Agriways 3(1): 10-13 (2015)

ISSN: 2321-8614 (Print)
ISSN:2454-2318 (Online)

EVALUATION OF DIFFERENT PLANT BASED ESSENTIAL OILS AGAINST *Rhizoctonia solani* CAUSING SHEATH BLIGHT OF RICE

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ABSTRACT

The antifungal effect of 30 plant essential oils against the pathogen Rhizoctonia solani was evaluated by food poison technique. Out of 30 plant essential oils tested, 2 essential oils i.e. Mentha arvensis have been found to be highest inhibitory towards R. solani, as it's resulted in 60.41%, 82.58%, 98.89%, 94.26% and 98.19% and Withania somnifera also was found to be second in order of inhibitory effect towards R. solani as resulted in 64.69%, 69.06%, 69.09%, 69.97% and 70.1%, inhibition at 100 ppm, 200 ppm, 300 ppm, 500 ppm and 1000 ppm, respectively. All remaining essential oils tested at different concentrations were more or less inhibitory to the growth of R. solani in vitro.

***Keywords*:** Rice, *Rhizoctonia solani*, Sheath blight, Plant essential oils, Food poison technique, Fungi-toxicity

Rice is an important cereal crop affected by various fungal, bacterial and viral diseases. Sheath blight caused by *Rhizoctonia solani* is emerging as a very destructive disease under favorable weather conditions in rice growing areas of the world which ultimately causes substantial yield losses (Gautam *et al*, 2003). Sheath blight of rice caused by *Rhizoctoina solani* Kuhn [*Thanetephorus cucumeris* (Frank) Donk] was first reported from Japan (Miyake, 1910) is at present one of the most serious threat for Basmati rice production. The disease is soil borne and remains, mainly confined to the leaf sheath but it also attacks all the aerial plant parts. Under North Indian conditions it is mainly soil borne; besides seed and air borne inoculums also plays an important role (Saksena, 1977). Management of this disease is difficulty due to viability of sclerotia in the soil for several years. Use of fungicides to control the disease causes several adverse effects *i.e.* development of resistance in the pathogen, residual toxicity, pollution in the environment, high cost etc. Therefore, it has become necessary to adopt ecofriendly approaches for better crop health and for yield. Plant essential oils are potential source of antimicrobial compound of natural origin. The plant oil has been reported to have antibacterial, antifungal, antiviral, antiparasitic and antidermatophytic properties. It is now considered as a valuable source of natural products for development of medicines against various diseases and also for the development of industrial products (Tabassum and vidyasagar, 2013). In the past, several higher plants have proved their usefulness against a number of fungi. The systematic search of higher plants for antifungal activity has shown that plant essential oils have the ability to inhibit spore germination and mycelia growth in many fungal species (Guerin and Reveille, 1984). Hence, in the present study some plant essential oils, from locally available plants were tested in *vitro* against *Rhizoctonia solani.*

MATERIALS AND METHODS

Essential oil of 30 different plants were tested @ 100ppm, 200ppm, 300ppm, 500ppm and 1000ppm concentrations for their efficacy against *R. solani in vitro* by food poison technique (Grover and Moore, 1962). Essential oils were collected from the Central Institute of Medicinal and Aromatic Plants *(*CIMAP), Lucknow and local shops as well. Different concentrations of essential oil were added in potato dextrose agar media in 250 ml conical flask. Conical flask containing media with essential oil were plugged and autoclaved at 121^0 C at 15 psi for 15 minutes. Then sterilized media containing essential oil was poured in sterilized Petri plates. After solidification of media into petriplate, the 5 mm disc from 4 days old culture of *R. solani* were placed in the centre of each petriplate. Petriplates without plant extracts served as check. The observations were recorded on radial growth after 8 hours of incubation at regular intervals (8 hrs). Percent inhibition in radial growth was calculated by using formula given by (Vincent, 1947).

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

ISSN: 2321-8614 (Print)
ISSN:2454-2318 (Online)

Where:

I = Inhibition of mycelial growth
G =Growth of pathogen in control
T = Growth of pathogen in treatment

RESULTS AND DISCUSSION

Thirty different essential oils which mentioned in Table-1 were evaluated at the concentrations of 100 ppm, 200 ppm, 300 ppm, 500 ppm and 1000 ppm concentrations for their efficacy against *R. solani* u;sing poisoned food technique *in vitro.* It is evident that all essential oils tested at any concentrations were more or less inhibitory to the growth of *R. solani in vitro.* At 100ppm concentration, the highest inhibition of mycelial growth in *R. solani* was exhibited by *Withania somnifera* (64.69%) followed by *Mentha arvensis* (60.41%), *Myristica fragrans* (54.28%), *Cedrus deodara* (53.26%), *Brassica nigra* (52.45%), *Datura stramonium* (49.18%), *Lawsonia inermis* (44.90%), *Pongamia glabra* (42.24%), *Olea europea* (39.80%), *Triticum aestivum* (37.35%), *Sesamum indicum* (34.90%), *Brassica juncea* (34.49%), *Dalbergia latifolia* (30%) and *Papaver somniferum* (28.57%) which were significantly different from each other among themselves and rest other essential oils. Remaining essential oils were also inhibitory to radial growth of *R. solani* but comparatively lesser than the above mentioned fourteen essential oils. At 200ppm concentration, the highest inhibition of radial growth *R. solani* was exhibited by *Mentha arvensis* (82.58%) followed by *Withania somnifera* (69.06%), *Myristica fragrans* (64.55%), *Triticum aestivum* (57.38%), *Cedrus deodara* (55.12%), *Datura stramonium* (54.30%), *Brassica nigra* (52.66%), *Sesamum indicum* (50.41%), *Olea europea* (46.31%), *Pongamia glabra* (44.88%), *Brassica juncea* (34.84%) and *Papaver somniferum* (31.56%) which were significantly different from each other among themselves. However, other essential oils at 200ppm concentration were also inhibitory to the growth of *R. solani* but comparatively lesser than the above mentioned twelve essential oils.

At 300 ppm concentration, the highest inhibition of *R. solani* was exhibited by *Mentha arvensis* (98.89%), *Withania somnifera* (70.1%), *Myristica fragrans* (64.21%), *Triticum aestivum* (59.15%) *Datura stramonium* (57.05%), *Sesamum indicum* (56.00%), *Pongamia glabra* (45.16%), *Cedrus deodara* (54.31%), *Brassica nigra* (54.10%), *Olea europea* (48.42%), *Dalbergia latifolia* (42.31%) and *Brassica juncea* (39.79%) which were significantly different from each other. Remaining essential oils at 300 ppm concentration were also inhibitory to *R. solani* but comparatively lesser than the above mentioned twelve essential oils. At 500 ppm concentration, the highest inhibition of *R. solani* was exhibited by *Mentha arvensis* (94.26%), followed by *Withania somnifera* (69.09%), *Myristica fragrans* (62.47%), *Sesamum indicum* (62.03%), *Triticum aestivum* (60.70%), *Datura stramonium* (57.39%), *Cedrus deodara* (56.07%), *Pongamia glabra* (53.64%), *Brassica nigra* (53.2%), *Dalbergia latifolia* (49.23%), *Olea europea* (46.79%), *Gossypium hirsutum* (39.73%), *Brassica juncea* (37.30%) and *Azadirachta indica* (36.64%) which were significantly different from each other among them self and also from remaining essential oils. However, rest essential oils at 500 ppm concentration were also inhibitory to *R. solani* but comparatively lesser than the above mentioned fourteen essential oils. At 1000 ppm concentration, the highest inhibition of *R. solani* exhibited by *Mentha arvensis* (98.19%) followed by *Olea europea* (80.13%), *Cocos nucifera* (75.62%), *Triticum aestivum* (71.78%), *Withania somnifera* (69.97%), *Cedrus deodara* (63.20%), *Myristica fragrans*(63.20%), *Dalbergia latifolia* (63.20%), *Sesamum indicum* (62.52%), *Ellattaria cardamomum* (60.04%), *Brassica nigra* (59.59%), *Datura stramonium* (58.69%), *Gossypium hirsutum* (56.20%), *Pongamia glabra* (52.59%), *Brassica juncea* (50.33%) and *Azadirachta indica* (47.62%) which were significantly different from each other among themselves & rest of other essential oils. Rest essential oils at 1000 ppm concentration were also inhibitory to *R. solani* but comparatively lesser than the above earlier mentioned sixteen essential oils. Iscan *et al.* (2002) also tested essential oils of peppermint (*Mentha piperita* L.), which are used as flavors, fragrances, and pharmaceuticals, were investigated for their antimicrobial properties against plant pathogenic microorganisms. The bioactivity of the oils menthol and menthone was compared using the combination of *in vitro* techniques such as microdilution, agar diffusion, and bioautography. It was shown that all of the peppermint oils screened strongly inhibited plant pathogenic microorganism. Seema and Devaki (2010) also essential oil of cinnamon was found most effective, as it exhibited complete inhibition of the pathogen at 500 ppm. Clove oil showed mycelial inhibition at 1000 ppm. Fennel and nutmeg oil were effective at 2000 ppm. Sehajpal *et al.* (2009) reported antifungal effect of 8 plant oils against the pathogen *R. solani*, evaluated by disc diffusion method. It was noticed that the

ISSN: 2321-8614 (Print)
ISSN:2454-2318 (Online)

Table-1: Effect of different concentrations of essential oils on radial growth of *R. solani in-vitro*

Treatments	*Average diameter of fungal colony (cm)					*Per cent inhibition over control				
	100 ppm	200 ppm	300 ppm	500 ppm	1000 ppm	100 ppm	200 ppm	300 ppm	500 ppm	1000 ppm
Cedrus deodara	2.29	2.19	2.17	1.99	1.63	53.26	55.12	54.31	56.07	63.2
Delonix regia	4.04	3.95	3.83	3.83	3.75	17.55	19.06	19.36	15.45	15.34
Eucalyptus globules	4.89	3.82	3.38	3.37	3.25	0.2	21.72	28.84	25.6	26.63
Semecarpus anacardium	3.98	3.83	3.77	3.74	3.52	18.77	21.52	20.63	17.44	20.54
Ellattaria cardamomum	3.63	3.58	3.43	3.09	1.77	25.92	26.64	27.79	31.79	60.04
Withania somnifera	1.73	1.51	1.42	1.4	1.33	64.69	69.06	70.1	69.09	69.97
Myristica fragrans	2.24	1.73	1.70	1.7	1.63	54.28	64.55	64.21	62.47	63.2
Brassica nigra	2.33	2.31	2.18	2.12	1.79	52.45	52.66	54.1	53.2	59.59
Pongamia glabra	2.83	2.69	2.13	2.1	2.1	42.24	44.88	45.16	53.64	52.59
Datura stramonium	2.49	2.23	2.04	1.93	1.83	49.18	54.3	57.05	57.39	58.69
Azadirachta indica	4.67	4.64	4.36	2.87	2.32	4.69	4.92	8.21	36.64	47.62
Allium sativum	4.55	4.36	4.30	3.88	2.83	7.14	10.65	9.47	14.35	36.11
Celastrus paniculatus	4.28	4.04	4.00	3.88	3.41	12.65	17.21	15.79	14.35	23.02
Gossypium hirsutum	4.50	4.02	3.14	2.73	1.94	8.16	17.62	33.89	39.73	56.2
Psoralea corylifolia	4.38	3.83	3.31	3.1	2.55	10.61	21.52	30.31	31.57	42.43
Mentha arvensis	1.94	0.85	0.48	0.26	0.08	60.41	82.58	98.89	94.26	98.19
Lawsonia inermis	2.70	4.29	4.68	4.5	4.38	44.9	12.09	1.47	0.66	1.12
Croton tiglium	4.47	4.43	4.32	4.3	3.72	8.77	9.22	9.05	5.07	16.02
Papaver somniferum	3.50	3.34	3.3	3.18	3.08	28.57	31.56	30.52	29.8	30.47
Triticum aestivum	3.07	2.08	1.94	1.78	1.25	37.35	57.38	59.15	60.7	71.78
Sesamum indicum	3.19	2.42	2.09	1.72	1.66	34.9	50.41	56	62.03	62.52
Madhuca indica	4.85	4.46	4.28	4.14	3.96	1.02	8.61	9.89	8.61	10.6
Dalbergia latifolia	3.43	3.4	2.74	2.3	1.63	30	30.33	42.31	49.23	63.2
Brassica juncea	3.21	3.18	2.86	2.84	2.2	34.49	34.84	39.79	37.3	50.33
Cucurbita maxima	4.83	4.73	4.43	4.35	3.3	1.43	3.07	6.74	3.97	25.5
Linum usitatissimum	4.78	4.51	4.37	4.08	3.9	2.45	7.58	8	9.93	11.96
Olea europea	2.95	2.62	2.45	2.41	0.88	39.8	46.31	48.42	46.79	80.13
Cocos nucifera	4.75	4.69	4.52	4.39	1.08	3.06	4	4.84	3.09	75.62
Musa paradisiaca	4.29	3.95	3.18	3.02	2.98	12.45	19.06	33.05	33.33	32.73
Ricinus communis	4.63	4.61	4.49	4.4	3.73	5.51	5.53	5.47	2.87	15.8
Control	4.9	4.88	4.75	4.53	4.43					
CD (p=0.05)	**0.064**	**0.068**	**0.091**	**0.093**	**0. 073**					

ISSN: 2321-8614 (Print)
ISSN:2454-2318 (Online)

oil of *Syzygium aromaticum* showed strong inhibition *i.e.* 7.5 mm at 1000 ppm whereas *Helianthus annus* and *Oryza sativa* (rice bran oil) were ineffective.

ACKNOWLEDGEMENTS

The authors are grateful to the Head, Department of Plant Pathology, S. V. P. University of Agriculture and Technology, Meerut for providing necessary facilities to conducting the research and needful guidance.

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