Effects of Some Plant Essential Oils against Fungi on Wheat Seeds

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ABSTRACT

Diseases, especially caused by seed borne fungi, are among the factors decreasing yield and quality of wheat. Common bunt is also an important seed borne disease of wheat worldwide. The objective of the study is to determine the effects of clove, ginger, mint, oregano and thyme oils on the fungal load of wheat seeds. In addition, effects of the oils on the germination rates of bunt spores were investigated. Blotter method was used to determine the effects of different concentrations (0.05 – 10%) of the oils on fungal load of wheat seeds. After incubation at 22°C for 7 days, seeds were investigated under stereomicroscope and fungi growing on the seeds were recorded. Germination rates of bunt spores were determined after incubation on water agar with different concentrations of oils. Highest doses of clove, mint and oregano oils totally inhibited the fungal growth on wheat seeds, but they also inhibited the germination of seeds. Lower doses failed to inhibit fungi on seeds, however they decreased or totally inhibited the germination of bunt spores. As a result, it was found that plant essential oils could be used against bunt disease of wheat as an alternative to fungicides.

Key words: Triticum aestivum, seed-borne fungi, Tilletia spp., control, Blotter test, Germination rate.

INTRODUCTION

Wheat (Triticum aestivum L.) is generally acknowledged as the most important agricultural crop since times immemorial. Diseases, especially caused by seed borne fungal agents, are among the main factors reducing yield and quality of wheat. Seed borne pathogens reduce viability, vigor, and germination capability of the seeds resulting in lower yield. Some of them may also cause losses with the diseases on plants growing from the infested seeds. Seed borne fungi not only decrease yield and seed quality, but they also produce mycotoxins which cause diseases on human or animals feeding with these seeds or food made with them. Seed health is important to obtain higher yields in agriculture. Thus, disease agents on or in the seeds should be determined and controlled. Common bunt is one of the important seed borne diseases of wheat causing significant yield losses and most of the seed lots of winter wheat are treated with synthetic fungicides in order to prevent the disease. Because of the negative side effects of the fungicides on environment and human health, alternative chemicals or control methods gained importance. Especially in organic agriculture, use of safer chemicals is essential. Plant extracts and essential oils, as safer natural chemicals, have long been known to have antimicrobial properties and used to control some plant diseases. There are also some studies on their use against seed borne fungal diseases of some plant species. In the current study, effect of clove, ginger, mint, oregano and thyme essential oils on the fungal load of wheat seeds was determined. In addition, effect of the essential oils on the germination rates of bunt spores was investigated.
Wheat seed samples (cv. Alpu-01) and wheat heads infected with bunt disease were obtained from Anadolu Agricultural Research Institute in Eskişehir province. Blotter method was used to determine the effects of different concentrations (0.01 – 10%) of the oils on fungal load of wheat seeds. Essential oils were applied by two different methods. In the first method, wheat seeds were dipped into oil dilutions for one hour, blotted dry and transferred to blotter papers in petri dishes. In the second method, used in order to determine the volatile effects of the essential oils, 20 μl oil was applied onto small blotter papers and they were placed on the lids of petri dishes where seeds were transferred. After incubation at 22°C for 7 days, seeds were investigated under stereomicroscope and fungi growing on the seeds were recorded. For both methods, seeds not subjected to essential oils served as controls. Means were subjected to analyses of variance after arcsin transformation and were compared by Tukey test.

**RESULTS & DISCUSSION**

**Effects of Oils on Fungal Load and Germination Rates of Wheat Seeds**

In this study, blotter method which was determined as the best media to isolate the fungi growing on or in the wheat seeds, were used to evaluate the fungal load of the seeds subjected to different doses of the essential oils. Fungal species belonging to *Acremonium, Alternaria, Arbrobotrys, Aspergillus, Cladosporium, Epicoccum, Fusicarium, Penicillium, Rhizopus, Trichoderma* and *Ulocladium* genera were determined on the wheat seeds. These fungi were previously reported as the most frequent seed borne fungi of wheat. Effects of the oils on fungal load and germination rates of wheat seeds differed according to the application methods and doses. When the seeds were dipped into oil dilutions, 5 and 10% doses of the essential oils reduced or totally inhibited fungal growth and germination of the seeds, while lower doses failed to inhibit fungal growth. Clove and oregano oils were the most effective oils and they totally inhibited the fungal growth on the wheat seeds in two higher concentrations, but they also totally inhibit seed germination. Mint oil failed to inhibit seed-borne fungi in 5% concentration, but this dose significantly lowered the germination rates of the seeds. However, the highest dose of mint oil totally inhibited fungal growth and germination of the wheat seeds (Table 1). In order to determine the intermediate doses of oregano and mint oils preventing fungal growth but not seed germination, effects of 2, 3 and 4% doses of clove and oregano oils and 6, 7 and 8% doses of mint oil were investigated. It was found that doses over 3% of clove oil and 2% of oregano oil totally inhibited fungal growth on the seeds, while those of mint oil reduced infestation rate to 65%. Unfortunately, intermediate doses of the oils totally inhibited seed germination. Volatile effects of 10% diluted clove, ginger, mint and thyme essential oils were not sufficient to inhibit the fungi on wheat seeds, while same dose of oregano oil decreased the infestation rate to 70% and seed germination to 40%. Effects of undiluted oils were better and clove, mint and oregano oils totally inhibit fungal growth, but also decreased or inhibited the germination of wheat seeds (Table 2).

**Effects of Essential Oils on Germination Rates of Bunt Spores**

It was determined that ustilospores of *Tilletia tritici* causing bunt disease on wheat were more sensitive to essential oils used in the study, than other saprobic or parasitic fungi on wheat seeds. All oils totally inhibited the germination of bunt spores when they were added to water agar even in the lowest dose (100 ppm) used in the study. Volatile effects of the undiluted oils were similar and they also inhibited the spore germination. However, 10% diluted clove and thyme oils were not effective and spore germination rates were similar with control plates. As a result we can recommend soaking
because of the difference of the application methods, but plants were different from the present study.\textsuperscript{2,16}

\section*{CONCLUSION}

Highest doses of clove, mint and oregano oils totally inhibited fungal growth and seed germination of wheat seeds. Lower doses permitting seed germination failed to inhibit fungi on seeds, however they decreased or totally inhibited the germination of bunt spores. Plant essential oils can be used against bunt disease of wheat as an alternative to fungicides, especially in the organic production.

\section*{ACKNOWLEDGEMENT}

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\section*{CONFLICT OF INTEREST}

None

\section*{ABBREVIATION USED}

\begin{itemize}
  \item cm\textsuperscript{2}: square centimeter; ml: milliliter; μl: microliter; ppm: parts per million; °C: degrees Celsius.
\end{itemize}

\section*{REFERENCES}

SUMMARY

• The objective of the study is to determine the effects of clove, ginger, mint, oregano and thyme essential oils on the fungal load of wheat seeds and on the germination rates of bunt spores. Blotter method was used to determine the effects of different concentrations (0.05-10%) of the oils on fungal load of wheat seeds. After incubation at 22°C for 7 days, seeds were investigated under stereomicroscope and fungi growing on the seeds were recorded. Germination rates of bunt spores were determined after incubation of spore suspension (1000 spores/ml) on water agar and exposure with different concentrations of oils by two different methods. Highest doses of clove, mint and oregano oils totally inhibited the fungal growth on wheat seeds, but they also inhibited the germination of seeds. Although lower doses failed to inhibit all fungi on seeds, they decreased or totally inhibited the germination of bunt spores.

PICTORIAL ABSTRACT

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