PROPERTIES OF HAZELNUT HUSKS AS MULCHING MATERIAL

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Abstract

More than 70 % of the world hazelnut production comes from Black Sea region of Turkey. Hazelnut farming is the main agricultural practices in Duzce region located in the northwestern part of Turkey. Therefore a significant amount of husk is produced annually as hazelnut harvesting residue. Thus there is a potential of using these hazelnut husks (HH) as mulching materials in nurseries and gardening applications of ornamental plants. A pot experiment is conducted to investigate the effects of HH as mulching materials on water retention, weed control and plant growth. Upon the pots filled with soils the mulching material was applied on top of the soils at four levels (0 cm, 3 cm, 5 cm, and 8 cm). The effects of different levels of mulching treatments on water retention, weed germination and growth of wild privet (Ligustrum vulgare) were compared. The analysis of the data indicated that water lost can be decreased up to 19 % by applying 8 cm thick mulch comparing to that of bare soil. The germination rates of English ryegrass (Lolium perenne) and European grass (Agropyron repens) were decreased by 94 and 67 % on 8 cm mulch layer treatment comparing to that of the bare soil, respectively. Therefore, using HH as mulching materials for gardening practices can substantially reduce water consumption and the cost of weed control.

Key words: *hazelnut-husk, organic-mulch, water-retention, duzce*

1. INTRODUCTION

Scarcity of soil moisture is the main stress factor for plant growth in most of the terrestrial ecosystems (Kozlowski and Pallardy, 1997). Semi-arid climatic conditions occur on majority of Turkey's land area. The high potential evapotranspiration and low precipitation result in soil moisture deficiency during hot and dry summer. Therefore, moisture deficiency is the main growth limiting ecosystem variable in semi-arid lands of Turkey (Çepel, 1995; Seçkin, 1998; Özyuvacı, 1999; Atalay, 2002). Despite the limiting precipitation, use of surface and underground water sources for domestic and agricultural consumption has been steadily increasing. Thus sustainable use of water resources is one of the main challenge for the natural resource managers in Turkey. Accordingly, Turkish government is promoting researches conducted on water use efficiency on domestic and agricultural usage.

Mulching is commonly used agricultural practice to control weeds, to create loose soil structure and to increase infiltration and water retention of soils (Rees et al., 1999; Sevgican, 1999; Yamarak et al., 2004; Diaz et al., 2005; Dahiya et al., 2007; Küçükyumuk, 2009; Demir et al., 2009; Kitiş, 2011). Due to environmental concerns and some of its advantages preference for organic materials over the inorganic ones have been increasing.

The higher rates of macropores in organic mulching materials prevent water loses by capillary movement through micropores during summer (Kimmins, 1997). Dahiya et al. (2007) showed that using harvesting residue such as roots and straw as mulching materials on clay soils decreased daily water evaporation as much as 0.39 mm. In the same experiment soil temperature during summer months at 5 and 15 cm depth decreased 0.74 ^{0}C and 0.66 ^{0}C, respectively. Due to its loose structure, organic materials applied on mineral soil surface may decrease bulk density and increase infiltration of rainfall to the underlying mineral soil and decrease the amount of water for surface runoff. Which in turn may help to prevent soil erosion (Mulumba et al., 2008).

More than 70 % of the world hazelnut production (more than 600 000 metric tons) comes from Black Sea region of Turkey (Anonym 2011b; Anonym 2011c). Hazelnut farming is the main agricultural practices in Duzce region located in the northwestern part of Turkey. A significant amount of husk is produced annually as hazelnut harvesting residue in the region. Available data indicate that there is a potential of using these hazelnut husks (HH) as mulching materials in nurseries and gardening applications of ornamental plants.

Therefore, the aim of this study is to investigate the potential of using hazelnut husk as mulching materials. The research questions we want to answer are; 1- does mulching prevent germination and growth of some of the common garden weeds? 2- Does mulching increase water use efficiency of ornamental plants? And 3-overall does mulching effects plant growth?

2. MATERIALS AND METHODS

The study is conducted as a pot experiment in a nursery located in Düzce province situated in the northwestern part of Turkey. The annual average precipitation and temperatures of the region are 850 mm and 13 ^{0}C, respectively (Yildiz et al 2005a; Yildiz et al., 2005b; Yildiz et al., 2007).

Pots with 20 L volume were filled with nursery soil. Wild privet (*Ligustrum vulgare*) were planted on 12 pots. English ryegrass (*Lolium perenne*) and European grass (*Agropyron repens*) were sown in 12 pots each. To calculate the germination rate 100 seeds from each species are used for each pots. Growth chamber experiment in the lab showed that English ryegrass had 76 and European grass had 81 % germination rates. Another set of 12 pots were used as control treatment to calculate water losses from the pots with no sowing and planting. Upon planting and sowing, mineral soils surface in the pots were covered with husks. One set of the pots received no husk cover (0), one set of the pots received 3 cm thickness of the husk cover, one set of the pots received 5 cm thickness of the husk cover and the other set of the pots received 8 cm thickness of the husk cover. Privet is a widely planted evergreen shrub in Turkey. It can tolerate water and heat stress. Its growth performance is higher in full sunlight and tolerate to partial shading. English ryegrass, is a cool-season perennial bunchgrass native to Europe, temperate Asia, and North Africa. It is widely distributed throughout the world. European grass is a very common perennial species and native to most of Europe, Asia, the Arctic biome, and northwest Africa. It has been introduced into other mild northern climates for foraging and erosion control.

After planting and sowing, the pots were weighted and irrigated until the soil is saturated. Between 4 to 6 hours are allowed to free drainage of water from the pots and each pots are weighted again. The weight measurements are repeated when the pots weight drop below 7 kg (2-3 day interval) and 1.5 -2 liter water is added. Water consumption data were recorded about 9 months. During the experiment the pots did not receive any other source of water. The average daily temperature during the experimental period was measured 24 ºC. The main relative humidity was recorded as 66 %.

After the germination rate of English ryegrass and European grass were recorded the plants were let to grow. When the germinated ryegrass and grass were fully grown they were cut from soil surface and oven dried at 65 ^{0}C for 48 hours to calculate the biomass (Yildiz et al., 2007; 2011). To compare the treatment effects on growth of Wild privet, the height, diameter at soil surface, the number of lateral branches, the length of the terminal branch and the root growth were measured. To compare the treatment effects on water consumption, weed germination and growth and privet growth performance, One-way Analysis of Variance was run with the aid of SPSS package software for statistical analysis. The results were considered statistically different at alpha= 0.05 level.

3. RESULTS AND DISCUSSION

At the end of the experiment total water consumptions among treatments were significantly different (P-value < 0.05). Mineral soil surface lost 18 and 23 % more water than those of 5 cm and 8 cm thick mulch treatments, respectively. During the hottest months, July and August this differences are more pronounced (Figure 1). In August, pots with no-mulch cover lost almost four times more water than that of the pots received 8 cm mulch treatments. Even 3 cm mulch cover help to save about 25 % water in August.

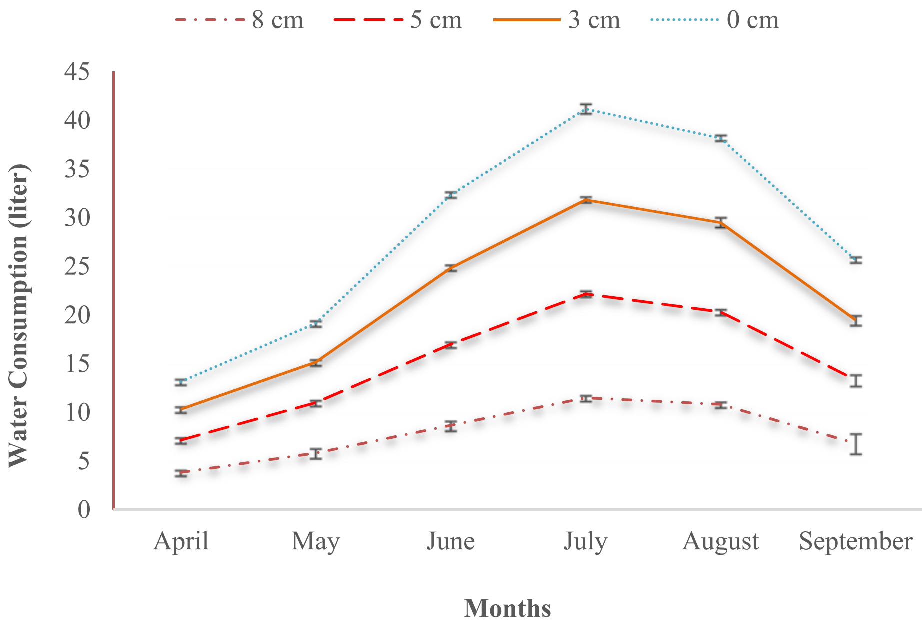

Figure 1. Means ± Stddev of monthly water consumptions for different mulching treatments

Our results suggest that covering mineral soil surface may prevent water lost during hot summer. However, thickness of the mulching materials may accelerate the prevention effects of the treatment. Organic materials may hold several times more moisture than its own weight and with its loose structure may decrease the evaporative losses (Kilham, 1996; Kimmins 1997; Yildiz et al., 2007; 2011; 2005a, 2005b). Some of these water loses can be contributed to evaporative losses due to lower relative humidity of the atmosphere and some can be contributed to transpirational losses of the plants. Further study is needed to fractionate these water losses to have more clear results to suggest to the practitioners.

In order to estimate the effect of organic mulch on germination and development of English ryegrass *(Lolium perenne*) and European grass (*Agropyron repens*) seeds were first germinated in growth chambers in lab for viable test. Then 100 seeds from each species were sown on each of the pots received different mulching treatment.

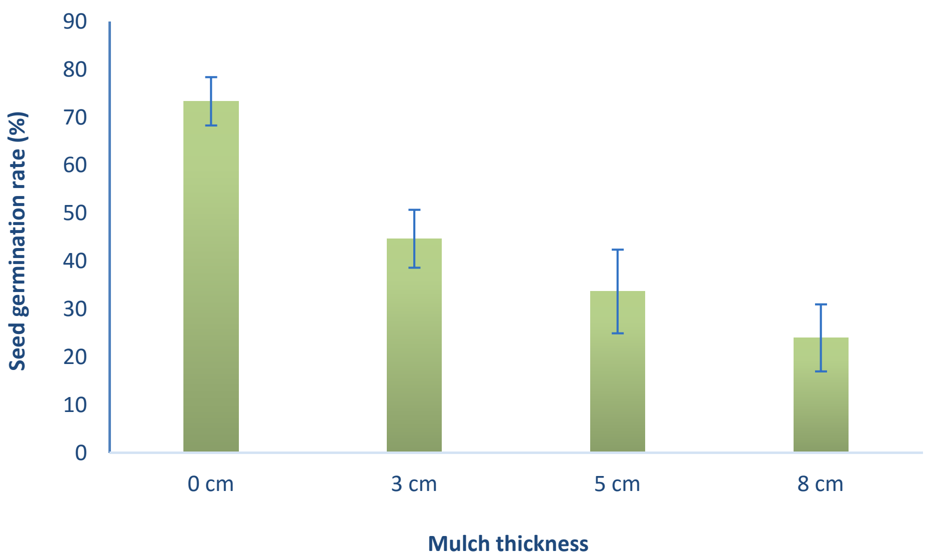

Figure 2. Means ± Stddev of seed germination for European grass (*Agropyron repens*)

Viable experiment showed that English ryegrass had 76 and European grass had 81 % germination rate. The result of the pot experiment released that mulching and thickness of the mulching materials significantly reduced grass germination (*P-value < 0.05*). The germination rates of the seeds were 67, 53 and 38 % lower in 8, 5 and 3 cm mulching treatment pots than that of the no-mulching pot, respectively.

The mulching treatments had also significant effects on seed germination of English ryegrass (*P-value < 0.05*). Data showed that the more the mulching thickness increase the better weed control achieved (Figure 3).

Using 3 cm mulching cover on the pots decreased ryegrass germination by 40 %. Further increase in cover thickness to 5 and 8 cm lowered the germination rates 81 and 95 %, respectively. Effects of the mulching thickness was more pronounced between 3 and 5 cm thickness. Increasing the mulching treatment from 3 cm to 5 cm lowered the rye grass germination rate about 68 %. Thus, data suggest that minimum thickness for these kind of mulching treatments should be at least 5 cm to get the highest effectiveness.

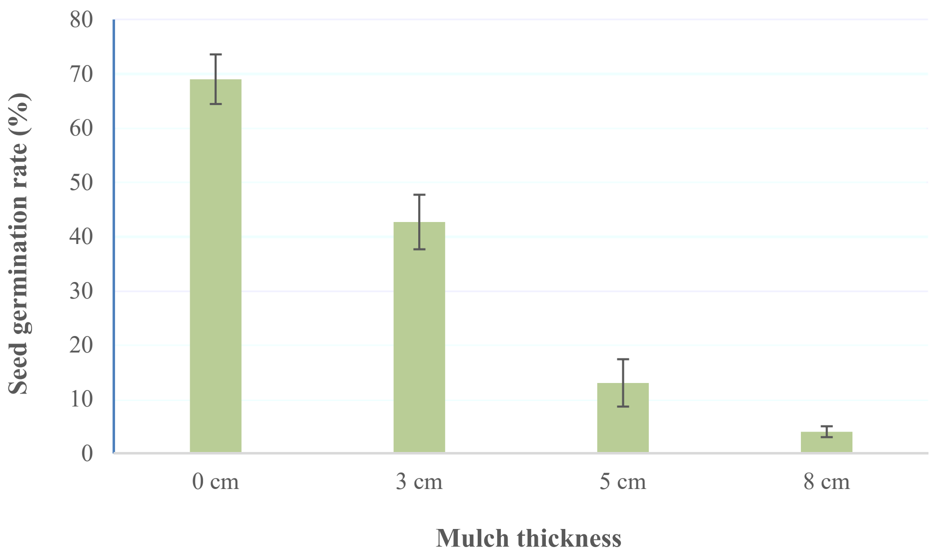

Figure 3. Means ± Stddev of seed germination for *English ryegrass (Lolium perenne)*

Biomass of European grass grown on different treatments were significantly different (Figure 4; *P-value < 0.05*).

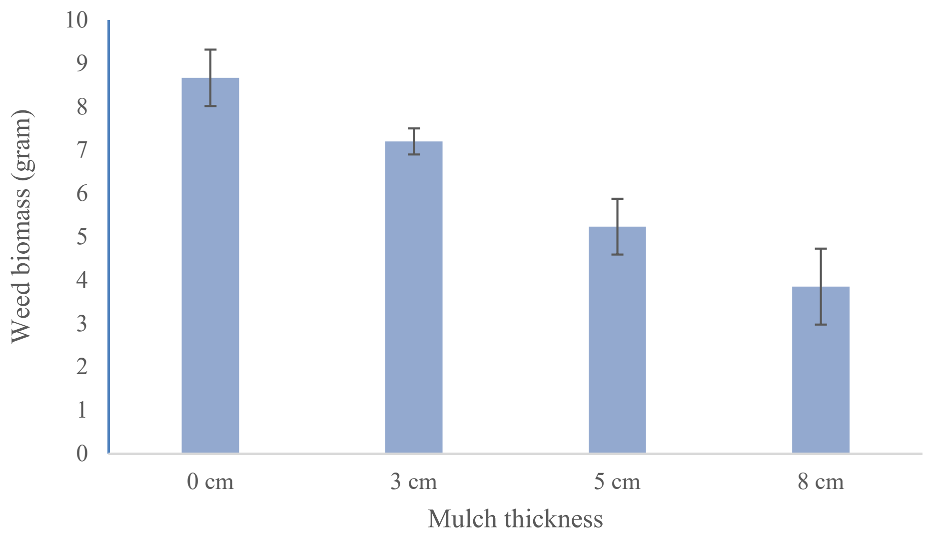

Figure 4. Means ± Stddev of biomass for European grass (*Agropyron repens*)

The pots received no mulching had 38, 53 and 67 % higher grass biomass than those of the pots received 3, 5, and 8 cm mulching treatments, respectively. The same trend was shown for the results of ryegrass treatments. The germination rate of ryegrass was significantly effected by mulching treatment (Figure 5; *P-value= 0.05*).

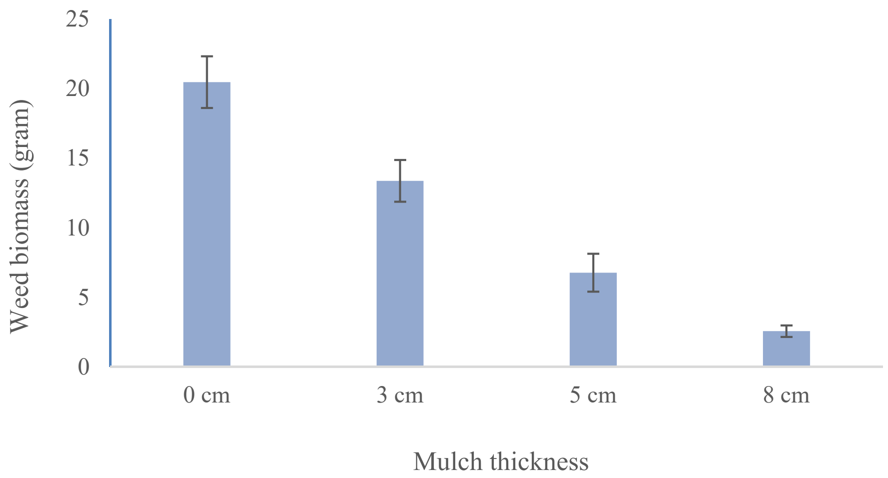

Figure 5. Means ± Stddev of biomass for English ryegrass (*Lolium perenne*)

The pots received no mulching had 35, 67 and 88 % higher grass biomass than those of the pots received 3, 5, and 8 cm mulching treatments, respectively. These biomass differences for both European grass and English ryegrass can be mostly attributed to the differences in germination rates differences among the treatments. The lower germination rates resulted in lower biomass of the weeds on the pots received different mulching treatments.

The mulching treatments significantly affected some of the growth variable (shoot-length, longest branch-length and root length) of wild privet (*Ligustrum vulgare*) seedlings (Figure 6; *P-value < 0.05*).

Seedling shoot-length, the longest-branch-length and root-length on 5 and 8 cm mulching treatments were about 20 % higher than those of 0 and 3 cm mulching treatments.

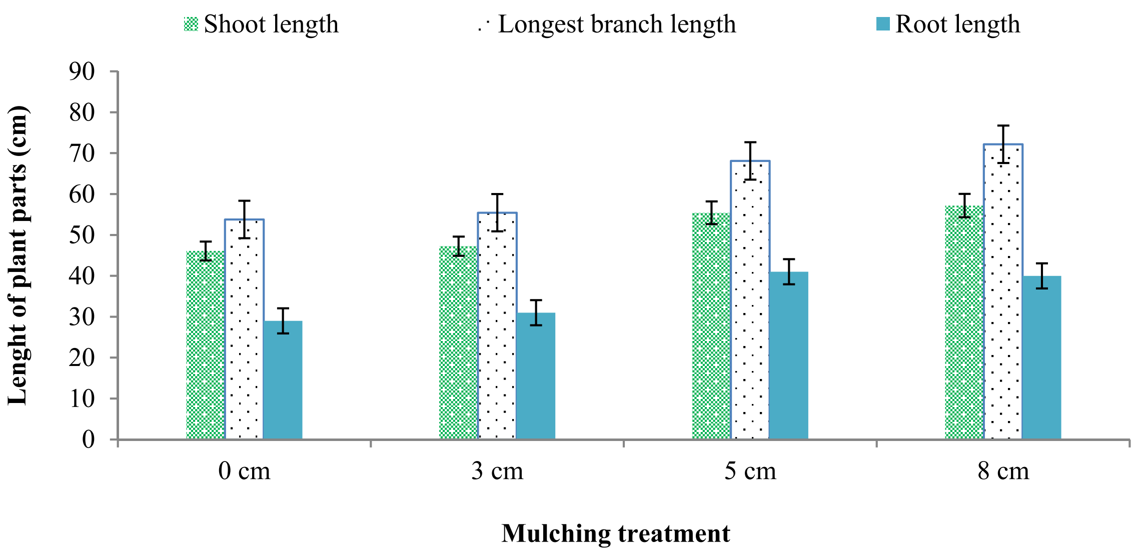

Figure 6. Means ± Stddev of the some of the growth variable of wild privet (*ligustrum vulgare*) received different mulching treatment.

The mulching and mulch thickness significantly increased the number of the lateral branches of privet (Figure 7; *P-value < 0.05*).

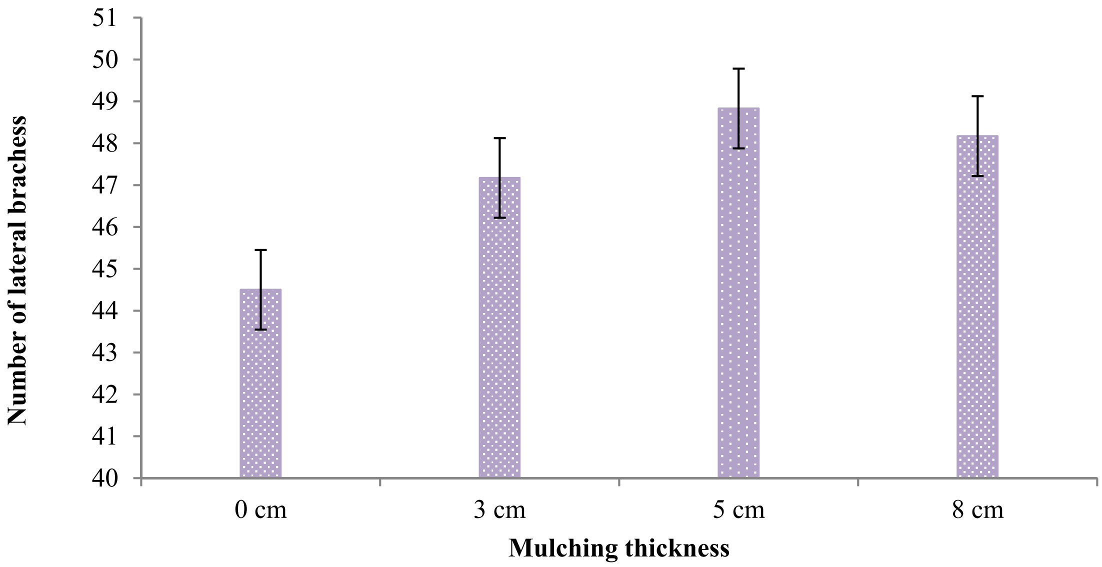

Figure 7. Means ± Stddev of the number of lateral braches of wild privet (*Ligustrum vulgare*) seedling received different mulching treatment.

The average number of lateral braches of privet seedling grown in 5 and 8 cm mulching treatments were about 9 % higher than that of the no-mulching treatment. The vigorous growth of the seedling in 5 and 8 cm mulching treatments can be resulted in more plant available water in these treatments during summer. The moisture data supports the results of the seedling growth data.

As a result of this study it can be concluded that substantial amount of hazelnut is produced in the black sea region of Turkey and the husk of hazelnut can be utilized as organic mulching materials. Our results indicate that water use efficiency of nurseries and other gardening applications can be increased by using hazelnut husk as mulching materials. The thickness of the mulching applications may also contribute to the magnitude of the effects. Our experiment showed that 5 cm application can provide most of the mulching benefits. Weed control can also be achieved by using this material for mulching applications. These means that more environmentally friendly way of weed control is possible by using these mulching materials instead of herbicides. And finally, better growth medium due to mulching can promote seedling growth.

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