Natural occurrence of cucumber mosaic virus infecting broccoli in Turkey

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Abstract Field surveys conducted during 2015–2016 to determine the natural occurrence and distribution of the viruses in broccoli in Samsun, Turkey revealed that samples tested in enzyme linked immunosorbent assay were infected with CMV but none of the other viruses tested. This is the first report of CMV infection of broccoli in Turkey-Samsun.

Keywords *Cucumber mosaic virus* · Brassica · Broccoli · Survey · Serological test

Broccoli (*Brassica oleracea* L. var. *italica*) gained as economic important value due to its ingredients like vitamin C and anticarcinogenic property [2]. Broccoli means ‘little sprouts’ in Italian. It’s part of the Brassica family of vegetables which includes broccoli, cauliflower, cabbage, Brussels sprouts, turnips and Swedes. Broccoli is one of the most important brassica vegetable crops in Turkey [1]. Annual broccoli production in Turkey is 46.353 tonnes according to 2015 records. Samsun province has a big share of broccoli production [14].

Diseases are important factors limiting the production of brassica vegetables, which are known to be affected by 10–20 different viruses [16]. A number of virus species such as *Cucumber mosaic virus* (CMV), *Cauliflower mosaic virus* (CaMV), *Turnip mosaic virus* (TuMV), *Turnip yellow mosaic virus* (TYMV), *Beet western yellows virus* (BWYV), *Tobacco mosaic virus* (TMV), and *Tomato spotted wilt virus* (TSWV) are known to infect brassica

crop [6, 11, 13, 16]. CMV is one of the the most important virus infecting field-grown vegetables in a survey of virus diseases in 28 countries [15].

CMV is the type species of the genus *Cucumovirus* with a wide host range of more than 1,000 species [12]. It is an economically important plant virus causing diseases of many field grown vegetables [10]. CMV is transmitted by some 80 species of aphids in 33 genera, in a non-persistent non-circulative manner. *Myzus persicae* (Sulz.) and *Aphis gossypii* Glov. are the most efficient vectors for CMV [4, 9].

The present study was conducted to determine the occurrence of common viruses and possible emerging viruses in major broccoli growing areas of the middle Black Sea region of Turkey during 2015–2016.

Surveys for the occurrence of common viruses in broccoli were made from different localities at Samsun province where members of Brassica were grown. There were frequent visits to assess the prevalence of the viruses during their growth periods. Samples from approximate ten individual plants per area in nine broccoli-growing areas were collected during the surveys. Broccoli leaf samples from 84 different plants analyzed by the double-antibody sandwich-enzyme linked immunosorbent assay (DAS-ELISA) using specific antisera to CMV, TuMV, CaMV, TYMV, TMV, TSWV (Bioreba), and BWYV (Agdia).

The samples for ELISA were homogenized by grinding of leaf tissue in 0.01 M phosphate-buffered saline (pH 7.4) containing polyvinylpyrrolidone, bovine serum albumin, and Tween 20. Sap extracts were tested by DAS-ELISA, described by Clark and Adams [3], according to the manufacturer’s instructions. All samples tested in two replicate wells and the samples were considered positive for the tested virus if the absorbance reading was more than three times that the mean absorbance of the negative controls [6, 16].

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In the 2015–2016 growing season, surveys were conducted in broccoli fields of Samsun, where some virus-like symptoms were observed visually. Mosaic, mottling, yellowing on leaves, stunting of the plant are symptoms observed on broccoli in the region. Symptom based diagnosis of virus infection in the cultivated varieties of broccoli are difficult in the field conditions. DAS-ELISA is routinely used for the detection and identification of viruses in vegetable crops. Because of its sensitivity, economical use of antiserum, availability of quantifiable data and amenability for automation for large scale application, ELISA has become a popular and preferred technique [7]. Eighty-four symptomatic and non-symptomatic leaf samples of broccoli were analyzed using DAS-ELISA to determine the presence of seven viruses in Samsun province of Turkey. The results of serological tests showed that broccoli plants were infected with only CMV. The CMV was present in 4.76% (four samples) of tested leaf samples. Tests were conducted using several negative controls for each virus. The range of ELISA absorbance values of negative controls varied from 0.045 to 0.091 at 405 nm, depending on antisera used. Positive samples gave absorbance values of 0.271–0.490 and the absorbance value of the positive control was above 0.4 for CMV.

In the present study, only CMV infections were found in broccoli crops at low frequency and incidence (4.7%). These results are similar to those from survey of Tasmanian vegetable crops (broccoli, carrots, cauliflower, common bean, and pea) over three seasons (2007–2010). Potyvirus and CMV infections were detected infrequently and at low incidence in broccoli (1/24 crops; 0.01% and 1/18 crops; 0.02%) only [16].

TuMV, CaMV, BWYV, TYMV, and TSWV have been reported from Crucifers and other agricultural crops in different countries [8], but these viruses were not detected on broccoli crops in the current study. Similarly, no infections with BWYV, CaMV or TuMV were found in eight broccoli crops in south-west Australia in 2001 [5].

In conclusion, in the current paper we report the occurrence of CMV infecting broccoli from Samsun province of Turkey. Its ubiquitous nature may be attributed to transmission by aphids and through seeds. However, the other viruses included in our survey in 2015–2016 were not detected with the antisera used.

References

1. Balkaya A, Yanmaz R. Status of Brassica vegetable germplasm resources of Turkey. *Acta Hortic.* 2007;729:115–9.
2. Carvalho PDT, Clemente E. The influence of the broccoli (*Brassica oleracea* var. *italica*) fills weight on postharvest quality. *Food Sci Technol.* 2004;24:646–51.
3. Clark MF, Adams AN. Characteristics of the microplate method of enzyme-linked immunosorbent assay for the detection of plant viruses. *J Gen Virol.* 1977;34:475–83.
4. Garzo EI, Duque M, Fereres A. Transmission efficiency of different non-persistent viruses infecting melon by four aphid species. *Span J Agric Res.* 2004;2:369–76.
5. Latham LJ, Smith LJ, Jones RAC. Incidence of three viruses in vegetable brassica plantings and associated wild radish weeds in south-west Australia. *Australas Plant Pathol.* 2003;32:387–91.
6. Moreno A, De Blas C, Biurrun R, Nebreda M, Palacios I, Duque M, Fereres A. The incidence and distribution of viruses infecting lettuce cultivated Brassica and associated natural vegetation in Spain. *Ann Appl Biol.* 2004;144:339–46.
7. Narayanasamy P. Diagnosis of viral and viroid diseases of plants. In: Narayanasamy P, editor. *Microbial plant pathogens-detection and disease diagnosis*. Dordrecht: Springer; 2011. p. 295–312.
8. Nooh S. An overview of oilseed rape (canola) virus diseases in Iran. *Int Res J Microbiol.* 2012;3:24–8.
9. Palukaitis P, Garcia-Arenal F. Cucumoviruses. *Adv Virus Res.* 2003;62:241–323.
10. Qiaolin J, Xueping Z, Yong L, Zhijiang W, Debao L. Identification of *Cucumber mosaic virus* infecting broccoli (*Brassica oleracea* L. var. *italica*). *Acta Agric Univ Chekian.* 1995;21:610–4.
11. Raybould AF, Maskell LC, Edwards ML, Cooper JI, Gray AJ. The prevalence and spatial distribution of viruses in natural populations of *Brassica oleracea*. *New Phytol.* 1999;141:265–75.
12. Roossinck MJ. Evolutionary history of *Cucumber mosaic virus* deduced by phylogenetic analyses. *J Virol.* 2002;76:3382–7.
13. Spence NJ, Phiri NA, Hughes SL, Mwaniki A, Simons S, Oduor G, Chacha D, Kuria A, Ndirangu S, Kibata GN, Marris GC. Economic impact of *Turnip mosaic virus*, *Cauliflower mosaic virus* and *Beet mosaic virus* in three Kenyan vegetables. *Plant Pathol.* 2007;56:317–23.
14. Turkstat. Agricultural structure, Turkish Statistical Institute. 2015. <http://tuikapp.tuik.gov.tr/bitkiselapp/bitkisel.zul>. Accessed 15 Oct 2015.
15. Walsh JA, Jenner CE. *Turnip mosaic virus* and the quest for durable resistance. *Mol Plant Pathol.* 2002;3:289–300.
16. Wilson CR, Lambert SJ, Dann AL, Cross P, Hay FS. Occurrence of viruses within Tasmanian vegetable crops and identification of a novel Polerovirus infecting pea. *Australas Plant Pathol.* 2012;41:311–9.