was carried out in the southern, eastern and western provinces, which are the major cassava growing regions of Rwanda, between February and March 2007.

2.1. Pre-surveys

A pre-survey was carried out with the objective of cataloguing the pests occurring on cassava in two of the major cassava growing provinces of Rwanda (Eastern, Bugesera District and Southern, Rusizi District). This survey was carried out between December 2006 and February 2007. Observations of pests were carried out in three fields in Bugesera and 11 in Rusizi district.

Prior to the main survey, a pre-test of the survey tool was conducted. All enumerators visited one field as one team to harmonize methods, particularly disease and pest scores. The pre-testing was carried out in two fields at Rubona in Huye District, Southern Province, in February 2007.

2.2. Survey sites

The survey was carried out in the southern, eastern and western provinces, which are the major cassava growing regions of Rwanda between February and March 2007. In the south, the districts of Huye, Kamonyi, Kirehe, Muhanga, Nyamagabe, Nyanza and Ruhango were selected whereas in the east, the districts of Bugesera, Kayonza, Nyagatare and Rwamagana were selected. In the west the district of Rusizi was surveyed. The number of districts selected from a region was based on cassava production with a greater number of districts selected in regions with higher production. The districts in each region were selected randomly. The number of sites (fields) visited per district ranged from seven to twenty and a distance of 6–10 km was allowed between sites, but the distance was greater where cassava fields were far apart, resulting in a smaller number of sites visited in such districts. Cassava fields between three and six months old were selected, the age recommended for distinguishing source of infection (from cutting or whitefly transmission) (Sseruwagi et al., 2004). A total of 252 sites were surveyed. Fields chosen had to be of such a size that it was possible to obtain 30 plants (sample size at a site) along two diagonals.

At each site data were taken on location including coordinates (altitude, latitude and longitude) using GPS sets. Cassava crop age and size of field were also noted, crop age information being obtained from the farmer and size of field determined from visual estimation. Note was taken of whether the cassava crop was a monoculture or intercropped. The name of variety of each cassava plant sampled, and whether it was local or improved, was noted. We recorded the presence of adjacent cassava and *Manihot glaziovii*, a reservoir of cassava pests and diseases (Fauquet and Fargette, 1990). A cassava field was considered adjacent if the cassava plants could be clearly identified by eye from the field sampled.

2.3. Pest and disease assessment

Thirty plants per field were sampled along two diagonals (15 plants each) for pest and disease assessment (Sseruwagi et al., 2004).

2.3.1. Pests

Damage by green mite was scored on a scale of 1–5 where a score of '1' represented no symptoms and '5' the most severe symptoms (Nukenine et al., 2002). Incidence of *T. aripo* was assessed by carefully opening the tip of the tallest shoot of 10 out of the 30 plants selected along the diagonals and recording presence or absence.

Whitefly adults were counted on the top five leaves from one shoot for each of thirty plants in the field (Sseruwagi et al., 2004). Nymphs were counted on one middle leaf of the selected shoot. Presence or absence of physical damage resulting from whitefly feeding, presenting as leaf chlorosis and size reduction, was noted. Presence or absence of sooty mould deposits caused by whiteflies was noted.

Mealybug damage was scored on a scale of 1–5, with '1' representing no symptoms and '5' representing very severe symptoms (Ayanru and Sharma, 1986). Number of grasshoppers (*Zonocerus* spp.) on each plant was recorded.

2.3.2. Diseases

Symptoms of mosaic disease (referred to as 'mosaic disease' in some cases for brevity) were scored on a scale of 1–5, where '1' represented no symptoms and '5' the most severe symptoms (Hahn et al., 1980). The type of mosaic disease infection was recorded: infection from cuttings was indicated by symptoms on the lower leaves whereas disease transmitted by whiteflies presented symptoms in the upper leaves only (Sseruwagi et al., 2004). We also recorded presence/absence of symptoms of infection of cassava bacterial blight and cassava brown streak virus disease on all sample plants.

2.4. Data analysis

Data were averaged to obtain means by each of the explanatory parameters recorded (cultivar type, altitude, crop age, field size, cropping system and the presence of adjacent cassava or *M. glaziovii*). In calculation of mean severity scores for green mite damage and mosaic disease, scores of '1' (no symptoms) were excluded (Sseruwagi et al., 2004). Two-tailed *t*-tests were used to compare whitefly densities between cultivar types (local or improved), between cropping systems (monocrop or intercropping) and absence/presence of adjacent cassava fields. Chi square tests were used to analyze green mite damage and mosaic disease incidence and severity between cultivar types and cropping systems. The score of '1' for green mite damage and mosaic disease was included in the Chi square tests. Examination of source of mosaic