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EFFECT OF WHEATGRASS (*Triticum aestivum* L.) JUICE ON SEEDLING GROWTH AND *Rhizoctonia solani* ON CORN

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Abstract

In this study, possibilities of using wheatgrass juice, as an encouraging or activator of seedling growth on corn, were investigated. In order to obtain grass juice, wheat seeds (bread wheat) were sown in plastic boxes and were harvested on the 10th day. Wheatgrass juice was obtained by using an electronic juicer. Pots with 10-15 cm diameter were filled with perlite+peat mixture and three corn seeds were sown into each pot. Fresh wheatgrass juice was used to irrigate the corn seeds and tap water was used for control pots. Seedlings were removed and washed at the end of 30th day. Stem and root lengths and weights of the seedlings were determined.
In order to determine the effect of wheatgrass juice on Rhizoctonia solani, the pathogen isolate was grown on Petri dishes with Potato Carrot Agar medium and transferred onto pots with perlite. Fifteen corn seeds were sown in each pot. Seeds were then irrigated with distilled water (control group: Rhizoctonia solani+distile water) or wheatgrass juice (Rhizoctonia solani+wheatgrass juice). Disease severity was determined two weeks after sowing.
As a result of the study, wheatgrass juice was significantly reduced both lengths and weigths of the corn seedlings (root+stem). It was also found that wheatgrass juice increased the severity of disease symptoms caused by Rhizoctonia solani.

Key words*: wheatgrass juice, root-stem length and weight, Rhizoctonia solani.*

INTRODUCTION

Germination/sprouting causes extensive changes on the seeds. During this stage, the synthesis of useful compounds such as vitamins and phenolics occurs. Wheat seedling germinated and grown over a period of 6-10 days is generally called wheatgrass. During germination, vitamins, minerals, and phenolic compounds including flavonoids are synthesized in wheat sprouts, and they reach the maximum antioxidant potential (Kulkarni et al., 2006a). It is reported that wheatgrass contains high amounts of vitamins, antioxidants and minerals in bioavailable form. Additionally, the concentrations of vitamins C and E, β-carotene, ferulic acid and vanillic acid increase during the germination period of wheatgrass (Hanninen et al., 1999). The inhibitory effect of wheatgrass on oxidative DNA damage and the high antioxidant content of wheat sprouts were shown (Falcioni et al., 2002). Antioxidants are capable of neutralizing the deleterious effects of free radicals.

In another study, it is shown that wheatgrass powder contained protein, carbohydrate, dietary fiber, chlorophyll, fat, calcium, potassium, vitamins (A, B_{12}, C, E, B_{17}, B_9), and aminoacids (histidine, isoleucine, lysine, leucine, threonine, tryptophan, valine, methionine, trozine, alanine, proline, serine, phenylalanine) (Pant et al., 2013).

Plant activators are natural or synthetic chemicals that help the plant to get the nutrients better from the soil, increase the yield and quality of the product especially under stress conditions by improving the soil structure and natural defense system of the plants. In different studies, it was reported plant extracts obtained from different plant parts contained more antioxidant compounds and their use reduced oxidative stress and encouraged development (Liu, 2004; Joseph et al., 2007; Pan et al., 2009; Pant et al., 2013).

In recent years, it was reported that there were various forms of wheatgrass as a healthy food, such as a ready-made juice, tablet or powder and that 100 g of wheatgrass powder is equal to 23 kg of fresh vegetables. Wheatgrass packs a nutritional punch, including (per 3.5 grams) 860 mg protein, 18.5 mg chlorophyll, 15 mg calcium, 38 mg lysine, 7.5 mg vitamin C and an abundance of micronutrients, such as B complex vitamins and amino acids. Also wheatgrass juice is high in vitamin K (Rana et al., 2011).

Rhizoctonia solani is a soil-borne pathogen causing pre- or post-emergence damping off disease resulting in seedling losses. If the pathogen attacks seeds before germination or just before the emergence of young seedling, seed or seedling root occurs and it is called pre-emergence damping off. If the fungus attacks stem of young seedling after emergence which then falls over the soil and dies, this symptom is called post-emergence damping off. Sometimes the pathogen causes late infections which don't kill the plant, but decreases yield.

The pathogen also causes reddish brown lesions on the roots which prevents nutrient uptake and causes nutrient deficiency symptoms (Agrios, 2005; Aşkın and Katırcıoğlu, 2008).

While there are many researches on the effects of wheatgrass juice on human health, there is no study showing its effects on plants and their diseases. In this study, the possibility of using wheatgrass juice, which is rich in proteins and amino acids, as a bio-fertilizer and to determine its effects on the disease symptoms caused by *Rhizoctonia solani* on corn plants.

MATERIALS AND METHODS

Two different experiments were carried out to determine the possibility of using wheatgrass juice as a bio-fertilizer and its effect on *Rhizoctonia solani,* on corn plants. The experiments were carried out as a factorial in base of completely randomized design with 4 replicates and conducted in the laboratory of the Department of Field Crops, Faculty of Agriculture, Süleyman Demirel University. In order to obtain grass juice, bread wheat seeds (cv. Gün 91) were sown in 35x50 cm plastic boxes and were harvested on the 10th day, by reaping with scissors. Then wheatgrass juice was obtained by using an electronic fruit juicer.

Determination of the effect of wheatgrass juice on plant growth

In the experiment carried out for the determination of the effect of wheatgrass as a bio-fertilizer, 10-15 cm diameter pots were filled with perlite+peat mixture and three corn seeds were sown into each pot. Initially, 100 ml of fresh wheatgrass juice was used to irrigate the corn seeds and same amount of tap water was used for control pots. Every two days pots were controlled and irrigated with 100 ml of wheatgrass juice or tap water for controls, as needed. Seedlings were removed and washed at the end of 30th day after emergence. Roots and stems were cut with a razor blade at their juncture and their lengths were measured with a millimeter ruler. The average root/stem length was determined as cm/plant by taking the average of the replicates per application. Separated stems and roots of the seedlings were placed on blotter paper and dried and they were weighed with mg precision analytical scale. Thus fresh weights of roots and stems of the corn seedlings were found. Samples were weighed again after they were dried at 70°C for 48 hours and dry weights of roots and stems were determined. Average fresh/dry weights were calculated as mg/plant. Nitrogen contents of the aboveground parts of the seedlings were determined by using Kjeldahl method. Crude protein ratios were estimated by multiplying with 6.25 factor (Kacar, İnal, 2010).

Determination of the effect of wheatgrass juice on *R. solani* caused disease

In order to determine the effect of wheatgrass juice on disease symptoms caused by *Rhizoctonia solani*, the pathogen isolate, obtained from the Department of Plant Protection, Faculty of Agriculture, Süleyman Demirel University, was grown on Petri dishes with Potato Carrot Agar medium at 25°C, in the dark for 5 days. Mycelia of the pathogen with agar were cut into small pieces with a scalpel and this inoculum was transferred onto pots with perlite, under aseptic conditions (Figure 1). Fifteen corn seeds were sown in

each pot and four replicate pots were used. Seeds were then irrigated with wheatgrass juice or distilled water for control group. Plants not inoculated with the pathogen, irrigated with wheatgrass juice and irrigated only with distilled water were evaluated as negative controls. At the end of two weeks growth period, plants were examined for root and crown rot symptoms and evaluated by using a 1-4 scale to determine the disease severity rates, where 1 represented healthy plant, 2 slight browning on lateral roots, 3 severe browning on roots and crown and 4 totally wilted or dead plant (Türkkan, Karaca, 2006). Disease severity was calculated by using Townsend and Heuberger's formula:

Disease severity (%) = $\Sigma(nv) / NV \times 100$,

where: n was the degree of infection according to the scale, v was the number of seedlings per category, V was the total number of seedlings screened and N was the highest degree in the scale (Townsend, Heuberger, 1943).

All data were statistically analyzed by using SAS program and differences between the applications were compared with LSD test.

Figure 1. Application of *R. solani* inoculum

RESULTS AND DISCUSSIONS

Effect of wheatgrass juice on the growth of corn seedlings

As a result of the experiment carried out in order to determine the effects of wheatgrass juice on seedling growth, there were statistically significant difference between the root ($P<0.01$) and shoot ($P<0.05$) length values obtained from seedlings irrigated with wheatgrass juice and controls. It was found that wheatgrass juice decreased both root and shoot growth of corn plants (Figure 2). Mean root length of the corn seedlings irrigated with wheatgrass juice was 4.63 cm, while it was 27.28 cm in the control group. Similarly, shoot length of the plants irrigated with wheatgrass juice was 14.54, while it was 23.68 in the control group (Figure 4).

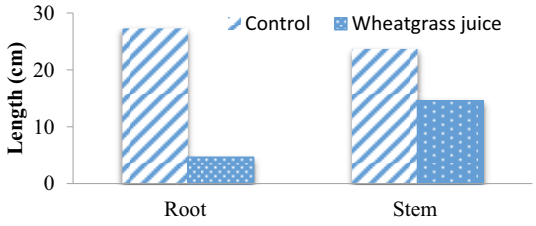

Figure 2. Effect of wheatgrass juice on root and shoot lengths (cm) of corn seedlings

Correspondingly, the effect of wheatgrass juice on root and shoot fresh and dry weights of corn seedlings were statistically significant ($P<0.01$). It was found that wheatgrass juice decreased both fresh and dry weights of roots and shoots (Figure 3). Mean fresh and dry

weights of the roots of corn seedlings irrigated with wheatgrass juice were 250 mg/plant and 50 mg/plant, while those were 790 mg/plant and 120 mg/plant in the control group, respectively. Mean fresh and dry weights of the shoots of the corn seedlings irrigated with wheatgrass juice were 250 mg/plant and 70 mg/plant, whereas the means of the control plants were 890 mg/plant and 110 mg/plant.

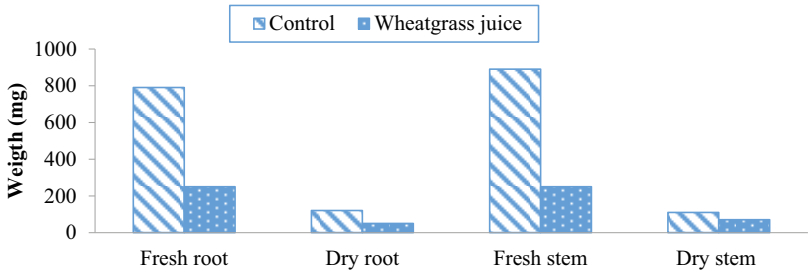

Figure 3. Effect of wheatgrass juice on the fresh and dry weigths of corn seedlings

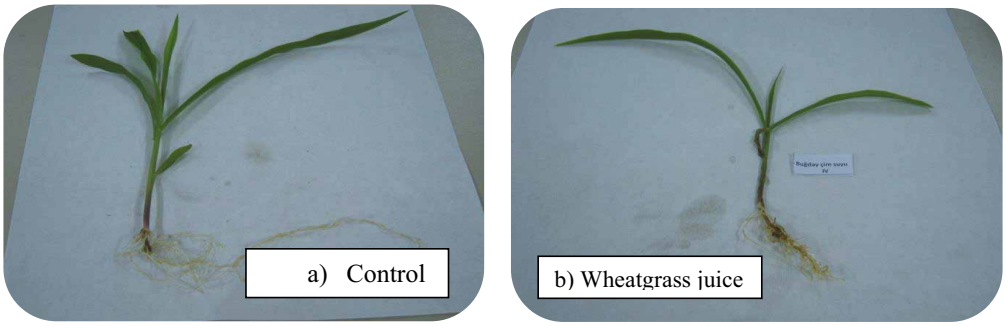

Figure 4. Difference between the root and shoot growth corn seedlings irrigated with distilled water (a. control) and wheatgrass juice (b)

As a result of protein analyses, it was found that the crude protein contents of the corn seedlings increased with the wheatgrass juice application. Crude protein content of the plants irrgated with wheatgrass juice was 19.17% while it was 11.28% in control plants (Figure 5). This difference between the applications were found statistically significant ($P<0.01$). Although wheatgrass juice slowed down the seedling growth, it caused an increase in protein contents of the plants depending on its high nutritive content.

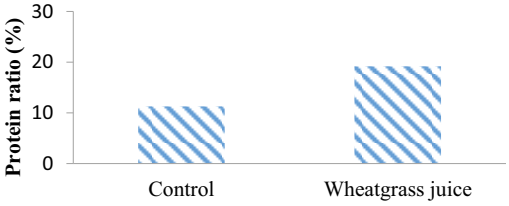

Figure 5. Protein contents of the corn seedlings irrigated with wheatgrass juice and distilled water (control)

Effect of wheatgrass juice on disease symptoms caused by *Rhizoctonia solani* on corn seedlings

As a result of the experiment conducted to determine the effect of wheatgrass juice on disease severity caused by *R. solani* on corn

plants, it was found that the mean disease severity of the plants irrigated with wheatgrass juice was higher than the plants irrigated with distilled water. Mean disease severity of the plants irrigated with wheatgrass juice was 79.60%, while that of those irrigated with distilled water was 64.18%. Most of the plants irrigated with wheatgrass juice had less root mass and roots with severe discoloration (Figure 6). Plants without pathogen inoculation showed no disease symptoms.

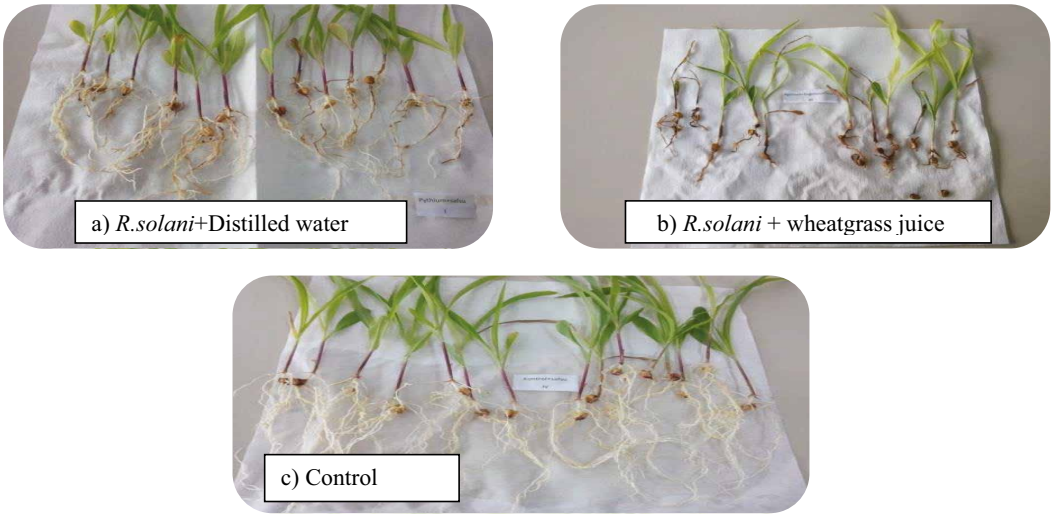

Figure 6. Effect of wheatgrass juice on disease symptoms caused by *R.solani* on corn seedlings: a) *R. solani* inoculated corn plants irrigated with distilled water; b) *R. solani* inoculated plants irrigated with wheatgrass juice; c) corn plants irrigated with distilled water (control)

It was found in this study that wheatgrass juice significantly reduced seedling growth on corn plants. On the other hand, corn seedlings irrigated with wheatgrass juice had higher protein contents. This indicates that wheatgrass juice contained macro and micro nutrients. As a matter of fact, different researchers reported that the extracts of wheatgrass were rich in macro and micro nutrients, amino acids and vitamins (Raheja et al., 2010; Rana et al., 2011; Pant et al., 2013). However, wheatgrass extract also contains important phenolic materials including flavonoids (Falcioni et al., 2002; Kulkarni et al., 2006b; Raheja et al., 2010). Ashok (2011) reported that wheatgrass juice contained alkaloids, saponins, gums, musilages, proteins and amino acids. These materials, which are found in wheatgrass juice, are thought to have an allelopathic effect on germination and development of corn plant. Allelochemicals can affect plant development by acting on metabolic pathways such as photosynthesis, respiration and ion uptake mechanisms. This effect may vary depending on the type and concentration of the allelochemical substance (Jose and Gillespie, 1998; Terzi, 2003).

In the study, wheatgrass juice was determined to increase the severity of *Rhizoctonia solani* caused disease. This is thought to be related to the decreasing effect of seedling and root development of wheatgrass juice. In addition, the nutrient content of wheatgrass juice may provide a suitable environment for fungus growth.

CONCLUSIONS

As a result, it was determined that direct use of wheatgrass juice as a plant activator or biofertilizer was not sufficient, hence wheatgrass juice had a negative effect on seedling growth on corn plants.

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