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PHYTOTOXIC PROPERTIES OF OILS (*Anethum* and *Cuminum*)

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ABSTRACT

During assay of phytotoxicity of oils and organoleptic tests, the oil fumigated fruits did not show any adverse symptoms on their peels and their flavour and taste were also found to be as normal fruits by prescribed fumigation technique. Moreover the effects of oils on seed germination, speed of germination index, seedling growth and external morphology of tomato plants has been observed and found that *Anethum* and *Cuminum*oils did not exhibit phytotoxic properties on their respective MICs after 1 hour of soaking with oils.

KEYWORDS: Oils, Toxicity, *Anethum* and *Cuminum*

Phytotoxic and off-odour effects of some prevalent synthetic fungicides have limited their use. One problem with these synthetic chemicals is that as their potency has been enhanced, so has been their side-effects, and also their cost (Tyler, 1992; Castro *et al.,* 1999; Falandysz, 2000; Kast-Hutcheson *et al.,* 2001;). In addition, synthetic fungicides can leave significant residues in treated commodities (Parmar and Devkumar, 1993; Fernandez *et al.,* 2001; Dogheim*et al.,*2002;). Lemongrass (*Cymbopogoncitratus*) essential oil was identified by GC–MS for their major compound constituents; six compounds representing 92.59% of the total essential oil were identified. The main constituent was citral (76.00%). In a laboratory bioassay, high concentration of essential oil significantly inhibited germination and seedling growth of *Echinochloa crus-galli* and affecting α-amylase activity of seeds.(pipet et.al 2013)

These hazardous chemicals are also present in ground water sources, through seepage into soil and reaches to rivers, the ponds and seas to make them poisoned. Recently, some toxic synthetic fungicides have been reported in cold and soft drinks in India with high concentrations. It is alarming for us to check the entry of such synthetics in our ecosystems by evaluating new sources (Anonymous, 2003). Over the past 50 years, more than 2000 plant species belonging to different families and genera have been reported to contain toxic principles that are effective against different pests. Such bioactive plant products are now a days used in pest management on large scale as botanical pesticides and are termed third generation pesticides. Among the well-represented plant pesticides is pyrethrum obtained from *Chrysantheum cinararaefolium,* which is mainly used as domestic insecticide because it is non-toxic to man and animals and is highly sensitive to light. Pyrethroids do not leave persistent residues and have a long record of safe use (Jacobson, 1976). Some of the natural pyrethroids have been used against lices and fleas in domestic as well as public buildings. It is also successfully used against mosquitoes, houseflies and other insects that spread diseases in animal and human beings. Recently, carvane, a monoterpene, standardized from essential oil of *Carumcarvi* has been introduced with the trade name TALENT in Netherlands, which has the ability to inhibit the sprouting of potatoes during storage and it also exhibited fungicidal activity in protecting the potato tubers from rotting (Anonymous, 1994) without exhibiting mammalian toxicity. This is an interesting approach in exploiting the plant products in enhancing the shelf life of stored fruits and vegetables from their microbial deterioration without altering the taste and quality of the treated commodities. Some essential oils have been reported as synergists in enhancing the insecticidal activity of pyrethrum. Combination of *Blumea* sp. andpyrethrum have been compared to piperonylbutoxide and pronounced variation in synergistic coefficient is recorded (Saxena and Koul, 1982). The pesticidal plant receiving global attention for the last two decades is the wonder tree of Indian origin Neem (*Azadirachtaindica*). Its seeds are a rich storehouse of over 100 teranortriterpenoids and diverse non isoprenoids. Neem based products have different modes of action and are medium to broad-spectrum insecticides. In addition, the neem products are harmless to humans and other mammals. The aqueous neem leaf extracts have shown inhibition to DNA polymerase enzyme of hepatitis B virus. Multinational firms from Japan, Germany and U.K. are trying to extract an enzyme from neem, which inhibits division of AIDS infected cells (Dev Kumar & Sukhdev, 1993). Therefore it is important to check the phytotoxicity of essential oil before use of oil as fungitoxic.

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MATERIALS AND METHODS

Effect of Oils on Treated Fruit Peel

The toxic effects of *A. graveolens* and *C. cyminum* oils were studied on fruit peel of tomatoes by fumigation & surface contact methods.

A. By Fumigation Method

Fresh fruits of harvested tomatoes were fumigated separately with each oil in plastic containers. Requisite amounts of oils of *Anethum* and *Cuminum* were introduced in plastic containers by soaking in cotton pieces so as to get final concentrations *viz*. 5, 10 and 25 % (v/v), respectively. In control set, fruits were placed in plastic containers without oils. The plastic containers were kept for 5 days in BOD incubator set at 25 ± 2^0C. The loss of the fruit tissue was measured (Table-1).

B. By Surface Contact Method

Fresh fruits of harvested tomatoes were taken from local market. The requisite amounts of each oil were dissolved separately in 0.5ml acetone and 9.5ml distilled water to prepare different / various concentrations *viz*. 5, 10, 25 % and was 2ml of prepared oil solutions were soacked in cotton pieces and were applied separately to the peel surface of fruits. In control sets, fruits were treated similarly with solution containing 0.5ml acetone and 9.5ml distilled water. The fruits were then kept in plastic containers for 5 days in BOD incubator at 25 ± 2^0C. The loss of the fruit tissues was measured (Table-1).

Table 1: Effect of Oils on Fruit Peels

Fruits	Fumigation Method							Surface Contact Method						
	Control	Treated with *Anethum* Oil			Treated with *Cuminum* Oil			Control	Treated with *Anethum* Oil			Treated with *Cuminum* Oil		
		5%	10%	25%	5%	10%	25%		5%	10%	25%	5%	10%	25%
Tomato	--	--	--	--	--	--	--	--	--	--	--	--	--	--

--, Indicates no effect on peel

++, Indicates adverse effect on peel of Tomato (reddish colour)

Effect on Seed Germination, Speed of Germination Index and Seedling Growth of Tomato

Requisite quantities of the oils were dissolved separately in 1 ml acetone and it was then pipetted in a flask containing requisite amount of distilled water so as to procure the 500 and 1000 ppm. 25 gm seeds of Tomato were soaked in these solutions separately for different intervals *viz.* 1, 2 and 3 hours. For controls requisite amount of sterilized water was used in place of oils and the seeds were soaked similarly. After soaking for requisite period 25 seeds were placed on two layered Whatman No.1 moistened filter paper in sterilized petriplates and their seed germination was recorded at regular intervals and the speed of germination index 'S' was computed as described by Bradbeer (1988) and Wardle *et al.* (1993) based on the following equation.

$$S = \frac{n_1}{1} + \frac{n_2}{2} + \frac{n_3}{3} + \frac{n_4}{4} + \frac{n_5}{5} + \cdots\cdots \times 100$$

where n_1, n_2, n_3, ... are the proportion of seeds germinated on days 1,2,3, ...

After the 10 days complete germination in control and treatment sets were converted in percent and seedling growth were also measured. The experiment was repeated for three times and data are presented in form of mean in Tables 2 &3. The data were analysed statistically using CD (Critical Difference) at 5% level of significance.

Table 2: Effect of *Anethum* oil on Seed Germination, Speed of Germination Index and Seedling Growth of Tomato Seeds at 10 days of Sowing

Conc. In ppm	Mean of % germination	Mean of speed of germination index	Mean length of seeding (mm)	
			Plumule	Redicle
After 1 hours soaking				
Control	72	67.46	4.1	5.37
500	69.33	64.35	3.58	4.85
1000	68	60.53*	3.78	4.82
CD at 5%	6.644	5.13	0.55	0.801
After 2 hours soaking				
Control	72	63.58	3.8	4.76
500	77.33	59.09	3.67	4.75
1000	64*	54.43*	3.34	4.01*
CD at 5%	5.912	7.43	0.417	0.713
After 3 hours soaking				
Control	76	66.67	4.17	5
500	78.67	59.79*	3.37*	4.38
1000	62.67*	56.24*	3.07*	3.95*
CD at 5%	4.091	2.59	0.545	0.92

*** Differences significant.**

Table 3: Effect of *Cuminum* Oil on Seed Germination, Speed of Germination Index and Seedling Growth of Tomato Seeds at 10 days of Sowing

Conc. In ppm	Mean of % germination	Mean of speed of germination index	Mean length of seeding (mm)	
			Plumule	Redicle
After 1 hours soaking				
Control	72	67.46	4.1	5.37
500	68	64.71	3.68	4.4
1000	65.33	60.62*	3.4	4.35
CD at 5%	12.03	4.5	0.717	1.71
After 2 hours soaking				
Control	72	63.58	3.8	4.76
500	69.33	55.27*	3.48	4.67
1000	65.33*	52.67*	3.13*	4.34
CD at 5%	4.09	5.25	0.382	0.961
After 3 hours soaking				
Control	76	66.67	4.17	5
500	68*	58.98*	3.32*	4.50*
1000	66.67*	57.14*	3.1*	4.44*
CD at 5%	6.98	5.82	0.47	0.341

*** Differences significant.**

Figure 1: Phytotoxic effects of *Anethum* and *Cuminum* oils on Tomato Seeds, treated with 500 ppm concentration of oils for 1 hour soaking

Effect on General Health and Morphology of Tomato

The solution of 500 ppm (MICs) of the *Anethum* and *Cuminum* oils were prepared by dissolving separately requisite quantity of oils in 1 ml of acetone and then taking in a flask containing requisite amount of distilled water. 1 gm seeds of Tomato were soaked, separately in these concentrations for 1 hour and then sown in earthen pots separately. For control sets seeds soaked only in requisite amount of distilled water containing acetone were sown. In general health and morphology of the plants and dipped sets were compared with those of control sets at their different growth stages.

RESULTS

Table 1 indicates that oils did not exhibit any adverse effect on peel of fruits up to 25% concentration by fumigation method. Morever, the oils could not exhibit any toxic effects on fruit peel up to 10% concentration by surface contact method though peeldiscolouration was observed by this method on 25% concentration.

It is evident from Table-2 and3 that the difference in speed of Germination Index, percent germination and seedling growth of Tomato in case of both the test oils at 500 ppm after 1 hour soaking are not significant on the basis of CD analysis. Therefore oils exhibited nonphytotoxic nature on MICs after 1 hour soaking (Fig.- 1). Moreover Speed of Germination Index and seedling growth are not significantly different at 1000 ppm after 1 hour soaking but oils significantly affect the percent germination of Tomato seeds at same concentration and same soaking time. Thus present study indicate the *Anethum* and *Cuminum* oils did not exhibit any phytotoxic effects upto their respective MIC(s) upto 1 hour soaking, beside of that oils exhibited phytotoxic effect at their increasing concentration and soaking times. Thus study indicates the phytotoxic effects of oils are dose and time dependent.

It was found that there was no visual abnormality in morphology of plants of dipped sets and the plants appeared as healthy as those of control sets, thereby further indicating the non-phytotoxic nature of the oils on recommended MICs concentration

DISCUSSION

Some higher plant products have proved their fruitfulness as promissing fungitoxicants due to their biodegradable nature (Beye, 1978) non-phytotoxicity and systemicity (Mishra & Dubey, 1994; Liu *et al.,* 2001a) and non-animal toxicity (Mishra *et al.,* 1992) and thus they can be exploited as natural fungitoxicants in place of the synthetic chemicals. Some plant products (essential oils) have recently proved their potentiality as natural fungicides in controlling the fungal rotting of some food and fruit commodities during storage (Dikshit*et al.*, 1983; Kishore *et al.*, 1993; Pandey, 2003; Agrawal, 2003).

The toxicity effect of *Anethum* & *Cuminum* oils were studied on fruit peel of tomato's by fumigation and surface contact methods ,obtained 5 to 10 % loss were present in controlled samples ,but no significant loss in treated sample following (mishra 1992).

Effect of *Anethum* & *Cuminum* oils were studied on seed germination, speed of germination index & seedling growth on tomato. Following (Badbeer & wardle ,1993) technique. experiment was reapeated three times and data were analysed statistically using CD (critical difference) at 5% level of significance, shows no significant effect on seed germination ,speed of germination index & seedling growth on tomato. Oils of *Anethum* and *cuminum* did not shows any significant effect on general health & morphology of tomato on solution of 500 ppm (MICs). Overall this study revals that *Anethum* and *Cuminum* oils did not show phytotoxicity on tomato.

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