Akademik Ziraat Dergisi 7(1):29-34 (2018)
ISSN: 2147-6403 DOI: http://dx.doi.org/10.29278/azd.440608

Araştırma
(Research)

Efficacy of hazelnut (*Corylus avellana* L.) dried husk extract and dried husk compost against root-knot nematodes (*Meloidogyne* spp.) on tomato*

Serkan ÇELİK[1], Faruk AKYAZI[1], Anıl Fırat FELEK[1]

[1]Department of Plant Protection, Faculty of Agriculture, University of ORDU

* This study was presented at IX. International Congress on Hazelnut at 15-19 August 2017 and published as abstract.

Alınış tarihi: 19 Ocak 2018, Kabul tarihi: 20 Mayıs 2018
Sorumlu yazar: Faruk AKYAZI, e-posta:farukakyazi@hotmail.com

Abstract

This study was conducted to evaluate some effects of hazelnut dried husk extract and husk compost on nematode infection and some plant parameters of tomato inoculated by mixed root-knot nematodes populations of *Meloidogyne hapla* and *M. arenaria* in pot experiment. The dried hazelnut husk obtained from after harvest were used. For both husk extract and husk compost treatment, 50 grams of hazelnut husk was used. Approximately 1000 second stage juveniles (J2) was inoculated to susceptible tomato cultivar (*Solanum lycopersicum* cv. Rio Grande). At the end of 8 weeks, the gall numbers on the root, number of the juveniles in the pot, plant fresh root weight and total plant fresh weight were measured. As result, the husk compost treated plants had lower gall on the root system and juvenile numbers in the pot soil by comparison with husk extract treatment. For plant growth parameters, the total plant fresh weight was significantly different for husk compost treatment. The all results seemed that the husk compost treatment has more effect on *Meloidogyne* spp. gall numbers than husk extract application on tomato.

Key words: Hazelnut, husk, *Meloidogyne*, tomato, root-knot nematode

Kurutulmuş fındık (*Corylus avellana* L.) zuruf ekstraktı ve kompostunun domates üzerindeki kök ur nematodlarına (*Meloidogyne* spp.) karşı etkinliği

Öz

Bu araştırma, kurumuş fındık zuruf ekstraktı ve kompostunun, kök ur nematodu *Meloidogyne hapla* ve *M. arenaria* karışık popülasyonları ve bazı bitki parametreleri üzerindeki etkilerini değerlendirmek amacıyla yürütülmüştür. Hasattan sonra elde edilen kurumuş fındık zurufundan gerek ekstrakt, gerekse kompost uygulaması için 50 gram kullanılmıştır. Nematoda duyarlı domates çeşidine (*Solanum lycopersicum* cv. Rio Grande), yaklaşık 1000 adet ikinci dönem (J2) juvenil bulaştırılmıştır. Uygulamadan sekiz hafta sonra, kökteki ur sayısı, topraktaki juvenil sayısı, bitki taze kök ağırlığı ile toplam bitki ağırlıkları ölçülmüştür. Sonuç olarak, zuruf kompostu ile muamele edilmiş bitkilerde, zuruf ekstraktına kıyasla, kökte daha az ur ve saksı toprağında daha az juvenile rastlanmıştır. Bitki büyüme parametrelerine bakıldığında, toplam bitki ağırlığı kompost uygulaması ektrakt uygulamasından farklı bulunmuştur. Sonuçlar göstermektedir ki, zuruf kompostu uygulamasının ekstrakt uygulamasına kıyasla kök ur nematodlarının domates üzerinde ur oluşumunu azaltmada daha fazla etkiye sahiptir.

Anahtar kelimeler: Fındık, zuruf, *Meloidogyne*, domates, kök ur nematodu

Introduction

Hazelnut (*Corylus avellana* L.) is an ancient perennial crop in Turkey and is always in great importance as a strategic crop that can be considered as the most adapted and suitable cultural plant of Black Sea Region and Ordu province by the context of geografical properties, farmer attitudes and the adaptation to climate. In worldwide, Turkey is the first country (450 000 tons) among the top ten countries producing hazelnut (FAO, 2014). Ordu is the province in the Black Sea region and produced 93 000 tons hazelnut with shell in 2016 (TÜİK, 2016) and this makes the province first among the provinces producing hazelnut in Turkey. This crop is used in many ways as firstly food for people, an economic commodity, wood for warming in winter, natural fertilizer, ingredient for chocolate industry etc. Among these areas of utilization, every year, prety great amount of husk waste is obtained while spliting the husk from kernel after drying process. Therefore, we thougt that husk waste might be used for plant protection purposes in addition to other usage ways on an important group of nematodes such as *Meloidogyne* species. The four most common species, *M. incognita*, *M. javanica*, *M. hapla* and *M. arenaria* are considered as most important and causing yield losses on cultural plants by formation of conspicuous root galls (Rajvasnshi and Sharma, 2007). Especially when considered the short period and high economic value of vegetable crops, the importance of management practices on nematodes is increasing. Collange et al. (2011) put forwarded that the decrease on the existence of chemical nematicides will direct people to use alternative techniques to manage *Meloidogyne* species problem on vegetables. One of the techniques they mentioned was organic amendments and as a commercially valuable cultural plant, tomato is the potantial plant for us to examine the *Meloidogyne* spp. damage by using a natural way. Tomato is a vegetable affected by *Meloidogyne* species resulting in considerable yield losses. The losses of this plant may change between 30.57–46.92% for *M. incognita* and 77.5% for *M. javanica* (Ravichandra, 2014). The management practices on this group of nematodes for vegetable production in Turkey are mainly based on syntetic pesticides as pre-plant applications in empty fields. In addition, the use of the pesticides are not cost effective, nature-friendly and healthy for people and animals. In this context, Ordu is a potential province to provide husk waste as a source of organic amendment.

The objectives of this study were to determine the effects of husk compost and husk extract treatments on root-knot nematodes infection and secondly to recommend an enviroment friendly method to manage nematode problems on tomato and in this way to decrease the farmer expences based on pesticides. Final objective was to contribute the literature by providing alternative way for the management of *Meloidogyne* species for vegetable production system.

Material and Methods

Preparation of nematode inoculum

Egg masses of previously identified *Meloidogyne* species, *M. hapla* and *M. arenaria* were hand picked from tomato roots (cv. Rutgers) and processed for the sterilization by sodium hypochlorite solution (NaOCl) (2.5%) for 4 min. with hand-shake (Hutangura et. al., 1998). The egg suspension was washed through sieve of 500 meshes, and eggs retained on the sieve were poured into beher glass containing distilled water in order to condense the sterilised eggs. Then, the eggs were retained to hatch by using Bearman funnel (Southey, 1986) and the hatched juveniles (J2) were transfered into 50 ml. falcon tube. As last, the J2 inoculum was adjusted as 1000 J2/ ml distilled water to use (Ahmad et. al., 2013; Seo et al., 2014).

Preparation of the treatment material

In this study, dried hazelnut husk obtained from after harvest were used as husk extract and husk compost. For preparing water husk extract, 50 grams of hazelnut husk soaked in 500 ml of distilled water (Serdari et al., 2015) was left on shaker for 24 hours at room temperature 27±1°C. Then, extract was filtered through a Whatman 1 filter paper and kept in refrigerator until use. For compost treatment, the dried material was directly used as 50 gr husk compost per pot.

Trial and treatment

Seeds of susceptible tomato cultivar (*Solanum lycopersicum* cv. Rio Grande) were planted into viols during 4 weeks in controlled chamber and then the seedlings were transplanted into the 500 ml plastic pots containing 500 gr of soil (2:1 sand and peat). The treatments and control were arranged in a completely randomised designed with ten replicates. The prepared husk extract at 2 ml 10% (w/v) dose and the husk compost of 50 gr dried husk material

were applied into pots except control pots. After 4 days, approximately thousand freshly hatched (24-48 h old) second stage juveniles (J2) from sterilized eggs was inoculated into the pots. The husk extract was applied in the same amount per week regularly until the end of experiment and irrigated after each application. Then, the pots were retained during 8 weeks at 27±1°C with 70% relative humidity for 16 h light/8 h dark and watered in case of need.

Data obtain

At the end of 8 weeks, the gall number on the root system and number of the juveniles in the pot were counted. The plant fresh root weight and total plant fresh weight were measured as well.

Statistics

For the continous data, before ANOVA, the assumptions which are data normality and homogenenity of variance were tested by Levene test. If the assumptions fited, then, the variables were analysed by one-way ANOVA. The mean results of ANOVA were compared in letters by Tukey's post-hoc test. Non-continuous data was analysed directly by Kruskal-Wallis test and in case of significance, multiple comparisons were compared in letters by Dunn post-hoc test. All calculations were performed with Minitab 17 (Minitab Ltd.) and SPSS 21 (IBM) statistical softwares. The alpha level was prefered as 5%.

Results and Discussion

As result of the experiment, treatments were significantly different from each other. Husk compost treatment seemed more promising to affect all parameters examined in the trial. Husk treatment reduced gall numbers on the root and effected the fresh root weight and fresh plant weight in positive ways. If the data of trail is examined in two sections:

Effects of treatments on nematode parameters

The husk compost treated plants had lowest gall (2 galls / per root system) number in comparison to the husk extract treatment (6 galls) and control (6.5 galls). Even the difference for gall numbers is significant between compost and extract treatment, the values are rather close between control and extract groups and non-significant in the same letter (Table 1). When examined the number of juveniles in the pots, the soil treated with the husk compost was lower in comparison to the husk extract treated pots, but both treatments were higher than the control (Table 1).

Table 1. The effects of treatments on nematode numbers in pot and gall numbers on root system

Treatment	N	Numbers of juveniles in pot			Gall numbers on root system		
		Median	Ave Rank*	Mean±SE	Median	Ave Rank[a]	Mean±SE
Control	10	39.50	7.3 a	37.9 ± 5.85	6.000	19.6 b	10.20 ± 2.83
Extract	10	346.00	24.5 b	361.2 ± 44.7	6.500	16.9 b	6.20 ± 1.25
Compost	10	112.00	14.8 a	132.1 ± 34.2	2.000	10.0 a	3.10 ± 1.13
P value			0.000			0.041	

[a]Ave ranks followed by the same letter within each column are not significantly different (P = 0.05) as indicated by Dunn

Table 2. The effects of treatments on plant yield parameters

Treatment	N	Fresh root weight	Fresh plant weight
		[a]Mean ± SE	
Control	10	1.204± 0.24 a	8.62 ± 2.83 ab
Extract	10	0.958± 0.18 a	5.95 ± 1.33 a
Compost	10	1.456± 0.24 a	14.50 ± 2.52 b
P value		0.317	0.042

[a]Means followed by the same letter within each column are not significantly different (P = 0.05) as indicated by Tukey

Effects of treatments on plant parameters

The plant root weights were not significantly different between in all treatments compared to the control, but highest for the husk compost group (1.45 gr roots) and for compost treatment, it was almost 50 % higher than extract treatment (Table 2). The total plant fresh weight was significantly different for the groups and husk compost treatment was the highest (14.5 gr total plant weight) among the groups. Plant fresh weight is approximately 3 fold more for compost group than the husk extract treatment (Table 2).

The root knot nematode management is a serious time consuming and expensive problem on vegetable production. Some features on this group of nematodes such as dormant phases in their life cycles result in difficulties by decreasing the effectiveness of nematicides and the applied syntetic nematicides cause cumulative negative effects on nature. Therefore, management practices based on natural ways are necessary and recommended. In this trial, the natural way is used and it is adequately effective to decrease nematode number and contribute positively to plant biomass. Accordingly, the lower number of juveniles in the pots and significant lowest gall numbers on the root system after the husk compost treatment might be interpreted that the compost revealed positive effect on plant growth and negative effect on nematode reproduction. In addition, husk extract also showed expected effects, but really lower than husk compost treatment. For plant parameters, even statistically no difference between groups for root weights, the 50 % higher value in root weight affected by husk compost treatment is a positive contribution to plant biomass. In addition, plant fresh weight is almost 3 fold more for husk compost treatment. These are the evidence that husk compost considerable effect on plant into both ways. The results of our investigation are consistent with previous researches using different organic amendments about obtaining negative effects on *Meloidogyne* and positive effects on tomato. Alam et al. (1980) added oilcakes of different plants into pots and they showed that these organic amendments decreased the root invasion of *M. incognita*. In addition, shoot weight of tomato was also increased in comparison by the application. Oka and Uri (2002) observed suppressive effects of two composts on tomato. Cattle manure and grape marc on *Meloidogyne javanica* in pot and in vitro experiments were tested. They mentioned no galls on tomato roots grown in soils containing 10 or 25% (v/v) cattle manure compost, and very few on those grown in 50% grape marc compost. Galling reductions on the tomato root system were also observed in soils containing lower concentrations of grape marc compost. Kaşkavalcı (2007) pointed out that root galling caused by *M. incognita* in tomato plants was decreased into lower level by the effect of soil solarization plus organic amendment application compared to only solarisation. Radwan (2009) found the similar affects in pot trial. They applied the oilcakes of (cotton, flax, olive, sesame and soybean) in different amounts and the increasing higher dosage rates per kg of soil for the each cake treatment decreased mean gall numbers/root system of tomato. Mean number of juveniles in the 250 of soil was also similarly reduced with the higher dosage effect. Hassan et al. (2010) tested the effect of soil amendment with three organic wastes of *Meloidogyne* spp. on tomato. As in previous investigation, higher dosage rates per ha for each waste reduced nematode final population in the soil and gall numbers on the root system. Waste application also contributed plant parameters in positive way which increased tomato fruit yield per ha with higher dosage rates. When considered the effect of aqueous plant extracts, the previous investigations proved also promising results. Jourad et. al. (2004) used the leaves of *Crotalaria virgulata* subsp. *grantiana* as aqueous extract at 1 mg / ml and the rate showed nematostatic effect on *M. incognita*. In this way, the tomato roots were protected against the nematode. Javed et.al. (2007) pointed out that aqueous extracts of neem cake (5% dose) and neem leave (1.5%) decreased the female invasion in the roots at approximately 30 % lower and the gall index to 12 fold lower on tomato agains *M. javanica*, respectively. Aydınlı and Mennan (2014) used the aqueous extracts diffrent plants against *M. arenaria* and observed the lowest gall index (5.0) on the roots of tomato exposured by *Viscum album* cold extract.

In this context, as seen in previous researches, different organic waste treatments on tomato are significantly effective on *Meloidogyne* spp. management. The mechanisms of nematode suppression can be mentioned as release of pre-existing nematicidal compounds in soil amendments, generation of nematicidal compounds during degradation, enhancement and/or introduction of antagonistic microorganisms, increase in plant tolerance and resistance, and changes in soil

physiology that are unsuitable for nematode behavior (Oka 2010). For these reasons, organic wastes are the promising tools for nematode management. Especially, the increasing level of amendments until optimum level might decrease the gall numbers effectively in different soil types (Coosemans 1982). In addition, organic waste treatment might affect nematode reproduction in negative way equally as chemical treatment showed (Rivera and Aballay 2008) and increases plant yield more than the growing plant in fumigated soil (Marull et. al. 1997).

In conclusion, husk compost treatment seemed that it has more positive effect than the effect of husk extract application. In this way, it can be recommended to the tomato producers in the region in order to contribute the plant growth parameters, but further investigations with repeated trials is needed by different year conditions to show if there is side effects in some aspects or to prove again if the effectiveness of hazelnut husk applications is repeatable and sustainable for nematode management.

References

Ahmad, F., Siddiqui, M. A., Olubukola O. Babalola, O. O. 2013. Characterization of nematicidal activity of plant residues and their application with moisture approach against *Meloidogyne incognita* in tomato. African Journal of Agricultural Research Vol. 8 (1), 93-101.

Alam, M. M., Ahmad, M., Khan, A. M., 1980. Effect of organic amendments on the growth and chemical composition of tomato, eggplant and chilli and their susceptibility to attack by *Meloidogyne incognita*. Plant and soil. 57 (2-3): 231-236.

Aydınlı, G., Mennan, S., 2014. Effect of some plant extracts on *Meloidogyne arenaria* Neal, 1889 (Tylenchida: *Meloidogynidae*) and tomato. Turkish Journal of Entomology, 38(3):323-332.

Collange, B., Navarrete, M., Peyre, G., Mateille, T., Tchamitchian, M., 2011. Root-knot nematode (*Meloidogyne*) management in vegetable crop production: The challenge of an agronomic system analysis. Crop Protection, 30 (10): 1251-1262.

Coosemans, J., 1982. Influence of organic material on the population dynamics of *Meloidogyne hapla* Chitwood. Agricultural wastes, 4 (3): 193-201.

FAO, 2014. http://www.fao.org/faostat/en/#data/QC (Data accessed: 14.08.2017).

Hassan M.A., Chindo P.S., Marley P.S., Alegbejo M.D., 2010. Management of root knot nematodes (*Meloidogyne* spp.) on tomato (*Lycopersicon lycopersicum*) using organic wastes in Zaria,Nigeria. Plant Protection Science, 46: 34-39.

Hutangura, P., Jones, M. G. K., Heinrich, T. ,1998. Optimisation of culture conditions for in vitro infection of tomato with the root-knot nematode *Meloidogyne javanica.* Australasian Plant Pathology, 27 (2): 84-89.

Javed, N., Gowen, S. R., Inam-ul-Haq, M., Anwar, S. A.,2007. Protective and curative effect of neem (*Azadirachta indica*) formulations on the development of root-knot nematode *Meloidogyne javanica* in roots of tomato plants. Crop protection, 26 (4): 530-534.

Jourand, P., Rapior, S., Fargette, M., Mateille, T. 2004. Nematostatic effects of a leaf extract from *Crotalaria virgulata* subsp. *grantiana* on *Meloidogyne incognita* and its use to protect tomato roots. Nematology, 6 (1): 79-84.

Kaşkavalcı, G., 2007. Effects of soil solarization and organic amendment treatments for controlling *Meloidogyne incognita* in tomato cultivars in Western Anatolia. Turkish Journal of Agriculture and Forestry 31 (3): 159-167.

Marull, J., Pinochet, J., Rodríguez-Kábana, R., 1997. Agricultural and municipal compost residues for control of root-knot nematodes in tomato and pepper. Compost science & utilization, 5 (1), 6-15.

Oka, Y. 2010. Mechanisms of nematode suppression by organic soil amendments-a review. Applied Soil Ecology, 44 (2): 101-115.

Oka, Y., Uri Y., 2002. Suppressive effects of composts against the root-knot nematode *Meloidogyne javanica* on tomato. Nematology 4 (8): 891-898.

Radwan, M. A. El-Maadawy, E. K. Kassem S. I., Abu-Elamayem, M. M.,2009. Oil cakes soil amendment effects on *Meloidogyne incognita*, root-knot nematode infecting tomato, Archives Of Phytopathology And Plant Protection, 42 (1): 58-64.

Rajvasnshi, I., Sharma, G.L. 2007. Eco-friendly Management of Phytonematodes. Rajdhani Printers, Delhi.

Ravichandra, N. G. 2014. Horticultural nematology (Vol. 3, p. 25). New Delhi: Springer.

Rivera, L., Aballay, E. 2008. Nematicide effect of various organic soil amendments on *Meloidogyne ethiopica* Whitehead, 1968, on potted vine plants. Chilean Journal of Agricultural Research, 68 (4): 412-412.

Sadi Sardari, A., Hojat Jalali, A.A., Bahraminejad, S., Safaee, D. 2015. Effect of plant extracts on the mortality of root-knot nematodes' J2, *Meloidogyne javanica*. Archives of Phytopathology and Plant Protection, 48, (4), 365–375.

Seo, Y., Jiyeong Park, J., Kim, Y.S., Par, Y. Kim, Y. H., 2014. Screening and Histopathological Characterization of Korean Carrot Lines for Resistance to the Root-Knot Nematode *Meloidogyne incognita*. Plant Pathol. J. 30 (1) : 75-81.

Southey, J. F. 1986. Laboratory methods for work with plant and soil nematodes. Ministry of Agriculture, Fisheries and Food, Her Majesty's Stationery Office, London, UK

TÜİK, 2016. https://biruni.tuik.gov.tr/bitkiselapp/bitkisel.zul. (Data accessed: 14.08.2017).