

# Evaluation of Soil Temperature under Mulches and Garlic Extract on Yield of Cucumber (*Cucumis sativus* L.) in Greenhouse Conditions

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## Abstract

The experiment was conducted during the growth season of autumn to spring at the desert Najaf on plant cucumber Toshika, 2012-2013 and the results showed that the highest heat accumulation in soil produced from black polyethylene, followed by transparent polyethylene, rice residues and control treatments (1705, 1583, 1428, and 1194) respectively. Black polyethylene gave a significant effect as compare with other mulch treatments on the yield and its component characteristics (fruits of number and yield). The garlic extract spray gave a significant effect on the yield and its components. The concentration 5 mL.L<sup>-1</sup> gave the highest means of the most yield and its components, fruit number, and green house productivity as compared with a season. The interaction results between mulches and garlic extract spray showed that there were a significant difference on yield and its components for both season. The interaction of black polyethylene with 5 mL.L<sup>-1</sup> garlic extract gave the highest mean of yield and its components in compared to control.

**Keywords:** Garlic extract; Soil mulching; Cucumber of yield; Soil temperature; Greenhouse

## Introduction

Cucumber belong to (*Cucumis sativus* L.) crops of the (Cucurbitaceae) family Cucurbitaceae from vegetable of summer and important countries in the world, including Iraq, India, Africa, and China, but it is characterized by food and medicinal value as it contains elements of Ca, P, K, vitamin C, B1, B2 [1,2]. The advantage of the fruits of desirable cucumber consumer demand for it increases the length of the months of the year and in order to meet this growing demand for a major development on the field of producing cucumbers happened in both open farms conditions and in protected agriculture. In order to increase production per unit area is followed by modern agricultural methods as such as soil mulching. Many producers use plastic mulch in horticulture due to several benefits such as beneficial microbial activity in the soil, increasing soil temperature, evaporation reduction, increasing root development, promoting faster crop development and observing earlier harvest. The main negative consequence of its usage is disposal of waste and the associated environmental impact [3]. Plastic mulch give satisfactory weed control without any application of herbicides [4,5]. Black and white polyethylene mulch or organic mulch are a reasonable expense and conserve soil moisture [6]. Polyethylene mulch also increases soil temperature and moisture especially in early spring. These synthetic mulches reduce weed problems and certain insect pests and also stimulate higher crop yields by more efficient utilization of soil nutrients [7,8]. Mulching with plant residues and synthetic materials is a well-established technique for increasing the profitability of many horticultural crops [9,10]. Such effects are mainly contributed to the capacity of mulch to conserve soil moisture [11]. Kwon et al. [12] investigated the effects of mulching by transparent polyethylene and

net polyethylene on the growth of garlic. Plant height and leaf number of garlic were highest at transparent polyethylene treatment and this treatment also promoted the number of cloves. But effect of garlic extract, the effect of garlic extract on different plant characters could be interpreted in the light of the following findings. Helmy [13] applied fresh garlic clove extract solution (in ethyl alcohol or tap water) to summer squash cv. Eskandarani plants. He remarked that soil side dressing of garlic extract at 250 mg dw/plant gave the best results in increasing the number of flowers. Ahmed et al. [14] confirmed that greater increase in number of pods of pea (cv. Meteor) was obtained with post inoculation treatment with garlic extract at 10 g/8 L. Sayeeda and Ahmad [15] reported that garlic bulb extract showed comparatively greater efficacy on promoting growth of two local varieties of groundnut. Therefore the aim of this study was to evaluate the study different types of soil mulching's to realize the best mulching in influencing soil temperature and yield of plant cucumber inside greenhouses and study the effect of different concentrations of garlic extract in a plant yield cucumber in greenhouses and see the effect of interactions between soil mulching's and garlic extract in a plant yield cucumber in greenhouse.

## Materials and Methods

### Experiment field and culture

The experiment was carried out in a non-heated greenhouses and deportation of 56 m × 9 m farm, located at the desert region of the city of Najaf for both seasons autumnal and spring. The soil were analyzed before planting field to take random samples from different places of the greenhouse and two depths 25 cm and 50 cm and are shown in (Table 1) as physical and chemical properties of soil greenhouse.

While Cucumber seeds cultivars of (Toshika) were germinated under greenhouse condition at line of length were 55 m and a width of

45 cm, after soil preparation. Seeds were sown in hole at line on 15 August 2012 and 15 January 2013, germinated and grown under mulches (black polyethylene, transparent polyethylene and rice residues) holes number at plastic black and transparent 10 each of

experiment unite and the distance between the center hole and other 35 cm, were sprayed plants from garlic extract until full wet and then rolled sprinkles and the duration were for two weeks between the spray and the other [16].

Property		Autumn		Spring	
Electrical conductivity (S.m <sup>-1</sup> )		Soil	Well water	Soil	Well water
		3.45	4.00	3.75	3.75
pH		6.65	6.50	7.45	7.33
Lime (g.Kg <sup>-1</sup> )		165.36	0	175.55	0
Cations (m-Mol shipment.L <sup>-1</sup> )	K <sup>+</sup>	0.2	0.5	0.6	1.1
	Na <sup>+</sup>	10.0	11.0	18.0	23.4
	Ca <sup>++</sup>	13.4	12.9	13.0	15.0
	Mg <sup>++</sup>	12.0	13.0	11.0	11.0
Anions dissolved (m-Mol charged. L <sup>-1</sup> )	HCO <sub>3</sub> <sup>-</sup>	1.8	1.6	1.5	2.0
	CO <sub>3</sub> <sup>-</sup>	Nil	Nil	Nil	Nil
	Cl <sup>-</sup>	13.5	16.4	15.0	17.0
	SO <sub>4</sub> <sup>-</sup>	24.7	25.6	25.1	25.0
Major elements Ready Mel.gm.L <sup>-1</sup>	N	5.0	2.50	3.75	2.50
	P	4.0	3.50	3.75	3.25
	Fe	3.25	0.33	3.0	0.55
	Clay	100		100	
Detached soil (g.Kg <sup>-1</sup> )	Silt	170		160	
	Sand	710		720	
Woven soil		Mixture sandy		Mixture sandy	

**Table 1:** Chemical and physical properties of soil culture and water used in irrigation.

## Design of experiment

The experiment was performed in Split-plot design with in Randomized Complete Block Design (RCBD) for two seasons so the experiment two factors of soil mulching (without mulching, black polyethylene, transparent polyethylene and rice residues) and garlic extract 0 mL.L<sup>-1</sup>, 2.5 mL.L<sup>-1</sup>, 5 mL.L<sup>-1</sup> and 7.5 mL.L<sup>-1</sup> at three replications as the number of experimental units, 48 units by the use of SAS program (2001) in the statistical analysis of the data.

## Measurement of soil temperature under mulches during season of spring only

Constant soil temperature was under the mulching by thermometers grounded in the soil at a depth of 25 cm as measured minimum temperature at six o'clock in the morning and the maximum temperature at two o'clock p.m. daily for all phases of plant growth, then by degrees of heat rate was compared in soil temperature account the degree of the base temperature [17,18].

## Results and Discussion

### Soil temperature

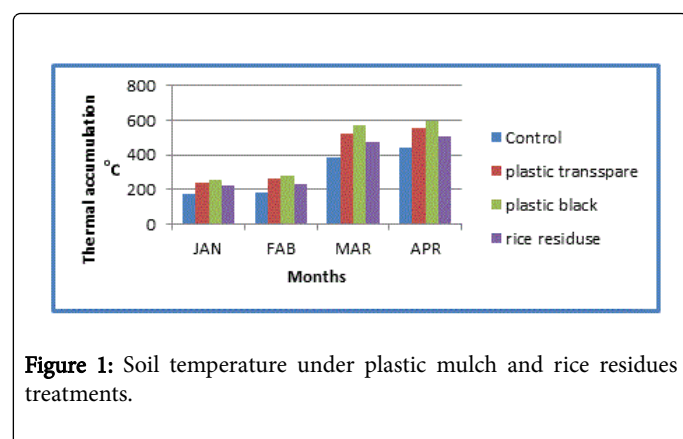
Soil mulching using the plastic black and transparent, made from polyethylene material as well as the way the soil mulching the rice residues to raise the degree of soil greenhouse temperature compared to without mulching. Figure 1 shows that the cumulative amounts of soil temperature during the months of cucumber plants growth, observed different degrees of temperature depending on the type of soil mulching, that in general, the soil temperature under the black mulching was higher than the soil temperature was under the transparent mulching and rice residues and also notes that less heat. Accumulation of all the transactions took place in January, as the highest thermal accumulation and all the location took place in the month of April, possibly due to the absorption of temperature transfer from the air to the soil as a result of the temperature difference between the soil and air which denotes from Figure 1 that the thermal accumulation of soil differed from mulching to last underscoring the importance of soil mulching in raising degree soil temperature and increase the readiness of the absorption of nutrients from the soil to

plant. This sees the class basis to store the soil quantities heat during the day and then begin by radiation during the night which keeps the leakage to the outside air degree varies depending on a difference type and color of the mulching. The soil temperature may fall more and for a longer period of the soil is mulching, compared with the mulching soil with polyethylene and rice of residue and it was also noted, there was a difference in the accumulation of soil temperature between the mulching (black, transparent, rice residues) where the soil temperature

under polyethylene black and transparent was the highest rice residues. It may be caused by the increase in soil temperature to prevent heat leakage and found that the soil temperature under plastic black was higher than the soil temperature under plastic transparent. The reason for this was to color mulching that absorbs radiation connecting it from the sun and most absorbed by the plastic transparencies, so the soil under plastic black stored more temperature from the plastic transparent (Table 2).

Month growth	Control	Plastic transparent	Plastic black	Rice residues
January	177.75	239.5	254.5	220.75
February	185.75	262.5	280	230
March	386.75	524	571.75	471.5
April	443.75	557.25	599	505.25
Total thermally accumulation	1194	1583	1705	1428

**Table 2:** Soil temperature under plastic mulch and rice residues treatments.



**Figure 1:** Soil temperature under plastic mulch and rice residues treatments.

### Impact of garlic extract spray and soil mulching on yield characteristics

**Number of Fruits (fruit.Plant<sup>-1</sup>):** Results Table 3 showed the existence of a significant effect of the soil mulching in the average number of fruits and seasonal agriculture, as it out performed all plants morally on the treatment comparison, and plastic transparencies plants gave the highest fruit rate per plant reached 32.38 fruit.Plant<sup>-1</sup> for the season autumn, while out performed black plastic plants gave the highest rate of fruit reached 28.48 fruit.Plant<sup>-1</sup>, while the comparison treatment gave the lowest number of fruits stood at 23.325 and 20.558 fruit.Plant<sup>-1</sup>, for seasonal agriculture respectively and showed the results in the Table 3 no significant impact to spray garlic extract in the number of fruits, as spraying outperformed all location on the significant superiority of the treatment comparison and concentration 5 mL.L<sup>-1</sup> in giving the largest number of fruits reached 31.95 and 27.75 fruit.Plant<sup>-1</sup>, while the concentration gave compare the lowest number of fruits reached 26.49 and 23.18 fruit.Plant<sup>-1</sup>, for two seasons in a row, the interactions between soil mulching and spray of garlic extract had a significant effect in increasing the number of fruits and seasonal agriculture had given the treatment of interference with the use of black plastic and spray 5.0 mL.L<sup>-1</sup> highest number of fruits for the autumn season amounted to 34.96 compared fruit.plant<sup>-1</sup> treatment.

The comparison was 21.10 fruit.Plant<sup>-1</sup>, the spring season had outperformed the treatment of overlap spraying and the use of transparent mulching 5.0 mL.L<sup>-1</sup> in giving the highest number of fruits stood at 31.867 fruit.Plant<sup>-1</sup> treatment compared to the comparison that gave the least number of fruits stood at 18.40 fruit.Plant<sup>-1</sup> may be it was due to high soil degree as a result of soil mulching black and transparent mulching the plastic. Figure 1 which shows the superiority of black and transparent mulching on the rice residues and comparison in giving the highest temperature in the soil, which increases the activity and growth of roots length and space standing, water absorption and the necessary elements dissolved and especially nitrogen, phosphorus and potassium development vegetative growth and its move to the fruits which leads to increase the number of fruits, may be due to the reason that garlic extract that contains some nutrients that have improved plant growth.

Treatment		Autumn season	Spring season
Soil mulching	Without mulching	25.49	20.55
	Plastic transparent	32.38	28.4
	Plastic black	31.8	28.48
	Rice residues	29.52	27.62
	L.S.D (0.05)	2.84	0.99
Concentrations garlic extract mL.L <sup>-1</sup>	0	26.49	23.18
	2.5	30.43	26.76
	5	31.95	27.75
	7.5	31.26	27.55
	L.S.D (0.05)	0.8	0.99
Soil mulching × garlic extract		0	21.1
Without mulching	2.5	27.06	21.46
	5	25.5	21.16

	7.5	28.33	21.2
	0	29.46	23.8
	2.5	33.26	28.1
	5	33.2	31.86
Plastic transparent	7.5	33.63	29.86
	0	27.7	25.43
	2.5	30.73	29.36
	5	34.96	27.7
Plastic black	7.5	33.8	31.43
	0	27.1	25.1
	2.5	30.66	28.13
	5	30.16	29.56
	7.5	29.56	27.7
Rice residues	L.S.D (0.05)	2.95	2.56

**Table 3:** Impact of spray garlic extract and soil mulching at the average number of fruits per plant and interaction and seasonal agriculture.

**The productivity of the greenhouse kg/m<sup>2</sup> (336 m<sup>2</sup> Area of greenhouse):** Table 4 showed effect of significant differences in the average total production of greenhouse to mulching the soil black plastic reached at 2681.7 kg and 2352.6 kg total, compared with the comparative treatment that gave the lowest total amounted of 1803.0 kg and 1722.8 kg for two seasons and the results showed in the Table 4. The existence of a significant effect of spray garlic extract in the total production rate and for two seasons, as it outperformed all plants, where the comparison superiority concentration 5 mL.L<sup>-1</sup> gave the highest total production rate of 2585.1 kg and 2240.1 kg in comparison with the comparison that gave less rate of 2129.4 kg and 1711.4 kg. For two season, it has shown interference between the soil mulching and spray garlic extract with significant differences in the average total production for two seasons, as it outperformed the treatment of interaction between the black mulching and spraying with 5 mL.L<sup>-1</sup> garlic extract on other transactions interaction in giving the highest average of 2808.4 kg and 2615.4 kg reached in less while the average production 1615.5 kg and 1523.5 kg when compared in the two seasons in green house. This may be due to the positive effect of temperature the area around the roots where excess heat in the vicinity of the roots, may roots respirations thus producing the necessary energy in the active absorption of some elements in particular phosphorus, potassium, or the process may be largely due to the nature of hormonal extract garlic as well as the contents of nutrients which help to give more vegetative growth and more total production, as well as the effect of the elements in the activity of enzymes and regulate vital events that take place within the plant tissue and all this was reflected in the development and growth of the fruit.

Treatment		Autumn season	Spring season
	Without mulching	2162.8	1722.8
Soil mulching	Plastic transparent	2436.4	2163.6

	Plastic black	2681.7	2352.6
	Rice residues	2121	2081
	L.S.D (0.05)	441.8	270.62
	0	2129.4	1711.4
	2.5	2349.9	2174.1
	5	2585.1	2240.1
	7.5	2405.2	2234.4
Concentrations garlic extract mL.L <sup>-1</sup>	L.S.D (0.05)	163.3	124.86
Soil mulching × garlic extract	0	1615.5	1523.5
	2.5	2167.2	1755.6
	5	2584.4	1780.9
Without mulching	7.5	2284.4	1831.2
	0	2234.4	1811.3
	2.5	2250	2352
	5	2671.2	2181.2
Plastic transparent	7.5	2590	2310
	0	2567.6	1895.3
	2.5	2766.4	2385.6
	5	2808.4	2615.2
Plastic black	7.5	2584.4	2514.4
	0	2100	1615.6
	2.5	1946	2203.3
	5	2276.4	2223.2
	7.5	2161.6	2282
Rice residues	L.S.D (0.05)	857.3	410.5

**Table 4:** Impact of soil mulching and spray garlic extract in total yield (kg) and interaction for two seasons.

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