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Aqueous extract effects of some common weed species against certain plant pathogenic fungi

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تأثيرات المستخلصات المائية لبعض الأعشاب الدخيلة على الفطريات المسببة لأمراض نباتية.

تم فحص التأثيرات المثبطة لأربعة و ستون نوعا عشبيا شائعا تنتمي لتسعة و عشرون عائلة نباتية ضد فطر البنيسيليوم ديجيتاتم و فطر سكلوروتينيا سكلوروشورم و فطر فيرتيسيليوم داليا و ذلك تحت ظروف المختبر. و قد أظهرت النتائج أن المستخلصات العشبية مختلفة في تأثيراتها المضادة للفطريات و في مثابرة تلك التأثيرات، كما أن التأثيرات المضادة للفطريات تختلف من نوع عشبي إلى آخر و من عائلة نباتية لأخرى. ومن بين جميع الأنواع العشبية التي تم فحصها فقد لوحظ أن مستخلصات عشب الرمرام و الحلاوي و الحوذان هي الأكثر تثبيطا لفطر السكلوروتينيا سكلوروشورم في حين أن مستخلصات الحلبلوب و اللزيق و الحويرنة و الحوذان كانت الأشد تثبيطا لنمو و تطور فطر الفيرتيسيليوم داليا. ولقد لوحظ أن المستخلصات المائية لعشب الحوذان كانت الأكثر تسمما للأنواع الفطرية الثلاث حيث منعت بشكل كامل نموها و إنتاج الأبواغ الفطرية طيلة فترة الحضانة.

الكلمات المفتاحية : السمية للفطريات – مستخلصات – بنيسيليوم ديجيتاتم – سكلوروتينيا سكلوروشورم – فيرتيسيليوم داليا – الأعشاب.

Effet des extraits aqueux de certaines adventices sur les champignons phytopathogènes

Les effets fongicides de 64 adventices fréquentes appartenant à 29 familles botaniques contre *Penicillium digitatum* Sacc., *Sclerotinia sclerotiorum* (Lib) De Bary et *Verticillium dahliae* Kleb ont été étudiés dans les conditions du laboratoire. Les extraits aqueux de plusieurs espèces de mauvaises herbes sont toxiques vis-à-vis de la croissance et/ou la sporulation des champignons étudiés. Cependant, les extraits aqueux de certaines espèces ont un effet stimulateur. L'activité fongicide et la persistance des extraits varient en fonction de l'espèce et de la famille botanique. *Chenopodium murale*, *Crepis aspera* et *Ranunculus asiaticus* ont des extraits plus toxiques sur *P. digitatum*. Cependant, les extraits d'*Enodium cruciatum*, *Euphorbia helioscopia*, *R. asiaticus* sont plus nocifs vis-à-vis de *S. sclerotiorum* alors que ceux d'*E. helioscopia*, *Galium tricornutum, Sisymbrium irio, R. asiaticus* sont plus nocifs vis-à-vis de *V. dahliae*. Les extraits de *R. asiaticus* ont été plus toxiques vis-à-vis des trois champignons étudiés (croissance et sporulation complétement inhibées durant toutes les périodes d'incubation).

Mots clés : Effet fongicide - Extraits - *Penicillium digitatum* - *Sclerotinia sclerotiorum* - *Verticillium dahliae* - Adventices

Aqueous extract effects of some common weed species against certain plant pathogenic fungi

Antifungal effects of 64 common weed species belonging to 29 plant families against *Penicillium digitatum* Sacc., *Sclerotinia sclerotiorum* (Lib.) De Bary, and *Verticillium dahliae* Kleb were investigated under laboratory conditions. Aqueous extracts of many weed species were toxic to growth and /or sporulation of one more of the tested fungi, while certain weed extracts showed stimulatory effects. Extracts were varied in their antifungal activities and in the persistence of their effects. Antifungal effects differ from species to species and from family to another. Among all species tested, the most toxic extracts were those of *Chenopodium murale*, *Crepis aspera* and *Ranunculus asiaticus* to *P. digitatum*. *Erodium cruciatum, Euphorbia helioscopia* and *R. asiaticus* to *S. sclerotiorum* and *E. helioscopia, Galium tricornutum, Sisymbrium irio* and *R. asiaticus* to *V. dahliae*. The extract from *R. asiaticus* was the most toxic to the three fungal species, and completely prevented their growth and sporulation at all periods of incubation.

Keys words : Fungi toxicity - Extracts - *Penicillium digitatum* - *Sclerotinia sclerotiorum* - *Verticillium dahliae* - Weeds

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INTRODUCTION

The important role that plants may play as a source of natural chemicals and their importance in controlling different agricultural pests is well documented (Frange, 1984 ; Rice,1986 ; Narwal, 1994). Many workers have reported antifungal activity of plant extracts, volatile materials or oils against different plant pathogenic fungi (Frange, 1984 ; Lapis & Dumancas, 1978 ; Guesin & Reveillera,1984 ; Akhtar *et al.*, 1986 ; Al Abed *et al.*, 1993) and recent studies on the subject emphasised the importance of natural chemicals as an alternative to synthetic pesticides in any future strategy for pest control (Beye,1978 ; Macias *et al.*, 1994 ; Singh, 1994).

Studies on the antifungal activities of plant species found in Jordan are in their infancy. Work on the possible antifungal effects of extracts of some of the most widely spread weed species is important in the search for less hazardous, cheaper and more selective chemicals.

MATERIALS AND METHODS

The effect of weed species on the growth and development of *Penicillium digitatum* Sacc. (causing green mold disease) from orange fruits, *Sclerotinia sclerotiorum* (Lib.) De Bary from eggplant shoots (causing cottony stem rot) and *Verticillium dahliae* Kleb from watermelon roots (causing wilt disease) was investigated under laboratory conditions. The shoots of 64 weed species belonging to 29 plant families were collected from different locations in the country and their aqueous extracts were tested for mycotoxic effects.

• Preparation of weed extracts

The shoots of different weed species were cut at various growth stages (Table 1). Samples (300 g) of the fresh shoots of each specie were first washed in running tap water and distilled water, then the plant material was placed in distilled water (1 L) and the mixture homogenized, using a Waring Blender, for five minutes. The mixture was then allowed to stand for half an hour. The supernatant was filtered through Whatman N° 1 filter paper followed by a membrane filter (0.2 µm to remove any bacterial or fungal contamination.

Fungi species selected for this study were *Penicillium digitatum* Sacc. from orange fruits, *Sclerotinia sclerotiorum* (Lib.) De Bary from eggplant shoots and *Verticillium dahliae* Kleb from watermelon roots.

Four discs (1 cm diameter) of each fungi specie, taken from 8 day old cultures, were placed in sterile Petri- dishes (11 cm diameter) containing 20 ml of sterile potato dextrose agar (PDA) medium and 3 ml extract of each weed species. The control treatment was 3 ml of sterile distilled water without any extract added.

The Petri-dishes were incubated for 16 days at 20°C (except for *V. dahliae* at 18°C) in the dark and then a visual estimation on the growth and spore formation of the tested fungi species, using 1-10 scale (with the lower score being most effective) was taken at 4, 8 and 16 days after incubation.

Treatments were arranged in a complete randomized block design with 4 replicates, all data were subjected to analysis of variance (ANOVA) and treatment means were compared using least significant differences (L.S.D. ; $P<0.05$).

RESULTS

Aqueous extract effects of different weed species on growth of the three fungi are shown in Table 1.

Many weed species showed antifungal activity against one or more fungi species. Extracts were different in the strength of their phytotoxic effects.

At 4 days of incubation, 52 weed species showed antifungal activity against *P. digitatum* and their extracts did significantly reduce its colony growth compared with the control. At 8 days of incubation, extracts of 20 species significantly reduced fungal growth while at 16 days, there were 18 species that showed inhibitory effect on this fungus. The most effective extracts were those of *C. murale, D. erocoides, P. rhoeas, R. asiaticus, S. irio* and *V. cruciatum* and at all periods of incubation.

Extracts of *C. iberica, C. murale, E. helioscopia, R. asiaticus, S.nigrum, S. palaestinum* and *V. cruciatum* strongly inhibited growth of *S. sclerotiorum* at all incubation periods. Colony growth reduction was more than 70% of the control. *E. cruciatum, Lamium sp.* and *S. arvensis* showed lower inhibitory effects.

Similar differences in the antifungal effects of extracts were obtained with *V. dahliae.*

Table 1.Visual estimation of the effect of shoot extracts of different weed species on the growth of *P. digitatum*, *S. Sclerotiorum* and *V. dahilae* at three dates of incubation [Nomenclature is that of Flora Palaestina, Zohary (1966)]

Family and Scientific name of weeds	Growth stage	*P. digitatum* Days of incubation			*S.sclerotiorum* Days of incubation			*V. dhaliae* Days of incubation		
		4	8	16	4	8	16	4	8	16
H_2O (Control)		6.3	8.7	9.3	8.7	8.7	10.0	1.7	2.7	8.7
Aristolochiaceae										
Aristolochia maurorum L.	Flowering	0.0	7.7	8.7	2.3	7.0	8.7	0.0	1.3	5.7
Asclepdaceae										
Calotropis procera Ait. Flt	Flowering	3.0	8.3	8.7	5.0	10.0	10.0	0.3	0.7	8.0
Boraginaceae										
Symphytum palaestinum Boiss	Flowering	1.0	7.3	8.3	1.3	2.3	2.3	1.4	4.0	4.0
Caryophyllaceae										
Cerastium dicotomum L.										
Stellaria media (L.) Vill	Flowering	1.3	8.3	9.7	8.3	8.7	9.0	1.0	2.7	6.3
Chenopodiaceae										
Atriplex leucoclada Boiss	Vegetative	0.0	9.7	10.0	7.0	9.0	9.0	2.0	2.0	2.0
Chenopodium murale L.	Flowering	0.7	2.3	4.3	1.7	1.7	2.0	1.0	1.7	8.3
Compositiae										
Anthemis cotula L.	Flowering	----	----	----	6.0	7.3	8.7	0.7	1.0	8.7
Calendula arvensis L.	Flowering	1.7	9.3	9.7	9.3	9.3	10.0	1.0	2.0	8.3
Carthamus nitidus Boiss	Vegetative	1.0	6.3	8.7	7.0	8.7	9.3	2.0	4.0	4.0
Centaurea iberica Spreng.	Flowering	----	----	----	2.7	2.7	3.0	0.3	1.0	8.7
Crepis aspera L.	Flowering	2.3	9.0	9.7	8.7	9.3	9.7	0.0	1.3	6.0
Gendelia tournefortii L.	Vegetative	3.3	10.0	10.0	8.3	8.3	8.7	0.7	1.0	7.7
Inula viscosa (L.) Cass	Vegetative	0.3	6.3	8.0	----	----	----	0.3	1.0	7.7
Notobasis syriaca (L.)Cass.	Vegetative	0.0	5.7	7.7	----	----	----	0.0	0.3	7.7
Onopordum jordanicolum Eig	Pre-flowering	0.3	7.3	8.7	6.3	8.0	8.3	0.0	1.7	7.0
Senecio vernalis L.	FLowering	0.3	9.3	9.7	3.7	8.3	9.3	0.3	1.3	7.3
Sonchus oleraceus L.	Flowering	0.3	6.0	8.0	7.7	10.0	10.0	0.3	1.0	4.7
Convolvulaceae										
Convolvulus althaeoides L.	Flowering	1.3	6.6	7.7	6.3	8.7	9.3	0.0	1.7	6.7
Convolvulus arvensis L.	Pre-flowering	0.0	8.3	9.0	7.0	7.7	8.0	0.7	2.0	6.7
Cruciferae										
Biscuttela didyma L.	Flowering	1.7	7.7	8.3	9.0	9.7	9.7	1.7	1.7	2.7
Capsella bursa-pastoris L.	Flowering	0.3	7.3	8.3	4.3	5.7	6.7	0.0	0.3	5.3
Cardaria draba (L.) Desv.	Vegetative	0.7	6.7	7.7	9.3	9.3	10.0	0.3	1.0	8.3
Diplotaxis erucoides (L.) DC.	Flowering	0.0	1.3	3.3	8.7	9.7	9.7	1.3	2.0	8.0
Eruca sativa Mill	Flowering	---	----	----	7.7	8.3	9.0	0.3	1.3	4.7
Erucaria hispanica (L.) Druce	Flowering	1.3	7.3	8.3	5.7	7.7	8.7	0.7	1.7	7.0
Sinapis arvensis L.	Flowering	1.3	6.7	8.3	3.7	5.3	5.3	1.0	2.0	6.7
Sisymbrium irio L.	Flowering	0.3	3.7	4.3	4.3	8.3	8.3	0.0	0.0	6.7
Cucurbitaceae										
Ecballium elaterium (L) Rich	Pre-flowering	3.0	8.7	9.0	7.0	7.0	7.7	1.0	2.0	7.7
Euphorbicaceae										
Euphorbia helioscopia L.	Flowering	0.0	7.0	8.0	1.3	2.0	2.0	0.3	1.7	4.3
Mercurialis annua L.	Seeding	0.3	4.7	8.3	8.3	8.3	8.7	0.3	1.0	8.7
Fumariaceae										
Fumaria densiflora DC	Earlyflowering	0.7	8.3	9.0	8.3	10.0	10.0	1.0	6.3	6.3
Geraniaceae										
Erodium cruciatum L.	Earlyflowering	----	----	----	2.7	4.3	4.7	0.0	1.0	7.7
Graminae										
Avena sterilis L.	Earlyseeding	0.0	6.3	8.3	----	----	----	----	----	----

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Family and Scientific name of weeds	Growth stage	*P. digitatum* Days of incubation			*Sclerotiorum* Days of incubation			*V. dahliae* Days of incubation		
		4	8	16	4	8	16	4	8	16
Lamiaceae										
Salvia sclarea L. Fresh	Vegetative	1.7	9.0	9.0	6.0	6.3	9.0	0.0	1.3	1.7
Lamium sp.	Flowering	0.0	5.0	8.0	2.7	3.3	3.7	0.7	2.3	6.7
Lamium amplexicaule	Flowering	1.0	3.7	9.7	6.0	10.0	10.0	1.3	3.0	3.0
Salvia sclarea L.	Flowering	1.0	7.0	8.0	6.7	9.3	9.7	1.0	1.7	6.7
Leguminosae										
Lupinus angustifolius L.	Flowering	3.3	9.7	9.7	7.3	7.7	8.7	3.1	1.5	4.0
Ononis antiquorum	Vegetative	---	--		5.0	9.0	9.3	0.0	1.5	1.0
Oleaceae										
Olea europaea subsp. *Europaea*	Flowering	---	--		8.0	9.0	9.3	1.0	2.0	9.7
Phillyrea angustifolia L. Wild	Vegetative	3.0	8.0	9.0				0.7	1.0	9.0
Orobanchaceae										
Verbascum sinuatum Seed	Preflowering	3.0	1.0	3.0	2.0	2.3	2.7	0.7	1.7	2.0
Malvaceae										
Malva sylvestris L.	Preflowering	3.0	8.0	9.0	----	----	----	0.3	0.7	7.7
Papaveraceae										
Papaver rhoeas L.	Flowering	2.3	5.0	5.3	5.7	10.0	10.0	0.3	1.3	7.7
Poaceae										
Scorpiurus muricatus L.	Flowering	0.0	5.0	7.7	3.0	5.3	9.0	0.7	1.3	7.7
Avena sterilis subsp. *ludoviciana* L.	Flowering	----	----	----	6.0	10.0	10.0	0.3	1.3	4.3
Plantaginaceae										
Plantago lanceolata L.	Flowering	0.0	1.3	6.0	6.7	7.0	7.0	0.0	0.7	1.3
Polygonaceae										
Polygonum aviculare L.	Early flowering	2.0	9.0	9.3	----	----	----	---	----	--
Rumex crispus	Vegetative	0.7	6.0	8.3	6.7	8.3	9.0	0.7	0.7	1.7
Primulaceae										
Anagallis arvensis L.	Flowering	8.3	10.0	10.0	7.3	7.7	8.7	0.0	1.3	1.7
Anagallis foemina Mill	Flowering	0.0	7.7	8.0	6.7	7.7	8.7	0.0	1.3	6.3
Ranunculaceae										
Ranunculus arvensis L.	Flowering	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rosaceae										
Potentilla supina L.	Flowering	----	----	-	8.3	9.3	9.0	0.0	0.3	0.4
Rubiaceae										
Galium tricornutum Dandy	Early flowering	3.7	9.0	7.0	--	---	---	2.0	2.3	3.3
Scrophulariaceae										
Scabiosa stellata L.	Fruiting	3.0	4.3	7.7	1.3	1.0	1.3	3.0	1.3	2.7
Umbelliferae										
Ammi majus L.	Flowering	3.7	7.3	8.3	8.7	10.0	10.0	0.3	0.7	7.3
Conium maculatum	Vegetative	3.3	7.3	8.7	9.0	10.0	10.0	0.7	1.3	7.7
Foeniculum vulgare Gaertn	Preflowering	7.7	8.7	9.3	5.7	7.7	8.7	1.3	2.0	7.7
Ferula communis L.	Preflowering	9.0	10.0	10.0	6.3	7.0	7.7	1.7	8.7	8.7
Foeniculum vulgare L.	Vegetative	3.7	8.3	9.0	7.7	8.3	9.3	0.0	1.0	5.3
Sandya peucedanoides L.	Flowering	1.0	6.7	8.3	5.3	8.0	9.3	0.0	1.3	6.7
Urticaceae										
Parietaria diffusa (L.) Koch.	Early flowering	3.0	4.7	7.3	5.7	9.3	9.7	0.0	0.3	2.3
Urtica urens L.	Flowering	1.7	7.7	8.7	9.7	9.3	9.3	0.3	0.7	4.3
LSD (P=0.5)		1.7	2.1	1.2	1.5	1.3	1.1	0.6	0.9	1.2

1-10 Scale where the lowest score denotes fungal growth while the highest score denotes healthy fungal growth

Table 1.Visual estimation of the effect of shoot extracts of different weed species on the growth of *P. digitatum*, *S. Sclerotiorum* and *V. dahliae* at three dates of incubation [Nomenclature is that of Flora Palaestina, Zohary (1966)] (continued)

Family and Scientific name of weeds	Growth stage	*P. digitatum* Days of incubation			*S.sclerotiorum* Days of incubation			*V. dhaliae* Days of incubation		
		4	8	16	4	8	16	4	8	16
Labiatae										
Ballota saxatilis C. Pres'	Vegetative	1.7	9.0	9.3	8.0	8.3	9.3	0.0	1.3	1.7
Lamium sp.	Flowering	0.3	6.3	8.0	2.7	3.3	3.7	1.7	2.3	6.7
Lamium amplexicaule L.	Flowering	1.3	9.7	9.7	8.0	10.0	10.0	1.3	5.0	3.0
Salvia syriaca L.	Flowering	1.3	7.3	9.3	8.7	9.3	9.7	1.3	1.7	8.7
Leguminosae										
Lupinus varius L.	Flowering	3.3	9.7	9.7	7.7	7.7	9.7	0.3	1.3	4.0
Ononis antiquorum	Vegetative	--	--	--	3.0	9.0	9.3	0.0	1.3	1.3
Liliaceae										
Bellevalia dubia Boiss	Flowering	--	--	--	6.0	8.0	8.3	1.0	2.0	8.7
Muscaria racemosum (L)Mill	Vegetative	0.0	8.0	9.0	---	--	---	0.7	1.0	5.3
Loranthaceae										
Viscum cruciatum Sieb	Pre-flowering	0.0	1.3	3.0	2.3	2.3	2.7	0.7	1.7	2.0
Malvaceae										
Malva sylvestris L.	Pre-flowering	3.0	8.0	9.0	---	---	---	0.3	0.7	7.7
Papaveraceae										
Papaver rhoeas L.	Flowering	2.3	5.0	5.3	5.7	10.0	10.0	0.3	1.0	7.7
Papilionaceae										
Scorpiurus muricatus L.	Flowering	0.0	5.0	7.7	9.0	9.3	9.3	0.7	1.0	7.7
Vicia narbonensis L.	Flowering	---	---	---	6.0	10.0	10.0	0.3	1.3	4.3
Plantaginaceae										
Plantago lanceolata L.	Flowering	0.0	1.3	6.0	6.7	7.0	7.0	0.0	0.7	1.3
Polygonaceae										
Polygonum aviculare L.	Early flowering	2.0	9.0	9.3	--	---	--	---	---	--
Rumex crispus L.	Vegetative	0.7	6.0	8.3	6.7	8.3	9.0	0.7	0.7	1.7
Primulaceae										
Anagallis arvensis L.	Flowering	8.3	10.0	10.0	7.3	7.7	8.7	0.0	1.3	1.7
Anagallis foemina Mill	Flowering	0.0	7.7	8.0	6.7	7.7	8.7	0.0	1.3	6.3
Ranunculaceae										
Ranunculus asiaticus L.	Flowering	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rosaceae										
Poterium spinosum L.	Flowering	--	--	---	6.3	8.3	9.0	0.0	0.3	0.4
Rubiaceae										
Galium tricornutum Dandy	Early flowering	0.7	5.0	7.0	---	---	---	2.0	2.3	3.3
Solanaceae										
Solanum nigrum L.	Fruiting	0.0	4.3	7.7	1.3	1.3	1.3	0.0	1.3	2.7
Umbelliferae										
Ammi majus L.	Flowering	0.7	7.3	8.3	8.7	10.0	10.0	0.3	0.7	7.3
Conium maculatum	Vegetative	0.0	7.3	8.7	9.0	10.0	10.0	0.7	1.3	7.7
Falcaria Vulgaris Bernh	Pre-flowering	7.7	8.7	9.3	5.7	7.7	8.7	1.3	2.0	7.7
Ferula communis L.	Pre-flowering	9.0	10.0	10.0	6.3	7.0	7.7	1.7	9.7	9.7
Foeniculum vulgare L.	Vegetative	0.7	8.3	9.0	7.7	8.3	9.3	0.0	1.0	6.3
Scandix pecten-veneris L.	Flowering	1.0	6.7	8.3	5.0	8.0	9.0	0.0	1.3	6.7
Urticaceae										
Parietaria diffusa (L.) Koch	Early flowering	0.0	4.7	7.3	5.7	9.3	9.7	0.0	0.3	2.3
Urtica urens L.	Flowering	1.7	7.7	8.7	8.7	9.3	9.3	0.3	0.7	4.3
LSD (P<0.5)		1.7	2.1	1.2	1.5	1.3	1.1	0.8	0.8	1.2

1-10 : Scale where the lowest score denotes no fungal growth while the highest score denotes that the Petri-dish was full of fungal growth

Table 1.Visual estimation of the effect of shoot extracts of different weed species on the growth of *P. digitatum*, *S. Sclerotiorum* and *V. dahilae* at three dates of incubation [Nomenclature is that of Flora Palaestina, Zohary (1966)] (continued)

Family and Scientific name of weeds	Growth stage	*P. digitatum* Days of incubation			*S.sclerotiorum* Days of incubation			*V. dhaliae* Days of incubation		
		4	8	16	4	8	16	4	8	16
Labiatae										
Ballota saxatilis C. Presl	Vegetative	1.7	9.0	9.3	8.0	8.3	9.3	0.0	1.3	1.7
Lamium sp.	Flowering	0.3	6.3	8.0	2.7	3.3	3.7	1.7	2.3	6.7
Lamium amplexicaula L.	Flowering	1.3	9.7	9.7	8.0	10.0	10.0	1.3	3.0	3.0
Salvia syriaca L.	Flowering	1.3	7.3	8.3	8.7	9.3	9.7	1.3	1.7	8.7
Leguminosae										
Lupinus varius L.	Flowering	3.3	9.7	9.7	7.7	7.7	9.7	0.3	1.3	4.0
Oninis antiquorum	Vegetative	----	----	----	3.0	9.0	9.3	0.0	1.3	1.3
Liliaceae										
Bellevalia densiflora Boiss	Flowering	----	----	----	8.0	8.0	8.3	1.0	2.0	8.7
Muscaria racemosum (L)Mill	Vegetative	0.0	8.0	9.0	----	----	----	0.7	1.0	5.3
Loranthaceae										
Viscum cruciatum Sieb	Pre-flowering	0.0	1.3	3.0	2.3	2.3	2.7	0.7	1.7	2.0
Malvaceae										
Malva sylvestris L.	Pre-flowering	3.0	8.0	9.0	----	----	----	0.3	0.7	7.7
Papaviraceae										
Papaver rhoeas L.	Flowering	2.3	5.0	5.3	5.7	10.0	10.0	0.3	1.0	7.7
Papilionaceae										
Scorpiurus muricatus L.	Flowering	0.0	5.0	7.7	9.0	9.3	9.3	0.7	1.0	7.7
Vivicia narbonensis L.	Flowering	----	----	----	6.0	10.0	10.0	0.3	1.3	4.3
Plantaginaceae										
Plantago lanceolata L.	Flowering	0.0	1.3	6.0	6.7	7.0	7.0	0.0	0.7	1.3
Polyginaceae										
Polygonum aviculare L.	Early flowering	2.0	9.0	9.3	----	----	----	----	----	----
Rumex crispus L.	Vegetative	0.7	6.0	8.3	6.7	8.3	9.0	0.7	0.7	1.7
Primulaceae										
Anagallis arvensis L.	Flowering	8.3	10.0	10.0	7.3	7.7	8.7	0.0	1.3	1.7
Anagallis foemina Mill	Flowering	0.0	7.7	8.0	6.7	7.7	8.7	0.0	1.3	6.3
Ranunculaceae										
Ranunculus asiaticus L.	Flowering	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rosaceae										
Poterium spinosum L.	Flowering	----	----	----	6.3	8.3	9.0	0.0	0.3	0.4
Rubiaceae										
Galium tricornutum Dandy	Early flowering	0.7	5.0	7.0	----	----	----	2.0	2.3	3.3
Solanaceae										
Solanum nigrum L.	Fruiting	0.0	4.3	7.7	1.3	1.3	1.3	0.0	1.3	2.7
Umbelliferae										
Ammi majus L.	Flowering	0.7	7.3	8.3	8.7	10.0	10.0	0.3	0.7	7.3
Conium maculatum	Vegetative	0.0	7.3	8.7	9.0	10.0	10.0	0.7	1.3	7.7
Falcaria Vulgaris Bernh	Pre-flowering	7.7	8.7	9.3	5.7	7.7	8.7	1.3	2.0	7.7
Ferula communis L.	Pre-flowering	9.0	10.0	10.0	6.3	7.0	7.7	1.7	8.7	8.7
Foeniculum vulgare L.	Vegetative	0.7	8.3	9.0	7.7	8.3	9.3	0.0	1.0	5.3
Sandix pecten-veneris L.	Flowering	1.0	6.7	8.3	5.0	8.0	9.0	0.0	1.3	6.7
Uriticaceae										
Parietaria diffusa (L.) Koch	Early flowering	0.0	4.7	7.3	5.7	9.3	9.7	0.0	0.3	2.3
Urtica urens L.	Flowering	1.7	7.7	8.7	8.7	9.3	9.3	0.3	0.7	4.3
LSD (P<0.5)		1.7	2.1	1.2	1.5	1.3	1.1	0.8	0.8	1.2

1-10 : Scale where the lowest score denotes no fungal growth while the highest score denotes that the Petri-dish was full of fungal growth

Out of 62 species tested for fungitoxic effects against this fungus, extracts of more than 40 weed species significantly reduced its colony growth compared with control. However, extracts of *A. arvensis, A. leucoclada, B. saxatilis, B. didyma, G. tricornutum, I. viscosa, L. amplexicaula, O. antiquorum, P. diffusa, P. spinosum, R. asiaticus, S. nigrum* and *V. cruciatum* were the most phytotoxic to the fungus and caused more than 60% growth inhibition compared with the control.

Fungitoxic effect of extracts on spore formation of *P. digitatum* and *V. dahliae* is shown in Table 2. Differences in the effect of various extracts on sporulation of *P. digitatum* were not clear at 4 days of incubation. However, at 8 days, they were 18 species inhibitory to spore formation and 24 species at 16 days of incubation. *C. murale, C. aspera, P. lanceolata, R. asiaticus, S. irio* and *V. cruciatum* extracts severeley reduced sporulation of this fungus compared with the control.

The effect of different extracts on sporulation of *V. dahliae* was clear at 4 days of incubation at which extracts of 40 weed species inhibited its spore formation. At 16 days of incubation period, there were 46 inhibitory weed species. The most effective extracts were those of *A. arvensis, B. saxatilis, O. antiquorum, P. Lanceolata* and *R. asiaticus.*

DISCUSSION

The study of the fungitoxic effects of aqueous shoot extracts from different weed species indicate the importance of many weed species as a possible natural source of fungitoxic materials (Tables 1 & 2).

Certain weed extracts inhibited growth and /or sporulation of one more fungi species tested. Antifungal effects of extracts of many plant species have been reported (Frange, 1984 ; Al Abed *et al.*, 1993 ; Singh, 1994). In the present study, extracts of some of the most common weed species showed antifungal activity. Among those were *A. arvensis, C. murale, I. viscosa, S. nigrum* and *R. asiaticus.*

Fungitoxicity of extracts of certain *Chenopodium* species against other plant pathogens have been reported (Dubey *et al.*, 1983 ; Rafik *et al.*, 1984), while results obtained with *R. asiaticus* confirmed the importance of *Ranunculus* species as plants exhibiting antifungal properties as *R. sclertatus , R. bulbosus* and *R. clematis* have also been reported to have antifungal properties (Misra *et al.*, 1974 ; Misra & Dixit, 1978 ; Mares, 1987).

Antifungal activity of *A. arvensis* and *I. viscosa* extracts against *Helminthosporium sativum* and *Fusarium oxysporum* have been also reported (Al Abed *et al.*, 1993). Results showed that extracts of different weed species varied in their antifungal potential. Such differences were to be expected since plants varied in their chemical constituent, habitats and growth stages at which they were collected. Differences in the nature and/or concentration of inhibitory materials even between different plant parts were found (Frange, 1984 ; Al Abed (1992).

Environmental conditions and growth habitats may greatly influence the production and concentration of inhibitory materials and the ability of plants to release them under stress conditions (Rice, 1984). Differences were also noticed among species of the same family as well as those of different families.

This may be due to differences in the nature and concentration of inhibitory chemicals between different plant species or to differences in their ability to diffuse through the growing medium and subsequently to inhibit fungus growth. Other researchers reported diffrences in the antifungal activities from species to species, genus to genus and from family to another (Al Abed *et al.*, 1993 ; Rizki *et al.*, 1984).

Extracts of certain weed species enhanced growth and/or sporulation of the fungus compared with the control. This stimulatory effect may be due to the presence of growth promoting substances or nutrients in their extratcts or to the stimulatory effect of growth inhibitors found at low concentration in plant tissues. Other researchers reported stimulatory effect of different plant extracts especially when low concentrations were used (Rizki *et al.*, 1984 ; Shakhawat & Prasada, 1971).

The antifungal effect of extracts reduced with incubation period for all species screened except that of *R. asiaticus.* This fate of chemical inhibitors may be due to the transformation of these materials to non toxic forms or the loss of some volatile inhibitors during the relatively long incubation period. Volatile materials of different plant species have been reported to have antifungal properties

Table 2. Visual estimation of the effect of shoot extracts of different weed species on the sporulation of *P. digitatum* and *V. dahliae* et three dates of incubation

Weed species	*P. digitatum* Days of incubation			*V. dahliae* Days of incubation		
	4	8	16	4	8	16
H_2O (control)	0.3	3.3	7.7	3.0	4.0	9.7
Aristolochiaceae						
Aristolochia maurorum	0.0	4.0	7.0	1.0	1.7	5.7
Asclepiadaceae						
Calotropis procera	0.3	6.0	6.7	1.0	3.0	8.7
Boraginaceae						
Symphytum palaestinum	0.0	6.3	7.3	0.0	0.3	4.3
Caryophyllaceae						
Cerastium dicotomum	0.0	5.7	7.7	0.7	1.7	7.0
Stellaria media	5.7	6.7	8.7	2.3	2.3	8.3
Chenopodiaceae						
Atriplex leucoclada	0.0	1.0	8.0	0.0	1.0	4.0
Chenopodium murale	0.6	0.3	2.3	2.0	2.7	9.3
Compositae						
Anthemis cotula	----	----	----	2.0	2.7	9.3
Calendula arvensis	0.0	5.3	7.7	2.3	3.3	9.3
Carthamus nitidus	0.6	3.7	6.7	2.7	3.7	4.7
Centaurea iberica	---	----	-----	1.7	4.0	9.3
Crepis aspera	0.0	0.3	2.3	2.0	3.0	8.0
Gendelia tournefortii	0.0	1.7	6.0	2.0	4.3	8.3
Inula viscosa	0.0	0.6	6.3	1.3	2.7	3.7
Notobasis syriaca	0.0	1.7	4.7	1.3	3.0	10.0
Onopordum jordanicolum	0.0	4.7	6.7	0.3	1.3	7.7
Senecio vernalis	0.0	1.7	8.7	0.3	1.0	7.7
Sonchus oleraceus	0.0	2.0	6.0	1.0	3.3	5.3
Convolvulaceae						
Convolvulus althaeoides	0..0	3.7	6.7	0.7	1.7	7.0
Convolvulus arvensis	0.3	4.7	7.3	2.7	3.0	7.7
Cruciferae						
Biscuttela didyma	0.0	2.7	7.3	2.7	3.3	3.7
Capsella bursa -pastoris	0.0	2.7	6.0	0.3	1.3	6.3
Cardaria draba	0.0	2.0	5.0	1.3	3.0	9.3
Diplotaxis erucoides	0.3	7.0	7.7	3.0	3.7	9.0
Eruca sativa	0.3	4.0	6.3	2.0	3.7	5.3
Erucaria hispanica	0.0	1.3	6.0	0.7	1.7	7.3
Sinapis arvensis	0.7	4.3	6.3	1.7	2.0	8.7
Sisymbrium irio	0.0	1.3	2.7	1.0	2.7	8.3
Cucurbitaceae						
Ecballium elaterium	0.0	1.0	6.3	2.0	3.0	8.3
Euphorbitaceae						
Euphorbia helioscopia	2.0	4.3	7.3	1.3	1.7	5.0
Mercurialis annua	0.0	1.0	5 .7	2.0	3.0	9.7
Fumariaceae						
Fumaria densiflora	0.0	1.0	5.0	2.7	3.3	6.3
Geraniaceae						
Erodium cruciatum	----	----	----	1.0	2.3	8.3
Graminae						
Avena sterilis	0.0	1.0	7.3	----	----	----

Table 2. Visual estimation of the effect of shoot extracts of different weed species on the sporulation of *P. digitatum* and *V. dahliae* et three dates of incubation (Continued)

Weed species	*P. digitatum* Days of incubation			*V. dahliae* Days of incubation		
	4	8	16	4	8	16
Labiatae						
Ballota saxatilis	0.3	7.0	7.3	0.7	2.3	3.0
Lamium sp.	0.0	1.0	6.7	3.3	4.3	7.3
Lamium amplexicaula	0.3	7.0	8.3	1.3	2.3	4.7
Salvia syriaca	0.3	1.7	7.0	2.7	3.0	9.7
Leguminosae						
Lupinus varius	0.0	5.3	7.7	2.0	2.7	5.3
Oninis antiquorum	----	----	----	0.0	0.7	2.7
Liliaceae						
Bellevalia densiflora	----	----	----	3.3	3.7	10.0
Muscaria racemosum	0.0	0.6	7.0	0.7	1.3	5.7
Loranthaceae						
Viscum cruciatum	0.0	0.3	2.3	2.3	3.0	4.0
Malvaceae						
Malva sylvestris	0.0	4.7	7.7	0.7	1.7	9.7
Papaviraceae						
Papaver rhoeas	0.3	4.7	4.7	1.7	4.0	8.3
Papilionaceae						
Scorpiurus muricatus	0.0	1.0	4.3	1.3	2.0	9.3
Vicia narbonensis	----	----	----	1.0	2.0	5.3
Plantaginaceae						
Plantago lanceolata	0.0	0.3	3.3.	0.0	0.7	3.3
Polyginaceae						
Polygonum aviculare	0.0	2.7	8.0	----	----	----
Rumex crispus	0.0	3.0	4.3	1.7	2.7	8.0
Primulaceae						
Anagallis arvensis	6.0	6.7	8.7	0.0	0.7	3.3
Anagallis foemina	0.0	4.0	6.7	0.7	1.0	7.7
Rununculaceae						
Ranunculus asiaticus	0.0	0.0	0.0	0.0	0.0	0.0
Rosaceae						
Poterium spinosum	----	----	----	0.7	3.0	4.7
Rubiaceae						
Galium tricornutum	0.3	7.7	8.3	2.0	3.0	4.3
Solanaceae						
Solanum nigrum	0.0	6.7	6.7	0.7	2.0	4.0
Umbelliferae						
Ammi majus	0.0	1.0	6.7	1.3	2.0	8.0
Conium maculatum	0.3	2.3	4.7	1.3	3.0	8.7
Falcaria vulgaris	8.3	8.3	8.3	2.3	2.3	8.0
Ferula communis	0.3	6.7	7.7	2.3	3.3	9.7
Foeniculum vulgare	0.0	6.7	7.3	1.7	3.3.	6.3
Scandix pecten- veneris	0.6	1.0	6.0	0.7	2.3	7.0
Urticaceae						
Parietaria diffusa	0.0	2.3	5.3	1.7	3.0	3.7
Urica uren	0.0	5.0	7.3	1.3	3.0	5.3
LSD (P <0.5)	1.1	1.8	1.2	1.2	1.1	1.2

1- 10 Scale where the lowest score denotes no fungal spores while the highest denotes that the petridish was full of fungal spores.

(Al Abed, 1992) and reduction in the phytotoxicity of plant extract with time has been well documented (Al Abed *et al.* , 1993 ; Dumancas, 1976 ; Chaturvedi *et al.*, 1987).

However, the persistance of inhibitory effect of *R. asiaticus* and to a less extent those of *C. murale* and *C. aspera* may be due to the high stability of inhibitory chemicals and less effect of incubation temperature on the activity of these inhibitors.

The effect of extracts on spore formation of the fungus is a useful indicator on the toxic effect they have against these fungus. This effect is of great importance for inhibiting fungi development and preventing them from successfuly completing their life cycles.

Extracts of certain species appeared to be highly selective against certain fungus while others such as *R. asiaticus* showed general effects. This confirm the previous speculation that the nature of inhibitory materials is different between species and reflects differences in their antifungal effects.

Plants were extracted in water and thus it is more likely that only water soluble inhibitors were dissolved. The solubility of chemical inhibitors of different weed species in water may be the reason behind the differences obtained in the antifungal activity of different extracts.

However, there is a good indication that many weed species contain water soluble antifungal material(s), and these could be easily extracted in water. This, however, did not negate the possible presence of other chemical inhibitors in plant tissues not soluble in water.

Our study was a premiminary one and as such avoided investigation using different organic solvents with their consequent complications.

CONCLUSION

This study showed that many weed species contain water soluble chemicals of antifungal properties in their tissues. Some of these proved to be good inhibitors to growth and /or sporulation one or more fungi species.

Extracts of *R. asiaticus* appeared to be highly effective against the three fungi and gave almost complete growth and sporulation inhibition. There is a great potential remaind to consider this study as a base to substantiate further work on the promosing extracts for further understanding the role that plants may play in the future for developing more safe and new natural pesticides.

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