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Effect of Mulching and Organic Fertilizer on Growth, Yield and Quality of Broccoli (Brassica oleracea var italica)

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Abstract

This study was carried out during 2014-2015 growing season at the vegetative research farm of the Faculty of Agriculture, Duhok University on broccoli plants, to study the effect of mulching compared with no mulching and three levels of organic fertilizers (organic manure) (0, 5, 10 ton/donum) on broccoli (Zen Hybrid F1). The results showed that mulching significantly increased plant height, leaf area, leaves number/plant, branches number/plant, head dry weight, head height, yield, fiber%, total sugar content, carbohydrate% and chlorophyll%. Organic fertilizer caused positive significant differences in all vegetative characteristics and most yield characteristics. The interaction between mulching and organic fertilizer significantly enhanced all studied traits.

Introduction

Broccoli (*Brassica oleracea* var italica) is one of the important cruciferous vegetable crops grown in Iraq and all over the world, it is a floral vegetable with an important nutrition value due to it is a rich content of many vitamins (especially vitamin A, B1, B2, B6 and vitamin C), minerals, antioxidant, glucosinolates and anticarcinogenic compounds [1], [2] and [3].The main role of mulching in general is a beneficial practice for vegetable crop productions. Mulching can reduce evaporation (conserves soil moisture), rises soil temperatures and prevent weed growth [4]. Polyethylene mulches benefits adjust the soil microclimate in order to increase the growing season and plant growth [5]. The application of plastic mulches can have a significant influence on the vegetables yield. Mulches are used to modify plants environment in order to optimize plants growth, earlier yield, increase yields and improve quality. some authors mentioned that mulching improved yield quality due to usage colored plastic[6].

Organic manure plays direct roles in plant growth as a natural source of all necessary macro and micronutrients in available forms during mineralization and improving physical and chemical prosperities of soils [7]. Nutrient contents in manures are more slowly released and are stored for a longer time in the soil ensuring longer residual effects, improved root development and higher crop yield [8] organic manure also plays an important role in the chemical behavior of several metals in soils throughout its active groups (humic acids and flavonic) which are able to retain the materials in complex and chelate forms[9].

The objectives of this study are to study the effects of mulching and organic manner on vegetative growth heads yield, heads quality and quantity of broccoli crops.

Materials and Methods

This experiment was carried out during 2014-2015 growing season, at the vegetable research farm, Faculty of Agriculture, Duhok University , on broccoli (Zen Hybrid F1),Seeds of broccoli were sown on 15 August 2014 in the nursery, after 45 days the seedling were transferred to the farm and planted on 50 cm between plants and 80cm between rows.

A completely randomized block design (RCBD) was used in this experiment. Each experimental unit was consisted of eight plants with three replicates. The factors undertaken in this study were two methods of mulching (mulching and no mulching) and three levels of organic manure (0, 5 and 10 ton/Donum). All plants in this study received the regular agricultural and horticultural practices that usually carried out in the vegetable crops farm. Mulching was done before planting by using black polyethylene, organic manure was added before planting. Data were analyzed by using SAS program [10].

For data collection five plants were randomly selected from each experimental unit. For vegetative characteristics data collected were on leaf area (cm^2), plant height (cm) of broccoli plants were measured from the contact point between the stem and soil surface to the growing point of the main stem in each plant of the experimental units at the end of the season, number of leaves /plant, number of branches /plant, and for yield properties such as Head dry weight (g), Head height (cm), Head diameter (cm), yield kg/plant and yield ton/hectare (All heads harvested from each treatment along the harvesting period were weighted to calculate the total yield kg/plant and Ton/hectare). furthermore, some chemical properties data were collected on (fiber%, vitamin C, total sugar%) using NIR instrument, Carbohydrate% (using spectrophotometer), TSS% (using Refractometer) and total chlorophyll (using chlorophyll-meter. Spad-502, Konica Minolta).

Results and Discussion

A.Vegetative characteristics

Table (1) demonstrated that the plants grown under mulch showed a significant increase in all vegetative characters as compared with no mulching plants. The highest average of plant height, leaf area, leaves number and branches number resulted from adding 5 ton/donum of organic fertilizer, where they recorded (54.28 cm, 175.24 cm2, 17.50 and 9.25) as compared with the lowest values (45.57 cm, 123.11 cm^2, 13.50 and 7.80) respectively at control treatment.

The interaction between mulching and organic fertilizer, there is actual effect shown from the interaction between mulching and 10 ton/donum of organic fertilizer was significant in plant height (cm) and branches number/plant. Whereas the interaction between mulching and 5 ton/donum of organic fertilizer was significant increase in leaf area cm^2 and leaves number/plant. The increase in growth characters may be due to sufficient soil moisture near root zone and reduction of evaporation due to mulching. Black plastic significantly enhanced root growth through higher nutrient uptake, which promoting plant growth and development [11].

Table-1: Effect of mulching, organic fertilizer and their interaction on some vegetative characteristics of broccoli plants

Treatment		***Plant height (cm)***	***Leaf area (cm^2)***	***Leaves number/ plant***	***Branches number/plant***
Mulching	***No mulching***	*47.80 b*	*131.33b*	*13.89b*	*8.33b*
	Mulching	*54.18a*	*166.45a*	*16.56a*	*9.14a*

Organic fertilizer ton/Donum	*0*	*45.57b*	*123.11c*	*13.50b*	*7.80b*
	5	*54.28a*	*175.24a*	*17.50a*	*9.25a*
	10	*53.12a*	*148.34b*	*14.67ab*	*9.17a*
No mulching	*0*	*43.40c*	*97.34c*	*13.00b*	*7.50c*
	5	*51.50b*	*144.30b*	*15.33ab*	*9.17ab*
	10	*48.50bc*	*152.36b*	*13.33b*	*8.33bc*
Mulching	*0*	*47.73bc*	*148.87b*	*14.00b*	*8.10bc*
	5	*57.07a*	*206.17a*	*19.67a*	*9.33ab*
	10	*57.73a*	*144.32b*	*16.00ab*	*10.00a*

Means within a column, row and their interaction following with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 level

B. yield characteristics

Data in table (2) shows that mulching significantly increase of head dry weight 9.50(g), head height 21.00 cm, yield 0.67 kg/plant and yield 14.70 t/ha as compared with no mulching (8.89 g, 19.90 cm, 0.58 kg/plant and 12.70 t/ha) respectively. Also showed that adding 5 t/donum organic fertilizer affect significantly on head dry weight(g), head diameter (cm), yield kg/plant and yield t/ha and adding 10 t/donum of organic fertilizer has a significant preference on head height (cm) as compared with control.

The interaction between mulching and organic fertilizer caused positive significant increases in all yield characters. Broccoli plants grown with mulch and 5 t/donum of organic fertilizer were characterized by the highest head dry weight (g), yield kg/plant and yield t/ha as compared with control plants

Table-2: Effect of mulching, organic fertilizer and their interaction on some yield characteristics of broccoli plants

Treatment		Head dry weight (g)	head height (cm)	Head diameter (cm)	yield kg/plant	Yield t/ha
Mulching	**No mulching**	8.89 b	19.90 b	12.26 a	0.58 b	12.70 b
	Mulching	9.50 a	21.00 a	12.50 a	0.67 a	14.70 a
Organic fertilizer ton/Donum	0	8.9 8b	18.13 b	11.50 b	0.57 c	12.47 c
	5	9.71 a	21.33 a	13.72 a	0.68 a	14.89 a
	10	8.89 b	21.88 a	11.92 b	0.63 b	13.75 b
No mulching	0	8.65 c	18.17 c	11.00 b	0.49 d	10.80 d
	5	9.50 ab	21.23 b	13.77 a	0.65b c	14.25 cb
	10	8.53 c	20.30 b	12.00 b	0.59 c	13.05 c
Mulching	0	9.32 ab	18.10 c	12.00 b	0.64 bc	14.14 cb
	5	9.92 a	21.43 b	13.67 a	0.71 a	15.52 a
	10	9.26 b	23.47 a	11.92 b	0.66 ab	14.45 ab

Means within a column, row and their interaction following with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 level

Data presented in table (3) show that mulching caused significant increase in fiber%, total sugar% ,carbohydrate % and chlorophyll% as compared with no mulching. The results showed that adding organic fertilizer caused positive significant differences in vitamin C%, but TSS% increased significantly as a result of adding 5 ton/donum with no significant difference when adding 10 tons/donum and chlorophyll% while the fiber%, total sugar% and carbohydrate% was not reached to the significant levels. The interaction between mulching and organic fertilizer caused significantly increases in all traits, since broccoli plants grown with mulch and adding 5 ton/donum were characterized by highest value in fiber 2.87%, carbohydrate 5.37%, TSS 8.00% and chlorophyll% 61.27 as compared with the lowest values of these characters which gave (1.73%, 3.53%, 5.83% and 48.57) respectively. Mulching could improve the crop and increase yield by providing an environment for optimal plant growth. In addition to reducing completion from weed, mulch is used to increase water infiltration, reduce evaporation, modify soil temperatures and increase crop yields. Mulching vegetables crop can increase yield and reduce head defects [12]. In the studies by [13] mulch contributed to increased dry mater, protein, and carbohydrate content in tomato. [14] were found that soil mulching caused an increased monosaccharides and total sugars contents in melon.

Table-3: Effect of mulching, organic fertilizer and their interaction on some chemical characteristics of broccoli plants

Treatment		Fiber%	Vitamin C%	Total sugar%	Carbohydrate%	TSS%	Chlorophyll%
Mulching	**No mulching**	2.00 b	28.68 a	1.90 b	3.88 b	7.06 a	50.87b
	Mulching	2.56 a	27.23 a	2.52 a	5.08 a	7.27 a	56.34a

Organic fertilizer ton/Donum	*0*	*2.13 a*	*25.33 b*	*2.32 a*	*4.45 a*	*6.45 b*	*51.82b*
	5	*2.30 a*	*29.18 a*	*2.20 a*	*4.50 a*	*8.00 a*	*55.97a*
	10	*2.40 a*	*29.35 a*	*2.12 a*	*4.48 a*	*7.03 ab*	*53.03b*
No mulching	*0*	*1.90 b*	*22.50 c*	*1.63 c*	*3.53 b*	*5.83 b*	*48.57e*
	5	*1.73 b*	*31.87 a*	*1.97 cb*	*3.70 b*	*8.00 a*	*50.67de*
	10	*2.37 ab*	*31.67 a*	*2.10 cb*	*4.40 ab*	*7.33 ab*	*53.37bc*
Mulching	*0*	*2.37 ab*	*28.17 b*	*3.00 a*	*5.30 a*	*7.07 ab*	*55.07b*
	5	*2.87 a*	*26.50 b*	*2.43 ab*	*5.37 a*	*8.00 a*	*61.27a*
	10	*2.43ab*	*27.03 b*	*2.13cb*	*4.57ab*	*6.73ab*	*52.70cd*

Means within a column, row and their interaction following with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 level

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The effect of organic fertilizer (organic manure) on quality and quantity yield in table (2 and 3) might be due to its additive effect on vegetative growth of the plants yet affecting on the yield. The physiological processes especially synthesis of amino acids, photosynthesis and proteins were improved by the adding organic manure that consequently resulted in an increase in productivity per unit area. It has been found that organic fertilizer has an important influence on slow release of nutrients which support root development leading to higher yield and quality of broccoli plants[15]. The mentioned results are in agreement with those of [16] on broccoli, [17] on cauliflower and [18] on potato.

Conclusion

According to the results of this study we can concluded that application of both mulching and organic fertilizers is beneficial in increasing nearly all the traits undertaken in this study.

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