J. Agric. Sci. Mansoura Univ., 27(6): 3807 - 3817, 2002

INFLUENCE OF FOLIAR APPLICATION WITH METHIONINE AND ZINC ON YIELD AND CHEMICAL CONSTITUENTS OF FENNEL (*Foeniculum vulgare* Mill.) PLANTS.

Farahat, M.M.
Botany Dept., National Research Centre, Dokki, Cairo, Egypt.

ABSTRACT

The present work was carried out at Salhia, Sharkia Governorate, Egypt during 1998/99 and 1999/2000 seasons. Fennel plants were sprayed with methionine at the rates of 0,50,100 and 200 ppm with or without three concentrations of zinc (as zinc sulphate) 0,50 and 100 ppm. Plants were sprayed twice during the season with methionine and zinc . The results indicated that application of methionine reduced plant height, chlorophyll content, soluble sugars and nitrogen content. While, methionine at 100 and 200 ppm increased number branches and umbels / plant , fruits yield, essential oil yield , total carbohydrates, P and K contents. Generally , application of zinc showed positive effects on growth, yield and chemical constituents of fennel. The combination between application of methionine at 100 ppm and zinc at 50 ppm increased significantly essential oil and fruits yield compared to control . While, the highest values of branches and umbels number / plant, essential oil yield and percentage; total carbohydrates and phosphorus contents resulted from spraying of methionine at 100 ppm combined with zinc at 100 ppm.

Keywords : Fennel, growth, methionine, zinc, essential oil, yield.

INTRODUCTION

The simple gas ethylene influences a diverse array of plant growth and developmental processes including germination, senescence, cell elongation, and fruit ripening (Kieber, 1997).

Direct evidence in support of the role of methionine as an ethylene precursor in vivo was soon reported by Lieberman *et al.* (1966), who found that labeled methionine was efficiently converted to ethylene by apple fruit tissue : as in the model system , ethylene was derived from C-3,4 of methionine. The view that methionine is a physiological precursol of ethylene was further supported by the observation that the ability of plant tissues to convert methionine into ethylene parallels their ability to produce ethylene endogenously and that the specific radioactivity of ethylene recovered approached that of the administered methionine ((Lieberman, 1979 and Yang, 1974). Adams and Yang (1979) found the following sequence for the pathway of ethylene biosynthesis in apple tissue :

Methionine → **S-adenosylmethionine (SAM)**

↓

1- aminocyclopropane 1-carboxylic acid (ACC) → **ethylene**

These results indicate that methionine is the major, if not the sole, precursor of ethylene.

Micronutrients play a very important role in vital processes of plants. They increase the chlorophyll content of leaves, improve photosynthesis which intensify the assimilating activity of the whole plants (Marschner, 1995). Many investigators found that plant growth, yield and essential oil content were increased with application of zinc (Subrahmanyam *et al.* (1991) on Japanese mint, Haridy *et al.* (1992) on coriander; Abd El-Salam (1999) on fennel and Mohamed (2000) on *Carum Carvi* .

Fennel, F*oeniculum vulagare* Miller, belongs to the family Apiaceae (Umbelliferae). Morelli *et al.* (1983) reported that fennel exihibits carminative, diuretic , antinflammatory, antimicrobial, galactogogye and oestrogenic activities. Evans (1989) stated that fennel and its volatile oil are used as an aromatic and carminative .

This work was conducted to investigate the feasibility of using the amino acid methionine to enhance the synthesis of ethylene under the application of zinc in fennel plant and to evaluate the potentially favourable effect of these treatments on promoting fruits yield, oil productivity and some chemical constituents.

MATERIALS AND METHODS

Two field experiments were conducted at El-Salhia, Sharkia Governorate during the two successive seasons of 1998/99 and 1999/2000, with the aim of studying the effect of foliar application of amino acid methionine (a precursor of ethylene) under zinc on fruits yield, essential oil yield and some chemical constituents of fennel (*Foeniculum vulgare* Mill.) plants. Every experiment included 12 treatments representing the different combinations of four methionine concentrations i.e. 0,50,100 or 200 ppm and three zinc concentrations (i.e. 0,50 or 100 ppm, as sulphate, using "Teepol" as wetting agent) .

Fennel seeds were obtained from Department of Medicinal and Aromatic Plants ARC. Fennel seeds were sown on the 28th and 25th October for the two seasons, respectively. A split-plot design with three replicates was used. Zinc concentrations were presented in the main plots while, methionine treatments were allocated in the sub-plot . The sub-plot area was 10.5 m^2 , containing five rows , the distance between rows was 60 cm and between plants 35 cm. Seeds were sown in one side of the rows . Thinning for one plant per hill was made 45 days after sowing (i.e. 50 plants in plot) . The soil was sandy in texture with pH7.9, organic carbon 0.92%, nutrients (N% 0.039%, P% 0.012, K% 0.016 and Zn 1.2 ppm) and electric conductivity 0.92 mmhos / cm at 25 °C.

Phosphorus as calcium superphosphate (15.5% P_2O_5) was added as a basal dose of 200 kg/ fed when preparing the soil, nitrogen as ammonium nitrate (33.5% N) and potassium as potassium sulphate (48% K_2O) were added at the rates of 33.5 kg N/fed and 30 kg K_2O/fed, respectively as two separate side dressings, the first addition was added after thinning immediately and the second after 45 days from the first one.

The plants were sprayed twice with methionine or zinc, the first one after two months from the planting . One month later the second spray was performed. Spraying methionine was applied after 7 days zinc treatment . The normal cultural practices were applied during the experiment.

Sample of leaves from five plants was taken at random from each plot on 3rd week of February to determine chlorophyll content (Saric *et al.,* 1967). On 3rd week of May of each season the plants were harvested and sample of ten plants was taken at random from the middle rows of each plot , where the following data were recorded : plant height (cm); No. of branches / plant and No. of umbels / plant . Fruits yield (kg/fed) was determined from the harvest of 2nd and 4th rows for each plot. Samples from the fruits of each treatment were subjected to the following chemical analyses : essential oil percentage (Guenther, 1961); essential oil yield (l/fed) which was calculated in proportion to the fruits yeild per feddan; total carbohydrates and soluble sugars (Dubois *et al* ., 1956); total nitrogen by modified micro-kjeldahl (Chapman and Pratt, 1978). and phosphorus (Troug and Mayer, 1939) as well as potassium and zinc were determined by atomic absorption .

Data were statistically analyzed using the least significant difference method (LSD at 5% level) according to Steel and Torrie (1980). The combined data of the results of the two seasons were recorded after testing the homogenity of the variance.

RESULTS AND DISCUSSION

I- Growth characters and fruits yield :

The results presented in Table (1) showed that the untreated plants were taller than the plants receiving any of the methionine concentrations . Moreover, methionine was more effective in reducing plant height when it was applied at concentration of 200 ppm . The physiological mechanism of ethylene action on the stem is little understood, although it has been suggested that it influences cell differentiation or division (Han *et al.,* 1990). However , in some plants, this inhibitory effect of ethylene on stem growth has been attributed to a reduction in auxin levels either through modification of their metabolism (Riov *et al* ., 1982) or inhibition of their transport (Koch and Moore, 1990). The highest values of branches and umbels number / plant resutled from methionine application at the rate of 200 ppm. Moreover, these increases in branches and umbels number were significant compared with control. Sakr *et al.* (1989) revealed that the significant effect of ethrel on increasing number of branches may be due to the liberation of ethylene. There was no significant difference between the various levels of methionine on branches number / plant. Methionine was more effective in increasing fruits yield when it was applied at the concentration of 100 ppm (907 kg/fed). In this connection, Bondok *et al.* (1994) reported that ethrel increased significantly the number of fruiting branches, open bolls and cotton yield . This may be due to the reduction of auxin levels in shoot extracts of cotton plants by ethrel treatment which led to release the dormant lateral buds to grow and develop into lateral branches.

Regarding the effect of zinc treatments, the results showed that application of Zn at 50 and 100 ppm increased significantly plant height compared to the control . Also, Abd El- Salam (1999) on fennel and Mohamed (2000) on *Carum Carvi* found that Zn at 100 ppm caused a significant increase in plant height . Raising zinc concentration from zero ppm (control) to 50 or 100 ppm gave a steady increase in both the number of branches and umbels / plant . This increase was significant in number of umbels / plant . However, the differences were insignificant in branches / plant. Similar results with zinc treatment were stated by Kocourkova and Vrzalova(1992) on *Mentha piperita* and Helal and Khalil (1997) on periwinkle.They found that spraying plants with Zn at the levels of 50 or 100 ppm increased the number of branches per plant. Application of Zn at 50 ppm resulted in significantly more fruits yield (kg/ fed) compared to control which reached 11%. The increase in fruits yield with zinc sulphate might be due to low availability or deficiency of zinc in soil. It indicates that foliar application of zinc sulphate has beneficial influence in increasing the fruits yield of fennel in sandy soil. The positive effects of zinc on number of umbels / plant and fruits yield are in harmony with those obtained by Abou Zeid *et al.* (1996) and Abd El - Salam (1999) on fennel.

The data presented in Table (1) showed that the effect of the interaction between methionine and Zn treatments was significant in plant height , branches & umbels / plant and fruits yield . Treating the plants with Zn especially at 100 ppm without methionine gave the tallest plants (150.1 cm) On the other hand, the shortest plants (124.7 cm) resulted from application of methionine at rate of 200 ppm without Zn application . Spraying of methionine at 100 ppm under zinc at 100 ppm resulted in a significant higher in number of branches / plant than the control. While, the greatest number of umbels / plant and fruits yield was obtained in methionine at 100 ppm under zinc at 50 ppm . These results may be due to the increase in number of branches and umbels per plant by application of methionine and zinc treatments as previously mentioned in this study. There were no significant differences between the treatments which were sprayed with the high level of methionine (200 ppm) under the levels of zinc in plant height, number of branches & umbels / plant and fruits yield.

II- Chlorophyll content :

The data on chlorophyll content in leaves of fennel as affected by methionine and zinc treatments are presented in Figs.(1,2and 3). All methionine concentrations had a significant effect on chlorophyll content which decreased with increasing methionine level. The reduction in total chlorophyll (a + b) reached 21% at the highest concentration of methionine (200 ppm) compared to the control. In this respect, Purvis (1980) mentioned that ethylene is thought to play an important role in stimulation of chloroplast breakdown . In addition, Bondok *et al.* (1994) found that ethrel decreased leaf chlorophyll content of cotton plants .

Table (1) : Effect of methionine and zinc on plant height ; number of branches/ plant; number of umbels / plant and fruits yield of fennel plants (average of the two years).

Treatments (ppm)	Zn0	Zn50	Zn100	Mean (A)	Zn0	Zn50	Zn100	Mean (A)
	Plant height (cm)				Branches No/ plant			
Control	139.7	145.3	150.1	145.0	9.2	10.5	11.6	10.4
Methionine 50	135.6	141.3	142.2	139.7	10.3	11.4	12.3	11.3
" 100	130.4	143.5	139.8	137.9	11.1	11.9	13.6	12.2
" 200	124.7	127.0	130.1	127.3	12.0	12.5	13.2	12.6
Mean (B)	132.6	139.3	140.6	-	10.7	11.6	12.7	-
	Umbels No / plant				Fruits yield (kg/fed)			
Control	24.3	26.6	27.1	26.0	670.4	687.5	698.7	685.5
Methionine 50	25.4	27.0	32.5	28.3	744.3	898.1	819.6	820.7
" 100	28.7	33.3	36.0	32.7	822.8	972.3	927.4	907.2
" 200	30.8	34.7	34.6	33.4	707.2	710.2	720.3	712.6
Mean (B)	27.3	30.4	32.6	-	735.9	817.0	791.5	-

LSD at 5% for	Plant height	Branches No./plant	Umbels No./ plant	Fruits yield
Methionine(A)	6.3	1.9	3.3	63.1
Zinc (B)	4.5	NS	2.8	51.3
A x B	8.7	2.3	5.7	89.4

Regarding the effect of zinc treatments, the results showed that application of zinc caused a significant increase in chlorophyll content compared to the control, although the differences in chlorophyll a and total chlorophyll (a + b) contents with the two levels of zinc (50 and 100 ppm) were no significant. These results agreed with findings by Abd El - Salam (1999) on fennel and Mohamed (2000) on caraway . In addition , Lipskaya and Fartotskaya (1971) found that Zn addition increased the number of cells and chloroplasts per unit of leaf area of cucumber plants.

As for the interaction between the effects of methionine and zinc treatments, the results indicated that raising the concentration of methionine under the same zinc level decreased gradually chlorophyll a & b and consequantly total chlorophyll (a + b) contents . Shimokawa *et al.* (1978) mentioned that the rapid loss of chlorophyll with ethylene can be expected because of the photooxidation of chlorophyll through the disintegration of the internal structure of chloroplasts.

III- Essential oil

It is clear from the data in Table (2) that application of methionine showed an increase in the mean of essential oil percentage and essential oil yield (1 / fed). The highest essential oil yield (14.52 l/fed) was produced when the plants were treated with methionine at the rate of 100 ppm and the increase was significant compared to control. No significant difference in essential oil percentage between the rates of methionine. In this regard, Mansour *et al* . (1999) reported that all methionine concentrations (25,50 or 100 ppm) increased the essential oil percentage and essential oil yield in *Mentha viridis, M. longifolia* and *Ocimum canum* plants.

Spraying fennel plants with zinc caused a general increase in essential oil % and essential oil yield (l/fed). Similar results were reported by Misra (1992) on *Mentha arvensis*; and Abd El- Salam (1999) on fennel , they found that spraying the plants with $ZnSO_4$ increased the volatile oil. Application of zinc at the rate of 100 ppm increased significantly these characters compared to control . This may be due to the favourable effect of zinc on metabolic processes. No significant difference in essential oil yield between zinc at the rates of 50 and 100 ppm.

As for the combination between methionine and zinc concentrations , the data showed that all combination treatments increased essential oil content and essential oil yield compared to control. The highest essential oil yield was obtained when the plants were treated with the combination between methionine at the rate of 100 ppm and zinc at the rate of 50 ppm.

VI- Carbohydrates content

Data in Table (2) showed that spraying of methionine at the all rates increased significantly total carbohydrates percentage compared to control . On the other hand, all concentrations of methionine decreased total soluble sugars, the reduction reached to the level of significant at rates of 100 and 200 ppm as compared to control. In this regard, Abd El-Al *et al.* (1987); Bondok *et al.* (1994) on cotton and Sakr *et al.* (1989) on potato, found that spraying of ethrel stimulates and enhanced the photosynthetic activity and increases the metabolities required for more carbohydrate biosynthesis . This also may be due to the indirect effect of ethrel on enzyme activity in cell organs.

Regarding the influence of zinc application on carbohydrates content, the obtained data indicated that, the two levels of zinc increased both total carbohydrates (%) and soluble sugars (mg/g) content . Similar results were reported by Abd El - Salam (1999) on fennel .

Spraying fennel plants with combination methionine at the rate of 100 ppm and zinc at the rate of 200 ppm increased significantly total carbohydrates % compared to control and the most other treatments . While , the highest total soluble sugars (mg/g DW) were recorded when the plants were sprayed with the lowest level of methionine (50 ppm) under zinc at the rate of 100 ppm

Table (2) : Effect of methionine and zinc on essential oil content ; essential oil yield, total carbohydrates % and soluble sugars (mg/g) of fennel fruits . (average of the two years)

Treatments (ppm)	Zn0	Zn50	Zn100	Mean(A)	Zn0	Zn50	Zn100	Mean (A)
	Essential oil %				Essential oil yield (l/fed)			
Control	1.36	1.43	1.52	1.44	9.12	9.83	10.62	9.86
Methionine 50	1.54	1.47	1.66	1.56	11.46	13.20	13.61	12.76
" 100	1.43	1.67	1.68	1.59	11.75	16.24	15.58	14.52
" 200	1.58	1.63	1.57	1.59	11.17	11.58	11.31	11.35
Mean (B)	1.48	1.55	1.61	-	10.88	12.72	12.78	-
	Total carbohydrates %				Soluble sugars (mg/g)			
Control	36.8	35.4	38.1	36.8	38.1	43.4	49.6	43.7
Methionine 50	36.3	40.2	41.3	39.3	33.5	40.7	52.6	42.3
" 100	39.1	42.3	45.7	42.4	31.7	41.3	45.0	39.3
" 200	39.2	41.6	42.8	41.2	29.6	39.1	44.8	37.8
Mean (B)	37.9	39.9	42.0	-	33.2	41.1	48.0	-

LSD at 5% for	Essential oil%	Essential oil yield	T.carbohydrates	Soluble sugars
Methionine(A)	0.08	0.97	2.2	NS
Zinc (B)	0.09	0.84	3.1	3.5
A x B	0.13	1.32	3.4	3.8

V- Minerals content :

The results in Table (3) show the effect of methionine and zinc treatments on the concentrations of N,P,K and Zn in fennel fruits .

Application of methionine at all concentrations decreased nitrogen content, methionine at the rate of 100 ppm produced a reduction of 12% compared to the control. On the other hand , phosphorus and potassium contents were increased by increasing the rate of methionine. Also, Sakr *et al.* (1989) found that ethrel increased P and K contents of shoot dry matter of potato . Zinc content was increased by using the low level of methionine (50 ppm) but it was reduced by increasing the rate of methionine (100 or 200 ppm) compared to control.

Increasing zinc concentration was associated with an increase in N,P,K and Zn contents. Application of zinc at 100 ppm produced the greatest N,P,K and Zn contents by 13,18,19 and 16% , respectively above the cotnrol. Similar results were obtained by Subrahmanyam *et al.* (1991) on Japanese mint; Late and Sedowska (1996) on *Catharanthus roseus;* Abd El-Salam (1999) on fennel and Mohamed (2000) on caraway . The results could be attributed to the role of zinc in indole acetic acid (IAA) formation as a growth regulator (Marschner, 1995).

The results of the interaction between methionine and zinc treatments showed that the highest N content resulted from application of zinc at 100 ppm without methionine . While, a combination of methionine at 100 ppm and zinc at 100 ppm gave the highest P content . Furthermore , the highest K content (2.41%) was recorded when methionine at 200 ppm were combined with zinc at 100 ppm . Application of methionine at the rate of 50 ppm with zinc at the rate of 100 ppm increased significantly Zn conten, while raising the level of methionine resulted in reduction of zn cotnent compared to methionine at zero level under any level of zinc.

From these results, it could be concluded that fennel plants responded to application of amino acid methionine and zinc. It can be recommeded that for the greatest fruits and essential oil yuield , the plants should be sprayed with methionine at 100 ppm under zinc at 100 ppm.

Table (3) : Effect methionine and zinc on nitrogen (N); phosphorus (P) ; potassium (K) and zinc (Zn) contents of fennel fruits (average of two years).

Treatments (ppm)	Zn0	Zn50	Zn100	Mean (A)	Zn0	Zn50	Zn100	Mean (A)
	Nitrogen %				Phosphorus %			
Control	2.18	2.34	2.43	2.32	0.431	0.483	0.536	0.483
Methionine 50	2.05	2.27	2.31	2.21	0.537	0.610	0.578	0.575
" 100	1.98	1.89	2.28	2.05	0.562	0.635	0.741	0.646
" 200	1.93	2.16	2.23	2.11	0.617	0.648	0.682	0.649
Mean (B)	2.04	2.17	2.31	-	0.537	0.594	0.634	-
	Potassium %				Zinc (ppm)			
Control	1.67	1.59	1.78	1.68	122	129	144	132
Methionine 50	1.74	1.84	2.05	1.88	127	135	154	139
" 100	1.88	2.17	2.35	2.13	118	126	133	126
" 200	1.93	2.32	2.41	2.22	115	123	128	122
Mean (B)	1.81	1.98	2.15	-	121	128	140	-

LSD at 5% for	Nitrogen	Phosphorus	Potassium	Zinc
Methionine(A)	0.12	0.035	0.23	NS
Zinc (B)	0.11	0.028	0.15	11
A x B	0.16	0.041	0.36	14

REFERENCES

Abd El-Al, M.H.; Fatma, M. Ahmed and M.A. Ashoub (1987). Response of cotton plants to ethrel treatment Ann. Agric. Sci. Fac. Agric., Ain Shams Univ. Cairo , Egypt 32 (2) : 1089 - 1105.

Abd El- Salam, I.Z. (1999). Physiologyical studies on *Foeniculum vulgare* Mill. plant . Ph.D. Thesis, Fac. Agric., Cairo Univ.

Abou Zeid, M.H.; S.K. Ahmed and M.R. Khater (1996) . Study on the effect of zinc treatments on fruit yield, oil percentage and its chemical constitutents of fennel, *Foeniculum vulgare.* Egypt. J.App. Sci., 11 (9) : 135 - 145.

Adams, D.O. and S.F. Yang (1979). Ethylene biosynthesis : identification of 1- aminocyclopropane -1- carboxylic acid as an intermediate in the conversion of methionine to ethylene . Proc. Natl. Acad. Sci. USA 76 : 170 - 174.

Bondok, M.A.; M.S. Saeed and O.M. Wassel (1994). Endogenous hormones as affected by promalin & ethrel and their role in increasing the productivity of cotton plants . 5th Conf. Agric. Dev. Res., Fac. Agric., Ain Shams Univ., Cairo , Egypt, 1 : 377-403 .

Chapman, H.D. and P.F. Pratt (1978). Methods of Analysis for Soil, Plants and Waters . Univ. California, Div. Agric . Sci. Priced Pub. 4034 pp. 12-19.

Dubois, M.; K.A. Gilles; J. Hamilton R.Rebers and F. Smith (1956). Colourmetric method for determination of sugars and related substances. Ann. Chem., 28 : 350 - 356.

Evans, W.C. (1989). Trease and Evans, Pharamcognosy. 13th Edition English Language Book Society Tindall pp 440.

Guenther , E. (1961). The Essential Oils. Vol. I. Van Nostrand Reinhold , London p. 253.

Han, S.S.; A.H. Halevy; R.M. Sachs and M.S. Reid (1990). Enhancement of growth and flowering of *Triteleia laxa* by ethylene . Journal of the American Society for Horticultural Science, 115 : 482 - 486 .

Haridy, I.M.; A.M. El-Zahwey and S.M. Mohamed (1992) . The effect of trace elements (Zn- Cu) on growth, yield and essential oil of coriander (*Coriandrum sativum* L.) plants. Menofiya J. Agric. Res. 17 (3) : 1231 - 1249.

Helal, A.A. and M.M. Khalil (1997). Response of *Catharanthus roseus* G.Don to salinity , iron and zinc treatments. Zagazig J. Agric. Res. 24 (6) : 1065 - 1079.

Kieber, J.J. (1997) . The ethylene response pathway in Arabidopsis . Ann. Rev. Plant Physiol. Plant Mol. Biol. 48 : 277 - 296.

Koch, B.L. and T.C. Moore (1990). On ethylene and stem elongation in green pea seedlings. Plant Physiol. , 93 : 1663- 1664 .

Kocourkova, B. and J. Vrzalova (1992) . The response of peppermint *(Mentha piperita* L.) to selected microelements . Sbornik UVITZ, Zahradnictvi, 19 (2) : 109 - 116.

Late, B. and A. Sedowska (1996) . Effect of N,P,K and Zn foliar fertilization on the yield of *Catharanthus roseus* L. (G) Dom. Folia Horticulturae, 8 (2): 51 - 58.

Lieberman, M. (1979) . Biosynthesis and action of ethylene. Ann. Rev. Plant. Physiol. 30 : 533 - 591.

Lieberman, M.; A. Kunishi; L.W. Mapson and D.A.Wardale (1966). Stimulation of ethylene production in apple tissue slices by methionine. Plant Physiol. 41 : 376 - 382.

Lipskaya, G.A. and I.K. Fartotskaya (1971). Anatomical structure of cucumber leaves under the effect of CO_2 added alone or together with Mn, B, Cu, Zn or Mo to the nutrient mixture . Biologicheskie Nauki BSSR No. 5, 24 - 29 .

Mansour, H.A.; M.A. Salem and S.M.N. Milad (1999) . The effect of tryptophan and methionine on the growth and productivity of *Mentha viridis, Mentha longifolia* and *Ocimum canum* plants. Proceedings of the 1st Congress, Recent Technologies in Agriculture, Cairo Univ., Faculty of Agric. 27-29 Novemeber 1999, Vol. 1 : 240 - 255.

Marschner, H. (1995). Mineral Nutrition of Higher Plants. 2nd ed. Academic Press, London, New York pp 889.

Misra, A. (1992). Effect of zinc stress in Japanese mint as related to growth, photosynthesis, chlorophyll content and secondary plant products : I. The monoterpenes. *Photosynthetica,* 26 (2) : 225 - 234.

Mohamed, M.I. (2000). Physiological studies on *Coriandrum sativum* L. and *Carum carvi* L. plants. Ph.D. Thesis Fac. Agric. Cairo Univ.

Morelli, I.; E. Bonan; A. M. Pagni and P.E. Tomei (1983). School of specialization science and technology of medicinal plants. Fac. of Pharmacy. Univ.of Piso Food and Agricultural Organization of United Nations. Rome 1983, 61 - 63. Plant Cell Physiol. 19 : 229 - 236.

Purvis, A.C. (1980). Sequence of chloroplast degreening in calamondin fruit as influenced by ethylene and $Ag^{\cdot}NO_3$. Plant Physiol., 66 : 624 - 627 .

Riov, J.; N. Dror and R.Goren (1982) . Effect of ethylene on (^{14}C) indole - 3- acetic acid metabolism in leaf tissues of woody plants . Plant Physiol. 70 : 1265 - 1270 .

Sakr, M.T.; M.A. Khafagy and M.N. Helaly (1989). Effect of some growth substances under different nitrogen levels on growth, yield and some biochemical constituents of potato plants. J. Agric. Sci. Mansoura Univ., 14 (2) : 533 - 543.

Saric, M.; R. Curic; T.Cupina and I. Geric (1967). Chlorophyll Determination. Univerzit et U Noveon Sadu Praktikum iz Fiziologize Biljaka - Beograd , Haucan Anjiga , pp. 215.

Shimokawa, K.;A. Sakinoshita and K.Horiba (1978). Ethylene – induced changes of chloroplast structure in Satsume mandarin *(Citrus unshiu* Marc).

Steel, R.G.D. and J.H. Torrie (1980). Principles and Procedures of Statistics. McGraw Hill N.Y., pp. 450 . Subrahmanyam, K.; A. Chattopadhyay; A.K. Nair and D.V. Singh (1991) . Effect of zinc on yield, quality and nutrient composition of Japanese mint and availability of nutrients in soil. J . Indian Soc. Soil Sci., 39 (2) : 399 - 401.

Troug, E. and A. Mayer (1939). Improvement in the dieness colorimetric method for phosphorus and arsenic. Ind. Eng. Chem. Anal. Ed., 1 : 136 - 139.

Yang, S.F. (1974). The biochemistry of ethylene : biogenesis and metabolism. Recent Adv. Phytochem. 7 : 131 - 164.

تأثير الرش بالمثيونين والزنك على المحصول والمكونات الكيميائية لنبات الشمر

محمود محمد فرحات
قسم النبات – المركز القومى للبحوث – الدقى – مصر

أجريت هذه الدراسة بمنطقة الصالحية – محافظة الشرقية – مصر خلال الموسمين ٩٨ – ١٩٩٩ ، ٩٩ – ٢٠٠٠ فى تجربة حقلية لدراسة تاثير الرش بالمثيونين والزنك على نبات الشمر – قد تم رش النباتات بأربعة تركيزات من الحمض الأمينى المثيونين وهى صفر ، ٥٠ ، ١٠٠ ، ٢٠٠ جزء فى المليون مع أو بدون ثلاثة تركيزات من الزنك وهى صفر ، ٥٠ ، ١٠٠ جزء فى المليون – ورشت النباتات مرتين أثناء الموسم .

أوضحت النتائج ان رش نباتات الشمر بالمثيونين أحدث نقص فى طول النبات والمحتوى الكلوروفيلى فى الأوراق والسكريات الذائبة والنيتروجين فى الثمار – بينما أدى استخدام المثيونين بالتركيزين ١٠٠ و ٢٠٠ جزء فى المليون إلى زيادة عدد الأفرع / نبات وعدد النورات / نبات ومحصول كل من الثمار والزيت بالنسبة للفدان – وأيضا زيادة محتوى الثمار من الفوسفور والبوتاسيوم. كان لرش النباتات بالزنك عامة تأثيرات ايجابية على صفات النمو والمحصول بالاضافة للمكونات الكيميائية للنبات .

معاملة النباتات بكل من المثيونين والزنك معا أدت إلى حدوث زيادة معنوية فى محصولى الزيت والثمار مقارنة بالكنترول خصوصا عند استخدام تركيز ١٠٠ جزء فى المليون من المثيونين متداخلا مع ٥٠ جزء فى المليون من الزنك فى حين كان لرش النباتات بالمثيونين بتركيز ١٠٠ جزء فى المليون بالتداخل مع الزنك بتركيز ١٠٠ جزء فى المليون أثرا واضحا فى زيادة عدد الأفرع والنورات المتكونه على النبات وأيضا زيادة محتوى الثمار من الكربوهيدرات الكلية والفوسفور.