

## EFFECT OF MULCHING AND LICORICE ROOT EXTRACT ON GROWTH OF TWO BROCCOLI CULTIVARS (*BRASSICA OLERACEA* VAR. ITALICA.)

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### ABSTRACT

This study was aimed to evaluate the effect of cultivars, mulching, foliar application of licorice root extract, on broccoli leaves (*Brassica oleracea* var. italica). The findings demonstrated that both cultivars Wisdom and Agassi have significant differences in terms of vegetative growth characters, All studied traits in both cultivars were significantly increased by the wisdom cultivar during the study seasons. It was also observed that plastic mulch significantly increased all investigated traits in both cultivars. The interactions between licorice root extract and straw were marked by the elevation of most detected traits. Black plastic mulch significantly impacted most measures, whereas 18g.L<sup>-1</sup> and black plastic mulch together produced the greatest overall result in all vegetative growth parameters (Number of leaf. plant<sup>-1</sup>, plant high (cm), stem length (cm) , branch number. Plant<sup>-1</sup> and chlorophyll contents (SPAD). Regarding nutrients contents, significant differences were showed. The combination among three factures was significant enhanced all studied traits.

**KEY WORDS:** Cultivars, Mulching, Licorice root extract, Broccoli.

### INTRODUCTION

**B**roccoli (*Brassica oleracea* var. italica.) is an edible green plant (family Brassicaceae) whose large curds head is eaten as a vegetable. It ranks 31 globally in terms of production, and is considered one of the few plants in Iraq, which is a crop of the cold season cultivated throughout the year in cold regions, It needs a temperate atmosphere that tends to warm during the vegetative growth stage (at the beginning of its life) and a cool atmosphere during the formation of the heads. Broccoli is a type of wild cabbage that is native to the Mediterranean region and was reportedly domesticated thousands of years ago., and has been distributed to Europe for long time, then to all over the word is a recently introduced to Iraq (Arshad and Ahmad, 2017). It is grown for its robust stalk, edible inflorescences in the vegetative phase, and flower buds (Decoteau, 2000). Its green inflorescence, or curd, is loaded with vitamins, minerals, ascorbic acid, and chlorophyll (Fabek *et al.*, 2012). Broccoli is cultivated throughout the winter, when there is typically little precipitation and a lot of evapotranspiration

This crop is also a vegetable rich in chemical compounds with anti-cancer characteristics (Kirsh *et al.* 2007 and Zhao *et al.* 2007), It's a significant crop for the Cole family in terms of nutrition, and it has 3.3 percent protein, high levels of vitamins A, C, iron, and calcium, carbs, and minerals including calcium, iron, phosphorus, potassium, and salt (Yoldas and Mordogan 2008 and Rana, 2008).

By modifying the surface's financial status and decreasing water loss, plastic mulch has a direct impact on the microclimate around the plant (Liakatas *et al.* 1986).

This process has many advantages: mulches are known to buffer soil temperature (Greenly and Rakow.1995) prevent soil water loss by evaporation (Gleason and Iles1998).,inhibit weed germination, and suppress weed growth (Rathinasabapathi Ferguson.(2005) Further, they can protect soils from wind-, water- and traffic-induced erosion and compaction (Chalker.2007).

Mulch is any covering material, organic or inorganic, that is used on the soil's surface to prevent evaporative. This material may be grown and kept in place, or it may be any substance that has been processed, manufactured, and transported before being placed. Mulching is one cultural custom that may be applied to solve this

issue. Mulch helps conserve water by decreasing surface evaporation. (Patil *et al.*, 2013). Additionally, the layer can significantly decrease or completely stop weed growth, which will increase the effectiveness of how much water is used. As byproducts, wheat straw, grass clippings, and leaf fragments are very common. These mulching materials are already produced by several businesses, who are presently investing efforts in getting rid of them. Using this waste as mulch is a cost-effective strategy that would increase soil health, regulate soil temperature, and preserve water.

By altering the surface's radiation budget and decreasing water loss, plastic mulch seems to have a direct impact on the microclimate around the plant. (Liakatas *et al.*, 1986). The color mulch is an important factor in soil temperature variations due to its effect on absorbance of short wave transparent radiation. Black and transparent clear plastic mulches provide extremes in the in the absorbance of short wave transparent radiation Vanker and Shinde (1997).

*Glycyrrhiza glabra*, often referred to as licorice and sweet wood, this plant originates from the Mediterranean and certain parts of Asia. Ancient Egyptian, Chinese, Greek, Indian, and Roman civilizations all used the dried rhizome and root of this plant as an expectorant and carminative. In Kurdistan, polyethylene plastic mulch is the type of plastic mulch utilized in vegetable farming. Over the past ten years, polyethylene mulch use in agriculture has grown significantly all over the world.

Some of the substances in licorice root extract have effects comparable to those of growth regulators such minerals, phenolic compounds, flavonoids, amino acids, and vitamins. Mevalonic acid, which improves the vegetative and blooming features of several plants, is also included in licorice root extract. Licorice root extract also contains a variety of other components and nutrients. (Moses *et al.*, 2002).

Due to the lack of research on the effect of licorice root extract in broccoli plantation, the effect of this natural plant extract will be traded in other vegetable crops. Abdel-Moniam *et al.*, (2011) treat bean (*Phaseolus Vulgaris* L.) plant with Algaren and licorice root extract that increased significantly plant length, leaf area, percentage of chlorophyll content and dry weight.plant<sup>-1</sup>.

## MATERIALS and METHODS

This experiment was conducted over the growing seasons of 2021–2022, at the Vegetable Research Farm, College of Agricultural Engineering Sciences, University of Dohuk, Kurdistan, Iraq in order to determine the impact of these two cultivars of broccoli (Agassi and Wisdom cv.), different types of mulching and different levels of licorice root extract on vegetative growth characters and some nutrient content of Broccoli (*Brassica oleracea* var. *italica*). The land was ploughed and the soil was softened, then it was divided into lines, drip irrigation system of the field was done before planting. Transplants were transported to the farm when it reached suitable stage of transplanting. Two cultivars were sown in August inside lath house two seed per pots a transplant was transfer to the field and planted in September 2021.,other agricultural practices was similarly carried out to each experimental unit as followed by farmers in the area., The treatments was arranged in split-split plot. The cultivars main-plot (Two cultivars) and the sub-plots is three ,types of mulching (without mulching, black mulch, straw of wheat ), and four concentrations of licorice root extracts (0.0, 6.0, 12, 18.0 g.L<sup>-1</sup>), that will randomly arranged in a factorial experiment in a Randomized Compete Block Design (RCBD) in sub-sub-plot Therefore, 24 treatments was involved in this trail (2×3×4=24) with three replication, every plot 9 meter long and 70cm wide. Each unit is one lines, the distance between the plants on a line is 40 cm each plot content 22 plants. The results were analyzed statistically by using Duncan test at 0.05% level to verify the differences between mean of treatments were determined by ( SAS, 2007).The experimental measurements were as follows: vegetative growth (No. of leaves before head formation (Leaf/plant<sup>-1</sup>, Brunch number per plant , Stem length (cm), Plant height (cm) chlorophyll content (SPAD), and macronutrient content in the leaves,(Nitrogen (N%) , Phosphorus (P%) and Potassium (K%).

**Note:** *The letters inside tables means the following*  
(C\* =Cultivar, L\* = Licorice root extract, M\* = Mulch (Straw, Black plastic).

## RESULTS ANDDISCUSSION

**Tables (1)** Showed that the leaves number plant<sup>-1</sup> was significantly influenced by cultivars,

mulching with black plastic, and concentrations of licorice root. In contrast to the other treatments, the plant covered with black plastic had the most leaves per plant (20.708), whereas the plant given 18g.L<sup>-1</sup> had the most leaves overall.

licorice root that recorded high number of leaves (21.667 leaf. plant<sup>-1</sup>) compared with untreated plant that gave recorded low number of leaves per plant (19.222 leaf.plant<sup>-1</sup>).

Concerning the double interaction between treatments a significant difference was noted, compared with untreated plants.

The triple interaction among three factors was significant effects, interaction among Agassi cv. 18 g.L<sup>-1</sup> licorice root extract and black plastic mulch gave the highest value (23.00) compared

with untreated plant that gave lower number (9.333branch/plant<sup>-1</sup>). The enhancement in vegetative growth in table (1) is attributable to the fact that plastic mulches improve moisture availability and conservation, which in turn improves plant development. It has been noted that utilizing mulch may boost growth characteristics because it increases photosynthesis and other metabolic processes (Parmar *et al.*, 2013).

It might be because foliar licorice extract treatment on plants significantly altered a few growth metrics (plant length, number of leaves, shoot dry weight, total chlorophyll content, and total soluble carbs) when compared to control plants. Abd al ameer and Ghaloom (2012).

**Table (1):-Effect of Cultivars, Mulching and licorice root extract on number of leaves (leaf.plant<sup>-1</sup>)**

| Cultivars (C*) | Mulching       | Licorice root extract (g.L <sup>-1</sup> ) (L*) |               |               |               | C * M                   | Mean Effect of cultivar |
|----------------|----------------|---|---------------|---------------|---------------|-------------------------|-------------------------|
|                |                | L0  | L6            | L12           | L18           |                         |                         |
| Wisdom cv.     | Without        | 18.333<br>f                                     | 18.667<br>ef  | 19.000<br>d-f | 20.000<br>d-f | 19.000<br>b             | 19.750<br>b             |
|                | Straw          | 18.667<br>ef                                    | 18.667<br>ef  | 18.667<br>ef  | 21.000<br>b-d | 19.250<br>b             |                         |
|                | Black          | 19.667<br>d-f                                   | 20.000<br>d-f | 22.333<br>ab  | 22.000<br>a-c | 21.000<br>a             |                         |
|                | Mean effect of | 19.222  | 20.167        | 19.944        | 21.667        |                         |                         |
| Agassi cv.     | Without        | 19.667<br>d-f                                   | 21.000<br>b-d | 20.333<br>d-f | 22.000<br>a-c | 20.750<br>a             | 20.750<br>a             |
|                | Straw          | 20.333<br>d-f                                   | 22.667<br>ab  | 19.333<br>d-f | 22.000<br>a-c | 21.083<br>a             |                         |
|                | Black          | 18.667<br>ef                                    | 20.000<br>d-f | 20.000<br>d-f | 23.000<br>a   | 20.417<br>a             |                         |
|                | Mean effect of | 19.222  | 20.167        | 19.944        | 21.667        |                         |                         |
| C * L          | W              | 18.889<br>e                                     | 19.111<br>de  | 20.000<br>b   | 21.000<br>ab  | Main effect of Mulching |                         |
|                | A              | 19.333<br>de                                    | 19.889<br>de  | 20.444<br>b   | 21.667<br>a   |                         |                         |
| M * L          | Without        | 19.000<br>d                                     | 19.833<br>c   | 19.667<br>cd  | 21.000<br>b   | 19.875<br>b             |                         |
|                | Straw          | 19.500<br>cd                                    | 20.667<br>b   | 19.000<br>c   | 21.500<br>b   | 20.167<br>ab            |                         |
|                | Black          | 19.167<br>cd                                    | 20.000<br>c   | 21.167<br>b   | 22.500<br>a   | 20.708<br>a             |                         |
|                | Mean effect of | 19.222  | 20.167        | 19.944        | 21.667        |                         |                         |
| Licorice       |                | c   | b             | b             | a             |                         |                         |

The mean with a column, row, and their interaction following with the same letter are not statistically different, according to Duncan multiple at the 0.05 level.

Data in table (2) revealed that the two cultivars' differences are rather considerable, the highest branch number was in Agassi cultivar (8.083branch.plant<sup>-1</sup>), as compared with the

Wisdom cultivar (6.361branch.plant<sup>-1</sup>). The mean effect with black plastic mulching gave higher branch number compared with other treatments licorice root with concentration

(18g.L) gave high number of branch (8.389 branch. plant<sup>-1</sup>), concerning double interaction among cv and mulching interaction among black plastic and with Agassi cultivars shows higher branch number. plant<sup>-1</sup> that recorded (8.417) as compared with other interaction. Interaction between licorice root extract at concentration (18g.L) with Agassi cultivar recorded high number of branches compared with infraction (7.889). Regarding the triple combination the higher branch.plant<sup>-1</sup>, it was noticed in the combination among black plastic, 18 g.l<sup>-1</sup> licorice root extract and with Ajassi cultivar that record (10.000 branch.plant<sup>-1</sup>) compared with untreated plant for the Wisdom cultivars that gave lowest value for branch number (5.000 branch.plant<sup>-1</sup>).

Table (3) was revealed that cultivars had a significant difference on the Stem length (cm), of broccoli plants. Wisdom cultivar gave the highest stem length (32.167cm), compared with Agassi cultivar. Regarding the effect of mulching, it increased the stem length with black plastic mulch resulting in (31.479cm). Concerning the effect of licorice root extract, it was shown that there was a linear increase in the stem length of broccoli plant by increasing the concentration of licorice root extract interaction among 18 g.l<sup>-1</sup> licorice root extract and cultivar Wisdom gave highest length of stem (33.222)cm., and Regarding double interaction among Wisdom cv and mulching with black plastic recorded higher length of stem (33.250)cm interaction among black plastic and with Ajjasi cultivars shows higher length of stem number.plant<sup>-1</sup> that recorded (8.417) as compared with other interaction. Interaction between licorice root extract at concentration (18g.L) with Agassi cultivar recorded high number of branch compared with infraction (7.88). Regarding the triple interaction among treatment significant differences were revealed when using mulching with straw and black plastic and especial in the Wisdom cultivars that

recorded high stem length (34.500cm) in both type of mulching.

Table (4): Indicated the effect of cultivars, mulching and licorice root extract on plant high (cm), It showed that the two cultivars' are significantly different, the highest plant length(cm) was in Wisdome cultivar (65.694cm), as compared with the Agassi cultivar (61.667cm). The mean effect with straw mulching were gave higher plant length compared with other treatments, concerning with

triple interaction among the cultivars, licorice root extract at concentration (18g.L) and mulching with black plastic in the Wisdom cultivar it was showed significant increase in plant high (66.750cm) compared with untreated plant with licorice root extract, straw and in Agassi cv. That gave lowest high of plant (58.667cm).

Concerning chlorophyll content (SPAD) it was observed that Wisdom cultivar, black plastic mulch and concentration with 18g.L<sup>-1</sup> licorice root extracts significantly increased the chlorophyll content as compared with other treatments (47.139, 47.917, 48.222 SPAD) respectively.

It was shown that the interaction involving mulching methods × cultivars, Wisdome × black plastic affecting the chlophylle content that gave higher content of it (49.333SPAD) compared with untreated plant with licorice root ,mulching anf in wisdom cv that recorded lowest values for chlorophyll content (43.000SPAD).

The significant differences in the tables (1,2,3 and 4) may be due to the role of mulch, licorice rot extract and mulching in both type (organic and inorganic ) that helped to enhanced vegetative growth of plant further lead to increase the parameters of vegetative growth, or may be role of organic mulches in vegetable crops cultivation that protect the soil surface from the influence of unfavorable factors and to improve the growing conditions for the crop plants (Derek *et al.* 2006, Olfati *et al.* 2008). They reduce soil wind and water erosion (Feldman *et al.* 2000), conserve soil moisture (Sinkevičienė *et al.* 2009) and help maintain stable soil temperature (Kar and Kumar 2007). Mulch increases soil porosity and suppresses weed growth (Uwah and Iwo 2011). Björkman and Pearson (1998) and Tan *et al.* (2000) claim that plant's growth conditions are the main determinant of the quality of their yield.

The previous study's findings showed that both onion cultivars had higher levels of photosynthetic pigments when LRE was used in comparison to the matching control plants, indicating that plants supplemented with LRE retained higher levels of photosynthetic ability. At both LRE doses, Shandaweel showed larger improvement in photosynthetic pigment and anthocyanin levels than Giza 20, which is significant. Additionally, the existence of Fe<sup>2+</sup> in LRE and Mg<sup>2+</sup>, a key atom in Chl pigments, may have been crucial for Chl biosynthesis and

production. and plant extracts/phytopathogenic organisms. AL-Mohmadi and Al-ani (2019) evaluated the effect of direct leaf application of licorice (*Glycyrrhiza glabra* L.) extract on the growth and productivity of grains of Sorghum

cv. Rabih, and reported an increase in plant height and in the productivity of grains in the period of Spring and Fall, when the sorghum plants were sown at high density.

**Table (2):-** Effect of Cultivars, Mulching and licorice root extract on branch number.plant<sup>-1</sup>

| Cultivars (C*) | Mulching | Licorice root extract (g.L-1) (L*) |       |       |        | C * M                   | Mean Effect of cultivar |
|----------------|----------|------------------------------------|-------|-------|--------|-------------------------|-------------------------|
|                |          | L0                                 | L6    | L12   | L18    |                         |                         |
| Wisdom cv.     | Without  | 5.000                              | 7.000 | 7.333 | 7.333  | 6.667                   | 6.361<br>b              |
|                |          | f                                  | b-f   | b-e   | b-e    | c                       |                         |
|                | Straw    | 5.333                              | 5.000 | 6.000 | 7.000  | 5.833                   |                         |
|                |          | ef                                 | Ef    | d-f   | b-f    | d                       |                         |
|                | Black    | 5.333                              | 5.333 | 7.000 | 8.667  | 6.583                   |                         |
|                |          | f                                  | c-f   | b-f   | a-c    | c                       |                         |
| Agassi cv.     | Without  | 7.333                              | 8.000 | 7.667 | 8.000  | 7.750                   | 8.083<br>a              |
|                |          | b-f                                | a-d   | a-e   | a-d    | b                       |                         |
|                | Straw    | 6.000                              | 8.000 | 9.000 | 9.333  | 8.083                   |                         |
|                |          | d-f                                | a-d   | a-c   | ab     | ab                      |                         |
|                | Black    | 6.667                              | 7.667 | 9.333 | 10.000 | 8.417                   |                         |
|                |          | d-f                                | a-e   | ab    | a      | a                       |                         |
| C * L          | W        | 5.222                              | 5.778 | 6.778 | 7.667  | Main effect of Mulching |                         |
|                | A        | 6.000                              | 6.111 | 6.889 | 7.889  |                         |                         |
| M * L          | Without  | 6.167                              | 7.500 | 7.500 | 7.667  | 7.208                   |                         |
|                |          | c-e                                | b-d   | bc    | bc     | ab                      |                         |
|                | Straw    | 5.667                              | 6.500 | 7.500 | 8.167  | 6.958                   |                         |
|                |          | e                                  | c-e   | b-d   | ab     | b                       |                         |
|                | Black    | 6.000                              | 6.500 | 8.167 | 9.333  | 7.500                   |                         |
|                |          | ed                                 | -e    | ab    | a      | a                       |                         |
| Mean effect of |          | 5.944                              | 6.833 | 7.722 | 8.389  |                         |                         |
| Licorice       |          | c                                  | b     | a     | a      |                         |                         |

The mean with a column, row, and their interaction following with the same letter are not statistically different, according to Duncan multiple at the 0.05 level

**Table (3):** -Effect of Cultivars, Mulching and licorice root extract on stem length (cm)

| Cultivars (C*) | Mulching | Licorice root extract (g.L-1) (L*) |        |        |        | C * M          | Mean Effect of cultivar |
|----------------|----------|------------------------------------|--------|--------|--------|----------------|-------------------------|
|                |          | L0                                 | L6     | L12    | L18    |                |                         |
| Wisdom cv.     | without  | 29.000                             | 33.500 | 34.500 | 30.667 | 31.917         | 32.167<br>a             |
|                |          | e-g                                | ab     | a      | c-e    | ab             |                         |
|                | Straw    | 26.333                             | 32.500 | 32.000 | 34.500 | 31.333         |                         |
|                |          | hi                                 | a-c    | a-d    | a      | ab             |                         |
|                | Black    | 33.500                             | 33.500 | 31.500 | 34.500 | 33.250         |                         |
|                |          | ab                                 | ab     | b-d    | a      | a              |                         |
| Agassi cv.     | Without  | 24.833                             | 22.500 | 28.333 | 26.500 | 25.542         | 28.500<br>b             |
|                |          | i                                  | j      | e-h    | g-i    | e              |                         |
|                | Straw    | 34.500                             | 27.500 | 30.500 | 28.500 | 30.250         |                         |
|                |          | a                                  | f-h    | c-e    | e-h    | cd             |                         |
|                | Black    | 26.500                             | 28.500 | 29.500 | 34.333 | 29.708         |                         |
|                |          | g-i                                | e-h    | d-f    | a      | d              |                         |
| C * M          | W        | 29.611                             | 33.167 | 32.667 | 33.222 | Main effect of |                         |
|                |          | b                                  | a      | a      | a      |                |                         |

|                |         |        |        |        |        |          |
|----------------|---------|--------|--------|--------|--------|----------|
| L              | A       | 28.222 | 29.500 | 30.611 | 31.833 | Mulching |
|                |         | b      | b      | b      | b      |          |
| M              | Without | 26.917 | 28.000 | 31.417 | 28.583 | 28.729   |
| *              |         | e      | de     | b      | cd     | b        |
| L              | straw   | 30.417 | 30.000 | 31.250 | 31.500 | 30.792   |
|                |         | b      | bc     | b      | b      | a        |
|                | black   | 30.000 | 31.000 | 30.500 | 34.417 | 31.479   |
|                |         | bc     | b      | b      | a      | a        |
| Mean effect of |         | 29.111 | 29.667 | 31.056 | 31.500 |          |
| Licorice       |         | b      | b      | a      | a      |          |

The mean with a column, row, and their interaction following with the same letter are not statistically different, according to Duncan multiple at the 0.05 level

**Table (4):-** Effect of Cultivars, Mulching and licorice root extract on plant height (cm)

| Cultivars (C*) | Mulching | Licorice root extract (g.L <sup>-1</sup> ) (L*) |        |        |        | C * M                   | Mean Effect of cultivar |
|----------------|----------|---|--------|--------|--------|-------------------------|-------------------------|
|                |          | L0  | L6     | L12    | L18    |                         |                         |
| Wisdom cv.     | Without  | 67.333  | 63.333 | 62.333 | 67.000 | 65.000                  | 65.694<br>a             |
|                |          | a-c   | d-f    | b-f    | ab     | ab                      |                         |
|                | Straw    | 62.667  | 65.000 | 65.667 | 68.000 | 65.333                  |                         |
|                |          | b-f   | a-e    | a-d    | ab     | ab                      |                         |
|                | Black    | 66.333  | 68.667 | 66.000 | 66.000 | 66.750                  |                         |
|                |          | a-d   | a      | a-d    | a-d    | a                       |                         |
| Agassi cv.     | Without  | 62.333  | 62.667 | 65.000 | 59.000 | 62.250                  | 61.667<br>b             |
|                |          | b-f   | b-f    | a-e    | ef     | bc                      |                         |
|                | Straw    | 58.667  | 62.333 | 60.667 | 61.333 | 60.750                  |                         |
|                |          | f   | b-f    | d-f    | c-f    | c                       |                         |
|                | Black    | 63.333  | 64.333 | 59.333 | 61.000 | 62.000                  |                         |
|                |          | a-f   | a-f    | ef     | c-f    | bc                      |                         |
| C * L          | W        | 65.444  | 65.667 | 64.667 | 67.000 | Main effect of Mulching |                         |
|                |          | ab  | ab     | ab     | a      |                         |                         |
|                | A        | 63.778  | 65.444 | 65.556 | 64.333 |                         |                         |
|                |          | bc  | ab     | ab     | ab     |                         |                         |
| M              | Without  | 64.833  | 63.000 | 63.667 | 63.000 | 63.625                  |                         |
|                |          | a   | ab     | ab     | ab     | ab                      |                         |
| *              | Straw    | 60.667  | 63.667 | 63.167 | 64.667 | 63.042                  |                         |
|                |          | b   | ab     | ab     | a      | ab                      |                         |
| L              | Black    | 64.833  | 66.500 | 62.667 | 63.500 | 64.375                  |                         |
|                |          | a   | a      | ab     | ab     | a                       |                         |
| Mean effect of |          | 63.444  | 64.389 | 63.167 | 63.722 |                         |                         |
| Licorice       |          | a   | a      | a      | a      |                         |                         |

The mean with a column, row, and their interaction following with the same letter are not statistically different, according to Duncan multiple at the 0.05 level

**Table (5):-**Effect of Cultivars, Mulching and licorice root extract on Chlorophyll Content (SPAD):

| Cultivars (C*)          | Mulching (M*) | Licorice root extract (g.L <sup>-1</sup> ) (L*) |        |        |        | C * M                   | Mean Effect of Cultivar |
|-------------------------|---------------|---|--------|--------|--------|-------------------------|-------------------------|
|                         |               | L0  | L6     | L12    | L18    |                         |                         |
| Wisdom cv.              | Without       | 43.000  | 46.667 | 48.667 | 46.333 | 46.167                  | 47.139<br>a             |
|                         | Straw         | 45.333  | 47.333 | 48.000 | 49.000 | 47.417                  |                         |
|                         | Black         | 46.667  | 47.000 | 48.333 | 49.333 | 47.833                  |                         |
| Agassi cv.              | Without       | 45.000  | 45.333 | 47.000 | 47.667 | 46.250                  | 46.972<br>b             |
|                         | Straw         | 47.000  | 45.000 | 46.667 | 48.000 | 46.667                  |                         |
|                         | Black         | 45.667  | 48.667 | 48.667 | 49.000 | 48.000                  |                         |
| C * L                   | W             | 45.000  | 47.000 | 48.333 | 48.222 | Main effect of Mulching |                         |
|                         | A             | 45.667  | 46.556 | 47.778 | 48.667 |                         |                         |
| M * L                   | Without       | 44.000  | 46.000 | 47.833 | 47.000 | 46.208                  |                         |
|                         | Straw         | 46.167  | 46.167 | 47.333 | 48.500 | 47.042                  |                         |
|                         | Black         | 46.167  | 47.833 | 48.500 | 49.167 | 47.917                  |                         |
| Mean effect of Licorice |               | 45.444  | 46.667 | 47.889 | 48.222 |                         |                         |
|                         |               | c   | bc     | ab     | a      |                         |                         |

The mean with a column, row, and their interaction following with the same letter are not statistically different, according to Duncan multiple at the 0.05 level.

**Table (6):-** Response of cultivars, mulching and licorice root extract and their interactions on the secondary yield(g.plant) of Broccoli.

| cultivars               | Mulching | Licorice ( ) |        |        |        | C * M       | Mean Effect of cultivar |
|-------------------------|----------|--------------|--------|--------|--------|-------------|-------------------------|
|                         |          | L0           | L6     | L12    | L18    |             |                         |
| W                       | without  | 20.470       | 23.661 | 23.445 | 26.345 | 23.480      |                         |
|                         | straw    | 19.559       | 17.151 | 24.900 | 27.552 | 22.290      | 21.644                  |
|                         | black    | 15.284       | 14.641 | 19.904 | 26.819 | 19.162      |                         |
| A                       | without  | 15.504       | 19.693 | 18.664 | 27.485 | 20.337      |                         |
|                         | straw    | 19.525       | 14.645 | 24.095 | 22.000 | 20.066      | 18.491                  |
|                         | black    | 17.019       | 20.791 | 20.613 | 1.860  | 15.071      |                         |
| C                       | W        | 18.438       | 18.485 | 22.750 | 26.905 | Main effect |                         |
|                         | A        | 16.783       | 17.162 | 21.156 | 27.285 |             |                         |
| M * L                   | without  | 17.987       | 21.677 | 21.055 | 26.915 | 21.908      |                         |
|                         | straw    | 19.542       | 15.898 | 24.497 | 24.776 | 21.178      |                         |
| L                       | black    | 16.152       | 17.716 | 20.258 | 14.339 | 17.116      |                         |
| Mean effect of Licorice |          | 17.894       | 18.430 | 21.937 | 22.010 |             |                         |

Table (6) observed that there were no significant effect on the percentage of nitrogen, while treating plant with ( $18\text{g.L}^{-1}$ ) licorice root extract gave a higher percentage of nitrogen (2.154%) appeared, compared with untreated plant with licorice root extract that recorded lowest value of nitrogen (1.480%). Regarding double interaction among Agassi cv., and licorice root extract with concentration ( $18\text{g.L}$ ) record high percent of nitrogen as compared with other interaction (2.104%), and the triple treatment among three factors (straw,  $6\text{g.L}^{-1}$  extract of licorice in the cultivar Wisdom significantly increased the percentage of nitrogen compared to the other treatment that recorded (2.345%) The lowest nitrogen percentage had in cultivar Wisdom when treated with zero licorice root extract (1.180%)

The results in table (7) revealed that significant differences were noticed between cultivars in leaf phosphorus (%) the plant treated with mulching method presented significantly differed that gave highest value of phosphorus percentage (0.649%). Regarding the effect of mulching, there were significant differences in the both cultivars with mulching by black plastic compared the control untreated plant that gave lowest value of phosphorus (0.657, 0.640. 0.531%) respectively.

Tables (8) showed that there were no significant differences Cultivars and using mulching treating plant extract at concentration ( $12\text{g.L}^{-1}$ ). Licorice extract gave higher percentage of potassium as compared with untreated plants that gave lowest value of potassium (1.265, 1.041).

Concerning the double interaction, it were noticed that there were significant effects between black plastic and in the Agassi cultivars that recorded high percentage of potassium (1.266%) as compared with other treatments. Regarding the interaction among cultivars (Agassi and Wisdom) and licorice root extract it was showed no significant on potassium percentage. Regarding the triple interaction among Agassi cultivar \*  $12\text{g.L}^{-1}$  licoric root extract and with black plastic mulch gave higher percentage of potassium percentage (1.548%) compared with interaction between Wisdom cultivars \* black plastic and without using licorice root extract that gave lowest value of potassium (0.823%), Table (8).

Results below demonstrate that there was an (N.P.K.) increase in the broccoli leaves which received mulching and licorice root These results indicated that mulching cultivar and licorice root extract on the nutritional value of the leaves improved the development of broccoli plants. In terms of bio stimulants, it was discovered that root extract enhances mineral absorption and translocation. This could be as a result of how it improves metabolism. They also revealed that licorice enhances the translocation and absorption of minerals. and “ development This may help control how stressed plants' nutritional and adaptive states are managed.

The ability of leaves to give nutrients to plants through two different pathways is known as foliar spray. There are two pathways by which the leaves can absorb nutrients for the plant: one is mediated by bridges or visceral tubes (ectodesmata) beneath the epidermal layer that extend to the epidermal cells and then to the cytoplasm, and the other is through the stomata, which is known as apoplasm (A.O.A.C. 2000).

A higher moisture content in the rhizosphere generated by mulching may have accelerated nutrient solubilization and encouraged optimal hydrothermal regimes for improved root growth, which in turn led to a larger exploitation/extraction of nitrogen from the soil. The higher nitrogen content in seed and pods under mulching may be responsible for the enhanced absorption of nitrogen and phosphorus (Choudhary, 2011).

The most well-known components are mineral elements and minute amounts of plant hormones. It is necessary to stress that neither the product's nutrition nor its natural plant hormone content should affect the biostimulant action. The mechanisms that biostimulants activate are sometimes working to determine and are continuously being researched [EP APPROVES FPR:A GIANT LEAP FOR BIOSTIMULANTS].

This results may be a factor of the licorice root extract's ability to enhance endogenous hormones like GA3 in treated plants, which raised the involvement of metabolic processes and their impact on tissue mineral content.(Thanaa *et al.*,2016 ).Foliar sprays with liquorice root extract at the rate of  $2.5\text{ g.L}^{-1}$  significant increased the nutrient contents in the plants.



**Table (6):-** Effect of Cultivars, Mulching and licorice root extract on nitrogen percentage

| Cultivars (C*)          | Mulching | Licorice root extract (g.L <sup>-1</sup> ) (L*) |       |       |       | C * M                   | Mean Effect of cultivar |
|-------------------------|----------|---|-------|-------|-------|-------------------------|-------------------------|
|                         |          | L0  | L6    | L12   | L18   |                         |                         |
| Wisdom cv.              | Without  | 1.180   | 2.345 | 1.541 | 2.213 | 1.820                   | 1.737<br>a              |
|                         |          | f   | a     | d-f   | a-c   | ab                      |                         |
|                         | Straw    | 1.403   | 1.710 | 1.728 | 2.178 | 1.755                   |                         |
|                         |          | ef  | a-f   | a-f   | a-d   | ab                      |                         |
|                         | Black    | 1.542   | 1.565 | 1.595 | 1.845 | 1.637                   |                         |
|                         |          | d-f   | d-f   | c-f   | a-e   | b                       |                         |
| Agassi cv.              | Without  | 1.670   | 1.747 | 1.811 | 2.290 | 1.879                   | 1.891<br>a              |
|                         |          | b-f   | b-f   | a-f   | Ab    | a                       |                         |
|                         | Straw    | 1.700   | 1.970 | 1.912 | 2.302 | 1.971                   |                         |
|                         |          | a-f   | a-e   | a-e   | Ab    | a                       |                         |
|                         | Black    | 1.385   | 1.807 | 2.000 | 2.095 | 1.822                   |                         |
|                         |          | ef  | a-f   | a-e   | a-d   | a                       |                         |
| C * L                   | W        | 1.375   | 1.873 | 1.621 | 2.079 | Main effect of Mulching |                         |
|                         | d        | b   | cd    | Ab    |       |                         |                         |
| A                       | 1.539    | 1.674   | 1.711 | 2.104 |       |                         |                         |
|                         | cd       | b   | c-e   | A     |       |                         |                         |
| M * L                   | Without  | 1.425   | 2.046 | 1.676 | 2.252 | 1.850                   |                         |
|                         |          | e   | a-c   |       | ab    | a                       |                         |
|                         | Straw    | 1.552   | 1.840 | 1.820 | 2.240 | 1.863                   |                         |
|                         |          | de  | a-e   | b-e   | a     | a                       |                         |
|                         | Black    | 1.463   | 1.686 | 1.797 | 1.970 | 1.729                   |                         |
|                         |          | e   | c-e   | c-e   | a-d   | a                       |                         |
| Mean effect of Licorice |          | 1.480   | 1.857 | 1.765 | 2.154 |                         |                         |
|                         |          | c   | b     | b     | a     |                         |                         |

According to Duncan multiple at the 0.05 level, the mean with a column, row, and their interaction after with the same letter are not statistically different

**Table (7):-** Effect of Cultivars, Mulching and licorice root extract on phosphorus percentage

| Cultivars (C*) | Mulching | Licorice root extract (g.L <sup>-1</sup> ) (L*) |       |       |       | C * M                   | Mean Effect of cultivar |
|----------------|----------|---|-------|-------|-------|-------------------------|-------------------------|
|                |          | L0  | L6    | L12   | L18   |                         |                         |
| Wisdom cv.     | Without  | 0.183   | 0.443 | 0.553 | 0.947 | 0.531                   | 0.598<br>b              |
|                |          | h   | f-g   | d-g   | a     | b                       |                         |
|                | Straw    | 0.594   | 0.675 | 0.597 | 0.623 | 0.622                   |                         |
|                |          | b-g   | b-e   | b-g   | b-e   | ab                      |                         |
|                | Black    | 0.431   | 0.604 | 0.596 | 0.930 | 0.640                   |                         |
|                |          | g   | b-f   | b-g   | a     | a                       |                         |
| Agassi cv.     | Without  | 0.441   | 0.523 | 0.657 | 0.743 | 0.591                   | 0.612<br>a              |
|                |          | gf  | e-g   | b-e   | b     | ab                      |                         |
|                | Straw    | 0.550   | 0.618 | 0.563 | 0.618 | 0.587                   |                         |
|                |          | d-g   | b-e   | c-g   | b-e   | ab                      |                         |
|                | Black    | 0.549   | 0.627 | 0.723 | 0.730 | 0.657                   |                         |
|                |          | eg  | b-e   | b-d   | cb    | a                       |                         |
| C * L          | W        | 0.402   | 0.574 | 0.582 | 0.834 | Main effect of Mulching |                         |
|                | e        | cd  | cd    | a     |       |                         |                         |
| A              | 0.488    | 0.601   | 0.617 | 0.766 |       |                         |                         |
|                | g        | d   | d     | cb    |       |                         |                         |
| M * L          | Without  | 0.312   | 0.483 | 0.605 | 0.845 | 0.561                   |                         |
|                |          | d   | c     | b     | a     | b                       |                         |
|                | Straw    | 0.572   | 0.646 | 0.580 | 0.621 | 0.605                   |                         |
|                |          | cb  | cb    | cb    | b     | ab                      |                         |
|                | black    | 0.490   | 0.615 | 0.659 | 0.830 | 0.649                   |                         |
|                |          | c   | cb    | b     | a     | a                       |                         |
| Mean effect of |          | 0.458   | 0.581 | 0.615 | 0.765 |                         |                         |

| Licorice   |          | c   | b     | b     | a     |       |                         |
|--|----------|---|-------|-------|-------|-------|-------------------------|
| According to Duncan multiple at the 0.05 level, the mean with a column, row, and their interaction after with the same latter are not statistically different. |          |   |       |       |       |       |                         |
| <b>Table (8):- Effect of Cultivars, Mulching and licorice root extract on potassium percentage.</b>  |          |   |       |       |       |       |                         |
| Cultivars (C*)   | Mulching | Licorice root extract (g.L <sup>-1</sup> ) (L*) |       |       |       | C * M | Mean Effect of cultivar |
|  |          | L0  | L6    | L12   | L18   |       |                         |
| Wisdom cv.   | Without  | 1.273   | 1.222 | 1.227 | 1.066 | 1.197 |                         |
|  |          | ac  | a-c   | a-c   | b-c   | ab    |                         |
|  | Straw    | 1.090   | 1.200 | 1.218 | 1.178 | 1.171 | 1.160                   |
|  |          | a-c   | a-c   | a-c   | a-c   | ab    |                         |
|  | Black    | 0.823   | 1.174 | 1.312 | 1.136 | 1.111 |                         |
|  |          | c   | a-c   | ab    | a-c   | ab    | a                       |
| Agassi cv.   | Without  | 0.941   | 1.345 | 1.144 | 1.091 | 1.130 |                         |
|  |          | bc  | ab    | a-c   | a-c   | ab    |                         |
|  | Straw    | 0.997   | 1.003 | 1.140 | 1.078 | 1.055 | 1.150                   |
|  |          | bc  | bc    | a-c   | a-c   | b     |                         |
|  | Black    | 1.118   | 1.206 | 1.548 | 1.192 | 1.266 |                         |
|  |          | bc  | a-c   | a     | a-c   | a     | a                       |
| C * L  | W        | 1.062   | 1.199 | 1.252 | 1.126 |       | Main effect of Mulching |
|  | A        | 0.951   | 1.240 | 1.224 | 1.135 |       |                         |
| M * L  | Without  | 1.107   | 1.284 | 1.185 | 1.079 | 1.164 |                         |
|  |          | b   | ab    | ab    | ab    | a     |                         |
|  | Straw    | 1.044   | 1.102 | 1.179 | 1.128 | 1.113 |                         |
|  |          | b   | ab    | ab    | ab    | a     |                         |
|  | Black    | 0.971   | 1.190 | 1.430 | 1.164 | 1.188 |                         |
|  |          | b   | ab    | a     | ab    | a     |                         |
| Mean effect of Licorice  |          | 1.041   | 1.192 | 1.265 | 1.123 |       |                         |

According to Duncan multiple at the 0.05 level, the mean with a column, row, and their interaction after with the same latter are not statistically different.

## CONCLUSION

From the above mentioned results, it can be concluded that using mulching in both cultivars and in the mulching with (straw and black plastic) concenter better, licorice root extract leads to the enhancement of vegetative growth, nutrient uptick. Furthermore the interaction between treatments also showed improvement in vegetative growth characters.

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کارتیکرنا جور و داپوشین و پهینکرنا بهلگا ژ دهرخستیی رهیت روہکی میکیکئی بی ل سہر بهلگیت روہکی بروکولی  
(*Brassica oleracea var. italica*)

پوختہ

نارمانج ژ قی فہکولینین ہلسہ نکاندنا کارتیکرنا جور و داپوشین و پهینکرنا بهلگا ژ دهرخستیی رهیت روہکی میکیکئی بی ل سہر بهلگیت روہکی بروکولی (*Brassica oleracea var. italica*). د نہنجاماندا دیار بی کو د ہردوو جوورین بروکولی ویسدوم وٹاجاسی جیاوازیہکا معنوی ہہی ژ لایی پیکھائی کہسکاتی و ئاستیی کانزایت مہزن. ہہمی ساخلہ تیت ہاتینہ وەرگرتن ژ جورئ ویسدوم جیاوازیہکا معنوی ہہی. ہہر و ہسا دیار بی کو داپوشین ب کایی و پلاستیکی بیہ نہگہرئ زیدہ بینہکا معنوی د ہہمی ساخلہ تین ہاتینہ وەرگرتن ژ ہردوو توخما. کارلیکا د ناقبہرا دهرخستیی رهیت میکیکئی و کایی ہہمی ساخلہ ت ب شیوہکی بہرجاف بلندکرینہ. کایی و پلاستیکی رہش کارتیکرنا مہزن ل سہر ہہمی ساخلہ تا ہہی، ژ لایہکی دیقہ داپوشین ب کایی دکہل 18 غم / لتر ز دهرخستیی رهیت روہکی میکیکئی کارتیکرنا مہزن ل سہر ہہمی ساخلہ تیت گہشہیا کہسکاتی ہہبین و ہک (ہژمارا بہلگیت رووہکی، بلندہیا رووہکی(سم)، دریزاہیا قہ(سم)، ہژمارا چہقا/ ہہر روہکی، پیکھاتی کلوروفیلی د بہلگادا (SPAD). سہبارہت پیکھاتی توخمیت خوراک، جیاوازی ہہی د ناف توخمیت خوراندی و تیکراہیا د ناقبہرا معاملاتا بیہ نہگہر بو باشرکرنا ہہمی وان ساخلہ تیت ہاتینہ وەرگرتن.

تأثير التغضية والتغذية الورقية لخلصة جذور عرق السوس على النمو لصنفين من البروكلي  
(*Brassica oleracea var. italica*)

الخلاصة

الهدف من هذه الدراسة هو تقييم تأثير الأسمدة ، والتغذية ، والتغذية الورقية لمستخلص جذور عرق السوس ، والمحتوى الغذائي على أوراق البروكلي (*Brassica oleracea var. italica*). أظهرت النتائج أن كلا الصنفين ويسدوم والأجاسي لهما فروق معنوية ذات دلالة معنوية من حيث مكونات النمو الخضري ومستويات العناصر الكبرى. جميع الصفات المدروسة في كلا الصنفين زادت معنوياً بواسطة صنف ويسدوم خلال موسم الدراسة. كما لوحظ أن القش و البلاستيك أدت إلى زيادة معنوية في جميع الصفات التي تم فحصها في كلا الصنفين. تميزت التفاعلات بين خلاصة جذور عرق السوس والقش بارتفاع معظم الصفات المدروسة. أثر القش والبلاستيك الأسود بشكل كبير على معظم المقاييس ، بينما أنتج التغضية بالقش و 18 جم / لتر من جذور عرق السوس معاً أكبر نتيجة إجمالية في جميع معايير النمو الخضري (عدد الأوراق ، النبات<sup>1</sup> ، ارتفاع النبات (سم) ، طول الساق (سم) عدد الافرع لكل نبات ، محتوى الكلورفيل في الاوراق (SPAD). فيما يتعلق بمحتويات العناصر الغذائية لوحظ وجود فروق محتوى العناصر المغذية وقد أدى التداخل بين المعاملات إلى تحسين جميع الصفات المدروسة معنوياً.