Chavan, A.A. Makne, V.G. and Chopde, P.R. (1982). Components of heterosis and inbreeding depression studies in Sesame *(Sesamum indicum* L.). *J. Maharastra agroc. Univ.* **7** : 15-16.

Pasoulas, A. (1980). Principles and Methods of Plant Breeding. Pub.Np.11; Dept.of Genetics and Plant Breeding, Aristotellian Univ. of Thessalonikil, Greece.

Hedge, V.S. Parameswarappa, R. and Goud, J.V. (1996). Heterosis and inbreeding depression in Mungbean *(Vigna radiata* L). Wilczek.) *Mysore J. agric. Sci.* **30** :101-105.

Kadu, S., Narkhede, M.N. and Khorgade, P.W. (1992). Studies on combining ability in Sesamum. *J. Maharashtra Agric. Univ.* **17** : 392-393.

Naidu, N.V. and Sathyanarayana, A. (1993). Heterosis and inbreeding depression for yield and yield components in Mungbean *(Vigna radiata* (L.) Wilczek). *Ann. Agric. Res.* **14** : 30-34.

Raj Gupta, T. (1980). A study on heterosis in Sesame *(Sesamum indicum* L.) *Madras Agric. J.* **67** : 295-299.

Sharma, R.L. and Chauhan, B.P.S. (1983). Heterosis and inbreeding depression in Sesame. *Madras Agric. J.* **70** : 561-566.

Snedecor, B.W. (1983). *Statistical Methods.* Oxford and IBH Publishing Co., New Delhi.

Sodani, S.N. and Bhatnagar, S.K. (1990). Heterosis and inbreeding depression in Sesame *(Sesamum indicum* L.) *Indian J. Genet.* **50** : **87-88.**

Subbalakshmi, B. (1996). Heterosis in Sesamum. *Madras Agric. J.* **83** : 345-348.

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Fungitoxic properties of some essential oils from higher plants

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Abstract : Essential oils of *Callistemone lanceolatus, Citrus medica, Eclipta alba, Hyptsis suaveolens and Ocimum canum* showed fungitoxicity against *Rhizoctonia solani,* the incitant of damping-off disease. The essential oils of *C. media, E.alba* and *O. canum* completely inhibit the growth of the fungus within 24 hours. Other oils take more time. The essential oil of *C. lanceolatus* was capable of penetrating the soil upto 4 cm while it was 3 and 2 cm respectively for *C. medica* and *O.canum.* The essential oil of *C. lanceolatus* and *O.canum* could control damping-off disease of tomato (*Lycopersicon esculentum*) and chilli (*Capsicum annum*) upto 57.13, 71.44, 40.90 and 83.32 percent respectively. *(Key words: Essentials oils, Higher plants, Fungitoxic properties.)*

Use of seed protectants, soil fumigants and cultural practices are some of the common methods for the control of damping-off diseases. Synthetic chemicals which are used for this purpose has now been cautioned due to their side effects (Arya, 1988 . Lingk, 1991). There is need for application of only selective chemicals which will not affect the non-target organisms that may even be beneficial to crops. Lately the increasing relience on plant products as alternative source for disease management is gaining importance. Essential oils of different plants has been explored by several workers for their antifungal activity (Singh *et al.* 1998, Caccioni *et al.* 1995).

Hence, essential oils from some higher plants were tried against *Rzhizoctonia solani* Kuhn, the incitant of damping-off of tomato and chilli. Formaldehyde, the routinely used chemical, was taken for comparison. Before conducting the actual *in-vivo* tests, some properties of these oils i.e., minimum inhibitory concentration, killing time and persistence of efficacy were studied. The data obtained were subjected to factorial design for statistical analysis.

Materials and Methods

Isolation of essential oils

Essential oils (volatile fungitoxic fractions) of some plants (*Callistemone lance olatus, Citrus medica, Eclipta alba, Hyptsis suaveolens* and *Ocimum canum*) were isolated by hydrodistillation

Table 1. Minimum Inhibitory Concentration and nature of different oils against *R. solani*

Essential Oils/ Chemical	Concentration (ml l^{-1})										
	200	300	500	700	800	1000	2000	3000	4000	5000	Mean (FD)
Callistemone lanceolatus	9.40	15.10	19.20	23.53	36.13	50.00	64.40	70.10	79.60	100.00*	46.746
Citrus medica	8.50	27.40	74.76	86.10	92.20	100.00*	100.00*	100.00*	100.00*	100.00*	78.396
Eclipta alba	18.30	28.10	35.10	47.40	53.10	57.40	66.60	100.00*	100.00*	100.00*	60.600
Hypstis suaveolens	19.33	30.30	42.30	56.00	65.53	71.00	87.80	89.70	92.30	100.00*	65.426
Ocimum canum	75.50	78.96	100.00*	100.00*	100.00*	100.00*	100.00*	100.00*	100.00*	100.00*	95.446
Formaldehyde	77.26	84.20	92.10	100.00*	100.00*	100.00*	100.00*	100.00*	100.00*	100.00*	95.356
Mean (FD)	34.716	44.011	60.577	68.838	74.494	79.733	86.466	93.30	95.31	100.00	

+ = denotes fungistatic nature * = denotes fungicidal nature

			SEM	C.D. (at 5%)
C.D. (at 5%) for	(i)	Oil/Chemical	0.929	0.317
	(ii)	Concentration	1.199	0.409
	(iii)	Oils/Chemical x concentration	0.293	1.004

Table 2. Killing time of different essential oils and formaldehyde against *R. solani*

Essential Oils/Chemical	Killng time (hours)				
	Control	24	36	48	72
Callistemone lanceolatus	+	+	+	-	-
Citrus medica	+	-	-	-	-
Eclipta alba	+	+	+	+	-
Hypstis suaveolens	+	+	+	+	-
Ocimum canum	+	-	-	-	-
Formaldehyde	+	+	+	-	-

+ = growth observed - = growth not observed

using Clavenger's apparatus (Langenau, 1948). Fresh leaves (500 g) of each plant were washed with water and subjected to hydrodistillation for 4 hour. The extracted essential oils were treated with anhydrous sodium sulphate to remove traces of moisture .

Minimum inhibitory concentration (MIC) and nature of fungitoxicity of oils and formaldehyde

The MIC of these was tested against *Rhizoctonia solani* by the poisoned food technique (Grover and Moore, 1962) at 200, 300, 500, 700, 800, 1000, 2000, 3000, 4000 and 5000 ml l^{-1}. The nature of toxicity (fungistatic / fungicidal) was determined by the method of Garber and Hauston (1959).

Killing time

The above mentioned oils and formaldehyde were taken at their MIC to determine the killing time

Table 3. Persistence of efficacy of essential oils and formaldehyde at different depths of soil against *Rhizoctonia solani*

Essential Oils/Chemical	Depth of Soil (cm)			
	1	2	3	4
Callistemone lanceolatus	-	-	-	-
Citrus medica	-	-	-	+
Eclipta alba	-	+	+	+
Hyptis suaveolens	-	-	+	+
Ocimum canum	-	-	+	+
Formaldehyde	+	+	+	+

growth observed - = growth not observed

f the test pathogen. Requisite amount of essential ils were dissolved in 0.5 ml acetone and then mixed ith 9.5 ml PDA. These plates were inoculated with discs (5 mm) of the test fungus and incubated. One isc from each plate was removed after 24,36,48 and 2 hours, washed with sterilised water and re-oculated to another set of PDA plates and incubated o observe growth, if any.

ersistence of efficacy

Small sterilised cotton plugs, soaked in equisite quantity of different oils and formaldehyde at their MIC) were separately kept at the bottom of 1 plastic containers (4 x 4 cm.) One cm sterilized oil was filled in these containers, leaving about 1 m unfilled space from the surface. Three discs (5 m) of actively growing *R.Solani* culture were covered with one cm sterilised soil. Culture discs were thus ept at different heights upto 4 cm and containers en covered with lids and incubated at 25 2°C upto illing time. After 24 hours all bits of *R. Solani* were emoved, washed and re-inoculated on PDA for bservation of growth. For *Hyptsis* and *Eclipa* oils he bits were removed after 48 hours.

n-vivo efficacy of essential oils and ormaldehyde

Soil, infested with 0.1 per cent, 10 day old noculum of *R.Solani*, grown on Jowar grains, was illed in earthern pots (capacity 250 g). Small cotton lugs, soaked in requisite amounts of different oils nd formaldehyde, were separately placed at different lepths (depending on *in-vitro* results), in the pots. he pots were covered with polythene sheets for 24 ours. These sheets were then removed and pots kept in the open for 24 hours so as to remove the vapours of essential oils and formaldehyde from soil. In these pots, 11 seeds/pot of tomato cv. Pusa Ruby and Chilli cv. Suryamukhi were separately planted in each pot equidistantly. Equal amount of water was used to irrigate the pots when require. Suitable control was also maintained alongwith treatments.

Results and Discussion

In the present work, essential oils from higher plants and formadehyde have been compared with a view to use them in the management of damping-off disease of tomato and chilli caused by *R. solani*. The MIC of essentials oils of *C. lanceolatus, C. medica, E. alba, H. suaveolens, O.canum* and formaldehyde is 5000, 1000, 3000, 5000, 500 and 700 respectively. These oils are fungicidal in nature at their MIC. However, the oil from *O. canum* is fungistatic upto 1000 (Table 1).

The result is slightly at variance with Thakur *et al.* (1989). As against 0.1 percent essential oil of *O. canum*, 0.2 percent essential oil checked the growth completely. Shukla *et al* (1990) reported identical results.

The essential oil of *C. medica* and *O. canum* completely inhibit the growth of the fungus within 24 hours. Essential oil of *C. lanceolatus* and formaldehyde take 48 hours for complete inhibition. Least effective are the essential of *H. suaveolens* and *E. alba* as they take 72 hours for complete inhibition of the fungal growth (Table 2).

Essential oil of *C. lanceolatus* is capable of penetrating upto 4 cm while that of *C. medica* is

Table 4. *In vivo* efficacy of *Callistemone, Citrus, Eucalyptus, Hyptis, and Ocimum* oils and Formaldehyde for control of damping-off disease of tomato (*Lycopersicon esculentum* M.)

Pathogen	Control		Treatment						% seedling mortality in inoculated control	% Seedling mortality in treatmnet						% Disease control					
	Un-ioculated	Ino-culated	CL	CM	EA	HS	OC	Fd		CL	CM	EA	HS	OC	Fd	CL	CM	EA	HS	OC	Fd
Rhizoctonia solani	11	4	8	6	6	7	9	5	63.64	27.28	45.47	45.47	36.37	18.18	54.55	57.13	28.56	28.56	42.86	71.44	14.29

CL = *Callistemone lanceolatus* EA = *Eclipta alba* OC = *Ocimum canum*
CM = *Citrus medica* HS = *Hyptis suaveolens* Fd = *Formaldehyde*

$$\text{Per cent seedling mortality} = 100 - \left[\frac{\text{Seedling stand in inoculated soil}}{\text{Seedling stand in uninoculated soil}} \times 100 \right]$$

$$\text{Per cent disease control} = 100 - \left[\frac{\text{\% disease in treated set}}{\text{\% disease in untreated control}} \times 100 \right]$$

Table 5. *In vivo* efficacy of *Callistemone, Citrus, Eucalyptus, Hyptis, and Ocimum* oils and Formaldehyde for control of damping-off disease of chillies (*Capsicum annum* L.)

Pathogen	Control		Treatment						% seedling mortality in inoculated control	% Seedling mortality in treatmnet						% Disease control					
	Un-ioculated	Ino-culated	CL	CM	EA	HS	OC	Fd		CL	CM	EA	HS	OC	Fd	CL	CM	EA	HS	OC	Fd
Rhizoctonia solani	11	5	8	7	6	9	10	6	54.55	27.28	36.37	45.46	18.19	9.1	45.56	49.9	33.33	16.67	66.67	83.32	16.67

CL = *Callistemone lanceolatus* EA = *Eclipta alba* OC = *Ocimum canum*
CM = *Citrus medica* HS = *Hyptis suaveolens* Fd = Formaldehyde

fective upto 3 cm. The least effective oil of *E. alba* uld inhibit the test organism upto 1cm only able 3).

Result of the pot experiment revealed that all e essential oils used as well as formaldehyde were le to control the damping-off disease of tomato and illi. Essential oils of *O. canum* and *C.lanceolatus*, owever, were much better than other chemicals used. able 4 and 5).

The present study clearly indicates the ossibility of effective exploitation of higher plants the management of damping-off disease of tomato d chilli.

ferences

ya, A. (1988). Control of *Phomopsis* fruit rot by leaf extracts of certain medicinal plants (Including microbes and fungi). (Purshotam Kuasik ed.) Today and Tommorrow's Printers and Publishers New Delhi:41-46.

ccioni, D.R.L., Deans, S.G. and Ruberto, G. (1995). Inhibitory effect of citrus fruit essential oil components on *Penicillium italicum* and *P. digitatum*. *Petrica* **5** : 177-181.

arber, R.H. and Houston, B.R. (1959). An inhibitor of *Verticillium alboatrum* in cotton seed. *Phytopathology*. **49** : 449-450.

Grover, R.K. and Moore, J.D. (1962). Toximetric studies of fungicidal action against brown rot organism, *Scloerotrium fructicola* and *S. laxa*. *Phytopathology*. **52** : 876-880.

Langenau, I.E.E. (1948). The examination & analysis of essential oils, synthetics and isolates. *In : The essential oils vol. I.* (E.Guenther, ed.), pp. 227-348.

Lingk, W. (1991). Health risk evaluation of pesticide contaminations in drinking water. *Gesunde Pflangen*. **43** : 21- 25.

Shukla, R.P., Singh, R.K. and Dwevedi, R.S. (1990). Toxicity of essential oils of against *Rhizoctonia solani kuhn* fungus causing sheath blight in rice. *International rice research Newsletter* **15** : 27

Singh, S.P; Rao, G.P. and Upadhayaya, P.P. (1998). Fungitoxicity of essentials oils of some plants against sugarcane pathogen. *Sugarcane* **2** : 14-17.

Thakur, R.N., Singh, P. and Khosla, M.K. (1989). In-viro studies on antifungal activities of some aromatic oils. *Indian Perfumer* **33** : 257 - 260.

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lime requirement methods for lateritic soils of 0rissa

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Abstract : The lime requirement of fourteen acid soils from Orissa as determined by calcium carbonate incubation method showed significant correlation with pH, product of increase in pH value due to liming and the organic matter content, clay content, exchangeable aluminium and exchange acidity but not with organic matter content or cation exchange capacity. Four lime requirement (LR) methods were evaluated regarding their suitability to these soils. Except Peech's method, the lime requirement as determined by the laboratory methods showed highly significant correlation with that obtained by $CaCO_3$ incubation. The New Woodruff did slightly better than Woodruff and SMP in estimating lime requirement and hence the New Woodruff may be recommended for adoption in routine soil testing work. *(Key words : Lime requirement, Lateritic soils)*

Lateritic region soils of Orissa are acidic and e productivity of the crops is affected severely. dicious application of lime is essential for the anagement of these soils. Laboratory procedure using various buffer solutions for rapid determination of lime requirement was developed by Woodruff (1948), Shoemaker *et. al.* (1961), Peech *et. al.* (1962) and Brown and Cisco (1984) but there seems to be