

## CELERY MOSAIC VIRUS ON FOENICULUM VULGARE IN BULGARIA

**Bistra Dikova<sup>1</sup> and Hristo Lambev<sup>2</sup>**

<sup>1</sup>*Nikola Poushkarov Institute for Soil Science, Agrotechnologies and Plant Protection  
7 Shosse Bankya Str., 1080 Sofia, Bulgaria,*

*E – mail: [b.dikova@abv.bg](mailto:b.dikova@abv.bg)*

<sup>2</sup>*Institute of Roses, Essential and Medical Cultures 49 Osvobozhdenie Bld.,  
6100 Kazanlak, Bulgaria,*

*E – mail: [lambev\\_iremka@abv.bg](mailto:lambev_iremka@abv.bg)*

### ABSTRACT

Fennel (*Foeniculum vulgare*) Mill. is important for Bulgaria essential oil-bearing culture, whose essential oil uses in food – processing and pharmaceutical industries and cosmetics. *Celery mosaic virus* (CeMV), genus *Potyvirus*, family *Potyviridae* is one of the most wide spread viruses, causing disease on fennel. The researches for the establishment of CeMV are carried out in 2010 and 2014 years by the serological method ELISA (Enzyme linked immunosorbent assay), variant DAS-ELISA in the former Plant Protection Institute in Kostinbrod, and from 2012 year division Plant Protection to the Institute Soil Science, Agrotechnologies and Plant Protection “N. Poushkarov”, Sofia. The most often symptoms of CeMV were yellowing (chloroses) or reddening (anthocyanins painting), as individual sprigs or entire plants from the observed crops of biennial fennel in 2010 and 2014 years were yellow or reddish. The symptoms of viral disease were from yellowing to browning (necroses) with consequence of dying of parts or entire leaf mass – sprigs of individual plants or entire plants. The loss of leaf mass or entire fennel plants decrease the yield of seeds for essential oil production. CeMV is aphid transmissible virus and we established correlation between the increasing populations of aphids and the increased number of fennel plants with symptoms of virus disease in biennial fennel crop in the trial field of the Institute of Rose, Essential and Medical plants in Kazanlak in 2010. The percentage of the infected with CeMV fennel plants was high – 78.57 % in June 2014 and 100 % in September 2010. The high percentage of infection was probably connected with the increasing of the aphid populations some of them from the species *Myzus persicae* Sulz. – the proven vectors of CeMV.

**Key words:** *CeMV, Foeniculum vulgare, aphids.*

### Introduction

The fennel - *Foeniculum vulgare* (Mill.) is important for Bulgaria essential oil-bearing culture. Annual fennel (*Foeniculum officinalis* var. *dulce* (Mill) Thell and biennial fennel (*Foeniculum officinalis* var. *vulgare* Mill refer to basic aromatic plants according to Yankulov (2000). The fennel is cultivated for the essential oil, founding application in the food and pharmaceutical industry. Special selection of fennel with swollen stems uses as vegetable.

*Celery mosaic virus* (CeMV), genus *Potyvirus*, family *Potyviridae* is one of the most wide spread viruses, causing disease on fennel. CeMV was established in different cultivars of celery plantations in South Australia, where the disease reached 70 % in some crops (Alberts et al., 1989). CeMV was proven in 13 celery cultivars with leaf chlorosis and some of them with severe chlorosis, chlorotic spots, leaf deformation and necrosis (Paduch-Cichal and Sala-Rejczak, 2010). CeMV was isolated naturally from celery, but it was infected artificially fennel (*Foeniculum vulgare*) plants, causing yellow spots on their leaves and coriander (*Coriandrum sativum*) plants, causing except yellow spots and leaf deformation (Ahmed Amal et al., 2012). CeMV was established in *Coriandrum sativum* L., *Foeniculum vulgare* Mill. and *Levisticum officinale* (L.) Koch. for the first time in Bulgaria in 2010 (Dikova, 2010).

The objective of the study is the establishment of the economically important for the species from Apiaceae family viral pathogen *Celery mosaic Potyvirus* (CeMV) on *Foeniculum vulgare* L. and its connection with aphid species in fennel crop.

### Material and methods

ELISA tests were carried out in the Institute for Soil Science, Agrotechnologies and Plant Protection, Sofia. Samples of plants *Foeniculum vulgare* – fennel from plantations in trial fields of the Institute of Rose and Essential and Medical cultures (IREMC) in Kazanlak were analyzed in 2010 and 2014. We collected samples with symptoms of viral diseases. Each sample from single plant was analyzed by ELISA method (DAS-ELISA); (Clark and Adams, 1977) with kit for CeMV, purchased from the German company LOEWE, Biochemica. The extinction values were measured using a spectrophotometer SUMAL PE, Karl Zeiss, Jena, Germany. All samples showing values two and a half times higher than the negative controls were assumed as virus positive namely virus carriers. Negative controls were samples of symptomless healthy plants and for positive controls were used positive control from the kit.

The extinction values (the optical density) of the samples were processed by statistical analysis of Student's criterion quoted by Lidanski (1988). Average extinction values of the optical density were calculated as well as the standard deviations of the confidence intervals at  $P \leq 0.05$ .

The observations of aphids and the counting of their populations, as and the fennel plants with symptoms of virus disease were carried out in 5 different dates on 20 number of diseased plants from the crops in IREMC in Kazanlak to the end of the spring and in the summer of 2010 (Figure 4).

### Results and discussion

The most often symptoms of *Celery mosaic virus* (CeMV) on fennel plants were yellowing of the needlelike leaflets, that leads later to necrotic colors of part of sprigs and staining in brown (Figures 1, Right). The separated sprigs revealed symptoms of yellowing, reddening and browning. Anthocyan staining (reddening) was observed in some cases in some fennel plants (Figure 1, Left).

The confidence intervals for the tested samples in both years showed that CeMV existed in fennel plants in moderate and more rarely in high viral concentration (Table 1, Figures 2 and 3). The viral concentration was established as moderate and in some cases as high in samples of 10 fennel plants, analyzed in September.2010 (Figure 2). Seven from ten plants were with moderate concentration from 0.4 OD to 0.6 OD and for three fennel plants the extinction values were higher – from 0.8 OD to near 1.0 OD (Figure 2). The viral concentration was moderate in six fennel plants - near 0.3 OD and in three fennel plants near 0.4 OD and higher in two fennel plants - over 1.0 OD for the samples, analyzed in June 2014 (Figure 3) CeMV consisted in individual fennel plants in high concentration. The extinction value in the second plant was 1.041 OD and in the fourteenth plant - 1.325 OD, analyzed in June 2014 (Figure 3). All ten fennel plants (100 %) on Figure 2 were infected with CeMV in September 2010 and this phenomenon was probably connected with the increasing of aphid populations from the spring to the summer 2010. Eleven from fourteen fennel plants were infected by CeMV (78.6 %) in June 2014. These results showed, that *Foeniculum vulgare* would be an important host for CeMV and one of the main sources of infection from this virus for the species of *Apiaceae* family, as celery. The number of the fennel plants with symptoms of viral infection increased when aphid populations increased (Figure 4). CeMV is aphid transmitted plant virus from *Potyviridae* family, genus *Potyvirus*. The populations of aphids increased from 2 to 15 and the plants with symptoms of virus disease with proven content of CeMV increased from 2 to 10 for the period of 48 days from 11.06. to 28.07.2010 (Figure 4). All ten fennel plants (100 %) on Figure 2 and Table 1 were infected with CeMV in September 2010 and this phenomenon was probably connected with the increasing of aphid populations from the spring to the summer 2010. The aphid species *Hyadaphis foeniculi* Pass. was one of the main species in the observed fennel crop in IREMC in Kazanlak in 2010, except aphid species *Myzus persicae* Sulz, that was the proven vector (carrier) of plant viruses, including CeMV. Symptoms of yellow mottling or chloroses were observed on fennel plants with registered aphid populations on them.

The aphid populations initially developed hiddenly in not fully opened young leaf laminas, and they latter developed open-air, colonized underdeveloped umbels.

**Conclusion**

*Celery mosaic Potyvirus* (CeMV) is large spread viral pathogen for the fennel plants, as it is wide spread for the celery plants and two crops from these cultures would be sources of infection one for other. There is correlation between the number of the fennel plants with symptoms of CeMV and apnid populations for the period from the beginning of June to the end of July 2010.



**Figure 1** Symptoms of *Celery mosaic virus* (CeMV) on *Foeniculum vulgare* (fennel) sprigs  
On the left – leaflets with reddening; on the right – leaflets with yellowing

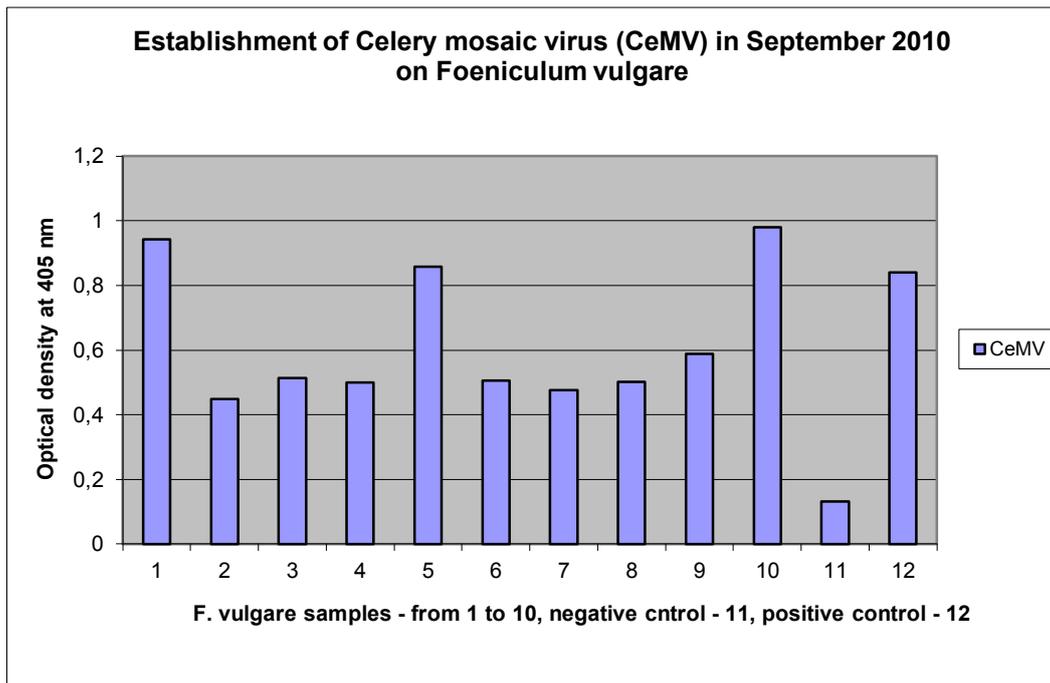
**Table 1** Establishment of *Celery mosaic virus* (CeMV) in *Foeniculum vulgare* (fennel) by DAS-ELISA

Month and Year of testing	Number of all tested plants	Plants with CeMV	Percentage	Optical density (OD)	
				Positive extinction values	Negative extinction values
September 2010	10	10	100 %	0.632* ± 0.138**	0.131
June 2014	14	11	78.57 %	0.533 ± 0.230	0.139 ± 0.051

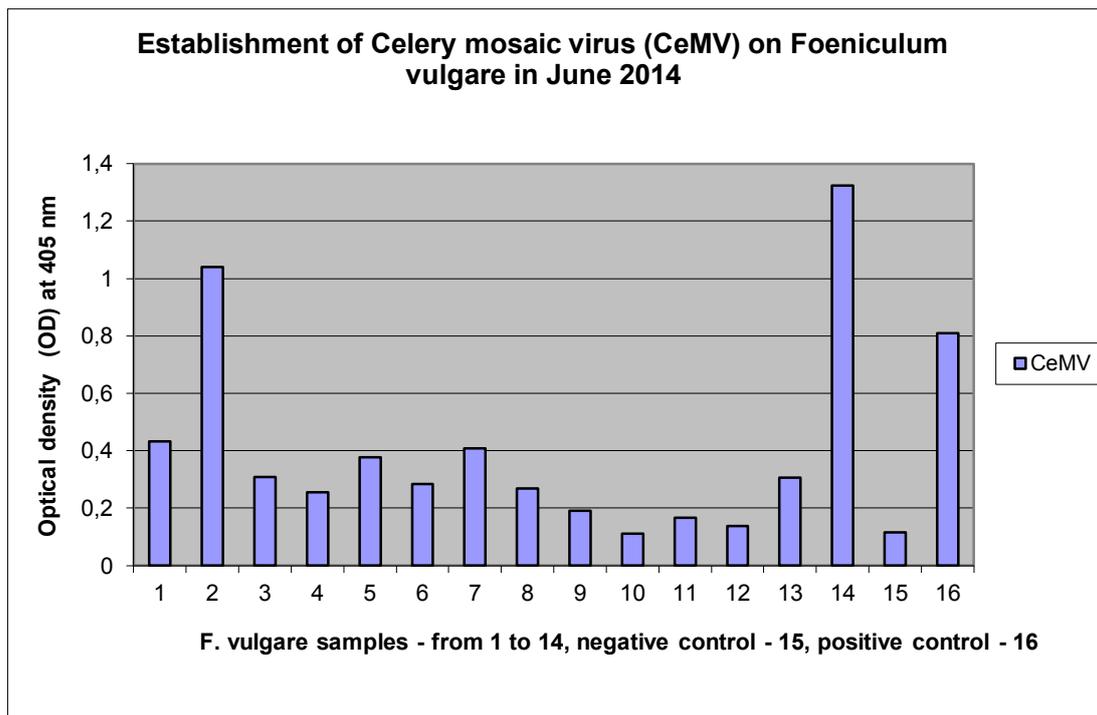
Legend

\* - confidence interval

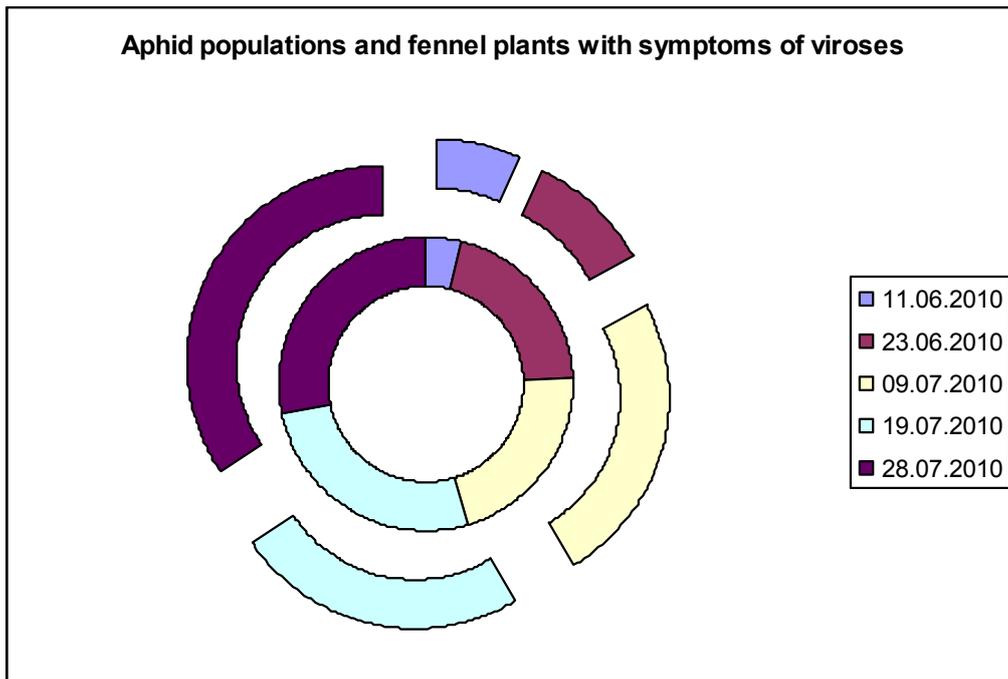
\*\* - standart deviation



**Figure 2** Establishment of CeMV in *F. vulgare* by DAS-ELISA in 2010



**Figure 3** Establishment of CeMV in *F. vulgare* by DAS-ELISA in 2014



**Figure 4** Correlation between aphid populations and fennel plants with symptoms of CeMV in five dates of summer 2010.

Legend

Internal circle – number of aphid populations in the respective different date

External circle – number of the fennel plants with symptoms of CeMV

### References

1. Ahmed Amal, A., N. Zein Salwa, A. H. Khatab Eman, 2012.Characterization of Celery mosaic virus Isolated fromSome Apiaceae Plants. International Journal of Virology, 8, 214-223. DOI: 10.3923/ijv.2012.214.223
2. Alberts, E., R.I.B.Francki, R.G. Dietzgen, 1989. An epidemic of *Celery mosaic virus* in South Australian celery. Australian Journal of Agricultural Research, **40**, 5, 1027-1036.
3. Clark, M. and A. Adams. 1977. Characteristics of the microplate method of enzyme linked Immunosorbent assay for the detection of plant viruses. J. Gen. Virol., 34, p.475 – 483.
4. Dikova, B., 2010. Virus diseases on economically important essential oil-bearing and medicinal plants in Bulgaria. Proceedings of Scientific Conference with International Participation “SCIENCE AND SOCIETY”, vol. 6, part 2, 90-95.
5. Lidanski, T. 1988. Statistical methods in Biology and Agriculture. – ZEMIZDAT, Sofia.
6. Paduch-Cichal, E., K. Sala-Rejczak, 2010. *Celery mosaic virus* occurring in Poland.Phytopathologia, **57**, 45-48. ISSN 2081-1756.
7. Yankulov, J., 2000. Basic aromatic plants, 19 Contemporary technologies for cultivation. ET “MDM-Zv. Markova”, Plovdiv, BG.