Efficacy of Thirteen Species of Wild Flora as Soil Amendments in the Control of the Root-Knot Nematode, *Meloidogyne javanica* on Common Bean in Saudi Arabia

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ABSTRACT

Powders of the aerial parts of thirteen Saudi wild plant species namely: *Achillea fragrantissima, Anastatica hierochuntica, Brassica sinaica, Calotropis procera, Cleome rupicola, Ducrosia anethifolia, Fagonia bruguieri, Lactuca serriola, Pulicaria crispa, Reseda muricata, Salsola imbricata, Trichodesma africanum* and *Zygophyllum migahidii* were screened for their nematicidal activity towards the root-knot nematode (*Meloidogyne javanica*) infecting common bean cv. Strike in a pot experiment under greenhouse conditions (35±5°C). Plant powders were applied as amendments of nematode-infested soil at 0.3% (w/w), comparing to a treatment with the nematicide, Carbofuran 10%G (0.1g/pot), 7 days prior to planting. Nematode-free soil and nematode-infested soil were served as checks. All studied plant powders significantly reduced ($P \leq 0.05$) numbers of root galls, nematode egg masses, final nematode egg populations and reproduction factor on common beans, as compared to nematode check. Among them, *C. rupicola, S. imbricata, T. africanum* and *Z. migahidii* provided the maximum reductions of all disease parameters ranged from 82.0-96.4%, whereas *F. bruguieri* gave the minimum ones (33.9-40.4%). Meanwhile, application of Carbofuran 10% resulted in 88.0-90.8% reduction of all disease parameters. On the other hand, common bean growth of the most treatments significantly increased ($P \leq 0.05$), as compared to nematode check plants, and mostly to the nematicide-treated and healthy ones. Percentages of increase were ranged from 80.1 - 188.3% in shoots and 106.8 - 278.8% in roots. On the contrary, soil treatments with the powder of *A. hierochuntica* and *Z. migahidii*, showed little phytotoxicity symptoms on common beans. Powders of *C. rupicola, S. imbricata, T. africanum* and *Z. migahidii* achieved relative nematicidal efficacy ranged from 66.5 – 269.1% of Carbofuran 10%.

The current results recorded new wild plants in Saudi Arabia with a potential nematicidal activity against the root-knot nematode. They may be considering a safe source of new alternative nematicides.

INTRODUCTION

The root-knot nematode (*Meloidogyne* spp.) is a real threat and damaging pest of vegetable crops and many economic plants growing in Saudi Arabia and worldwide (Al-Hazmi *et al.*, 1995). Its management has been relied mainly on chemical nematicides, but due to the environment pollution caused as a result of repeated application of chemical pesticides, several attempts were devoted towards recent approaches for safe nematode management. Pesticidal chemicals of plant origin have received more attention by many researchers because of they are less concentrated than synthetic ones, biodegrade rapidly and they can be derived from renewable natural resources (Quarles, 1992).

In Saudi Arabia, little trials were carried out to study the nematicidal activity of indigenous wild flora. Study of Al-Rajhi *et al.*, (1997) revealed that *Juniperus polycarpos* and *Rhazya stricta* (plants wildly grown near Riyadh) have *in vitro* nematicidal properties towards *Meloidogyne javanica.* Similarly, Al-Yahya *et al.*, (2005) gave a short report on the nematicidal activity of 14 different species of Saudi wild plants against *M. javanica* under laboratory conditions.

Fortunately, Saudi Arabia is gifted by a great diversity of natural vegetations and wild plants in its deserts. Among the common plants wildly growing in Saudi deserts are: *Achillea fragrantissima, Anastatica hierochuntica, Brassica sinaica, Calotropis procera, Cleome rupicola, Ducrosia anethifolia, Lactuca serriola, Pulicaria crispa, Reseda muricata, Salsola imbricata, Trichodesma africanum, Fagonia bruguieri,* and *Zygophyllum migahidii* (Chaudhary, 1999; Chaudhary and Al-Jowaid, 1999).

Indeed, most of the above mentioned wild plants have therapeutic properties and traditionally used in the folk medicine to cure and/or reduce symptoms of various disorders including infectious diseases among Bedouins (Salamah *et al.*, 1989; Mossa *et al.*, 1991; Tanira *et al.*, 1994; Rahman *et al.*, 2004; Bogdadi *et al.*, 2007; Abdel-Sattar *et al.*, 2010; Ahmed *et al.*, 2010 and Maghraby *et al.*, 2010).

Nothing was found in the literature regarding the nematicidal activity of the most studied wild plants, except for *A. fragrantissima* (Oka *et al.*, 2000) and *C. procera* (Nandal and Bhatti, 1990; Rao *et al.*, 1996).

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However, some available informations concerning antimicrobial and/or toxic activities of these plants were reported. *A. hierochuntica* showed strong antibacterial, anticandidal and antifungal activities against certain species of Gram positive and Gram negative bacteria, *Candida* spp., and *Aspergillus* spp. (Mohamed *et al.*, 2000; Mohamed *et al.*, 2009).

Cleome rupicola (syn. *Cleome arabica*) is a wild plant with a distinct foetid smell. It has an effective antibacterial activity against *Klebsiella pneumoniae* and *Staphylococcus aureus* (Salamah *et al.*, 1989). Moreover, *C. arabica* and other *Cleome* species wildly growing in Saudi Arabia have antimicrobial, anthelmintic, antiseptic and toxic activities (Rahman *et al.*, 2004). Similarly, *D. anethifolia* have a strong aromatic odour and it has antimycobacterial, antifungal, antibacterial and anticandidal activities (Janssen *et al.*, 1984; Stavri *et al.*, 2003; Pirbalouti, 2009).

Crude methanolic extract of *L. serriola* posses antiplasmodial, antitrypanosomal and antilishmanial activities (Abdel-Sattar, *et al.*, 2010).

Pulicaria crispa (syn. *Francoeuria crispa*) is commonly named as Gethgath in Saudi Arabia. It has multiple antimicrobial and pesticidal activities including: antiplasmodial (Sathiyamoorthy *et al.*, 1999), insecticidal (Al-Doghairi and Elhag 2003), strong antibacterial and anticandidal (Bogdadi *et al.*, 2007) and anthelmintic activities (Maghraby *et al.*, 2010).

Extracts and the essential oil of *T. africanum* showed strong antibacterial, antifungal, anticandidal (Abd El-Moaty, 2009), antiplasmodial, antitrypanosomal and antilishmanial activities (Abdel-Sattar, *et al.*, 2010).

Beside the nematicidal activity of *A. fragrantissima* (Oka *et al.*, 2000), it has also antiplasmodial (Sathiyamoorthy *et al.*, 1999), antibacterial, antifungal and anticandidal activities (Al-Gaby and Allam, 2000).

Herein, we studied the nematicidal efficacy of thirteen species of Saudi wild plants against the root-knot nematode, *Meloidogyne javanica* infecting common bean (*Phaseolus vulgaris* L.) cv. Strike, comparing to the chemical nematicide Carbofuran 10%G under greenhouse conditions.

MATERIALS AND METHODS

Plant materials:

Fresh aerial parts of eleven species of Saudi wild plants belonging to nine families namely: *Brassica sinaica* (Brassicaceae), *Calotropis procera* (Asclepiadaceae), *Cleome rupicola* (Capparaceae), *Ducrosia anethifolia* (Apiaceae), *Fagonia bruguieri*, *Zygophyllum migahidii* (Zygophyllaceae), *Lactuca serriola*, *Pulicaria crispa* (Asteraceace), *Reseda muricata* (Resedaceae), *Salsola imbricata* (Chenopodiaceae) and *Trichodesma africanum* (Boraginaceae) were collected from different localities of western Riyadh deserts during the period from January-March, 2005. Dried whole plants of *Anastatica hierochuntica* (Brassicaceae) and aerial parts of *Achillea fragrantissima* (Asteraceace) were purchased from an herbal shop at Riyadh city. The studied plants were botanically identified according to descriptions given by Chaudhary, (1999) and Chaudhary and Al-Jowaid (1999), left to air drying on a clean bench at lab temperature for 10-15 days till complete dryness, well-ground in a coffee grinder and sieved through a 100 mesh stainless steel sieve (150μ pore aperture) to obtain the fine powders.

Nematode culture and inoculum:

The root-knot nematode, *Meloidogyne javanica* (Treub) Chitwood, originally isolated from severely galled eggplants grown in Riyadh, was cultured on tomatoes (*Lycopersicon esculentum* Mill.) cv. Marmande in the greenhouse for 60 days. For soil infestation, nematode eggs were extracted from galled tomato roots using 0.5% sodium hypochlorite (Hussey and Barker, 1973).

Experiment procedures:

Clean plastic pots of 14cm diam (ca. 1300g soil) were filled with a steam sterilized soil mixture of sand, silt, and ground peat moss (4:2:1, v:v:v). Soil mixture was weighted before placing in the pots. Powders of the studied wild plants at 0.3% w/w (4g/pot) were mixed thoroughly with the potted soils. For comparison, granules of the nematicide Carbofuran 10% (0.1g/pot) were mixed with a potted soil in a separate treatment. Each treated soil was thoroughly infested with 20ml of nematode eggs suspension containing 4500 eggs. Nematode-free soil and soil infested with nematode only were kept as checks. All treated pots were watered upto the field capacity for 7 days in order to decompose plant powders (Dahiya, 2003). Treatments were replicated five times and arranged in a complete randomized design on a clean bench in the greenhouse (air temperature 35±5°C). Following the 7 days of decomposition, each pot was planted with three common bean seeds, and seedlings were thinned to one/pot, three days after emergence and received their needs of water and fertilization. Fifty days after planting, plants were carefully uprooted and roots were gently washed with running tap water, stained for 15 minutes in an aqueous solution of Phloxine B (0.15g/L. water), then rewashed with running tap water to remove the residuals of stain and emphasize nematode egg masses for counting (Holbrook *et al.*, 1983). Numbers of root galls and nematode egg masses were counted using a hand counter. Moreover, final nematode egg populations (Pf) in the egg masses in common bean roots were extracted by the sodium hypochlorite method (Hussey and Barker, 1973) and counted, then nematode reproduction factor (Rf) was calculated (Oostenbrink, 1966). Fresh shoots and roots of common beans were weighted prior to root staining.

Statistical analysis:

Nematode disease parameters (including numbers of root galls, nematode egg masses, nematode Pf and Rf values) and plant growth parameters were subjected to the analysis of variance (ANOVA) using SAS software program (SAS, 1997). Means of all treatments were compared with Fisher's protected LSD at 5% level of probability.

RESULTS AND DISCUSSION

All tested plant powders achieved good control of *M. javanica* on common beans, as compared to nematode check plants. The percentages of nematode reduction ranged from (33.9 - 40.4%) for *F. bruguieri* to (88.2 - 96.4%) for *T. africanum*. Also, Carbofuran 10%G provided considerable nematode control ranged from 88.0 - 90.8% (Table 1).

Numbers of final egg populations (Pf) and reproduction factor (Rf values) of *M. javanica* greatly ($P \leq 0.05$) suppressed by soil treatment with all tested plant powders at 0.3% w/w (Table 1). Generally, these findings are similar to the results of Oka, *et al.*, (2001). They found that leaf powder of *Inula viscosa* (a wild plant from Palestine) when mixed to *M. javanica*-infested soil at a low concentration (0.1% w/w) greatly reduced the number of second-stage juveniles of the nematode in a sandy soil.

Soil treatment with powders of *A. fragrantissima* significantly reduced (60.6 – 68.6%) nematode infection on common beans. Nematicidal effects of *A. fragrantissima* essential oil on egg hatching and mobility of second stage juveniles of *M. javanica* under laboratory conditions were previously confirmed by Oka *et al.*, (2000). Moreover, powders of *B. sinaica* controlled *M. javanica* on common beans with acceptable reduction (48.5 - 61.4%). This result is agreed with that given by Ibrahim *et al.*, (1994), who found that soil amendment with powders of cauliflower leaves (*Brassica oleracea* var. *botrytis*) at 2% (w/w) gave a considerable reduction (72-80%) of *M. incognita* on corn. Also, soil treatment with chopped broccoli leaves (*Brassica oleracea* var. *botrytis*) at 2% (w/w) significantly reduced *M. incognita* and *M. javanica* infections on melon plants (Ploeg and Stapleton, 2001).

C. procera provided a satisfied reduction of *M. javanica* (61.7 - 67.6%) on common beans. This finding confirmed the earlier reports on the nematicidal potential of this plant in the management of root-knot nematodes on eggplant (Nandal and Bhatti, 1990) and tomato (Rao *et al.*, 1996).

Phytochemical constituents of the studied wild plants are summarized in Table 3. Chitwood, (2002) documented that naturally occurring phytochemicals antagonistic towards plant-parasitic nematodes found in higher plants are including: polythienyls; isothiocyanates and glucosinolates (from Brassicaceae); cyanogenic glycosides; polyacetylenes (from Asteraceae); alkaloids; fatty acids and their derivatives; essential oils; terpenoids; sesquiterpenoids; diterpenoids; quassinoids; steroids; triterpenoids; and phenolics. Therefore, it was suggested that nematicidal activity of the studies plants against *M. javanica* may be attributed to one or more of the listed phytochemical constituents (Table 3).

Growth parameters of common bean of the most treatments were significantly ($P \leq 0.05$) increased, as compared to nematode check plants and mostly to the nematicide-treated and healthy ones. Percentages of increase were ranged from 80.1 - 188.3% in shoots and 106.8 - 278.8% in roots (Table 2). On the contrary, powders of *A. hierochuntica* and *Z. migahidii* showed little phytotoxicity symptoms. Ibrahim and Ibrahim (2000) reported that leaf powders of *Eucalyptus* sp. and *Psidium guagava* caused phytotoxicity on common beans cv. Giza 3. Although, soil application with powders of *F. bruguieri* gave the minimum nematode reduction (Table 1), it greatly enhanced plant growth (Table 2). Therefore, it is suggested that increase in plant growth may attributed to nematode reduction caused by one or more of the phytochemical constituents (Table 3) and/or nutrients released during the decomposition of plant powders as organic soil amendments. It seemed that most studied plant powders improve soil fertility. Nematode suppression caused by organic soil amendments have a lot of possibilities including release of pre-excising nematicidal compounds in soil amendments, generation of nematicidal compounds such as ammonia and fatty acids during decomposition, increase in plant tolerance to nematode infection, and changes in soil physiology and structure that are unsuitable for nematode behavior (Oka, 2010).

Based on the relative efficacy of all studied plant powders to the nematicide, Carbofuran 10%G (Table 1), it is clear that *T. africanum* was the best plant in suppressing nematode infection on common beans with respectable nematicidal efficacy (101.1–269.1%), followed by *C. rupicola*, *S. imbricata* and *Z. migahidii* with nematicidal efficacies ranged from 66.5–102.4%. On the other hand, *P. crispa* and *R. muricata* gave a nematicidal efficacy slightly less than half (33.8-44.4%) of the nematicide.

Table 1. Effect of powders of thirteen species of Saudi wild plants as soil amendments at 0.3% (w/w) and Carbofuran 10%G (0.1g/pot) on root galling and reproduction of *Meloidogyne javanica* (*Mj*) on common bean cv. Strike, 50 days after planting in nematode-infested soil under greenhouse conditions (35±5°C)

Treatment	No. of root galls	Reduction (%)	No. of egg masses	Reduction (%)	Pf	Rf	Reduction (%)	Relative efficacy*		
								No. of root galls	No. of egg masses	Rf
Nematode check (*Mj* only)	312.4 a	—	287.0 a	—	105597 a	23.47 a	—	—	—	—
Carbofuran 10%G +*Mj*	37.4 h	88.0	29.6 g	89.7	9704 g	2.16 g	90.8	—	—	—
Achillea fragrantissima +*Mj*	123.0 d	60.6	113.0 d	60.6	33226 e	7.38 e	68.6	30.4	26.2	29.3
Anastatica hierochuntica +*Mj*	166.0 c	46.9	149.8 c	47.8	59646 c	13.25 c	43.5	22.5	19.8	16.3
Brassica sinaica +*Mj*	160.8 c	48.5	142.6 c	50.3	40796 d	9.07 d	61.4	23.3	20.8	23.8
Calotropis procera +*Mj*	101.2 e	67.6	93.4 e	67.5	40395 d	8.98 d	61.7	37.0	31.7	24.1
Cleome rupicola +*Mj*	53.6 g	82.8	39.8 g	86.1	12135 g	2.70 g	88.5	69.8	74.4	80.0
Ducrosia anethifolia +*Mj*	164.0 c	47.5	154.4 c	46.2	56480 c	12.55 c	46.5	22.8	19.2	17.2
Fagonia bruguieri +*Mj*	186.2 b	40.4	173.2 b	39.7	69788 b	15.51 b	33.9	20.1	17.1	13.9
Lactuca serriola +*Mj*	119.6 d	61.7	102.6 de	64.3	40108 d	8.91 d	62.0	31.3	28.8	24.2
Pulicaria crispa +*Mj*	87.0 f	72.2	77.0 f	73.2	28811 ef	6.40 ef	72.7	43.0	38.4	33.8
Reseda muricata +*Mj*	84.2 f	73.0	70.0 f	75.6	26540 f	5.90 f	74.8	44.4	42.3	36.6
Salsola imbricata +*Mj*	38.6 h	87.6	30.0 g	89.5	10788 g	2.40 g	89.8	96.9	98.7	90.0
Trichodesma africanum +*Mj*	37.0 h	88.2	11.0 h	96.2	3765 h	0.84 h	96.4	101.1	269.1	257.1
Zygophyllum migahidii +*Mj*	56.2 g	82.0	37.4 g	87.0	9507 h	2.11 g	91.0	66.5	79.1	102.4

- Data are means of five replicates.
- Values within each column followed by the same alphabetical letter(s) are not significantly different according to Fisher's protected LSD at $P = 0.05$.
- Pf = final nematode egg population.
- Rf = nematode reproduction factor = Pf/Pi, where Pi=initial nematode egg population (4500 egg).
- * Relative efficacy (%) of plant powders, as compared to the nematicide (Carbofuran 10%G) = [1 – (Treatment – Nematicide / Treatment)] X 100.

Table2. Effect of powders of thirteen species of Saudi wild plants as soil amendments at 0.3%(w/w) and Carbofuran 10%G (0.1g/pot) on growth of common bean cv. Strike, 50 days after planting in *Mj*-infested soil under greenhouse conditions (35±5°C)

Treatment	Fresh weight (g)			
	Shoot	Increase (%)*	Root	Increase (%)
Nematode check (*Mj* only)	2.06 g	–	1.32 i	–
Healthy plants (nematode-free)	3.08 ef	49.5	2.25 gh	70.5
Carbofuran 10%G + *Mj*	3.06 ef	48.5	2.00 h	51.5
Achillea fragrantissima + *Mj*	4.56 bc	121.4	3.13 ef	137.1
Anastatica hierochuntica + *Mj*	2.52 fg	22.3	2.19 gh	65.9
Brassica sinaica + *Mj*	4.87 bc	136.4	4.09 bcd	209.8
Calotropis procera + *Mj*	5.00 bc	142.7	4.61 abc	249.2
Cleome rupicola + *Mj*	5.33 ab	158.7	4.01 cd	203.8
Ducrosia anethifolia + *Mj*	4.49 cd	118.0	3.55 de	168.9
Fagonia bruguieri + *Mj*	5.94 a	188.3	4.73 ab	258.3
Lactuca serriola + *Mj*	5.87 a	185.0	5.00 a	278.8
Pulicaria crispa + *Mj*	4.84 bc	135.0	3.86 d	192.4
Reseda muricata + *Mj*	4.55 bc	120.9	3.09 ef	134.1
Salsola imbricata + *Mj*	3.71 de	80.1	2.73 fg	106.8
Trichodesma africanum + *Mj*	4.47 cd	117.0	3.67 de	178.0
Zygophyllum migahidii + *Mj*	3.13 ef	51.9	1.68 hi	27.3

- Data are averages of five replicates.
- Values within each column followed by the same alphabetical letter(s) are not significantly different according to Fisher's protected LSD at $P= 0.05$.

* Increase (%) = ($G_T - G_N / G_N$) X 100, where G_T = growth of the treatment and G_N = growth of the nematode check.

These results are in agreement with those given by Ibrahim and Ibrahim (2000), who found that soil treatment with powders of the air-dried brown alga *Botryocladia cappilaceae*, leaves of *Psidium guajava*, and cattle and chicken manures at 2% (w/w) gave a relative efficacy in suppressing *M. incognita*-infection on common beans approximately the same as the nematicide Carbofuran 10% applied at 0.2g/pot.

It is worth mentioning that application of these plant powders on a large scale under field or greenhouse conditions may have two constraints. First, we need great amounts of these plants and this is, sometimes, unavailable. Second, some species of wild plants, especially those grown on sludge or waste materials, have an ability to accumulate certain heavy metals toxic to plants such as Cu, Zn, Pb, Cd, Cr and Ni (Porębska and Ostrowska, 1999). Therefore, the adverse effect of *Z. migahidii* on the growth of common beans in the current study probably attributed to the presence of some heavy metals in its tissues. Studies of Taia and El-Ghanem (2004) confirmed the presence of significant concentrations of Cu and Zn among mineral contents of *Z. migahidii* wildly grown in Riyadh, Saudi Arabia. On the other hand, some wild plants have allelopathic and toxic effects on other plants. It was found that shoot aqueous extract of *A. hierochuntica* inhibited seed germination, seedling growth, and cell division of certain plant species under laboratory conditions (Hegazy *et al.*, 1990). This observation may explain the phytotoxicity symptoms of *A. hierochuntica* appeared on common beans in the present study.

Lastly, wild plants with effective nematicidal activity in the current study should be subjected to further research works to investigate chemical structure of their bioactive constituent(s) with nematicidal activity, their mode(s) of action, and possibility of formulation.

We believe that natural wild vegetations still have a lot of hidden secrets and great benefits to human phytotherapy and nematode management.

Table 3. Phytochemical constituents of the studied wild plants that responsible for their biological activities and may involve in their nematicidal activity

Wild plant / Family	Phytochemical constituents	Reference(s)
Achillea fragrantissima (Asteraceae)	Glaucolides, sesquiterpene lactones, flavonoids, alkaloids, tannins, saponins, phenolic compounds and essential oil.	Abel-Mogib *et al.*, (1989) Al-Gaby and Allam, (2000) Al-Nowaihi *et al.*, (2005)
Anastatica hierochuntica (Brassicaceae)	Tannins, sterols, terpenes, flavonoids, alkaloids, saponins, resins, phenols and glycosides.	Mohamed *et al.*, (2000) Mohamed *et al.*, (2009)
Brassica sinaica (Brassicaceae)	Not available in the literature, but generally *Brassica* species contain glucosinolates and isothiocyanates. In addition, phenols and ascorbic acid in their tissues may compliment the activity of glucosinolates.	Chitwood, (2000) Antonious *et al.*, (2009)
Calotropis procera (Asclepidaceae)	Alkaloids, cardiac glycosides, tannins, saponins, flavonoids, sterols and/or triterpenes.	Mossa *et al.*, (1991) Tanira *et al.*, (1994)
Cleome rupicola (Capparaceae)	Saponins, flavonoids, tannins, terpenes and/or sterols.	Tanira *et al.*, (1994)
Ducrosia anethifolia (Apiaceae)	Prenylated furanocoumarin pangelin and essential oil consisted of 20 compounds with majority of α-pinene (12.4%), n-decanal (70.1) and dodecanal (5.4%).	Janseen, *et al.*, (1984) Stavri *et al.*, (2003) Hajhashemi *et al.*, (2010)
Fagonia bruguieri (Zygophyllaceae)	Diterpenes, flavonoids and phenolics.	Abdel-Kader *et al.*, (1993) Tawaha *et al.*, (2007)
Lactuca serriola (Asteraceae)	Alkaloids, flavonoids, saponins and sesquiterpene lactones.	Mojab *et al.*, (2003) Michalska *et al.*, (2009)
Pulicaria crispa (Asteraceae)	Sesquiterpene lactones, kaurane glycosides, sesquiterpenes, monoterpenes, flavonoids, tannins, sterols, saponins, essential oil and phenolics.	Abdel-Mogib, *et al.*, (1990) Ahmed *et al.*, (2010) Liu *et al.*, (2010)
Reseda muricata (Resedaceae)	Flavonoids and phenolic acids.	El-Sayed *et al.*, (2001)
Salsola imbricata (Chenopodiaceae)	Alkaloids, coumarins, saponins, sterols and/or terpenes.	Al-Saleh, *et al.*, (1997)
Trichodesma africanum (Boraginaceae)	Essential oil, steroids, coumarins, flavonoids, phenolics, alkaloids and glycosides.	Abd El-Moaty, (2009)
Zygophyllum migahidii (Zygophyllaceae)	Not available in the literature, but generally *Zygophyllum* species contain glycosides and triterpenoid saponins in their tissues.	Hassanean *et al.*, (1993) Elgamal *et al.*, (1995)

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الملخص العربي

فعالية ثلاثة عشر نوعاً من النباتات البرية كمحسنات للتربة في مكافحة نيماتودا تعقد الجذور *Meloidogyne javanica* على نباتات الفاصوليا بالمملكة العربية السعودية

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تمت دراسة فعالية إضافة مساحيق المجاميع الخضرية لثلاثة عشر نوعاً من النباتات البرية بالمملكة العربية السعودية، كمحسنات للتربة، لمكافحة نيماتودا تعقد الجذور *Meloidogyne javanica* على نباتات الفاصوليا (صنف Strike) تحت ظروف الصوبة الزجاجية (درجة حرارتها ٣٥±٥°م). النباتات المختبرة هي كالآتي: *Achillea fragrantissima*، *Anastatica hierochuntica*، *Brassica sinaica*، *Calotropis procera*، *Cleome rupicola*، *Ducrosia anethifolia*، *Fagonia bruguieri*، *Lactuca serriola*، *Pulicaria crispa*، *Reseda muricata*، *Salsola imbricata*، *Trichodesma africanum*، *Zygophyllum migahidii*. تم خلط المساحيق النباتية بالتربة الملوثة بالنيماتودا بتركيز ٣,٠٪ (وزن/وزن)، قبل الزراعة بإسبوع. كانت هناك معاملة- للمقارنة- بالمبيد النيماتودي كاربوفيوران ١٠٪ (١,٠جم/الأصيص)، إضافة إلى معاملتين أخريتين كشواهد أحداها لنباتات سليمة والأخرى لنباتات مصابة بالنيماتودا فقط. أظهرت النتائج أن جميع المساحيق النباتية المستخدمة أدت إلى خفض معنوي في أعداد كل من العقد الجذرية، كتل البيض، عدد البيض النهائي، وقيم عامل تكاثر النيماتودا المختبرة على جذور نباتات الفاصوليا، مقارنة بالنباتات المصابة بالنيماتودا فقط.

سجلت مساحيق نباتات *C. rupicola*، *S. imbricata*، *T. africanum*، *Z. migahidii* أعلى نسبة خفض في المقاييس المرضية المذكورة تراوحت بين ٨٢,٠ – ٩٦,٤٪، بينما كانت أقل نسبة خفض (٣٣,٩ – ٤٠,٤٪) لمسحوق نبات *F. bruguieri*. وقد تسببت المعاملة بمبيد كاربوفيوران ١٠٪ في خفض كبير في مقاييس الإصابة تراوح بين ٨٨,٠-٩٠,٨٪. من ناحية أخرى أدت معظم المعاملات إلى زيادة معنوية في نمو نباتات الفاصوليا تراوحت بين ٨٠,١-١٨٨,٣٪ في المجموع الخضري، ١٠٦,٨-٢٧٨٪ في المجموع الجذري مقارنة بالنباتات المصابة بالنيماتودا، وكذلك بالنسبة للنباتات المعاملة بالمبيد النيماتودي والأخرى السليمة. وعلى النقيض من ذلك، لوحظت أعراض سمية نباتية قليلة على نباتات المعاملات بمساحيق كلاً من النباتين *A. hierochuntica*، *Z. migahidii*.

حققت مساحيق نباتات *C. rupicola*، *S. imbricata*، *T. africanum*، *Z. migahidii* فعالية إبادية للنيماتودا تراوحت نسبتها بين ٦٦,٥ – ٢٦٩,١٪ من فعالية مبيد كاربوفيوران ١٠٪.

تعتبر تلك الدراسة بمثابة التقرير الأول عن نباتات برية جديدة بالمملكة العربية السعودية لها تأثير إبادي لنيماتودا تعقد الجذور، والتي ربما تكون مصدراً لمبيدات نيماتودية بديلة آمنة على البيئة والإنسان.