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Effect of Metal Salts, Amino Acid, Reducing Agent and Metabolic Inhibitors, Plant Growth Regulators, Plant Extracts, Homoeopathic Drugs on Radial Growth of *Sarocladium oryzae*

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ABSTRACT

An experiment was conducted to assess the efficacy of non conventional chemicals, plant extracts, and homoeopathic drugs in the laboratory against Sheath rot of rice revealed that copper sulphate, zinc sulphate, mercuric chloride, diphenylamine, cysteine and 2,4 –D among non conventional chemicals at 10^{-2}M concentration, Neem, vinca and dhatura among the plant extracts at 10 per cent concentration, Thuja ,sulpher and calcaria carb among the homoeopathic drugs at 750 ppm were found effective in inhibiting the radial growth of S. oryzae. In the present studies, it is just preliminary screening of chemicals, plant extracts and homoeopathic drugs were done in laboratory for further testing in the field.

Keywords: *Rice, Metal salts, Amino acid, Reducing agent and Metabolic inhibitors, Plant growth regulators, Plant extracts, Homoeopathic drugs, Sarocladium oryzae.*

INTRODCTION

Rice (*Oryza sativa* L.) plays a unique role in providing calories to the majority of eastern and South East Asian, African and South American countries. The prevalence of diseases and pests has been diagnosed as major problem towards reducing the productivity in Rice (Siddiq, 2000). Among the several diseases of rice, sheath rot cause by *Sarocladium oryzae* (Swada) has gain importance due to huge quantitative and qualitative yield losses ranging 3-85 per cent (Reddy, 1991). Hither to many workers has suggested the effectiveness of certain non conventional chemicals, plant extracts and homoeopathic drugs against Sheath rot of rice (Reddy et al., 1998 and Alagarswamy and bhaskaran, 1986).Detailed trails are hence required to find out the effectiveness of different group of chemicals, plant extracts and homoeopathic drugs to develop as an alternative and most promising means of the management of Sheath rot of rice.

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Keeping this in view, it is essential to carry out the detailed studies on the etiology of the pathogen. As such considering the seriousness of disease, the present investigation on Sheath rot of rice has been carried out with the objective to evaluate non conventional chemicals, plant extracts and homoeopathic drugs against Sheath rot pathogen of rice.

MATERIALS AND METHODS

Effect of non-conventional chemicals on radial growth of *S. oryzae*

Required amount of stock solution of various con conventional chemicals were poured in 100 ml conical flask containing 60 ml of sterilized melted PDA and mixed thoroughly to get final concentration of 10^{-4} M, 10^{-3} M and 10^{-2} M. PDA poisoned with each chemical separately was poured into sterilized petri plates @ 20 ml per plate and allowed to solidify. Plates containing PDA without chemicals served a check.

Effect of plant extracts on radial growth of *S. oryzae*

Neem (*Azadirachta indica*) leaf, Dhatura (*Dhatura sterimonium*) leaf, Ashoka (*Polyalthia longifolia*) leaf, Tulsi (*Ocimum basilicum*) leaf and Vinca (*Vinca rosea*) leaf were evaluated against *S. oryzae* in vitro by following the poison food technique

Cold water extracts were evaluated against. *S. oryzae*, *in vitro*. The leaves were crushed in sterilized distilled water (1: 1) with the help of a mortar and pestle and strained though double layered muslin cloth. This formed the standard extract solution (100%). The plant extract were incorporated into potato dextrose agar medium at three different concentrations i.e., 2, 5 and 10 per cent. For obtaining 2, 5 and 10 per cent concentration of plant extracts in the medium, respectively, 1.6, 4.0 and 8.0 ml of plant extract were added in PDA to make volume 80 ml. Streptomycin 30 ppm and penicillin 125 ppm was also added to the medium before pouring in the petri plates to prevent bacterial contamination. PDA not amended with extract served as check. The amended PDA @ 20 ml/plate was poured into 90 mm sterilized petri plates, aseptically. Three plates were poured for each treatment.

Effect of homoeopathic drugs on radial growth of *S. oryzae*

Homoeopathic drugs (Acid nitrate, China, Cina, Sulphur, Tecurium, Thuja, Kali iodide and Calcaria carb) were evaluated against *S. oryzae* to explore the possibility of management of sheath rot by poison food technique. Three potency i.e. 250 ppm, 500 ppm and 750 ppm of all eight homoeopathic drugs were tested.

Fifty ml stock solution of 20000 ppm was prepared for each homoeopathic drug separately in sterilized distilled water in 100 ml conical flasks. To obtain the desired concentration of homoeopathic drugs in the medium, the amount of stock solution to be added in PDA was assessed

Required amount of stock solution of all homoeopathic drugs i.e., 0.75 ml, 1.50 ml and 3.00 ml was poured into 60 ml of sterilized melted PDA separately and mixed thoroughly, so as to get final concentration of 250 ppm, 500 ppm and 750 ppm respectively. PDA poisoned with each homoeopathic drug was poured into sterilized petri plates @ 20 ml/plate and allowed to solidify. Petri plates not amended with homoeopathic drug served as the check.

Incubation

The inoculated petri plates were incubated at 28 ± 1^0C in B.O.D. incubator for required period. For inoculation in different solid media containing different types of non-conventional chemicals, plant extracts and homoeopathic drugs in petri plates, 7 days old culture grown on potato dextrose agar medium was used. The size of the inoculums was standardized by cork borer of 5 mm diameter. The inoculums was cut and placed at the center of the plate in an inverted position, so that it came in direct contact with the surface of the medium. PDA plate not amended with chemicals, plant extract and homoeopathic drugs but inoculated with test fungus served as the check. Three replications for each treatment were maintained.

Measurement of radial growth

Radial growth of the regular colonies was measured in two directions at right angles with the help of a linear scale. In case of irregular colonies measurement were recorded at the broadest and narrowest diameter and average of two different directions were taken as growth. It the all cases radial growth was recorded after 7 and 15 days of inoculation. The data were converted into per cent inhibition of growth over check by using following formula.

$$\text{Per cent growth inhibition (\%)} = \frac{C - T}{C} \times 100$$

Where,

C = Colony diameter (mm) in check.

T = Colony diameter (mm) in treatment amended media

Table 1: Effect of metal salts on radial growth of *S. oryzae*

Metal Salts	Concentrations	Colony diameter (mm)*		Percent inhibition of radial growth	
		Incubation period (days)*		Incubation period (days)*	
		7	15	7	15
Copper sulphate	10^{-4} M	12.66	15.00	45.76^{hi}	50.03^{h} **
	10^{-3} M	10.00	12.00	57.20^{f}	61.04^{ef}
	10^{-2} M	6.00	7.00	74.21^{a}	76.72^{a}
Zinc sulphate	10^{-4} M	15.33	26.00	34.38^{l}	40.03^{k}
	10^{-3} M	13.00	15.00	44.31^{i}	50.03^{h}
	10^{-2} M	6.33	8.00	72.88^{a}	73.38^{b}
Ferrous sulphate	10^{-4} M	15.00	17.00	35.71^{l}	43.36^{j}
	10^{-3} M	12.33	14.67	47.26^{h}	51.11^{gh}
	10^{-2} M	7.00	8.67	69.91^{bc}	71.09^{bc}
Ferric chloride	10^{-4} M	13.00	16.00	44.31^{i}	46.70^{i}
	10^{-3} M	9.00	12.33	61.50^{e}	58.89^{f}
	10^{-2} M	8.00	10.00	65.80^{d}	66.72^{d}
Barium chloride	10^{-4} M	16.00	20.83	31.41^{m}	32.20^{l}
	10^{-3} M	15.00	18.00	35.71^{l}	40.03^{k}
	10^{-2} M	13.00	16.00	44.31^{i}	46.70^{i}
Mercuric chloride	10^{-4} M	15.00	17.00	35.71^{l}	43.36^{j}
	10^{-3} M	14.00	15.00	40.01^{jk}	50.03^{h}
	10^{-2} M	6.00	8.33	71.44^{ab}	72.23^{bc}
Nickel chloride	10^{-4} M	13.66	17.00	41.52^{j}	43.36^{j}
	10^{-3} M	8.66	11.33	62.77^{e}	63.23^{e}
	10^{-2} M	7.33	9.00	68.59^{cd}	70.05^{c}
Zinc chloride	10^{-4} M	19.00	24.00	18.52^{o}	20.01^{n}
	10^{-3} M	17.00	20.00	27.12^{n}	33.35^{l}
	10^{-2} M	14.33	17.33	38.49^{k}	41.21^{jk}
Copper chloride	10^{-4} M	19.00	22.00	18.52^{o}	26.61^{m}
	10^{-3} M	15.33	16.00	34.20^{l}	46.70^{i}
	10^{-2} M	11.00	14.00	52.90^{g}	53.37^{g}
Control		23.33	30.00	-	-
SEm				1.01	1.00
CD (P=0.05)				2.81	2.77

* Each value is an average of three replications.

** Values followed by the same letter do not differ significantly at 5% level of significance.

Table 2: Effect of amino acids on radial growth of *S. oryzae*

Amino acid	Concentrations	Colony diameter (mm)*		Percent inhibition of radial growth	
		Incubation period (days)*		Incubation period (days)*	
		7	15	7	15
Metheonine	10^{-4} M	23.33	27.66	24.78 ^{fg}	20.96^{f**}
	10^{-3} M	21.00	25.33	32.28^{e}	27.59^{e}
	10^{-2} M	18.33	22.00	40.89^{d}	37.16^{d}
Tryptophan	10^{-4} M	26.00	28.00	16.10^{h}	19.95^{f}
	10^{-3} M	20.00	23.00	35.51^{e}	34.30^{d}
	10^{-2} M	13.66	17.00	55.95^{b}	51.41^{b}
Lysine	10^{-4} M	22.33	26.66	27.95^{f}	23.76^{e}
	10^{-3} M	18.33	23.00	40.92^{d}	34.27^{d}
	10^{-2} M	15.33	19.00	49.42^{c}	42.71^{c}
Diphenylamine	10^{-4} M	23.66	26.33	23.67^{g}	24.80^{e}
	10^{-3} M	20.00	22.66	35.51^{e}	35.28^{d}
	10^{-2} M	6.00	8.66	80.63^{a}	75.25^{a}
Control	-	31.00	35.00	-	-
S.Em				1.20	1.34
CD (P=0.05)				3.53	3.93

* Each value is an average of three replications.
** Values followed by the same letter do not differ significantly at 5% level of significance.

Table 3: Effect of reducing agent and metabolic inhibitors on radial growth of *S. oryzae*

Reducing agent and Metabolic inhibitors	Concentrations	Colony diameter (Mm)*		Percent inhibition of radial growth	
		Incubation period (days)*		Incubation period (Days)*	
		7	15	7	15
Cysteine	10^{-4} M	24.66	28.00	22.96^{f}	22.94^{e} **
	10^{-3} M	19.00	21.33	40.65^{c}	41.28^{c}
	10^{-2} M	13.00	15.00	59.41^{a}	58.69^{a}
Sodium sulphite	10^{-4} M	28.00	30.33	12.47^{g}	16.46^{f}
	10^{-3} M	22.00	24.66	31.23^{e}	32.08^{d}
	10^{-2} M	16.00	18.33	50.00^{b}	49.49^{b}
Sodium molybdate	10^{-4} M	30.00	33.33	6.25^{h}	8.22^{g}
	10^{-3} M	27.66	31.00	13.51^{g}	14.65^{f}
	10^{-2} M	20.66	23.00	36.41^{d}	36.62^{cd}
Sodium azide	10^{-4} M	25.66	31.33	19.80^{f}	13.70^{f}
	10^{-3} M	21.33	24.66	33.22^{de}	31.99^{d}
	10^{-2} M	16.00	18.00	50.67^{b}	50.42^{b}
Control	-	32.00	36.33	-	-
SEm				1.26	1.65
CD (P=0.05)				3.70	4.84

* Each value is an average of three replications.
** Values followed by the same letter do not differ significantly at 5% level of significance.

Table 4: Effect of Plant growth regulator on radial growth of *S. oryzae*

Plant growth regulators	Concentrations	`Colony diameter (mm)*		Percent inhibition of radial growth	
		Incubation period (days)*		Incubation period (days)*	
		7	15	7	15
Indol acetic acid	10^{-4} M	19.66	23.66	15.74^{g}	16.49^{f} **
	10^{-3} M	17.00	20.00	27.12^{e}	29.40^{e}
	10^{-2} M	11.66	13.66	50.05^{c}	51.80^{c}
2,4,5-T	10^{-4} M	16.33	20.33	29.97^{e}	28.21^{e}
	10^{-3} M	13.33	16.00	42.79^{d}	43.54^{d}
	10^{-2} M	9.00	11.00	61.50^{b}	61.22^{b}
2,4-D	10^{-4} M	16.66	22.66	20.04^{f}	20.02^{f}
	10^{-3} M	13.33	16.33	42.97^{d}	42.43^{d}
	10^{-2} M	7.00	9.66	70.10^{a}	65.87^{a}
Indol butyric acid	10^{-4} M	18.33	22.66	21.49^{f}	19.98^{f}
	10^{-3} M	12.33	15.66	47.09^{c}	44.61^{d}
	10^{-2} M	8.66	10.66	62.83^{b}	62.33^{b}
Control	-	23.33	28.33	-	-
SEm				1.25	1.13
CD (P=0.05)				3.67	3.30

* Each value is an average of three replications.
** Values followed by the same letter do not differ significantly at 5% level of significance.

Table 5: Effect of Plant extracts on radial growth of *S. oryzae*

Plant extracts	Concentrations	Colony diameter (mm)*		Percent inhibition of radial growth	
		Incubation period (days)*		Incubation period (days)*	
		7	15	7	15
Ashoka leaf	2	27.00	29.33	18.04^{h}	19.16^{h} **
	5	21.66	23.66	34.42^{e}	34.94^{e}
	10	16.00	17.00	51.52^{c}	53.23^{c}
Dhatura leaf	2	25.66	28.00	22.15^{g}	22.97^{gh}
	5	21.33	23.00	35.31^{e}	36.64^{e}
	10	12.33	13.33	62.59^{b}	63.30^{b}
Vinca leaf	2	24.66	27.00	25.18^{fg}	25.65^{fg}
	5	22.00	23.66	23.22^{e}	34.79^{e}
	10	11.00	12.00	66.70^{a}	67.01^{a}
Neem leaf	2	27.00	29.33	18.10^{g}	19.21^{h}
	5	21.33	23.00	35.31^{e}	36.69^{e}
	10	10.00	11.00	69.74^{a}	69.76^{a}
Tulsi leaf	2	23.66	25.66	28.22^{c}	29.33^{f}
	5	19.33	21.33	41.45^{d}	41.33^{d}
	10	16.66	18.00	49.55^{f}	50.47^{c}
Control	-	33.00	36.33	-	-
SEm				1.29	1.33
CD (P=0.05)				3.74	3.86

* Each value is an average of three replications.
** Values followed by the same letter do not differ significantly at 5% level of significance.

Table 6: Effect of homoeopathic drugs on radial growth of *S. oryzae*

Homoeopathic drugs	Concentrations	Colony diameter (mm)*		Percent inhibition of radial growth	
		Incubation period (days)*		Incubation period (days)*	
		7	15	7	15
Acid nitrate	250	22.67	27.00	31.98^{hi}	28.91^{i} **
	500	16.67	22.67	43.99^{fg}	40.41^{gl}
	750	14.67	19.00	56.01^{bc}	50.00^{de}
China	250	21.67	26.00	35.04^{h}	31.63^{i}
	500	17.00	21.33	49.07^{de}	43.88^{fg}
	750	13.33	17.00	60.08^{b}	55.36^{c}
Cina	250	34.67	39.00	-4.01^{l}	-2.63^{l}
	500	33.00	37.00	0.95^{l}	2.63^{l}
	750	30.67	35.00	7.91^{k}	7.77^{k}
Sulphur	250	19.00	21.00	43.10^{fg}	44.82^{fg}
	500	14.66	16.67	56.07^{bc}	56.19^{c}
	750	10.00	12.00	70.05^{a}	68.45^{ab}
Tecurium	250	33.33	37.67	0.00^{l}	0.00^{l}
	500	31.00	35.00	6.96^{k}	7.90^{k}
	750	28.33	32.67	14.96^{j}	13.97^{j}
Thuja	250	18.00	20.67	46.10^{ef}	45.70^{ef}
	500	13.67	16.67	59.07^{b}	55.45^{c}
	750	9.00	10.33	73.05^{a}	72.80^{a}
Kali iodide	250	23.33	27.67	29.98^{i}	27.15^{i}
	500	19.66	23.67	40.99^{g}	37.79^{l}
	750	14.33	18.67	56.93^{bc}	50.79^{d}
Calcaria carb	250	22.00	22.67	40.09^{g}	40.42^{gh}
	500	15.67	18.67	53.06^{-cd}	50.87^{d}
	750	10.33	12.67	68.95^{a}	66.60^{b}
Control (Water)	-	33.33	38.00	-	-
SEm				1.64	1.71
CD (P=0.05)				4.57	4.75

* Each value is an average of three replications.

** Values followed by the same letter do not differ significantly at 5% level of significance.

RESULT AND DISCUSSION

Effect of metal salts on radial growth of *S. oryzae*

Present findings of in Table **1** clearly indicated that out of nine metal salts tested, none could completely inhibit the radial growth of *S. oryzae* even at 10^{-2} M concentration. Copper sulphate, Zinc sulphate, Mercuric chloride, Ferrous sulphate, Nickel chloride and Ferric chloride produced about 65 to 74 percent inhibition of radial growth at 10^{-2} M concentration. In general all the metal salts at lower concentrations produced less than 65 per cent inhibition, mostly less than 50 per cent of inhibition of radial growth. In all the cases lower concentrations were less effective. Similar trend was observed even after 15 days of incubation.

References on direct effect of meal salts on radial growth of *S. oryzae* could not be traced in the literature, however, a number of workers have tested these chemicals in the field against the disease and have found them effective. Alagarswamy (1986) reported that foliar spray of Calcium sulphate and Zinc sulphate gave the most effective control of sheath rot rice. Metal salts namely Copper sulphate (Alagaswamy & Bhaskaran, 1986 b), Zinc sulphate (Reddy et al., 1998) have been reported to be effective in management of these disease. Sunder et al. (2010) advocated the similar results using ferric chloride, Sodium salinate and Nickel nitrate in reducing brown spot of Rice and increasing grain yield. Giri and Sinha (1979) and Trivedi and Sinha (1980) also reported the same findings using non toxic chemicals and heavy metal salts. Krish Remond Robichaur (2001) highlighted the use of calcium silicate in green house and

field condition for reducing the sheath blight disease of rice to a considerable limit. In the present studies preliminary screening of metal salts was done in lab and five metal salts namely Copper sulphate, Zinc sulphate, Mercuric chloride, Nickel chloride and Ferrous sulphate have been identified for further testing in the field.

Effect of amino acid on radial growth of *s. oryzae*

Present finding in Table **2** clearly indicated that none of the amino acid could completely inhibit the growth of *S. oryzae* even at 10^{-2}M concentration Diphenylamine (10^{-2}M) which producing around 80 per cent inhibition of growth of *S. oryzae* has potential to check the radial growth of the fungus. In general lower concentrations of all the amino acids were less effective as compare to higher concentration. Other treatments were practically less effective in inhibiting the radial growth of *S. oryzae*. No reference on the direct effect of amino acid on radial growth of *S. oryzae* or, any other fungus, was available. However when applied as seed treatment with amino acids are known to affect Brown spot of rice (Trivedi & Sinha, 1980).

Effect of reducing agent and metabolic inhibitors on radial growth of *S. oryzae*

Present finding in Table **3** clearly indicated that all the chemicals, at all the concentrations tested inhibited the growth of *S. oryzae*. However, none of the chemicals could completely inhibit the growth of *S. oryzae*. Out of four reducing agent/metabolic inhibitors, only cysteine (10^{-2}M) has got some potential to inhibit the radial growth of *S. oryzae* as it produced around 60 per cent inhibition. While Polanco et.al. (2014) justified that Sodium molybdate singly or in combination with Potassium silicate produces lowest Area under Anthracnose Progress Curve (AUDPC), higher growth variables leaf area index (LA1), Healthy leaf area index (HLA1) and maximum yield of common bean has been achieved. Caiser et. al.;(2005) also revealed the role of Molybdenum in various forms protecting a number of diseases. Lower concentrations of all the chemicals were less effective as they could produce less than 50 per cent inhibition of radial growth. No reference on the direct effect of reducing agent/metabolic inhibitors on radial growth of *S. oryzae*, or any other fungus, was available. However, when applied as seed treatment, reducing agent/metabolic inhibition are known to affect the charcoal rot and Brown spot of rice (Chakraborty and Purkayastha, 1987 and Sarkar & Sinha, 1991)

Effect of plant growth regulator on radial growth of *S. oryzae*

Data presented in Table **4** clearly indicated that 2,4-D, 2,4,5-T and Indol butyric acid (10^{-2}M) have potential to control the growth of *S. oryzae*. Other treatments were either less effective or practically non effective in inhibiting the radial growth of *S. oryzae*. Present finding clearly indicated that out of four plant growth regulators, three namely 2,4-D, 2,4,5-T and Indol butyric acid (10^{-2} M) have potential to control the radial growth of the fungus as they produced more than 60 per cent inhibition. Effect of these chemical on radial growth of *S. oryzae* could not be traced in literature, However, Roychoudhury and Purkayastha (1980) have reported that gibberellic acid @ 10-100 mg/ml inhibited the growth of the pathogen. However, when applied as seed treatment, plant growth regulators are known to affect the sheath rot (Ghosal & Purkayastha, 1984).

Effect of plant extracts on radial growth of *S. oryzae.*

Data presented in Table **5** clearly indicated that Neem, Vinca and Dhatura leaf extracts have potential to check the radial growth of *S. oryzae* at 10 percent concentration as they produced more than 60 percent inhibition of growth of the fungus. Lower concentrations of all the leaf extract were less effective as they could produce less than 50 per cent inhibition of radial growth. Disease management through plant products has been gaining importance in view of their selective properties, low cost and safety to ecosystem. Many plant products have been identified for the control of plant disease (Ahmed & Grainge, 1982). Gayatry Nahak and

Rajani Kanta Sahu (2014) reflected the bio efficacy of neem leaf extract on leaf spot and wilt disease of Brinjal as well as boosting the yield matrix thereof. Jagtapa and Dey (1913), Mahajan et al. (2011) and Gawade et al. (2009) also worked on aqueous leaf extract of aforesaid botanicals against *Colletotrichum truncatum* causing Anthracnose of Soybean and other crops. Sunder et al. (2010) also reported the fungitoxic effect of Neemagold, Achook,Trachio, Thujaleavs, garlic cloves and vanish in reducing thr stock rot incidence in rice by 16-19 per cent. Riazuddin et al. (2013) also advocated the plant extract of garlic cloves and neem leaf for controlling the major seedling disease of rice besides improving seedling quality of Rice. Mukesh and Sobita Simon (2016) reported the leaf extract of *Azadirachta indica* @ 10 percent foliar spray was found most effective treatment against Brown leaf spot of Rice, increase in maximum fresh shoot weight and dry shoot weight. Very little information is available on the effect of plant extracts on radial growth of *S. oryzae*. Present finding are in accordance with the finding of Pramanik and Phookan (1998), who have reported that aqueous extracts of Tulsi was most affective followed by Neem in inhibition mycelial growth of *S. oryzae*. Neem leaf extracts have been reported by various workers to affect the growth/spore germination of many fungi (Singh *et.al.* 1998, Roy et al. 2000 and Shabana Praveen and Kumar 2000). Marked reduction of mycelial growth of *Pyricularia oryzae* and *Helminthosporium oryzae* by leaf extract of *Vinca rosea* has been reported by Ganguly (1994).

Effect of homoeopathic drugs on radial growth of S. *oryzae*.

Data presented in Table **6** clearly indicated that after 7 days of incubation, Thuja, Sulphur and Calcaria carb were highly effective in inhibiting the radial growth of *S. oryzae* at 750 ppm concentrations as they produced 73.05, 70.05 and 68.95 per cent inhibition, respectively and they are statistically at par. However, they were significantly superior to rest of the treatment in inhibiting the growth of the fungus. Rest of the treatment produced less than 50 per cent inhibition of growth.

Lower concentrations were less effective in inhibiting of growth of *S. oryzae.* Probably homoeopathic drugs have not been tried against radial growth of *S. oryzae*, however, homoeopathic drugs have been known to affect the various plant pathogenic fungi. Thuja has been found effective against *alternaria alternata* (Khanna & Chandra, 1976a). Similarly sulpher have been found effective against *Drechslera austriallensis* (Kumar & Kumar, 1980). Calcaria carb have been found effective against fungi associated with seeds of *A. esculentus* (*Saxena* et al., 1987) and *Aspergillus niger* associated with coriander seeds (Mishra, 1983).Chaudhary et al. (2010) also showed the efficacy of various Homoeopathic drugs in controlling Brown leaf spot disease of rice under field condition.

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