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Evaluation of Biofumigation Effects on Controlling Root-Knot Nematode, *Meloidogyne Incognita* (Kofoid and White) Chitwood, Infecting Pepper Plants (*Capsicum annuum* L.)

Shimaa M. A. Mohamed[1*]; Kh. A. Khatab[2]; Sahar H. Abdel-Baset[3] and A. A. ElSharawy[4]

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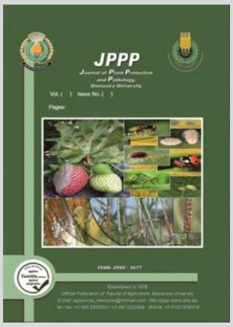
[1]Plant Production Department. Fac. Environmental, Agricultural, Sciences, Arish University, Egypt, Al Arish- 45516, Egypt
[2]Soil, Water and Environ. Res., Institute, Agric. Res. Center, Giza, Egypt.
[3]Department of Nematode Diseases Research, Plant Pathol. Res. Inst., Agric. Res. Centre, Giza, Egypt.
[4]Plant Pathology Lab., Plant Production Department, Faculty of Environmental Agricultural Science, Arish University, Al Arish-45516, Egypt



ABSTRACT

Six fresh brassica biofumigants—including three cultivated and three wild plants: radish (Raphanus sativus L.), arugula (Eruca vesicaria (L.) Cav.), and white mustard (Sinapis alba L.) were mixed with loamy sand soil in pots at a rate of 2 % (w/w) to control the root-knot nematode *Meloidogyne incognita* (Kofoid and White)Chitwood infecting pepper plants, *Capsicum annuum* L**.** Results revealed that chopped brassica of the six evaluated plants significantly ($P \leq 0.05$) reduced all nematode parameters i.e. number of galls and egg masses , full- grown females , developmental stages in the root system ,number of eggs/egg mass , number of juveniles /250 g soil, final nematode population (Pf) and reproduction factor (RF) compared to control treatment. A significant reduction in Pf and RF was detected in the wild radish treatment (74.72and74.70%), similar to the oxamyl chemical synthetic nematicide (81.72 and 81.00%), respectively.. All brassica treatments significantly improved the growth of pepper plants compared to the control with varying degrees of effectiveness . The study showed that all brassica biofumigants markedly increased the available N, P and K in the soil leading to higher levels of these nutrients in pepper plants. The highest enhancement was obtained when pepper plants were treated with wild radish followed by common cultivated radish treatment. It seems that soil biofumigation with chopped brassica plants may consider ecofriendly and economic measure in controlling root-knot nematodes on pepper, especially in organic farming practice conditions.

Keywords: Biofumigation ,brassicas , root -knot nematodes, control , pepper plants, NPK.

INTRODUCTION

Root-knot nematodes (*Meloidogyne* spp.) are considered, the main agents that damage crops worldwide ,among all plant-parasitic nematodes (Saucet *et al.*, 2016).Most cultivated plant species are susceptible to root-knot nematode infection (Sasser and Carter, 1985).They attack more than 2000 plant species including vegetables . Infected plants are subjected to vascular damage, with disturbing of water and nutrient absorption (Abd- Elgawad and Aboul-Eid,2001and Luc *et al.*, 2005). Plant-parasitic nematodes damage economically significant crops and cause substantial yield loss and decreased agricultural production (Schleker *et al.*, 2022). *Meloidogyne* species induce reductions in plant yield, chlorosis, wilting, root galling, and leaf nutritional deficits. It has been demonstrated that root gall formation limits the intake of water and nutrients, resulting in wilting, mineral shortages, reduced plant growth and decreased plant biomass and production (Abd-Elgawad , 2021).The most effective measures for controlling root_knot nematodes are chemical nematicides. The detrimental impacts of such nematicides on the environment and public health have necessitated a reevaluation of other strategies. Biofumigation is a method used to suppress soil-borne pests and diseases by incorporating fresh plant biomass into the soil and covering it with polyethylene material for two to three weeks (Sowmya et al., 2023).Biofumigation has been show promising measure as a sustainable management for plant- parasitic nematode (Bello *et al.*2004 and Ploeg, 2008）.Biofumigation occurs when pesticidal properties volatile compounds are released during plant material decomposition (Halbrendt, 1996; Kirkegaard & Sarwar, 1998; and Bello *et al.*,2004) .However, the main biofumigants research has focused using brassicaceous crops (Kirkegaard and Mathiessen,2004). During disruption of the brassicaceous tissues, glucosinolates produce isothiocyanate ,biocidal compounds which released in the soil (Brown and Morra*,* 1996).The suppressive effects of using brassicaceous as biofumigants on soil borne pathogens, weeds and plant-parasitic nematodes, has been studied in laboratory, greenhouse and field conditions (Ploeg and Stapleton, 2001; Ploeg, 2008 and Zasada *et al.*, 2003).The. The glucosinolate hydrolysis products refer to the term biofumigation via isothiocyanates formation which is used to control soil-borne pests and pathogen. The biocidal volatiles released from brassica green manure or seed meal amendments incorporated into the soil (Mathiessen and Kirkegaard,2006). Sulfur -containing volatile compounds in Brassicaceae plants have been reported to have great potentiality in–reducing *Meloidogyne* spp. population via biofumigation (Curto *et al*, 2005 and Monfort *et al.*, 2007）. Oliveira *et al.*, (2011), found that Brazilian wild mustard amended in soil resulted in nematicidal effect on *M. incognita.* Lopez- Perez *et al*, (2010) found that broccoli

* **Corresponding author.**
E-mail address: Shimaaaa2509@gmail.com
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incorporation to the soil reduced 36% root galling on tomato. Green manure brassica incorporation lowered nematode populations and root damage *M.incognita* which were higher than non-brassica species. The nematocidal effect was found variable among different *Brassica* species (Morra and Kirkegaard, 2002; Zasada *et al*.,2003;Monfort *et al*.,2007; Avato *et al.* , 2013 and Ntalli & Caboni ,2017). Zasada *et al.,* (2010), indicated that nematode suppressive effect of brassica has met with variable results, which could be due to some factors as glucosinolate profile content in the tissues of the biofumigants plant. Sarikamis *et al.,*(2017), found that radishes may have a more biofumigation effects than other brassica plants if used as a green manure . Biofumigation effect of Brassicaceae material depends mainly on glucosinolate content as well as chemical profile, which depended on plant species genotype, environment, phenological stage and tissue. The wide range of the previous studies could provide an important tool to select brassica plants with highly nematicidal potential to target organisms (Avato *et al.*,2013).

The aim of the current investigation was to determine the effect of six brassica plants including wild and common cultivated varirties against root knot nematode, *M. incognita* infecting pepper plants.

MATERIALS AND METHODS

The current study was carried out during 2022/2023 at Agriculture Research Station , Ismailia Governorate , Egypt to evaluate six brassica biofumigants included both common cultivated and wild plant green manures on pepper plants (*Capsicum annuum* L.) cv. Balady under greenhouse conditions. Multiplication of *Meloidogyne* spp. was performed as follows:galled tomato plant roots were washed with flow of water to remove soil particles . Each egg-mass collected by using special needle. The pure culture of *M. incognita* from single egg-mass has been maintained on tomato seedling(*Solanum lycopercicum L.* cv. G.S) under green house conditions . Identification of species was based on measurements of second-stage juveniles (J2s) as well as adult females perineal pattern system , according to Eisenback *et al .,(*1981) and Jepson(1987).

Each seedling of pepper (*Capsicum annuum* L.) cv. Balady was inoculated with 1000 freshly hatched second stage juveniles (J2s)of *M. incognita* .

The six brassica biofumigants used were included three cultivated species Balady cultivars of: radish (*Raphanus stativus* L.) , argula (*Eruca vesicaria* (L.) Cav) , and mustard (*Sinapis alba* L.) . Seeds were supplied by the Agricultural Research Center were cultivated in plastic pots (30 cm diameter) on 10/12/2022. All brassicas were managed using standard agricultural practices until the blooming stage , then uprooted. The fresh uprooted plants were chopped into small pieces (approximately 1mm). The chopped fresh plants were mixed with 2 kg of loamy sand soil in 15 cm diameter plastic pots at a rate of 2%(w/w).

The experiment included six chopped biofumigants brassica plants in addition to check (control) and a comparative synthetic chemical nematicide (oxamyl 24%SL -Vydate®)treatments . The treatments were arranged in a randomized complete block design with four replicates.

A thin layer of transparent plastic sheet was used to cover all pots. The soil moisture was kept at field capacity during the decomposition period of 30 days. After that, the thin sheets were removed, and forty-day-old healthy and uniform pepper seedlingsand uniform pepper seedlings,(cv Balady) were transplanted at a rate of one seedling /pot .

Oxamyl chemical nematicide was added at the rate of 4 L/Fed (0.2 ml /plant) as recommended after two days from nematode inoculation. All pepper-potted plants were managed using standard agricultural practices throughout the 60-day growing period . Plants were uprooted and roots were washed with tap water .Number of galls and egg masses were counted on roots ,then stained with acid fuchsin in lactic acid (Byrd *et al.* , 1983) and examined to record the number of developmental stages and full- grown females per root system .Second stage juveniles (J2s)in the soil were extracted using sieving and modified Bearman technique (Goody,1957). The reproduction factor (Rf) was calculated using the formula , RF=Pf/Pi where Pi is the initial population and Pf is the final population (Sasser *et al.* ,1984).

Pf=No. of J_2s in the soil + No. of developmental stages root -1 + No of females root -1.Vegetative plant growth parameters i.e. ,root and shoot length (cm), fresh root and shoot weights (g/plant), dry root and shoot weights (g/plant).N,P and K in pepper plant were determined according to Chapman and Pratt(1982). Available N, P and K in the soil were determined as described by Jackson(1968). C/N ratio was determined according to Cottenie *et al* (1982).

Statistical analysis:

All collected data were subjected to statistical analysis using F-test and means were compared by L.S.D at the 0. 05 level according to Costat Software (2008). Version 6.4."version 6.4.

RESULTS AND DISCUSSION

Results

Obtained data in Table 1 illustrate C/N ratio of studied brassica species . The results indicated that C/N ratio of all studied brassica plants ranged between 9,28 to 10,25 with the lowest ratio found in wild radish brassica plant.

Table 1. C/N ratio of screened brassica plants .

Plant	C	N	C/N ratio
Cultivated radish	29.80	3.10	9.61
Wild radish	29.70	3.20	9.28
Cultivated argula	32.80	3.20	10.25
Wild argula	32.10	3.30	9.91
Cultivated mustard	31.9	3.14	10.16
Wild mustard	31.6	3.15	10.03

Root-knot nematode parameters:

Results in Table 2 and Figs. 1 showed that all brassica chopped soil amendments significantly ($P \leq 0.05$) decreased nematode populations on pepper plants .All biofumigants reduced nematode infection parameters included number of galls or egg masses /root system , eggs/ egg mass,full-grown females /root system, J2s /250 g soil , final population (Pf) and reproduction factor (RF) . Data showed that wild radish (*Raphanus sativus* L. had a significant reducing effect on all root knot nematode parameters followed by common cultivated radish . The lowest number of galls (23.00)was recorded with wild radish treatment resulting in a reduction percentage of 79.60 while common cultivated radish had a reduction of 67.90 % . The highest gall number value (57.30) was recoded with wild mustard showing a reduction of 49.20% compared to control treatment .

Examination of pepper root system cleared that all treatments significantly(P ≤ 0.05) lowered number of egg masses /root system compared to untreated pots. Wild and cultivated radish exhibited a high reduction in egg masses number with values of 69.60, and 57.9% respectively compared to control treatment. Wild radish brassica was the most effective treatment in decreasing females /root system with a reduction of 82.3% followed by common cultivated radish with 64.6% and common mustard with the lowest reduction percentage of 55.4%. The data obtained revealed that wild radish treatment recorded the highest effectiveness in reducing the mean number of second stage juveniles /250 g soil with a reduction percentage of 74.4% followed by common cultivated radish which recorded a reduction percentage of 63.9% lower than control treatment. The least effective treatment was wild mustard with a reduction percentage of 54.1% %. The application of all studied brassica chopped green manures as soil amendments resulted in a significant (P ≤ 0.05) reduction in eggs /egg mass with varying magnitudes .Wild radish treatment caused the highest significant reduction percentage of 56.0 followed by common cultivated radish at 50.7 % lower than the control treatment , respectively . The lowest reduction percentage of eggs /egg mass 15.10% was recorded as a result of mustard biofumigants treatment.

Concerning developmental stages , obtained data cleared that wild radish treatment resulted in the highest reduction percentage of 75.8 followed by common cultivated radish at 66.0% while the lowest reduction of 49.37 was caused by common mustard treatment.The calculated data for (Pf) and (RF) showed that wild radish was the highest effective treatment with reduction percentages of 74.72 and 74.70% , respectively, lower than those of control treatment, which were comparable to those of oxamyl treatment (81.27 and 81.00%). The second most effective treatment was common cultivated radish, which recorded reductions of 63.99 and 64.00 % while the lowest effective treatment was common mustard with reduction percentages of 50.80 and 50.8 % lower than control treatment.

Table 2. Effect of brassica biofumigants green manures on the root knot nematode (*M.incognita*) infection parameters.

Treatment	Galls /root system	Egg masses/ root system	Egg / Egg mass	J2s/250 g soil	females /root system	Developmental stage /root system	Pf	Rf
Cultivated radish	36.30f (67.9%)	22.50f (57.9%)	148.50f (50.7%)	960.50f (63.9%)	34.50e (64.6%)	28.50f (66.0%)	1023.3 (63.9%)	1.023 (64.0%)
Wild radish	23.00g (79.6%)	16.30g (69.6%)	132.50g (56.0%)	681.00g (74.4%)	17.30f (82.3%)	20.30g (75.8%)	718.50 (74.7%)	0.719 (74.7%)
Cultivated Argula	48.50d (57.0%)	28.50d (46.7%)	215.80d (28.3%)	1130.30d (57.5%)	40.80e (58.2%)	38.80d (53.7%)	1209.75 (57.4%)	1.209 (57.4%)
Wild argula	42.50e (62.3%)	24.80e (53.7%)	201.00e (33.2%)	1031.00e (61.3%)	37.50c (61.5%)	35.80e (57.3%)	1104.25 (61.1%)	1.104 (61.1%)
Cultivated mustard	56.00e (50.3%)	31.30b (41.6%)	255.50b (15.1%)	1250.80b (62.4%)	43.50b (55.4%)	42.50b (49.3%)	1336.75 (52.9%)	1.337 (52.9%)
Wild mustard	57.50b (49.2%)	29.50e (44.9%)	247.30e (17.9%)	1220.80e (54.1%)	41.50e (57.4%)	40.30c (51.9%)	1302.50 (54.1%)	1.303 (54.1%)
Oxamyl 24% SL	19.80h (82.9%)	10.00h (81.3%)	102.00h (66.1%)	491.30h (81.5%)	14.30g (85.4%)	14.00h (83.3%)	519.50 (81.7%)	0.52 (81.0%)
Control	112.80a	53.50a	301.00a	2660.80a	97.50a	83.80a	2842.0	2.842
L.S.D(0.05)	1.084	0.855	0.965	0.976	0.999	1.104		

Means in each column followed by the same letters are not significantly different at (P ≤ 0.05).
Values in parenthesis are percentages of reduction in comparison to control treatment.

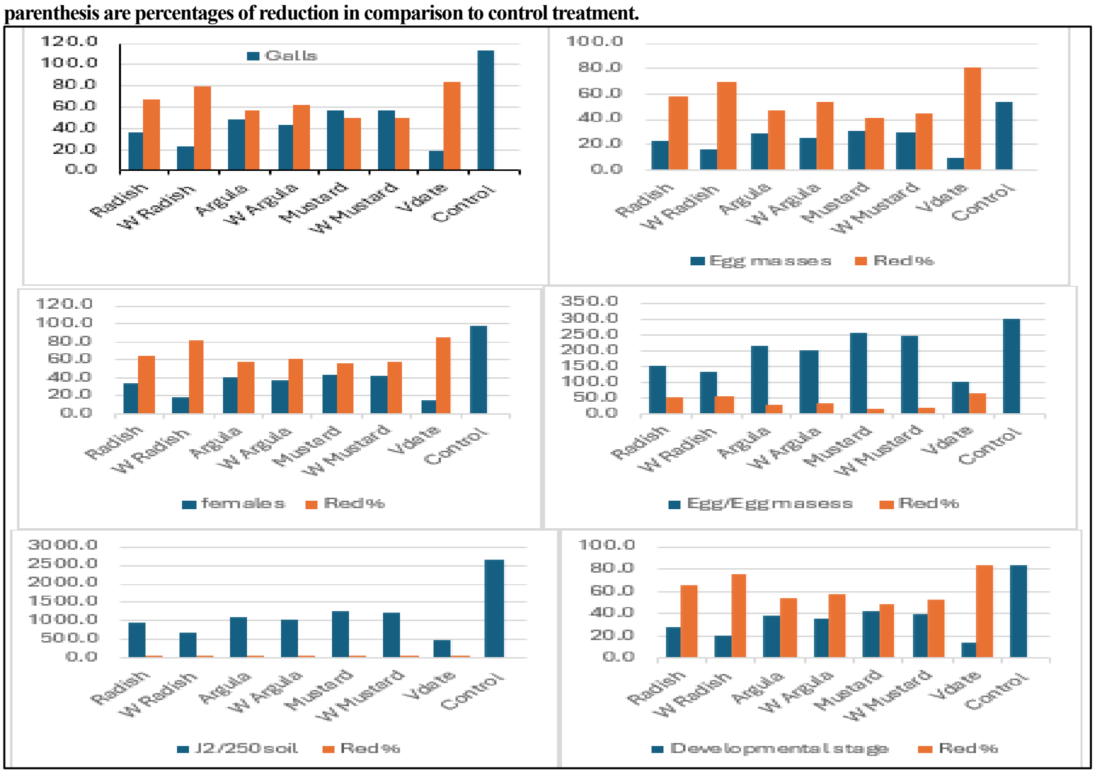

Fig. 1. Effect of brassica biofumigants green manures on the root knot nematode (*M. incognita*) infection parameters.

Pepper plant growth attributes:

Data in Table 3 show that all treatments significantly ($P \leq 0.05$) increased pepper plant growth parameters . The highest shoot length (48.43 cm) was in pepper plant treated with wild radish followed by cultivated radish (46.90 cm) .The lowest shoot length was recorded under in pepper plants treated with common mustard brassica (36.53 cm). Additionally , the highest root length was achieved with wild radish treatment (17.18 cm) followed by cultivated radish (15.50 cm) compared to control treatment (8.15 cm) . The lowest root length(12.15cm) was observed in pepper plants treated with common mustard .

The highest shoot fresh weight (22.88 g/plant) was recorded as a result of wild radish brassica followed by cultivated radish (20.25 g/plant). The lowest values of shoot fresh weight were recorded with mustard and wild mustard both having the same value of 14.15 g/plant. Regarding , shoot dry weight , the data in Table 3 cleared that the highest value (13.03 g/plant) was recorded when plants were treated with wild radish followed by cultivated radish (12.70 g/plant) .The highest root fresh weight 10.23g/plant was found under wild radish treatment followed by 9.70 g/plant with cultivated radish treatment. The lowest root fresh weight value (7.20 g/plant)was recorded with mustard brassica amending soil treatment. Wild radish treatment recorded the highest value of root dry weight (4.50 g/plant) followed by 4.28 g /plant with cultivated radish treatment while the lowest one (2.65 g/plant) was recorded with mustard brassica amending soil treatment. The lowest root dry weight value (3.33 g /plant)was recorded with wild mustard while 2.33 g /plant was obtained under control treatment

Table 3. Effect of brassica biofumigants green manures on pepper plant growth attributes.

Treatments	Shoot length(cm)	Root length(cm)	Shoot fresh weight.(g)	Shoot dry weight (g)	Root fresh weight(g)	Root dry weight(g)
Cultivated radish	46.90c	15.50c	20.25c	12.70 c	9.70c	4.28c
Wild radish	48.43b	17.18b	22.88b	13.03 b	10.23b	4.50b
Cultivated argula	41.48e	13.28d	16.15e	11.63 d	8.45d	3.18d
Wild argula	43.25d	13.80c	17.23d	10.00 e	8.65d	3.30d
Cultivated mustard	36.53g	12.15f	14.15g	8.00 f	7.20g	2.65f
Wild mustard	39.15f	12.55e	14.16fg	7.80 g	7.60f	2.95e
Oxamyl 24% SL	51.25a	17.23a	25.55a	14.63 a	12.23a	5.00a
Control	21.03h	8.15g	12.08h	4.30 h	5.25h	2.40g
L.S.D 0.05	0.557	0.195	1.173	0.145	0.121	0.2137

Means in each column followed by the same letter(s) are not significantly different at ($P \leq 0.05$).

N, P and K availability in the soil and their content in pepper plants:

Results in Table 4 revealed that all studied brassica biofumigants significantly ($P \leq 0.05$) increased the values of N, P and K nutrients in the soil and pepper plant. Concerning available N, wild radish treatment recorded the highest value (0.421 mg/kg) followed by common cultivated radish (0.396 mg/kg) compared to control treatment (0.218 mg/kg). The lowest N available in the soil was recoded with common mustard treatment (0.252 mg/kg).The same trend was found with available P , as wild radish treatment recorded the highest value (1.396 mg/kg) compared to control treatment (1.00 mg /kg).

Concerning available K in the soil, results showed that the highest value (49.211 mg/kg) was recorded with wild radish while (18.312 mg /kg) was recorded under control treatment. On the other hand, results cleared that N, P, and K content in pepper plants followed the same trend as the available nutrients in the soil.The availability of N, P, and K in the soil, directly impacts their content in pepper plants .These effects were found true under all studied brassica fumigants with varying magnitudes. Wild radish treatment recorded the highest N, P, and K content in pepper plant (4.10 %) , (450.13 ppm) and (8050.13 ppm), respectively followed by common cultivated radish (3.36 %), (370.20ppm) and (7675.21ppm) , respectively. The lowest N, P, and K content in pepper plants were recorded under control treatment which recorded (1.65%), (221.37 ppm) and(1265.11 ppm), respectively.

Table 4. Effect of brassica biofumigants green manures on N,P and K in the soil and pepper plants .

Treatments	Available N.P.K in the soil			Content of N.P.K in pepper plants		
	Available N mg Kg^{-1}	Available P mg Kg^{-1}	Available K mg Kg^{-1}	N (%)	P (ppm)	K (ppm)
Cultivated radish	0.396b	1.223b	35.930b	3.36 b	370.20 b	7675.21 b
Wild radish	0.421a	1.396a	49.211a	4.10 a	450.13 a	8050.13 a
Cultivatedargula	0.273c	1.113d	29.631c	2.36 e	320.63 d	6751.12 d
Wild argula	0.269d	1.121c	29.121a	2.75 c	332.71c	6813.47 c
Cultivated mustard	0.252f	1.056f	24.131e	2.26 f	302.76 g	5271.31 g
Wild mustard	0.261e	1.111e	35.222d	2.63 d	310.66 e	5731.16 e
Oxamyl 24% SL	0.216h	1.002g	20.133f	2.19 g	305.73 f	4576.56 f
Control	0.218g	1.000h	18.312g	1.65 h	221.37 h	1265.11 h

Means in each column followed by the same letter(s)are not significantly different at ($P \leq 0.05$).

Discussion

Soil biofumigation with chopped leaves of wild and cultivated brassica plants (radish, arugula, and mustard) significantly reduced all parameters of the root–knot nematode (*M. incognita*) and increased all pepper plant growth attributes compared to the control treatment. Wild radish showed the highest effects similar to oxamyl chemical synthetic nematicide treatment. Hanschen *et al.*, (2015) reported that isothiocyanates (ITCs) originating from biofumigation are slowly released resulting in a longer biological activity compared to synthetic analogs. According to Bello *et al*, (2004), soil biofumigation management of *M. incogni*ta, in belt pepper was similar to methyl bromide. Sikora *et al.,* (2005) found that radishes might have high biofumigation potential compared to different brassica amendments under green manure amending soil. El- Nagde *et al.*, (2019) found that radish leaf residue was the most effective with 60.6% reduction in nematode population and 41.9%% increase in cowpea yield. Aydinli and Mennan (2018) found that galls index and egg masses significantly decreased in tomato treated with *E. sativa* and *R. sativas* biofumigents.

The difference effects of brassica biofumigants could be due to the glucosinolates (GLSs) content as well as chemical profile depending on plant species genotype, environmental, phenological stage and tissue (Avato *et al*, 2013). Plants demonstrate considerable variation in the concentration of GSL within their cells. Therefore, it is crucial to find species that effectively reduce soil-borne diseases like nematodes (Zasada and Ferris, 2004, Antonious *et al*, 2009 and Avato *et al*, 2013 Sowmya *et al. ,*2023)

Brassicaceous plants contain high levels of glucosinolates (GLSs) which is transformed into isocyanates and other similar chemicals through enzymatic hydrolysis by endogenous enzymes myrosinas (Avato et al., 2013).

The GLS metabolic compounds are the main factor of bioactivity. The potential of nematode suppression using brassica amended soil also depends on the amount used, C/N ratio and time of decomposition in the soil. Organic matter with C/N ratio lower than 20:1 have more decomposition and nematocidal effects (Mc Sorley& Gallaher, 1995 , Ritzinger &Mc Sorley , 1998 and Mashela,2002).

The C/N ratio and the rate of organic matter breakdown by microbes determine the effectiveness of organic amendments in suppressing nematodes .It was found that materials with the lowest C/N ratio have highly nematocidal effects (Rodriguuez-Kabana *et al,* 1995 ; D'Addabbo & Sasanelli,1997;Akhtar & Malik, 2000; Ismail *et al.* , 2006 and Renco *et al.* , 2011). On this basis, all studied brassica plants in the current study have low C/N ratios values below 20:1 with the lowest value (9.28:1), which found in wild radish with the highest effect, on nematode suppression than other studied brassica green manure fumigants. The nematocidal properties of studied brassica plants varied indicating that they could be a valuable selective tool for targeting nematodes(Avato *et al.*,2013).

Brassica plants release naturally accruing nematocidal compounds like isothiocyanates during biodegradation and increase soil fertility which reflect on increasing plant tolerance or resistance to nematodes infection (Chitwood, 2002, Oka, 2010 and Chindo *et al.*, 2012). The improvement in pepper growth attributes could also be due to increase in nutrients from green manuring .This result is in accordance with Dunn(2002) and Jean *et al.*, (1992),who reported that the application of organic soil amendments improve soil conditions as plant grew reducing plant sensitivity to nematodes. Moreover,the obtained results indicated that all six botanicals whether wild or commonly cultivated significantly increased N, P and K available in the soil and the content in pepper plant compared to control treatment. According to Zambolim *et al* (2001) and Agrios(2005), nutrients can predispose plants to attack with pathogen directly or indirectly. Plant nutrients can partially offset nematode induced the damage via simulating plant development (Ferraz *et al*., 2010).

A number of mechanisms have been proposed to explain the beneficial effects of soil organic amendments application. Generally, organic amendments on phytoparasitic nematodes are referred to many factors like increasing host resistance as well as improvment of plant growth performance. Zakie *et al* .,(2004)reported that via degradation of organic soil amendment , result in changing of soil properties due to releasing of volatile fatty acids , organic acids and nitrogen compounds. Such effects caused an increase availability of macro and micronutrients for plant absorption. Obtained data clear that N, P and K significantly increased with all studied brassica soil green manuring with varying magnitudes. Coutency and Maallen (2008) indicated that the effect of organic manuring on phytoparasitic nematodes could be due to host resistance to nematode infection as well as improvement of plant growth performance. The highest available N in the soil and content in pepper plant were recorded by using wild radish treatment followed by common cultivated radish, which recorded (0.396mg/kg), and (3.36%), respectively. According to Zambolim *et al.,* (2001) and Ferraz *et al.,* (2010), a plant which deficient nitrogen can subject to debilitated with suffer slow growth and become highly susceptible. Results also clear that the highest available P in the soil and content in pepper plant were recorded under wild radish brassica green manure amending soil treatment followed by common cultivated radish treatment. Zambolion *et al.,* (2005) reported that plants become highly resistant with supply P due to increasing in protein synthesis , polyphenols, peroxidase and ammonia.

Available potassium (K) in the soil and content in pepper plant were higher in wild radish treatment compared to all other brassica and control treatments. Perrenoud (1990) reported that adequate plant K can reduce the incidence of disease as a result to increase resistance to penetration and development of pathogens. Also, Barbosa (2010) showed that increasing K, can reduced females numbers in plant root system and nematode reproduction factor in susceptible soybean cultivars.Thus, using both wild and cultivated brassica species as soil bio fumigants could become sustainable ecofriendly measure in the management of root-knot nematodes in pepper. Generally ,the use of brassica biofumigants as pre-planting green manures reduce nematode infection parameters and enhance plant growth criteria in addition to the high availability of N, P and K in the soil and their absorption by plant compared to control treatment. Using brassica green manures offers viable alternatives to manufactured chemical nematicides, which negatively influence the environment, beneficial soil organisms, and human health. To further understand how brassica crops affect the growth and reproduction of root-knot nematodes, more research is required.

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تقييم تأثير التدخين الحيوى على مكافحة نيماتودا تعقد الجذور فى نباتات الفلفل

شيماء مصطفى على محمد[١] ، خطاب عبد الباقى السيد خطاب[٢] ، سحر حسن عبد الباسط[٣] وأحمد عبد العليم الشعراوى[٤]

[١]قسم الانتاج النباتى – كلية العلوم الزراعية البيئية – جامعة العريش
[٢]معهد بحوث الأرضي والمياه والبيئة ـ مركز البحوث الزراعية ـ الجيزه ـ مصر
[٣]قسم بحوث الامراض النيماتودية –معهد بحوث امراض النبات – مركز البحوث الزراعية – جيزة- مصر
[٤]معمل امراض النبات، قسم الانتاج النباتي ، كلية العلوم الزراعية البيئية ، جامعة العريش

الملخص

اجريت تجربة أصص تحت ظروف الصوبة على نباتات الفلفل(صنف بلدى) لدراسة تأثير التدخين الحيوى للتربة على مكافحة نيماتودا تعقد الجذور قبل الزراعة بأستخدام ٣انواع من نباتات من العائلة الصليبية (الفجل – الجرجير – الخردل) وتمثل كل نوع بصنف منزرع واخر برى بمعدل اضافة ٢٪ للتربة (وزن / وزن) مقارنة مع المبيد الكيمائى (الاوكساميل) بالاضافة الى المعاملة الضابطة (الكنترول) وقد أوضحت النتائج ما يلى :أدت جميع المعاملات الى خفض معنوى فى جميع مؤشرات الاصابة بالنيماتودا فى نباتات الفلفل حيث انخفض التعداد النهائى للنيماتودا كذلك معدل التكاثر مقارنة مع النباتات المصابة بالنيماتودا فقط (كنترول). حققت معاملة التدخين الحيوى باستخدام الفجل البرى اعلى نسبة خفض فى كل من التعداد النهائى و معدل التكاثرالنيماتودا حيث بلغت نسب الخفض ٧٤,٧٢ و ٧٤,٧٠ بينما انخفضت تلك القيم الى ٨١,٧٢ و ٨١,٠٠ % فى معاملة المبيد الكيمائى (الاوكساميل) بينما بلغ اقل تأثير للتدخين الحبوى باستخدام نبات الجرجير المنزرع حيث حقق انخفاضا قدرة ٥٧,٤٣ و ٥٧,٤٦ % مقارنة بمعاملة الكنترول .ادت معاملات التدخين الحبوى المستخدمة الى زيادة معنوية فى نسب النيتروجين والفوسفور والبوتاسيوم المتاح للنبات فى التربة مما انعكس ايجابيا على زيادة امتصاص النبات لهذه العناصر. أدى استخدام التدخين الحيوى الى زيادة معنوية فى جميع مؤشرات النمو فى نباتات الفلفل مقارنة مع معاملة الكنترول حيث اعطت المعاملة باستخدام الفجل البرى اعلى القيم تليها معاملة الفجل المنزرع. وعموما تعتبرطريقة التدخين الحيوى للتربة قبل الزراعة باستخدام نباتات العائلة الصليبية ـ كما فى هذه الدراسة ـ طريقة اقتصادية وصديقة للبيئة لمكافحة نيماتودا تعقد الجذور على نباتات الفلفل خاصة تحت ظروف نظم الزراعة العضوية او كاحد عناصر المكافحة المتكاملة .