Advanced Engineering Days

aed.mersin.edu.tr

Novel methods to improve the plant immunity

Ayşe Ayhan [*1], **Furkan Ayaz**[1,2]

[1]*Mersin University, Biotechnology Department, Türkiye, ayseayhan@mersin.edu.tr*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Ayhan, A., & Ayaz, F. (2022). Novel methods to improve the plant immunity. 3rd Advanced Engineering Days, 57-58

Keywords
Wood vinegar
Plant health
Pesticide
Biopesticide

Abstract

The aim of the agricultural activities is obtaining high quality products with higher yields without adversely affecting the ecological balance, but today the presence of the pesticide residues in agricultural products and their accumulation on the soil surface adversely affect human and environmental health. The problems arising from the excessive use of synthetic pesticides have made it important to do research on the alternative methods and on utilization of natural pesticides in plant protection studies. Wood vinegar, a product that can be used in this context, is a by-product produced by the pyrolysis of side products such as agricultural wastes, fruit peels or wood wastes at 200-600 °C in the absence of oxygen. Wood vinegar contains more than 200 chemicals, including acetic acid, methanol, phenol, ester, acetal, ketone, formic acid and many other organics. In many studies, it has been proven that wood vinegar has antimicrobial, antioxidant, antifungal effects and can be used as a biopesticide due to these effects. It has also been reported in studies that wood vinegar, which is effective in the growth of some bacterial species, also increases the fertilizer retention in the soil, and is good for plant rooting and plant health.

Introduction

Although the benefits of pesticides, which have been used for the plant protection in agricultural activities for centuries, cannot be denied, their negative effects on soil ecology and human health cannot be ignored as well. Pesticides, which remain on the soil surface for a long time, inhibit the activities of the beneficial microorganisms, reduce their numbers or make them ineffective [1]. Despite important chemicals such as glyphosate, glufosinate, diquat and paraquat used in the weed control in traditional agriculture, unfortunately many weed populations have developed resistance to these chemicals [2]. Considering all these situations, alternative new methods and biopesticides have begun to be investigated in order to minimize the damage to the soil ecology and environmental health [1].

Wood vinegar emerges as a by-product of the carbonization process, and its first use was found to date back to Neanderthal times [3]. Scientific studies on the use of wood vinegar in agriculture first started in Japan in the early 1950s. In the continuation of these studies, Japan took the efficiency and use of wood vinegar into the research agenda, and today, wood vinegar is widely used in Japan, Taiwan and Korea, and it is known that the annual production is around 14,000 tons [4].

Results

Wood vinegar is an aqueous solution of a yellowish or dark brown color with an acidic nature. Wood vinegar is derived from pyrolysed lignocellulose, the essential element of biomass (4h). Wood vinegar contains more than 200 chemicals, of which 80-90% is water, 10-20% is acetic acid, methanol, phenol, ester, acetal, ketone, formic acid and many other organics [4].

Wood vinegar, which is produced by the pyrolysis of wood waste, acts as herbicide against many broad leaf and weeds. Wood pyrolysis is a process that decomposes the biomass with a thermal system at a temperature of 200-600 °C without oxygen, resulting in a variety of product output such as solid coal (biochar). The main product of the pyrolysis process is biochar and the by-product is wood vinegar. Although the content of wood vinegar may vary according to the raw material used in the pyrolysis process, it has been reported that the content of wood vinegar in general terms has acetic acid content of 4.34% by weight, together with many organic acids including acetyloxyacetic acid, butanoic acid and propanoic acid [5].

Wood vinegar with antimicrobial and antioxidant properties can be used mostly as an animal feed additive, anti-odor or anti-inflammatory agent, while low doses can be used as soil or foliar fertilizer. It has also been suggested that wood vinegar, which is used in low doses, prevents harmful algae formation [2]. It has been observed that wood vinegar eliminates the fungus in the PDA medium, which is caused by the strong phenolic compounds it contains [3]. Due to the high acidity, ethanol and phenol it contains, it has bactericidal properties at high concentrations [4]. Some studies have also reported that wood vinegar restricts or completely destroys the growth ability of microorganisms such as *E.coli*, *Salmonella*, *B. Subtilis*, *S.aureus*, *Listeria monocytogenes*, *Colletothricumcapsici* and *Phytophthora palmivora* [6]. At the same time, as a result of the leaf application with the wood vinegar, it was observed that the leaves got a brighter and more lively appearance by increasing the chlorophyll thanks to the wood vinegar ester that promotes photosynthesis. As a result of the application of wood vinegar made from leaves, some bacteria die directly and the microbiological ecosystem prevents the spread of the pathogenic bacteria [4].

Discussion

In summary, wood vinegar can be used as a new alternative method, considering the harm caused by pesticides used in traditional agriculture to the environment and human health, and the resistance gained by the pests [6]. It has been stated that wood vinegar has no harmful effects on the humans and animals, if it is used in agricultural activities. It also acts by improving plant and soil quality, combating plant diseases and harmful insects, and reduces the fertilizer need by the plant during the plant growth [7]. Correct dosage and use also increases the uptake of the fertilizer components from the soil and reduces the damage of most of the diseases, regulates the conditions of nutrients in the soil, increases rooting and balances the microbiological population. The change in the microbiological population not only reduces soil-related diseases, but also increases the resilience of the roots, thus providing better uptake of the nutrients [4]. A highly diluted tree vinegar shows antioxidant and anti-bacterial activities as well [5]. More studies in the field will definitely encourage the utilization of similar products for the agricultural activities.

References

1. İbrahim, K., & Yardım, E. N. (2019). Pestisitlerin ve odun sirkesinin bazı mikrobiyal ve fiziko-kimyasal toprak parametrelerine etkilerinin araştırılması. *Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi*, *22*(6), 896-904.
2. Liu, X., Zhan, Y., Li, X., Li, Y., Feng, X., Bagavathiannan, M., ... & Yu, J. (2021). The use of wood vinegar as a non-synthetic herbicide for control of broadleaf weeds. *Industrial Crops and Products*, *173*, 114105.
3. İbrahim, K., Yardım, E. N., Çelik, A., Mendeş, M., Mirtagioğlu, H., & Namlı, A. (2018). Fındık kabuklarından elde edilmiş odun sirkesi'nin in-vitro şartlarında küf etmenlerine karşı antifungal etkisinin belirlenmesi. Bitlis Eren Üniversitesi Fen Bilimleri Dergisi, 7(2), 296-300.
4. Namlı, A., Akça, M. O., Turgay, E. B., & Soba, M. R. (2014). Odun sirkesinin tarımsal kullanım potansiyelinin araştırılması. Toprak Su Dergisi, 3(1), 44-52.
5. Liu, X., Wang, J., Feng, X., & Yu, J. (2021). Wood vinegar resulting from the pyrolysis of apple tree branches for annual bluegrass control. *Industrial Crops and Products*, *174*, 114193.
6. Desvita, H., & Faisal, M. (2022). Antimicrobial potential of wood vinegar from cocoa pod shells (Theobroma cacao L.) against Candida albicans and Aspergillus niger. *Materials Today: Proceedings*.
7. İbrahim, K., Yardım, E. N., & Yildiz, Ş. (2017). InVitro Şartlarında Küf Etmenlerine Karşı Tavuk Gübresinden Elde Edilmiş Odun Sirkesinin Antifungal Etkisi. Yüzüncü Yıl Üniversitesi Tarım Bilimleri Dergisi, 27(4), 516-520.