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In vitro efficacy of new fungicides against *Curvularia hawaiiensis* (Bugnic. ex m. B. Ellis) causing leaf spot of pearl millet

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Abstract
Pearl millet (*Pennisetum glaucum* L.) is being affected by several fungal diseases. Among the all diseases, the leaf spot caused by *Curvularia hawaiiensis* has been gaining importance in recent years by causing considerable losses in high yielding varieties and hybrids, than native cultivars. It reduces the productivity of pearl millet and became a major limiting factor in pearl millet cultivation. Therefore, present *in vitro* study was planned and conducted, in 10 treatments replicated thrice, to assess the efficacy of new fungicides against *Curvularia hawaiiensis*, at the Department of Plant Pathology, College of Agriculture, Dhule, during 2018-19. Results revealed that the fungicides Mancozeb recorded maximum growth inhibition (88.22%) and found significantly superior over rest of the fungicidal treatment followed by Hexaconazole (76.33%), Copper oxychloride (65.55%), Azoxystrobin (47.11%), Carbendazim (61.11%) and Captan (50.44%). Among the all fungicides the minimum growth inhibition 32.22% recorded in Tebuconazole + Trifloxystrobin.

Keywords: Pearl millet, *Curvularia hawaiiensis*, fungicides, inhibition

Introduction
Pearl millet (*Pennisetum glaucum* L.) is an important warm season cereal grown primarily for grain production in some of the most marginal environment in the arid and semi-arid tropical (SAT) region of Asia and Africa. The area under cultivation of pearl millet was 7.128 million ha with grain production of 10.08 metric tons and productivity of 1132 kg ha^{-1} in India. In Maharashtra state it is about 6.47 lakh ha with production of 4.20 lakh tones having average productivity of 632 kg ha^{-1}. India is a major Pearl millet producing country with 43.3% of the world area and 42% of world production. The crop is cultivated in almost all the districts of Maharashtra state, except konkan area, however, the major pearl millet growing districts are Nashik, Dhule, Ahmednagar, Pune, Satara, Sangali, Aurangabad and Solapur (Anon., 2017) [1].
Pearl millet (*Pennisetum glaucum* L.) is being affected by several fungal diseases. The Pearl millet crop grown extensively with a limiting factor that invariably attacked by fungal diseases like Downey Mildew (*Sclerospora graminicola*), Smut (*Moesziomyces penicillariae*), Ergot (*Claviceps fusiformis*), Blast (*Pyricularia grisea),* Rust (*Puccinia substriata*), Leaf spot (*Bipolaris, Cercospora, Curvularia, Drechslera, Exeserohilum, Pyricularia) etc.* Among these, leaf spot is gaining importance in recent years by causing considerable losses in high yielding varieties and hybrids, than native cultivars. *Curvularia* is a hyphomycete (mold) fungus which is a facultative pathogen of many plant species and of the soil. Most *Curvularia* are found in tropical regions, though a few are found in temperate zones.
Curvularia leaf spot of pearl millet is becoming increasingly important in India. It reduces grain as well as fodder yield and also reduced the fodder quality. The disease severity observed more during *kharif* season with severe economic losses and it reduces the productivity of pearl millet and became a major limiting factor in pearl millet cultivation. Therefore, present study on *in vitro* efficacy of new fungicides against *Curvularia hawaiiensis*, causing pearl millet leaf spot was planned and conducted at the Department of Plant Pathology, College of Agriculture, Dhule, during 2018-19.

Materials and Methods

In vitro evaluation of new fungicides

Experiments were planned to evaluated *in vitro* the efficacy of new fungicides by applying Completely Randomized Design (CRD), all the treatments replicated thrice. The Poisoned Food Technique (Nene and Thapliyal, 1993) [2] was followed to evaluate the efficacy of fungicides in inhibiting the mycelial growth of *Curvularia hawaiiensis* using Potato Dextrose Agar as basal culture medium.

Observations on radial mycelial growth / colony diameter (mm) were in all the replicated treatments at 24 hrs interval and continued till growth of the test pathogen in untreated control plates was fully covered. Per cent inhibition of the test pathogen over untreated control was calculated by applying following formula.

$$\text{Per cent Inhibition (I)} = \frac{C - T}{C} \times 100$$

Where,

C = Growth (mm) of the test fungus in untreated control plate

T = Growth (mm) of test the fungus in treated plates

The data obtained was statistically analyzed (Panse and Sukhatme, 1978) and the results were interpreted thereof.

Results and Discussion

In vitro efficacy of different fungicides against the *Curvularia hawaiiensis*

Ten fungicides were evaluated in *in vitro* condition by employing "Poisoned Food Technique". The data obtained on the effect of various fungicides *in vitro* on the vegetative growth and spore formation of the test fungus *Curvularia hawaiiensis* is presented in Table-1.

The results presented Table-1 revealed that the fungicides Mancozeb recorded maximum growth inhibition (88.22%) and found significantly superior over rest of the fungicidal treatment. The next best treatment in superiority is Hexaconazole (76.33%), Copper oxychloride (65.55%), Azoxystrobin (47.11%), Carbendazim (61.11%) and Captan (50.44%) with mean colony diameter 2.13 cm, 3.1 cm, 4.76 cm, 3.5 cm and 4.46 cm respectively. It was further observed that, Trycyclazole, Thiophanate methyl, Propineb and Tebuconazole + Tryfloxystobin showed 40.00%, 37.11%, 32.66% and 32.22% growth inhibition with mean colony diameter 5.4 cm, 5.66 cm, 6.06 cm and 6.1 cm respectively.

Overall result from the present investigation showed that the fungicide Mancozeb (0.3%) was most effective in inhibiting the growth of *Curvularia hawaiiensis* as compared to other fungicides. On the other hand Tebuconazole + Tryfloxystobin (0.05%) recorded as least effective fungicide for controlling leaf spot of bajara. The results are conformity with reports of Saravanan and Karuppiah (2005) [5], Singh *et al.* (2011) [4] and Pawar (2012) [3].

Table 1: *In vitro* effect of fungicides on growth and inhibition of *C. hawaiiensis.*

Tr. No.	Fungicides	Concentration (%)	Mean	Inhibition (%)
T_1	Azoxystrobin	0.05	4.76	47.11
T_2	Captan	0.2	4.46	50.44
T_3	Carbendazim	0.1	3.5	61.11
T4	Copper oxychloride	0.2	3.1	65.55
T_5	Hexaconazole	0.1	2.13	76.33
T_6	Mancozeb	0.3	1.06	88.22
T_7	Propineb	0.05	6.06	32.66
T_8	Tebuconazole + Tryfloxystrobin	0.05	6.1	32.22
T_9	Thiophanate methyl	0.1	5.66	37.11
T_{10}	Trycylazole	0.1	5.4	40.00
T_{11}	Control	-	9.00	00.00
	S.E. +		0.34	
	C.D. at 5%		1.02	

*Mean of three replication

Conclusion

Hence, from ongoing results and discussion, it is concluded that *in vitro* testing of fungicides against *C. hawaiiensis* revealed that the fungicides mancozeb @ 0.3%, exhibited maximum growth inhibition (88.22%) of the test pathogen and it was found significantly superior over rest of the fungicidal treatments.

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