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Biopotency of Promising Plant Extracts against Rice Sheath Rot Disease

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Partially purified protein fraction of leaf extracts of *Convolvulus arvensis, Acalypha indica, Catharanthus roseus* and *Ocimum tenuiflorum* at 100, 250 and 500 ppm effectively inhibited the mycelial growth, sporulation, spore germination and germ tube elongation of *Sarocladium oryzae.* Non-protein fractions were less effective. In pot culture experiment, spraying of leaf extract of *C. arvensis* protein fraction at 500 ppm recorded the maximum disease reduction which was on par with protein fractions (500 ppm) of *A. indica, O. tenuiflorum* and *C. roseus.*

Key words: Rice sheathrot, botanicals, protein fractions, non-protein fractions.

Rice sheath rot caused by *Sarocladium oryzae* is a serious disease affecting in all rice growing areas of Tamil Nadu and there was 85 per cent yield loss (Prabhakaran *et al*., 1973). The leaf extracts of *Ocimum sanctum*, *Curcuma longa*, *Datura metal* and *Azadirachta indica* inhibited the spore germination of *S. oryzae* (Komala *et al.,* 1988). Selvaraj and Narayanasamy (1994) reported that the seed extract of *Tribulus terrestris* and leaf extract of *Agave americana* effectively inhibited the spore germination, germ tube elongation and mycelial growth of *S. oryzae.* Extract from tender stem of *Euphorbia tirucalli* and leaf extract of *Urginea indica* reduced the sporulation of *S. oryzae.* Dried leaf extract of *Ipomoea* spp. effectively inhibited the mycelial growth of *S. oryzae* (Rajappan *et al.,* 1997).

Materials and Methods

In order to find out the nature of the active principle(s) effective against sheath rot pathogen, leaf extracts (10%) of *Acalypha indica* L., *Ocimum tenuiflorum* L., *Convolvulus arvensis* Burm., *Catharanthus roseus* (L.) G.Don., *Datura stramonium* L., *Cymbopogon martini* Wats., *Ipomoea carnea* Jacq., *Pithecolobium dulce* Roxb. & Benth., *Bougainvillaea spectabilis* Willd., *Vitex negundo* var. *purpurascense* (L.) Siv. & Mold, *Quisqualis indica* L., *Eucalyptus globulus* Labill., *Phyllanthus emblica* L., *Thevetia peruviana* (Pers). Merr., *Euphorbia hirta* L., *Parthenium hysterophorus* L., *Polyalthia longifolia* Benth., *Tabernaemontana divaricata* (L.) R.Br.ex. & Schult., *Curcuma longa* L., *Acacia leucophloea* Willd., *Pongamia glabra* Vent. and *Phyllanthus niruri* L. were fractioned and the various fractions were assayed for their ability to induce resistance to *S. oryzae.*

Protein and non-protein fractions

Leaf extracts were mixed with equal volumes of saturated ammonium sulphate and the mixture was left to stand overnight. The protein precipitate was collected by centrifugation for 20 min at 10,000 rpm (Van Loon *et al.,*1987). The protein fractions were then dialysed against running tap water. Then, these fractions were lyophilized in a lyophilizer. The required amount of lyophilized protein was dissolved in 80 per cent alcohol to get 100, 250 and 500 ppm concentrations. Alcohol was allowed to evaporate and the remaining solution was made up to original volume with sterile distilled water. The effect of these solutions on the mycelial growth, sporulation, spore germination, germ tube elongation and on the disease intensity was studied. Similarly the effect of the non-proteins fraction at dilutions of 1:100, 1:50 and 1:25 were also tested.

The efficacy of protein and non-protein fractions of plant extracts on the mycelial growth and sporulation of *S. oryzae* was assessed by poisoned food technique (Schmitz, 1930).

The efficacy of protein and non-protein fractions of plant extracts on spore germination and germ tube elongation was assessed by the slide germination technique described by the Committee on Standardization of Fungicidal Tests (CSFT, 1947).

The effect of protein fractions at 100, 250, and 500 ppm concentrations and non-protein fractions at dilutions of 1:100, 1:50 and 1:25 on sheath rot intensity was also studied by spraying the fractions on 85 day old CO 43 rice plants under pot culture condition. After 24h, the plants were inoculated with *S. oryzae*. Ten days after inoculation, one more spraying was given with the same treatments on the respective groups of plants. Suitable control was also maintained for each treatment. Sheath rot intensity was assessed based on the new scoring

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Table 1. Efficacy of fractions of leaf extracts against mycelial growth of *Sarocladium oryzae*

Plant	Per cent mycelial growth inhibition *						Mean
	Conc. of protein fraction (ppm)			Conc. of non-protein fraction (dilution)			
	100	250	500	1:100	1:50	1:25	
Acalypha indica	44.19$^{a8\text{-}a11}$	53.57$^{a3\text{-}a6}$	59.38$^{a1\ a2}$	10.27$^{a33\text{-}a37}$	11.61$^{a33\text{-}a35}$	15.62 ^{a32}	32.44 ^{a}
Ocimum tenuiflorum	41.52$^{a9\text{-}a13}$	48.66$^{a6\text{-}a8}$	56.25$^{a1\text{-}a4}$	7.58$^{a37\text{-}a43}$	9.82$^{a35\text{-}a39}$	13.84$^{a32\text{-}a33}$	29.62 ^{b}
Convolvulus arvensis	46.88$^{a7\text{-}a9}$	54.92$^{a2\text{-}a5}$	60.71 ^{a1}	10.26$^{a34\text{-}a38}$	10.71$^{a33\text{-}a36}$	15.61 ^{a32}	33.18 ^{a}
Catharanthus roseus	42.41$^{a9\text{-}a12}$	50.89$^{a4\text{-}a7}$	58.48$^{a1\text{-}a3}$	7.14$^{a39\text{-}a44}$	9.81$^{a35\text{-}a39}$	13.39$^{a32\text{-}a34}$	30.35^{d}
Datura stramonium	39.29$^{a10\text{-}a15}$	46.43$^{a7\text{-}a9}$	50.90$^{a4\text{-}a7}$	4.90$^{a44\text{-}a48}$	6.35$^{a41\text{-}a46}$	9.82$^{a35\text{-}a39}$	26.28^{c}
Cymbopogon martini	27.69$^{a25\text{-}a31}$	32.15$^{a18\text{-}a25}$	36.61$^{a13\text{-}a18}$	4.02$^{a46\text{-}a48}$	5.81$^{a41\text{-}a47}$	7.14$^{a38\text{-}a44}$	18.90^{efg}
Ipomoea carnea	37.94$^{a12\text{-}a17}$	41.52$^{a9\text{-}a13}$	49.55$^{a5\text{-}a8}$	6.68$^{a40\text{-}a45}$	8.03$^{a36\text{-}a42}$	10.26$^{a34\text{-}a38}$	25.66^{c}
Pithecolobium dulce	37.50$^{a12\text{-}a17}$	40.62$^{a10\text{-}a14}$	44.64$^{a8\text{-}a10}$	5.80$^{a41\text{-}a47}$	6.70$^{a40\text{-}a45}$	9.37$^{a35\text{-}a40}$	24.11^{c}
Bougainvillaea spectabilis	30.81$^{a20\text{-}a27}$	33.48$^{a17\text{-}a24}$	38.84$^{a11\text{-}a16}$	4.47$^{a45\text{-}a48}$	5.36$^{a42\text{-}a47}$	8.04$^{a36\text{-}a42}$	20.17^{de}
Vitex negundo var *purpurascense*	29.02$^{a24\text{-}a29}$	34.83$^{a15\text{-}a22}$	37.50$^{a12\text{-}a17}$	4.02$^{a46\text{-}a48}$	5.80$^{a41\text{-}a47}$	6.25$^{a41\text{-}a46}$	19.57^{ef}
Quisqualis indica	34.81$^{a15\text{-}a22}$	36.61$^{a13\text{-}a18}$	40.62$^{a10\text{-}a14}$	4.45$^{a45\text{-}a48}$	5.81$^{a41\text{-}a47}$	8.48$^{a35\text{-}a41}$	21.80^{d}
Eucalyptus globulus	26.34$^{a27\text{-}a31}$	31.25$^{a19\text{-}a26}$	35.72$^{a14\text{-}a20}$	3.57$^{a47\text{-}a48}$	5.36$^{a42\text{-}a47}$	6.70$^{a40\text{-}a45}$	18.16^{fghi}
Phyllanthus emblica	25.00$^{a29\text{-}a31}$	30.36$^{a21\text{-}a27}$	35.72$^{a14\text{-}a20}$	4.02$^{a46\text{-}a48}$	5.36$^{a42\text{-}a47}$	6.70$^{a40\text{-}a45}$	17.86^{fghi}
Thevetia peruviana	27.23$^{a26\text{-}a31}$	31.26$^{a19\text{-}a26}$	36.61$^{a13\text{-}a18}$	4.02$^{a46\text{-}a48}$	5.36$^{a42\text{-}a47}$	7.14$^{a38\text{-}a44}$	18.60^{efgh}
Euphorbia hirta	29.46$^{a23\text{-}a29}$	34.37$^{a15\text{-}a23}$	38.40$^{a12\text{-}a17}$	4.47$^{a45\text{-}a48}$	5.81$^{a41\text{-}a47}$	8.04$^{a36\text{-}a42}$	20.09^{de}
Parthenium hysterophorus	26.34$^{a27\text{-}a31}$	31.71$^{a18\text{-}a26}$	36.16$^{a14\text{-}a19}$	3.57$^{a47\text{-}a48}$	4.46$^{a45\text{-}a48}$	6.70$^{a40\text{-}a45}$	18.16^{fghi}
Polyalthia longifolia	24.11$^{a30\ a31}$	29.46$^{a23\text{-}a29}$	34.83$^{a15\text{-}a22}$	3.12^{a48}	4.90$^{a43\text{-}a48}$	5.81$^{a41\text{-}a47}$	17.04^{hi}
Tabernaemontana divaricata	23.21^{a31}	28.13$^{a25\text{-}a30}$	33.93$^{a16\text{-}a24}$	3.12^{a48}	4.01$^{a46\text{-}a48}$	5.81$^{a41\text{-}a47}$	16.37^{i}
Curcuma longa	25.44$^{a28\text{-}a31}$	29.91$^{a22\text{-}a28}$	35.28$^{a15\text{-}a21}$	3.12^{a48}	4.91$^{a43\text{-}a48}$	5.36$^{a42\text{-}a47}$	17.34^{ghi}
Acacia leucophloea	27.23$^{a26\text{-}a31}$	32.14$^{a18\text{-}a25}$	36.16$^{a14\text{-}a19}$	4.02$^{a46\text{-}a48}$	4.90$^{a43\text{-}a48}$	7.14$^{a39\text{-}a44}$	18.60^{efgh}
Pongamia glabra	24.11$^{a30\ a31}$	30.81$^{a20\text{-}a27}$	35.26$^{a15\text{-}a21}$	3.57^{a47a48}	4.46$^{a45\text{-}a48}$	5.81$^{a41\text{-}a47}$	17.34^{ghi}
Phyllanthus niruri	23.66$^{a30\ a31}$	27.69$^{a25\text{-}a31}$	33.48$^{a17\text{-}a24}$	3.57$^{a47\text{-}a48}$	4.46$^{a45\text{-}a48}$	5.36$^{a42\text{-}a47}$	16.37^{i}
Control	0.00^{a49}	0.00^{a49}	0.00^{a49}	0.00^{a49}	0.00^{a49}	0.00^{a49}	0.00^{j}
Mean	30.18^{c}	34.03 ^{b}	40.22^{a}	4.77 ^{f}	6.08^{d}	8.19^{d}	

CD (P = 0.05); Treatment : 1.28 ; Concentration : 0.66; T x C : 3.14, *Mean of three replications, (Data in parentheses are arc sine transformed values) In a column, means followed by common letter(s) are not significantly different at 5 % level by DMRT.

system developed by Narayanasamy and Viswanathan (1990). The disease index and per cent disease reduction were worked out.

Results and Discussion

Mycelial growth

The results on the efficacy of protein fractions of

Table 2. Efficacy of fractions of leaf extracts against sporulation of *Sarocladium oryzae*

Leaf extracts	Per cent sporulation inhibition*						Mean
	Conc. of protein fraction (ppm)			Conc. of non-protein fraction (dilution)			
	100	250	500	1:100	1:50	1:25	
A. indica	46.24$^{a5\text{-}a8}$	55.24$^{a2\ a3}$	61.20^{a1}	13.44$^{a28\text{-}a31}$	17.16$^{a27\text{-}a28}$	20.12$^{a26\ a27}$	35.57^{a}
O. tenui florum	40.35$^{a9\text{-}a13}$	48.45$^{a4\text{-}a6}$	54.48$^{a2\ a3}$	12.68$^{a30\text{-}a32}$	16.40$^{a27\text{-}a29}$	19.37$^{a26\ a27}$	31.96^{b}
C. arvensis	44.79$^{a6\text{-}a9}$	53.72$^{a2\text{-}a4}$	58.20$^{a1\ a2}$	13.44$^{a28\text{-}a31}$	16.40$^{a27\text{-}a29}$	19.43$^{a26\ a27}$	34.33^{a}
C. roseus	40.32$^{a9\text{-}a13}$	49.97$^{a3\text{-}a6}$	55.24$^{a2\ a3}$	11.92$^{a30\text{-}a33}$	14.17$^{a28\text{-}a30}$	19.40$^{a26\text{-}a27}$	31.84^{b}
D. stramonium	36.56$^{a12\text{-}a18}$	45.52$^{a5\text{-}a9}$	50.72$^{a3\text{-}a5}$	10.44$^{a31\text{-}a36}$	11.20$^{a30\text{-}a34}$	14.20$^{a28\text{-}a30}$	28.11^{c}
C. martini	33.60$^{a16\text{-}a20}$	38.04$^{a11\text{-}a16}$	41.04$^{a8\text{-}a12}$	7.48$^{a35\text{-}a39}$	9.68$^{a32\text{-}a36}$	12.68$^{a30\text{-}a32}$	23.75^{efg}
I. carnea	33.56$^{a16\text{-}a20}$	38.04$^{a11\text{-}a16}$	44.76$^{a6\text{-}a10}$	10.47$^{a31\text{-}a35}$	12.72$^{a29\text{-}a32}$	16.40$^{a27\text{-}a29}$	25.99^{cd}
P. dulce	28.36$^{a21\text{-}a24}$	35.08$^{a14\text{-}a20}$	40.35$^{a9\text{-}a13}$	9.72$^{a32\text{-}a36}$	11.99$^{a30\text{-}a33}$	13.44$^{a28\text{-}a31}$	23.16^{efgh}
B. spectabilis	35.80$^{a13\text{-}a19}$	39.56$^{a10\text{-}a14}$	47.00$^{a5\text{-}a7}$	7.48$^{a35\text{-}a39}$	9.72$^{a32\text{-}a36}$	12.72$^{a29\text{-}a32}$	25.38^{de}
V. negundo var purpurascense	32.08$^{a18\text{-}a22}$	36.56$^{a12\text{-}a18}$	42.55$^{a7\text{-}a11}$	8.20$^{a34\text{-}a38}$	10.4$^{a31\text{-}a35}$	13.44$^{a28\text{-}a31}$	23.88^{ef}
Q. indica	28.36$^{a21\text{-}a24}$	33.60$^{a16\text{-}a20}$	38.80$^{a11\text{-}a15}$	8.23$^{a34\text{-}a38}$	10.44$^{a31\text{-}a36}$	13.44$^{a28\text{-}a31}$	22.15^{fghi}
E. globulus	28.36$^{a21\text{-}a24}$	32.08$^{a18\text{-}a22}$	38.80$^{a11\text{-}a15}$	7.45$^{a36\text{-}a39}$	9.68$^{a32\text{-}a36}$	11.20$^{a30\text{-}a34}$	21.26^{i}
P. emblica	30.63$^{a20\text{-}a23}$	38.08$^{a11\text{-}a16}$	45.52$^{a5\text{-}a9}$	6.72$^{a37\text{-}a39}$	9.72$^{a32\text{-}a36}$	11.20$^{a30\text{-}a34}$	23.65^{efghi}
T. peruviana	34.32$^{a15\text{-}a20}$	38.08$^{a11\text{-}a16}$	42.52$^{a7\text{-}a11}$	6.72$^{a37\text{-}a39}$	9.68$^{a32\text{-}a36}$	11.92$^{a30\text{-}a33}$	23.87^{efg}
E. hirta	30.63$^{a20\text{-}a23}$	35.83$^{a13\text{-}a19}$	41.03$^{a8\text{-}a12}$	7.48$^{a35\text{-}a39}$	9.72$^{a32\text{-}a36}$	12.68$^{a30\text{-}a32}$	22.90^{fghi}
P.hysterophorus	33.60$^{a16\text{-}a20}$	37.32$^{a12\text{-}a17}$	39.56$^{a10\text{-}a14}$	6.69$^{a37\text{-}a39}$	8.96$^{a33\text{-}a37}$	11.92$^{a30\text{-}a33}$	23.01^{fghi}
P.longifolia	36.56$^{a12\text{-}a18}$	38.80$^{a11\text{-}a15}$	45.52$^{a5\text{-}a9}$	6.69$^{a37\text{-}a39}$	8.20$^{a34\text{-}a38}$	11.20$^{a30\text{-}a34}$	24.50^{ef}
T. divaricata	23.88$^{a24\text{-}a26}$	27.60$^{a22\text{-}a25}$	32.08$^{a18\text{-}a22}$	5.24^{a39}	7.45$^{a36\text{-}a39}$	9.72$^{a32\text{-}a36}$	17.66^{j}
C. longa	32.08$^{a18\text{-}a22}$	36.56$^{a12\text{-}a18}$	40.32$^{a9\text{-}a13}$	5.96$^{a38\text{-}a39}$	7.48$^{a35\text{-}a39}$	10.47$^{a31\text{-}a35}$	22.15^{ghi}
A.leucophloea	32.08$^{a18\text{-}a22}$	36.56$^{a12\text{-}a18}$	40.32$^{a9\text{-}a13}$	6.69$^{a37\text{-}a39}$	9.72$^{a32\text{-}a36}$	11.20$^{a30\text{-}a34}$	22.76^{fghi}
P. glabra	31.36$^{a19\text{-}a22}$	35.83$^{a13\text{-}a19}$	39.56$^{a10\text{-}a14}$	5.96$^{a38\ a39}$	8.20$^{a34\text{-}a38}$	10.47$^{a31\text{-}a35}$	21.90^{hi}
P. niruri	23.12$^{a25\ a26}$	26.12$^{a23\text{-}a25}$	32.84$^{a17\text{-}a21}$	5.24^{a39}	6.72$^{a37\text{-}a39}$	8.96$^{a33\text{-}a37}$	17.17^{j}
Control	0.00^{a40}	0.00^{a40}	0.00^{a40}	0.00^{a40}	0.00^{a40}	0.00^{a40}	0.00^{k}
Mean	32.03^{c}	37.25^{b}	42.28^{a}	7.93^{f}	10.26^{e}	12.85^{d}	

CD (P = 0.05) Treatment : 1.24; Concentration : 0.63 ; T x C : 3.03 * Mean of three replications ; (Data in parentheses are arc sine transformed values), In a column, means followed by common letter(s) are not significantly different at 5 % level by DMRT.

the leaf extracts from selected 22 plant species tested *in vitro* at three different concentrations (100, 250 and 500ppm) and non-protein fractions at three dilutions (1:100, 1:50 and 1:25) against the mycelial growth of the pathogen are furnished in Table 1.

The protein fraction of the leaf extract of *Convolvulus arvensis* at 500 ppm showed the least mycelial growth (2.93cm) as against 7.47cm in the control which accounted for 60.71 per cent inhibition. This was on par with the protein fractions (500ppm) of the leaf extract of *Acalypha indica* (59.38%), *Catharanthus roseus* (58.48%) and *Ocimum tenuiflorum* (56.25%). This was followed by protein fraction (250ppm) of the leaf extracts of *C.arvensis* (54.92%), that of (250ppm) *A.indica* (53.57%), 500ppm *Datura stramonium* (50.90%), 250ppm *C.roseus* (50.89%) and that of (500ppm) *Ipomoea carnea* (49.55%) which were all on par.The non-protein fractions from the leaf extract of all the plant species tested were less effective at all the three concentrations as compared to the protein fractions of the respective plant sources (Table 1).

Table 3. Efficacy of fractions of leaf extracts against spore germination of *Sarocladium oryzae*

Leaf extracts	Per cent spore germination inhibition *						Mean
	Conc. of protein fraction (ppm)			Conc. of non-protein fraction (dilution)			
	100	250	500	1:100	1:50	1:25	
A. indica	41.92$^{a3\text{-}a7}$	49.94$^{a1\ a2}$	53.65^{a1}	11.48$^{a37\text{-}a42}$	16.09$^{a34\ a35}$	18.90$^{a31\text{-}a34}$	32.00^{a}
O. tenui florum	39.32$^{a4\text{-}a8}$	46.23$^{a2\ a3}$	52.56^{a1}	10.74$^{a37\text{-}a45}$	13.59$^{a35\text{-}a37}$	15.71$^{a34\text{-}a36}$	29.69^{b}
C. arvensis	42.18$^{a3\text{-}a6}$	50.55$^{a1\ a2}$	54.72^{a1}	11.13$^{a37\text{-}a44}$	13.35$^{a35\text{-}a38}$	17.84$^{a32\text{-}a34}$	31.63^{ab}
C. roseus	35.42$^{a8\text{-}a11}$	39.07$^{a5\text{-}a8}$	44.18$^{a3\text{-}a4}$	9.99$^{a39\text{-}a47}$	11.24$^{a37\text{-}a43}$	16.22$^{a33\text{-}a35}$	26.02^{c}
D. stramonium	33.38$^{a9\text{-}a12}$	37.07$^{a7\text{-}a10}$	43.19$^{a3\text{-}a5}$	7.10$^{a48\text{-}a59}$	8.01$^{a45\text{-}a55}$	11.73$^{a37\text{-}a42}$	23.41^{d}
C. martini	25.84$^{a18\text{-}a25}$	30.47$^{a12\text{-}a17}$	33.62$^{a9\text{-}a12}$	5.89$^{a54\text{-}a61}$	8.10$^{a44\text{-}a55}$	11.09$^{a37\text{-}a44}$	19.17^{ef}
I. carnea	28.44$^{a13\text{-}a21}$	35.28$^{a8\text{-}a11}$	40.42$^{a4\text{-}a17}$	8.90$^{a41\text{-}a51}$	9.89$^{a40\text{-}a48}$	13.14$^{a35\text{-}a39}$	22.68^{d}
P. dulce	21.99$^{a25\text{-}a32}$	32.10$^{a11\text{-}a14}$	38.82$^{a5\text{-}a8}$	7.10$^{a48\text{-}a59}$	8.85$^{a41\text{-}a52}$	11.44$^{a37\text{-}a42}$	20.05^{e}
B. spectabilis	24.65$^{a20\text{-}a26}$	27.73$^{a14\text{-}a22}$	29.69$^{a12\text{-}a19}$	6.18$^{a53\text{-}a61}$	7.77$^{a46\text{-}a57}$	10.49$^{a37\text{-}a46}$	17.75^{fg}
V. negundo var purpurascense	22.49$^{a24\text{-}a31}$	26.00$^{a17\text{-}a25}$	30.99$^{a11\text{-}a16}$	6.69$^{a49\text{-}a61}$	8.40$^{a43\text{-}a54}$	11.85$^{a37\text{-}a41}$	17.74^{fg}
Q. indica	22.99$^{a24\text{-}a31}$	30.37$^{a12\text{-}a17}$	37.82$^{a6\text{-}a9}$	6.35$^{a51\text{-}a61}$	7.35$^{a47\text{-}a58}$	12.29$^{a36\text{-}a40}$	19.53^{ef}
E. globulus	20.55$^{a27\text{-}a32}$	23.23$^{a23\text{-}a30}$	28.48$^{a13\text{-}a21}$	5.64$^{a55\text{-}a61}$	6.77$^{a49\text{-}a60}$	9.84$^{a40\text{-}a48}$	15.75^{hij}
P. emblica	20.29$^{a28\text{-}a33}$	24.48$^{a21\text{-}a27}$	29.11$^{a12\text{-}a20}$	5.43$^{a56\text{-}a61}$	6.44$^{a50\text{-}a61}$	9.59$^{a40\text{-}a48}$	15.89^{hij}
T. peruviana	25.75$^{a18\text{-}a25}$	29.97$^{a12\text{-}a18}$	35.42$^{a8\text{-}a11}$	5.39$^{a57\text{-}a61}$	7.60$^{a46\text{-}a58}$	9.64$^{a40\text{-}a48}$	18.96^{ef}
E. hirta	24.58$^{a20\text{-}a27}$	27.48$^{a15\text{-}a23}$	32.69$^{a10\text{-}a13}$	6.19$^{a53\text{-}a61}$	7.64$^{a46\text{-}a58}$	10.15$^{a38\text{-}a47}$	18.12^{fg}
P. hysterophorus	24.32$^{a21\text{-}a27}$	30.72$^{a11\text{-}a16}$	32.54$^{a10\text{-}a13}$	5.17$^{a58\text{-}a61}$	6.22$^{a52\text{-}a61}$	9.28$^{a40\text{-}a49}$	18.04^{fg}
P. longifolia	22.49$^{a24\text{-}a31}$	27.56$^{a15\text{-}a23}$	32.29$^{a10\text{-}a13}$	6.69$^{a49\text{-}a61}$	7.85$^{a45\text{-}a57}$	9.78$^{a40\text{-}a48}$	17.78^{fg}
T. divaricata	19.40$^{a30\text{-}a34}$	22.66$^{a24\text{-}a31}$	25.33$^{a19\text{-}a26}$	4.64$^{a60\ a61}$	6.44$^{a50\text{-}a61}$	7.52$^{a47\text{-}a58}$	14.33^{j}
C. longa	21.25$^{a26\text{-}a32}$	24.07$^{a21\text{-}a28}$	29.68$^{a12\text{-}a19}$	4.89$^{a59\text{-}a61}$	6.44$^{a50\text{-}a61}$	8.78$^{a42\text{-}a53}$	15.85^{ij}
A. leucophloea	21.32$^{a26\text{-}a32}$	25.25$^{a20\text{-}a26}$	28.51$^{a13\text{-}a21}$	5.89$^{a54\text{-}a61}$	8.01$^{a45\text{-}a56}$	10.03$^{a39\text{-}a47}$	16.50^{ghi}
P. glabra	23.41$^{a22\text{-}a29}$	28.34$^{a13\text{-}a21}$	31.35$^{a11\text{-}a15}$	5.64$^{a55\text{-}a61}$	7.76$^{a46\text{-}a57}$	9.15$^{a41\text{-}a50}$	17.61^{fgh}
P. niruri	19.47$^{a29\text{-}a34}$	26.51$^{a16\text{-}a24}$	30.47$^{a12\text{-}a17}$	4.39^{a61}	5.64$^{a55\text{-}a61}$	7.35$^{a47\text{-}a58}$	15.64^{ij}
Control	0.00^{a62}	0.00^{a62}	0.00^{a62}	0.00^{a62}	0.00^{a62}	0.00^{a62}	0.00^{k}
Mean	25.28^{c}	30.22^{b}	34.59^{a}	6.59^{f}	8.24^{e}	10.95^{d}	

CD (P = 0.05); Treatment : 1.18 ; Concentration : 0.60; T x C : 2.90, *Mean of three replications, (Data in parentheses are arc sine transformed values) In a column, means followed by common letter(s) are not significantly different at 5 % level by DMRT.

Sporulation

The protein fraction of the leaf extract of *A. indica* at 500ppm recorded the minimum (4.33x10^5 conidia/ ml) sporulation as against 11.17x10^5 conidia/ml in the control which accounted for 61.20 per cent inhibition. This was on par (58.20%) with the protein fraction (500ppm) of *C. arvensis* followed by protein fraction (500ppm) of *C. roseus* (55.24%), protein fraction (250ppm) of *A. indica* (55.24%), protein fraction (500ppm) of *O. tenuiflorum* (54.48%) and protein fraction (250ppm) of *C. arvensis* (53.72%) which were on par. The non-protein fractions (1:25 dilution) of the leaf extract of *A. indica, C. arvensis, C. roseus* and *O. tenuiflorum* were on par in their antisporulant effect recording only 20.12, 19.43, 19.40 and 19.37 per cent inhibition in sporulation respectively (Table 2).

Spore germination

The results on the effect of these fractions on the inhibition of spore germination of the pathogen are shown in Table 3. The protein fraction (500ppm) of *C. arvensis* registered the least (40.29%) spore germination as against 88.99 per cent in the control which accounted for 54.72 per cent inhibition and it was on par with protein fraction (500ppm) of *A. indica* (53.65%), that of (500ppm) *O. tenuiflorum* (52.56%), 250ppm of *C. arvensis* (50.55%) and 250ppm of *A. indica* (49.94%). The non-protein fractions of all these leaf extracts were less effective.

Germ tube elongation

The protein fraction of *C. arvensis* at 500ppm had the minimum (11.62mm) germ tube elongation as against 27.37mm in the control which accounted

Table 4. Efficacy of fractions of leaf extracts against germ tube elongaton of *Sarocladium oryzae*

Leaf extracts	Per cent *germ tube elongation* inhibition *						Mean
	Conc. of protein fraction (ppm)			Conc. of non-protein fraction (dilution)			
	100	250	500	1:100	1:50	1:25	
A. indica	43.48$^{a5\text{-}a7}$	51.28$^{a2\text{-}a4}$	56.52$^{a1\ a2}$	8.34$^{a33\text{-}a41}$	9.44^{a36}	14.62$^{a29\text{-}a30}$	30.61^{a}
O. tenui florum	40.50$^{a7\text{-}a10}$	47.69$^{a4\ a5}$	53.64$^{a1\text{-}a3}$	6.82$^{a35\text{-}a45}$	8.89$^{a32\text{-}a37}$	12.24$^{a30\text{-}a32}$	28.30^{b}
C. arvensis	44.15$^{a5\text{-}a7}$	51.53$^{a2\text{-}a4}$	57.55^{a1}	9.50$^{a31\text{-}a36}$	11.45$^{a30\text{-}a33}$	16.51^{a28a29}	31.78^{a}
C. roseus	41.24$^{a6\text{-}a9}$	48.24$^{a3\text{-}a5}$	54.32$^{a1\ a2}$	6.76$^{a35\text{-}a45}$	8.71$^{a33\text{-}a39}$	12.54^{a30a31}	28.64^{b}
D. stramonium	35.51$^{a10\text{-}a13}$	42.81$^{a5\text{-}a8}$	46.77$^{a4\text{-}a6}$	5.24$^{a42\text{-}a50}$	7.85$^{a34\text{-}a43}$	10.23$^{a31\text{-}a34}$	24.74^{c}
C. martini	26.75$^{a19\text{-}a25}$	31.54$^{a12\text{-}a19}$	36.79$^{a9\text{-}a12}$	5.79$^{a40\text{-}a49}$	7.92$^{a34\text{-}a42}$	9.80$^{a31\text{-}a35}$	19.77^{e}
I. carnea	32.40$^{a11\text{-}a17}$	37.70$^{a8\text{-}a11}$	43.25$^{a5\text{-}a7}$	5.42$^{a42\text{-}a50}$	6.89$^{a35\text{-}a45}$	9.74$^{a31\text{-}a35}$	22.57^{d}
P. dulce	28.64$^{a16\text{-}a23}$	34.59$^{a11\text{-}a14}$	37.58$^{a8\text{-}a11}$	4.50$^{a45\text{-}a50}$	5.42$^{a42\text{-}a50}$	8.77$^{a33\text{-}a38}$	19.92^{ef}
B.spectabilis	28.15$^{a17\text{-}a24}$	32.40$^{a11\text{-}a17}$	35.38$^{a10\text{-}a13}$	3.96$^{a47\text{-}a50}$	5.17$^{a42\text{-}a50}$	7.73$^{a34\text{-}a43}$	18.80^{efg}
V.negundo var purpurascense	26.63$^{a20\text{-}a25}$	32.10$^{a12\text{-}a18}$	34.53$^{a11\text{-}a14}$	5.30$^{a42\text{-}a50}$	7.49$^{a34\text{-}a44}$	9.62$^{a31\text{-}a35}$	19.28^{ef}
Q. indica	31.61$^{a12\text{-}a18}$	33.25$^{a11\text{-}a16}$	37.45$^{a8\text{-}a11}$	4.44$^{a45\text{-}a50}$	5.12$^{a43\text{-}a50}$	7.79$^{a34\text{-}a43}$	19.94^{ef}
E. globulus	24.61$^{a22\text{-}a27}$	29.42$^{a14\text{-}a21}$	33.74$^{a11\text{-}a16}$	5.36$^{a42\text{-}a50}$	6.58$^{a36\text{-}a46}$	8.59$^{a33\text{-}a40}$	18.05^{efg}
P. emblica	23.33$^{a24\text{-}a27}$	28.68$^{a16\text{-}a23}$	33.37$^{a11\text{-}a16}$	3.71$^{a48\text{-}a50}$	4.93$^{a44\text{-}a50}$	6.37$^{a37\text{-}a47}$	16.73^{ghi}
T.peruviana	26.38$^{a20\text{-}a25}$	29.30$^{a15\text{-}a22}$	34.53$^{a11\text{-}a15}$	4.20$^{a46\text{-}a50}$	5.29$^{a42\text{-}a50}$	7.43$^{a34\text{-}a44}$	17.86^{fg}
E. hirta	27.41$^{a18\text{-}a25}$	32.40$^{a11\text{-}a17}$	35.38$^{a10\text{-}a13}$	3.84$^{a48\text{-}a50}$	5.67$^{a41\text{-}a49}$	6.83$^{a35\text{-}a45}$	18.59^{efg}
P.hysterophorus	24.25$^{a23\text{-}a27}$	29.72$^{a14\text{-}a21}$	34.41$^{a11\text{-}a15}$	4.32$^{a45\text{-}a50}$	5.73$^{a40\text{-}a49}$	7.55$^{a34\text{-}a44}$	17.66^{fg}
P.longifolia	23.58$^{a24\text{-}a27}$	27.29$^{a18\text{-}a25}$	32.83$^{a11\text{-}a17}$	4.38$^{a45\text{-}a50}$	5.85$^{a39\text{-}a48}$	7.86$^{a34\text{-}a43}$	16.97^{gh}
T.divaricata	20.53$^{a27\ a28}$	25.47$^{a21\text{-}a26}$	30.76$^{a13\text{-}a20}$	3.35^{a50}	4.74$^{a45\text{-}a50}$	5.23$^{a42\text{-}a50}$	15.01^{i}
C.longa	23.27$^{a24\text{-}a27}$	26.56$^{a20\text{-}a25}$	31.79$^{a12\text{-}a18}$	3.59$^{a48\text{-}a50}$	4.39$^{a45\text{-}a50}$	5.91$^{a38\text{-}a48}$	15.92^{hi}
A.leucophloea	25.23$^{a21\text{-}a27}$	30.57$^{a13\text{-}a20}$	34.59$^{a11\text{-}a14}$	4.51$^{a45\text{-}a50}$	5.79$^{a40\text{-}a49}$	7.67$^{a34\text{-}a43}$	18.06^{fg}
P. glabra	22.79$^{a25\text{-}a27}$	27.29$^{a18\text{-}a25}$	32.52$^{a11\text{-}a17}$	3.47$^{a49\ a50}$	4.56$^{a45\text{-}a50}$	5.61$^{a41\text{-}a50}$	16.04^{hi}
P. niruri	21.45$^{a26\ a27}$	25.39$^{a21\text{-}a26}$	31.55$^{a12\text{-}a19}$	3.71$^{a48\text{-}a50}$	4.62$^{a45\text{-}a50}$	5.48$^{a42\text{-}a50}$	15.37^{i}
Control	0.00^{a51}	0.00^{a51}	0.00^{a51}	0.00^{a51}	0.00^{a51}	0.00^{a51}	0.00^{j}
Mean	27.91^{c}	32.84^{b}	37.36^{a}	4.80^{f}	6.20^{e}	8.44^{d}	

CD (P = 0.05) ; Treatment : 1.31 ; Concentration : 0.67; TxC : 3.21; * Mean of three replication (Data in parentheses are arc sine transformed values) *In a column, means followed by common letter(s) are not significantly different at 5 % level by DMRT.*

for 57.55 per cent inhibition and it was on par with that (500ppm) of *A. indica* (56.52%), *C. roseus* (54.32%) and *O. tenuiflorum* (53.64%). These were followed by protein fraction (250ppm) of *C. arvensis* (51.53%), that of (250ppm) of *A. indica* (51.28%), 250ppm of *C. roseus* (48.24%), 250ppm of *O. tenuiflorum* (47.69%) and

Table 5. Efficacy of fractions of leaf extracts against sheath rot (*S.oryzae*) incidence under pot culture (artificial inoculation) conditions

Leaf extracts	Per cent disease reduction *						Mean
	Conc. of protein fraction (ppm)			Conc. of non-protein fraction (dilution)			
	100	250	500	1:100	1:50	1:25	
A. indica	23.57$^{a12\text{-}a19}$	35.36$^{a3\ a4}$	46.97^{a1}	4.23$^{a44\text{-}a55}$	6.63$^{a39\text{-}a42}$	9.58$^{a36\text{-}a38}$	21.06^{ab}
O. tenui florum	23.21$^{a13\text{-}a19}$	34.27$^{a3\text{-}a5}$	44.02^{a1}	3.67$^{a47\text{-}a57}$	6.26$^{a40\text{-}a44}$	8.47$^{a38\text{-}a40}$	19.98^{bc}
C. arvensis	26.15$^{a8\text{-}a14}$	38.66$^{a2\ a3}$	47.51^{a1}	4.05$^{a45\ a55}$	6.26$^{a40\text{-}a44}$	8.84$^{a37\text{-}a39}$	21.91^{a}
C. roseus	22.11$^{a15\text{-}a21}$	33.89$^{a4\ a5}$	43.09$^{a1\ a2}$	3.68$^{a47\text{-}a57}$	5.52$^{a41\text{-}a47}$	7.36$^{a38\text{-}a41}$	19.28^{c}
D.stramonium	17.69$^{a23\text{-}a29}$	25.42$^{a9\text{-}a15}$	32.41$^{a4\text{-}a6}$	2.57$^{a55\text{-}a57}$	4.78$^{a42\text{-}a51}$	6.63$^{a39\text{-}4a2}$	14.92^{d}
C. martini	17.29$^{a24\text{-}a30}$	24.31$^{a11\text{-}a18}$	31.30$^{a4\text{-}a7}$	2.76$^{a53\text{-}a57}$	4.42$^{a43\text{-}a53}$	6.63$^{a39\text{-}a42}$	14.45^{de}
I. carnea	16.37$^{a26\text{-}a32}$	23.20$^{a13\text{-}a19}$	30.20$^{a5\text{-}a8}$	2.57$^{a55\text{-}a57}$	4.42$^{a43\text{-}a53}$	6.26$^{a40\text{-}a44}$	13.84^{def}
P. dulce	15.49$^{a27\text{-}a33}$	21.00$^{a17\text{-}a23}$	29.10$^{a6\text{-}a9}$	2.76$^{a53\text{-}a57}$	4.05$^{a45\text{-}a55}$	6.63$^{a39\text{-}a42}$	17.31^{efg}
B. spectabilis	15.08$^{a28\text{-}a34}$	20.63$^{a18\text{-}a24}$	29.11$^{a6\text{-}a9}$	2.94$^{a52\text{-}a57}$	4.05$^{a45\text{-}55}$	6.45$^{a39\text{-}a43}$	13.04^{efgh}
V. negundo var purpu rascense	15.08$^{a28\text{-}a34}$	20.26$^{a19\text{-}a25}$	28.73$^{a6\text{-}a10}$	2.76$^{a53\text{-}a57}$	4.06$^{a45\text{-}55}$	5.90$^{a41\text{-}a45}$	12.80^{fghi}
Q. indica	15.49$^{a27\text{-}a33}$	21.36$^{a16\text{-}a22}$	28.36$^{a6\text{-}a11}$	2.94$^{a52\text{-}a57}$	3.67$^{a47\text{-}57}$	5.15$^{a41\text{-}a50}$	12.83^{fghij}
E. globulus	14.75$^{a29\text{-}a34}$	19.89$^{a19\text{-}a25}$	28.36$^{a6\text{-}a11}$	2.68$^{a54\text{-}a57}$	3.87$^{a46\text{-}a56}$	5.71$^{a41\text{-}4a6}$	12.54^{fghij}
P. emblica	14.38$^{a30\text{-}a35}$	19.15$^{a20\text{-}a26}$	27.62$^{a7\text{-}a12}$	2.39$^{a56\text{-}a57}$	3.69$^{a47\text{-}a57}$	5.35$^{a41\text{-}a48}$	12.10^{ghijk}
T. peruviana	13.97$^{a31\text{-}a35}$	19.15$^{a20\text{-}a26}$	27.25$^{a7\text{-}a13}$	2.39$^{a56\ a57}$	3.51$^{a48\text{-}a57}$	5.16$^{a41\text{-}a49}$	11.91^{ghijkl}
E. hirta	13.60$^{a32\text{-}a35}$	18.78$^{a20\text{-}27}$	26.89$^{a8\text{-}a13}$	2.39$^{a56\text{-}a57}$	3.13$^{a51\text{-}57}$	5.34$^{a41\text{-}4a8}$	11.69^{ijklm}
P.hysterophorus	13.27$^{a32\text{-}a35}$	18.05$^{a22\text{-}a28}$	26.52$^{a8\text{-}a13}$	2.21 ^{a57}	3.32$^{a50\text{-}a57}$	4.98$^{a42\text{-}a51}$	11.39^{jklm}
P. longifolia	13.60$^{a32\text{-}a35}$	18.41$^{a21\text{-}a27}$	26.89$^{a8\text{-}a13}$	2.39$^{a56\ a57}$	3.69$^{a47\text{-}a57}$	5.17$^{a41\text{-}a50}$	11.69^{hijklm}
T. divaricata	12.91$^{a33\text{-}a35}$	17.69$^{a23\text{-}a29}$	25.05$^{a9\text{-}a16}$	2.21^{a57}	3.32$^{a49\text{-}a57}$	4.60$^{a42\text{-}a52}$	10.96^{klmn}
C. longa	12.17$^{a34\text{-}a36}$	16.92$^{a25\text{-}a31}$	24.68$^{a10\text{-}a17}$	2.21^{a57}	2.94$^{a52\text{-}a57}$	4.42$^{a43\text{-}a53}$	10.56^{lmno}
A. leucophloea	12.17$^{a34\text{-}a36}$	16.00$^{a26\text{-}a33}$	23.57$^{a12\text{-}a19}$	2.21^{a57}	3.13$^{a51\text{-}a57}$	4.61$^{a42\text{-}a52}$	10.28^{mno}
P. glabra	11.80$^{a34\text{-}a36}$	15.49$^{a27\text{-}a33}$	22.47$^{a14\text{-}a20}$	2.21^{a57}	2.94$^{a52\text{-}a57}$	4.42$^{a43\text{-}a53}$	9.89^{no}
P. niruri	11.43$^{a35\text{-}a37}$	14.75$^{a29\text{-}a34}$	20.64$^{a18\text{-}a24}$	2.21^{a57}	2.76$^{a53\text{-}a57}$	4.24$^{a44\text{-}a54}$	9.34^{o}
Control	0.00^{a58}	0.00^{a58}	0.00^{a58}	0.00^{a58}	0.00^{a58}	0.00^{a58}	0.00^{p}
Mean	15.29^{c}	21.42^{b}	29.16^{a}	2.63^{f}	3.93^{e}	5.73^{d}	

CD (P = 0.05) ; Treatment : 1.09 ; Concentration : 0.56 ; TxC : 2.68 * Mean of three replications (Data in parentheses are arc sine transformed values) In a column, means followed by common letter(s) are not significantly different at 5 % level by DMRT.

500ppm of *Datura stramonium* (46.77%) which were all on par. The inhibitory effect of non-protein fractions on germ tube elongation exerted by all the leaf extracts was appreciably less than that of their protein fractions (Table 4).

Sheath rot incidence

Among the protein fractions of 22 selected leaf extracts tested, 500ppm of *C. arvensis* recorded the maximum (47.51%) disease reduction (380.00 disease index) and it was on par with that (500ppm) of *A. indica* (46.97%), *O. tenuiflorum* (44.02%) and *C. roseus* (43.09%). These were followed by protein fractions (250ppm) of *C. arvensis* (38.66%), *A. indica* (35.36%) and *O. tenuiflorum* (34.27%) which were all on par. The non-protein fractions of these leaf extracts were less effective. The non-protein fraction of *A. indica* (1:25 dilution) recorded 9.58 per cent disease reduction followed by that of *C. arvensis* (8.84%), *O. tenuiflorum* (8.47%) and *C. roseus* (7.36%) which were all on par (Table 5).

In the present study, the protein fractions of the leaf extracts of *C. arvensis* at 500 ppm showed the maximum inhibitory effect on the mycelial growth, spore germination and germ tube elongation of *S. oryzae* .The protein fraction of *A. indica* at 500 ppm recorded the maximum antisporulant effect. In the pot culture study, the protein fraction of *C. arvensis* at 500 ppm recorded the highest disease reduction which was on par with protein fractions (500 ppm) of *A. indica*, *O. tenuiflorum* and *C. roseus*. Protein fraction of *C. arvensis* at 200 ppm had the maximum inhibitory effect on the germ tube elongation and the mycelial growth of *S. oryzae*.Protein fraction (200 ppm) of *C. roseus* recorded the maximum inhibition on the spore germination and sporulation of *S. oryzae*. Protein fraction of *C. arvensis* (500 ppm) registered the maximum reduction of rice sheath rot intensity. Selvaraj and Narayanasamy (1994) also documented that the protein fraction from *Tribulus terrestris* seed extract recorded the maximum inhibitory effect on the spore germination of *S. oryzae*.The present findings provides for further studies on the scope of developing an agro product using these protein fractions for the management of this important disease of rice.

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