

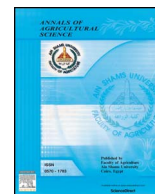
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## Seasonal and spatial variation in the prevalence of viral diseases and associated aphid-borne viruses in cucurbits in Cote d'Ivoire

Nahoua Kone<sup>a,b</sup>, Elvis Asare-Bediako<sup>b,\*</sup>, Ousmane Koita<sup>c</sup>, Daouda Kone<sup>a</sup>, Stephan Winter<sup>d</sup>

<sup>a</sup> University Felix Houphouët Boigny, 22 BP 582 Abidjan 22, Cote d'Ivoire

<sup>b</sup> Department of Crop Science, School of Agriculture, University of Cape Coast, Cape Coast, Ghana

<sup>c</sup> Laboratory of Applied Molecular Biology, Faculty of Science and Techniques, Bamako BP E3206, Mali

<sup>d</sup> Leibniz Institute DSMZ – German Collection of Microorganisms and Cell Cultures, Inhoffenstraße 7B, 38124 Braunschweig, Germany

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## ABSTRACT

Viral diseases are a major constraint to cucurbit production worldwide. In 2014 rainy and dry cropping seasons, cross-sectional surveys were conducted in farmers' cucurbits fields in six agro-ecological zones (AEZs) of Côte d'Ivoire to assess prevalence and distribution of viral diseases. A total of 757 leaf samples were collected from melon, squash, cucumber, watermelon, gourd calabash, and pumpkin plants showing various virus-like symptoms. Enzyme linked immunosorbent assay (ELISA) using antisera against cucumber mosaic virus (CMV), zucchini yellow mosaic virus (ZYMV), papaya ringspot virus (PRSV), watermelon mosaic virus (WMV) and Moroccan watermelon mosaic virus (MWMV) were performed to detect viruses in the samples collected. Results revealed that viral diseases were prevalent in all the agro-ecological zones, with significantly higher mean prevalence in the dry season (53.6%) than in the rainy season (29.35%). The overall mean disease severity index was also significantly higher in the dry season (47.58%) than in the rainy season (28.17%). CMV, ZYMV and PRSV were found in all AEZs at varying rates between the rainy and dry seasons, whereas WMV and MWMV were not detected. CMV was more prevalent in the dry season (32%) whereas ZYMV was more prevalent in the rainy season (34%). This study has revealed that viruses infecting cucurbits are widespread and occurred in mixed infection which poses a potential threat to cucurbit crops production in Cote d'Ivoire.

## Introduction

Cucurbits are well-known vegetables in West Africa because of their nutritive value and the incomes they generate. Indeed, cucurbits are rich in ingredients such as vitamins (A, B, C) and other dietary substances including protein, lipid, carbohydrates, mineral salts (calcium, iron, phosphorus) and lycopene having an antioxidant activity (Ozslan et al., 2006). Cultivation of cucurbits ensures a substantial income to the farmers (Dje Bi et al., 2011).

Pests and diseases are major biotic constraints to the production of cucurbits worldwide (Loebenstein and Thottappilly, 2009). Among these, plant viral diseases are the most important limitation to cucurbit production (Lecoq and Katis, 2014; Ayo-John et al., 2014), causing physiological disorders and enormous losses all over the world in terms of quantity and/or quality of products (Nicaise, 2014). It is reported that up to 39 well characterized viruses of the genera *Begomovirus*, *Crinivirus*, *Polerovirus*, *Cucumovirus*, *Ipomovirus*, *Tobamovirus*, *Tospovirus* and *Potyvirus* are known to naturally infect cucurbits (Antignus et al.,

2001; Knierim et al., 2010). In West Africa, viruses infecting cucurbits are reported in Nigeria (Ayo-John et al., 2014), Mali (Tsai et al., 2010) and Côte d'Ivoire (Fauquet and Thouvenel, 1987; Koné et al., 2010; Agneroh et al., 2012; Kone et al., 2015). Aphid-borne CMV, ZYMV, PRSV and pepo aphid-borne yellows virus (PABYV) infecting cucurbits have been found in Cote d'Ivoire (Fauquet and Thouvenel, 1987; Koné et al., 2010; Agneroh et al., 2012; Kone et al., 2015). These viruses are efficiently transmitted by several species of aphids notably *Myzus persicae*, *Aphis gossypii*, *Macrosiphum euphobiaceae*, in a non-persistent manner, and are readily transmitted through mechanical activities (cell sap) (Franki et al., 1979; Gal-On, 2007).

Management of viral diseases is very important in order to improve yields and quality of cucurbits in Côte d'Ivoire. Information on viruses, their host plants and their prevalence at different cropping seasons across the various agro-ecological zones is an important prerequisite in developing effective control strategies. Such information is however limiting in Cote d'Ivoire. Fauquet and Thouvenel (1987) reported the presence of CMV and PRSV; on cucumber and squash. The study

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\* Corresponding author.

E-mail address: [eamare-bediako@ucc.edu.gh](mailto:eamare-bediako@ucc.edu.gh) (E. Asare-Bediako).

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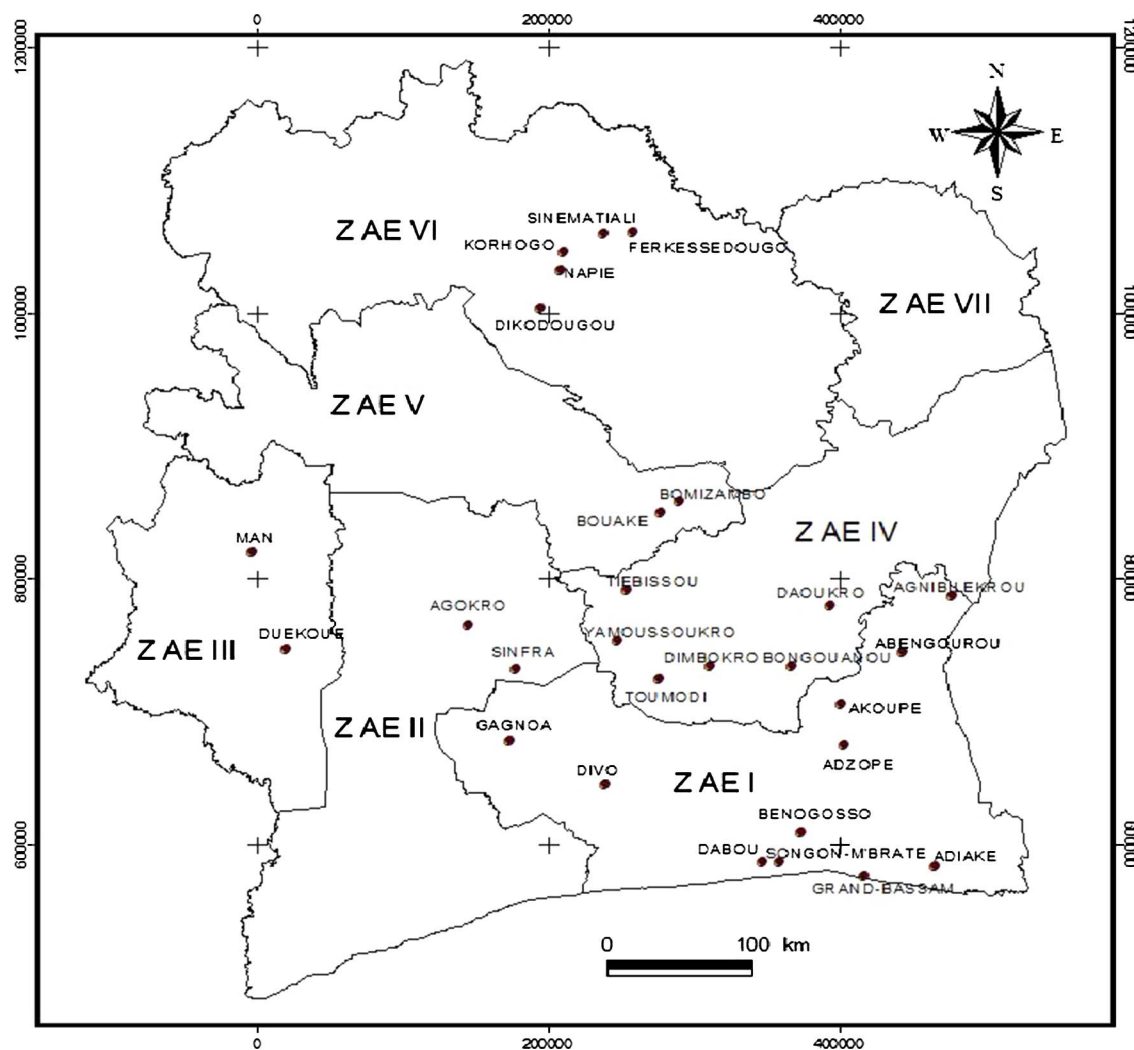


Fig. 1. Map of Côte d'Ivoire showing the six agro-ecological zones (AEZ) surveyed with sampling sites. AEZ = ZAE (Zone agro-ecologic) numbered from I to VI.

conducted by Koné et al. (2010) was in rainy season in the southern part of Côte d'Ivoire where ZYMV was reported for the first time in cucurbits. The study done by Agneroh et al. (2012) was conducted in three districts of the country and involved only two cucurbit species, *Lagenaria siceraria* and *Citrullus* sp. In view of these limitations, this study was conducted to assess the prevalence of virus disease in cucurbit crops during rainy and dry seasons in six out of seven agro-ecological zones (AEZs) in Côte d'Ivoire, and to identify the associated aphid-borne viruses.

## Material and methods

### Study areas

The study was conducted in 28 districts across six AEZs in Côte

d'Ivoire (Fig. 1). The features of the various AEZs are shown in Table 1.

### Field survey, data collection, sampling

The survey was conducted on several cucurbit crops including cucumber, squashes (zucchini and pumpkin), watermelon, melon and gourd (*lagenaria*) between February and August 2014. The dry season survey was done between February and March 2014, while that of rainy season was carried out between June and August 2014. Twenty-eight districts diverse in their climate and conditions under which cucurbits crops are grown were surveyed, and fifty-eight fields selected at intervals of 5 km were assessed. In each district, the fields were surveyed in a vicinity of 10–30 km.

Cropping patterns and field sanitations with regards to weedy status of the fields surveyed were observed and recorded.

Table 1  
Features of the agro-ecological zones surveyed in Côte d'Ivoire in 2014.

Agro-ecological zones	Altitude (m)	Mean annual temperature (°C)	Mean annual rainfall (mm)	Vegetation
AEZ I	9–225	29 (5.6)	1400–2500	Humid dense forest of south
AEZ II	215–240	23.5(13.4)	1300–1750	Semi-deciduous forest
AEZ III	241–340	24.5 (7.7)	1300–2300	Humid green forest of West
AEZ IV	87–193	23.5(13.4)	1300–1750	Transitional, forest-savanna zone
AEZ V	243–322	23.5 (13.4)	1300–1750 (unimodal)	Transitional Savannah zone
AEZ VI	235–378	26.7(1.1)	1150–1350 (unimodal)	Savannah

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