

## *Lecanicillium fungicola*, the predominant cause of *Agaricus bisporus* basidiocarp deformity in Isfahan, Alborz and Khuzestan provinces

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*Agaricus bisporus* or button mushroom is one of the most famous edible mushrooms in Iran. In 2018, Iran became the sixth largest producer of button mushrooms with an average of 170 tons of edible mushrooms. Dry bubble disease (caused by *Lecanicillium fungicola*) and wet bubble disease (caused by *Mycogone perniciosa*) are two important fungal diseases of button mushroom in Iran with almost similar symptoms. Symptoms of the diseases are lack of differentiation of the button mushroom primary organs, fruiting body hyperplasia, sclerodermoid masses, and lack of differentiation and development in the gills (Fig. 1). It is important to identify the predominant causal organisms in order to control the disease. Attempts have been made to identify the pathogens of button fungus e.g., in Ardabil, 49% of isolated pathogens were *Lecanicillium* and 18% were *Mycogone*. In this study, sampling of button

mushroom production fields in Isfahan, Alborz and Khuzestan provinces was performed. In order to culture the pathogen, 200 g of button mushroom caps and 500 mL of sterile distilled water were just mixed and passed through filter paper, 20 mL of the obtained liquid was added to one liter of the PDA medium. Infected samples were surface sterilized using 10% sodium hypochlorite for one minute and then washed three times with sterile distilled water and placed on the above culture medium for 10 days. Moreover, to confirm the morphological identification, DNA extraction was performed by CTAB method and ITS-rDNA regions was amplified and sequenced using specific primers. After morphological and molecular identification, it was found that out of 100 collected samples, 80 samples belonged to *L. fungicola* (Fig. 2) and only one sample was *M. perniciosa* (Fig. 3) on the morphological basis. Sequences were registered with number MW737632, MW737629 and MW737630 and it seems that according to the present samplings, the dry bubble disease is predominant in all three provinces. If the disease is not controlled, severe damage will be occurred to the mushroom breeding units. The predominant species has different varieties such as *L. fungicola* var. *fungicola* which is common in Europe and *L. fungicola* var. *aleophilum* is common in warmer countries and the United States.



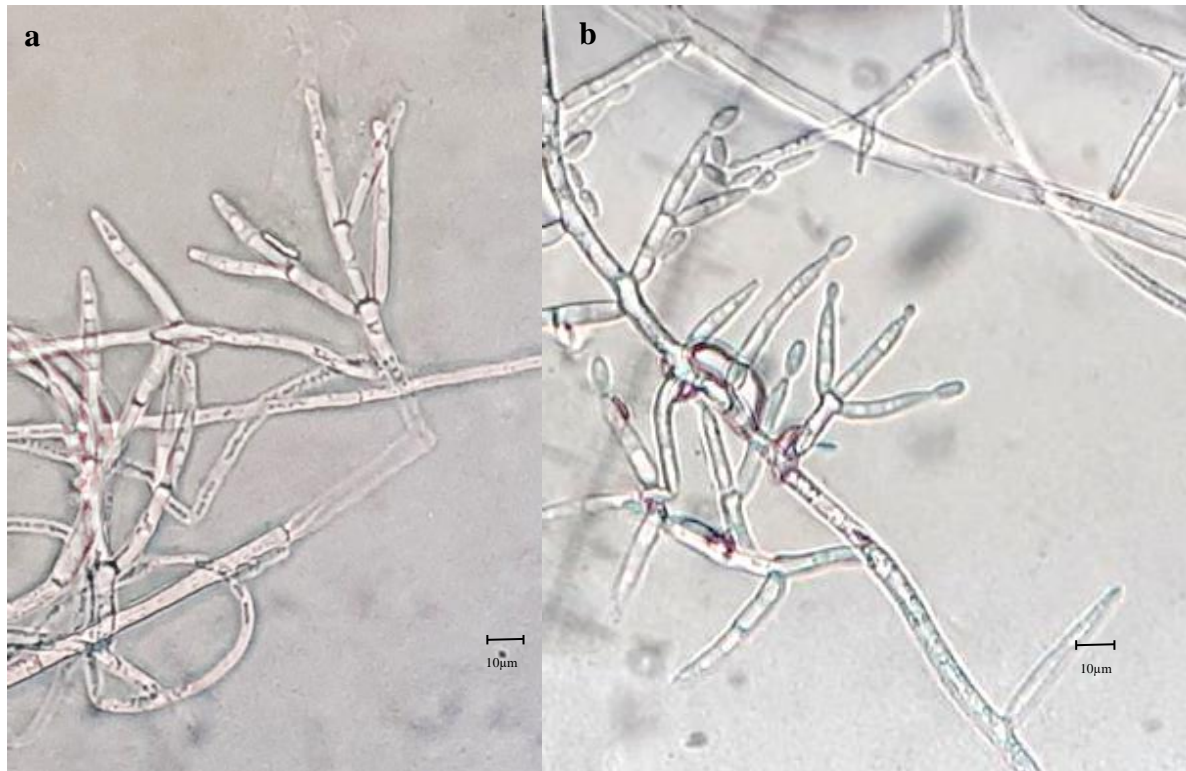
**Fig. 1.** *Agaricus bisporus* infected by *Lecanicillium fungicola*, symptoms of basidiocarp deformation on button mushroom. a. hyperplasia of fruiting bodies and sclerodermoid masses; b. malformation and lack of differentiation

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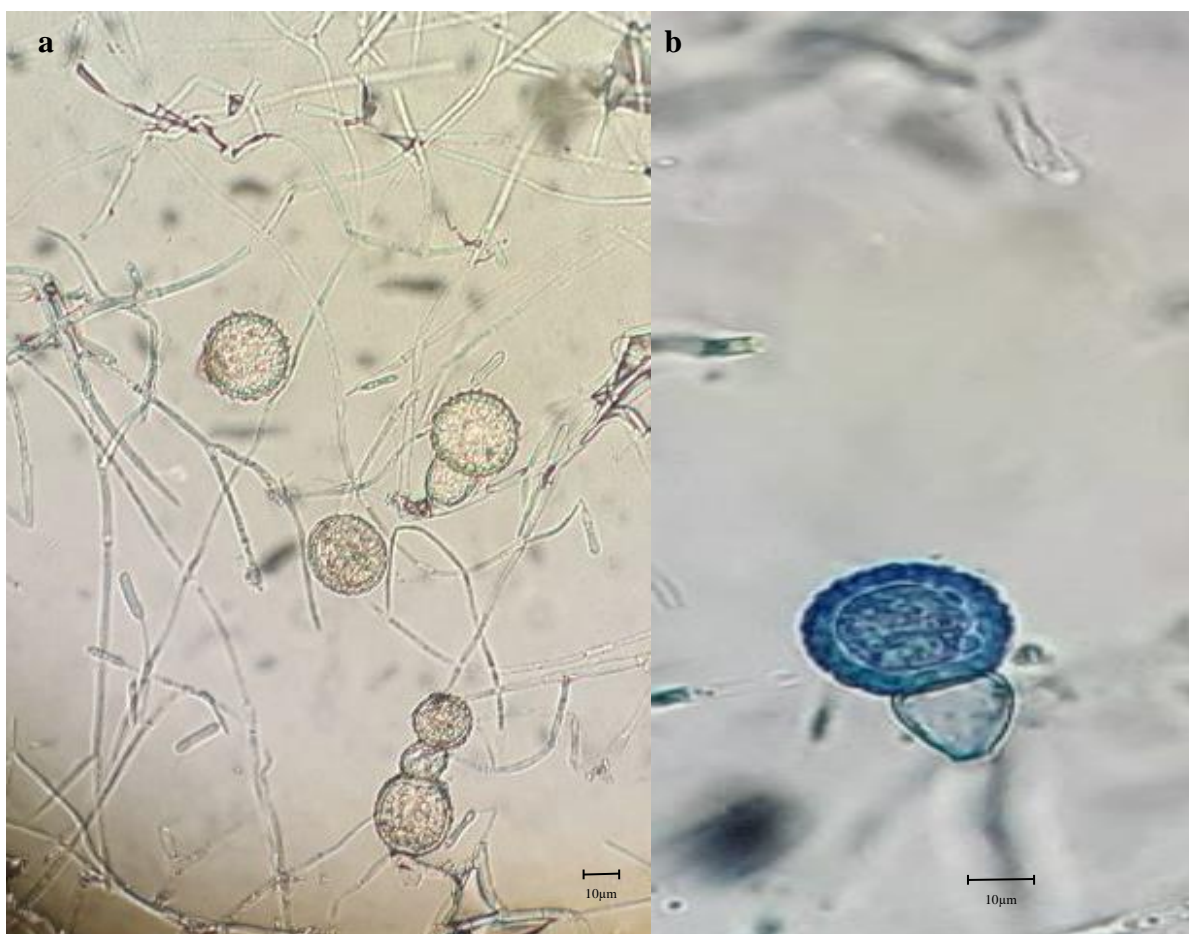
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**Fig. 2.** *Lecanicillium fungicola*. Conidiophores and phialide. a. branching conidiophores and phialides; b. conidium and conidiophores.



**Fig. 3.** *Mycogone perniciosae*. Bicellular aleurospores showing terminal cell with numerous cone-like ornaments a. conidia and aleurospores; b. aleurospore.

The two varieties are separated only on the basis of ITS sequence or division into two parts based on RAPD primers as well as growth at temperatures above 30°C in the culture medium. All isolates at 30°C did not grow after ten days, so it could be concluded that *L. fungicola* var. *fungicola*, is the predominant variety in all three provinces of Iran.

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