

Effect of four types of mulch including wood chips, municipal compost, sawdust and gravel in four different thicknesses on soil temperature, soil moisture and weeds growth

Payam Pakdel¹, Ali Tehranifar², Hosain Nemati³, Amir lakzian⁴

Abstract:

In this study effect of four types of mulch including wood chips, municipal compost, sawdust and gravel in four different thicknesses on weeds growth during two years was studied. The experiment was conducted in Mashhad located in semi-arid climate. The experimental design was factorial based on randomized complete block, with four replications. Treatments included four types of mulch including wood chips, municipal compost, sawdust and gravel in four thicknesses (0, 5, 10 and 15 cm). During the study, soil moisture and temperature and fresh weight of weeds was measured. Sawdust and gravel mulch with 15cm thickness had highest soil moisture (23.62%) and lowest soil temperature (25C°) and lowest weeds. It seems that sawdust and gravel mulch with reducing soil temperature and made barrier for weeds growth could help to better control of weeds growth compare to other mulches in dry and semi-arid areas.

Key word: mulch, weeds growth, soil moisture, soil temperature

1- M.Sc. Student of Horticultural Science, Department of Horticulture, Faculty of Agriculture, Ferdowsi University of Mashhad, Iran

2- Associate Professor of Horticultural Science, Department of Horticulture, Faculty of Agriculture, Ferdowsi University of Mashhad, Iran

3- Assistant Professor of Horticultural Science, Department of Horticulture, Faculty of Agriculture, Ferdowsi University of Mashhad, Iran

4- Associate Professor of Soil Science, Department of Soil Science, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran

1. Introduction

Application of mulch is one of the most effective ways to conserve moisture during dry periods. Since it has a number of other beneficial effects, it should be considered a useful practice even in non-drought situations. Suppresses weeds, and protect against temperature extremes (Rakow, 1989). Mulching as a means for landscape weed control is highly effective (Chalker-scotte, 2002). Polythene and straw mulch were effective in suppressing the weed infestation (Ramakrishna, 2006). Sinkeviciene *et al* (2009) reported that Peat mulch significantly decreased weed number although it has a significant negative effect on crop yield and mulching decreased weed density. Mulching has proven to be effective in controlling the amount and type of weed

growth for several reasons: 1) applying mulch directly on top of mature weeds may slow or damage them by removing light, interfering with stem elongation, encouraging fungal growth with the increased moisture content, and by acting as a physical barrier 2) mulches interfere with weed seed germination by blocking light and 3) weeds which germinate in organic mulch are easier to pull either because the ground is softer due to higher moisture levels, larger pores, and greater aggregation, or frequently because of shallower rooting (Green Lee and Rakow, 1995).

2. Material and method

The experiment was carried out in Mashhad, Iran. Some plane trees (*Platanus orientalis*) were planted and consequently mulched in March 2009. The experiment was a randomized complete-block design with split plot arrangements and four replications. Dimensions of each plot was 3m × 3m. The main plot was kinds of mulches including wood chips, MSW compost (Municipal Solid Waste Compost), sawdust and gravel and the subplot was the thicknesses including 0 (control), 5, 10 and 15 cm. The soil temperature and soil moisture were evaluated 15 times and the fresh weight of weeds was measured 4 times from May to September in 2008 and 2009.

The data were analyzed using the MSTAT C software and Duncan's Multiple Range test was used for mean comparison.

3. Results and discussion

3.1. Soil temperature: Results showed that soil temperature in 5 cm of soil depth (under mulched layer), significantly affected by different mulches, thicknesses and their interaction (Fig. 1). The highest and lowest soil temperatures obtained by 5 cm of SMW and 15 cm of sawdust, respectively. Generally, with increasing mulch thickness the soil temperature was reduced. One of the main functions that mulches provide moderation of soil temperature fluctuations (daily and seasonal) Green Lee and Rakow (1995) and they reported the increase of mulch layer reduced of soil temperature. The primary benefit of mulching is moderation of soil moisture loss and more uniformly moist the soils, moreover, soil temperatures are kept cooler during summer and warmer during the winter, and can keep soils from freezing (Dell, 2005).

The results of effect of mulch in soil temperature in this investigation were in agreement with the results of Sinkevicien *et al* (2009) and Green Lee and Rakow (1995) experiments.

2. Soil moisture: Results showed that soil moisture in 0-30cm of soil depth (under mulched layer) significantly affected by different mulches, thicknesses and their interaction. The sawdust with 15cm thickness resulted to the highest soil moisture, and the lowest soil moisture was obtained from control and gravel. Generally, with increasing the mulch thickness the moisture content of the beneath soil was increased (Fig2). A mulch layer disrupts the impact of rain drops on the soil surface, slows runoff, reduces transpiration and acts as a mechanical barrier to diffusive processes (Green Lee and Rakow, 1995). Any of mulch layer particles smaller can improve soil moisture conservation (Haishen LÜ *et al*, 2007. Rakow, 1989). The results in this study about soil moisture were in agreement with the results of Haishen LÜ *et al* (2007) , Green Lee and Rakow(1995) and Dell (2005) experiments.

Fig.1.The effect of mulch and thickness on soil temperature in 2008 and 2009 (°c)

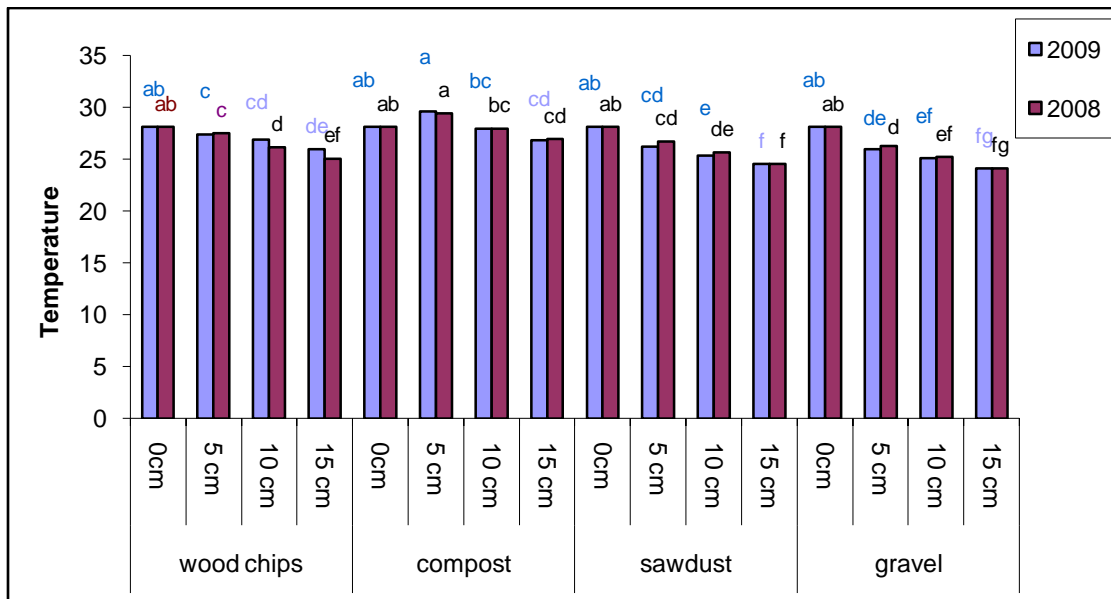
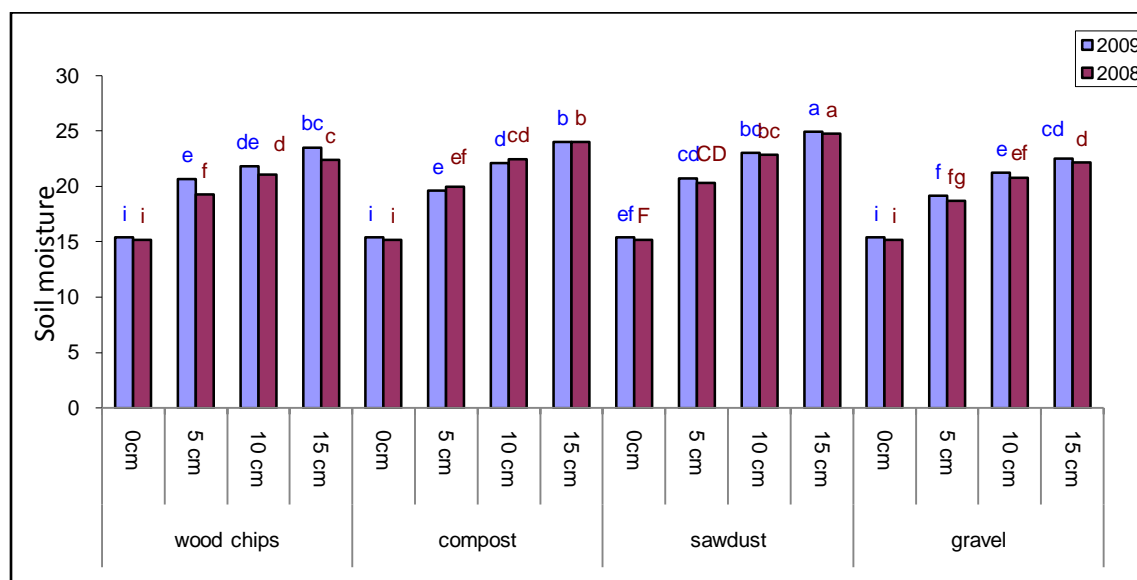


Fig.2. The effect of mulch and thickness on soil moisture in 2008 and 2009



3.3. Weeds growth: In both years the sawdust and gravel mulch with 15cm thickness have lowest weeds fresh weight and compost with 5cm thickness and 0cm thickness (control) resulted to the highest weeds fresh weight. Generally, SMW compost, followed by wood chips, gravel and sawdust mulch provided the highest weeds fresh weight. The range of weeds fresh weight was the lowest at 15 cm depth than other depths for any selected date. Results showed that over time mulch can better suppress of weeds growth.

Mulching has proven to be effective in controlling the amount and type of weed growth for several reasons: 1) applying mulch directly on top of mature weeds may slow or damage them by removing light, interfering with stem elongation, encouraging fungal growth with the increased moisture content, and by acting as a physical barrier 2) mulches interfere with weed seed germination by blocking light and 3) weeds which germinate in organic mulch are easier to pull either because the ground is softer due to higher moisture levels, larger pores, and greater aggregation, or frequently because of shallower rooting (Green Lee and Rakow, 1995).

In secondary year results showed in all treatments the weeds growth was increased because we don't have any soil tillage operating or herbicide application but no mulching plot (control) have most increasing of weeds growth (fresh weight). Applying mulch especially plant material with low thickness may be increase to weed germination as moisture content increased. There was a great deal of variation in rate of weed establishment at the thicker mulch depths because a herbicide was not applied previous to mulching, and some of the plots had perennial weeds that grew thorough and thrived in the thicker layers of mulch (Green Lee and Rakow 1995). The results in this study about soil

moisture were in agreement with the results of Ramakrishna *et al* (2006), Sinkeviciene *et al* (2009) and Dell (2005) experiments.

Table1: effect of thickness on weeds growth (fresh weight) in Spring and summer 2008

Thickness	6/16/2008	7/19/2008	8/18/2008	9/15/2008
0cm	2748/11a	3012/32a	2627/15a	2345/57a
5cm	2419/74a	2869/81ab	2354/21ab	2234/65ab
10cm	2154/67ab	2314/29b	1895/33b	1662/49b
15cm	1837/62b	2046/25c	1439/83c	1271/65c

Table2: effect of mulch type on weeds growth (fresh weight) in 2008

Mulch	8/18/2008	9/15/2008
Wood chips	1967/24ab	1881/36ab
Compost	2284/68b	1976/91b
Sawdust	1599/41c	1149/74c
Gravel	1638/91c	1408/95c

Weeds growth Analyses in spring and summer 2008 (means within the same sampling time marked by the same letter are not significantly different ($P < 0.05$)).

Table 3: Interaction between mulch and thickness on weeds growth in secondary year (2009)

Date		6/16/2009	7/19/2009	8/18/2009	9/15/2009	
		treatments				
Wood	0cm	7986 a	6847 a	5193 a	3230 a	
	5cm	5387 de	4946 c	4462 b	2628 b	
	Chips	10cm	4357 e	4084 d	3805 fg	2178 de
		15cm	3899 a	3264 de	2969 e	1796 e
Compost	0cm	7986 a	6847 a	5193 a	3230 a	
	5cm	7046 a	6584 a	5042 a	3096 a	
	10cm	5303 b	5711 b	4359 bc	2487 bc	
	15cm	4022 c	4463 cd	3329 ef	2182 de	
Sawdust	0cm	7986 a	6847 a	5193 a	3230 a	
	5cm	3228 cd	3156 de	3987 cd	2100 de	
	10cm	3092 cd	2623 e	3159 fg	1939 de	
	15cm	2247 d	1892 f	2094 h	964 g	
Gravel	0cm	7986 a	6847 a	5193 a	3230 a	
	5cm	4145 bc	4207 d	3971 cd	2310 cd	
	10cm	3197 cd	3072 de	3459 ef	1908 de	
	15cm	2579 d	2707 e	2723 g	1427 f	

Means within the same sampling time marked by the same letter are not significantly different ($P < 0.05$).

Conclusion:

1. The depth of mulch layer has great influence on soil temperature and soil moisture (under mulch) and with increasing mulch thickness the soil temperature was reduced and soil moisture was increased.
2. Apparently color of mulch has great impact on the soil temperatures (under mulch).
3. The result showed that the effects of treatments on soil temperature and weeds growth are similar in this study. The highest soil temperature and highest weed growth. Generally, SMW compost mulch, followed by wood chips, sawdust and gravel mulch, provided the highest soil temperatures and weeds growth. It seems that any mulch can reduce soil temperature so it can suppress more weeds growth.
4. The mulches with smaller particle could better to conserve soil moisture and suppress of weed growth.
5. Some of mulches similar to sawdust can reduce soil temperature and weed growth and increase soil moisture. This type is the best choice for arid and semi arid area because they can help to increase plant growth and reduce maintaining cost.

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