# Plant extracts for the management of sheath blight (*Rhizoctonia solani* Kuhn) of rice

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## ABSTRACT

*Four plant extracts (Calotropis procera R.Br., Allium sativum C., Piper betle L., Vitex negundo L.) and one phytochemical (Geraniol) were tested against Rhizoctonia solani Kuhn causing sheath blight disease of rice exhibited fungi-toxic properties under glass house conditions. Among these, Calotropis procera emerged as the most effective, showing highest disease reduction closely followed by Piper betle at 1500 ppm. However at 1000 ppm Piper betle ranked first. Maximum reduction in infected tillers was also observed in Calotropis procera followed by Piper betle at 1500 ppm.*

***Key words:*** *Plant extracts, phyto-chemical, rice, sheath blight, Rhizoctonia solani*

Sheath blight of rice caused by *Rhizoctonia solani* Kuhn is potentially a serious threat in rice growing areas. The potential losses alone in India has been up to 51.3 percent (Rajan, 1987). Plant extracts have assumed special significance in the present day strategy of developing ecologically safe methods of plant disease management. Several plant extracts have been demonstrated to possess excellent fungicidal properties (Tewari and Dath, 1984, Mishra *et al* 1990; Mishra and Tewari, 1992; Tewari and Mandakini, 1991; Ansari, 1995; Sunderraj *et al*, 1996; Kurucheve *et al*, 1997; Pramanick *et al*, 1998; Kandhari and Singh, 2000). Recently excellent fungitoxicity of extracts of *Vitex negundo* and *Calotropis* sp has been reported (Dev *et al*. 2002). The present investigation was undertaken to test the efficacy of a few commonly available botanicals against *R. solani* under glass house conditions in anticipation of disease reduction along with reduction in infected tillers.

## MATERIALS AND METHODS

The extraction of four common plant materials *viz., Calotropis procera* R.Br. *Allium sativum* C, *Piper betle* L. and *Vitex negundo* L. was carried out from different parts of the plant. Geraniol is a major constituent of oil of Palmarosa, a perfumery chemical. Extracts of four plant materials were prepared by the following methods.

Rind of the stem of C*alotropis procera* plants were peeled out, dried and cut into small pieces to weigh 330g. and were filled in a thimble of a Soxlet apparatus and extracted with freshly distilled methanol over a water bath for 2-3 days. The extract was cooled, filtered and the solvent was removed using rotary evaporator under reduced pressure. The solvent-free amorphous extract was kept in refrigerator for further use. The yield of the extract was 9.5 g. *Piper betle* leaves were cut into small pieces to weigh 100g. were immersed in freshly distilled methanol for three days. The extract was processed as described above. The yield of extract was 9 g and was kept in refrigerator for further use. Paste of *Allium sativum* bulbs prepared to weigh 100g., were soaked in freshly distilled methanol for 3 days. The extract was processed and preserved as described above. The yield of the extract was 2.3 g. The fresh leaves of *Vitex negundo* weighing 100 g. were cut into small pieces and extracted in cold with freshly distilled methanol. The methanolic extract was distilled as described above to yield 3.7 g. of solvent-free extract. Geraniol-a phytochemical (constituent of oil of palmarosa) was procured from the market and its purity was ascertained through spectroscopic and gas chromatographic analysis.These extracts and the geraniol were tested against sheath blight in glass house conditions as follows.

A susceptible variety Pusa Basmati-1 was

planted in earthen pots (35 cm). The test concentrations used were 1500, 1000 and 500 ppm. For geraniol, extracts of *Calotropis procera* and *V. negundo*, Cyclohexanone as solvent and Tween 80 as surfactant was used for preparing emulsifiable concentrate. The extracts of *Allium sativum* and *Piper betle* were dissolved in water. In total there were eight treatments, three replications and 5 plants $pot^{-1}$. A standard fungicide Carbendazim 50WP @1000 ppm was used for comparison along with control (inoculated with *R. solani* only).

Inoculations were carried out at maximum tillering stage with colonized typha (wild plant) leaf pieces (Bhaktavatsalam, *et al.* 1978). Extracts of plant materials were sprayed twice uniformly on the plants at the first appearance of the disease. Twenty-five days after inoculations, sheath blight lesion, height and number of infected tillers was recorded following Standard Evaluation System (SES) for rice(IRRI 1996).

## RESULTS AND DISCUSSION

The efficacy of plant products against sheath blight disease of rice in terms of percent infected plant height and percent infected tillers are given in Table 1. The plant extracts exhibited varying degree of disease control. At the highest test concentration, all the four plant extracts reduced infection measured in terms of infected plant height. The extracts of *Piper betle* and *Calotropis procera* were found effective at all the three test concentrations. The *Allium sativum* and *V. negundo* extracts were significantly effective at 1500 and 1000 ppm only. The phyto-chemical, geraniol was found to be at par with infected control. However carbendazim 50 WP (Bavistin) used as standard fungicide @ 1000 ppm resulted in highest disease reduction.

In terms of infected tillers, only extracts of *C. procera* and *P. betle* at 1500 ppm significantly controlled the sheath blight disease.

Several plant products are reported to posses anti-fungal property against sheath blight. Tewari and Dath (1984) showed anti-fungal activity of *Ocimum sanctum, Piper betle, Lawsonia inermis* and *Nyctanthes arbor-tristis* against *R. solani*. *In vitro* they showed that *Corticium sasaki*, the perfect stage of *R. solani* could not grow in the leaf extract of *Piper betle* showing strong anti-fungal activity. In the present studies also *Piper betle* was effective in controlling the disease *in vivo*.

**Table 1. Efficacy of plant extracts against sheath blight disease of rice**

| Plant Extract botanical name(family) | Part of plant | Conc. (ppm) | Infected plant height (%) | Infected tillers (%) |
|---|---|---|---|---|
| ***Calotropis procera*** (Asclepiadaceae) | Stem | 1500 | 63.23 $^{b}$ | 53.80$^{b}$ |
| | (Rind) | 1000 | 73.79$^{bcd}$ | 96.53$^{c}$ |
| | | 500 | 79.25$^{cd}$ | 99.21$^{c}$ |
| ***Allium sativum*** (Alliaceae) | Bulbs | 1500 | 79.68$^{cd}$ | 90.03$^{c}$ |
| | | 1000 | 80.69$^{cd}$ | 88.58$^{c}$ |
| | | 500 | 86.78$^{def}$ | 100.0$^{c}$ |
| ***Piper betle***(Piperaceae) | Leaves | 1500 | 62.6$^{b}$ | 54.74$^{b}$ |
| | | 1000 | 70.0$^{bc}$ | 78.57$^{c}$ |
| | | 500 | 79.9$^{c}$ | 97.00$^{c}$ |
| ***Vitex nugando*** (Verbenaceae) | Leaves | 1500 | 69.2$^{bc}$ | 81.13$^{c}$ |
| | | 1000 | 69.91$^{bc}$ | 87.42$^{c}$ |
| | | 5000 | 82.26$^{cdef}$ | 97.78$^{c}$ |
| Geraniol | _ | 1500 | 85.68$^{def}$ | 93.37$^{c}$ |
| | | 1000 | 86.19$^{def}$ | 100.0$^{c}$ |
| | | 500 | 90.30$^{ef}$ | 100.0$^{c}$ |
| Carbendazim | _ | 1000 | 6.1$^{a}$ | 4.97$^{a}$ |
| Control | _ | _ | 96.49$^{c}$ | 100.0 |

Figures followed by the same letter are at par statistically as per DMRT analysis.

Mishra *et al* (1990) showed that leaves of *Calotropis procera* possessed toxic properties against *R. solani* and were in accordance with present studies. Tewari and Mandakini (1991) reported complete reduction of *R. solani in vitro* and also checked the spread of the disease by *O. sanctum*. According to Mishra and Tewari (1992) ethanolic extract of *Polyalthia longifolia* completely inhibited the growth of *R. solani* at 2.5 percent concentration.

Ansari (1995) showed that *Trachispermum ammi* and *Ocimum* sp extracts were effective at much higher dilution *i.e.* 1:20 (v/v) and *Vitex trifolia* at 1:10 (v/v) than in the other plant extracts. *Vitex trifolia* also showed 37.50 percent of growth inhibition of sclerotium. In the present study, a different species *V. negundo* showed 27.2 percent disease reduction and found effective. Sunderraj *et al* (1996) reported cold water extract of *Allium sativum* bulbs at 10 percent concentration recorded complete inhibition of the *R. solani* growth and it was at par with bavistin. Over 50 percent reduction in fungal growth was recorded in case of *Vitex negundo* extracts. Kurucheve *et al.*(1997) reported maximum inhibition of *R. solani* growth in *Prosopis juliflora* but in hot water *Thevita peruviana* was more effective. *Piper betle* tested by them also found effective especially in the reduction of sclerotial formation.Pramanick *et al*. (1998) reported *Allium sativum* inhibited colony growth of *R. solani.*

*In vitro,* antifungal efficacy extracts of *Calotropis* spp and *Vitex negundo* (Dev *et al*. 2002) and *P. betle* (Mohamed *et al.,* 1996) have been reported earlier. Given hot and humid conditions in Delhi, the volatile antifungal components such as geraniol and essential oils might not be persistent in plant surface. This might be possible reason for the poor efficacy of geraniol and the plant extracts. Interestingly, the extracts of *A. sativum* and *P. betle* were water soluble and thus the antifungal constituents could be more persistent in the plant system.

## ACKNOWLEDGEMENTS

The authors are grateful to the Head, Division of Plant Pathology, IARI, New Delhi for providing necessary facilities.

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