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Research Article

SOLARIZATION PERIOD AND THICKNESS OF POLYETHYLENE SHEET EFFECTS ON WEED DENSITY AND BIOMASS

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ABSTRACT
To investigate the effect of soil solarization and thickness of plastic on weed characteristic an experiment was carried out in 2013 based on randomized complete block design with three replications in the research and education of Islamic Azad University of Karaj. Examined factors include solarization period at seven levels (0, 1, 2, 3, 4, 5 and 6 weeks) and polyethylene thickness in two levels (100 and 200 microns). According to the results there were significant effect through solarization duration and thickness plastic on weed density and biomass. Their interaction, however, was statistically insignificant. By increasing the solarization period, weed density as well as biomass is decreased. In this term the highest reduction was dedicated for 6 weeks solarization. Moreover, the density and biomass of treatments with plastic coating thickness of about 100 micron was respectively 30.7 and 33.9% lower than the 200 microns ones due to the greater temperature increase under the plastic with thicker density. So, the weeds reduced by creating unfavorable conditions.

Keywords: *Solarization, Polyethylene Sheet, Weeds Management, Weed Density, Weed Biomass*

INTRODUCTION
Nowadays by extending the current agriculture and immense pressure on agro ecosystems, the negative effects of the chemical pesticides made more trouble. Not only has the higher consumption rate of these chemical elements led problematic situation in the term of weed management, but also it causes extra problems for human′s health and environment existence. Furthermore, the stability wreak of production system and crop yield dissipation is the consequence of numerous factors such as increasing the production costs, less accessibility to the newer herbicides formulation and weeds resistance to herbicides; air pollution due to greenhouse gases production as well as subterranean water contamination and soil erosion (Kristiansen *et al*., 2006). So utilization of non-chemical methods, which are more compatible with environment in order to weed control, is going to be ubiquitous. Soil solarization is the main non-chemical method in this term (Candido *et al*., 2011). Soil solarization due to the high efficiency, simple process, low cost and safetyness for environment and live creatures is the most appropriate method in equatorial countries aimed to weed control (Stapleton *et al*., 2005). Plastic utilization, predominantly, devised as one of the alternative ways of chemical method in the organic agriculture system term (Minbashi-moeini *et al*., 2011). The initial achievement about the high efficiency of soil solarization acquired in early 1980s (Jacobsohn *et al*., 1980). Solarization is the pre-plant treatment, which can be run in the arid regions where there are less cloud covertness or has a warm summers (Johnson *et al*., 2007). Solarization is a hydrothermal process, in this method the surface of the wet soil covered by a bright plastic layer, which can transfer lights easily. Then in the warm days in summer according to pest types, plant disease and weeds the solarization treatment will be minimally run for 4 weeks in espousing to sun radiations. This method has great alternations on biology, physics and chemical soil traits. At least solarization provided the appropriate situation for plant growth and development. This method derived instead from two physics factors, temperature and humidity. Meanwhile, solarization raise the soil

temperature at the levels that most of the weeds, pests and plant disease can be barely remained (Durant and Caocolo, 1988). In the equatorial situation in India, solarization reduced the *Cyprus spp*. populations at the rate of 90% after passing 32 days (Kumar *et al*., 2005). Benlioglu *et al.,* (2005) in their study in order to control strawberry weed by solarization method reported not only solarization appropriately controlled strawberry weed, but also most of the annual weeds like *Poa annua*, *Amaranthus retroflexsus*, *Echinochloa crus-galli* and *Portulaca oleracea* eliminated all the way. Stapleton *et al.,* (2005) conducted a research at SanJokein valley for 8 years aimed to study the soil solarization effect on weed biomass. According to their result within solarization application the strawberry weed density and biomass was significantly decreased. Indeed, it is known as an effective economical treatment aimed to weed control compared to methyl bromide utilization. Also Sahile *et al.,* (2005) reported, 2 years consecutive utilization of solarization on *Orobanche spp*. in tomato field for 6 weeks respectively reduced the weed biomass at the rate of 97% (in the first year) and 98% (in the second year) compared to weedy check. The higher temperature and period of exposing weed pods at the mercy of sun radiations known as a main factor in the weed seed bank reduction term (Pullman *et al*., 1981). Singh *et al.,* (2006) reported plastic covers utilization in wheat-soybean cultivation for 5 weeks in, respectively reduced the weed biomass and population at the rate of 68.8 and 70.8%. Also the wheat yield increased about 27% in this treatment compared to evidence treatment (without plastic cover). Therefore, the study aimed to investigate the solarization effect by utilizing different polyethylene plastic cover on weed population and dry weight under the Karaj weather situation.

MATERIALS AND METHODS

To investigate the effect of soil solarization and plastic thickness on weed seed bank and soil properties an experiment was carried out in 2013 based on randomized complete block design with three replications in the research and education of Islamic Azad University of Karaj. Examined factors include solarization period length at 7 levels (0, 1, 2, 3, 4, 5 and 6 weeks) and polyethylene thickness in 2 levels (100 and 200 microns). The land preparation operation included plough and land flatten function carried out. The region′s soil characteristics considered at table 1.

Table 1: Some soil physico-chemical properties of experimental site

Organic matter (%)	E.C ($ds.m^{-1}$)	Silt (%)	Clay (%)	Sand (%)	pH	K (ppm)	P (ppm)	N (%)
0.86	0.54	35	50	15	7. 3	215	5.7	0.09

Clods, stones and excessive materials gathered from field surface before covering the land with plastic layer and then the foliage irrigated. After water absorption to the field capacity level the plastic sheets immediately covered the experimental plots according to predetermined scheme. Then the light polyethylene plastic sheets, which cut before according to each experimental foliage, placed in such way to cover the whole foliage. The edges of the plastic sheet vertically buried in the soil at 5 cm depth and covered with soil in order to interrupt the temperature transmission, which acquired from the sun radiation. After passing the period of foliage solarization, the plastic sheets are aggregated. To assess the weeds density and dry weight, the distractive sampling is carried out. Sampling is done with the help of the quadrate (25×25 cm) in plots. In each quadrate weed distinguished in different categories according to the relevant spices and counted. Then the acquired samples of plots placed in the dark plastic and transferred to the laboratory. Samples settled in the paper pocket and placed in oven at 75 °C in order to be dried and then samples are scaled. The name and general traits of weed species, which was developed in the field through the experiment period is presented in table 2. Data analysis variance accomplished by the help of statistical software SAS (Version 9.1). Duncan multiple rang test (DMRT) set at 0.05 was used to determine the significance of the difference between treatment means and by using excel software graphics were drawn.

Table 2: The scientific names and general characteristics of the weed in the field

Weed	Family	Broad leaf	Grass	Annual	Perennial
Amaranthusretroflexus	Amaranthaceae	×		×	
Convolvulus arvensis	convolvulaceae	×			×
Digitaria sanguinalis	Poaceae		×		×
Euphorbia sp.	Euphorbiaceae	×			×
Melilotus officinalis	Fabaceae	×			×
Portulaca oleracea	Portulacaceae	×		×	
Cyperus rotundus	Cyperaceae		×		×
Setaria viridis	Poaceae		×	×	
Hordeum murinum	Poaceae		×	×	

RESULTS AND DISSCUTION

Weed Density

The analysis variance result showed there was significant difference between the effect of different solarization levels and plastic cover thickness on weed density (Table 3). So that, by increasing the solarization period length, weeds density significantly decreased in the level of surface plantation. The high temperature and the period time of exposing at the mercy of this temperature are the main factors to decrease weeds population in the soil (Pullman *et al*., 1981). The compression mean of solarization period effects on weeds density showed the highest weed density was pertained to evidence treatment (without covering), which had no significant difference with 1, 2 and 3 weeks of solarizations. Also the lowest rate of weed density observed at 6 weeks of solarization, which reduced the weed density about89.5% compared to evidence treatment (Figure 1).

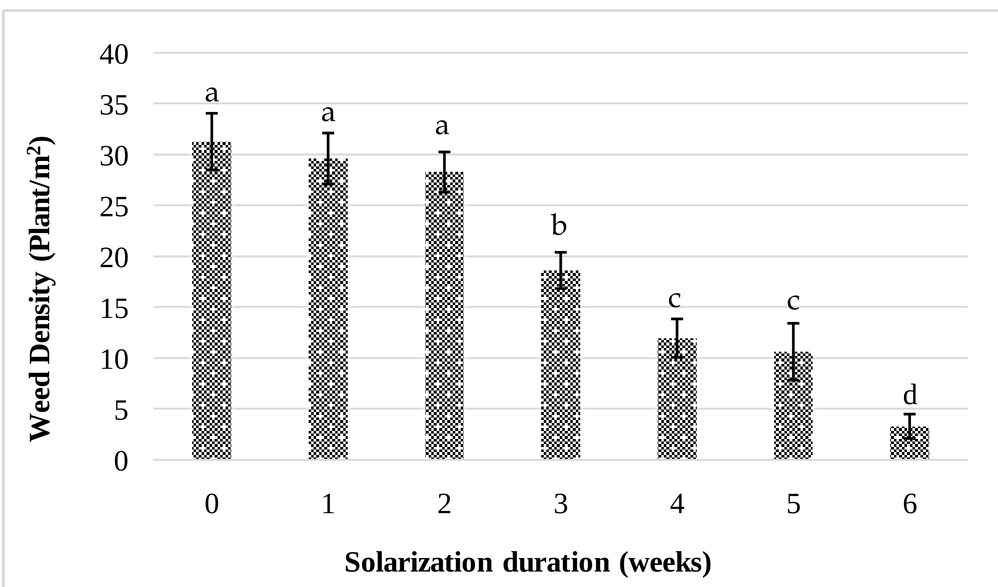

Figure 1: Effect of solarization duration on weed density (plant/m^2)

Haidar and Sidahmed (2000) reported by increasing the solarization period from 2 to 6 weeks, weeds density reduced at the rate of 100% in the 6th week. In convergence of this research (Patricioa *et al*., 2006) in their study aimed to investigate the solarization effect on *Lactuca sativa* control reported, solarization controlled field occupied weed at the rate of 100%. According to obtained result it can be assumed that utilizing of light plastic cover is the main factor to increase the soil temperature and subsequently can controlled weed populations. The light polyethylene plastic sheets due to their sun ray transmission traits (280-2500 nanometer), kept the thermal radiation in an appropriate rate (Devay, 1990). In the dark plastic sheets the heat transmitted through the thermal conduction. Behalf of that entered into soil and behalf spreads to the air and the high rate of energy is exchanged through the atmosphere, so the soil warming process becomes dull. Whereas, with the light polyethylene sheets approximately the whole radiation transferred into the soil and the soil warming process anticipated (Maged, 2006). The dark polyethylene absorbs waives length of ultraviolet, visible and far red more and reflects the absorbed energy into the thermal energy or infra-red waives (Lamont, 2005). The compression mean result of plastic covering thickness effect on weeds density indicated, the rather thickness of plastic coating has the more weed density. So that the thickness of 100 micron compared to 200 micron reduced the weed density of about 30.7% (Figure 2).

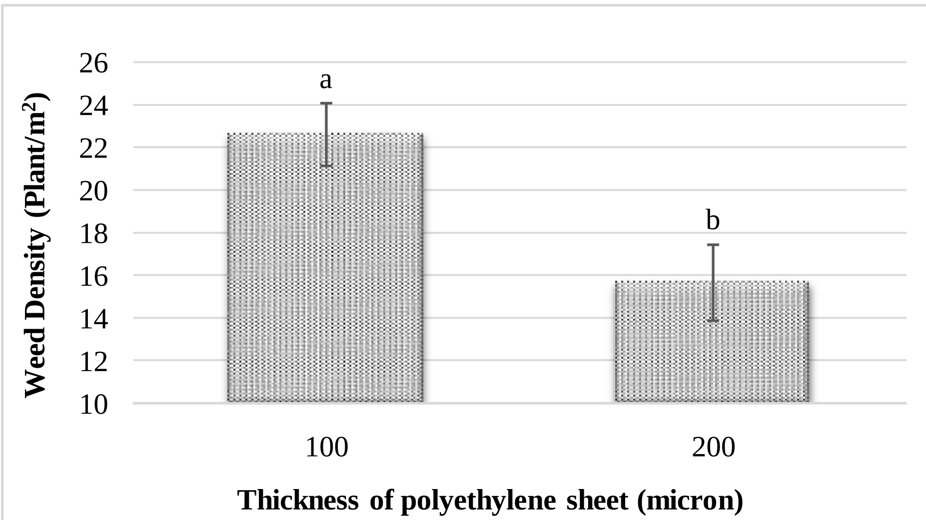

Figure 2: Effect of plastic thickness on weed density (plant/m^2)

The plastic coating of 100 micron thickness compared to 200 micron coating thickness due to the rather increasing of temperature under the plastic sheet, resembled greenhouse situation and by creating inappropriate situation for weed growth cause weed density reduction. Table 3 showed that there was no significant difference between interaction of solarization period and plastic covering thickness on weed density. Marenco and Lustosa (2000) in their study in order to investigate the effect of two polyethylene thickness types (100 and 150 micron) on controlling weeds in *Daucus carota* field reported that there was no significant difference between two polyethylene thickness.

Weed Biomass

Analysis variance result (Table 3) showed there was significant difference between solarization time effect and thickness of polyethylene cover on weed biomass. The result of compression mean showed by increasing the durations of keeping plastic cover on plots consequently the weed dry weight is reduced. Temperature and the high level of humidity play a major role in weeds demolishing process, because by increasing the solarization time subsequently the soil temperature and humidity is increased. Humidity can increase the solarization efficiency in three reasons: First of all, seeds and stable organs of the weeds physiologically in the dampened situation show more sensitivity to the higher temperatures; whereas, in the dried soil they have rather resistance. Secondly, the soil thermal conduction in dampened situation is rather and ultimately, the adequate humidity increase the soil biological activity and afterward made weeds mortality (Elmore *et al*., 1997). The lowest weed dry weed dedicated to 6 weeks solarization, which can reduced the weed dry weight at the level of 87.64% compared to evidence treatment (Figure 3). It is considered that the reason of weed dry weight reduction in this treatment is pertained to the higher soil temperature and inappropriate soil situation for weeds vitality. In convergence of increasing temperature, the characteristic of hydrogen and D-sulfide bonds in proteins and lipids altered and consequently changes the membrane′s construction (Brock, 1978). Also the highest weed biomass was pertained to evidence treatment, which had no statistically difference with 1 and 2 weeks solarization treatment (Figure 3).

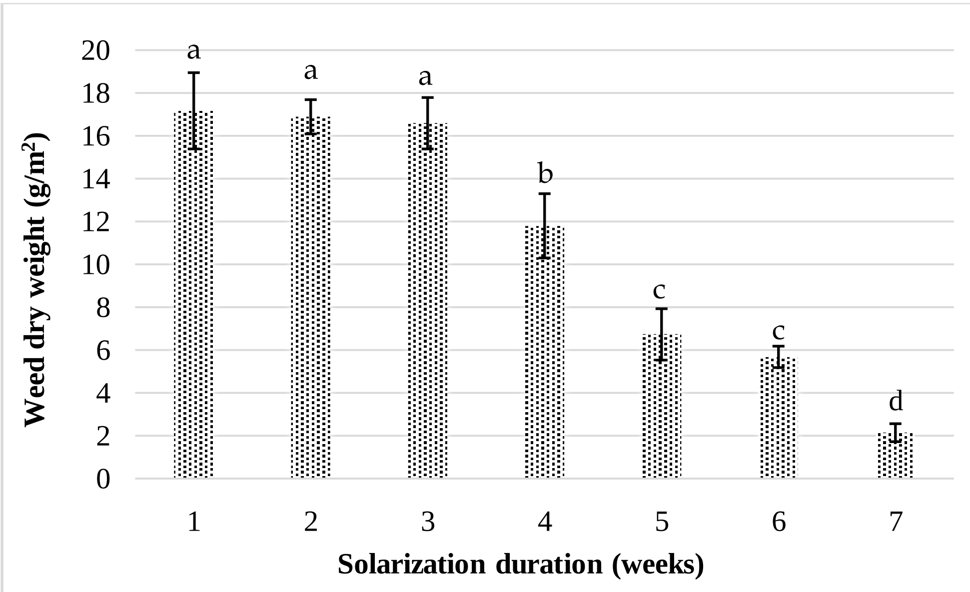

Figure 3: Effect of solarization duration on weed biomass (g/m^2)

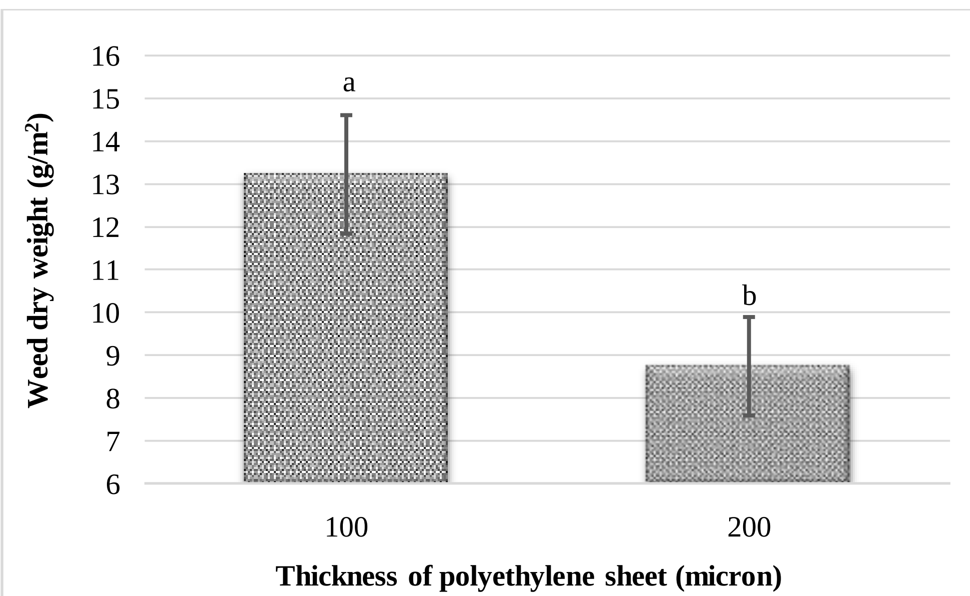

Figure 4: Effect of plastic thickness on weed biomass (g/m^2)

Marenco and Lustosa (2000) reported that 3, 6 and 9 weeks of solarizations respectively decreased the weed dry weight at the rate of 22, 38 and 60%. They also indicated the upper temperature and CO_2 level as the main reason of this reduction under the plastic situation. The effect of thickness plastic cover on weed dry weight was significant at the level of 1% (Table 3). The compression mean result showed the plastic cover with thickness of 100 micron reduced the weed dry weight approximately at the rate of 33.9% rather than plastic covers with the thickness of 200 micron (Figure 4). This can be referenced to the temperature enhancement under the plastic situation. The plastic layers with the thinner thickness have the lower light reflectance compared to the thicker plastic layers, so they can increased the soil temperature more (Minbashi-moeini *et al*., 2011).

Table 3: Analysis of variances for weed density and dry weight

S.O.V	DF	Mean of Squares (M.S.)	
		Weed Density	**Weed Dry weight**
Replication	2	85.87*	42.38*
Solarizaton Period	6	31.74**	328.19**
Plastic Thickness	1	7.98*	678.12**
Thickness×Solarizaton	6	$2.37^{N.S.}$	$5.45^{N.S.}$
Error	26	1.45	3.12
C.V(%)	-	11.08	10.12

*** and *: Significant at %1 and %5 probability level. N.S.: Non-Significant*

The double layer plastic cover utilization in the soil surface increased the soil temperature 10 °C rather than single layer ones (Ben-Yaphet *et al*., 1987). Horowtz *et al.*, (1983) declared the soil increasing temperature leads a direct damage to the cell′s construction, cells metabolism and ultimately reduces the weed dry weight. Kumar and Sharma (2005) reported the polyethylene plastic cover with the thickness of 0.05 mm compared to the ones with the thickness of 0.01 mm had a better control on weed dry weight. The thinner plastic covers (19 and 25 micron) compared to thicker ones (50 and 100 micron) could increase the soil temperature more and subsequently were more effective in weed biomass reduction (Stapleton and Devay, 1984). Also the analysis variance result in table 3 presented no significant difference between interaction of different solarization levels and thickness of plastic cover on weed biomass.

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