# Effect of Foliar Spraying Faba Bean Plants with Some Botanical Extracts and Salicylic Acid on Growth, Yield and Chocolate Spot Disease Severity

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## ABSTRACT

Two faba bean (*Vicia faba* L.) cultivars namely Giza 716 and Giza 40 were investigated for their response to foliar application with some botanical extracts and salicylic acid to improve vegetative growth, yield, and its relation to chocolate spot disease caused by *Botrytis fabae* Sard. Garlic cloves (GE), onion bulb (OE), eucalyptus leaves (EE) extracts (50 and 100 ml/L) and salicylic acid (SA 100 and 200 ppm) were used during two successive seasons of 2017/2018 and 2018/2019 at Etay El-Baroud Agricultural Research Station Farm, El-Beheira Governorate. Under field conditions Giza 716 had better values of growth, agronomic parameters and higher leaves content of chlorophyll a, b, (a+b), seed content of total carbohydrates %, protein %, leaves peroxidase and catalase activities and total phenols in both seasons. GE, OE, EE and SA increased faba bean growth and yield compared to Mancozeb and control treatments. SA 200 ppm increased leaf area /plant after 95 days in the first season. It had the first grade of shoot dry weight after 75 and 95 days and seed weight/plant in the second season and increased leaf area /plant after 75 days, plant height, number of branches/plant, number of pods/plant, 100 seed weight and seed yield/fed in both seasons. It increased chlorophyll a in the first season, chlorophyll b in the second season and chlorophyll a+b in both seasons. As well as, it had the highest catalase activity, total phenols content and protein %. In this respect, GE 100 ml/L significantly increased shoot dry weight /plant after 75 days and leaf area/plant after 95 days in the first and second seasons, respectively. It significantly increased shoot dry weight/plant after 95 days and seed weight/plant in the first season only compared to Mancozeb and control treatments. *B. fabae* spore suspension was applied using two techniques; foliar spray and droplet on leaflets. Using detached leaf test in the laboratory, Giza 716 had lower disease severity % (DS %) and spot diameter than Giza 40. In case of spore suspension foliar spray technique the treatments of GE 100 ml/L, SA 200 ppm and Mancozeb had the least DS %. In case of spore suspension droplet technique the treatments of OE 50 and OE100 ml/L and Mancozeb had the least spot diameter values. Under field conditions, disease severity increased with increasing periods from 75 to 105 days. Giza 716 had the lower DS % after 75, 90 and 105 days from sowing in both seasons than Giza 40. SA 200 ppm and OE 100 ml/L had the lowest DS % values in the first and second seasons, respectively.

**Key words: Faba bean, Botanical extracts, Salicylic acid, Growth, Yield, Peroxidase, Catalase, Phenols, Detached leaf, Chocolate spot severity**

## INTRODUCTION

Faba bean (*Vicia faba* L.) is considered as one of the most profitable field crops in Egypt and grown mainly for its green pods and dried seeds, which are rich in a protein and other compounds (Nassib *et al.,* 1991). It breaks disease cycles of cereals, and adds high amounts of fixed nitrogen to soils (Baka *et al*., 2012).

Chocolate spot, which caused by *Botrytis fabae* Sard., is one of the most yield limiting constraints of faba bean worldwide (Torres *et al*., 2004), as in the northern region of the Nile Delta of Egypt, where low temperature and high relative humidity favoring its spread are dominant (El-Banoby *et al*., 2013) cause severe yield losses reach 60-80% among the susceptible cultivars (Mbazia *et al*., 2016). It decreases the total carbohydrates, nitrogen, protein and nucleic acid (DNA and RNA) contents of yielded seeds (Aldesuquy, 2015).

Fungicides extensive applications had a harmful effect such as an appearance of new fungicide-resistant pathogenic strains, contamination of the environment and modification of the balance of the beneficial microorganisms (Tola *et al*., 2016). Plants are a store house of natural compounds that share in inhibiting phytopathogens (Sales *et al*., 2016) and these are less persistent and hence easily biodegradable, thus are considered safe to the environment and human health compared to the synthetic ones (Pattnaik *et al*., 2012). The active principles components in plant extracts may either act on the pathogen directly (Amadioha, 2000) or induce systemic resistance in host plants causing a reduction of the disease development (Kagale *et al.*, 2004).

Garlic (*Allium sativum* L.) has at least 100 types of sulfuric compositions and 70-80% of them are constituted of allicins (Murray *et al*., 2012) and different bioactive compounds, such as alliin, diallyl sulfide, diallyl disulfide, diallyl trisulfide, ajoene, and S-allyl-cysteine (Shang *et al*., 2019). El-Saadony *et al*. (2017) reported that spraying pea plants with garlic extract (5%) had a significant effect in most agronomic traits.

The onion (*Allium cepa*) extract contains plant growth hormones which positively influenced the root growth and plant height of chrysanthemum (Purwitasari, 2012). Antimicrobial properties of onion (*A. cepa*) have been reported by many researchers such as Irkin and Korukluoglu (2007) against *Aspergillus niger* and Carnago *et al*. (2011) against *Fusarium oxysporum* and *Colletotrichum*.

Alabi *et al*. (2005) revealed that the use of *Eucalyptus globulus* extract had positive effect on the agronomic traits of cowpea. Also Tola *et al*. (2016) reported that crude extract of leaves of *E. globulus* have natural fungitoxic potential for the control of *B. fabae* and stimulating effect on some faba bean agronomic traits.

Salicylic acid (SA) plays an important role in controlling plant growth and development, pigment content, photosynthesis and transpiration rate, ion uptake and transport, seed germination, fruit yield, glycolysis and inducing changes in leaf anatomy and chloroplast ultrastructure (Jayakannan *et al*., 2015). Many investigators exhibited significant reduction of chocolate spot disease severity of faba bean caused by *Botrytis fabae* when using salicylic acids (Aldesuquy *et al*., 2014 and El-Sayed, 2017).

El-Hendawy *et al*. (2010) stated that there was a significant increase in the activity of peroxidase (PO) and polyphenol oxidase (PPO) after treatment of wheat, sugar beet and faba bean plants with salicylic acid. The enhanced peroxidase activity induced systemic resistance in plants against several pathogens (Baysal *et al*., 2005) and associated with a number of physiological functions that may contribute resistance against Fusarium wilt of banana (Thakker *et al*., 2013). Catalase (CAT) is an important enzyme that protects the plant cells from oxidative damage by reactive oxygen species (ROS) (Gill and Tuteja, 2010). Plant phenolics increase the rigidity of plant cell wall acting as molecular bridge between cell wall components (Ozyigit, 2008).

The aim of this study was planned to evaluate the effect of spraying garlic cloves, onion bulb, eucalyptus leaves extracts and salicylic acid as alternative chemicals on faba bean growth, yield, some chemical components and its effect on chocolate spot disease severity caused by *Botrytis fabae* under laboratory and field conditions.

## MATERIALS AND METHODS

The present study was carried out at the experimental farm of Itay El-Baroud Agricultural Research Station during the two successive seasons of 2017/2018 and 2018/2019.

**Field Experiment**

The experiment was conducted in split-plot design with four replicates where the two faba beans cultivars, Giza 716 (resistant) and Giza 40 (susceptible), were chosen for this study and arranged in the main plots and the ten treatments mentioned in Table (1) in the sub-plots. Seeds of faba bean cultivars used in this investigation were obtained from Legumes Dept., Field Crops Res. Institute, Agric. Res. Center, Giza, Egypt. The plot size was 5 ridges each ridge was three meters long and 70 cm apart. Seeds were planted in two sides of the ridge at 15 cm hill spacing with one seed per hill. Faba bean seeds were sown in 5$^{th}$ and 3$^{th}$ of November 2017 and 2018, respectively and all the other cultural practices were carried out according to the recommendations of Ministry of Agriculture and Land Reclamation, Egypt.

**Preparation of extracts**

All extracts were prepared by grinding 500 g of plant materials of garlic gloves, red onion and eucalyptus dry leaves in 1000 ml distilled water. The filtrate was used for preparation of different concentrations, *i.e*., 50 and 100 ml/L. Such preparation techniques of garlic and onion from one hand and eucalyptus from another hand were carried out according to Dahab *et al*., (2018) and Tola *et al*., (2016), respectively.

**Foliar Spraying of the Treatments**

Faba bean plants were sprayed with the previous plant extracts and salicylic acid three times at ages of 30, 45 and 60 days during the two seasons. The fungicide (Mancozeb) was used at the rate of 250 g/ 100 L as a positive control while a tap water was used as negative control (Table 1).

**Table 1: Foliar spraying treatments**

| Abbreviation | Foliar spraying treatments |
|---|---|
| GE 50 | Garlic cloves extract 50 ml/L |
| GE100 | Garlic cloves extract 100 ml/L |
| OE 50 | Onion bulb extract 50 ml/L |
| OE 100 | Onion bulb extract 100 ml/L |
| EE 50 | Eucalyptus leaves extract 50 ml/L |
| EE 100 | Eucalyptus leaves extract 100 ml/L |
| SA 100 | Salicylic acid 100 ppm |
| SA 200 | Salicylic acid 200 ppm |
| M | Mancozeb 250 g/ 100 L (positive control) |
| C | Water (negative control) |

**Character measurements**

**Growth characters**

Shoot dry weight / plant (g) and leaf area / plant ($cm^2$) were estimated as the average of five plants chosen randomly at 75 and 90 days after sowing. To determine leaf area/plant (LA), the area of 10 disks ($10 \times 3.14 \times (1.5)^2$) = 70.65 $cm^2$ was calculated and the leaf area was determined according to Hunt (1990) using the following formula:

$$LA = 70.65 \frac{\text{dry weight of leaves per plant}}{\text{dry weight of leaves disks}}$$

Plant samples were dried in an electric oven with drift fan at 70 $^oC$ for 48 h, till constant dry weight.

**Yield and its attributes**

At harvesting time (after 165 and 163 days from sowing in the first and second seasons, respectively), ten plants from central row in each sub-plot were randomly taken to determine plant height (cm), number of branches/plant, number of pods/plant, 100-seed weight (g), and seed weight/plant (g). Plants in the central area of each sub-plot were harvested and weighed then converted to seed yield (kg/fed).

**Physiological traits**

**Determination of leaf chlorophyll**

Leaves were selected from different positions on the faba bean stem after 75 days from sowing date and homogenized in 5 ml of 85% cold acetone and centrifuged. The extract was measured spectrophotometrically at 663 and 647 nm (Metzner *et al*., 1965). The chlorophyll content was then expressed as mg/ g fresh weight. The following equations were applied for determining the chlorophyll content of the leaf sample:

Chl a= 11.79 ($E_{663}$) – 2.29 ($E_{647}$)

Chl b= 20.05 ($E_{647}$) – 4.77 ($E_{663}$)

**Determination of total carbohydrates and protein in dried seeds**

Total carbohydrates were determined using phenol sulphuric method (Dubois *et al*., 1956). Total nitrogen percentage was determined by Modified Micro-Kjeldahl method as described by AOAC (1988) and the percentage of protein was calculated by multiplying total N values by factor 6.25.

**Determination of enzyme activities**

The sample of one g of leaves (after 75 days from sowing) was homogenized in 8 ml of 0.1 M sodium phosphate buffer (SPB) pH 6.5 at 4°C. The filtrate was centrifuged at 20,000 rpm for 15 min. The supernatant served as an enzyme extract for enzyme assay of peroxidase and catalase.

**Peroxidase (PO) activity**

Peroxidase activity was assayed colorimetrically according to the method described by Amako *et al*. (1994). The increase in optical density at 430 nm against blank was continuously recorded every minute. Peroxidase enzyme activity was expressed as change in absorbance at 430 nm per min/g fresh leaves.

**Catalase (CAT) activity**

Catalase activity was assayed by measuring the rate of disappearance of $H_2O_2$ at 240 nm according to the methods of Cakmak and Horst (1991). The decrease in absorbance at 240 nm was recorded for 1 min by spectrophotometer. One unit was defined as the amount of enzyme necessary to decompose 1 mmol $H_2O_2$ /min/g fresh leaves under the conditions of the assay.

**Determination of total phenols**

Total phenols at 75 days from sowing were determined using the colorimetric method described by Folin and Ciocalteau (Singleton and Rossi, 1965). Total phenols content was then expressed as mg/ g fresh leaves.

**Isolation and identification of the causal organism**

Samples of naturally infected faba bean leaves were used for isolation of chocolate spot pathogen. Infected leaflets having symptoms were cut into small pieces, each with single lesion of the concerned disease, surface was sterilized by immersing them in 1% sodium hypochlorite solution for 2 min, rinsed in sterile water and dried between double layers of sterile filter paper. The samples were plated on Potato Dextrose Agar (PDA) plates. Four pieces were put in each plate then incubated at 20°C for one week. Pure isolates were obtained using single spore technique (Haggag *et al*., 2006).

**Fungal culture and inoculum preparation**

To induce sporulation, the fungal culture was transferred to Faba Leaf Dextrose Agar (FLDA) medium (extract of 400 g of faba bean leaves, 18 g agar and 20 g dextrose and the volume made up to 1L). The composition was then autoclaved at a temperature of 121°C and pressure of 15 p. s. i. for 20 min, cooled down to about 45°C and poured into sterilized 9 cm diameter Petri dishes (Haggag *et al*., 2006) and incubated at 20 °C in a cycle of 12h darkness and 12h visible light to induce sporulation for 15 days at 20-22$^o$C as described by (Derckel *et al*., 1999). Conidia were collected by washing plates with 4-5 ml of sterile distilled water, and the resulting spore suspension was adjusted to $3\times10^6$ conidia/ml using a hemocytometer (Bouhassan *et al*., 2004).

**Determination of chocolate spot disease severity using detached leaf test *in vitro***

In the second season, after 24 h from the last spray with the tested compounds (Table 1) under field conditions, fully expanded leaflets of similar age group were detached from the middle nodes of the two cultivars. Leaflets were surface disinfected by 1% sodium hypochlorite for 2 min, and subsequently rinsed with distilled sterile water and allowed to dry on sterile filter paper. The cut end of each leaflet petiole is covered with moistened cotton to maintain leaves at maximum turgor. This experiment was divided in two groups: at the first group, one drop (20 µl) of the fungal spore suspension was placed near the midrib of the leaflets, and at the second group *B. fabae* spore suspension sprayed with 1ml/4 leaflets/replicate (Taffa *et al*., 2013). Each treatment had three replicates each one had four leaflets. The benches are then covered with polythene sheets and left at room temperature (20±2 °C) for 5–6 days till disease is assessed. A 1–4 scale can be used (ICARDA, 1986), where 1: no infection or very small flecks (1–25% necrosis); 2: necrotic flecks with few small lesions (26–50% necrosis), and very poor sporulation; 3: medium coalesced lesions (51–75% necrosis) with intermediate sporulation; 4: large coalesced lesions (76–100% necrosis) with abundant sporulation. Diameters of emerging lesions were measured after 6 days.

Disease severity % = [Σ (n x v) / 4N] x 100

Where: (n) = Number of plants in each category; (v) = Numerical values of symptoms category; (N) = Total number of plants; (4) = Maximum numerical value of symptom category.

**Determination of chocolate spot disease severity under field conditions**

Severity due to natural infection was determined after 75, 90 and 105 days from sowing. Ten randomly pre-tagged faba bean plants in the three central rows, disease severity on leaves was rated using 1-9 rating scale (Bernier *et al*., 1993), where 1: no disease symptoms or very small specks; 3: few small discrete lesions; 5: some coalesced lesions with some defoliation; 7: large coalesced sporulating lesions, 50% defoliation and some dead plant; and 9: extensive lesions on leaves, stems and pods, severe defoliation, heavy sporulation, stem girdling, blackening and death of more than 80% of plants (Bernier *et al*., 1984). Chocolate spot disease severity % was assessed according to the following formula:

Disease severity % = [Σ (n x v) / 9N] x 100

Where: (n) = Number of plants in each category; (v) = Numerical values of symptoms category; (N) = Total number of plants; (9) = Maximum numerical value of symptom category.

Then efficacy percentage (E %) of each compound in reducing disease severity percentage of faba bean was assessed according to the equation adapted by Rewal and Jhooty (1985) as follow:-

E% = (C – T / C) x 100

Where: C = Disease severity % in control; T = Disease severity % in the treatment

**Statistical Analysis**

All data were subjected to the analyses of variance (ANOVA) for split-plot design followed by compared means with LSD at level probability 5% according to (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

**Growth characters**

**Effect of foliar spraying treatments on cultivars and their interaction for faba bean shoot dry weight/plant after 75 and 95 days from sowing**

Data in Table (2) appear that Giza 716 cv. had higher shoot dry weight/plant after 75 and 95 days from sowing in both seasons than Giza 40 with averages (9.28 and 9.72 g) and (17.44 and 17.36 g), respectively.

The results showed that spraying botanical extracts and SA significantly increased shoot dry weight compared to Mancozeb and control treatments (Table 2). At the first season, after 75 days it can be noticed that GE 100 ml/L had the first grade followed by SA 200 ppm with averages of (9.96 and 9.78 g) and after 95 days OE 100 ml/L had the first grade followed by SA 200 ppm with averages of (18.66 and 18.38 g), respectively. These results were similar with those of garlic extract on dwarf umbrella tree (*Schefflera arboricola*) plants (Hanafy *et al*., 2012). These founding's might relate to the content garlic extract of nutrients, vitamins and some other compounds, which encourage the production of plant hormones such as gibberellins and cytokinins and eventually lead to an increase in plant growth (Al-Mayahi and Fayadh, 2015). At the second season, SA 200 ppm had the highest value after 75 days followed by GE 100 ml/L with averages of (10.50 and 10.21g) and SA 200 ppm had the highest value after 95 days followed by GE 100 ml/L with averages of (17.93 and 17.90 g), respectively. These results are in agreement with the findings mentioned by Aldesuquy (2015) and El-Awadi *et al*. (2017) who reported that spraying faba bean plants with salicylic acid significantly increased dry weight of shoot system compared with non-sprayed (control) plants. In this respect, spraying sugar beet and pea plants with salicylic acid or garlic extract had a positive significant effect on plant growth (Youssef *et al*., 2016 and El-Saadony *et al*., 2017). The promotive effect of salicylic acid could be attributed to its bio regulator effects on physiological and biochemical processes in plants such as ion uptake, cell elongation, cell division, cell differentiation (El-Tayeb, 2005).

For the interaction effect, at the first season Giza 716 x GE 100 ml/L had the highest shoot dry weight after 75 day followed by Giza 716 x SA 200 ppm and the same treatments at the second season after 95 days.

**Table 2: Effect of foliar spraying treatments on cultivars and their interaction for faba bean shoot dry weight/plant after 75 and 95 days from sowing during two successive seasons under field conditions.**

| Parameter | Shoot dry weight/ plant after 75 days (g) | | Shoot dry weight/ plant after 95 days (g) | |
|---|---|---|---|---|
| Season / Factor | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 |
| **Cultivar (C)** | | | | |
| Giza 716 | 9.28[a] | 9.72[a] | 17.44[a] | 17.36[a] |
| Giza 40 | 7.57[b] | 7.59[b] | 14.94[b] | 15.04[b] |
| **Foliar spray (F)** | | | | |
| GE 50 ml/L | 8.25[bc] | 8.70[b] | 17.30[ab] | 16.95[a] |
| GE 100 ml/L | 9.96[a] | 10.21[a] | 17.24[ab] | 17.90[a] |
| OE 50 ml/L | 8.59[b] | 8.19[b] | 15.59[b] | 16.79[a] |
| OE 100 ml/L | 9.53[a] | 9.33[ab] | 18.66[a] | 17.58[a] |
| EE 50 ml/L | 7.77[b] | 8.57[b] | 15.87[b] | 14.89[b] |
| EE 100 ml/L | 8.62[b] | 9.02[b] | 17.31[ab] | 17.78[a] |
| SA 100 ppm | 8.45[b] | 8.78[b] | 16.84[ab] | 16.54[a] |
| SA 200 ppm | 9.78[a] | 10.50[a] | 18.38[a] | 17.93[a] |
| Mancozeb | 7.50[c] | 7.06[c] | 13.05[c] | 13.43[bc] |
| Control | 5.80[d] | 6.20[c] | 11.70[c] | 12.2[bc] |
| **Interaction (C x F)** | | | | |
| Giza 716 | | | | |
| GE 50 ml/L | 9.21 | 10.14 | 19.14 | 18.60 |
| GE 100 ml/L | 11.14 | 11.69 | 18.39 | 20.09 |
| OE 50 ml/L | 9.98 | 9.46 | 17.27 | 17.87 |
| OE 100 ml/L | 10.47 | 10.58 | 20.17 | 18.35 |
| EE 50 ml/L | 8.43 | 9.27 | 17.20 | 16.35 |
| EE 100 ml/L | 9.16 | 10.24 | 18.26 | 18.23 |
| SA 100 ppm | 9.70 | 9.89 | 17.82 | 18.0 |
| SA 200 ppm | 10.94 | 11.80 | 20.79 | 19.65 |
| Mancozeb | 7.43 | 7.62 | 13.69 | 13.67 |
| Control | 6.36 | 6.54 | 11.79 | 12.05 |
| Giza 40 | | | | |
| GE 50 ml/L | 7.31 | 7.27 | 15.47 | 15.20 |
| GE 100 ml/L | 8.78 | 8.74 | 16.10 | 15.71 |
| OE 50 ml/L | 7.20 | 6.92 | 13.93 | 14.98 |
| OE 100 ml/L | 8.34 | 8.09 | 17.16 | 16.83 |
| EE 50 ml/L | 7.12 | 7.89 | 14.55 | 13.43 |
| EE 100 ml/L | 8.09 | 7.82 | 16.38 | 17.34 |
| SA 100 ppm | 7.22 | 7.68 | 15.87 | 15.09 |
| SA 200 ppm | 8.63 | 9.21 | 15.97 | 16.21 |
| Mancozeb | 6.05 | 6.52 | 12.42 | 13.20 |
| Control | 5.25 | 5.88 | 11.62 | 12.49 |
| L.S.D 0.05 (C) | 0.29 | 0.51 | 1.66 | 1.21 |
| L.S.D 0.05 (F) | 0.90 | 0.98 | 1.45 | 1.57 |
| L.S.D 0.05 (C x F) | 1.27 | NS | NS | 2.23 |

Means in the same column followed by the same letter(s) are not significant according to L.S.D at the probability of 0.05.

**Effect of foliar spraying treatments on cultivars and their interaction for faba bean leaf area/plant ($cm^2$) after 75 and 95 days from sowing**

Data present in Table (3) reveal that leaf area/ plant was significantly differ by cultivars at 75 and 95 days from sowing during the two growing seasons. It can be noticed that Giza 716 cv. had higher leaf area/plant after 75 and 95 days than Giza 40; these were 707.81 and 702.03 $cm^2$ and 1753.05 and 1814.30 $cm^2$ in the first and second seasons, respectively.

**Table 3: Effect of foliar spraying treatments on cultivars and their interaction for faba bean leaf area/plant ($cm^2$) after 75 and 95 days from sowing during two successive seasons under field conditions.**

| Parameter | Leaf area/plant after 75 days ($cm^2$) | | Leaf area/plant after 95 days ($cm^2$) | |
|---|---|---|---|---|
| Factor / Season | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 |
| **Cultivar (C)** | | | | |
| Giza 716 | 707.81$^{a}$ | 702.03$^{a}$ | 1753.05$^{a}$ | 1814.30$^{a}$ |
| Giza 40 | 548.88$^{b}$ | 557.21$^{b}$ | 1432.13$^{b}$ | 1422.30$^{b}$ |
| **Foliar spray (F)** | | | | |
| GE 50 ml/L | 626.17$^{ab}$ | 642.47$^{a}$ | 1517.63$^{bc}$ | 1581.13$^{b}$ |
| GE 100 ml/L | 651.55$^{a}$ | 666.61$^{a}$ | 1692.57$^{ab}$ | 1888.29$^{a}$ |
| OE 50 ml/L | 615.43$^{ab}$ | 606.32$^{ab}$ | 1592.07$^{b}$ | 1617.06$^{b}$ |
| OE 100 ml/L | 676.54$^{a}$ | 694.12$^{a}$ | 1793.18$^{a}$ | 1793.91$^{a}$ |
| EE 50 ml/L | 629.90$^{a}$ | 646.23$^{a}$ | 1488.61$^{bc}$ | 1563.70$^{b}$ |
| EE 100 ml/L | 658.16$^{a}$ | 657.26$^{a}$ | 1786.58$^{a}$ | 1779.55$^{ab}$ |
| SA 100 ppm | 683.40$^{a}$ | 646.72$^{a}$ | 1552.56$^{bc}$ | 1644.28$^{b}$ |
| SA 200 ppm | 694.13$^{a}$ | 610.27$^{a}$ | 1798.70$^{a}$ | 1866.54$^{a}$ |
| Mancozeb | 548.84$^{b}$ | 544.06$^{ab}$ | 1407.78$^{c}$ | 1399.73$^{c}$ |
| Control | 499.32$^{b}$ | 483.15$^{b}$ | 1296.70$^{c}$ | 1298.80$^{c}$ |
| **Interaction (C x F)** | | | | |
| Giza 716 | | | | |
| GE 50 ml/L | 709.33 | 689.32 | 1656.95 | 1789.89 |
| GE 100 ml/L | 692.13 | 721.13 | 1827.71 | 2191.70 |
| OE 50 ml/L | 685.48 | 672.84 | 1684.91 | 1726.64 |
| OE 100 ml/L | 805.58 | 783.82 | 1979.55 | 1951.92 |
| EE 50 ml/L | 704.98 | 737.96 | 1662.92 | 1640.80 |
| EE 100 ml/L | 747.87 | 719.14 | 1984.64 | 1970.38 |
| SA 100 ppm | 771.60 | 763.94 | 1716.98 | 1763.44 |
| SA 200 ppm | 799.54 | 838.38 | 2026.14 | 2101.63 |
| Mancozeb | 578.88 | 591.77 | 1562.17 | 1566.23 |
| Control | 549.17 | 502.27 | 1428.59 | 1440.39 |
| Giza 40 | | | | |
| GE 50 ml/L | 543.03 | 546.13 | 1378.31 | 1372.38 |
| GE 100 ml/L | 610.99 | 612.11 | 1557.44 | 1584.89 |
| OE 50 ml/L | 545.39 | 539.81 | 1499.25 | 1507.50 |
| OE 100 ml/L | 547.51 | 602.44 | 1606.83 | 1635.90 |
| EE 50 ml/L | 554.84 | 554.51 | 1314.32 | 1486.62 |
| EE 100 ml/L | 568.46 | 595.39 | 1588.54 | 1588.74 |
| SA 100 ppm | 595.22 | 529.76 | 1388.16 | 1525.13 |
| SA 200 ppm | 587.42 | 582.17 | 1571.27 | 1631.46 |
| Mancozeb | 486.53 | 496.36 | 1253.41 | 1233.24 |
| Control | 449.48 | 439.04 | 1163.83 | 1157.23 |
| L.S.D 0.05 (C) | 43.61 | 85.82 | 96.48 | 45.86 |
| L.S.D 0.05 (F) | 79.53 | 107.71 | 179.44 | 143.50 |
| L.S.D 0.05 (C x F) | NS | NS | NS | NS |

Means in the same column followed by the same letter(s) are not significant according to L.S.D at the probability of 0.05.

The results indicated that spraying GE, OE, EE (50 and 100 ml/L) and SA (100 and 200 ppm) significantly increased faba bean leaf area/plant compared to Mancozeb and control treatments. In this respect El-Saadony *et al*. (2017) found that foliar spray with SA or GE increased pea leaf area. Similar results were obtained with garlic extract on *Schefflera arboricola* plants (Hanafy *et al*., 2012). These results might relate to garlic contains vitamins, minerals, flavonoids, ascorbic acid, sulphur and trace of iodine (Azzini *et al*., 2014).

Foliar spraying of SA 200 ppm had the highest mean values of leaf area with averages of (694.13 and 610.27 $cm^2$), respectively after 75 days in the two seasons and at the first season only after 95 days with an average of (1798.70 $cm^2$). These results were in harmony with Aldesuquy (2015) whom stated that foliar spray of faba bean plants with SA increased leaf area. OE 100 ml/L treatment had the second grade of this trait with averages of (676.54 and 694.12 $cm^2$) after 75 days in the two seasons, respectively and (1793.18 $cm^2$) after 95 days in the first season only. Asad Ullah *et al*. (2019) reported that foliar spraying with salicylic acid significantly increased tomato leaf area. Ibrahim *et al*. (2019) found that foliar application of salicylic acid significantly increased vegetative growth, fruit yield, and quality of red sweet pepper as compared with the control plants.

The role of SA on the leaf area attributes to its important roles on activating cell division, biosynthesis of organic foods and availability as well as movement of mineral nutrients towards the leaves (Shaaban *et al*., 2011).

**Yield and its attributes**

**Effect of foliar spraying treatments on cultivars and their interaction for faba bean plant height (cm) and number of branches/plant**

Data presented in Table (4) show that Giza 716 cv. had the taller plants than Giza 40 in both seasons with averages of (93.87 and 96.05 cm), respectively. The same trend was cleared in case for number of branches/plant. Giza 716 had higher value than Giza 40. This result was in harmony with that mentioned by El-Shafey *et al*. (2019).

Tested botanical extracts and SA spraying treatments had significant effect in increasing faba bean height compared to control. These results were in close to that mentioned by El-Saadony *et al*. (2017) who reported that spraying pea plants with salicylic acid at (100 ppm) had a positive effect in plant height. In case of number of branches/plant, the spraying treatments had desired effect in this parameter compared to control treatment except with the GE 50 ml/L treatment in the first season only. Asad Ullah *et al*. (2019) reported that foliar spray with SA significant increased number of tomato branches/plant. Noreen and Ashraf (2008) suggested that growth enhancement of SA treated plants might be due to the influence of SA in inducing changes in photosynthesis, antioxidant capacity and ion homeostasis processes.

In the considerable of the interaction treatments, data recorded significant effect for number in branches in the second season only. Giza 716 x SA 200 ppm had the best value of number of branches/plant.

**Effect of foliar spraying treatments on cultivars and their interaction for faba bean number of pods/plant and seed weight/plant**

Data mentioned in Table (5) show that Giza 716 cv. had higher number of pods/plant in the second season and seed weight/plant in both seasons than Giza 40 with averages of (11.97) and (23.02 and 24.48 g), respectively. These results are in agreement with the findings reported by El-Shafey *et al*. (2019).

In case of spraying treatments, SA 200 ppm significantly had the highest number of pods/plant in both seasons with averages of (11.15 and 13.82) and seed weight/plant with an average of (25.91 g) in the second season only. These results are in agreement with the findings reported by Asad Ullah *et al*. (2019) who reported that foliar spray with salicylic acid significantly increased number of tomato fruit/plant and yield/plant. Moreover, El-Saadony *et al*. (2017) reported that spraying pea plants with salicylic acid at (100 ppm) had a positive significant effect in number of pods per plant, number of seeds per pod and per plant. In this respect OE100 ml/L had the first grade with seed weight/plant with an average of (24.92 g) in the first season only and the second grade in number of pods/plant in both seasons with averages of (10.53 and 12.07), respectively.

From the interaction, it clear that there are significant differences between the two tested cultivars and the spraying botanical extracts or salicylic acid in the first season only. Giza 40 x SA 200 ppm had the highest number of pods/plant followed by Giza 716 x OE 100 ml/L and Giza 716 x SA 200 ppm. In case of seed weight/plant Giza 716 x OE 100 ml/L had the highest seed weight/plant in the first season followed by Giza 716 x EE 100 ml/L and Giza 716 x SA 200 ppm.

**Effect of foliar spraying treatments on cultivars and their interaction for faba bean 100–seed weight (g) and seed yield/fed (kg)**

Data presented in Table (6) show that Giza 716 cv. had higher 100- seed weight and seed yield/fed than Giza 40 in both seasons with averages of (74.40 and 83.61 g) and (1645.95 and 1732.47 kg/fed), respectively.

In case of spraying treatments, the botanical extracts and salicylic acid treatments had significant increase in both parameters compared to control treatment. SA 200 ppm had the highest 100 seed weight followed by OE 100 and EE 100 ml/L in both seasons. These results are in close to that mentioned by Aldesuquy (2015) on faba bean plants. In case of seed yield/fed, SA 200 ppm had the highest value followed by GE 100 and OE 100 ml/L with averages of (1723.72, 1699.05 and 1670.87 kg/fed), respectively.

**Table 4: Effect of foliar spraying treatments on cultivars and their interaction for faba bean plant height (cm) and number of branches/plant during two successive seasons under field conditions.**

| Parameter | Plant height (cm) | | Number of branches/plant | |
|---|---|---|---|---|
| Factor / Season | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 |
| **Cultivar (C)** | | | | |
| Giza 716 | 93.87[a] | 96.05[a] | 1.55 | 1.80[a] |
| Giza 40 | 82.47[b] | 87.32[b] | 1.45 | 1.61[b] |
| **Foliar spray (F)** | | | | |
| GE 50 ml/L | 87.25[ab] | 88.75[bc] | 1.17[b] | 1.37[d] |
| GE 100 ml/L | 92.12[a] | 95.75[ab] | 1.55[ab] | 1.62[c] |
| OE 50 ml/L | 86.50[ab] | 90.87[b] | 1.35[ab] | 1.32[d] |
| OE 100 ml/L | 93.50[a] | 95.50[ab] | 1.50[ab] | 1.57[cd] |
| EE 50 ml/L | 86.00[ab] | 92.12[b] | 1.52[ab] | 1.57[cd] |
| EE 100 ml/L | 91.62[a] | 95.37[ab] | 1.70[ab] | 1.92[b] |
| SA 100 ppm | 85.37[ab] | 90.12[b] | 1.60[ab] | 2.05[b] |
| SA 200 ppm | 94.00[a] | 99.37[a] | 1.90[a] | 2.87[a] |
| Mancozeb | 85.37[ab] | 85.37[bc] | 1.55[ab] | 1.45[cd] |
| Control | 80.00[b] | 83.62[c] | 1.20[b] | 1.32[d] |
| **Interaction (C x F)** | | | | |
| Giza 716 | | | | |
| GE 50 ml/L | 90.00 | 92.50 | 1.25 | 1.40 |
| GE 100 ml/L | 97.75 | 101.75 | 1.45 | 1.60 |
| OE 50 ml/L | 90.25 | 93.00 | 1.35 | 1.35 |
| OE 100 ml/L | 99.25 | 100.75 | 1.60 | 1.65 |
| EE 50 ml/L | 91.75 | 94.25 | 1.55 | 1.50 |
| EE 100 ml/L | 97.50 | 97.50 | 1.75 | 2.15 |
| SA 100 ppm | 92.00 | 92.75 | 1.65 | 2.30 |
| SA 200 ppm | 100.50 | 106.50 | 2.05 | 3.25 |
| Mancozeb | 92.75 | 91.75 | 1.70 | 1.45 |
| Control | 87.00 | 89.75 | 1.20 | 1.40 |
| Giza 40 | | | | |
| GE 50 ml/L | 84.50 | 85.00 | 1.10 | 1.35 |
| GE 100 ml/L | 86.50 | 89.75 | 1.65 | 1.65 |
| OE 50 ml/L | 82.75 | 88.75 | 1.35 | 1.30 |
| OE 100 ml/L | 87.75 | 90.25 | 1.40 | 1.50 |
| EE 50 ml/L | 80.25 | 90.00 | 1.50 | 1.65 |
| EE 100 ml/L | 85.75 | 93.25 | 1.65 | 1.70 |
| SA 100 ppm | 78.75 | 87.50 | 1.55 | 1.80 |
| SA 200 ppm | 87.50 | 92.25 | 1.75 | 2.50 |
| Mancozeb | 78.00 | 79.00 | 1.40 | 1.45 |
| Control | 73.00 | 77.50 | 1.20 | 1.25 |
| L.S.D 0.05 (C) | 3.68 | 2.20 | NS | 0.03 |
| L.S.D 0.05 (F) | 5.93 | 6.45 | 0.38 | 0.27 |
| L.S.D 0.05 (C x F) | NS | NS | NS | 0.38 |

Means in the same column followed by the same letter(s) are not significant according to L.S.D at the probability of 0.05.

In this respect, Fuglie (2000) mentioned that garlic leaf extract sprayed onto leaves of tomato, melon, maize, sorghum, coffee, tea, onions, bell pepper, soya beans and chili increased the yield of these crops. The increase in fruit yield by SA application may be due to a significant increase in vegetative growth parameters, minerals, photosynthetic pigments and some bio-constituents (EL-Yazeid, 2011). El-Saadony *et al*. (2017) reported that spraying pea plants with SA (100 ppm) and GE (5%) had a positive significant effect in yield and 100-seed weight. The promoting effect of OE on growth and yield might be attributed to its higher own content from sulphur, amino acids, minerals, vitamins and thiamine, riboflovine, phytosterols, saponins and flavonoids, that act as antioxiants protecting plant cells from death and enhancing cell division and the biosynthesis of organic foods (Marrelli *et al.,* 2019).

**Table 5: Effect of foliar spraying treatments on cultivars and their interaction for number of pods/plant and seed weight/plant during two successive seasons under field conditions.**

| Parameter | No. pods/plant | | Seed weight/plant (g) | |
|---|---|---|---|---|
| Factor \ Season | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 |
| **Cultivar (C)** | | | | |
| Giza 716 | 9.71 | 11.97[a] | 23.02[a] | 24.48[a] |
| Giza 40 | 9.34 | 10.41[b] | 19.91[b] | 21.59[b] |
| **Foliar spray ( F )** | | | | |
| GE 50 ml/L | 8.41[d] | 10.67[b] | 19.46[bc] | 21.17[c] |
| GE 100 ml/L | 8.51[d] | 11.37[b] | 23.52[a] | 25.19[ab] |
| OE 50 ml/L | 8.96[cd] | 10.07[b] | 21.07[b] | 22.28[bc] |
| OE 100 ml/L | 10.53[ab] | 12.07[b] | 24.92[a] | 24.88[ab] |
| EE 50 ml/L | 9.97[bc] | 10.50[b] | 19.51[bc] | 22.30[bc] |
| EE 100 ml/L | 9.48[c] | 11.01[b] | 23.81[a] | 24.97[ab] |
| SA 100 ppm | 10.36[b] | 11.62[b] | 21.34[b] | 23.96[b] |
| SA 200 ppm | 11.15[a] | 13.82[a] | 24.31[a] | 25.91[a] |
| Mancozeb | 9.23[cd] | 11.02[b] | 18.85[c] | 20.41[cd] |
| Control | 8.65[d] | 9.75[b] | 17.83[c] | 19.27[d] |
| **Interaction ( C x F )** | | | | |
| Giza 716 | | | | |
| GE 50 ml/L | 9.10 | 11.73 | 20.64 | 22.44 |
| GE 100 ml/L | 8.75 | 12.50 | 25.48 | 27.02 |
| OE 50 ml/L | 9.68 | 10.35 | 22.70 | 24.35 |
| OE 100 ml/L | 10.88 | 12.80 | 27.07 | 26.93 |
| EE 50 ml/L | 10.35 | 9.90 | 19.92 | 23.37 |
| EE 100 ml/L | 9.10 | 11.63 | 26.83 | 26.01 |
| SA 100 ppm | 10.13 | 13.40 | 22.77 | 24.96 |
| SA 200 ppm | 10.83 | 15.40 | 26.30 | 27.63 |
| Mancozeb | 9.55 | 12.05 | 19.81 | 21.76 |
| Control | 8.75 | 10.00 | 18.76 | 20.36 |
| Giza 40 | | | | |
| GE 50 ml/L | 7.75 | 9.63 | 18.29 | 19.90 |
| GE 100 ml/L | 8.28 | 10.25 | 21.58 | 23.38 |
| OE 50 ml/L | 8.25 | 9.80 | 19.45 | 20.23 |
| OE 100 ml/L | 10.19 | 11.35 | 22.79 | 22.85 |
| EE 50 ml/L | 9.60 | 11.10 | 19.11 | 21.25 |
| EE 100 ml/L | 9.88 | 10.40 | 20.81 | 23.94 |
| SA 100 ppm | 10.60 | 9.85 | 19.93 | 22.98 |
| SA 200 ppm | 11.48 | 12.25 | 22.34 | 24.19 |
| Mancozeb | 8.93 | 10.00 | 17.90 | 19.08 |
| Control | 8.55 | 9.50 | 16.92 | 18.20 |
| L.S.D 0.05 (C) | NS | 1.01 | 1.28 | 1.70 |
| L.S.D 0.05 (F) | 0.78 | 1.61 | 1.43 | 1.86 |
| L.S.D 0.05 (C x F) | 1.10 | NS | 2.02 | NS |

Means in the same column followed by the same letter(s) are not significant according to L.S.D at the probability of 0.05.

From the interaction, there are significant differences between cultivars and the spraying treatments in first season for 100- seed weight. The obtained data indicated that Giza 716 x SA 200 ppm had the highest 100- seed weight followed by Giza 716 x EE 100 and Giza 716 x OE 100 ml/L. In case of seed yield/fed the interaction between cultivars and spraying treatments showed significant increase compared to control treatment. In the first season, Giza 716 x SA 200 ppm had the highest value followed by Giza 716 x OE 100 and Giza 716 x GE 100 ml/L.

**Table 6: Effect of foliar spraying treatments on cultivars and their interaction for 100- seed weight (g) and seed yield/fed (kg) during two successive seasons under field conditions.**

| Parameter | 100- seed weight (g) | | Seed yield/fed (kg) | |
|---|---|---|---|---|
| Factor / Season | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 |
| **Cultivar (C)** | | | | |
| Giza 716 | 74.40$^{a}$ | 83.61$^{a}$ | 1645.95$^{a}$ | 1732.47$^{a}$ |
| Giza 40 | 64.93$^{b}$ | 66.97$^{b}$ | 1418.25$^{b}$ | 1450.29$^{b}$ |
| **Foliar spray (F)** | | | | |
| GE 50 ml/L | 67.31$^{cd}$ | 74.88$^{b}$ | 1489.32$^{b}$ | 1587.90$^{b}$ |
| GE 100 ml/L | 69.06$^{bc}$ | 75.81$^{ab}$ | 1699.05$^{a}$ | 1722.02$^{a}$ |
| OE 50 ml/L | 69.50$^{bc}$ | 71.84$^{bc}$ | 1504.02$^{b}$ | 1627.12$^{b}$ |
| OE 100 ml/L | 74.00$^{a}$ | 80.05$^{ab}$ | 1670.87$^{a}$ | 1736.05$^{a}$ |
| EE 50 ml/L | 67.87$^{c}$ | 75.19$^{b}$ | 1520.60$^{b}$ | 1537.90$^{b}$ |
| EE 100 ml/L | 71.18$^{b}$ | 79.19$^{ab}$ | 1574.00$^{b}$ | 1596.67$^{b}$ |
| SA 100 ppm | 69.87$^{bc}$ | 73.57$^{bc}$ | 1526.25$^{b}$ | 1612.75$^{b}$ |
| SA 200 ppm | 75.12$^{a}$ | 81.18$^{a}$ | 1723.72$^{a}$ | 1779.12$^{a}$ |
| Mancozeb | 67.75$^{c}$ | 71.96$^{bc}$ | 1337.22$^{c}$ | 1382.35$^{c}$ |
| Control | 65.00$^{d}$ | 69.21$^{c}$ | 1284.75$^{c}$ | 1331.92$^{c}$ |
| **Interaction (C x F)** | | | | |
| Giza 716 | | | | |
| GE 50 ml/L | 71.13 | 83.58 | 1518.85 | 1680.80 |
| GE 100 ml/L | 71.63 | 84.17 | 1838.60 | 1941.15 |
| OE 50 ml/L | 75.00 | 80.31 | 1638.30 | 1794.90 |
| OE 100 ml/L | 76.75 | 89.92 | 1853.70 | 1935.90 |
| EE 50 ml/L | 74.00 | 82.48 | 1630.85 | 1622.30 |
| EE 100 ml/L | 78.25 | 89.26 | 1711.60 | 1754.25 |
| SA 100 ppm | 75.25 | 81.10 | 1656.00 | 1819.45 |
| SA 200 ppm | 80.25 | 89.16 | 1928.50 | 1993.90 |
| Mancozeb | 72.75 | 80.07 | 1364.55 | 1410.90 |
| Control | 69.00 | 76.07 | 1318.50 | 1370.93 |
| Giza 40 | | | | |
| GE 50 ml/L | 63.50 | 66.20 | 1441.80 | 1495.00 |
| GE 100 ml/L | 66.50 | 67.47 | 1559.50 | 1502.90 |
| OE 50 ml/L | 64.00 | 63.64 | 1370.10 | 1459.35 |
| OE 100 ml/L | 71.25 | 70.20 | 1488.05 | 1536.20 |
| EE 50 ml/L | 61.75 | 67.91 | 1410.35 | 1453.50 |
| EE 100 ml/L | 64.13 | 69.14 | 1436.35 | 1439.10 |
| SA 100 ppm | 64.50 | 66.05 | 1396.50 | 1406.05 |
| SA 200 ppm | 70.00 | 73.20 | 1518.95 | 1564.35 |
| Mancozeb | 62.75 | 63.85 | 1309.90 | 1353.90 |
| Control | 61.00 | 62.35 | 1251.00 | 1292.60 |
| L.S.D 0.05 (C) | 1.98 | 3.75 | 48.63 | 73.74 |
| L.S.D 0.05 (F) | 2.53 | 5.50 | 91.65 | 72.11 |
| L.S.D 0.05 (C x F) | 3.59 | NS | 129.95 | 102.24 |

Means in the same column followed by the same letter(s) are not significant according to L.S.D at the probability of 0.05.

**Physiological traits**

**Effect of foliar spraying treatments on cultivars and their interaction for faba bean chlorophyll a, b and a+b content (mg/g leaves fresh weight)**

Data presented in Table (7) show that Giza 716 cv. had higher contents of chlorophyll a (1.362 and 1.368), chlorophyll b (0.636 and 0.663) and chlorophyll a+b (1.999 and 2.032) in both seasons, respectively. These results are in agreement with the finding exhibited by El-Shafey *et al*. (2019).

The results indicated that spraying treatments had significant effects in increasing faba bean leaves chlorophyll contents compared to control treatment. Plants sprayed with SA 200 ppm, GE 100 and OE 100 ml/L had the highest chlorophyll content in the first season, while in the second season, OE 100 had the highest chlorophyll a content followed by GE 100 ml/L and SA 200 ppm.

**Table 7: Effect of foliar spraying treatments on cultivars and their interaction for leaf chlorophyll a, b and a+b content (mg/g leaves fresh weight) after 75 days from sowing during two successive seasons under field conditions.**

| Parameter | Chlorophyll a | | Chlorophyll b | | Chlorophyll a+b | |
|---|---|---|---|---|---|---|
| Factor / Season | 2017/ 2018 | 2018/ 2019 | 2017/ 2018 | 2018/ 2019 | 2017/ 2018 | 2018/ 2019 |
| **Cultivar (C)** | | | | | | |
| Giza 716 | 1.362$^{a}$ | 1.368$^{a}$ | 0.636$^{a}$ | 0.663$^{a}$ | 1.999$^{a}$ | 2.032$^{a}$ |
| Giza 40 | 1.319$^{b}$ | 1.331$^{b}$ | 0.549$^{b}$ | 0.562$^{b}$ | 1.869$^{b}$ | 1.894$^{b}$ |
| **Foliar spray (F)** | | | | | | |
| GE 50 ml/L | 1.301$^{e}$ | 1.290$^{e}$ | 0.570$^{d}$ | 0.585$^{d}$ | 1.871$^{e}$ | 1.875$^{e}$ |
| GE 100 ml/L | 1.438$^{a}$ | 1.440$^{a}$ | 0.648$^{b}$ | 0.663$^{b}$ | 2.086$^{a}$ | 2.103$^{a}$ |
| OE 50 ml/L | 1.300$^{e}$ | 1.327$^{d}$ | 0.576$^{d}$ | 0.600$^{d}$ | 1.876$^{e}$ | 1.926$^{d}$ |
| OE 100 ml/L | 1.425$^{b}$ | 1.450$^{a}$ | 0.663$^{a}$ | 0.666$^{b}$ | 2.087$^{a}$ | 2.117$^{a}$ |
| EE 50 ml/L | 1.351$^{d}$ | 1.375$^{c}$ | 0.555$^{e}$ | 0.580$^{d}$ | 1.906$^{d}$ | 1.955$^{c}$ |
| EE 100 ml/L | 1.381$^{c}$ | 1.400$^{b}$ | 0.620$^{c}$ | 0.643$^{c}$ | 2.00$^{b}$ | 2.043$^{b}$ |
| SA 100 ppm | 1.355$^{d}$ | 1.367$^{c}$ | 0.570$^{d}$ | 0.583$^{d}$ | 1.925$^{c}$ | 1.951$^{c}$ |
| SA 200 ppm | 1.450$^{a}$ | 1.433$^{a}$ | 0.652$^{ab}$ | 0.683$^{a}$ | 2.102$^{a}$ | 2.117$^{a}$ |
| Mancozeb | 1.242$^{f}$ | 1.250$^{f}$ | 0.582$^{d}$ | 0.601$^{d}$ | 1.827$^{f}$ | 1.852$^{e}$ |
| Control | 1.165$^{g}$ | 1.165$^{g}$ | 0.492$^{f}$ | 0.525$^{e}$ | 1.658$^{g}$ | 1.691$^{f}$ |
| **Interaction (C x F)** | | | | | | |
| Giza 716 | | | | | | |
| GE 50 ml/L | 1.310 | 1.282 | 0.620 | 0.650 | 1.930 | 1.932 |
| GE 100 ml/L | 1.490 | 1.477 | 0.680 | 0.730 | 2.170 | 2.207 |
| OE 50 ml/L | 1.282 | 1.347 | 0.600 | 0.642 | 1.882 | 1.990 |
| OE 100 ml/L | 1.477 | 1.492 | 0.717 | 0.712 | 2.192 | 2.207 |
| EE 50 ml/L | 1.352 | 1.372 | 0.617 | 0.650 | 1.970 | 2.022 |
| EE 100 ml/L | 1.402 | 1.430 | 0.662 | 0.687 | 2.067 | 2.117 |
| SA 100 ppm | 1.377 | 1.382 | 0.637 | 0.647 | 2.012 | 2.030 |
| SA 200 ppm | 1.500 | 1.450 | 0.717 | 0.737 | 2.217 | 2.187 |
| Mancozeb | 1.252 | 1.272 | 0.612 | 0.622 | 1.867 | 1.897 |
| Control | 1.182 | 1.172 | 0.502 | 0.557 | 1.687 | 1.730 |
| Giza 40 | | | | | | |
| GE 50 ml/L | 1.292 | 1.970 | 0.520 | 0.520 | 1.812 | 1.817 |
| GE 100 ml/L | 1.387 | 1.402 | 0.617 | 0.597 | 2.000 | 2.000 |
| OE 50 ml/L | 1.317 | 1.307 | 0.552 | 0.557 | 1.870 | 1.862 |
| OE 100 ml/L | 1.372 | 1.407 | 0.610 | 0.620 | 1.982 | 2.027 |
| EE 50 ml/L | 1.350 | 1.377 | 0.492 | 0.510 | 1.842 | 1.887 |
| EE 100 ml/L | 1.360 | 1.370 | 0.577 | 0.600 | 1.937 | 1.970 |
| SA 100 ppm | 1.332 | 1.352 | 0.502 | 0.520 | 1.837 | 1.872 |
| SA 200 ppm | 1.400 | 1.417 | 0.587 | 0.630 | 1.987 | 2.047 |
| Mancozeb | 1.232 | 1.227 | 0.552 | 0.580 | 1.787 | 1.807 |
| Control | 1.147 | 1.157 | 0.482 | 0.492 | 1.630 | 1.652 |
| L.S.D 0.05 (C) | 0.007 | 0.005 | 0.009 | 0.o13 | 0.017 | 0.009 |
| L.S.D 0.05 (F) | 0.012 | 0.015 | 0.011 | 0.015 | 0.016 | 0.023 |
| L.S.D 0.05 (C x F) | 0.014 | 0.022 | 0.119 | 0.020 | 0.020 | 0.031 |

Means in the same column followed by the same letter(s) are not significant according to L.S.D at the probability of 0.05.

In case of chlorophyll b OE 100 ml/L had the highest content followed by SA 200 ppm and GE 100 ml/L with averages of (0.663, 0.652 and 0.648) in the first season but in the second season SA 200 ppm had the highest chlorophyll b content followed by OE 100 and GE 100 ml/L. Finally SA 200 ppm had the first grade followed by OE 100 and GE 100 ml/L for chlorophyll a+b content in both seasons. The increase in chlorophyll content with SA confirmed the report of El-Awadi *et al*. (2017) for faba bean. El-Saadony *et al*. (2017) reported that spraying pea plants with SA (100 ppm) and GE (5%) had a positive significant effect in photosynthetic pigments (chlorophyll a, chlorophyll b, chlorophyll a+b). The positive effect of spraying SA on photosynthetic pigments may be due to their enhancing effect on the endogenous cytokinins level (Shehata *et al*., 2001) which stimulate growth and chloroplast differentiation.

The interaction between cultivars and foliar spray had significant effect on chlorophyll content. Giza 716 x SA 200 ppm had the highest value of chlorophyll a+b.

**Effect of foliar spraying treatments on cultivars and their interaction for faba bean seed contents of total carbohydrates and total proteins % in the second season**

Data illustrated in Figure (1) appear that seeds of Giza 716 cv. significantly had higher total carbohydrates and protein % than Giza 40 cv.

Spraying treatments increased significantly total carbohydrates and protein seed contents compared to control. GE 100 ml/L treatment had the first grade of total carbohydrates % followed by SA 200 ppm and EE 100 ml/L treatments with averages of (53.16, 52.94 and 52.82%), respectively. While, in case of total protein % GE 100 ml/L and SA 200 ppm had the first grade followed by OE 100 ml/L with averages of (24.42, 24.42 and 23.95%), respectively. Wanas (2007) reported that faba bean seeds soaked in GE (50 and 100 ml/L) and SA (100 and 200 ppm) significantly enhanced concentrations of crude protein and total carbohydrates in seeds. The same trend was obtained by Aldesuquy (2015) and El- Awadi *et al*. (2017) for SA. Dawood *et al*. (2012) reported that salicylic acid treatment enhanced biosynthesis of total carbohydrates of sunflower plants. El-Saadony *et al*. (2017) reported that spraying pea plants with salicylic acid at (100 ppm) and garlic extract at (5%) had a positive significant effect in increasing carbohydrates. Mady (2014) reported that application of SA caused an increment of carbohydrates content; this might be due to the activation of the movement and translocation of nitrites in the internal plant tissues and enhances synthesis of chlorophyll to increase the photosynthesis mechanism that may lead to more carbohydrates production.

In this respect the interaction between cultivars and spraying treatments had significant increase in seed carbohydrates and protein %. Giza 716 x OE 100 ml/L treatment had the highest content of carbohydrate followed by SA 200 ppm and GE 100 ml/L. While, Giza 716 x GE 100 ml/L had the highest content of protein followed by SA 200 ppm and OE 100 ml/L.

**Effect of foliar spraying treatments on cultivars and their interaction for peroxidase, catalase activities and total phenols content in leaves after 75 days from sowing in the second season.**

To limit oxidative damage caused by the excess ROS, plants have a defense antioxidative systems to control the cytotoxic effects of these free radicals, which include enzymes such as superoxide dismutase (SOD), peroxidase (PO), ascorbate peroxidase (APX) and catalase (CAT) (Mittler, 2002).

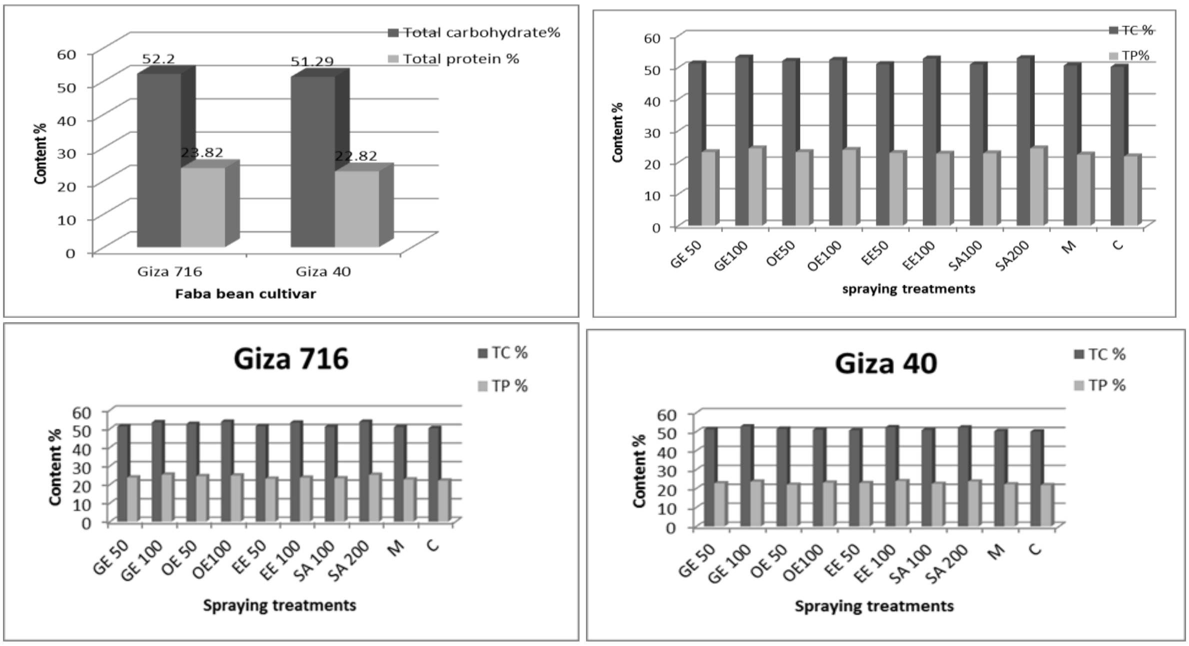


**Fig. 1. Effect of foliar spraying treatments (upper right) on cultivars (upper left), and their interaction (lower row) for faba bean seed total carbohydrates content % (TC %) and total protein % (TP %) in the second season.**

**LSD 5% for cultivars = 0.58 (TC %) and 0.17(TP %).**
**LSD 5% for spraying= 0.34 (TC %) and 0.24(TP %).**
**LSD 5% for interaction= 0.48 (TC %) and 0.34(TP %).**

Accumulation of phenolic compounds at the infection sites showed a correlation with the restriction of pathogen development, since such compounds are toxic substances to pathogens. The resistance may be increased by change of pH of plant cell cytoplasm, due to the increase in phenolic acid content, resulting in inhibition of pathogen development (Khaledi *et al*., 2015). In addition, phenolic compounds may impede pathogen infection by increasing the mechanical strength of the host cell wall (Usha and Jyothsna, 2010).

Data in Table (8) appear that Giza 716 cv. had higher peroxidase, catalase activities and total phenol content after 75 days from sowing in the second season than Giza 40 with averages of (0.662, 0.760 and 0.603), respectively.

**Table 8: Effect of foliar spraying treatments on cultivars and their interaction for peroxidase, catalase activities, total phenols content in leaves after 75 days from sowing, chocolate spot disease severity% (DS %) and spot diameter using detached leaf technique *in vitro* during the second season.**

| Factor \ Parameter | Peroxidase activity | Catalase activity | Total phenols | Disease severity% | Spot diameter (mm) |
|---|---|---|---|---|---|
| **Cultivar (C)** | | | | | |
| Giza 716 | 0.662[a] | 0.760[a] | 0.603[a] | 28.56[b] | 0.49[b] |
| Giza 40 | 0.497[b] | 0.525[b] | 0.609[b] | 33.62[a] | 1.55[a] |
| **Foliar spray (F)** | | | | | |
| GE 50 ml/L | 0.582[c] | 0.560[c] | 0.608[e] | 29.91[d] | 1.82[b] |
| GE 100 ml/L | 0.649[a] | 0.613[b] | 0.787[b] | 25.00[e] | 1.12[d] |
| OE 50 ml/L | 0.580[c] | 0.576[c] | 0.604[e] | 36.04[b] | 0.26[g] |
| OE 100 ml/L | 0.648[a] | 0.599[b] | 0.780[b] | 31.68[c] | 0.20[g] |
| EE 50 ml/L | 0.558[d] | 0.545[d] | 0.714[c] | 27.78[e] | 1.42[c] |
| EE 100 ml/L | 0.633[b] | 0.615[b] | 0.785[b] | 26.39[e] | 0.39[f] |
| SA 100 ppm | 0.574[c] | 0.565[c] | 0.650[d] | 27.78[e] | 0.87[e] |
| SA 200 ppm | 0.631[b] | 0.639[a] | 0.821[a] | 25.00[e] | 0.95[e] |
| Mancozeb | 0.534[e] | 0.526[e] | 0.600[e] | 25.00[e] | 0.22[g] |
| Control | 0.410[f] | 0.406[f] | 0.497[f] | 56.31[a] | 2.92[a] |
| **Interaction (C x F)** | | | | | |
| Giza 716 | | | | | |
| GE 50 ml/L | 0.658 | 0.592 | 0.711 | 27.78 | 0.21 |
| GE 100 ml/L | 0.727 | 0.655 | 0.901 | 25.00 | 0.13 |
| OE 50 ml/L | 0.674 | 0.610 | 0.682 | 34.80 | 0.17 |
| OE 100 ml/L | 0.711 | 0.634 | 0.898 | 27.08 | 0.13 |
| EE 50 ml/L | 0.618 | 0.576 | 0.763 | 26.39 | 1.10 |
| EE 100 ml/L | 0.701 | 0.646 | 0.863 | 26.39 | 0.25 |
| SA 100 ppm | 0.685 | 0.624 | 0.698 | 27.78 | 1.00 |
| SA 200 ppm | 0.721 | 0.682 | 0.917 | 25.00 | 0.13 |
| Mancozeb | 0.639 | 0.574 | 0.625 | 25.00 | 0.13 |
| Control | 0.494 | 0.440 | 0.550 | 40.36 | 1.60 |
| Giza 40 | | | | | |
| GE 50 ml/L | 0.506 | 0.529 | 0.506 | 32.03 | 3.43 |
| GE 100 ml/L | 0.573 | 0.527 | 0.674 | 25.00 | 2.10 |
| OE 50 ml/L | 0.486 | 0.543 | 0.527 | 37.28 | 0.35 |
| OE 100 ml/L | 0.585 | 0.564 | 0.663 | 36.28 | 0.27 |
| EE 50 ml/L | 0.499 | 0.515 | 0.667 | 29.17 | 1.73 |
| EE 100 ml/L | 0.565 | 0.585 | 0.709 | 26.39 | 0.53 |
| SA 100 ppm | 0.463 | 0.507 | 0.603 | 27.78 | 1.60 |
| SA 200 ppm | 0.542 | 0.596 | 0.725 | 25.00 | 0.90 |
| Mancozeb | 0.431 | 0.479 | 0.575 | 25.00 | 0.31 |
| Control | 0.328 | 0.370 | 0.445 | 72.26 | 4.23 |
| L.S.D 0.05 (C) | 0.007 | 0.006 | 0.006 | 2.49 | 0.27 |
| L.S.D 0.05 (F) | 0.013 | 0.014 | 0.024 | 1.47 | 0.12 |
| L.S.D 0.05 (C x F) | 0.019 | 0.020 | 0.031 | 4.65 | 0.38 |

Means in the same column followed by the same letter(s) are not significant according to L.S.D at the probability of 0.05.

In this respect El-Komy (2014) reported that the differences in the activities between cultivars suggested that CAT plays a major role in faba bean resistance to chocolate spot.

Spraying treatments significantly increased PO and CAT activities compared to Mancozeb and control treatments. Chickpea plants responded very quickly to SA at 1.5 mM and showed higher induction of peroxidase (POD) and polyphenol oxidase (PPO) activities, besides the higher accumulation of phenols (War *et al*., 2011). GE 100 ml/L treatment had the highest PO activity followed by OE 100 and EE 100 ml/L with averages of (0.649, 0.648 and 0.633), respectively. In case of CAT activity SA 200 ppm treatment had the highest value followed by EE 100 and GE 100 ml/L with averages of (0.639, 0.615 and 0.613), respectively. Gholamnezhad *et al*. (2016) showed that the maximum activity of CAT was observed after 24 h of *Mycosphaerella graminicola* infection in Zagros (tolerant wheat cultivar) when sprayed with 2 mM of SA. In this respect, spraying treatments significantly increased total phenols compared to control treatment only. SA 200 ppm treatment had the highest value followed by GE 100 and OE 100 ml/L with averages of (0.821, 0.787 and 0.780), respectively. Mbazia *et al*. (2016) found that foliar spray of faba bean with SA increased total phenols.

On the other hand, the interaction between cultivars and spraying treatments showed significant differences in PO, CAT and total phenols. It can be noticed that the response of Giza 716 to spraying treatments was more than that of Giza 40. In case of PO activity, Giza 716 x GE 100 had the first grade followed by SA 200 ppm, OE 100 and EE 100 ml/L. While, the activity of CAT was the highest by SA 200 ppm, GE 100, EE 100 and OE 100 ml/L. SA 200 ppm treatment had the highest value of total phenols followed by GE 100, OE 100 and EE 100 ml/L.

**Chocolate spot disease severity**

**Effect of cultivars, foliar spraying treatments and their interaction on chocolate spot disease severity % (DS) and spot diameter using detached leaf technique *in vitro* in the second season**

Data presented in Table (8) show that sprayed detached leaves of faba bean Giza 716 cv. (taken after 24 h from plants previously sprayed with the tested botanical extracts under field conditions) with spores suspension of *Botrytis fabae* ($3 \times 10^6$) significantly had the least disease severity % (28.56 %) compared to Giza 40 (33.62 %). The same trend was cleared using spore suspension droplet using leaflet technique where spore diameter in case of the leaflets of Giza 716 was (0.49 mm) but it was (1.55 mm) on the leaflets of Giza 40. These results may be due to the effect of the defensive enzymes had the plants. In this respect El-Komy (2014) reported that peroxidase and catalase enzymes activities increased in leaves of resistant cultivars of faba bean compared to susceptible one.

The results indicated that spraying treatments with GE, OE, EE, SA and Mancozeb decreased DS % and spot diameter (mm) compared to control treatment. Şimşek and Duman (2017) mentioned that 1, 8-cineole (eucalyptol) was the major component in the leaves of *Eucalyptus globulus* and had an antimicrobial effect against some microorganisms. GE 100 ml/L, SA 200 ppm and Mancozeb had the best effect in reducing DS % with an average of 25% for each. In case of spot diameter (mm) OE 100 ml/L treatment had the least value followed by Mancozeb, OE 50 ml/L with averages of (0.20, 0.22 and 0.26 mm), respectively. There were significant differences between spraying botanical extracts treatments and control.

The interaction effect data indicated that spraying Giza 716 and Giza 40 cultivars with GE 100 ml/L, SA 200 ppm and Mancozeb had the least values for disease severity with an average of 25 % for each. Giza 716 sprayed with GE 100, OE 100 ml/L, SA 200 ppm and Mancozeb had the least values for spot diameter with an average of (0.13 mm) for each. While, when Giza 40 sprayed with GE 100 ml/L, Mancozeb, GE 50 and EE 100 ml/L had the averages of (0.27, 0.31, 0.35 and 0.53 mm), respectively.

**Effect of foliar spraying treatments on cultivars and their interaction for chocolate spot disease severity under field coditions**

Data presented in Table (9) and Figure (2) show the response of faba bean cultivars and the effect of spraying treatments under study and their interaction on disease severity (DS %). Generally, disease severity increased with increasing periods from 75 to 105 days. Giza 716 had the lower DS % after 75, 90 and 105 days from sowing in both seasons than Giza 40 with general averages of (1.79 and 1.93%) in first and second seasons, respectively (Fig. 2-A). In this respect Yitayih and Azmeraw (2018) mentioned that the differences between faba bean cultivars for chocolate spot disease incidence and severity may be due to the genetic variation among cultivars to the infection.

Spraying treatments significantly decreased DS % compared to control treatment in both seasons. SA 200 ppm had the lowest DS % values in the first season followed by OE 100 ml/L with general averages of (1.66 and 1.77 %), respectively. In the second season OE 100 ml/L had the lowest DS % values followed by SA 200 ppm with general averages of (1.85 and 1.90 %), respectively (Fig. 2-B).

**Table 9: Effect of foliar spraying treatments on cultivars and their interaction for chocolate spot disease severity % caused by *Botrytis fabae* after 75, 90 and 105 days from sowing during two successive seasons under field conditions.**

| Parameter | Chocolate spot disease severity % | | | | | |
|---|---|---|---|---|---|---|
| Factor / Season | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 |
| | (75 day) | | (90 day) | | (105 day) | |
| **Cultivar (C)** | | | | | | |
| Giza 716 | 1.01 | $1.13^{b}$ | $1.48^{b}$ | 1.97 | 2.88 | $2.68^{b}$ |
| Giza 40 | 1.07 | $1.34^{a}$ | $1.86^{a}$ | 2.50 | 3.56 | $4.14^{a}$ |
| **Foliar spray (F)** | | | | | | |
| GE 50 ml/L | $1.24^{ab}$ | $2.02^{a}$ | $2.02^{a}$ | $2.23^{bc}$ | $3.27^{b}$ | $3.85^{ab}$ |
| GE 100 ml/L | $1.13^{b}$ | $1.84^{ab}$ | $1.84^{ab}$ | $2.28^{bc}$ | $3.18^{b}$ | $3.30^{bc}$ |
| OE 50 ml/L | $1.05^{bc}$ | $1.72^{ab}$ | $1.72^{ab}$ | $2.20^{bc}$ | $3.43^{b}$ | $3.27^{bc}$ |
| OE 100 ml/L | $0.85^{cd}$ | $1.44^{ab}$ | $1.44^{ab}$ | $1.83^{c}$ | $3.01^{b}$ | $2.77^{c}$ |
| EE 50 ml/L | $1.14^{b}$ | $1.71^{ab}$ | $1.71^{ab}$ | $2.10^{bc}$ | $3.15^{b}$ | $3.53^{b}$ |
| EE 100 ml/L | $1.00^{bc}$ | $1.60^{ab}$ | $1.60^{ab}$ | $1.95^{bc}$ | $3.10^{b}$ | $3.47^{b}$ |
| SA 100 ppm | $0.93^{c}$ | $1.60^{ab}$ | $1.60^{ab}$ | $2.01^{bc}$ | $3.20^{b}$ | $3.51^{b}$ |
| SA 200 ppm | $0.75^{d}$ | $1.28^{b}$ | $1.28^{b}$ | $1.87^{bc}$ | $2.95^{b}$ | $2.93^{bc}$ |
| Mancozeb | $0.95^{c}$ | $1.45^{ab}$ | $1.45^{ab}$ | $2.45^{b}$ | $3.11^{b}$ | $3.22^{bc}$ |
| Control | $1.39^{a}$ | $2.01^{a}$ | $2.01^{a}$ | $3.43^{a}$ | $3.83^{a}$ | $4.23^{a}$ |
| **Interaction (C x F)** | | | | | | |
| Giza 716 | | | | | | |
| GE 50 ml/L | 1.21 | 1.92 | 1.92 | 2.18 | 2.92 | 2.93 |
| GE 100 ml/L | 1.06 | 1.53 | 1.53 | 1.95 | 2.72 | 2.90 |
| OE 50 ml/L | 1.14 | 1.55 | 1.55 | 2.03 | 3.00 | 2.80 |
| OE 100 ml/L | 0.84 | 1.28 | 1.28 | 1.53 | 2.71 | 2.05 |
| EE 50 ml/L | 1.10 | 1.56 | 1.56 | 2.00 | 2.82 | 2.93 |
| EE 100 ml/L | 1.02 | 1.39 | 1.39 | 1.68 | 2.98 | 2.70 |
| SA 100 ppm | 0.89 | 1.35 | 1.35 | 1.70 | 2.85 | 2.58 |
| SA 200 ppm | 0.73 | 1.20 | 1.20 | 1.60 | 2.69 | 2.30 |
| Mancozeb | 0.97 | 1.25 | 1.25 | 2.03 | 2.89 | 2.58 |
| Control | 1.19 | 1.75 | 1.75 | 3.08 | 3.25 | 3.05 |
| Giza 40 | | | | | | |
| GE 50 ml/L | 1.27 | 2.13 | 2.13 | 2.30 | 3.62 | 4.78 |
| GE 100 ml/L | 1.19 | 2.16 | 2.16 | 2.63 | 3.64 | 3.70 |
| OE 50 ml/L | 0.96 | 1.89 | 1.89 | 2.38 | 3.86 | 3.75 |
| OE 100 ml/L | 0.86 | 1.60 | 1.60 | 2.15 | 3.31 | 3.50 |
| EE 50 ml/L | 1.18 | 1.86 | 1.86 | 2.20 | 3.49 | 4.15 |
| EE 100 ml/L | 0.98 | 1.80 | 1.80 | 2.20 | 3.22 | 4.25 |
| SA 100 ppm | 0.96 | 1.84 | 1.84 | 2.33 | 3.56 | 4.45 |
| SA 200 ppm | 0.78 | 1.37 | 1.37 | 2.15 | 3.21 | 3.58 |
| Mancozeb | 0.94 | 1.65 | 1.65 | 2.88 | 3.33 | 3.88 |
| Control | 1.59 | 2.27 | 2.27 | 3.80 | 4.40 | 5.43 |
| L.S.D 0.05 (C) | NS | 0.26 | 0.26 | NS | NS | 0.49 |
| L.S.D 0.05 (F) | 0.17 | 0.36 | 0.36 | 0.37 | 0.31 | 0.61 |
| L.S.D 0.05 (C x F) | NS | NS | NS | NS | NS | NS |

Means in the same column followed by the same letter(s) are not significant according to L.S.D at the probability of 0.05.

These results are in agreement to the findings of Hassan *et al*. (2006) who revealed that SA caused remarkable induced resistance effects against chocolate spot disease of faba bean when compared with control. Aldesuquy *et al*. (2014) reported that the application of SA could be effective in enhancing the uptake of some inorganic nutrients which play a role in decreasing the incidence of chocolate spot disease. Thus, improvement in plant nutrition can enhance plant development and increased plant resistance against the effect of disease.

Many reports showed that some natural plant products increased oxidative enzymes in plants that can play an important role in the resistance (Senthilraja *et al*., 2013 and Raj *et al*., 2016). In case of the botanical extracts, leaves of *Eucalyptus globulus* were reported to have high amount of oxalic acid (Alabi *et al*., 2005) which is among chemicals known to act as defense inducers in plants (Mousavi and Raftos, 2012).

The inhibitive action of garlic bulb crude extract on fungal growth has been attributed to the existence of allicin, as the major anti-bacterial, anti-fungal and anti-viral component (Miron *et al*., 2000). Presence of flavonoids from the onion (*Allium cepa*) extract was reported by Palomar *et al*. (2004) these flavonoids inhibit the growth of microorganisms. Irkin and Korukluoglu (2007) proved that garlic, onion, and leek extracts inhibited the multiplication of *Aspergillus niger*.

In case of the interaction between faba bean cultivars and the spraying treatments data in Table (10) and Fig. (2-C and D) show that DS % decreased with the two sprayed cultivars, while the difference between cultivars was not significant.

Figure (3) appear the efficacy of spraying some botanical extracts, salicylic acid and Mancozeb in reducing chocolate spot disease severity. Data appear that in the first season, SA 200 ppm had the highest efficacy followed by OE 100 ml/L with averages of (31.12 and 26.56 %), respectively. In the second season, OE 100 ml/L had the highest efficacy followed by SA 200 ppm with averages of (43.25 and 41.72 %), respectively.

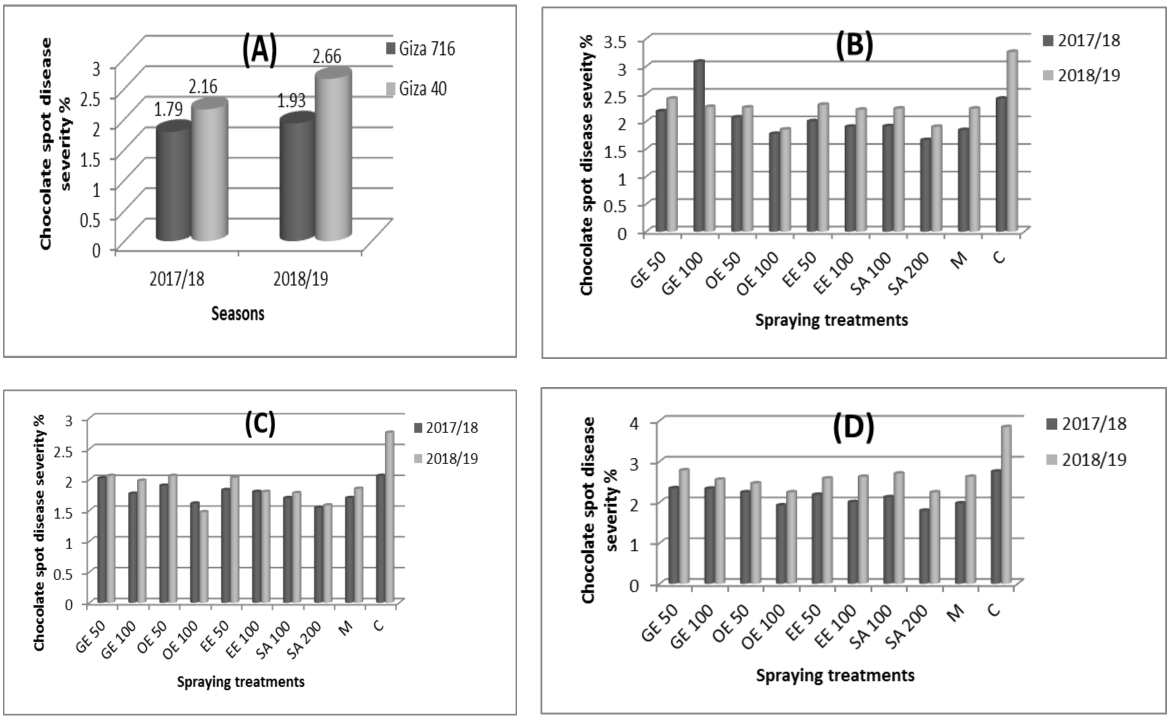


**Fig. 2: Response of faba bean cultivars (A), spraying treatments (B) and their interaction Giza 716 (C), Giza 40 (D) on chocolate spot disease severity % under field conditions (averages of two seasons).**

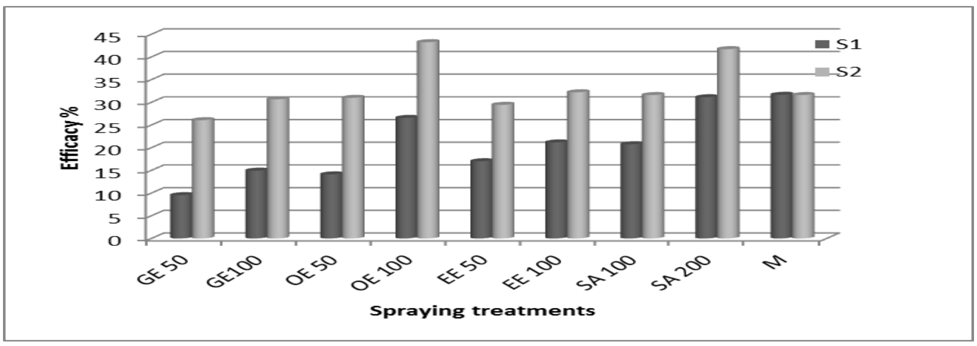


**Fig. 3: Efficacy of spraying garlic cloves (GE), onion bulb (OE), eucalyptus leaves (EE) extracts (50 and 100 ml/L), salicylic acid (100 and 200 ppm) and Mancozeb in reducing faba bean chocolate spot disease severity % during two successive seasons 2017/2018 (S1) and 2018/2019 (S2) under field conditions.**

## CONCLUSION

Based in the previous results and discussion, under field conditions it can be concluded that spraying the aqueous extracts of garlic cloves, onion bulb and eucalyptus leaves (50 and 100 ml/L) in addition to salicylic acid (100 and 200 ppm) improved most characteristics of faba bean vegetative growth, yield and some chemical components. SA 200 ppm increased chlorophyll a, b and a+b also it had the highest catalase activity, total phenols and seed protein %. SA 200 ppm and OE 100 ml/L treatments had the lowest chocolate spot disease severity. Using detached leaf technique under laboratory conditions, the chocolate spot diameter and its severity were well decreased after spraying the previous plant extracts or salicylic acid. Therefore, these green chemicals can be used as naturally and environmentally safe fungitoxicant agents to control the chocolate spot disease of faba bean.

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## الملخص العربى

# تاثير رش نباتات الفول البلدى ببعض المستخلصات النباتيه وحمض الساليسيلك على النمو والمحصول وشدة اصابته بمرض التبقع الشيكولاتى

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تم دراسة مدى إستجابة صنفى الفول البلدى جيزه ٧١٦، جيزه ٤٠ للرش ببعض المستخلصات النباتيه بالإضافه لحمض الساليسيلك على تحسين بعض صفات النمو والمحصول والمكونات الكيميائية وعلاقة ذلك بشدة الإصابه بالتبقع الشيكولاتى الذى يسببه فطر بوترايتس فابى. تم إستخدام مستخلصات فصوص الثوم، البصل، أوراق الكافور

(بالتركيزين ٥٠، ١٠٠ مل/لتر) وحمض الساليسيلك (بالتركيزين ١٠٠، ٢٠٠ جزء فى المليون) خلال الموسمين ٢٠١٧/٢٠١٨، ٢٠١٨/٢٠١٩ فى مزرعة محطة البحوث الزراعيه– إيتاى البارود– محافظة البحيره. تحت الظروف الحقليه وجد أن الصنف جيزه ٧١٦ الأعلى فى قيم القياسات الخضرية والمحصوليه المختبره فى كلا الموسمين. وأظهر الصنف جيزه ٧١٦ أعلى محتوى من كلوروفيل أ، ب، (أ+ب)، محتوى البذور من الكربوهيدرات الكليه، البروتين وكذلك نشاط إنزيمى البيروكسيديز، الكتاليز والفينولات الكليه فى الأوراق. كما وجد أن رش مستخلصات فصوص الثوم، البصل، أوراق الكافور، حمض الساليسيلك لها تأثير جيد فى زيادة نمو ومحصول الفول البلدى مقارنة بمعاملتى مبيد مانكوزيب والمقارنه. معاملة رش حمض الساليسيلك ٢٠٠ جزء فى المليون إحتلت المرتبه الأولى فى المساحه الورقيه/نبات بعد ٩٥ يوم فى الموسم الأول فقط وكذلك فى الوزن الجاف للمجموع الخضرى بعد ٧٥، ٩٥ يوم ووزن البذور/نبات فى الموسم الثانى كما أدت إلى زياده معنويه فى المساحه الورقيه/نبات بعد ٧٥ يوم، طول النبات، عدد الفروع/نبات، وزن ١٠٠ بذره، محصول البذور/فدان فى كلا الموسمين. إحتلت هذه المعامله المرتبه الأولى وأدت إلى زياده معنويه فى محتوى أوراق الفول البلدى من كلوروفيل أ فى الموسم الأول، كلوروفيل ب فى الموسم الثانى، كلوروفيل أ+ب فى كلا الموسمين. أيضا هذه المعامله الأعلى نشاطا لإنزيم الكتاليز والفيونولات الكليه فى الأوراق ومحتوى البذور من البروتين. وجد أن معاملة رش مستخلص فصوص الثوم ١٠٠ مل/لتر أدت إلى زياده معنويه فى الوزن الجاف للمجموع الخضرى/نبات بعد ٧٥ يوم والمساحه الورقيه/نبات بعد ٩٥ يوم فى الموسمين الأول والثانى على التوالى. أيضا أدت هذه معاملة إلى زياده معنويه للوزن الجاف للمجموع الخضرى/نبات بعد ٩٥ يوم ووزن البذور/نبات فى الموسم الأول مقارنة بمعاملتى مانكوزيب والمقارنه. تحت الظروف المعمليه وبإستخدام طريقة الورقه المفصوله للصنفين تم إستخدام معلق جراثيم الفطر إما رشا أو بوضع قطيرات بعد ٢٤ ساعه من آخر رشه بالمستخلصات حقليا. وجد أن وريقات الصنف جيزه ٧١٦ كان الأقل فى شدة الإصابه وكذلك متوسط قطر البقعه مقارنة بالصنف جيزه ٤٠. عند إستخدام طريقة رش معلق الجراثيم على الأوراق المفصوله السابق رشها حقليا وجد أن الوريقات السابق رشها بمستخلص فصوص الثوم ١٠٠ مل/لتر كانت الأقل فى شدة الإصابه يليها حمض الساليسيلك ٢٠٠ جزء فى المليون ثم مبيد مانكوزيب ٢,٥ جم/لتر. فى حالة العدوى بقطيرات معلق الجراثيم وجد أن الوريقات السابق رشها بمستخلص البصل ٥٠، ١٠٠ مل/لتر، مانكوزيب الأقل فى متوسط قطر البقعه على التوالى. تحت الظروف الحقليه وجد أن شدة الإصابه تزداد بزيادة الفتره من ٧٥ إلى ١٠٥ يوم. كما أن الصنف جيزه ٧١٦ كان الأقل فى شدة الإصابه بعد ٧٥، ٩٠، ١٠٥ يوم من الزراعه فى كلا الموسمين مقارنة بالصنف جيزه ٤٠. معاملة حمض السلسليك ٢٠٠ جزء فى المليون ومعاملة مستخلص البصل ١٠٠ مل / لتر كانتا الأقل فى شدة الإصابه فى الموسمين الأول والثانى على التوالى.