

# EFFECT OF CELOSIA MOSAIC VIRUS ON *CELOSIA ARGENTEA* L.

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(Received 13 March 2000; Revision accepted 15 December 2000)

## ABSTRACT

The effect of inoculation of *Celosia argentea* L. var. "TLV 8" with celosia mosaic virus at successive weekly interval for five weeks was investigated. Inoculation of plants at an early age of 3 - 4 weeks resulted in more severe symptoms than inoculation at a later stage (5 - 7 wk). Plant age at time of inoculation also affected yield parameters. Early virus infection significantly reduced leaf size and plant height by 42.4% and 18.2% and leaf number, shoot fresh and dry weight by 17.0 - 37.0%. Data obtained for these parameters for plants inoculated at 5 - 7 wk after planting were not significantly different from those of controls. Economic losses attributable to this virus may warrant the need for a method of control.

**Key words:** *Celosia argentea*, celosia mosaic virus, inoculation

## INTRODUCTION

*Celosia argentea* L. is widely cultivated for its leaves and succulent stem in Nigeria, particularly in the southwest. It is boiled and prepared as vegetable sauce and usually served with starchy staples such as rice, cassava, and yam flour (Oke, 1966; Omueti, 1980). It serves as an important source of vitamins and mineral salts required for healthy growth and reproduction (Omueti, 1980).

A mosaic and leaf curl disease of *C. argentea* induced by celosia mosaic virus (CIMV) has been described by Owolabi *et al.* (1998). Preliminary studies indicated that sap inoculated plants showed mosaic, apparent reduction in leaf size and moderate to severe stunting. The disease symptoms in all the varieties available for testing were so severe as to render them unmarketable, thus indicating that the virus might be of considerable economic importance.

Although quantitative data have been reported on the effect of age on yield components of *C. argentea* (Omueti, 1980), no information is available on virus effect. The effect of infection on plant growth may be influenced dramatically by the host variety, the virus or viroid strain and the age of plants at time of inoculation (Mikel *et al.*, 1981a, b; Agrios *et al.*, 1985). This paper reports on the effects of plant age at the time of CIMV inoculation on the growth and yield of *C. argentea*.

## MATERIALS AND METHODS

### Source of seeds and experimental design

Seeds of susceptible *C. argentea* variety "TLV 8", the most popular in Nigeria and the natural host of celosia mosaic virus (CIMV) obtained from the National Institute of Horticultural Research Institute (NIHORT), Ibadan, Nigeria was used in this study. The seeds were sown in manure-supplemented, sterilised soil in wooden trays. The seedlings were transplanted when they were 2 wk old into 16 cm-diameter

polyethylene bags at one seedling per bag. The polyethylene bags were arranged in five replications in a randomised complete block design as described by Agrios *et al.* (1985). Each replication contained 60 seedlings. Each group of 12 seedlings per triple column (4 in each column) constituted a plot. There were five of such plots in each replication and the plots were inoculated at different ages. The ages at which the plots were inoculated constituted the treatments. Each replication was separated from the adjacent one by a distance of 40 cm. A distance of 40 cm also separated successive plots (groups of 12 seedlings within each replication) while plants were placed 16 cm apart (along both columns and rows) in each plot.

The study was conducted in the open in the Botanical Garden of the University of Lagos. The treatments were randomised within each replication using the method described by Spiegel (1972). Inoculations were carried out weekly for five successive weeks, beginning from when the plants were 3 wk old. Infectious sap was prepared by triturating symptomatic leaves of *C. argentea* infected by CIMV with sterilised cold pestle and mortar in 0.03 mol/l sodium phosphate buffer, pH 8.0 containing 0.1% (w/v) sodium sulphite.

The inoculum was then applied by rubbing onto carborundum (600 mesh) dusted young leaves of 6 out of 12 plants in each plot and in all the replications (5 replicates for each inoculation age). The inoculated plants were rinsed with water and appropriately labelled. Successful inoculation was confirmed by symptom development. The control plants were inoculated with buffer only.

### Effect of virus inoculation on leaf size

The effect of the virus on leaf size was determined by using an electronic planimetre (Paton/CSIRO, USA). The samples measured for each treatment (inoculation age) was the tenth leaf on the

inoculated on live plants, which were randomly selected from the five replicates. The leaves were fed into the conveyor belt of the planimetre and the values read. Each sample was read five times and the values recorded for each treatment was the mean of the readings for the five replicates. Leaves from control plants (one per plant) were also randomly picked and the size of each determined as described above. Data were analysed by using Student's t-test.

#### Effect of virus on plant height and leaf number

In order to determine the viral infection on plant height, the plants were cut above soil level. For each treatment, five inoculated plants from each of the five replicates were measured. This was also measured for all 25 buffer inoculated plants. The leaves of the five harvested plants and healthy controls for each treatment were counted and the means calculated, to determine effect of virus infection on leaf number.

#### Effect of virus on fresh and dry weights of shoot and leaf per plant

Each of the five plants whose height and leaf number were determined for each treatment was separately weighed and the mean weight was obtained. The leaves were detached and weighed to obtain mean fresh weight. After obtaining the mean fresh weights, the materials were dried to constant weight in the oven after which the mean dry weights for both shoot and leaves were determined. Similar data were obtained for buffer inoculated control plants. All data were subjected to analysis of variance. Means were compared to detect differences among treatments by Duncan's multiple range test.

## RESULTS

### Symptom development and severity

Symptoms of infection on all plants inoculated at 3 and 4 wk after planting began to appear about 5 days post inoculation on var. "TLV 8" used in this study. Infected leaves developed characteristic leaf curl and mosaic symptoms. In addition, they were more upright than normal, giving a bunchy appearance. Plants inoculated at 5, 6 and 7 wk after planting were less affected compared to plants inoculated at 3 and 4 wk. Symptom appearance was delayed and did not manifest until about 9 to 12 days post inoculation. Symptomatic leaves showed mosaic, mild leaf curl or no curling at all.

### Effect of virus inoculation on leaf size

Significant leaf size reductions were observed when plants were inoculated at 3, 4 and 5 wk. Mean leaf size values of 22.7, 22.18 and 22.78 cm<sup>2</sup> were recorded for the inoculated plants in comparison to 39.53, 35.08 and 38.04 for the corresponding controls. Percentage reductions were 42.4, 36.8 and 40.1 respectively. Inoculation at 6 and 7 wk resulted in leaf sizes that were not significantly different from those of buffer inoculated control (Fig. 1a).

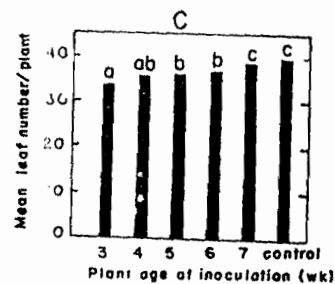
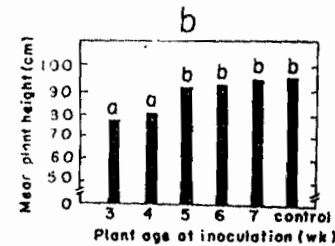
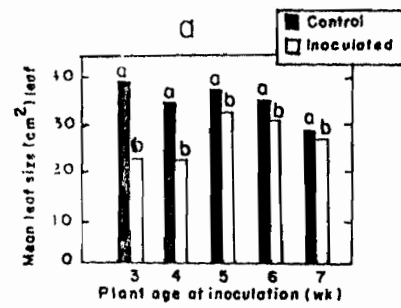


Fig. 1. Effect of inoculation of *Celosia argentea* with celosia mosaic virus at different ages on (a) leaf size (b) plant height and (c) leaf number. For leaf size, pair of bars topped by the same letter are not significantly different using Student's t test. Bars topped by the same letter for the other parameters are not significantly different ( $P = 0.05$ ) according to Duncan's multiple range test.

### Effect of virus inoculation on plant height and leaf number

Early inoculation (3 and 4 wk after planting) resulted in greater reduction in plant height than late inoculations (5 to 7 wk after planting). When the study was terminated, the average height of healthy *C. argentea* was 96.7 cm while those of inoculated plants ranged from 78.2 cm for those inoculated at 3 wk to 95.5 cm for plants inoculated at 7 wk after planting (Fig. 1b). Reductions in plant height ranged from 0.2% to 18.2% for inoculations at 7 wk and 3 wk respectively. The reductions were significant when inoculations were carried out at 3 and 4 wk after planting only.

Significant reduction in the number of leaves was observed at all inoculation ages except at 7 wk when compared to the control (Fig. 1c). Plants that were inoculated 3 wk after planting produced the least number of leaves with an average of 33.6 (representing 3.2% reduction) compared to 39.2 (representing 17% reduction) for those inoculated 7 wk after planting. Average value for the buffer inoculated control was 40.5.

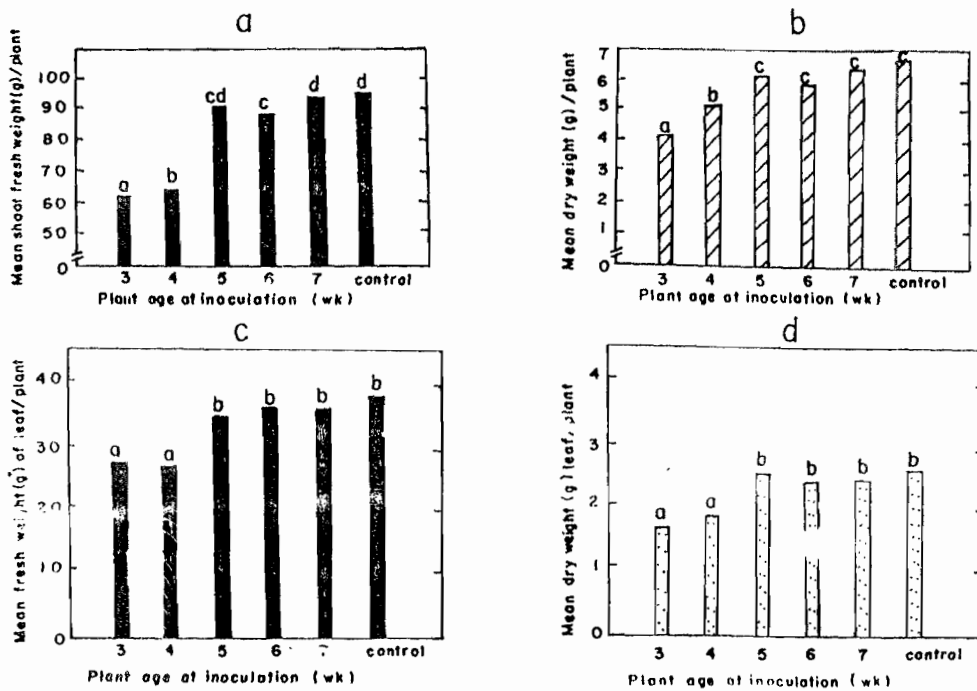


Fig. 2: Effect of inoculation of *Celosia argentea* with celosia mosaic virus at different ages on (a) mean shoot fresh weight / plant (b) mean dry weight / plant (c) mean fresh weight of leaf / plant and (d) mean dry weight of leaf / plant. Bars topped by the same letter for each parameter are not significantly different ( $P = 0.05$ ) according to Duncan's multiple range test.

### Effect of virus inoculation on fresh and dry weights of shoot and leaf per plant

Infection by CIMV caused reductions in the shoot fresh weight of *C. argentea* at all inoculation ages. The results showed that the mean shoot fresh weight was 62.2 g for plants inoculated at 3 wk, while the values ranged from 64.4 to 93.7 for those inoculated during the subsequent 4-wk period. The value for the buffer inoculated control was 94.5 g. Reductions were between 0.8% and 34.2% for plants inoculated at 7 wk and 3 wk of age respectively. The reductions were significant at all inoculation ages except at 7 wk, which had comparable values with the control (Fig. 2a). Similarly, CIMV infection had comparable effects on plant dry weight. Mean values ranged from 4.2 to 6.4 and 3 and 7 wk after planting (Fig. 2b) with corresponding reductions of 36.3% and 3.0% respectively.

The result of CIMV infection on fresh and dry weights of leaves of *C. argentea* showed similar trend. Inoculations at 3 and 4 wk after planting resulted in significantly greater reductions in both parameters than late inoculations (Fig. 2c and 2d). Reductions of 28.3% and 29.6% in fresh and 37.0% and 29.6% were recorded in dry leaf weights for inoculations at 3 and 4 wk respectively.

### DISCUSSION

The result of this study agrees with previous reports that the younger the plants at the time of viral infection the greater the severity of disease symptoms (Uyemoto *et al.*, 1981; Agrios *et al.*, 1985). The effect of CIMV infection on all the parameters investigated in this study indicated a relationship between age at time

of inoculation and virus effect. The leaf size and number, plant height and other growth parameters assessed were significantly reduced in plants inoculated at an early age, while virus effects decreased with delay in inoculation. Considering the results of inoculating with CIMV on the number of leaves per plant, early inoculation resulted in significantly fewer leaves than inoculations at 5 to 7 wk of plant age. In contrast, pepper inoculated with cucumber mosaic cucumovirus (CMV) at successive weekly interval (Agrios *et al.*, 1985) and tomato var. "Ife No 1" and *Lycopersicon peruvianum* inoculated with bunchy top virus (Ladipo, 1976) did not show a significant decrease in leaf number irrespective of the plant age at inoculation. This may be attributable to differences in the virus/host combinations and the fact that both pepper and tomato are fruity vegetables.

The significantly higher fresh and dry weight values for plants inoculated at a later stage of growth compared with those inoculated early is probably due to the attainment of maturity by the plants before they were inoculated. *C. argentea* is a fast growing succulent herb reaching marketable size in about 6-7 weeks after seeding. Virus infection at this stage produced less deleterious effect. This observation is similar to that reported by Beniwal and Chaubey (1980) who observed a progressively reduced virus effect on urdbean infected by leaf crinkle virus with delay in infection.

The cultivation of *C. argentea* is primarily for the production of the succulent leaves and stem. The data generated by this study show that infection of this vegetable by CIMV at an early stage of growth could result in severe economic losses. The potted plants used

could also possibly reduce growth because the roots are restricted. However, further studies will be carried out under more natural conditions. Meanwhile, economics losses could be prevented through practices that stem early virus infection such as the use of oil sprays, which are known to be effective against transmission of stylet-borne viruses (Singh, 1981) or the use of resistant varieties. Although, all the four varieties *C. argentea* available for testing showed immunity to the virus (Owolabi *et al.*, 1998), the use of resistant variety as a means of control against CIMV when available holds greater promise and needs further exploitation.

#### ACKNOWLEDGEMENT

The first author is grateful to the authority of the University of Calabar for the award of a study fellowship during which this research was carried out.

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