Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.11, 2015

Evaluation of Avocado Root Rot (Phytophthora cinnamomi Rands) Control Options in Southwest Ethiopia

Demelash Teferi* Getachew WeldeMichael
Jimma Agricultural Research Center, P.O. Box, 192, Jimma, Ethiopia
Email- teferidemelah2008@gmail.com

Abstract
Avocado root rot disease, which is caused by the fungus *Phytophthora cinnamomi* Rands, is one of the major avocado production constraints in southwest Ethiopia. Evaluation of root rot control options was carried out 20011-2012 on root rot infested field at Gera and green house at Jimma. For field experiment at Gera Six treatments (compost, mulching, EM with compost, EM with mulch, stem injection with cannon chemical and untreated control) were tested in RCB design with three replications and three trees per plot. For laboratory experiment at jimma, six treatments namely, compost, mulching, EM with compost, EM with mulch, stem injection with cannon chemical and untreated control were tested in completely randomized design. The result indicated that there was no a significant difference among the treatments for field experiment but treatments showed highly significant differences for green house experiment. None of the treatments tested gave any significant remedial effect for trees already infected and showing avocado root rot symptoms over the course of this trial. Therefore, growers are highly advised to use preventive measures to control avocado root rot problem.
Keywords: Root rot, stem injection, compost, mulching

INTRODUCTION

Avocado (*Persea americana* Miller) is native to Mexico. Despite the favorable weather condition, Avocado was unknown to both producer and consumers in Ethiopia before two decades (Zekarias, 2010). Avocado was first introduced to Ethiopia in 1938 by private orchardists in Hirna and Wondo-genet and production gradually spread into the countryside where the crop was adapted to different agro-ecologies (Edossa, 1997; Woyessa and Berhanu, 2010). jimma Agricultural Research Center has introduced avocado to jimma from Wondogenet and Debrezeit (Edossa,1997). Its introduction and dissemination has contributed a lot in income generation and employment creation to the farming society of southwest Ethiopia. It has become greater source of income for trader, private business institutes, governmental and non-governmental organizations (Zekarias, 2010).

According to the annual report of Bearu of agriculture (2010) avocado occupied 75 % fruit farmland in the area. However, currently most these avocado trees have been lost due to avocado root rot (*Phytophthora cinnamoni* Rands), which is one the major problem of avocado in southwest Ethiopia and in most of the countries where this tree is grown. The symptoms of avocado trees infected with Phytophthora root rot are a gradual decline in growth where the foliage becomes sparse at the tops of the tree and branch die back can occur (Pakand Everett, 2001). It infects plants through the roots and interferes with water and nutrients uptake from the soil. This causes rotting of the cambium leading to wilting of the leaves and eventually death of the plant. Additional factors that contribute to death of the plants are the extensive loose of fine roots. The pathogen can also survive in roots, soil and plant material as chalamydospores, thus protecting it from fungicides and fumigation. Activities during wet seasons or irrigation can increase disease spread through oospores movement to non-infected areas. The wide host range and its ability to survive in soils and plants are some of the difficulties faced in controlling *P. cinnamoni* spread and infestation.

The result of survey, which was conducted at jimma, indicated that avocado root rot incidence varied between 6.6-20% for *Seka*, 11.6-33.3 for *kersa* and 0-27.4 for *Mana woredas* (JARC crop protection, unpublished data). This indicated that the avocado root rot problem is very serious and requires serious attention. The ultimate solution to the negative financial impact of avocado (*Persea american* Mill.) root rot has on the southwest Ethiopian avocado farmers is developing methods to control root rot disease of avocado. With this objective, avocado root rot control options were evaluated so as to select the best disease control practice which can be acceptable and affordable by the farmers.

MATERIAL AND METHODS

The field study was conducted on established avocado trees of Gera Research Center, Gera is located at latitude of 7^{o} 46' N and longitude of 36^{0} 26' ' E with an altitude of 1974 m. a.s.l. The area receives mean annual rainfall of 1616 mm with maximum and minimum temperature of 28.4 ^{0}C and 12.4 ^{0}C, respectively (Zebene and Wondwosen, 2008).

For field experiment, three trees were selected and all trees were photographed as a benchmark for comparison in future assessments of tree health. Canon chemical/stem injection and other five treatments, namely, Mulch, compost mulch with effective microorganisms, compost with effective microorganisms and

untreated control were investigated.

Canon chemical which was obtained from Agency for International Development Cooperation (MASHAV) was applied 7.5 cc per canopy diameter with similar quantity of distilled water when there was no vegetative flush. For mulching treatment, vetivar grass was applied at a thickness of 7cm around the base of the tree. For compost treatment, 200kg decomposed coffee husk was applied around the base of each tree. For combined treatments, 0.1 % effective microorganism with 45 liter was irrigated on 7cm thick mulch on each tree. EM plus compost mix, which was prepared by mixing EM on 200kg of decomposed coffee husk, was applied around the base of each tree. One year after the trial was established, tree health was assessed. Canopy health and vigor was assessed using the same 0 to 5 scale.

The laboratory experiment was conducted at Jimma Agricultural Research Center (JARC). The center is located at latitude 7^{o} 40.00' N and longitude 36^{o} 47'.00' E with an altitude of 1753 m.a.s.l. The area receives mean annual rainfall of 1432 mm with maximum and minimum temperature of 25.9 ^{0}C and 11.2 ^{0}C, respectively. The soil is characterized Eutric Nitosol (reddish brown) with pH of 5.2 (IAR, 1997). Avocado cultivar was sown on sterilized sand and soon after germination; seedlings were transplanted into soil mix with a ratio of 2:1:1, infected soil, sand and compost, respectively. Infected soil was checked for the presence of fruiting bodies / sporangium/ under laboratory condition. Six treatments, which were applied for field experiment at Gera, were also applied on fully grown seedlings for laboratory experiment at Jimma. Treatments were tested in CRD in three reps using three seedlings per bucket. When the seedlings were reaching optimum size feeder root health assessments were made at the end of the seasonal flushes in root growth. Roots were gently washed to remove soil and disease severity was assessed based on percent root necrosis.

In additon, *Lutpinus angustifolius* L.which was obtained from MASHAV and used as indicator of *Phytophtora cinamomi* was planted in contaminated soil and sterilized sand to see whether *Lutpinus* can serve as indicator or not .

RESULTS AND DISCUSSION

In the assessments of tree health, none of the differences between treatments were statistically significant ($P>0.05$). Thus, none of the treatments tested were effective as remedial treatments for trees already infected and showing moderate to severe Phytophthora symptoms. However, the potential of these treatments especially application of compost as part of a preventative programme was effective in areas where the disease pressure very low (Demelash, personal observation).. In contrast to this finding, Hornen and Jensen (2014) reported that avocado trees treated with phosphonic acid and injecting trees in both spring and autumn tended to give a greater and more rapid improvement in tree health compared to injecting trees only in either spring or autumn. The variation is probably due to the differences in stem injection frequency and time of application, inoculum load, and propagation method as well as due to the difference in the environments on which the experiment was conducted. During the application of canon injection no phytotoxcity to leaves stems was observed

Measurement of root health is more rapid assessment of treatment response, rather than waiting for canopy symptoms to develop. There existed significant ($p<0.001$) difference among treatments tested in green house experiment. In the green house experiment, the highest healthy root was recorded on avocado seedlings treated with phosphonic acid /canon drenching (37.8%). The result in general indicated that canon drenching found to control avocado root rot disease relatively at seedling stage. However, mulch and compost treatments showed the least percentage of healthy roots whether they are used alone or in combination with EM and these treatments showed no significant differences among each other and with the untreated control treatment (Table 3). The result of this experiment also indicated that successful control of the pathogen is not easy once the soil is infected with avocado root rot.

Lutpinus angustifolius L,which was obtained from MASHAV as indicator of *Phytophtora cinamomi, was planted* in contaminated soil and sterilized sand to see whether Lutpinus can serve as indicator or not. Lutpinus planted in root rot infested soil showed wilting symptom and death of the seedlings. However, Lutpinus planted in sterilized soil found to survive. The result confirmed that Lupinus angustifolius is a true indicator plant for the presence or absence of phythpothera root rot (Figure 4).

SUMMARY AND CONCLUSION

None of the treatments tested gave any significant remedial effect for trees already infected and showing avocado root rot symptoms over the course of this trial. Stem injection, which is the main controlling means avocado root rot, didn't show any significant difference from the untreated control, Therefore, phosphorous acid injection should be tested at different seasons of the year and at different growth stage of the avocado tree. In conclusion, fencing, disinfection at the entrance of avocado orchards, use of drainage system, application of compost and disinfection of seeds can be used as a short term strategy to control this serious disease. On the other hand, introducing avocado root rot resistant root stocks form known avocado producing countries and selecting resistant root stocks by collecting avocado seeds from different avocado producing areas of this country

where the problem is severe can be used as long-term strategy to alleviate the root rot problem.

REFERENCES

Edossa, E., 1997. Selection of Avocado (*Persea american* M.) collection for desirable fruit characteristics and yield at jimma. Proceedings of the 8th annual conference of the crop science society of Ethiopia, Feb 26-27, Addis Ababa, Ethiopia, pp: 26-35.

Garedew, E and Tesgaye B. 2011.Trends of Avocado production and its constraints in Mana Woreda, Jimma Zone: Potential crop for coffee diversification, trends in Horticultural research 1(1): 20-26, 2011.

Institute of Agricultural Research (IAR). 1997. Jimma Research Center Progress report for thePeriod 1996. IAR, Jimma

Horner, I.J. and Jensen,E.H. 2004. Evaluation of phythopthra control in avocados, New Zealand Avocado Growers' Association Annual Research Report 2004. 4: 1–7.

Pak, H.A. and Everett, K.R. (2001). Root rot management. New Zealand Avocado Growers'Association Growers' Manual, Fourth Edition.

Zebene Mikru and Wondwosen Tena, 2008. Potential and constraints of Nitosol and Acrisols.pp. 209-216. In: Girma Adugna, Bayetta Belachew, Tesfaye Shimber, Endale Taye and Taye Kufa (eds.).Coffee Diversity and Knowledge. Proceedings of a National Workshop Four Decades of Coffee Research and Development in Ethiopia, 14-17 August 2007, Addis Ababa, Ethiopia.

Zekarias Shumeta. 2010. Avocado production and marketing in southwest Ethiopia. Trends in Agricultural economics, 3(4): 190-206.

Table 1. Treatments applied for field and green house experiments

	Treatment	
1	EM + compost	200 kilogram of compost was applied on each tree after preparing EM and compost mix (100 liter of water, one liter of Effective microorganism (EM) and one kg of sugar which was stayed for one week was used to prepare EM plus compost mix). (Fig)
2.	Compost only	200 kilogram of decomposed coffee husk was applied on each tree
3.	EM + Mulch	0.1 % EM was irrigated (45 liter) after mulching (7cm thickness),
4.	Mulch only	7 cm thickness of vitivar grass was applied
5.	Stem Injection	Canon chemical which was obtained from Agency for International Development Cooperation (MASHAV) was applied 7.5 cc per canopy diameter with similar quantity of distilled water when there is no vegetative flush.
6.	control	Untreated

Table 2. Disease symptom and their descriptive value

Ser.no	Treatment	Disease score
1	Deep green no die back	0
2	Die back /chlorosis can be observed at least on one branch	1
3	Chlorosis extent increase at least greater than 5-10%	2
4	Chlorosis > 20%, wilting starts	3
5	Leaf defoliation > 95%	4
6	100 % leaf defoliation & complete death	5

Table 3. Percentage of healthy roots for avocado pot experiment at Jimma Agricultural Research Center

Ser. no	Treatment	Mean
1	EM+ compost	3.3c
2	Compost only	4c
3	EM+ Mulch	3.4c
4	Mulch only	0.2c
5	Drenching canon	37.8b
6	Control	0.3c
	Mean	17.7

NB. Means followed with the same letter are not different according to Tukey test

Table 4. Disease rating using 1-5 scale of avocado field experiment at Gera Research sub centerv

Treatment	Mean
EM+ compost	2.7a
Compost only	2.6a
EM+ Mulch	2a
Mulch only	2.5a
Stem injection	2.9a
Control	2.9a
Mean	2.4

NB. Means followed with the same letter are not different according to Tukey test

Figure 1. Application of mulch

Figure 2. Application of compost

Fig 3. Stem injection

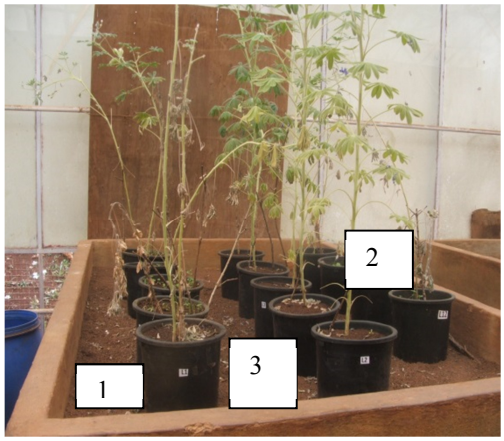

Fig 4. Lupinus in infected soil (1and 2) and sterilized sand (3)

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar