



First report of *Golovinomyces cichoracearum sensu lato* on *Cannabis sativa* in Israel

M. Maymon, S. Jerushalmi and S. Freeman*

Department of Plant Pathology and Weed Research, Agricultural Research Organization, The Volcani Center, Rishon LeZion, 7505101, Israel

*E-mail: freeman@volcani.agri.gov.il

Received: 30 Aug 2020. **Published:** 29 Sep 2020. **Keywords:** hemp, medical cannabis, pathogens, plant disease, powdery mildew

In recent years, the use of cannabis (*Cannabis sativa*) has gained popularity for medical and other purposes, and its cultivation worldwide has expanded rapidly (Ruchlemer *et al.*, 2015; Jerushalmi *et al.*, 2020).

During April 2020, symptoms of powdery mildew were observed on commercially cultivated medical cannabis in the greenhouses of several farms in Israel, causing serious concerns, since affected material was discarded, deemed unfit for medical consumption. Symptoms initially appeared as small, white circular patches of epiphytic mycelia with conidia on the upper sides of mature leaf surfaces, similar to those described by Pépin *et al.* (2018). As the disease progressed, colonies expanded in size, coalescing and covering entire leaf surfaces, succulent stems and inflorescences (Fig. 1). Conidia were produced in chains on conidiophores that were single and erect, unbranched and cylindrical, arising from the colonies (Fig. 2). The conidia were hyaline, cylindrical to ellipsoid in shape, measuring 38.8-45.4 µm in length and 15.9-21.1 µm in width (Fig. 3). No chasmothecia were observed.

The pathogen was identified by molecular analyses and sequencing of the internal transcribed spacer (ITS) region of rDNA following amplification by PCR using ITS1 and ITS4 primers. Sequences were deposited in GenBank (Accession Nos. MT791387- MT791389), and BLAST analyses revealed 100% identity to *Golovinomyces cichoracearum sensu lato*, as recently reported from cannabis plants in Canada (Pépin *et al.*, 2018). Due to its complex taxonomy, *G. cichoracearum* is considered a species complex, composed of specialised as well as less specialised races, taxa or even cryptic species.

Pathogenicity of the Israeli isolate was confirmed following inoculation of eight-week-old healthy *C. sativa* cv. 'BB 734' from the Agricultural Research Organization (Jerushalmi *et al.*, 2020), by brushing conidia and pressing naturally infected leaves onto healthy ones. Inoculated plants were maintained at 22 ±2°C in a growth chamber under a photoperiod of 18 hr light (3000 lux) and 6 hr dark. Powdery mildew symptoms developed on mature leaves from two to five weeks post-inoculation, whereas non-inoculated plants remained healthy (Fig. 4).

Until the recent discovery of *Golovinomyces cichoracearum sensu lato*, on *C. sativa* from Canada, powdery mildew on cannabis was thought to be caused by *Sphaerotheca macularis* and *Leveillula taurica* (McPartland *et al.*, 2017). The *Golovinomyces* sp. isolate that we obtained shared 100%

identity with the strain from Canada and to the best of our knowledge, is the first report from Israel of this species on *C. sativa*. *Golovinomyces cichoracearum* has been reported from Israel on lettuce and other hosts, particularly belonging to the Asteraceae, however no molecular confirmation or pathogenicity tests were done (Chorin & Palti 1962; Voytyuk *et al.*, 2006). The disease has already spread to three of the largest medical cannabis facilities over the past year and there is an imminent threat of further dissemination. The appearance of powdery mildew in these facilities is of concern and will require appropriate management strategies to ensure procurement of healthy and safe products for use by predominantly immunocompromised patients.

References

- Chorin M, Palti J, 1962. *Erysiphaceae* in Israel. *Israel Journal of Agricultural Research* **12**, 153-166.
- Jerushalmi S, Maymon M, Dombrovsky A, Freeman S, 2020. Effects of cold plasma, gamma and e-beam irradiations on reduction of fungal colony forming unit levels in medical cannabis inflorescences. *Journal of Cannabis Research* **2**, 1-12. <http://dx.doi.org/10.1186/s42238-020-00020-6>
- McPartland JM, Clarke RC, Watson DP, eds, 2017. *Hemp Diseases and Pests: Management and Biological Control - An Advanced Treatise*. Wallingford, UK: CABI.
- Pépin, N, Punja ZK, Joly DL, 2018. Occurrence of powdery mildew caused by *Golovinomyces cichoracearum sensu lato* on *Cannabis sativa* in Canada. *Plant Disease* **102**, 2644. <http://dx.doi.org/10.1094/PDIS-04-18-0586-PDN>
- Ruchlemer R, Amit-Kohn M, Raveh D, Hanuš L, 2015. Inhaled medicinal cannabis and the immunocompromised patient. *Supportive Care in Cancer* **23**, 819-822. <http://dx.doi.org/10.1007/s00520-014-2429-3>
- Voytyuk SO, Heluta VP, Wasser SP, Nevo E, 2006. Genus *Golovinomyces* (Erysiphales) in Israel: species composition, host range, and distribution. *Mycologia Balcanica* **3**, 131-142. <http://dx.doi.org/10.5281/zenodo.2547590>



Figure 1

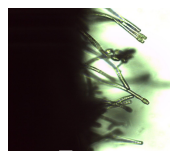


Figure 2



Figure 3



Figure 4

To cite this report: Maymon M, Jerushalmi S, Freeman S, 2020. First report of *Golovinomyces cichoracearum sensu lato* on *Cannabis sativa* in Israel. *New Disease Reports* **42**, 11. <http://dx.doi.org/10.5197/j.2044-0588.2020.042.011>

©2020 The Authors

This report was published on-line at www.ndrs.org.uk where high quality versions of the figures can be found.