J. Plant Prot. and Path., Mansoura Univ., Vol.7 (5), 327– 332, 2016

Nematicidal Effect of Sunn Hemp Amendment on Infectivity and Reproductivity of Soil Nematodes in Vegetable Plants

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ABSTRACT

The first step to control many noxious nematodes by using organic amendments, is to select the suitable biocidal plant such as, sunn hemp (SH) *Crotalaria juncea* L. this plant used mainly as a green manure and it is a poor host for several plant-parasitic nematodes as well. In the present study Sunn hemp was cultivated as an amendment plant in the crop rotation. The dried dropped leaves were plowed in the soil. After two weeks, the initial population (Pi) of nematodes was estimated, the land was divided into small plots and cultivated with one of following plants: *Lactuca sativa* L., *Chorchorus olitarius* , *Cucumis sativus*, *Allium cepa*, *Lycopersicum esculentum*, *Capsicum annum*, *Solanum melongena*, *Phaseolus vulgaris*, *Vigna sinenses* and *Vicia faba*. Final population (Pf) and rate of reproduction were estimated, and data showed that, lethal effects varied with regard to nematode type. *Rotylenchulus reniformis* was the high tolerant to SH as a green manure followed by *Pratylenchus*, while, *Meloidogyne* and *Helicotylenchus* were less tolerant to sunn hemp amendment. On the other hand, sunn hemp increased the abundances of non parasitic nematodes. In conclusion, using sunn hemp could increase the fertility of the soil, and promising as an alternative for managing plant parasitic nematodes efficiently and has the ability to enhance the free living nematodes.

Keywords: *Crotalaria juncea, Rotylenchulus, reniformis, Pratylenchus*, sp. *Meloidogyne incognita, Helicotylenchus* sp., free living nematodes.

INTRODUCTION

The use of organic amendments to control the plant-parasitic nematodes has been reported in voluminous reportes (Akhtar and Malik, 2000; Litterick *et al*., 2004 and Oka, 2010). free-living and Plant-parasitic nematodes are the dominant nematode in the soil communities. several cover crops were used to reduce the population densities of plant-parasitic nematodes (Wang *et al*., 2001; Marahatta *et al*., 2010). Sunn hemp (SH), *Crotalaria juncea* L. (Leguminacae), receiving high concerning due to its ability to fix nitrogen, increase soil organic matter (Marshall,2002) and suppress many plant-parasitic nematodes (Wang *et al*., 2001) which mean, changing in nematode diversity in soil. In addition to that, SH can enhance the abundance of free-living nematodes which play important role in soil nutrient decomposing (Wang *et. al*., 2004b; and Oka, 2010 and Wang *et al*, 2004,) and natural antagonists of plant parasitic nematodes (Kimenju *et al*. 2004). This including nematode-antagonistic fungi (Wang *et al*., 2004), omnivorous and predatory nematodes (Wang *et al*., 2006 and Mcsorley, 2011) and bacterivorous nematodes (Wang *et al*., 2002). Sunn hemp roots is a poor host for several plant parasitic nematodes such as *Meloidogyne* spp. (Wang *et al*., 2002), *Rotylenchulus reniformis* (Wang *et. al*., 2002; and Marla *et. al*., 2008) , stunt nematodes (McSorley *et. al*. 2009). On the other hand, Hosseinikhah Choshali *et. al*., 2015, reported that, no significant correlation between number of nematode populations of *Pratylenchus loosi* and other soil organic matter content. In contrast, Walker, (2004) found that, addition of many soil organic matter may increase some plant parasitic nematodes. In this content, logically, management of plant parasitic plant agricultural crops may be differ due to host plant susceptibility (Wang *et al*., 2003 and McSorley, 2011).

The objectives of the current research is to evaluate the nematicidal effect of sunn hemp amendment in field plots planted with vegetable crops on the population of some economic plant parasitic nematodes along with free- living nematodes.

MATERIALS AND METHODES

1-Preparing of the field:

This research was carried out in field plots at Plant Protection Department, Faculty of Agriculture, Ain Shams, Shoubra El-Kheima. The type of the soil is sandy clay soil.

The field was planted with *Crotalaria juncia* in summer season of 2014. After seed formation, and leaf defoliation, *crotalaria* plants were uprooted in the early spring season of 2015.

The dried dropped leaves (estimated as $20g/m^2$soil) were plowed to homogenate the residues as well as nematodes in the soil. After two weeks, all the land was divided into small plots (2x3m). Each plot was cultivated with one of the vegetable host plant: *Lactuca sativa* L.(Lettuce), *Chorchorus olitarius L.*(Jew's mallow), *Cucumis sativus L.* (Cucumber), *Allium cepa L* (Onion), *Lycopersicum esculentum* (Tomato), *Capsicum annum L.* (Pepper), *Solanum melongena* L. (Eggplant), *Phaseolus vulgaris* **(**snap bean), *Vigna sinenses* **(**Cowpea), and *Vicia faba* (bean) .

2-Extraction of nematodes from soil:

After uprooting sunn hemp plants, ten samples of the field soil were taken to calculate the initial population (Pi) of soil nematodes. Samples were taken monthly during the cropping season, from March to the end of June of 2015. Five soil samples were collected per each plot from the rhizosphere region. Nematode were extracted by means of modified Burmman funnel and counted by light microscope.

3-Nematode identification:

The periodicaly surveyed nematodes were identified to generic level depending on morphological characteristic of larvae, males and females.

4-Nematode estimation:

Nematode densities (numbers of nematodes per 250g soil) were determined for all genera and recorded.

Rate of nematode reproduction was estimated . RF = Final nematode population/Initial nematode population.

RESULTS AND DISCUSSION

Data in Fig. (1) showed the presence of some plant parasitic nematodes and non parasitic genera. These genera comprised *Rotylenchulus reniformis*, *Meloidogyne* sp., *Pratylenchus* sp., *Hoplolaimus* sp., *Helicotylenchus* sp. *Tylenchorhynchus* sp., and free living nematodes such as *Tylenchus* sp., *Dorylaimus* sp., *Aphelenchus* sp., *Acrobeles*, C*ephalopus*, and *Rhabditis* sp. It is noticed that *Pratylenchus* sp. and *Rotylenchulus reniformis* were more predominant in samples (320 and 200 nematodes/250g soil, respectively).

Rotylenchulus reniformis showed the most tolerant nematode to SH as a green manure reported final population 2052, 1692, 1600, and 1200 nematodes/250g soil while the rate of reproductions were 10.3, 8.5, 8.0, and 6.0 on lettuce, snap bean, cowpea, and eggplant, respectively) at the end of the experiment (Fig. 2,3).

Pratylenchus sp. was less tolerant to SH and the highest Pf was reported on bean, tomato, and lettuce, i.e, 865, 467, and 410 nematodes/250g soil, while RF was 2.7, 1.5, and 1.3 respectively (Fig. 4,5).

As shown in Fig. 6 & 7 and 8 & 9 *Meloidogyne* and *Helicotylenchus* were the less tolerant to SH, whereas reported 300, 180, and 165 nematodes/250g soil and the RF was 4.0, 2.4, and 2.2 on eggplant, tomato, and cucumber, respectively for *Meloidogyne* while it was 202, and 10۱ nematodes/250g soil while RF was 4.0, and 2.0 on cucumber, and bean respectively for *Helicotylenchus.*

Fig. 10,11 showed that, Sunn hemp amendment increased the abundances of non parasitic nematodes and the highest populations were recorded in Eggplant, and Jew's mallow: 1925 and 1507 nematodes/250g soil, whereas RF was 3.2 and 2.5 respectively

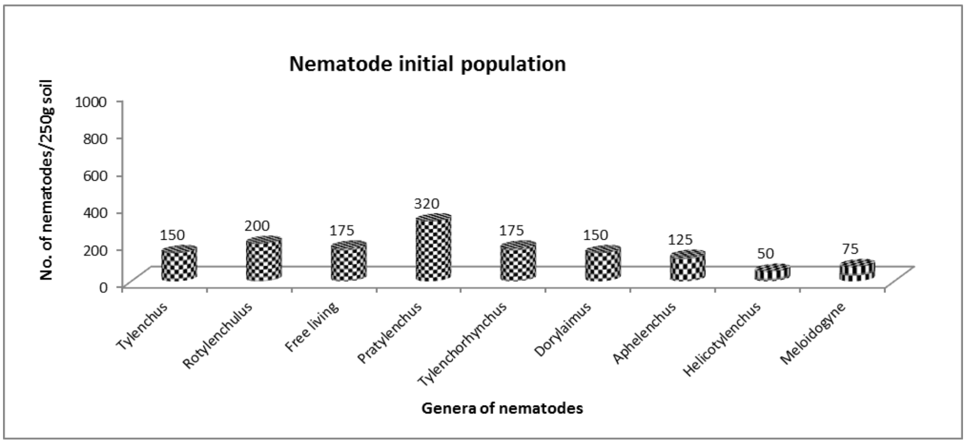

Fig. (1): Number of initial population (Pi) of plant parasitic and non parasitic nematodes.

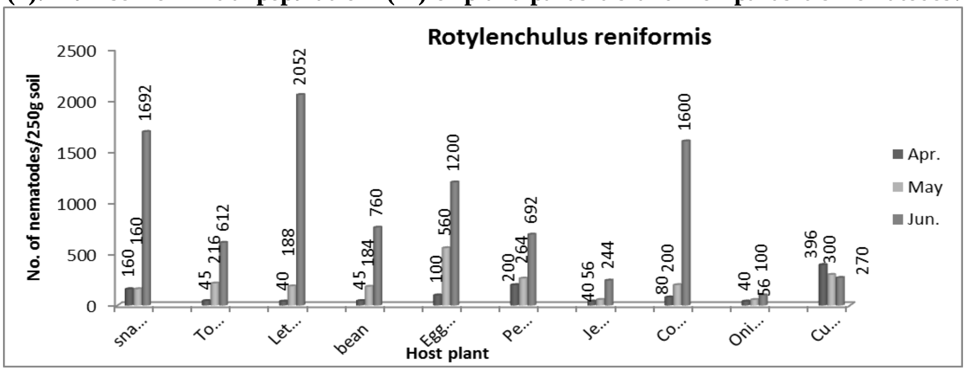

Fig.(2): Number of final population (Pf) of *Rotylenchulus reniformis* on different plant host.

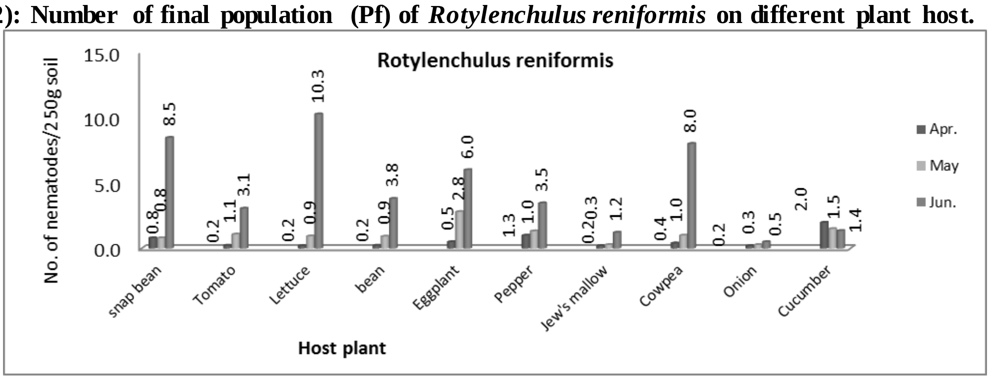

Fig.(3): Rate of reproduction (RF) of *Rotylenchulus reniformis* on different plant host.

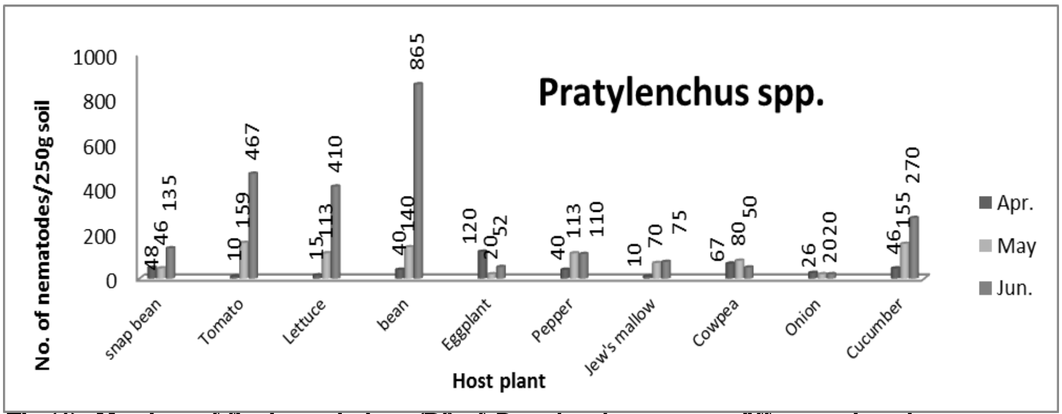

Fig.(4): Number of final population (Pf) of *Pratylenchus* spp. on different plant host.

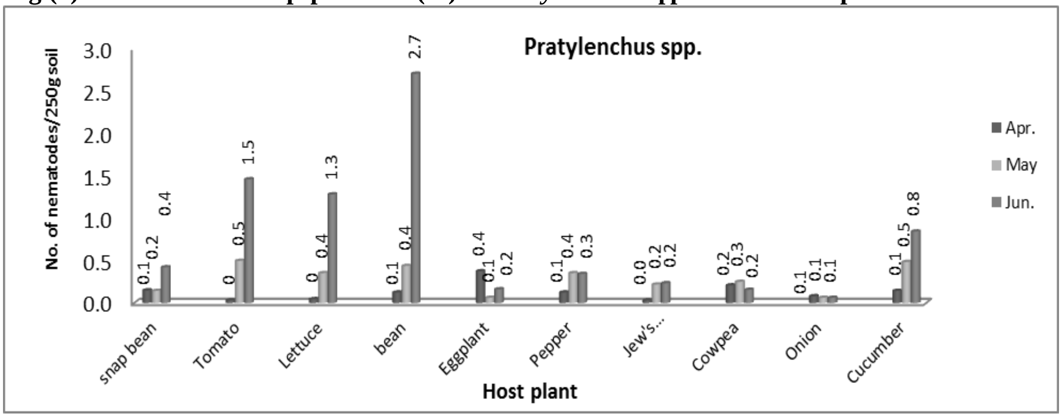

Fig.(5): Rate of reproduction (RF) of *Pratylenchus spp*.on different plant host.

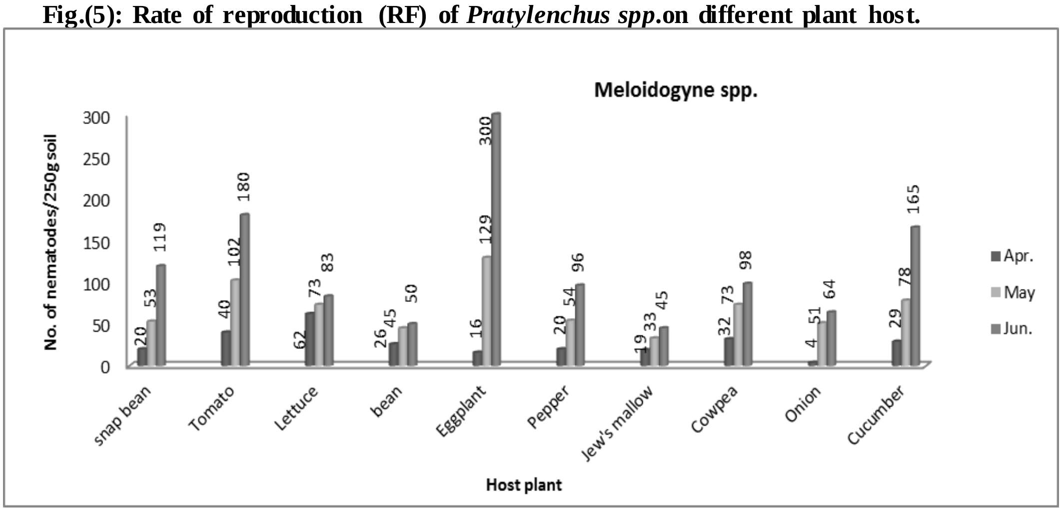

Fig.(6): Number of final population (Pf) of *Meloidogyne spp*. on different plant host.

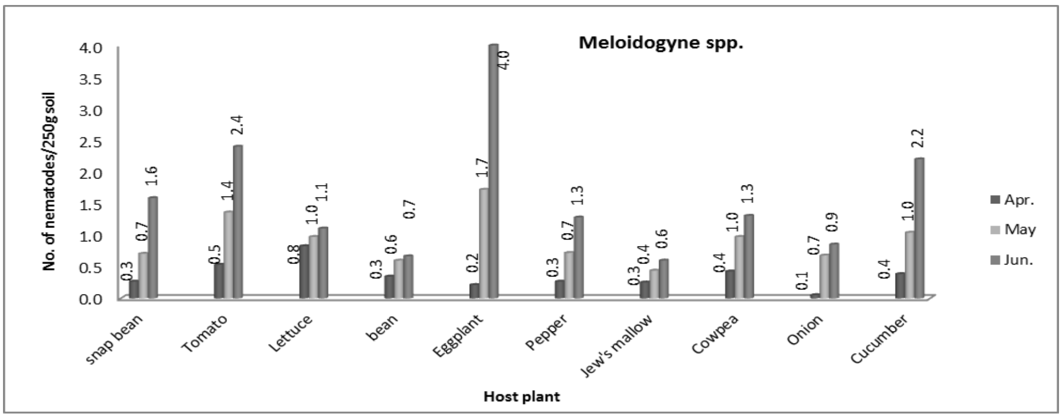

Fig.(7): Rate of reproduction (RF) of *Meloidogyne spp*. on different plant host.

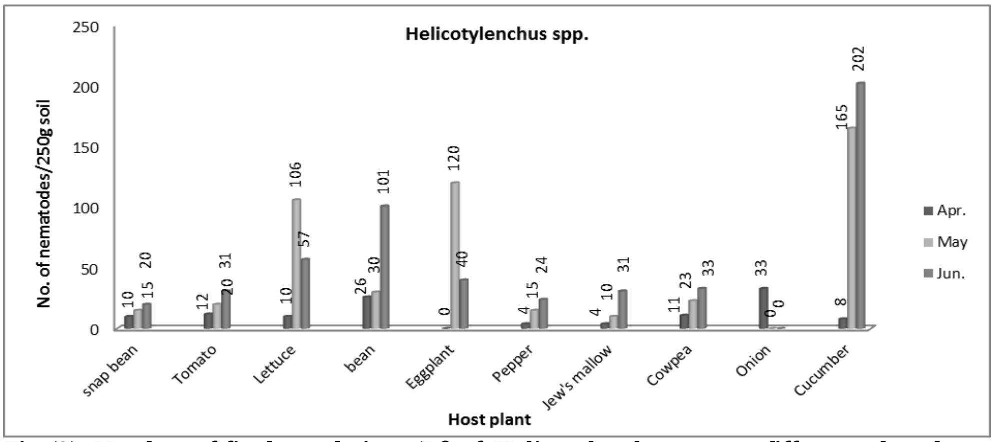

Fig (8): Number of final population (Pf) of *Helicotylenchus spp*. on different plant host.

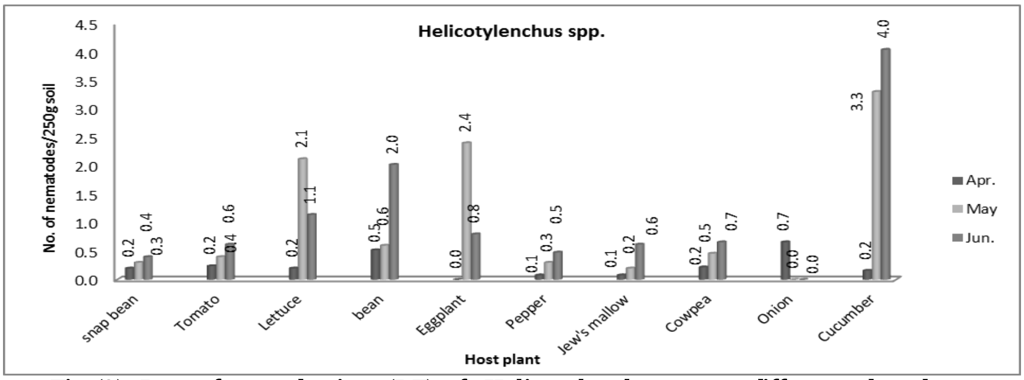

Fig (9): Rate of reproduction (RF) of *Helicotylenchus spp*. on different plant host.

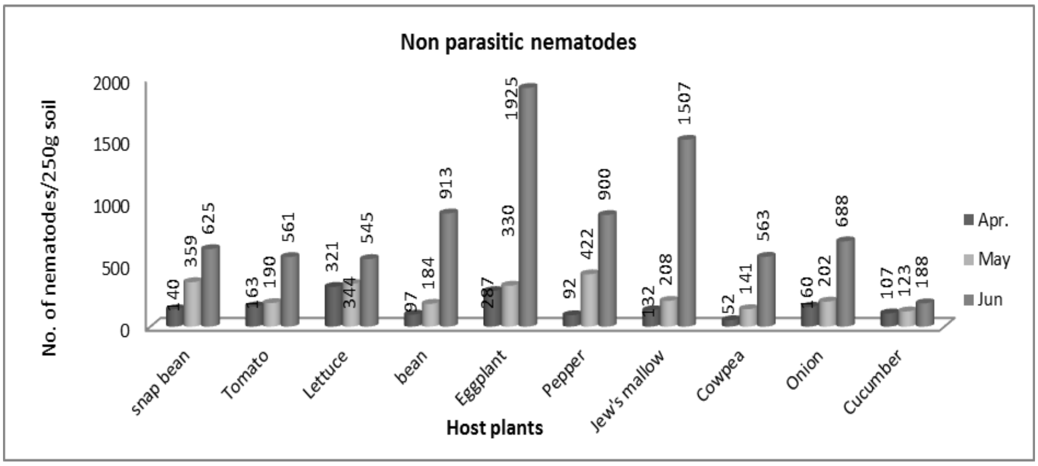

Fig.(10): Number of final population (Pf) of *non parasitic nematodes* on different plant host.

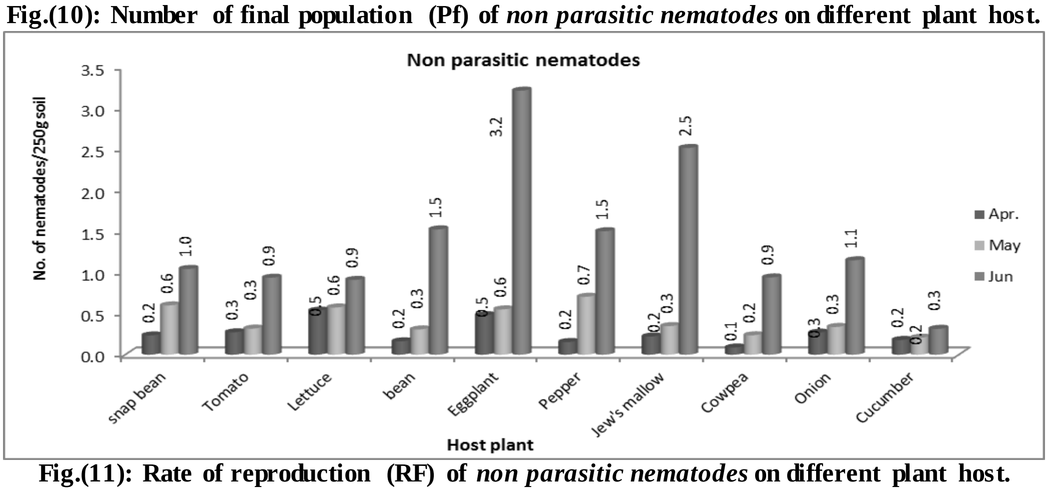

Fig.(11): Rate of reproduction (RF) of *non parasitic nematodes* on different plant host.

Many factors can affect the influence of organic amendments on nematode population therefor, it can be difficult to make generalizations about their effects on nematodes for many reasons (McSorley, 2011). Such factors include: 1- how to apply i.,e., without proper soil incorporation amendmentswill not be effective (Wang *et al*. 2008); 2- initial population i.,e., amendments will be effective on nematodes with low initial population density; 3- soil type (Wang *et al*. 2003a); and 4- the time of exposure to the green manure (Okada and Harada, 2007). Moreover, The speed of the decomposition for organic matter depend on several factors: the type of these matters , the chemical properties of the organic matter, (i) the C/N ratio and the type of carbon within the organic matter (lignin/N ratio), (ii) the activity of decomposers (number and types of organisms present), moisture and tempertature. Valenzuela-Solano and Crohn (2006) found that, grass clippings had completely decomposed after one year, while redwood pieces had only lost 20% of their biomass at the same time.

Adding amendment to healthy soil is known to support life process such as plant health and nutrient supply. Furthermore, the changing in nematode communities can be considered as a bioindecator for measuring the soil enrichment or depletion (Ferris *et al*., 2001)and for measuring the previous life processes (Wang and McSorley, 2005) i.e. bacterivorous and fungivorous nematodes (Wang and McSorley, 2005).

Sunn hemp produces allelopathic compounds (monocrotaline) and contain pyrrolizidine alkaloids (PA) against several key nematode pests and able to enhance some nematode-antagonistic microorganisms (Wang *et al*., 2004a; Jourand *et al*., 2004; Dover *et al*., 2003; Wang and McSorley, 2004) especially when incorporated into the soil (Wang *et al.*, 2004). Moreover, number of free-living nematodes increased with increasing the prolongation of decomposition time and this is may be due to that, the free-living nematodes may enhance the decomposition of soil organic matter and increase phosphorous and nitrogen which finally increase their population (Kimenju *et al.*, 2004), especially a legume plantsuch as Sunn hemp which has a relatively low C:N ratio (C:N ratio = 18:92; Marshall, 2002).

However, difficulties to manage of some plant parasitic nematodes in organic amendment soil may be due to the persistence of these nematodes under unfavorable conditions, viz, anhydrobiotic quiescence in *Rotylenchulus reniformis* (Torres *et al*., 2006) which can survive for 1.5 years in this state (Apt, 1976).

Finally, the previous encouraged results may aid in establishing a devised schemes of applications of organic amendments including sunn hemp dried leaves to obtain the greatest refundable yield and nematode execution.

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التأثير القاتل للكروتالاريا كسماد على قدرة النيماتودا على العدوى والتكاثر على بعض نباتات الخضر

انتصار حلمى طه
قسم وقاية النبات – كلية الزراعة – جامعه عين شمس

تم زراعة نبات الكروتالاريا فى الحقل التجريبى الملحق بمعمل النيماتودا بقسم وقاية النبات - كلية الزراعة – جامعة عين شمس، وفى نهاية المحصول تم حرث الارض وما عليها من اوراق جافة وما بها من جذور لدراسة تأثيرها على نيماتودا التربة. قدرت اعداد النيماتودا الموجودة بالتربة واجناسها. تم تقسيم الحقل الى احواض وزراعة كل حوض بعائل نباتى من العوائل النباتية الاتية: طماطم، خيار ،خس، باذنجان، ملوخية، فلفل، بصل، فاصوليا، لوبيا و فول بلدى . وكانت الاجناس المنتشرة من النيماتودا الممرضة للنبات: (*Rotylenchulus reniformis*, *Meloidogyne* sp., *Pratylenchus* sp., *Helicotylenchus* sp. *Tylenchorhynchus* sp) والغير ممرضة للنبات: (*Tylenchus* sp., *Dorylaimus* sp., *Aphelenchus* sp., *Acrobeles*, C*ephalopus*, and *Rhabditis* sp.) وتم الفحص باخذ ٥ عينات من كل حوض كل شهر لمدة ثلاثة اشهر بعد الانبات وكانت النتائج كالتالى: سجلت نيماتودا القطن الكلوية من جنس *Rotylenchulus reniformis* اعلى تحمل لتأثير الكروتالارياحيث كانت الاعداد النهائية المتحصل عليها ٢٠٥٢و ١٦٩٢و ١٦٠٠و ١٢٠٠ و كان معدل التكاثر ١٠.٣و ٨.٥و ٨.٠ و ٦.٠ على نباتات الخس والفاصوليا والوبيا والباذنجان بالترتيب. بينما سجلت نيماتودا التقرح من جنس *Pratylenchus* sp ٨٦٥و ٤٦٧و ٤١٠ للاعداد النهائية وكانت ٢.٧ و ١.٥ و ١.٣ بالنسبة لمعدل التكاثر على نباتات الفول و الطماطم و الخس بالترتيب. سجلت نيماتودا تعقد الجذور من جنس *Meloidogyne* sp ٣٠٠و ١٨٠و ١٦٥ في حين كان معدل التكاثر ٤.٠و ٢.٤و ٢.٢ على نباتات الباذنجان و الطماطم والخيار بالترتيب. اقتربت النتائج المتحصل عليها في جنس نيماتودا *Helicotylenchus* sp. من نيماتودا تعقد الجذور حيث كانت الاعداد النهائية ٢٠٢و ١٠١ ومعدل التكاثر كان ٤.٠و ٢.٠ على نباتات الخيار والفول بالترتيب. سجلت النيماتودا حرة المعيشة ارتفاع في الاعداد حيث كانت ١٩٢٥و ١٥٠٧ و ٩١٣ و ٩٠٠ ومعلات التكاثر سجلت ٣.٢و ٢.٥و ١.٥ و ١.٥ على نباتات الباذنجان و الملوخية و الفول والفلفل بالترتيب. وعليه فانه يمكن القول ان: للكروتالاريا تأثير سلبى على نيماتودا النبات متفاوت على حسب الجنس حيث كانت نيماتودا القطن الكلوية تليها نيماتودا التقرح اكثر تحمل لتأثير الكروتالاريا في حين اظهرت نيماتودا تعقد الجذور والنيماتودا الحلزونية تأثر اشد بالكروتالاريا كمبيد نيماتودى. على العكس من ذلك كان للكروتالاريا تأثير منشط على النيماتودا الغير ممرضة للنباتات أو على الاقل لم يكن هناك تأثير سلبى. وعليه فانه يمكن استخدام نبات الكروتالاريا كسماد له تاثير مثبط لتكاثر بعض اجناس النيماتودا الممرضة للنبات بعيدا عن استخدام المبيدات والتعرض لمخاطرها ، وذلك دون الاضرار بالنيماتودا حرة المعيشة التى تساهم في تحلل المادة العضوية واستفادة النبات منه.