Journal

J. Biol. Chem. Environ. Sci., 2018, Vol. 13(3): 177-195
http://biochemv.sci.eg

ROLE OF SOME ANTIOXIDANTS IN INDUCING EARLY FLOWERING OF CORIANDER PLANT.

Hanan M.H. Ali* and Nahlaa A.S.M. Ahmed*

Medicinal and Aromatic Plant Research Department, Horticulture Research Institute (HRI), Agricultural Research Center (ARC), Giza, Egypt.

ABSTRACT

This work was carried out during two seasons (2016/ 2017 and 2017/ 2018) at the Experimental Farm of El Quassassin Horticulture Research Station, Ismailia Governorate, Agricultural Research Center, Egypt. This paper aimed to study the role of some antioxidants(ascorbic acid and α -tocopherol) in inducing early flowering of coriander plant in order to avoid the harmful effect of the temperature fluctuation during spring as well as increasing growth, fruit yield and volatile oil production. In general results indicated that, both antioxidants (ascorbic acid and α-tocopherol at 0, 200, 300 and 400 ppm each of them solely) had a significant effect on vegetative growth expressed as (plant height, number of branches/ plant), flowering (flowering time and number of umbels / plant), fruit yield (fruit yield/ plant and seed index as weight of 100 seeds) and volatile oil production as compared to control in the two seasons. The plants received ascorbic acid at 400 ppm recorded the highest values of vegetative growth, number of umbels / plant, fruit yield, volatile oil production and reduced flowering by 27days in the first season and 22 days in the second one compared with control. These positive effects led to fruiting acceleration before the bad temperature fluctuation that happened during spring.

Key words: Ascorbic acid, Alpha- tocopherol, Coriander, Flowering, Fruit yield, Volatile oil.

INTRODUCTION

Crop production is inherently sensitive to variability in climate. Temperature is a major determinant of rate of plant development and under climate change, warmer (spring) temperature that shorten development stages of determinate crops will most probably reduce the yield of a given variety. Earlier crop flowering and maturity have been observed. These are often associated with warmer (spring) temperatures (**Hampton *et al.*, 2016**). The optimum temperature for germination and early growth of coriander is 20 -25°C (**Sharma and Sharma, 2004**). Hot and dry winds during flowering can lead to the dropping of flowers, resulting substantial yield reduction. It has also been noticed that volatile oil content increases during cool and moist summer and vice versa. Farm management practices have also changed and attribution of observed change. Options for crop to adapt to climate change include moving sites production, changing sowing date, induce early flowering and the development of cultivars with traits which allow them to adapt to climate change conditions (**Craufurdnd and Wheeler,2009**).

Vitamins could be considered as bio regulator compound which is the relatively low concentrations exerting profound influences on plant growth as regulating factors that in turn influence many physiological processes, such as synthesis of enzymes (**Abdel- Halim, 1995 and Hathout, 1995**).

Ascorbic acid (Vitamin C) is one of the most important water soluble antioxidant in plants, having an essential role in several physiological processes, including plant growth, differentiation and metabolism (**Degara *et al.*, 2003**). It is acting as a modulator of plant development through hormone signaling and as co- enzyme in reactions by which carbohydrates, fats and proteins are metabolized (**Postori *et al.*, 2003**). Ascorbic acid is involved in the regulation of many critical biological processes such as photoinhibition and cell elongation (**Noctor *et al.*, 1998**) and many other important enzymatic and non enzymatic reactions (**Smirnoff, 2000**).Moreover, ascorbic acid is very important for regulation of photosynthesis, flowering and senescence (**Barth *et al.*, 2006**) , as well as for α- tocopherol (vitamin E) regeneration ,which has been reported to act as the primary antioxidant (**Bortoli, 1997**).

Alpha – tocopherol (vitamin E) is a low molecular weight lipophilic antioxidant that generally protects plants from stress-induced cellular oxidation. It is well known that exogenously applied α-tocopherol is effective in improving plant growth and developmental processes under adverse conditions (**Muhammad *et al.*,2017**).

Coriander *(Coriandrum sativum,* L) is an important aromatic annual condiment and spice crop belongs to family Apiaceae (Umbelliferae). Coriander is the foremost medicinal plants in Egypt. In addition to its medical value, it has been used in flavor soup, sausage and salad .Its leaves and fruits are used in flavoring food , fragrant, condiment, flavor food like pickles confectionery and to suppress offensive oders in pharmaceutical preparations as an antispasmodic, carminative, stimulant and stomachic (**Hassan *et al.*, 2012**).

The goal of this work was to investigate role of ascorbic acid and α- tocopherol in inducing early flowering, accelerating fruiting, increasing the quality and quantity of fruit yield as well as volatile oil production of coriander plant before sharp temperature fluctuation that occurred in spring.

MATERIALS AND METHODS

This work was conducted at the Experimental Farm of El Quassassin Horticulture Research Station, Ismailia Governorate, Agricultural Research Center, Egypt, during two successive seasons (2016 / 2017 and 2017/ 2018).

1.Plant materials and producers:

The fruits of coriander (*Coriandrum sativum* L) were obtained from the Experimental Farm of Medicinal and Aromatic Plants Research Department, in El Kanater El Khairia, Egypt. The fruits were sown on 26 th September in the field at distance of 25 cm between hills and 60 between rows in the two seasons. The experimental unit area was 2.4 m^2 and it contained 16 plants.

The plants were sprayed with ascorbic acid (AA) and α-tocopherol (To) at concentrations (0, 200, 300 and 400 ppm) each of them solely for three times at 30 days intervals, the first dose was done 30 days after sowing in both seasons.

2.Chemical fertilization:

The chemical fertilizers (NPK) were ammonium sulphate (20.6% N) , calcium super phosphate (15.5% P_2O_5) and potassium sulphate (48% K_2O). NPK fertilizers were added at the recommended level in three doses, the 1st was for all phosphorous amount which was added during soil preparation, the rest (NK) were applied in two equal doses, the 1st dose was applied 45 days after sowing and the second was added 30 days later.

3.Treatments:

The following treatments were used

1.Control (tap water).
2. AA_1 200 ppm.
3. AA_2 300 ppm.
4. $AA_3$400ppm.
5. To_1 200 ppm.
6. To_2 300 ppm.
7. To_3 400 ppm.

Tween 20 was used with all treatments as spreading agent.

4. Data recorded:

The following data were recorded

1. Plant height (cm).
2. Number of branches / plant.
3. Flowering time from sowing date.
4. Number of umbels /plant.
5. fruit yield(g)/ plant.
6. Seed index as weight of 100 seeds.
7. Volatile oil percentage and oil yield (ml)/ plant were estimated as described in the (**British Pharmacopeia, 1963).**
8. Volatile oil composition was analyzed for some samples of the second 2nd season by GLC according to (**Hoftman, 1967 and Bunzen *et al*., 1969**).

5. Layout of the experiment:

The experiment layout was designed in complete randomized blocks included seven treatments each treatment was replicated three times and every replicate contained 16 plants. The recorded data were statistically analyzed according to the procedure of(**Snedecor and Cochran, 1980**).

The ANOVA was conducted and the means of the treatments were compared by least significant differences (L.S.D. 5 % level of probability).

RESULTS AND DISCUSSION

1.Vegetative growth:

Data in **Table (1)** indicated that, application of ascorbic acid and α- tocopherol each of them solely had a positive effect on vegetative growth in both seasons.

a- Plant height:

Data in **Table (1)** revealed that, spraying coriander plants with ascorbic acid at concentrations (200, 300 and 400 ppm) significantly increased plant height (cm) compared to control. Ascorbic acid at 400 ppm gave the highest value (159.00 cm) as compared with untreated plants and other treatments during the first season . The same trend was obtained in the second season. These results are in agreement with those obtained by (**Bahaa *et al.*, 2015**) on cotton.

Regarding the effect of foliar application of α-tocopherol at concentrations (200,300 and 400 ppm) on coriander plants data in **Table (1)** showed significant increase in plant height, giving (129.67, 138.00 and 145.33 cm) compared with control which

Table 1. Effect of ascorbic acid and α- tocopherol treatments on vegetative growth of *Coriandrum sativum* plant during 2016/ 2017 and 2017/2018 seasons.

Treatments	Growth characters			
	1st season		2nd season	
	Plant height(cm)	Number of branches /plant	Plant height(cm)	Number of branches /plant
Control	113.67	8.67	121.33	9.00
AA_1(200ppm)	153.00	11.33	154.33	11.67
AA_2(300ppm)	156.67	12.00	159.33	12.67
AA_3(400ppm)	159.00	13.00	161.33	13.33
To_1(200 ppm)	129.67	9.33	139.67	9.67
To_2(300 ppm	138.00	10.00	146.67	10.33
To_3(400ppm)	145.33	10.67	149.67	11.00
L.S.D.	4.91	1.21	3.77	1.27

AA= ascorbic acid To = tocopherol

recorded 113.67 in the first season, similar trend was found in the second season. These results are in accordance with those found

by (**El Bassiouny *et al.*, 2005**) on *Vicia faba* (**El-Tohamy *et al.*, 2008**) on eggplant and (**Badawy *et al.*, 2015**) on *Antirrhinum majus* L.

b-Number of branches / plant:

Results presented in **Table (1)** showed the response of number of branches / plant to ascorbic acid and α-tocopherol. It is obvious that number of branches were significantly increased due to the tested treatments in both seasons.

As for the effect of ascorbic acid data in **Table (1)** indicated that, number of branches / plant gradually increased with increasing the dose of ascorbic acid , which recorded 13.00 and 13.33 branches /plant in the first and second seasons, respectively. These results are in harmony with those reported by (**Abo Leila and Eid , 2011**) on gladiolus, they attributed these effects to ascorbic acid which involved in regulating plant growth and development (**Athar *et al.*, 2008**).

Concerning the effect of foliar spray with α- tocopherol at different concentrations (200, 300 and 400 ppm) on coriander plants, data showed that, the two concentrations of α tocopherol (300 and 400 ppm) significantly increased number of branches /plant. The values were (10.00 and 10.67 branches/plant) in the first season, and (10.33 and11.00 branches/plant) in the second season, respectively compared to control. These results are in agreement with those obtained by (**Soltani *et al.*,2012**) on *Calendula officinals* and (**Shafeek *et al.*,2013**) on *Lactuca sativa* cv. Nevoda. They found that, all concentrations of α- tocopherol increased number of branches /plant. Such effect may be due to α -tocopherol application affected photosynthesis efficiency these positively reflected in plant growth (**Semida *et al.*,2016**).

2.Flowering:

a- Flowering time:

From data in **Table (2)** and **Fig (1)** it could be noticed that, treating coriander plants with ascorbic acid and α- tocopherol each of them solely significantly induced early flowering compared to control in both seasons.

Raising the dose of ascorbic acid from 0 to 400 ppm gradually decreased flowering time from sowing date. In the first season, coriander plants started to flower after 76.33, 68.67 and 64.00 days from sowing date compared to control which began to flower after 91.33 days. In the second season, coriander plants started to flower

after 72.67, 67.00 and 63.67 days compared to the control 86.33 days. These results may be due to ascorbic acid is not only an important antioxidant, it also appear to promote flowering time , developmental senescence. Some studies suggest that, total endogenous level of ascorbic acid influences induction of flowering and senescence. Both processes require the co- ordintal regulation of gene expression, which is mediated by various phytohormones. For example, gibberellins and salicylic acid are known to promote flowering, but retard senescence. Ascorbic acid serves as an important co- factor for the synthesis of some of these hormones. Therefore, it is assumed that, ascorbic acid affects phytohormone mediated signaling processes during the transition the vegetative to reproductive phase and the final stage of development and senescence(**Barth *et al.*,2006**).

Concerning the effect of α- tocopherol data in **Table (2)** showed that, foliar application of α- tocopherol at concentrations of (200, 300 and 400 ppm) significantly reduced the time to flowering compared to untreated plants in both seasons. The plants started to flower after 87.33, 83.33 and 78.33 days, respectively from sowing as compared to 91.33 days in the control in the first season. The same trend was obtained in the second season plants started to flower after 82.67, 78.64 and 76.00 days, respectively compared to the control 86.33 days.

It could be concluded that, both ascorbic acid and α- tocopherol had a positive effect on flowering of coriander plants. The best results were obtained by using ascorbic acid at high doses (400 ppm). They gave the shortest time to flowering (64.00 and 63.67) with a reduction about 27.33 and 22.66 days compared with control in the first and second seasons, respectively.

Table 2. Effect of ascorbic acid and α- tocopherol treatments on flowering of *Coriandrum sativum* plant during 2016/ 2017 and 2017/2018 seasons.

Treatments	1st season		2nd season	
	Flowering time from sowing date	Number of umbels /plant	Flowering time from sowing date	Number of umbels /plant
Control	91.33	35.67	86.33	41.00
AA_1(200ppm)	76.33	79.67	72.67	84.33
AA_2(300ppm)	68.67	91.00	67.00	94.33
AA_3(400ppm)	64.00	92.00	63.67	95.00
To_1(200ppm)	87.33	47.67	82.67	54.00
To_2(300ppm)	83.33	58.00	78.64	65.67
To_3(400ppm)	78.33	64.00	76.00	73.33
L.S.D.	3.73	1.78	3.61	2.14

AA= ascorbic acid To = tocopherol

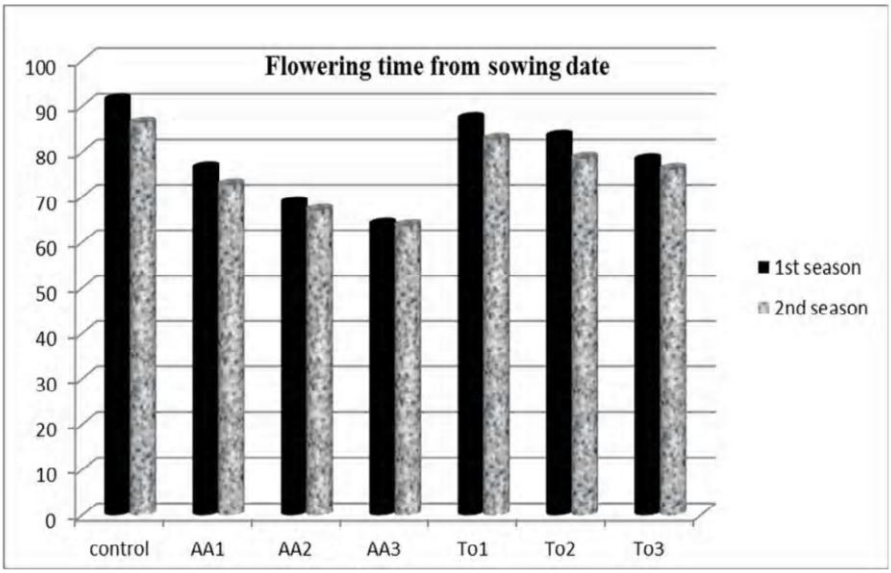

Fig. (1). Effect of ascorbic acid and α- tocopherol treatments on flowering time from sowing date of *Coriandrum sativum* plant.

b- Number of umbels/ plant:

Data in **Table (2)** showed that, number of umbels / plant were significantly responded to ascorbic acid and α - tocopherol at different doses.

Regarding the effect of ascorbic acid, data revealed that the treatments of 300 and 400 ppm achieved the highest number of umbels/ plant over the rest treatments and untreated ones. The values were (91.00, 92.00 and 94.33, 95.00 umbels/plant) in the first and second seasons, respectively. The differences between these two treatments were not significant in the two seasons. These results are in harmony with those reported by (**Youssef and Imam, 2003**) on fennel.

As for α- tocopherol the results in **Table (2)** showed that, spraying α- tocopherol at different concentrations significantly increased number of umbels /plant in the first and second seasons. Meanwhile, the highest dose of α- tocopherol at 400 ppm gave higher values (64.00 and 73.33 umbels/plant) in the first and second seasons, respectively. These results are in accordance with those obtained by (**Badawy *et al.*, 2015**) on *Antirrhinum majus* L. (**El –Bassiouny *et al.*,2005**) on Faba bean and (**El- Tohamy *et al.*,2008**) on eggplant. They reported that, α- tocopherol increased number of flowers /plant. These increments were attributed to the beneficial effects of α - tocopherol on growth characters (**Abd -El –Hakim, 2006 and Al Qubaie,2012**).

3.Fruiting:

a- Fruit yield:

Data in **Table (3) and Fig(2)** showed that, spraying coriander plants with ascorbic acid and α- tocopherol each of them solely had a significant effect on fruit yield in the two seasons.

As for the effect of ascorbic acid application, data indicated that, ascorbic acid gave the highest values over control and other treatments. Fruit yield gradually increased with increasing the concentration from 0 to 400 ppm. The values were (51.34, 53.83 and 57.10 g / plant) and (52.47, 55.20 and 57.77 g/plant) in the first and second seasons,

Table 3. Effect of ascorbic acid and α- tocopherol treatments on fruit yield (g/plant) of *Coriandrum sativum* plant during 2016/ 2017 and 2017/2018 seasons.

Treatments	1st season		2nd season	
	fruit yield (g) / plant	seed index as weight of 100 seeds	fruit yield (g) / plant	seed index as weight of 100 seeds
Control	34.97	0.96	36.67	1.03
AA_1(200ppm)	51.34	1.32	52.47	1.36
AA_2(300ppm)	53.83	1.36	55.20	1.38
AA_3(400ppm)	57.10	1.39	57.77	1.41
To_1(200ppm)	39.33	1.10	41.77	1.12
To_1(300ppm)	43.73	1.16	45.30	1.21
To_1(400ppm)	49.50	1.26	51.01	1.28
L.S.D.	0.72	0.01	0.84	0.03

AA= ascorbic acid To = tocopherol

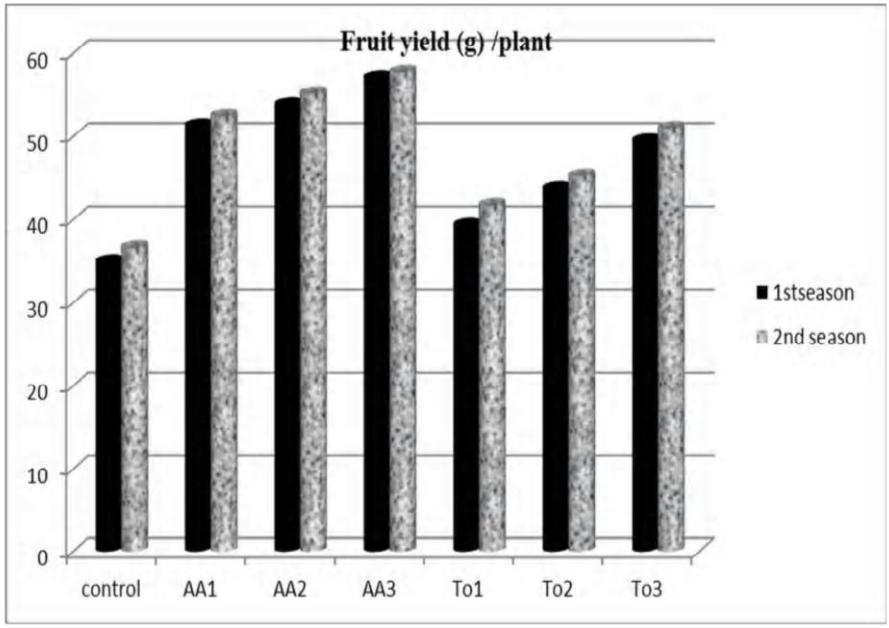

Fig. (2). Effect of ascorbic acid and α- tocopherol treatments on fruit yield (g /plant) of *Coriandrum sativum* plant.

respectively. These increments may be due to ascorbic acid application induced early flowering, therefore accelerated fruiting of coriander plant under harmful fluctuating temperature conditions . This early flowering had a positive effect on umbels number /plant consequently the fruit yield /plant. These results are in harmony with those obtained by (**Youssef and Imam, 2003**) on fennel and **(Mohamed, 2013**) on wheat.

Concerning the effect of α-tocopherol, addition of α-tocopherol at all concentrations significantly increased fruit yield / plant compared to control in both seasons. These results are in line with those obtained by (**Semida *et al.*,2014 and Rady *et al.*,2015**).The stimulating effect of α-tocopherol on growth characteristics could be attributed to the effect of this component on the endogenous phytohormones specially the growth promoters *i.e.* auxins, gibberellins and cytokinins (**Waffaa *et al.*, 1996 and Shehata *et al.*,2000**).

b- Seed index as weight of 100 seeds:

From data in **Table (3)** it could be noticed that, foliar application of ascorbic acid at all concentrations (200, 300 and 400 ppm) significantly increased weight of 100 seeds, giving the highest values (1.32, 1.36 and 1.39 g/ 100 seeds) compared with untreated plants which recorded (0.96 g/100 seeds) in the first season, respectively. The same trend was found in the second season, the values were (1.36, 1.38 and 1.41 g/ 100 seeds) as compared to control which gave (1.03 g/ 100 seeds). Similar results were obtained by (**Saker *et al.*,2008**) on wheat.

Regarding the effect of α- tocopherol data in the same **Table (3)** indicated that, application of α- tocopherol at (200, 300 and 400 ppm) significantly increased weight of 100 seeds compared with control. The heavier weights were obtained by α- tocopherol at 400 ppm (1.26 and 1.28 g/100 seeds), respectively as compared to untreated plants and other concentrations during the two seasons.

4.Oil production:

a- Volatile oil percentage :

Data presented in **Table (4)** showed that, foliar spraying of ascorbic acid significantly increased volatile oil percentage as compared to control. The treatment of ascorbic acid at 400 ppm

achieved the highest volatile oil percentage compared with control and all other treatments. The values were (0.73 and 0.78%) in the first and second seasons, respectively. These results are in agreement with those reported by (**Reda *et al.*,2007**) on *Thymus vulgaris* L.

Regarding the effect of α- tocopherol, data revealed that, raising the rate of α tocopherol from 0 to 400 ppm gradually increased volatile oil percentage in the two seasons. The highest dose 400 ppm gave (0.63 and 0.64 %) in the first season and second seasons, respectively.

b- Volatile oil yield/ plant:

Data in **Table (4)** recorded that, volatile oil yield / plant was positively affected by ascorbic acid and α- tocopherol each of them alone in the two seasons.

Ascorbic acid application had a significant effect on volatile oil yield/plant. The plants treated with ascorbic acid at 400 ppm gave the highest volatile oil yield /plant in both seasons. These results may be due to ascorbic acid increased number of branches/ plant that could be positively affected the number of umbels /plant and consequently fruit yield/ plant.

Concerning the effect of foliar spray with α-tocopherol at different concentrations (200, 300 and 400 ppm) on volatile oil yield /plant, data in **Table (4)** indicated that all concentrations increased this character compared to control. In the first season using α -tocopherol at concentration 400 ppm gave the higher significant increase in volatile oil yield / pant, the value was 0.31(ml) / plant. The same trend was observed in the second season.

Table 4. Effect of ascorbic acid and α- tocopherol treatments on volatile oil production of *Coriandrum sativum* plant during 2016/ 2017 and 2017/2018 seasons.

Treatments	Volatile oil production			
	1st season		2nd season	
	Oil percentage %	Oil yield (ml) / plant	Oil percentage %	Oil yield (ml) / plant
Control	0.33	0.12	0.37	0.14
AA_1(200ppm)	0.65	0.34	0.68	0.36
AA_2(300ppm)	0.71	0.38	0.74	0.41
AA_3(400ppm)	0.73	0.44	0.78	0.45
To_1(200ppm)	0.40	0.16	0.45	0.19
To_1(300ppm)	0.53	0.24	0.58	0.26
To_1(400ppm)	0.63	0.31	0.64	0.33
L.S.D.	0.02	0.01	0.01	0.01

AA= ascorbic acid To = tocopherol

c- Volatile oil composition:

Data in **Table (5) and Figs (3-5)** revealed that volatile oil composition was analyzed for some samples only (control, ascorbic acid at 300 and 400 ppm) in the second season. Linalool was the main component (with content of 76.74, 78.65 to 83.15 %), respectively. It was observed that ascorbic acid had a beneficial effect on linalool content, treatment of ascorbic acid at 400ppm gave higher linalool content over control and the plants treated with ascorbic at 300 ppm.

Table .5. Effect of ascorbic acid treatments on volatile oil composition of *Coriandrum sativum* plant during 2017/2018.

Treatments	Apinene	sabinene	myrcene	P.cymene	Linalool	Geraniol	borneol	Linalyl acetate	Geranyl acetate
control	5.18	1.51	5.96	1.56	76.74	1.67	2.70	1.39	0.38
AA_3	4.81	0.66	1.45	6.09	78.65	0.74	2.55	1.15	0.36
AA_4	4.10	0.47	1.10	5.32	83.15	0.34	2.26	1.31	0.39

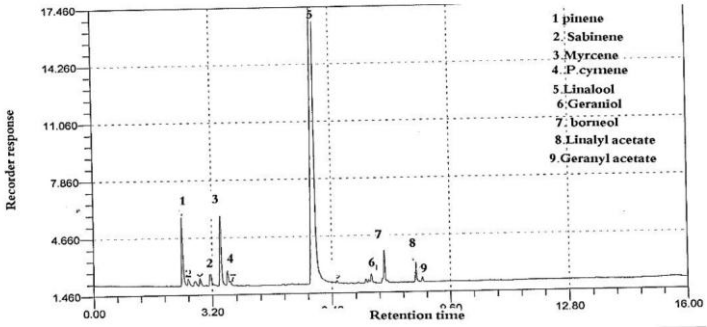

Fig. (3) GLC. Chromatogram of coriander oil (control)

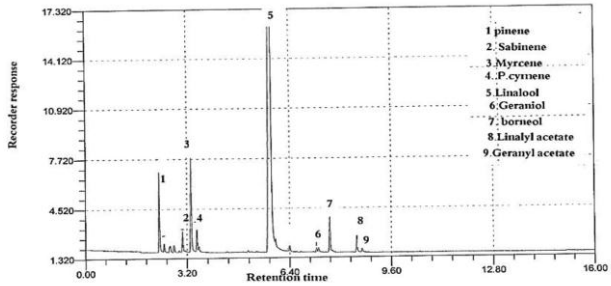

Fig.(4) GLC. Chromatogram of coriander oil (ascorbic acid at 300ppm)

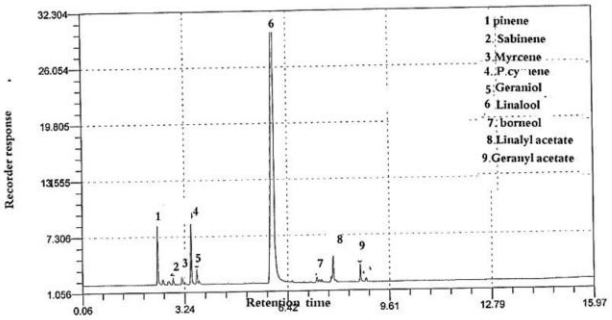

Fig.(5) GLC. Chromatogram of coriander oil (ascorbic acid at 400ppm)

Recommendation

From the present results, ascorbic acid at 400 ppm was the most effective treatment, it gave the highest growth parameters, fruit yield, volatile oil production, linalool content, reduced the flowering time by (27.33،22.66days) and accelerated fruiting before harmful temperature fluctuation that occurred in spring. So treating coriander plants with ascorbic acid at 400 ppm three times during the growing season could be recommended.

REFERENCES

Abdel – Halim, S.M. (1995). Effect of some vitamins on growth, yield and endogenous hormones of tomato plants during winter. Egypt. J. Appl. Sci.,(10): 322-334.

Abdel-El-Hakim, W.M. (2006). Effect of some antioxidant treatments on chemical constituents, antinutritional factors and yield of some vegetable legumes. Ph.D. Thesis, Fac. of Agric., Minia Univ,.Minia, Egypt.

Abo Leila, B.A. and A.R. Eid, (2011). Improving gladiolus growth , flower keeping quality by using some vitamins application. Journal of American Science,7(3):169-174.

Al - Qubaie, A.L. (2012). Response of sunflowers cultivar Giza-102 (*Helianthus annuus* L.) plant to spraying some antioxidants. Nature and Science ,10 (11): 1-6.

Athar, H.R.; A. Khan , and M. Ashraf, (2008). Exogenously applied ascorbic alleviates salts –induced oxidative stress in wheat. Environ. Exp. Bot.,63:224-231.

Badawy, M.E.S.; M.M.Kandil,; A.M. Habib, and I.M. El- Sayed. (2015). Influence of diatomite, putrescine and alpha- tocopherol on some vegetative growth and flowering of (*Antirrhinum majus* L.)plants. Journal of Horticultural Science Ornamental Plants, 7(1): 7-18.

Bahaa, E. D.M.; A.H. Hebat, and S. Hanaa, (2015) Role of glutathione , ascorbic acid and α tocopherol in alleviation of drought stress in cotton plants. International Journal of Chem. Tech. Research , 8(4):1573-1581.

Barth, C. ; M. De Tullio , and P. L. Conklin, (2006). Role of ascorbic acid in the control of flowering time and the onset of senescence. J. Exp. Bot., 57: 1657-1665.

Bortoli, C.G. (1997). Drought and water dependent oxidative stress effect on antioxidant content in (*Triticum aestivum* L.) leaves. Journal of Experimental Botany , 50: 375-383.

British Pharmacopeia (1963). Determination of Volatile Oil in Drugs. The Pharamaceutical Press London.

Bunzen, J.N.; J.Guchard,; P. Labbe,; P.J. Sperinnet, and J. Trenchant, (1969). Practical Manual of Gas Chromatography. J. Trenchant Ed., El-Seiver Publ. Comp., Amsterdam, London.

Craufurdnd P.Q. **and T.R. Wheeler, (2009).**Climate change and the flowering time of annual crops. Journal of Experimental Botany, 60 (9): 2529-2539.

Degara, L.; M. C. Depinto,; V.M.C. Moliterni, and M.G D, egidio,.(2003). Redox regulation and storage processes during maturation in Kernels of (*Triticum durum*). J. Exp. Bot., 54: 249-258.

El-Bassiouny, H.M.S.; M.E. Gabarah, and A.A. Ramadan, (2005). Effect of antioxidants on growth, yield and favism causative agents in seeds of(*Vicia faba* L.)plants grown under reclaimed sandy soil. J. Agronomy, 4(4): 281-287.

El-Tohamy,W A.;El-Abagy and N.H.M. El-Greadly,(2008). Studies on the effect of putrescine, yeast and vitamin c on growth, yield and physiological response of eggplant (*Solanum melongena* L.) under sandy soil conditions. Australian Journal of Basic and Applied Science., 2(2): 296-300.

Hoftman , E. (1967). Chromatography. Reinhold Pulb. Corp. 2nd Ed., 208-515.

Hampton, J.G. ; A.J.; Conner, B. Boelt, and T.G. Chastain, (2016). Climate change : Seed production and options for adaption. Agriculture. 6, 33; doi:10.3390.

Hassan, F.A.S.; E.F. Ali, and S.A. Mahfouz, (2012). Comparison between different fertilization sources, irrigation frequency and their combinations on the growth and yield of coriander plant. Australain Journal of Bsic and Applied Sciences, 6(3):600-615.

Hathout, T.A. (1995). Diverse effect of uniconazole and nicotinamid on germination, growth, endogenous hormones and some enzymatic activity of peas. Egypt J. Physiol Sci. 19: 77-95.

Mohamed, N.E. M.(2013). Behaviour of wheat c.v. Masr-1.plants to foliar application of some vitamins. Nature& Science, 11(6).

Muhammad, S.A.D.I.Q.; A. A. Nudrat, and A.S.H.R.A.F. Muhammad, (2017). Foliar applications of alpha –tocopherol improves the composition of fresh pods of *Vigna radiata* subjected to water deficiency. Turkish Journal of Botany, 41: 244-252.

Noctor, G. ; M.; Ana-Carolina, J.L. Arisi, and C.H. Foyer, (1998). Manipulation of glutathione and amino acid biosynthesis in the chloroplast. Plant Physio. ,118:471- 482.

Postori, G.M. ; G. Kidde, and J. Antoniw, (2003). Leaf vitamin contents modulate plant defense transcripts and regulate genes that control development through hormone signaling. Plant Cell, 15: 939-951.

Rady, M.M. ; M. S.H.Sadak,; S. R. El –Lethy, and M.T. Abdelhamid,(2015). Exgenous has a beneficial effect on **(***Glycine max* L*)*. Plant irrigated with difuted sea water. J. Horti. Biotech., 90:195-202.

Reda, F.; G.S.A.; Boroty, I.M.; Talaat, I.A. Abdel-Rhim, and H.S. Ayad, (2007). Effect of some growth regulators and vitamins on essential oil, phenolic content and activity of oxidoreductase enzymes of *Thymus vulgaris* L. World Journal of Agricultural Sciences, 3(5): 630-638.

Saker, M.T.; E. A. Khatab, and M.H. Afifi, (2008). Role of plant antioxidants (ascorbic acid, glutathione,α tocopherol and aspernine) on alleviating salinity stress on growth and yield of wheat plants. Egypt. J. Agron. , 30 (2):153-165.

Semida, W.M. ; R.S.; Taha, M.T.Abdelhamid, and M.M. Rady, (2014). Foliar applied α tocopherol enhances salt tolerance in *Vicia faba* L. plant grown under saline conditions. S. Afr. J. Bot., 95:24-31.

Semida, W.M. ;. T.A. Abdel – Mageed,; S.M. Howladar, and M.M. Rady , (2016). Foliar applied α tocopherol enhances salt tolerance in onion plants by improving antioxidant defense system. Australian Journal of Crop Science, 10(7): 1030-1039.

Shafeek,M.R.; Y.I.; Helmy, N.M.; Marzauk, M.A. Shalaby, N.M. and Omer, (2013). Effect of foliar application of some antioxidants on growth, yield and chemical composition of (*Lactuca sativa* L.) under plastic house condition. Middle East Journal of Applied Sciences, 3(2): 70-75.

Sharma, M.M.. and R.K. Sharma, (2004). Coriander IN: Handbook of Herbs and Spices. Vol.2(ed) Peter K.V. Woodhead Pub. Ld. Abington Hall, Abington Cambridge. CBI6AH, England, 145-161.

Shehata , S.A.M.; M. A. Saeed, and M.S. Abou- Nour, (2000). Physiological response of cotton plant to the foliar spray with salicylic acid. Annals Agric. Sci., Ain Shams Univ., Cairo,45(1):1-18.

Soltani , Y.S. ; R.S. Vahid,; M.M. Ali, and M. Mitra, (2012). Effect of foliar application of α tocopherol and pyridoxine on vegetative growth, flowering and some biochemical constituents of *Calendula officinals* L. plants. African Journal of Biotechnology.,11(56): 11931-11935.

Smirnoff, N.(2000). Ascorbic acid: Metabolism and functions of multi – facetted molecule – Curr.Opin .Plant. Biol., 3: 229-235.

Snedecor, G.W. and W.G Cochran,. (1980). Statistical Methods. 6th Ed. Iowa State Univ. Press, Ames, Iowa, USA., 507 p.

Waffaa ,M. ; N.Y. Abdel – Ghafar , and S.A.M. Shehata , (1996). Application of salicylic acid and aspirin for induction of resistance to tomato plants against bacterial wilt and its effect on endogenous hormones. Annals Agric. Sci. Ain Shams Univ., Cairo, 41(2):1007-1020.

Youssef, A.A. and M.T. Imam, (2003). Physiological response of fennel plants to some vitamins. Egypt. Pharm. J., 1:81-93.

دور بعض مضادات الاكسدة فى تبكير الازهار على نبات الكزبرة

حنان محمد حرب على * نهلة ابو سبع محمد احمد*

* قسم بحوث النباتات الطبية والعطرية- معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة – ج.م.ع.

اجريت هذه الدراسة خلال موسمين (2016/ 2017&2018/2017) فى مزرعة محطة بحوث البساتين بالقصاصين بمحافظة الاسماعيلية وذلك بهدف دراسة دور بعض مضادات الاكسدة (حمض الاسكوربيك وفيتامين ه) على تبكير الازهارفى نبات الكزبرة وذلك لتجنب التاثير الضار لتذبذب درجات الحرارة الذى يحدث اثناء الربيع وكانت اهم النتائج كالاتى: ادى رش نباتات الكزبرة بحمض الاسكوربيك وفيتامين ه كلا منها على حدة بتركيز(200و300و400) جزء فى المليون الى زيادة معنوية فى النمو الخضرى وعددالنورات على النبات وكذلك محصول الثمار وانتاج الزيت فى كلا الموسمين مقارنة بالكنترول.وكانت افضل النتائج عند معاملة نباتات الكزبرة بحمض الاسكوربيك بتركيز 400جزء فى المليون حيث انهااعطت اعلى زيادة فى النمو الخضرى وعدد النورات ومحصول الثمار وكذلك انتاج الزيت كما انها بكرت الازهار حوالى (22،27يوم) مقارنة بالكنترول وذلك فى الموسم الاول والثانى على التوالى وذلك اثر تاثير ايجابيا على الاسراع فى عقد الثمار قبل التعرض للتاثير الضار لتذبذب درجات الحرارة الذى يحدث فى الربيع.