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EFFECT OF DIFFERENT PLANTING METHODS, MIXED SOIL WITH FERMENTED ALHAGI (*ALHAGI GRAECORUM*) PLANT AND BIOCONTROL AGENT *PENICILLIUM CHRYSOGENUM* AND PATHOGENIC FUNGUS (*RHIZOCTONIA SOLANI*) ON CUCUMBER GROWTH

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Abstract

The study was carried out in the Laboratory of Plant Protection Department, College of Agriculture, University of Kufa and the filed trials was conducted in the Agriculture College Research Station of Al-Muthana University. The purpose of this study was to investigate the effect of different planting methods, addition to the fermented debries of Alhagi plant (*Alhagi graecorum*) and biocontrol agent (*Penicillium chrysogenum*) on some growth parameters of cucumber plants. In the normal method of planting, the treatment of of Alhagi + *P. chrysogenum* gave the highest weight of the vegetative growth, which rached to 189.25 g/plant, while the lowest weight was 6.70 g/plant in tunnels planting with addition of the residues of Alhagi plant and *R. solani*. Also, in the normal method of planting, the addition of the residues of Alhagi and *P. chrysogenum* gave the highest vegetative length of plant, reaching to 84.25 cm/plant, while the lowest length of vegetables was 11.17 cm/plant with addition of the residues of Alhagi and *P. chrysogenum* in tunnels planting method. Furthermore, the length of the roots was a 25.25 cm and 23.25 cm/plant, respectively with the debries of Alhagi plant and *P. chrysogenum*, while the length of roots was 10.25 cm/plant with addition of the residues of Alhagi plant, *R. solani* and *P. chrysogenum* in tunnels planting method. In addition, the highest root weight was 7.73 g /plant *P. chrysogenum* treatment alone while the addition of the debries of Alhagi plant and *R. solani* showed the lowest total root inplanting tunnels method.

Key words : Cucumber, *Rhizoctonia solani*, *Penicillium chrysogenum*, tunnel planting, bages planting, *Alhagi graecorum*.

Introduction

Cucumber plant (*Cucumis sativus* L), a summer vegetable crop, belongs to the Cucurbitaceaefamily, and it was cultivated in most areas of Iraq. The plant was considered an important crop, grown in fields and in greenhouses throughout the year. Cultivated area with cucumber plant in Iraq is about (82160) acres (Central Bureau of Statistics, 2015). There are many plant diseases that affect in plant cucumber such as *Rhizoctonia solani*, which is one of main problems that cause a significant reduction in crop production. *R. solani* is a highly virulent pathogen and has the ability to effect on the plant at all stages of growth (Agrios, 2007). The quality of organic manure and its source has a role in changing the electrical conductivity (E.C.). In previous publication, Al-Sahaf and Aati (2007) showed that the addition of organic waste to the soil led to a significant increase in EC soil values. The addition of organic fertilizers to the soil leads to a reduction in the degree of their reaction. Fertilizers decomposes are releasing many humic and organic acids (Al-Obeidi, 2002). During the process of metallization, CO_2 is released and combined with water to produce carbonic acid, which reduces soil pH and increases nutrient availability (Ganinger *et al*., 2012 and ELagamy, 2006). The optimal utilization of the soil and the water wealth in Iraq could trigger an agricultural country capable of self-sufficiency rather than imports (Janabi, 2010). Using biological methods to control plant pathogens and to enhance plant growth was an active alternative method instead of using chemical pesticides. For instance, the usage of fungus (*Penicillium chrysogenum*) is one of the most important fungus, which has some characters such as the ability to control pathogens, increasing the speed germination, improving the growth of plants, and reduction of irrigation water (Moussawi, 2016 and Alwan, 2018).

Materials and Methods

Isolation of the *R. solani*

The isolates of the fungus *Penicillium chrysogenum* was kindly provided by Prof. Dr. Majeed M. Dewan from the laboratory of the biological agent for postgraduate studies at college of Agriculture, the University of Kufa. *Rhizoctonia solani* fungus was isolated from wilting cucumber seedlings.

Preparation of organic waste

The weeds were collected from the fields. The weeds were cut to small pieces and dried by air for 21 days. The cut weeds were placed in a hole with dimensions 4×2×1.5 m and covered by polyethene to isolate the residues from the saline effect of the soil. The organic waste was completely wetted with water and covered with transparent polyethene to promote anaerobic reactions and reduce nitrogen loss during the bio decomposition process. The contents were changed four times a month for humidity moisture for three months (Hassan *et al*., 1990).

Propagation of fungi

Millet seeds were used to increases the growth of *Penicillium chrysogenum* and *R. solani*. The seeds were soaked in water for 6 h and were put on layers of blotting paper to remove the free water. The seeds were were put autoclaved 5plugs of 0.5 cm diameter from colony of *P. chrysogenum* and *R. solani* were placed into each the flasks. Then, the flasks were incubated at 25±2 °C for 10 days (Dewan, 1989).

Field experiences

In the field, the soil was ploughed and divided into 6 plots, each with 0.5×40m between 1m. Each terrace was divided into 4 transactions and four replicates per treatment. Three methods of planting were followed:

1. **Traditional cultivation:** The terraces were measured as mentioned above and the height of each terrace is about 10 cm from the level of the surface of the field. Each terrace was planted as line of seeds and each line has 8. The residues of polluted wall (1:5 size) was added to one of the terraces, while other terraces were with soil only.
2. **Bags planting:** eight plastic bags with diameters of 0.25 m and depth of 0.3 m were placed into a longitudinal section which was made at a depth of 0.4 m along the bedsteads where with 8 bags per duplicate. The sides of the bags were buried in the field soil and three seeds of cucumber were planted into each bag. The residues of polluted wall (1:5 size) was added to one of the bags, while other bags were filled with soil only.
3. **Tunnels planting:** make a longitudinal in the terraces' the depthof 0.4 m, taking into account not to dig the distance between each repeater and the other left as it is and put the plastic cover in the tunnel in the form of U letters and then added soil and the waste to one of the tunnels and added the soil only to the second tunnel

Inoculation of fungi

The inoculated millet seeds by fungi were added at 1 g /kg soil and turned to ensure the spread of the fungal inoculum into soil. Then, the soil was moisture with water and left for 3 days before the planting.

Characterization studied

The length of vegetative growth and root of cucumber plants

The height of the cucumber plants was measured by a measuring tape and the measurement was carried out between the highest point of the plant and the crown area, while the length of roots were measured from crown area to end the root.

Fresh weight of the vegetative part

Three plants from each experiment unit were randomly collected at the end of the season and weighted to represent the fresh weight of the plant. The weight of roots also weighted as in vegetative part.

Results and Discussion

Effect of the method of planting and the addition of fermented Alhagi and fungi *Rhizoctonia solani* and *Penicillium chrysogenum* on the weight of the fresh vegetation

The results showed that the normal planting coefficients+ Faulty + *P.ch* and normal treatment + F.A.V.G. + *R.s*+ *P.ch*, gave the highest weight of the vegetative total of 189.25 g/plant and 183.25 g/plant respectively and significant differences compared to other treatments While the lowest value of the vegetative growth in the treatment of planting of tunnel + F.A.v.g. + *R. s* where, it was 6.70 g/plant (table 1).

Table 1 : Effect of the method of planting and the addition of fermented Alhagi vegetative growth(F.A.v.g) and fungi *R. solani* and *P. chrysogenum* on the length fresh vegetative weight of the cucumber plants.

		Con	*R.s*	*P.ch*	*R.s+P.ch*	mean
Normal	F.A.v.g	160.00	113.75	189.25	183.25	161.56
	Without F.A.v.g	84.75	65.75	116.00	104.75	92.81
	mean	122.38	89.75	152.63	144.00	
Bags	F.A.v.g	119.00	61.00	94.75	111.50	96.56
	Without F.A.v.g	34.15	23.50	106.50	69.00	58.29
	mean	76.58	42.25	100.63	90.25	
Tunnels	F.A.v.g	13.25	6.70	28.73	17.23	16.48
	Without F.A.v.g	15.56	12.75	16.04	19.50	15.96
	mean	14.41	9.73	22.38	18.36	

$LSD_{0.05}$=12.398

Table 2 : Effect of the methods of planting and the addition of fermented Alhagi vegetative growth (F.A.v.g) and fungi *R. solani* and *P. chrysogenum* on the length the vegetative growth of the cucumber plants.

		Con	*R.s*	*P.ch*	*R.s+P.ch*	mean
Normal	F.A.v.g	58.50	58.50	84.25	69.50	66.44
	Without F.A.v.g	37.75	37.75	60.50	51.75	45.69
	mean	48.13	48.13	72.38	60.63	
Bags	F.A.v.g	53.50	53.50	47.00	50.50	46.19
	Without F.A.v.g	24.75	24.75	58.00	41.75	38.38
	mean	39.13	39.13	52.50	46.13	
Tunnels	F.A.v.g	26.75	26.75	26.50	26.00	24.06
	Without F.A.v.g	15.00	15.00	11.17	20.75	15.98
	mean	20.88	20.88	18.83	23.38	

$LSD_{0.05}$=5.697

For the interaction between the addition of fungi *R. solani* and *P. chrysogenum* and methods of planting on the weight of the total vegetative, the normal method of planting gave the best results in increasing the weight of the vegetative and significant differences compared to the other two methods, while the lowest vegetative weight values were in the method of tunnel. The addition of the fungus biocontrol agent *P.ch* and the treatment of *R.s* + *P.ch* in the normal method gave of the highest vegetable weight was about 152.63 and 144.00 g/plant, respectively and significant differences compared to other treatments. The lowest weight of vegetables in the treatment of fungus *R.s* + method of expenditure, which was about 9.73 g / plant.

The increase in vegetative weight may be due to the role of soil organic matter, which has helped fungi to grow and to carry out biochemical processes more effectively, by made up of various mechanisms such as dissolving nutrients from their insoluble compounds in the soil as well as acid secretion (Malviya *et al*., 2011). The microorganisms are effective in the increase in the weight of the total vegetative as it has two roles in the first by these organisms to dissolve the nutrients and the production of plant growth regulators such as cytokines, dioxins, grains and ethylene. The second effect is the direct effect where microorganisms produces antibiotics and enzymes that decompose cells of the pathogen (Ahmad *et al*., 2008). The increase in the weight of the vegetative total of the plant can be explained by the increase in the activity of microorganisms by the presence of organic matter, which is a source of energy, carbon and moisture. These factors help the microorganism to grow, reproduce and release the enzymes and organic acids that analyze the sources of the added fertilizer (Maamouri, 2016). The decrease in the vegetative weight in the manner of expenditure to increase the concentration of salts in the soil to high levels is not suitable for plant growth.

Effect of the planting methods and the addition of F.A.v.g and fungi *Rhizoctonia solani* and *Penicillium chrysogenum* on the along length of the vegetative total of the cucumber plant

The normal cultivation + without F.A.v.g+ *P.ch* was significantly higher than the other treatments and gave the highest vegetative length of the plant which was about 84.25 cm/plant, while the lowest length of vegetables in the treatment of tunnel + without F.A.v.g + *P.ch* as the length of 11.17 cm/plant. The addition of plant F.A.v.g was increased the length of the vegetative of the cucumber plant in all cultivation methods compared with the addition of the F.A.v.g. The traditional planting with the addition of plant F.A.v.g recorded the highest length of total vegetative with a rate of 66.44 cm/plant, which was significantly different compared with other treatment. The method of bags planting with the addition of plant F.A.v.g and the normal method of planting without a F.A.v.g values showed total vegetative, which was about o 46.19 cm / plant and 45.69 cm/plant respectively and without significant differences between the two treatments. While the lowest length of the total vegetative of cucumber was about 15.98 cm/plant at tunnel planting method and without addition F.A.v.g (table 2). The results indicated that the addition of *P. chrysogenum* in the traditional planting method increased the total length of the vegetation with the highest results compared with other treatments which was about 72.38 cm/plant. While the lowest value for the length of vegetative growth was in the tunnel planting methods and addition of the fungus *R. solani* which was about 17.00 cm/plant. The addition of plant F.A.v.g gave an increasing in the length of the vegetative total of the cucumber plant compared to the absence of any F.A.v.g in all the treatments. The treatment of the *P.ch* + F.A.v.g increased the total length to 52.58 cm/plant, while the lowest value for total length of vegetative growth was 26.25 cm plant in waste + *Rs*.

The reason for increasing the length of the plant when adding *Penicillium chrysogenum* to the soil is due to the secretion of many enzymes and secondary metabolites and the F.A.v.g decomposition, which promote the growth of plant (Bahadli, 2009 and Mousayi, 2016). Increasing in the length of the total vegetative in addition of organic matter may be due to the presence of some important nutrients such as potassium, magnesium, which may increase the secretion of certain enzymes (Pilar *et al.*, 2012). It was found that there is a positive and stimulating effect of the interaction between microorganisms and organic matter on wheat groth and productivity (Jones *et al.*, 2013).

Effect of the method of planting method and the addition of fermented Alhagi vegetative growth (F.A.v.g) and fungi *Rhizoctonia solani* and *Penicillium chrysogenum* and their effect on the lengths of the root of the cucumber plant

The coefficients of normal + without waste + *P.ch* and normal + *P.ch*+ F.A.v.g gave the highest length of cucumber root, which reached to 25.25 cm/plant and 23.25 cm/plant respectively and without differences between them. while the differences were clear compared to the other treatments. The treatment of: tunnel + F.A.v.g +*R.s* + *P.ch* was showed less root length, which was 10.25 cm / plant. The results showed that the traditional planting method without adding a F.A.v.g gave the highest rate of the root length of the cucumber plant, which reached to 20.56 cm/plant and with significant differences compared with the other treatments. The tunnel method and addition of the F.A.v.g had the lowest root length of 13.25 cm (table 3). The results showed that the normal method of planting with the addition of *P. chrysogenum* gave the highest root length and significant differences compared to the other treatments. The root length was 24.25 cm/ plant. The root length of the tunnel method was the lowest in *R.s* + *P. ch* and *R.s* where it was 12.13 and 12.25 cm/ plant respectively and without significant differences between them.

The interaction between plant F.A.v.g and biocontrol fungus has increased the rate of the total root weight of the cucumber plant as organic matter is characterized by its ability to hold water and increase the moisture of the soil (Kumar *et al.*, 2011). The presence of microorganisms will lead to an increase in the production of Jabrlin in the plant due to the high temperature of the environment of the roots. and this leads to increased division of cells and then increase the branches as well (Rajan and Nair, 2011). Humidity and water activity are key in organic farming environments and their production. Also, water availability greatly influences the growth of microorganisms, so the moisture content of organic matter must be within the appropriate range (Maamouri, 2016). EL-Haggar *et al.* (2004) explained that the addition of microorganisms and organic matter to the soil leads to an increase in some process such as decomposition of organic matter, the release of nitrogen, some major and minor elements into a formula which is soluble and ready to be absorbed by plant roots. This will eventually increase the dry weight of the plant's root total. This increasing in the light weight of the vegetative total of the plant can be

Table 3 : Effect of planting methods and the addition of F.A.v.g and fungi *R. solani and P. chrysogenum* on the lengths of the root of the cucumber plant.

		Con	*R.s*	*P.ch*	*R.s+P.ch*	mean
Normal	F.A.v.g	15.00	11.25	23.25	20.50	17.50
	Without F.A.v.g	19.50	16.25	25.25	21.25	20.56
	mean	17.25	13.7, 5	24.25	20.88	
Bags	F.A.v.g	21.50	14.75	24.75	16.50	19.38
	Without F.A.v.g	17.25	12.00	20.75	16.50	16.63
	mean	19.38	13.38	22.75	16.50	
Tunnels	F.A.v.g	14.25	13.00	15.50	10.25	13.25
	Without F.A.v.g	12.75	11.50	15.50	14.00	13.44
	mean	13.50	12.25	15.50	12.13	

$LSD_{0.05}$=3.054

Table 4 : Effect of planting method and the addition of fermented Alhagi vegetative growth (F.A.v.g) and fungi *R. solani and P. chrysogenum* on the weights of the root of the cucumber plant.

		Con	*R.s*	*P.ch*	*R.s+P.ch*	mean
Normal	F.A.v.g	3.11	2.30	6.84	5.70	4.49
	Without F.A.v.g	2.65	1.78	6.32	3.41	3.54
	mean	2.88	2.04	6.58	4.55	
Bags	F.A.v.g	4.89	3.45	6.32	4.20	4.72
	Without F.A.v.g	4.31	1.95	7.73	5.08	4.77
	mean	4.60	2.70	7.03	4.64	
Tunnels	F.A.v.g	1.65	0.94	1.51	1.11	1.30
	Without F.A.v.g	1.28	1.34	1.70	1.41	1.43
	mean	1.46	1.14	1.61	1.26	

$LSD_{0.05}$=0.435

explained by the increase in the activity of microorganisms by the presence of organic matter. These factors help the microorganism to grow, reproduce and excrete enzymes and organic acids (Maamouri, 2016).

Effect of the planting method of agriculture and the addition of fermented Alhagi vegetative growth (F.A.v.g) and fungi *Rhizoctonia solani* and *Penicillium chrysogenum* and their effect on the weights of the root of the cucumber plant

The treatment of bags + without F.A.v.g + *P.ch* was showed the highest weights for the root of the cucumber plant and with significant differences with other treatments at 7.73 g/plant. The treatment of *P. chrysogenum* in the method of bags was showed root weight, which reached to 7.03 g/plant and significant differences compared to other treatments. While the lowest value of the root weights was in the treatment of *R. solani* and the method of tunnel planting of 1.14 g/plant (table 4). The addition of F.A.v.gincreased the total root weight in all treatments, except for the treatment of *P. chrysogenum*. This treatment significantly exceeded all treatments by increasing the root weight of the cucumber plant by 5.25 g/plant .*R. solani* and without adding aF.A.v.g of 1.69 g /plant.

Increasing the weight of root is due to the method of planting followed by the addition of F.A.v.g and the fungus *P. chrysogenium* in increasing the growth of the plant and protect the root region from infection with pathogens. The addition of plant debries has a role for increasing soil fertility, which effect on the growth and spread of roots. Fertilization of the soil increases the depth of the root mass which benefits from water and nutrient sources in the soil (Miralles *et al*., 2010). The increase in the total root weight may be due to one or more of the proposals for increasing the nutrient from decomposition of plant residue or microorganisms activities, as Kumari *et al*.

(2008) and Rajankar *et al*. (2007). The addition of *Penicillium chrysogenum* improves the growth of treated plant roots, which gaining a deep root mass in the soil. Decrease in root weight due to from of *R. solani* effect which is highly pathogenic on plant root, causing severe damage to them and reduced root growth. As the concentration of higher salts in the tunnel planting (Aziz, 1999) decreasing. The decrease in the weight of the root mass in tunnel planting is due to the high concentration of salts in this method at the end of the season. Pendawi (2014) indicates that the accumulation and distribution of salts in green clay soil occur in the surface layers (0-30 cm). The salt accumulation in the surface layers is due to evaporation and absorption of roots.

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