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EFFECT OF MULCH AND FOLIAR SPRAY WITH BIOSTIMULANTS AND CHEMICAL NUTRIENTS ON CUCUMBER PLANTS UNDER PLASTIC HOUSES: I-MULCH EFFECT

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Abstract

The experiments were carried out during successive early summer season of 2004 and 2005 years, under doublespan plastic house (5.1 x 17 x 55 m), Kafr El-Sheikh Governorate. The main objective of this research was to study the effect of mulches (black plastic and rice straw) and foliar nutrition with biostimulants and chemical fertilizer on growth, yield, analysis of disease infection of hybrid cucumber (Petostar, gynoecious), as well as soil temperature. The results are summarized as follows:

Soil mulched with black plastic had higher monthly minimum, maximum and mean temperatures than both rice straw and bare soil, while soil mulched with rice straw had higher min. temperature, but it had lower max. temperature than of the bare soil. Also gave the highest values of vegetative growth parameters (stem length and diameter, internodes and lateral branches), early, and total yields, compared with control (bare soil) which had the lowest values.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is essentially a warm season crop. In Egypt cucumberis grown in open field during summer, and under plastics in winter and spring. Cucumber is considered the main protected crop in Egypt, it occupied 5404924 m^2 (52.5% from the total covered area) with an average yield of 11.52 kg/m^2. The main problems are the low temperature, salinity and fertilizer pollution. Therefore, the present research was carried out to study the effect of some mulching treatments (black plastic and rice straw) and foliar application with biostimulants (soft bread yeast and seaweed extracts) and chemical fertilizer (containing macro-and micronutrients) on cucumber growth and yield, disease severity % during early summer season inside unheated double span plastic house under Kafrelsheikh conditions.

Temperature strongly influences plant growth. Karlsen [9] found that a maximum vegetative growth of cucumber plants was reached at air temperature of 30°C and roots temperature within the range from 16 to 25°C. Tachibana [15] showed that air temperature of 20-25°C and soil temperature of 23-25°C gave the best growth of cucumber plants. Krug and Liebig [10] deduced that cucumber growth was divided

into three phases: in the first phase (one week after planting) stem growth was increased by raising soil temperature up to about 24°C, such stage of plant was most sensitive for soil temperature. In the 2nd (from the second week after planting to anthesis) and 3rd phase (from anthesis to the end of fruit harvesting), cold treatment during night caused a depression in growth, increased lateral branching and showed leaf chlorosis.

Many kinds of mulch are used in cucumber and other vegetable crops in the open field and inside plastic houses, several investigators indicated that all mulch types (black and clear plastic and organic, i.e., rice straw and grass mulches) increased the minimum soil temperature at 5 and 10 cm depths compared with the unmulched control [12]. El-Aidy et al. [5] found on cucumber plants of plastic house that, using rice hulls mulch decreased EC, pH and soil temperature.

Several researchers showed that application of black plastic mulch increased vegetative growth of cucumber [12, 5 and 6]. Using black plastic mulch on cucumber plants increased early and total fruit yields [12, 7, 16 and 13]. Meanwhile, application of black plastic mulch increased total fruits yield more than rice straw mulch [16, 5 and 13].

MATERIAL AND METHODS

Two experiments were carried out under unheated doublespan plastic house, during successive early summer seasons of 2004 and 2005, at Kafr El-Sheikh Governorate. The main objective of this research work was to study the influence of mulch types (black plastic and rice straw) and foliar nutrition with biostimulants (seaweed extracts and soft yeast) and chemical nutrients on growth and yield of cucumber F_1 hybrid cv. Petostar (gynoecious), as well as temperature and biological activity of the soil and disease incidence, i.e., downy and powdery mildew.

Treatments were the following:

1. Black plastic film 40 mm.
2. Rice straw which was cut and spread on the soil surface about 5 cm layer.
3. Bare soil.
4. Treatments 4, 5, 6 and 7 are mentioned in Part II.

All cultural practices were carried out whenever necessary. Harvesting started on March 21st and continued until June 21st in both years. The experiment included 12 treatments which were the combinations of the three mulch treatments and four foliar nutrition treatments. The previous treatments were arranged in a split-plot using a randomized complete blocks design with four replications. Mulching treatments were assigned in the main plots where each main plot was splitted to four treatments of foliar nutrition as sub-plots. The control treatment was no spray with bare soil. The experimental sub-plot area was 9.75 m^2 and 2.6 plant/m^2. Data

were tested by analysis of variance [11]. Duncan's multiple range test was used for comparison among treatments means [4].

Data recorded:

Soil temperature (^{o}C): It was recorded at 10 cm below the soil surface at 3-days interval during the growing season and recorded at 8.00 and 18.00 o'clock.

Vegetative growth parameters such as stem length and diameter, number of nodes, number of lateral branches were recorded at 30, 60 and 90 days after transplanting (DAT). Fruit yield: Data included early (first 10 pickings) and total fruit yields. Downy mildew (*Pseudoperonospora cubensis*) and powdery mildew (*Erysiphe chichoracearum*) were estimated as disease severity percentage according to scale of Biswas [1]. (D.S.%) after 90 days from transplanting.

RESULTS AND DISCUSSION

Vegetative growth:

Effect of mulch: The application of black plastic mulch had the best effect on promoting vegetative growth of cucumber plants compared with the nonmulched plants (table 2). Therefore plants grown in black plastic mulch had the tallest and the thickset stem, internodes and lateral branches. On the contrary, the nonmulched plants had the lowest values of tested growth characters at all sampling dates in both seasons. Rice straw mulch occupied an intermediate position between black plastic mulch and the bare soil with nonsignificant differences between this treatment and the bare soil in most tested growth parameters during both seasons.

Table 1

Effect of mulch on soil temperature (^{o}C) at 10 cm depth

Treatments	Bare soil			Rice straw mulch			Black plastic mulch		
Month	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
February (04)	17.1	22.1	19.6	18.7	20.5	19.6	19.4	25.2	22.3
March	18.1	22.9	20.5	19.5	21.2	20.4	19.9	24.4	22.2
April	19.6	22.5	21.1	20.7	21.8	21.3	20.6	23.3	22.0
May	21.1	23.4	22.3	21.7	22.9	22.3	21.8	24.3	23.1
June	23.0	25.8	24.4	23.4	25.0	24.2	23.4	25.9	24.7
Mean	19.8	23.3	21.6	20.8	22.3	21.6	21.0	24.6	22.9
February (05)	17.1	22.1	19.6	18.2	22.0	20.1	19.4	23.4	21.4
March	18.2	22.0	20.1	19.6	21.4	20.5	19.6	23.4	21.5
April	18.8	21.5	20.2	20.5	21.0	20.8	20.0	22.0	21.0
May	20.2	22.9	21.6	21.5	22.2	21.9	22.0	24.3	23.2
June	23.5	26.2	24.9	23.7	24.7	24.2	25.1	28.3	26.7
Mean	19.6	22.9	21.3	20.7	22.3	21.5	21.2	24.3	22.8

Several researchers obtained similar results [12, 5]. Improvement of vegetative growth characters of cucumber plants by mulch with either black plastic or somewhat with rice straw might be due to maintaining uniform soil moisture by reducing evaporation from surface soil, inhibiting weed growth by reducing light penetration [7], decreasing soil compaction and fertilizer leaching [7], increasing mineral nutrients uptake as N, P, K, Ca, Mg, Cu, B, Zn &Mn [3], activating roots growth [6], more microbial population and CO_2 production [8], raising minimum soil temperature in roots zone and reducing salt accumulation on the soil surface [5].

Table 2

Effect of mulch on some stem growth characteristics of cucumber plants

Characters	Stem length (cm)			Stem D (cm)		No. of internodes/plant			No. of branches/plant		
	Days after transplanting										
Mulch	**30**	**60**	**90**	**60**	**90**	**30**	**60**	**90**	**30**	**60**	**90**
	2004 season										
Black plastic	66.8 a	166.8 a	297.5 a	0.93 a	1.10 a	11.2 a	28.0 a	42.0 a	2.9 a	5.5 a	7.6 a
Rice straw	43.3 b	133.7 c	281.3 b	0.88 a	1.07 ab	8.5 b	23.0 b	39.4 b	2.5 b	4.9 b	6.3 b
Bare soil	44.6 b	146.2 b	278.8 b	0.81 b	1.03 b	8.9 b	24.4 b	40.7 b	2.3 b	5.0 b	6.0 b
	2005 season										
Black plastic	71.8 a	173.1 a	307.9 a	0.94 a	1.17 a	13.8 a	30.8 a	47.9 a	3.7 a	8.5 a	8.7 a
Rice straw	60.6 bc	155.6 b	289.2 b	0.91 a	1.12 ab	12.5 b	29.0 b	46.8 b	2.8 b	7.2 ab	7.6 ab
Bare soil	56.5 c	158.7 b	287.5 b	0.83 b	1.09 b	12.2 b	29.4 b	46.5 b	2.3 b	6.5 b	7.2 b

Fruit yield:

Early fruit yield: Effect of mulch:

Data in table 3 indicate that black plastic mulch had a highly significant increase in number and weight of early fruit yield over both the rice straw mulch and nonmulched plants that did not considerably differ from each other in both seasons. The increment in early yield by using black plastic mulch might be due to producing more vigorous plants (table 3). Similar results were obtained by Salman, [12]. Total fruit yield: Data in table 3 illustrate that the differences in total fruit yield were highly significant due to mulch treatments in both seasons. The plots of cucumber plants which were mulched with black plastic produced the heaviest weight and number of total fruit yield, followed by the plots of plants mulched with rice straw and finally the nonmulched plants which had the lowest values in both seasons. The increases % in weight of total fruit yield over no mulch were 18.2 and 13.7% for black plastic mulch and 7.4 and 8.2% for rice straw mulch in both seasons, respectively. Such increases in total fruit yield by mulch was a reflection to its stimulatory effect on vegetative growth characters, successful fruiting % and early yield that were previously discussed. These results are in accordance with those obtained by Singha *et al.* [14].

Diseases infection

Table 3

Effect of mulch on early and total yields of cucumber plants during

Characters	Early fruits yield/m^2			Total fruits yield/m^2 (2.66 plants)		
Mulch	No. of fruits	Wt. of fruits (kg)	Increase in wt. %	No. of fruits	Wt. of fruits (kg)	Increase in wt. %
	2004 season					
Black plastic	40.8 a	3.819 a	47.4	163.6 a	16.494 a	18.2
Rice straw	27.0 b	2.415 b	-6.8	150.2 b	14.989 b	7.4
Bare soil	28.8 b	2.591 b	-	139.9 c	13.952 c	-
	2005 season					
Black plastic	52.3 a	5.270 a	24.0	152.2 a	16.048 a	13.7
Rice straw	46.9 ab	4.643 ab	9.2	147.6 a	15.282 a	8.2
Bare soil	42.7 b	4.250 b	-	135.7 b	14.119 b	-

Values having the same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's test

Effect of mulch on downy and powdery mildews infection: Data in (figure 1) demonstrate that there was a highly significant reduction in disease severity percentage (D.S. %) of downy and powdery mildews when plots of cucumber plants were covered with either black plastic or rice straw compared with the plants of bare soil which had the highest D.S.% in both seasons. Black plastic mulch tended to be the best treatment for reducing downy and powdery mildews infection in most cases during both seasons.

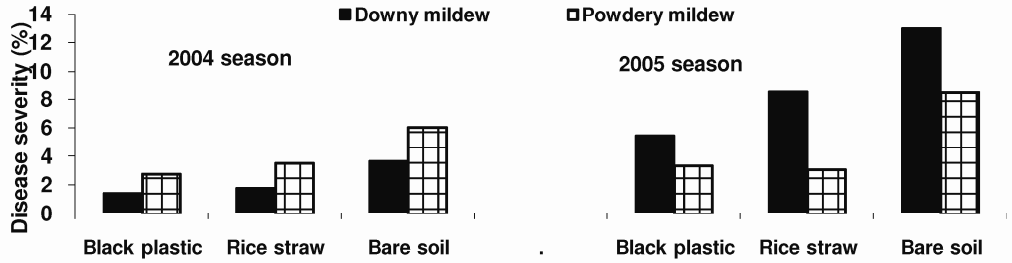

Fig. 1. Effect of mulch on disease severity (%) of downy and powdery mildews.

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