



RESEARCH ARTICLE

## Influence of bio-ecological factors on population dynamics of a native biocontrol agent *Aspergillus versicolor* in arid soil

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**ABSTRACT:** The effects of microbial population, soil moisture and temperature on population dynamics of *Aspergillus versicolor*, a heat tolerant bio agent, were studied at different soil depths for a period of 12-months. The population of *A. versicolor* was highest at 6-10 cm but declined at 0-5 followed by 11-20 cm soil depths. At upper soil depths, decline in population of *A. versicolor* was estimated from July to September, but then a sudden upsurge was recorded. At 11-20 cm depth, progressive increase in population of *A. versicolor* was estimated from July to November, but it did not reach to the level recorded at other depths in the month of October. Population of *A. versicolor*, after 12 months was 48 and 80% higher at 6-10 and 11-20cm soil depth than the initial one but remained stationary at 0-5 cm. The total fungi mimics *A. versicolor* at all soil depths with positive correlation ( $P = 0.001$ ), while its negative correlations were established with actinomycetes and soil moisture. Multiple regression equations accounted for almost 79-97% of variations in the population of *A. versicolor* by studied factors. Low residual factors in the path coefficient analysis also indicated that no other factor had significant contribution in influencing *A. versicolor* population. Studies revealed that minimum soil temperature and total bacteria played negligible role in influencing population of *A. versicolor*.

**Key words:** Cumin, *Fusarium oxysporum* f. sp. *cumini*, soil temperature, soil moisture

Cumin (*Cuminum cyminum* L.) is grown extensively in arid and semi arid regions of India in winter season (Nov-March). In Indian arid region, approximately 40% yield losses were recorded only due to wilt caused by *Fusarium oxysporum* f.sp. *cumini*-*Foc* (Lodha *et al.*, 1986). Inoculum of *Foc* increases in the soil with continuous cultivation of susceptible strains of cumin (Lodha, 1995). Combining cruciferous residues with summer irrigation has been developed as a practical management strategy to reduce soil population densities of the pathogen and wilt incidence on the crop (Mawar and Lodha, 2002; Sharma *et al.*, 1995). A native heat tolerant strain of *Aspergillus versicolor* (Vuill.) Tirab., antagonistic to *Foc* was isolated from cruciferous residue amended soil, which was able to survive and multiply even at 65°C (Israel and Lodha, 2004). Its bio control potential against *Puccinia helianthi* (Patil *et al.*, 2000), *Macrophomina phaseolina* (Bhattacharya *et al.*, 1985) and *Phymatotrichum omnivorum* (Kenerley and Stack, 1987) is well documented. Better survival and multiplication of *A.versicolor* at low soil moisture content and high soil temperature favors its adaptation in dry sandy soils of hot arid region of India.

Once a bio control agent has proved its potential in control of a target pathogen, some specific aspects need investigations particularly in relation to the host and climate under which its use can be promoted. Studies are required to know its survival rate at different soil depths in fluctuating weather conditions and how other bio-ecological factors are governing population dynamics of the bio control agent. By generating this information, manipulation of soil environment and other associated

bio-ecological factors in favor of bio agent, its population and activity can be enhanced in order to develop soil suppressiveness.

Mode of action, survival in soil, growth promotion abilities of *Trichoderma harzianum* and *T. viride* as a biocontrol agents has been studied in detail. (John *et al.*, 2010; Harman *et al.*, 2004) but no information is available on population dynamics of *A. versicolor*. Studies of population dynamics over time and space have two basic goals: (a) to identify recurring pattern in the dynamics of a population; (b) to understand how such patterns are generated. The present investigation, therefore, was undertaken to study how biotic and abiotic factors influence population of *A.versicolor* at different soil depths in arid soils.

### MATERIALS AND METHODS

#### Location

The experiment was conducted at the Central arid zone research institute, Jodhpur (Rajasthan), India, during June 2006 to June 2007. The loamy sand soil (85.6% sand, 8.9% clay, 5.5 % silt) of the field had 0.03% total nitrogen, 0.25% organic carbon, 9 g g<sup>-1</sup> Olsen-P at pH 8.1, electrical conductivity - 0.88 d Sm<sup>-1</sup> (soil: water ratio 1: 2.5); bulk density - 1.56 g cm<sup>-3</sup> and 10.4% moisture holding capacity (MHC).

#### Inoculum preparation

*A. versicolor* isolated from native soil of the region was multiplied in bulk in potato dextrose broth. Fungal mats were harvested after 15 days on filter paper and blended

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