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Efficacy of chemical fungitoxicans in fruit rot of jackfruit in Jhansi vicinity

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Abstract
Jackfruit (*Artocarpus heterophyllus Lam.,)* belongs to the family Moraceae is a plant with high remunerative value due to important fruit. It is grown in various states of India. Its fruit is the largest tree born fruit and used in various purposes, susceptible to a number of diseases. Rhizopus soft rot disease caused by *Rhizopus stolonifer*. Rhizopus rot is a common fungal disease of jackfruit flowers, inflorescence and fruit. Symptoms appear at first, soft, watery, brown spots develop on the flowers and fruit. Subsequently, a powdery, fuzzy-looking mass of black spores and white fungal mycelia covers the jackfruit surface. The pathogen engulfs the young fruit, resulting in the characteristic black, rotten, shrunken, and sometimes mummified fruit remains. Fruit symptoms can appear on the tree or can develop on fruit that are in storage or transit, resulting in a significant decrease in fruit set. The pathogen grown on Potato dextrose Agar (PDA) produced colony of moderately fast growing usually in the beginning dull, a powdery, fuzzy-looking mass of black spores and white fungal mycelia with abundant sporulation Rhizoids well developed. Sporangiophores (on stolons) are brown, in groups of 1-3 and occasionally more. There were variation in Maximum Inhibition Concentration) MIC of three fungitoxicans *viz* bavistin, Indofil M-45 (Mancozeb) and ridomil. MIC on agar plate ranged from 0.5 to 2.5%. Among the three fungicides tested against *R. stolonifer*. Ridomil was found highly effective in inhibiting the mycelial growth followed by Ridomil at 0.5%, 1.0% and 2.5%. Key words: Rhizopus rot, *Rhizopus artocarpi*, Jackfruit fruit rot, MIC

Keywords: chemical fungitoxicans, fruit rot, jackfruit

1. Introduction
Jackfruit (*Artocarpus heterophyllus*) culture as an alternative crop due to its high demand on a regional, national and international level. It produces heavier yield than any other tree species, and bear the largest known edible fruit (up to 35 kg). The jackfruit tree has several uses. Jackfruit is adapted to humid tropical and near tropical climates. India is the second biggest producer of the jackfruit in the world and is considered as the motherland of jackfruit In India Jackfruit cultivated in 14,826 acres (26,000 ha) (Ghosh, 1996; AEC, 2003) [1, 2]. Jackfruit plays a significant role in Indian agriculture and culture. It is popularly known as poor man's fruit in the eastern and southern parts of India. The tender fruits of the tree are used as vegetables and the ripe ones as table fruits.
Jackfruit is also considered as rich source of carbohydrate and Iron (Angeles, 1983; Arkroyd *et al*., 1966; Bhatia *et al*., 1995) [3, 4, 5]. Plant diseases play a major role in reducing yields of horticultural crops in the tropics (Pathak, 1980a; Rawal, 1990; Ploetz *et al.*, 1998; Mariau, 2001) [6, 7, 8, 9]. Some of the major pests and diseases include shoot borers, bark borers, mealy bug and scale insects, blossom and fruit rots, and bacterial dieback. There are more than 20 diseases reported on jackfruit tree. Among them leaf spot is caused by *Colletorichum lagenarium* (paris.) Ell. and Holst. Another leaf spot is caused by *Septoria artocarpi* Cke. The pink disease is caused by *Corticium salmonicolor* Berk and Br. Stem rot is caused by *Phytophthora palmivora* Butler and brown rot is caused by Fomes noxious. Fruit and inflorescence rot caused by Rhizopus artocarpi is very common disease and serious disease of jackfruit. (Chuadhari, 1949) [10]. The infection of Rhizopus artocarpi forms layer of black spore mass then white fungal mycelium covers the surface of fruit of jackfruit. The pathogen engulfs the inflorescence, young fruits and results into black, shrunken, mummified fruits. Sometime it causes the total fruit loss of jackfruit.

2. Material and Methods

2.1 Collection of symptomatic fruit material

The infected fruits of jackfruit were collected from Jhansi vicinity of Bundelkhand region (Fig-1). The infected fruit materials were brought to the laboratory and were cut into small pieces (0.5-1.0cm length) along the symptomatic region of fruit and subsequently surface sterilized by sequential dipping in 70% ethanol for 30 s and in 0.1% HgCl2 for 1 min., rinsed in sterilized distilled water (Mali *et al*, 2015) [11]. The sterilized portion was cultured on the leaf pieces were placed on to potato dextrose agar (PDA) medium (Fig-2). The cultures incubated at 25±2^{0}C for 07 days to promote fungal growth and sporulation. The fungi were isolated, and pure culture were obtained from single spores and hyphal tips and culture was maintained on potato dextrose agar medium in plates. The morphological and culture characteristic of the isolated organism were studied, conidia and conidiophores details were considered. The identification was further confirmed from NCFT by Dr. P. N. Chowdhry Principal Mycologist National Centre for Fungal Taxonomy Inderpuri, New Delhi.

Fig 1: Symptoms on Jackfruit

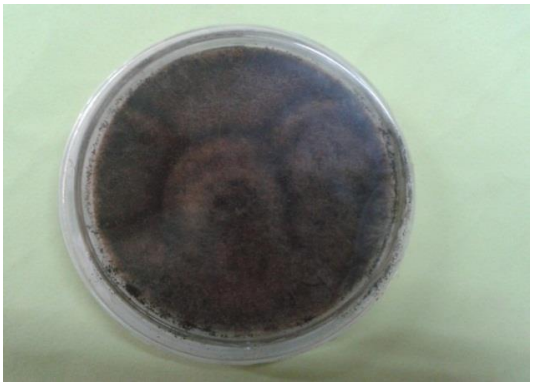


Fig 2: Culture of *R stolonifer* on PDA

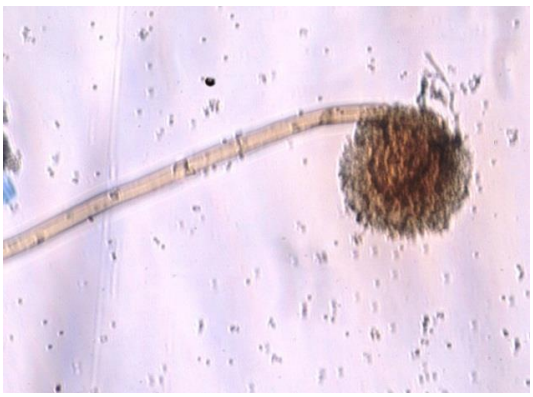


Fig 3: Micrograph of *R stolonifer*

The plates were observed for fungal outgrowth through the symptomatic parts of plants. After 5-6 days of culture, fungal mass was observed. On the basis of visual morphological characters and microscopic characters the fungal isolate was identified as Rhizopus artocarpi. The sensitivity of Rhizopus artocarpi was carried out by using Food Poisoning Technique (Schmitz, 1930) [12]. by deploying various concentrations of fungicides, *viz* Bavistine, Indofil M-45 (Mancozeb) and ridomil. Requisite quantities of fungicides were added in three different concentrations (0.5, 1.0 and 2.5) in 2 percent PDA medium, which was shaken well to make it homogenous. The medium was then poured into petri plates. The experiment was conducted in completely Randomized Block design with three replication and suitable control was also maintained without adding any fungicide in the petri plates. A circular disc of 1-2 mm diameter was taken from 7 days old culture of the pathogen, place in the centre of each petriplates and a petriplate was kept as control without any fungicide. After inoculation the petriplates were incubated at 25±2 temperature for 7 days. The radial growth of the fungal colony was assessed by measuring the growth of the colony diameter in mm and interpreted in percent inhibition over control by the following formula:

$$PI = \frac{RC - RT}{RC} \times 100$$

Where PI=Percent Inhibition, RC=Radial growth in control, RT= Radial growth in treatment.

3. Result and Discussion

Bio assay of fungicides against *R stolonifer;* The result presented in the (Table No.1) revealed that all the fungicides were superior over control. Out of them only Ridomil proved to be the most effective as it inhibited the fungal growth completely whereas Indofil M-45 was the least effective. Bavistin was found to be the next best in inhibiting the growth of the pathogen. The superiority and most fungi toxic quality of these fungicides was in descending order, Ridomil. >Bavistin >Indofil M-45. The affectivity of fungicides increased with higher concentration of dose. In Indofil M-45 change in the concentration percentage increased inhibition percentage of the pathogen. Bavistin was effective at high concentration, the growth of the test pathogen was 4mm in 0.5% concentration, after increase in concentration (1.0% and 2.5%) the pathogen showed total inhibition. (Fig 4),(Graph 1).

Table 1: Bio assay of fungicides against the *Rhizopus stolonifer*.

S. No	Fungicides	Doses (%)	Average Diameter (mm)	Inhibition (%)
1.	Ridomil	0.5	0.0	100
		1.0	0.0	100
		2.5	0.0	100
2.	Bavistin	0.5	04	95.23
		1.0	00	100
		2.5	0.0	100
3.	Indofil M-45	0.5	38	54.76
		1.0	32	61.90
		2.5	20	76.19
4.	Control	--	84	--

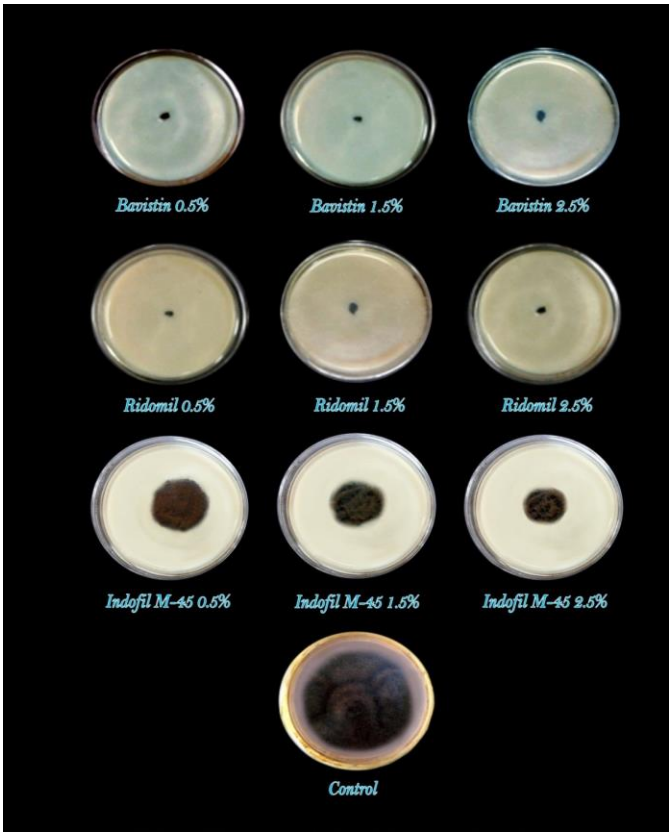
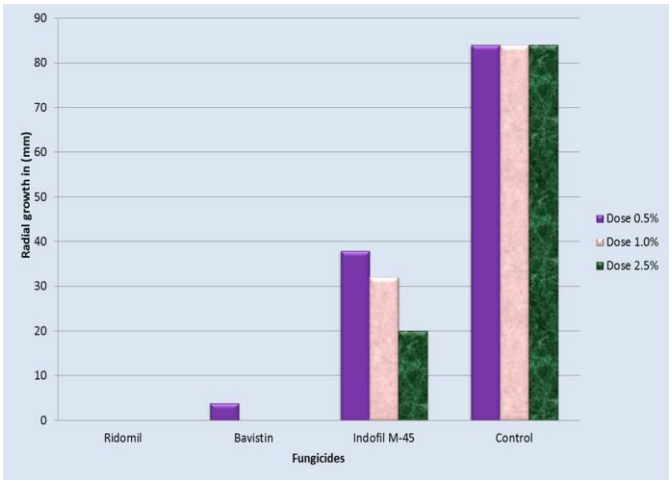


Fig 4: Bioassay of fungicides against the *Rhizopus stolonifer*



Graph 1: Bioassay of fungicides against the *Rhizopus stolonifer*

Conclusion

From present study, it can be concluded that, mixture of different fungicides proved to be an useful approach for the management of fruit rot of jackfruit caused by *Rhizopus artocarpi*.

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