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Curvularia linata as bioherbicide for management of *Xanthium strumarium* L., an abnoxious weed - A Critical Evualation

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Abstract
Xanthium strumarium L. is an exotic plant responsible for several agricultural, environmental and health problems in India. Due to non-acceptability of conventional methods of control, the possibilities of its management through an indigenous strain of *Curvularia lunata* had been explored. In the present study, the organism was recovered in pure culture from the infected/infested parts of the weed, seedling and detached leaf bioassays were employed to evaluate the effect of different epidemiological factors on efficacy of mycoherbicidal agent. Significant effect on herbicidal potential of *C. lunata* was recorded when subjected to different conditions. Maximum efficacy of the pathogen was observed at 30°C, 80% RH, 2-3 leaves stage when sprayed @ of 4.5 x 105 Sp. /ml. The present study experimentally emphasizes on the development of *Curvularia lunata* as a mycoherbicide in the management of the weed, *Xanthium strumarium* L.

Keywords: *Curvularia lunata,* mycoherbicide, pathogen, *Xanthium strumarium* L.

INTRODUCTION

Xanthium strumarium L. popularly known as Common cocklebur an exotic plant responsible for several agricultural, environmental and health problems in India. Due to non-acceptability of conventional methods of control, the possibilities of its management through an indigenous strain of *Curvularia lunata* had been explored. Preliminary evaluation studies viz. Pathogenicity, herbicidal potential, safety to non- target organisms etc. carried out in laboratory conditions and the pathogen was found to have excellent mycoherbicidal potential against this weed. However, herbicidal potentials of mycoherbicidal agents are known to be influenced by environmental conditions and growth stage of the weeds.

Bioherbicides are biological agents applied to plants in similar ways as chemical herbicides to control the propagation of weeds. The active ingredient in a bioherbicide is the living microorganisms which are applied in doses of propagules. The most commonly used microorganism is a fungus and the propagules are the spore or fragments of mycelium. In the present study the bioherbicide is referred as a Mycoherbicide as it is a fungus. *Xanthium strumarium* is a coarse annual herb, belongs to family Asteraceae and is popularly known as common cocklebur, *banokra*, *Gokhru* or *Chota Datura*. It is an extremely competitive weed creating several serious problems in agriculture and rangelands [1]. It grows luxuriantly and seriously in infested paddy, sorghum and other *kharif* annual crop-fields in Andhra Pradesh, Maharashtra, Rajasthan and Madhya Pradesh [2, 3]. The weed is considered as one of the world's worst weed [4]. All the parts of the weed are highly toxic and allergic to humans and animals [5, 6]. The major toxic substance in *Xanthium* is carboxyatractyloside which is capable of killing hogs, cattle, goats, horses, sheep and poultry. Though the seed and seedlings contain the highest quantity of toxin, the whole plant can also be toxic [7]. The allelochemicals produced from different parts of the weed also inhibit the seed germination and seedling growth of many crops viz. Wheat, maize, pearl millet, chickpea, rapeseed, tobacco and lettuce [8]. Therefore the present investigation was carried out to critically evaluate the possibility of using *Curvularia lunata* as bioherbicide against *Xanthium strumarium* L.

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MATERIALS AND METHODS

Recovery of Pathogen

Systematic periodical and thorough survey of various localities of Jabalpur was conducted and diseased specimens of the fungus *Curvularia lunata* were collected. The organism was recovered in pure cultures as per Agarwal *et al*. [9].

Bioassay

The efficacy of the fungus *Curvularia lunata* was evaluated by detached leaf bioassay [10] and intact plant bioassay [11-13].

Mycoherbicidal Potential

Effect of temperature on spore germination & incidence of disease:

The inoculum was prepared and seedlings at 2-3 leaf stage were inoculated, incubated at 80-100%, RH humidity and different temperatures viz., 15, 20, 25, 30, 35°C. Efficacy of test fungus was evaluated as mentioned earlier.

Relative humidity : Seedlings at 2-3 leaf stage were inoculated with test fungus, RH conditions ranging from 33% to

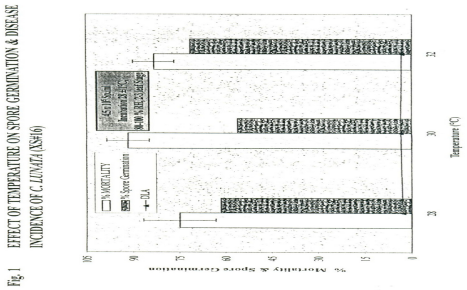
100% were provided in air tight desiccators' using various chemicals [14, 15].

Weed growth stage: Seedlings of *X. strumarium* from cotyledonary to pre-inflorescence stage were inoculated with test fungus. Plants were subjected to 24hrs incubation of dew period and moved to green house and the disease severity was evaluated as mentioned earlier.

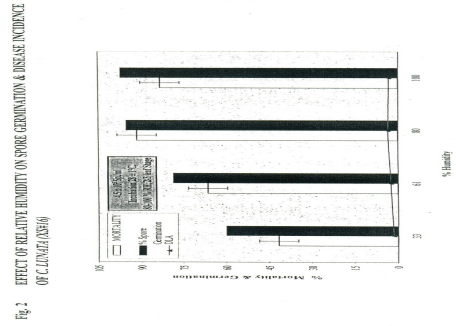
Inoculum Concentration: Different concentrations of inoculums were prepared in sterile distilled water. Spore suspension was sprayed by using atomizer on 2nd -3rd leaf stage of the weed.

RESULTS

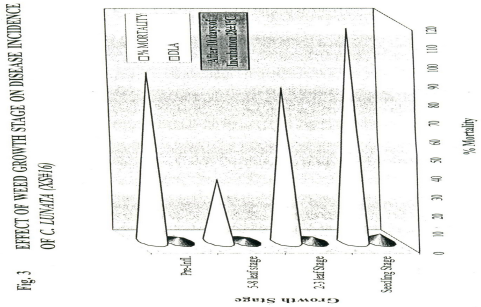
The temperature of 28-30°C supported maximum spore germination of test fungus, which was directly related with disease development (Fig 1). The maximum mortality percent of weed was observed at 30°C (Fig 1).



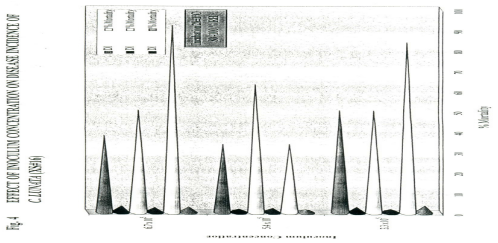
The results presented in Fig (2) clearly indicate that relative humidity had significant impact on the disease severity. Maximum incidence of disease was recorded at 80-100% More than 91.6% seedlings were died at these humidity.



From data presented in the Fig (3), it is evident that, the weed was highly susceptible to all the growth stages; however, it was maximum at the cotyledonary or 1st -2nd true leaf stage.



Results depicted in Fig (4), showed that inoculum concentration had significant influence on disease development, Maximum disease severity was observed at 6.7 x 10^5 sp/ml and below 3. 7x 10^5 sp/ml pathogen had no significant effect on mortality of the weed.



DISCUSSION

The development of a fungus as potential mycoherbicide needs the knowledge of its interaction with the environment as well as the host plant. Significant influence of various environmental factors on biological activities at the test pathogen was also observed during the course of the present investigation. A range of temperatures i.e. 28-32°C supported maximum spore germination and percent mortality of the weed. Similar results have also been reported by many other workers [16-18] while evaluating the potential of *Alternaria crassa* for biological control of Jimson weed. Although the spore germinated optimally between 20- 30°C the infectivity of *Datura strumarium* was reduced at temperatures between 20-30°C, but the temperature between 20-30°C favored epidemics of *Alternaria cucumerina* on cucurbits in Florida [19]. Maximum incidence of disease was recorded at 80-100% RH. More that 91.6% seedlings died at this humidity. Similar results were observed while working with *Colletotrichum lindemuthianum*, *C. dematium* and *Curvularia lunata* [17, 18, 20]. It is also a known fact that spore of the pathogen germinate rapidly under higher humidity conditions, while they tend to desiccate in the absence of moisture [21, 22]. The weed was highly susceptible at the cotyledonary or 1-2 leaf stage. Increase in infection from the youngest to oldest leaves or plants due to *Alternaria* have also been reported by [13, 23, 24]. Similar variation in susceptibility has also been reported on same plants that plant age and inoculum concentration played a major role in the development of *Aschocyta* blight of Chickpea [25-27]. The pathogen was capable to produce a disease after two days of treatment and reached its maxima after 14 days of treatment. Similar results regarding inoculum concentration versus growth stage for different bio-control agents and their respective hosts were earlier reported [28-30]. Thus it can be boldly concluded that the mycoherbicidal agents can be applied in the field conditions for the biological control of weeds.

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