Journal of
Plant Development Sciences
Meerut, India

RESEARCH

MANAGEMENT OF SHEATH BLIGHT OF RICE USING DIFFERENT SOLVENT-BASED PLANT EXTRACTS

Hitesh[1]*, R.K.S. Tiwari[2], V.K. Nirmalkar[3], Sonal Kumar[4], Gangaram[5], Varsha Awasthi[6] and D.S. Dhurwey[7]

[1]Plant Pathology, Section of Plant Pathology, BTC, College of Agriculture and Research Station, Sarkanda, Bilaspur (IGKV), Chhattisgarh, India.
[2,3,5]Section of Plant Pathology, BTC, College of Agriculture and Research Station, Sarkanda, Bilaspur (IGKV), Chhattisgarh, India.
[4]Plant Pathology, Section of Plant Pathology, College of Agriculture Raipur, (IGKV), Chhattisgarh, India.
[6,7]Plant Pathology, Section of Plant Pathology, BTC, College of Agriculture and Research Station, Sarkanda, Bilaspur (IGKV), Chhattisgarh, India.
Email: hiteshpawlehp4@gmail.com

Received-03.12.2023, Revised-15.12.2023, Accepted-27.12.2023

Abstract: Rice (*Oryza sativa* L.) belong to the Gramineae family is the most extensively grown food crop in the world and about 90 per cent of rice grown in the world is produced and consumed in Asia. Sheath blight is one of the most destructive rice diseases, found throughout the world's rice-growing regions. In present investigation different solvent based plant extracts were evaluated against sheath blight of rice *in vitro* as well as *in vivo*. Results indicated that Hexaconazole 5% SC (100%), Methanol based neem extract(100%), Methanol based plant extract mixture (100%), Ethanol based plant extract mixture (100%) and Ethanol based neem extract (100%) completely inhibited the mycelia growth of *Rhizoctonia solani* at 10 per cent concentration. Cow urine-based plant extracts were found significantly effective in suppressing the sheath blight severity and increasing the yield over control plot. Lowest per cent disease index (PDI) was observed in Hexaconazole 5% SC @0.1% (PDI-8.08%) which was found to be most effective and at par with Hexaconazole 5% SC @0.05% (PDI-8.88%) followed by Pure Cow urine (5%) + Hexaconazole 5% SC @0.05% (PDI-9.35%) and Cow urine-based plant extracts mixture (5%) + Hexaconazole 5% SC @0.05%(PDI -9.60%) over control. Pure Cow urine @10%, (PDI –27.81%) and Cow urine-based plant extracts mixture @10 % (PDI –29.61%) were also found significantly highly effective controlling sheath blight disease and statistically at par with each other. Combination of half doses of Pure Cow urine (5%) + Hexaconazole 5% SC @0.05% (PDI-9.35%) was found significantly effective as compare to control.

Keywords: Rice, Sheath blight, Plant extracts, Cow urine

INTRODUCTION

Rice (*Oryza sativa* L.) belong to the Gramineae family is the world's highest cultivated cereal crop. Rice is the most extensively grown food crop in the world and about 90 per cent of rice grown in the world is produced and consumed in Asia.Sheath blight is one of the most destructive rice diseases, found throughout the world's rice-growing regions (Ou, 1985; Teng *et al*., 1990; Savary *et al*., 2006). This disease is also known as "Oriental sheath and leaf blight," which was first recognized in Japan by Miyake. Paracer and Chahal (1963) were the first to report sheath blight in India from Gurdaspur. Tiwari and Das (2011) studied plant extracts of *P. corylifolia*, *A. racemosus* and *C. forskohlii* against *Rhizoctonia solaniin-vivo* and they found results were at par with hexaconazole. However, cow urine extracts of *C. gladiata*, *P. Corylifolia*and *S. suaveolens* were more consistent and showed similar results.Reddy *et al*. (2002) tested botanicals tested and foundleast disease severity of 65.1 % in Achook (Azadirachtin 0.15% W/W - neem kernel extract in methanol solvent) as comparison to 82.9% in control. Efficacy of neem formulations such as neem fungicide (0.5%) and neemark (0.5%) were found to be the best in controlling sheath blight disease in rice cultivar IR50 under glass house conditions.Plant extracts are effective against number of soil borne plant pathogens like Kumar *et al*. (20119ab) reported efficacy of *Allium sativum*, *Allamanda cathertica* and *Laurus nobilis*against *Pythium aphanidermatum* and *Fusarium oxysporum*.Similarly, Choudhury *et al*. (2017) extracted plant extracts using three different solvents (hexane, chloroform and methanol) sequentially and evaluated against *Rhizoctonia solani*.

*Corresponding Author

MATERIALS AND METHODS

Preparation of plant extracts

Collection of cow urine and preparation of cow urine-based plant extracts

The cow urine was collected in the morning from an indigenous breed of cow in a sterile container, brought to the laboratory immediately and urine were filtered aseptically. Cow urine-based extraction of selected plants were prepared using technique given by Rakesh *et al*. (2013).

Collection of plants leaves

Fresh leaf was collected randomly from the medicinal plant nursery maintained at Agriculture College Campus, Bilaspur (Chhattisgarh). The following plant parts used for under the present investigation.

Table 1. List of plants used against *Rhizoctonia solani*

S.N.	Plant Name	Botanical name	Family	Part used
1	Neem	*Azadirachta indica* (L.)	Meliaceae	Leaf
2	Karanj	*Millettia pinnata* (L.)	Fabaceae	Leaf
3	Kanher	*Cascabelathevetia* (L.)	Apocynaceae	Leaf
4	Calotropis	*Calotropis gigantea* (L.)	Apocynaceae	Leaf

Organic solvent extracts (acetone, ethanol, methanol and petroleum ether) were prepared by incorporating the chopped plant materials in equal quantity of respective solvents (1:1 W/V). Plant parts were mixed well in solvents using pestle mortar and kept open for overnight to evaporate the organic solvents. Remaining content were filtered and the filtrates were subjected to low-speed centrifugation at 5000 rpm for five min using a centrifuge (Priya and Ganjewala,2007). The supernatant thus obtained were collected gently with the help of a micropipette and transferred in glass vials. Vials were kept open overnight at room temperature for the evaporation of any residual solvent. Crude plant extracts thus obtained were regarded as standard stock solution (100%) and stored at 4ºC for future use (Tiwari *et al*.,2005).

Plant leaf extracts of medicinal plants i.e.- *Azadirachta indica* (Neem), *Millettia pinnata* (karanj), *Cascabelathevetia* (kanaher), *Calotropis gigantea* (Ankh), were prepared in different solvent and used under *in vitro* and *in vivo* experiments.

Evaluation of Plant extracts against *R. solani* using poison food techniques

To evaluate the *in vitro* antifungal efficacy of crude plant extracts 'poisoned food technique' was applied (Grover and Moore, 1962; Mishra and Tiwari, 1992; Nene and Thapliyal, 2000). 100 ml of Potato Dextrose Agar medium (PDA) was prepared in 250 ml Erlenmeyer flask and sterilized in autoclave. Crude plant extracts were used at two concentrations (5% and 10%) for this experiment. Two different concentrations of extracts were prepared by mixing aseptically 5 ml and 10 ml of stock solution (100%) in 100 ml of semisolid PDA medium at a temperature of 40°-45°C (Tiwari *et al*., 2005). Media with same volume of sterile distilled water and different extraction solvents served as control and solvent control respectively. Hexaconazole at 100 ppm concentrations were used to compare the efficacy of plant extracts and regarded as fungicide control for *R. solani* respectively. In general, antibiotic Streptomycin (100 ppm) was added to semisolid PDA medium before pouring Petri plates to check any bacterial contamination.

Petri plates with gelled medium were aseptically inoculated at the centre with mycelial dies of 7 mm diameter taken from 96 hrs old culture of *R. solani*. Plates were incubated at 26 +1°C in BOD incubator and mycelial growth were recorded. Colony diameters were recorded twice perpendicularly. Observations for *R. solani* were taken 96 hrs after inoculation using a transparent millimeter ruler. Percentage inhibition of mycelial growth (Verma and Kharwar, 2006) was calculated by the following formula.

The per cent inhibition of mycelial growth of the pathogen were measured by the formula (Vincent 1927),

$$I = \frac{C - T}{C} \times 100$$

Where, I = Per cent inhibition of mycelial growth,
C= radial growth of fungus in control plate (mm)
T=radial growth of fungus on treatment plate

Management of sheath blight of rice under field condition.

Cow urine-based plant extracts were sprayed after the appearance of first symptoms of sheath blight.Cow urine-based plant extracts include different combinationsi.e. pure cow urine, Cow urine-based plant extracts mixture, cow urine-based Neem extract, Brahmastra 5% and 10% as well as combination of Pure cow urine + Hexaconazole. Cow urine-based plant extracts mixture + Hexaconazole along with fungicide were applied foliar application with the help of micro sprayer, three sprays were applied at an interval of seven days. Pre-treatment observations were observed after 7 days of inoculation whereas, post treatment observations were observed just after the completion of first second and third spray. The final observation was recorded after 7 days of third spray.

Table 2. Visual scoring of sheath blight incidence rating scale given by International Rice Research Institute (IRRI),1996.

Scale	Symptoms
0	No infection
1	vertical spread of the lesions up to 20% of plant height
3	vertical spread of the lesions up to 21-30% of plant height
5	vertical spread of the lesions up to 31-45% of plant height
7	vertical spread of the lesions up to 46-65% of plant height
9	vertical spread of the lesions up to 66-100% of plant height

The Per cent Disease Index (PDI) will be calculated by formula given by Wheeler (1969).

$$PDI = \frac{\text{Sum of all individual rating}}{\text{Total number of plants observed} \times \text{Maximum disease scale}} \times 100$$

RESULTS AND DISCUSSION

Evaluation of Plant extracts against *R. solani* using poison food techniques

Data presented in table 3 and plate1indicated that the treatments (5 and 10%) significantly inhibited mycelial growth of *Rhizoctonia solani* over untreated control. However, treatments i.e. Hexaconazole 5% SC (100%), Methanol based neem extract (100%), Methanol based plant extract mixture (100%), Ethanol based plant extract mixture (100%) and Ethanol based neem extract (100%) showed complete inhibition of the pathogen at 10 per cent concentration. Moreover, Cow urine-based plant extracts mixture (52.41 and 56.50%), cow urine-based neem extract (54.26 and 56.30%), hot water-based plant extracts mixture (43.01 and 51.48 %), hot water-based neem extracts (44.04 and 50.00%), Pure Cow urine (35.00 and 43.78%), Acetone based plant extract mixture (33.89 and 42.41 %) and Acetone based neem extracts (30.74 and 41.67%) significantly inhibited mycelial growth at 5 and 10 per cent concentration respectively.

Table 3. *In vitro* efficacy of different solvent-based plant extracts against mycelial growth of *Rhizoctonia solani*

	Treatments	**Mycelial Growth (mm)**			**Per cent Inhibition**		
		5%	**10%**	**Mean**	**5%**	**10%**	**Mean**
T_1	Cow urine-based neem extract	41.17 (39.91)	39.33 (38.84)	39.38	54.26 (47.44)	56.30 (48.62)	48.03
T_2	Cow urine-based plant extract mixture	42.83 (40.88)	38.83 (38.55)	39.71	52.41 (46.38)	56.85 (48.94)	47.66
T_3	Pure cow urine	58.50 (49.91)	50.60 (45.35)	47.63	35.00 (36.25)	43.78 (41.40)	38.82
T_4	Hot water-based calotropis extract	74.17 (59.53)	68.50 (55.87)	57.70	17.59 (24.61)	23.89 (29.24)	26.93
T_5	Hot water-based karanj extract	75.60 (60.48)	70.83 (57.33)	58.91	16.00 (23.35)	21.30 (27.45)	25.40
T_6	Acetone based neem extract	62.33 (52.15)	52.50 (46.43)	49.29	30.74 (33.66)	41.67 (40.20)	36.93
T_7	Acetone based plant extract mixture	59.50 (50.48)	51.83 (46.05)	48.27	33.89 (35.59)	42.41 (40.63)	38.11
T_8	Petroleum ether-based neem extract	75.00 (60.01)	70.67 (57.23)	58.62	16.67 (24.08)	21.48 (27.56)	25.82
T_9	Petroleum ether-based plant extract mixture	74.17 (59.50)	69.83 (56.71)	58.10	17.60 (24.68)	22.41 (28.21)	26.44
T_{10}	Methanol based neem extract	20.83 (27.15)	0.00 (0.23)	13.69	76.85 (61.25)	100 (89.77)	75.51

T_{11}	Methanol based plant extract mixture	22.50 (28.30)	0.00 (0.23)	14.27	75.00 (60.02)	100 (89.77)	74.89
T_{12}	Ethanol based neem extract	29.83 (33.10)	0.00 (0.23)	16.67	66.85 (54.85)	100 (89.77)	72.31
T_{13}	Ethanol based plant extract mixture	31.67 (34.24)	0.00 (0.23)	17.24	64.81 (53.62)	100 (89.77)	71.69
T_{14}	Hexaconazole 5% SC	7.17 (15.52)	0.00 (0.23)	7.88	92.04 (73.62)	100 (89.77)	81.70
T_{15}	Hot water-based neem extract	51.67 (45.96)	45.00 (42.13)	44.04	42.59 (40.73)	50.00 (45.00)	42.87
T_{16}	Hot water-based plant extract mixture	49.43 (44.67)	43.67 (41.36)	43.01	45.07 (42.17)	51.48 (45.85)	44.01
T_{17}	Control	90.00 (71.57)	90.00 (71.57)	71.57	0 (0.23)	0 (0.23)	0.23
	Mean	**45.49**	**35.21**		**40.15**	**51.30**	
		Factor A	**Factor B**	**A×B**	**Factor A**	**Factor B**	**A×B**
	C.D. 5%	**0.65**	**1.91**	**2.70**	**0.78**	**2.29**	**3.23**
	SE(m) ±	**0.55**	**0.03**	**0.55**	**0.66**	**0.04**	**0.66**
	C.V. %	**4.11**			**4.33**		

* Figures in the parentheses indicate arc sine transformed
* (Plant extracts mixture- neem leaf + karanj leaf + calotropis leaf + kanher leaf)

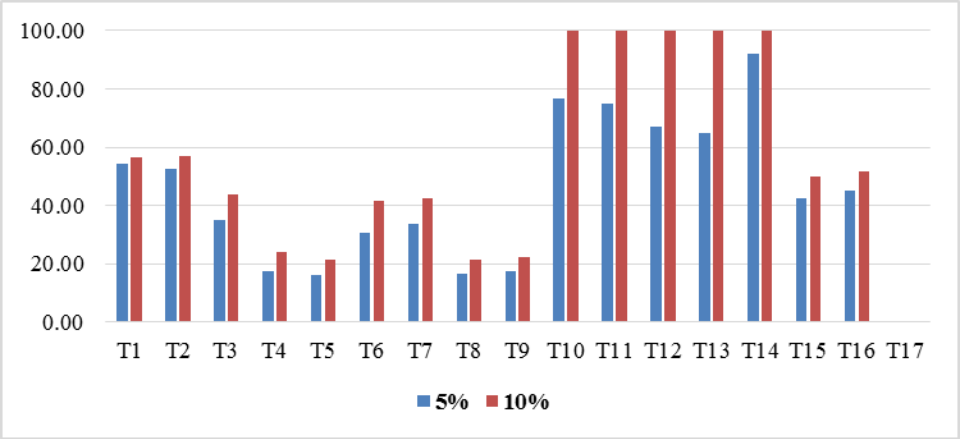
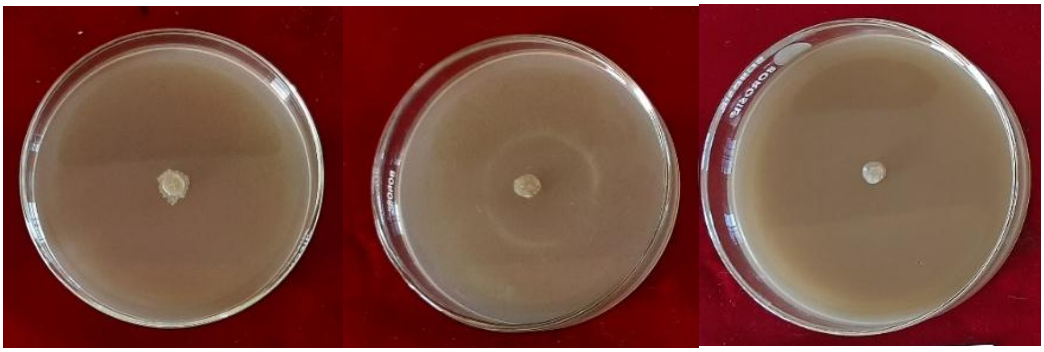


Figure 1 *In vitro* efficacy of different solvent-based plant extracts against mycelial growth of *Rhizoctonia solani*



Hexaconazole 0.05% Hexaconazole 0.1% Ethanol based plant extracts mixture 10%

Methanol based plant extracts mixture- 10% | Methanol based Neem extracts- 10% | Ethanol based neem extracts 10% | Control

Plate 1. *In vitro* efficacy of different solvent-based plant extracts against mycelial growth of *Rhizoctonia solani*

Among all the treatments, Hexaconazole 5% SC, Methanol based neem extract, Methanol based plant extract mixture, Ethanol based plant extract mixture, Ethanol based neem extract and Cow urine-based neem extractwere found highly effective against *R. solani*. Petroleum ether-based neem extract, Petroleum ether-based plant extract mixture, Cow Urine based neem extract, Cow Urine based plant extract mixture, Hot Water based karanj extractwere found to be least effective against *R. solani*.

Management of sheath blight of rice under field condition.

Data presented in table4 and plate 2 indicated that all cow urine-based plant extracts were found significantly effective in suppressing the sheath blight severity and increasing the yield over control plot. Lowest per cent disease index (PDI) was observed in Hexaconazole 5% SC @0.1% (PDI-8.08%) which was found to be most effective and at par with Hexaconazole 5% SC @0.05% (PDI-8.88%) followed by Pure Cow urine (5%) + Hexaconazole 5% SC @0.05% (PDI-9.35%) and Cow urine-based plant extracts mixture (5%) + Hexaconazole 5% SC @0.05%(PDI -9.60%) over control (67.49%). Pure Cow urine @10%, (PDI –27.81%) and Cow urine-based plant extracts mixture @10 % (PDI –29.61%) were also found significantly highly effective controlling sheath blight disease and statistically at par with each other. Combination of half doses of Pure Cow urine (5%) + Hexaconazole 5% SC @0.05% (PDI-9.35%) was found significantly effective as compare to control.

Table 4. Efficacy of cow urine-based plant extracts against rice sheath blight in field condition

	Treatment	**PDI Index**				**% Reduction over control**	**Yield q/ha**
		Before Spray	**7th DAS After 1st spray**	**15th DAS After 2nd spray**	**30th DAS After 3rd spray**		
T1	Pure Cow urine - 5%	11.10 (19.45)	34.6 (35.96)	30.76 (33.58)	29.87 (32.89)	55.74	37.42
T2	Pure Cow urine - 10%	11.87 (20.13)	32.71 (34.840	29.49 (32.78)	27.81 (31.53)	58.8	42.75
T3	Cow urine-based plant extracts mixture -5 %	11.10 (19.45)	36.77 (37.27)	31.93 (34.29)	30.91 (33.61)	54.2	42.08
T4	Cow urine-based plant extracts mixture -10 %	11.59 (19.89)	36.24 (36.96)	32.44 (34.62)	29.61 (32.81)	56.12	38.67
T5	Hexaconazole 5% SC (0.05%)	11.1 (19.45)	15.69 (23.32)	11.38 (19.69)	8.88 (17.33)	86.84	52.58
T6	Hexaconazole 5% SC (0.1%)	12.24 (20.45)	13.72 (21.72)	10.48 (18.86)	8.08 (16.49)	88.03	54.75
T7	Pure Cow urine 5% + Hexaconazole 5% SC (0.05%)	11.74 (20.02)	17.32 (24.57)	13.59 (21.62)	9.35 (17.77)	86.15	51.58

T8	Cow urine-based plant extracts mixture 5% + Hexaconazole 5% SC (0.05%)	11.34 (19.66)	18.18 (25.22)	14.79 (22.59)	9.60 (18.02)	85.77	50.75
T9	Brahmastra - 5%	11.20 (19.54)	31.80 (34.27)	26.85 (31.03)	30.66 (33.42)	54.58	42.75
T10	Brahmastra - 10%	11.76 (20.04)	33.13 (35.09)	28.66 (32.21)	29.63 (32.73)	56.09	45.58
T11	Cow urine-based Neem extracts - 10%	11.34 (19.66)	33.47 (35.30)	30.85 (33.59)	31.97 (34.26)	52.63	36.58
T12	**Control**	11.6 (19.90)	49.13 (44.49)	58.19 (49.76)	67.49 (55.37)	00	33.17
	SEm±	**0.26**	**1.17**	**1.32**	**1.77**	-	**2.81**
	CD 5%	**NS**	**3.46**	**4.05**	**5.22**	-	**8.31**
	CV	**2.3**	**6.27**	**7.82**	**10.31**	-	**11.06**

*Per cent values in parentheses are arcsine transformed

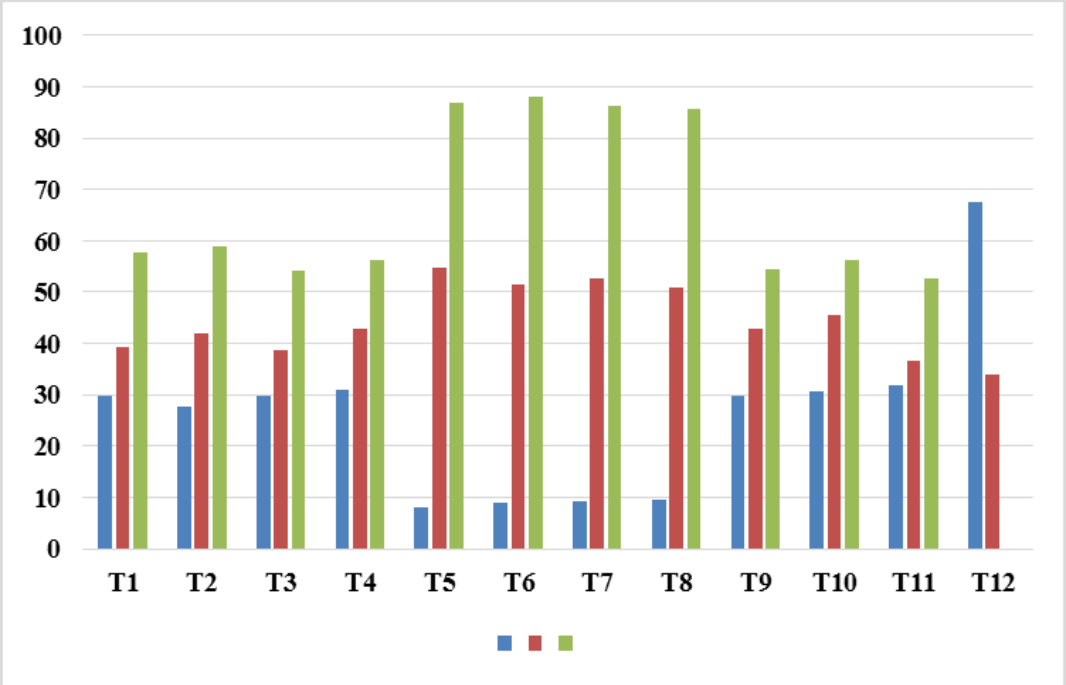
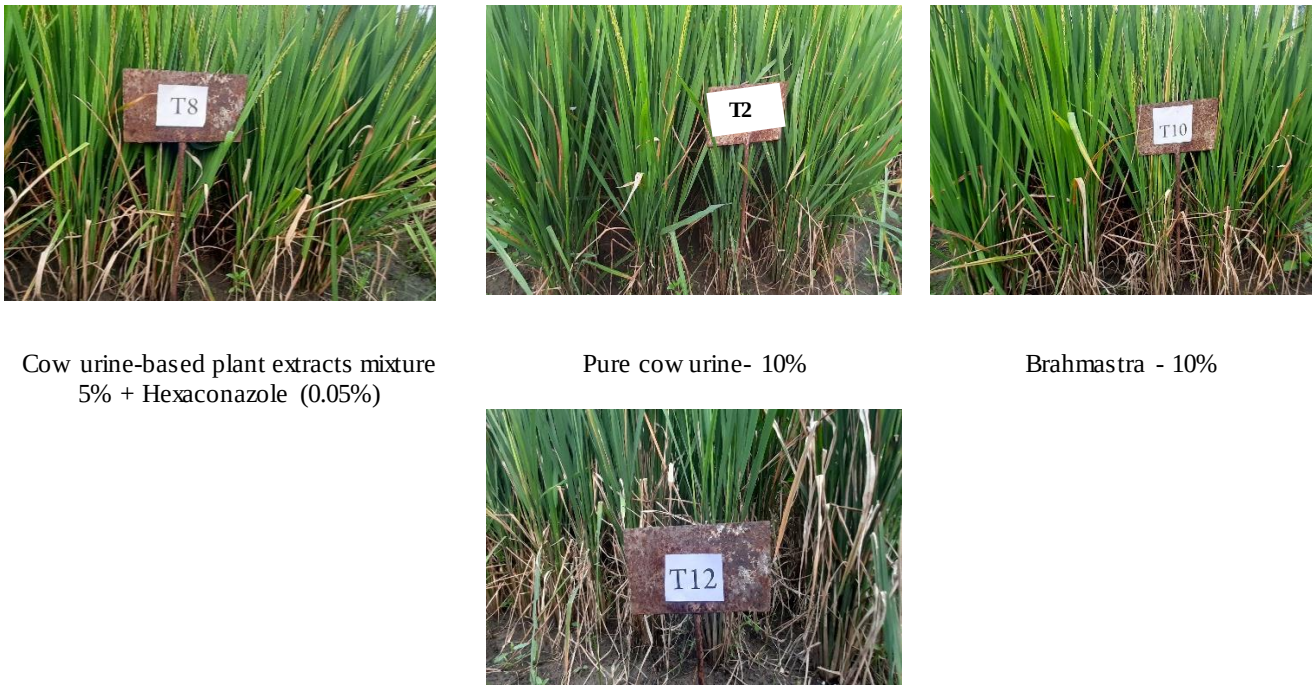


Figure 2. Efficacy of cow urine-based plant extracts against sheath blight of rice under field condition

Hexaconazole- 0.1%

Hexaconazole- 0.05%

Pure Cow urine 5% + Hexaconazole (0.05%)



Cow urine-based plant extracts mixture 5% + Hexaconazole (0.05%)

Pure cow urine- 10%

Brahmastra - 10%

Control

Plate 2. Efficacy of cow urine-based plant extracts against sheath blight of riceunder field condition

Most of the cow urine-based plant extracts produced significantly grain yield over control. However, Hexaconazole 5% SC @0.1% treated plots provided significant highest grain yield (54.74 q/ha) over control and found at par with Hexaconazole 5% SC @0.05% (52.58 q/ha), Pure Cow urine (5%) + Hexaconazole 5% SC @0.05% (51.58 q/ha), Cow urine-based plant extracts mixture (5%) + Hexaconazole 5% SC @0.05% (50.75 q/ha), Pure Cow urine (10%), (42.75 q/ha), Brahmastra (10%) 45.58 q/ha.). Cow urine-based plant extracts mixture (5 %) (42.72 q/ha) were also found significantly more effective in increasing grain yield over control (33.17 q/ha).

The findings therefore suggest that the fungicide used alone or in combination with cow urine-based plant extracts outperformed all other treatments in respect to providing significantly higher grain yield. The combination of half dose of Hexaconazole 5% SC and cow urine-based plant extracts was found to be at par with Hexaconazole 5% SC used alone.

CONCLUSIONS

Under *in vitro* conditions, Methanol based neem extract (100%) followed by Methanol based plant extract mixture (100%), Ethanol based plant extract mixture (100%) and Ethanol based neem extract (100%) were found superior with the highest per cent growth inhibition of *Rhizoctonia solani*.*In vivo* studies revealed that Hexaconazole 5% SC was highly effective fungicide against sheath blight of rice under field experiment followed by Pure Cow urine (5%) + Hexaconazole 5% SC @0.05% (PDI-9.35%) and Cow urine-based plant extracts mixture (5%) + Hexaconazole 5% SC @0.05%(PDI -9.60%) over control (67.49%) which suggests the possibility of using cow urine-based plant extracts with reduced dose of compatible fungicides for control of sheath blight of rice.

SUGGESTION

There is need of isolation and quantification of active chemical present in different solvent-based plant extracts. More number of different solvent-based plant extract need to study against different plant pathogens. Large number of field trails may be conducted to evaluate the efficacy of combination of fungicide and cow urine-based plant extractsfor the control of soil borne and foliar diseases i.e. sheath blight of rice, powdery mildew of okra and *Cercospora* leaf spot of okra etc.

ACKNOWLEDGEMENT

Author thanks the major advisor Dr. R. K. S. Tiwari for consistent guidance during whole research work and also thanks members of advisory committee, BTC College of Agriculture and Research Station, Bilaspur (C.G) for providing all necessary laboratory facilities.

REFERENCES

Grover, R. K. and Moore, J. D. (1962). Toximetric studies of fungicides against BROWN rot organisms,

sclerotinia-fructicola and S-Laxa. *Phytopathology*, **52**(9), 876.

Google Scholar

Kumar, S., Bhattacharyya, A. and Kashyap, P. (2019a). Morphogenetic characterization of Fusarium oxysporum associated with storage rot of ginger in Assam and in vitro evaluation of botanicals. *Journal of Pharmacognosy and Phytochemistry*, **8**(6), 2513-2518.

Google Scholar

Kumar, S., Bhattacharyya, A., Savani, A. K. and Gogoi, S. (2019b). Antifungal Activity of Some Local Botanicals of Assam against Pythium aphanidermatum Inciting Storage Rot of Ginger. *Int. J. Curr. Microbiol. App. Sci*, **8**(11), 528-535.

Google Scholar

Mishra, R. K. and Gupta, R. P. (2012). In vitro evaluation of plant extracts, bio-agents and fungicides against purple blotch and Stemphylium blight of onion. *Journal of Medicinal Plants Research*, **6**(48), 5840-5843.

Google Scholar

Paracer, C. S. and Chahal, D. S. (1963). Sheath blight of Rice caused by Rhizoctonia solani Kühn-a new record in India. *Current Science*, **32**(7), 328-329.

Google Scholar

Savary, S., Teng, P. S., Willocquet, L. and Nutter Jr, F. W. (2006). Quantification and modeling of crop losses: a review of purposes. *Annu. Rev. Phytopathol.*, **44**, 89-112.

Google Scholar

Thakur, P., Tiwari, R. K. S., Nirmalkar, V. K., Verma, S. K. and Chaure, N. K. (2022). Antagonistic activity and Bioefficacy of *Bacillus subtilis* against Sheath Blight of Rice (*Oryza sativa* L.) caused by Rhizoctonia solani. In *Biological Forum-An International Journal*, **14** (3), pp. 1305-1311).

Google Scholar

Tiwari, R. K. S. and Das, K. (2011). Inhibitory effect of cow urine-based plant extracts against Rhizoctonia solani causing sheath blight of rice. *Indian Phytopathology*, **64**(3), 265.

Google Scholar

Verma, V. C. and Kharwar, R. N. (2006). Efficacy of neem leaf extract against it's own fungal endophyte Curvularialunata. *J. Agri Technol*, **2**(2), 329-335.

Google Scholar