ATTEMPTS TO REGULATE GROWTH oF *CUPRESSUS MACROCARPA*, HARTW CV GOLDCREST THROUGH GROWTH REGULATORS AND CHEMICAL FERTILIZATION.

El-Keltawi N.E.[(1)]; A.E. El-Naggar [(1)]; S.Sh. Abdien[(1)] and M.A. Ibrahim[(2)]

[1.] Department of Horticulture, Faculty of Agriculture, Assiut University, Assiut 71562, Egypt.

[2.] Faculty of Agriculture, South Valley University, Qina, Egypt.

ABSTRACT

Cupressus macrocarpa, commonly known as Montery Cypress or Lemon Cypress, is a handsome tree widely used as an ornamental plant. In order to obtain rapid growth and golden green colour, which are required for the commercial use of Cypress, NPK fertilizers and some growth regulators are needed. Therefore, the present experiment was conducted to investigate the interaction between GA_3, Cycocel and Kristalon fertilizer at different concentrations to achieve the desired plant growth characteristics. The obtained results showed positive effect of GA_3 at 100 ppm comparing to the untreated plants "control" with respect to all vegetative growth and chemical composition parameters except for calcium and total carbohydrates contents which decreased with the application of 100 ppm GA_3. The plant growth was improved as a result of Cycocel at either 500 or 1000 ppm. The high concentration of Cycocel noticeably decreased almost all vegetatives growth and chemical composition parameters comparing to the low one (500 ppm). Fertilizing Cypress plants with Kristalone at any applied concentration enhanced all recorded plant growth characteristics. The combination between GA_3 at 100 ppm, Cycocel at 500 ppm and Kristalone at 10 g/pot could be recommended to obtain the best growth characters of Lemon Cypress.

KEYWORDS: *Cupressus macrocarpa*, Kristalone, Gibberellic acid, Cycocel, growth regulators.

Referees:Prof.Dr.Ismaeil.H.Alslamy Prof.Dr.Farouk.S.E.Badran

INTRODUCTION

Cupressusmacrar(c.v.Goldcrest) is a cultivar of Montery Cypress that is endemic to Montery Bay on the central coast of California(Hogan and Frankis 2009).It is, however, widely cultivated in England, Western Europe, New Zealand and Australia. Mature Monterey Cypress can achieve a height of 20 to 25 meters, and ages realized in both groves have been estimated to be as high as 200 to 300 years (Jepson 1993). Mnotery cypress is considered one of the most usable ornamental trees. It is very salt tolerant and an excellent choice for seaside plantings where it becomes windswept and develops a handsome irregular shape. It is often grown in a group to create a wind break or screen. Under ideal conditions, Monterey cypress can grow into a dense, 40 ft (12 m) tall tree in just ten years . It can be pruned to form a hedge whilst smaller cultivars (such as 'Goldcrest') are grown in containers. Monterey cypress is used extensively for bonsai since the twisted and gnarled form that makes bonsai specimens so attractive comes naturally to Monterey cypress. Nevertheless, Montery cypress growth is characterized by slow growing rate, particularly during juvenile years.(Farjon 2005).

Therefore, accelerating its growth and improving its form is desirable and could be accomplished by different agricultural treatments such as GA_3 and Cycocel sprays in addition to complete fertilizers. Several investigators stated that GA_3 treatment enhanced apical dominance and simplified the branching system (Black and Edelman 1970). The positive effect of GA3 on the growth of cypress was proved by several investigators, i.e. El-Sallami and Makary (1997) studied the response of *Cupressus sempervirens, L.* seedlings to GA3 sprayes at 0 ,100 ,200 and 300 ppm found that plant height, number of branchs as well as fresh and dry weight of the areal parts per plant were considerably increased as a result of using GA3 at all concentrations, especially the medium one (200 ppm) which was generally more effective.

Growth retardants also have a property of altering photoassimilate partitioning by suppressing apical growth and causing diversion of photoassimilates for profuse lateral growth in many horticultural plants (El-Khateeb, 1989). Growth retardants have been used to control stem growth of many plants where most retardants act by inhibiting gibberellin (GA) biosynthesis (Gianfagna, 1987). One of the growth retardants widely used for tree seedlings is CCC (chlormequat chloride). When Aphalo *et al*. (1997) studied the use of CCC in the production of silver birch container seedlings, they found that height growth and accumulation of dry mass were partially inhibited after CCC application. They conclud-ed that CCC could be a useful tool in nursery management, especially for controlling end-of-season growth during warm au-tumns. Meawad *et al*. (1991) stated that the combination of cycocel at 250 ppm or 500 ppm with gibberellin at 100 or 200 ppm concentrations resulted in the highest values of plant height, stem diameter and branches number as well as fresh and dry weight of shoots.

The effect of different NPK ferti-lizers has been investigated on various plant species. Abdo (1972) reported that 5 gm NPK/pot at monthly intervals was the most effective treatment in increasing the vegetative growth of *cupressus sempervi-rens*. All rates of Greenzit foliar fertilizer (0.0 , 0.2 , 0.4 , and 0.6 %) studied by El-Sallami and Makary (1997) considerably increased plant height , number of branches as well as fresh and dry weight of the areal parts of *Cupressus sempervirens ,L* whlist the medium level 0.4% gave more stimulative and enhancing effects on varius growth characters tested

Thus, the main objective of the present investigation was to study the influence of growth regulators and chemical fertiliz-ers on growth of *Cupressus mac-rocarpa, Hartw cv Goldcrest* seedlings.

MATERIALS AND METHODS

A pot experiment was carried out during the two successive seasons of 2007 and 2008 at the Floriculture Experimental Farm, Faculty of Agriculture, Assiut University, Assiut, Egypt.

1- Materials :

I-*Plant materials:* Homogenous-ly two-years old vegetivley prop-agated seedlings obtained in 15cm polyethylen bages from commercial nursery in the Mansoreya area of *cupressus macrocarpa*, Giza, Egypt were used.

II- Potting media: Growing medium was clay(Local soil of Floriculture Experimental Farm, Faculty of Agricutlure, Assiut University, Assiut, Egypt) mixed with cattle manure in ratio of 3:1, respectively. The constituents and characteristics of the media used are represented in Table (1).

III-Chemical fertilizers:

Kristalone:(19-19- 19 + 1) NPK + MgO distributed by zeven-manshaven67,3133CA Vlaar-dingen,(Netherland),inmporter in A.R.E Yara Agri Trade Misr was used as a source of N,P and K nutrients.

IV – Growth regulators :

1- Gibberellic acid :Berlex tab-lets containing1gram Gibberellic Acid as GA3. a.i. Imp. Chem. Ind.Ltd ,ICI , product was used .

1 -Cycocel: (2-chloroethyl)-trimethylammonium chlo-ride.distributed by BASF New Zealand Limited was used as a growth retardants.

Table (1): Constituents and characteristics of the used medium at the beginning of the experiment:

Particle size Distribution (%)				pH	EC	Calcium carbonate	Organic matter	Total nitrogen
Clay	Silt	Fine sand	Coarse sand		dSm^{-1}	(%)	(%)	(%)
52.47	32.86	8.23	6.10	7.72	1.15	1.74	2.74	0.23

Soluble cations cmolc kg^{-1} soil			Soluble anions cmolc kg^{-1} soil			
Ca^{2+} + Mg^{2+}	Na^{+}	K^{+}	CO^{2-}_3 + HCO^-_3	Cl^-	Available K	Available P
0.72	0.28	0.09	0.41	1.55	2.02	15.66

2. Methods:

On March 15th of 2007 and 2008 seasons homogenous healthy seedlings, which had been separatley grown in peat moss in 15cm plastic bags, were repotted into 25cm clay pots filled with clay soil mixed with cattle manure at 3:1, respectively. All plants were grown under shade condition(73%shade)until the end of the experiment for both seasons.

The treatments were fertilized with Kristalone(0,5,10gm/plant), then sprayed with Gibberellic acid (0, and 100ppm) and Cycocel (0,500,1000 ppm) at biweekly intervals. Gibberellic acid and Cycocel were applied as foliar sprays until the point of run off starting one month after repotting.Gibberellic acid treatments were applied one week after Cycocel application, and followed by Kristalone one day later. Plants sprayed with distilled water served as control. Irrigation, weeding and other agricultural practices were carried out for the experiment as usual.

Experimental design:

The treatments were arranged in a factorial experiment in a completely randomized block design (split-split-plot) with three replicates. The main plots represented Kristalone rates (0, 5 and 10 gm/plant). Each main plot was divided into two sub- plots containing GA3 concentrations (0 and 100 ppm). Each sub-plot comprised three sub-sub-plots representing Cycocel concentrations(0,500 and 1000 ppm). Each replicate consisted of 18 treatments(3 Kristalone rates x 2 GA3 concentrations x 3Cycocel levels) with 4 plants(pots) per treatment.

Collected data and analysis :

I – Vegetative parameters :

At the end of the experiment (at the beginning of December) ; data recorded were plant height (cm), number of branches per plant, stem diameter (cm) and foliage fresh and dry weights per plant (g).

II – Chemical analysis :

Leaf mineral nutrients content:

Plant samples were collected, prepared and digested according to Piper (1967). The following nutrient minerals were estimated:

- **Nitrogen** content was determined using the modified micro Kjeldahal method, Black *et al* . (1965).
- **Phosphorus** content was determined spectrometrically, Jackson (1973).
- **Potassium** content was determined by the flame photometer method, Jackson (1973).
- **Calcium and Magnesium** contents were determined by titration method, Jackson (1973).
- **Protein percentage** was estimated according to the method by Ranganna (1978).
- **Total carbohydrate percentage:** was calorimetrically determined, Fales (1951).

IV- Statistical analysis :

Data were subjected to statistical analysis using "F" test according to Snedecor and Cochran (1973) and L.S.D. value for comparisons according to Gomez and Gomez (1984); Steel and Torrie (1982).

RESULTS AND DISCUSSION

Vegetative growth:

Data presented in Tables(2and3) showed that different growth measurements were markedly affected by the various treatments.

Concerning the specific effect of Cycocel (CCC) and gibberellin (GA_3) application (Tables 2 and 3), it was observed that CCC treatment at 500 ppm combined with GA_3 at 100 ppm concentration improved plant height, stem diameter, branches number and foliage fresh and dry weights. Similar results were obtained by Meawad *et al* (1991) on casuarina, who found that cycocel application at 250 ppm combine with GA_3 at 100 or 200 ppm enhanced plant height, stem diameter, branches number and fresh and dry weights of shoots. Using CCC at 200 ppm was proved by Awad and Kamel (1983) to enhance plant height of datura. Also, Tawfik (1986) stated that the treatments of GA_3 or CCC showed positive effect on plant height of lemon grass.

However, such increase in plant height might be due to that GA_3 and CCC enhancement cell division and /or cell elongation within stem tissues leading to more height and internode length. GA_3 might promote cell enlargement and help in cell division, whereas CCC might caused anticlinical cell division leading to the increase in plant diameter. Similar results were obtained by Awad (1973) on roses which showed that CCC increased number of branches. His results also indicated that GA_3 and CCC at the lowest concentration increase in branche number. Meanwhile, GA_3 may enhance the lateral buds growing to lateral branches by activating cell division, while CCC may overcame apical dominance leading to more branche number of cypress seedlings.

Under the conditions of the present study, feeding lemon cypress with Kristalone at 10gm/plant resulted in the highest values of vegetative measurements compared with the other treatments including the control, except number of branches which reached its highest values when plants were treated with Kristalone at 5gm/plant.

The increase in plant growth due to using Kristalone could be explained upon the effect of its nutrient contents which stimulated the biosynthesis of enzyme, protein and other fractions. The constituents of Kristalone are quite enough for increasing the growth. These results are in agreement with those obtained by Paparozzi and Tukey (1979) on some indoor plants; Shedeed *et al.* (1986) on roses and Mohamed (1988) on *Aglaonema modestum*, *Syngonium podophyllum* and *Euphorbia pulcherrima*, Mohamed (1992b) on *Livistonia chinensis* and Abo El- Ghait and Wahba (1994) on Violet plants.

With regard to the interaction effects between Cycocel, GA_3 and Kristalone fertilizer on growth measurements, data showed that applying a combination of 500 ppm Cycocel,100 ppm GA_3 and 10 gm/plant Kristalone gave the best results of plant height and fresh and dry weights. Applying the combination of Cycocel at 500 ppm, GA3 at 100 ppm and Kristalone at 5 gm/plant enhanced number of branches/plant. However, the combination of both of Cycocel at 500 ppm and Kristalone at 10 gm/plant produced thicker stems (Table 2).

Nutrient contents:

Nutrient contents of cypress branches showed considerable responses to Kristalone, GA_3, and CCC (Tables 4 and 5). The highest concentrations of N, P, K and Mg and the lowest Ca were obtained from plants received Kristalone, GA_3, and CCC at either medium or high level. Such results pointed out that these levels were the most suitableons as they furnished plants with N, P, K and Mg at adequate levels and consequently obtaining the best plant growth. From the above mentioned results it could be noticed that there was a close relationship between the nutrient contents in branches of cypress plants and their growth characters. Clearly, there are many possible roles by which these nutrients stimulate the growth of cypress seedlings. Among their vital roles are being constituents of plant tissues, catalysts in various reactions, osmotic regulators and performing an active role in biosynthesis of enzymes and amino acids; Devlin and Witham (1983).

Concerning the interaction between GA_3 and Kristalone, the combined treatment of GA_3 (200 ppm) plus Kristalone (5gm) proved to be the most effective on producing better nutritional status. Several reports concluded that GA_3 showed enhancement effect on increasing plant nutrient contents. Broughton and McComb (1967) demonstrated that GA_3 stimulated the synthesis of protein which was reflected in increasing the plant growth and consequently the absorption of N, P, K and Mg was increased. Demisova and Lupinovich (1961) reported that GA_3 application increased the rate of mineral transport from the root system to the areal parts of plant. Castro *et al* (1978) found that GA_3 treatment at 100 ppm stimulated the accumulation of N and P in *Zinnia elegans*. Also, Meawad (1981) mentioned that GA_3 increased total N, P and K contents in gladiolus leaves. El-Sallami and Makary (1997) recorded that, spraying *Cupressus sempervirens*, *L*. seedlings with NPK as a foliar fertilizer at the rates of (0.0, 0.2, 0.4 and 0.6%) increased the content of N, P, K, Mg and Fe in cypress branches, while Ca content showed a negative effect. Barros *et el.,* (1975) pointed out that *Eucalyptus saligna* treated with NPK (3-15-3) at a rate of 5g/plant/month had improved contents of N, P and K. On *Thuja orintales L.* El-Sallami and Mahros (1997) reported that, the leaf content of N, P, K and Mg as well as total carbohydrate were generally increased by mineral nutrition, especially at the rate of 6 gm(6-8-6) per plant. Mohamed (1992a) revealed that spraying chrysanthemum plants with "Foliar-X" increased the leaf contents of N, P, K and Mg. El-mahrouk (2000) on *Swietenia mahogoni(L)* found that, the percentages of N, P, and K in the leaves were increased by increasing different fertilizer treatments. El-Khateeb and Salem (1988) on *Thuja orientalis* reported that, NPK fertilization had a favourable effect in increasing the concentrations of N, P and K in plants which led to producing the best vegetative growth. El-Sallami (2002) studied the response of three ornamental trees *(Chorisia speciosa, Leucaena leucocephala* and *Prosopis juliflora)* to different NPK fertilization levels (0, 60, 90, 120, and 150p/plant) and showed that the highest foliar concentrations of N, P,K, Mg, Fe and total carbhydrates, were increased with increasing NPK level. However, the rates of 90 and 120 g/plant were the most effective.

Results presented in Table (5) show also that, calcium and magnesium percentage in shoots of cypress seedlings were increased as a result of using the combination between GA3 at 100 ppm and CCC at 500 ppm treatments in comparison with the other ones. In this respect, Mohamed (1988) on housplants seedlings, and Knavil (1969) on tomato plants found that cycocel-treated plants contained more calcium than control plants. The interaction effects between Cycocel, GA3 and Kristalone fertilizer on nutrient contents were found to be in harmony with the vegetative growth measurements where data showed that applying a combination of Kristalone at 500 ppm CCC,100 ppm GA3 and 10 gm/plant Kristalone gave the best results, in most cases.

Total carbohydrates and protein contents:

It is clear from the data given in Table (6) that fertilizing the cypress plants with Kristalone increased total carbohydrates content in leaves. Either concentrations of Kristalone (5 or 10 g/pot) increased total carbohydrates comparing to the control. The medium level of Kristalone (5gm/pot) was most effective in thise respect. On the contrary, total carbohydrates were decreased with increasing the concentration of GA3 during both seasons. Meanwhile, the plants were sprayed with the medium level of CCC contained the highest total carbohydrates percentage comparing to either the control or the higher CCC concentration.

Concerning the interaction effect, applying either Kristalone at 5gm/pot or CCC at 500 ppm without GA_3 (control) had better effect than the combine dtreatments with GA_3 at 100 ppm. Besides, using both Kristalone at 5gm/pot and CCC at 500 ppm resulted in better carbohydrates content comparing to the other combinations between both Kristalon and CCC. The highest total carbohydrates contents were noticed on plants treated with the combination of Kristalone at 5gm/pot, GA_3 at 0 (control) and CCC at 500 ppm.

On the other hand, protein content is typically realated to the results obtained form nitrogen content in branches. This is obviously due to the statistical method by which protein content was calculated through multiplying nitrogen content by 6.25. Therefore, the best treatment regarding protein content is Kristalone at 5 g/pot, GA3 at 100 ppm and CCC at either 0 or 500 ppm.

These results could be attributed to the role of all nutrients in this commercial fertilizer at their suitable rate in raising the physiological activity of the plant and consequantly increasing the photosynthates in branches. Similar results were obtained by Mantrova and Nikitina (1972) who stated that the optimum NPK reates stimulated carbohydrate synthesis whiich was accumulated in rose plants. Mohamed *et al*. (1987) reporteed that NPK fertilizer increased the total soluble sugars in leaves of *Eucalyptus camaldulensis*. Mazru *et al*. (1988) found that spraying chrythanthemum plants with “Foliar-x” fertilizer at 0.3% increased the total carbohydrates content in the different plant organs. The reduction in total carbohydrates by using GA3 could be explained through the role of GA3 in decreasing the photosynthetic pigments in the branches, led to a decrease in the synthesis of sugars and starch, and cosequantly less accumulation of carbohydrate in plant organs. In this conection, some authors reported that application of GA3 decreased total carbohydrate content in plant; El-Khateeb and Selim (1988) on *Thuja orientalis* and Matter (1992) on carnation.

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Table (2) Effect of GA3, cycocel application and kristalone fertilizer on plant height, number of branches and stem diameter of *Cupressus macrocarpa* during 2007/2008 seasons

Kristalone (gm)/plant	Gibberellic acid rates (ppm / plant)	Plant height (cm)				No.of branches /plant				Stem diameter (cm)			
		Cycocel (ppm)/ plant											
		0	500	1000	Means	0	500	1000	Means	0	500	1000	Means
		2007 season											
0	0	72.5	78.9	74.0	75.1	50.2	59.6	54.6	54.8	1.03	1.24	1.06	1.11
	100	75.7	81.6	77.6	78.3	57.5	74.7	71.4	70.4	0.98	1.27	1.01	1.09
	means	74.1	80.3	76.6	77.0	53.2	67.1	63.0	62.6	1.01	1.26	1.04	1.10
5	0	82.6	89.9	84.3	85.6	75.4	86.4	78.3	80.3	1.13	1.36	1.17	1.22
	100	86.1	92.9	88.4	89.1	78.1	99.6	94.4	93.2	1.08	1.40	1.11	1.20
	means	84.4	91.4	86.4	87.4	80.5	93.0	86.4	86.8	1.11	1.38	1.14	1.21
10	0	86.9	93.9	88.1	89.6	67.3	78.4	75.9	73.8	1.16	1.55	1.33	1.35
	100	94.4	97.1	92.3	94.7	69.2	86.4	81.6	79.8	1.11	1.44	1.16	1.24
	means	90.7	95.5	90.4	92.2	69.4	82.4	78.8	76.8	1.13	1.50	1.25	1.29
Means of Gibberellic acid	0	80.7	87.6	82.1	83.5	64.3	74.8	69.6	69.5	1.11	1.38	1.19	1.23
	100	85.4	90.5	86.8	87.6	74.1	86.9	82.5	81.2	1.06	1.37	1.09	1.17
Means of Cycocel		83.1	89.1	84.5	85.5	69.2	80.8	76.1	75.4	1.08	1.38	1.14	1.20
L.S.D. at 5% of													
Kristalone		7.1				7.3				0.15			
GA3		12.6				12.8				0.27			
Cycocel x GA3		10.1				10.3				0.22			
Cycocel		7.1				7.3				0.15			
Cycocel x Kristalone		9.0				9.2				0.20			
GA3 x Kristalone		10.1				10.3				0.22			
Kristalone x GA3 x Cycocel		12.8				13.0				0.28			
		2008 season											
0	0	67.5	73.5	68.9	70.0	46.9	55.1	51.9	76.0	0.95	1.17	0.99	1.04
	100	76.3	81.8	75.2	77.8	53.7	69.4	66.7	65.6	0.88	1.14	0.91	0.98
	means	71.9	77.7	72.1	73.9	50.3	62.3	59.3	70.8	0.92	1.16	0.95	1.01
5	0	76.9	83.7	78.5	79.7	70.5	80.7	73.5	74.9	1.14	1.31	1.09	1.18
	100	86.9	92.9	85.7	88.5	73.0	93.3	88.3	87.3	1.05	1.26	1.03	1.11
	means	81.9	88.3	82.1	84.1	75.4	87.0	80.9	81.1	1.10	1.29	1.06	1.15
10	0	82.9	89.1	82.5	84.8	62.3	73.3	70.8	68.8	1.18	1.46	1.25	1.30
	100	93.4	98.3	90.5	94.1	64.3	80.9	76.2	74.6	1.10	1.29	1.05	1.15
	means	88.2	93.7	86.5	89.5	64.5	51.4	73.2	71.7	1.14	1.38	1.15	1.22
Means of Gibberellic acid	0	75.8	82.1	76.6	78.2	59.9	69.7	65.4	65.0	1.09	1.31	1.11	1.17
	100	85.5	91.0	83.8	86.8	69.3	81.2	77.0	75.8	0.98	1.23	1.00	1.07
Means of Cycocel		80.7	86.6	80.2	82.5	64.6	75.5	71.2	70.4	1.05	1.27	1.05	1.12
L.S.D. at 5% of													
Kristalone		8.1				8.0				0.11			
GA3		14.3				14.2				0.20			
Cycocel x GA3		11.4				11.4				0.16			
Cycocel		8.1				8.0				0.11			
Cycocel x Kristalone		10.2				10.2				014			
GA3 x Kristalone		11.4				11.4				0.16			
Kristalone x GA3 x Cycocel		14.4				14.4				0.20			

Table (3) Effect of GA3, cycocel Application and kristalone fertilizer on fresh and dry weight of *Cupressus macrocarpa* during 2007/2008 seasons

Kristalone (gm)/ plant	Gibberellic acid rates (ppm / plant)	Fresh weight (gm)				Dry weight (gm)			
		Cycocel (ppm)/ plant							
		0	500	1000	Means	0	500	1000	Means
		2007 season							
0	0	91.1	101.4	95.0	95.8	33.1	37.0	33.7	34.6
	100	97.6	109.5	99.7	102.3	35.5	39.9	36.1	37.1
	means	94.4	105.5	97.4	99.0	34.3	38.5	34.9	35.9
5	0	118.0	131.6	123.2	124.2	43.4	48.9	45.8	46.0
	100	126.4	141.8	129.3	132.5	47.1	53.3	46.2	48.9
	means	122.2	136.7	126.3	128.4	45.2	51.1	46.0	47.5
10	0	134.0	147.3	130.5	134.6	49.6	51.9	48.4	49.8
	100	143.5	159.2	144.9	142.5	53.5	59.2	53.5	55.4
	means	138.8	153.3	137.7	138.6	51.6	55.6	50.8	52.6
Means of Gibberellic acid	0	114.4	126.8	116.2	118.2	42.0	45.9	42.5	43.5
	100	122.5	136.8	124.6	125.8	45.4	50.8	45.3	47.1
Means of Cycocel		118.4	131.8	120.4	122.0	43.7	48.4	43.9	45.3
L.S.D. at 5% of									
Kristalone		9.9				4.9			
GA3		17.4				8.6			
Cycocel x GA3		14.0				6.9			
Cycocel		9.9				4.9			
Cycocel x Kristalone		12.5				6.1			
GA3 x Kristalone		14.4				6.9			
Kristalone x GA3 x Cycocel		17.7				8.7			
		2008 season							
0	0	87.8	97.7	91.5	92.3	32.8	35.5	32.5	33.6
	100	99.3	111.4	101.4	101.4	36.9	41.2	34.8	37.6
	means	93.6	104.6	96.5	98.2	34.9	38.4	33.7	35.6
5	0	115.5	128.5	120.4	121.5	42.6	47.9	44.1	44.9
	100	123.7	138.8	126.6	129.7	46.3	50.6	44.5	47.1
	means	119.6	133.7	123.5	125.6	44.5	49.3	44.3	46.0
10	0	131.7	146.6	137.3	138.5	48.9	53.8	50.5	51.1
	100	141.4	157.1	144.4	147.6	52.1	57.8	52.6	54.2
	means	136.6	151.9	140.9	143.1	50.5	55.8	51.6	52.6
Means of Gibberellicacid	0	111.7	124.3	116.4	117.4	41.4	45.7	42.4	43.2
	100	121.5	135.8	124.4	127.1	45.1	49.9	44.0	46.3
Means of Cycocel		116.6	130.0	120.3	122.3	43.3	47.8	43.2	44.8
L.S.D. at 5% of									
Kristalone		9.4				5.4			
GA3		16.6				9.5			
Cycocel x GA3		13.3				7.6			
Cycocel		9.4				5.4			
Cycocel x Kristalone		11.9				6.8			
GA3 x Kristalone		13.3				7.6			
Kristalone x GA3 x Cycocel		16.9				9.7			

Table (4) Effect of GA3, cycocel applications and kristalone fertilizer on nitrogen, phosphorus and potassium contents in leaves of *Cupressus macrocarpa* during 2007/2008 seasons

Kristalone (gm)/ plant	**Gibberellic acid rates (ppm / plant)**	**N %**				**P %**				**K %**			
		Cycocel (ppm)/ plant											
		0	**500**	**1000**	**Mean**	**0**	**500**	**1000**	**Mean**	**0**	**500**	**1000**	**Mean**
		2007 season											
0	0	2.51	2.66	2.57	2.58	0.379	0.383	0.371	0.378	1.23	1.35	1.29	1.29
	100	2.96	3.24	3.13	3.11	0.403	0.405	0.373	0.394	1.32	1.48	1.34	1.38
	means	2.74	2.95	2.85	2.85	0.391	0.394	0.372	0.386	1.28	1.42	1.31	1.34
5	0	2.99	3.47	3.33	3.26	0.418	0.403	0.392	0.404	1.31	1.44	1.35	1.37
	100	3.53	3.59	3.37	3.50	0.471	0.444	0.395	0.437	1.44	1.61	1.57	1.54
	means	3.26	3.53	3.35	3.38	0.445	0.424	0.394	0.421	1.38	1.53	1.46	1.45
10	0	2.87	2.94	2.82	2.88	0.399	0.395	0.388	0.394	1.33	1.48	1.33	1.38
	100	3.38	3.45	3.15	3.33	0.418	0.421	0.391	0.413	1.57	1.77	1.54	1.63
	means	3.13	3.20	2.99	3.10	0.413	0.408	0.390	0.404	1.45	1.63	1.43	1.50
Means of Gibberelic acid	0	2.79	3.02	2.91	2.90	0.399	0.394	0.384	0.392	1.29	1.42	1.32	1.35
	100	3.29	3.43	3.22	3.31	0.431	0.423	0.386	0.415	1.44	1.62	1.48	1.63
Means of Cycocel		3.04	3.23	3.06	3.11	0.416	0.409	0.385	0.404	1.37	1.52	1.40	1.44
L.S.D. at 5% of													
Kristalone		0.23				0.030				0.19			
GA3		0.45				0.054				0.34			
Cycocel x GA3		0.36				0.043				0.27			
Cycocel		0.26				0.030				0.19			
Cycocel x Kristalone		0.33				0.038				0.25			
GA3 x Kristalone		0.36				0.043				0.27			
Cycocel x GA3 xKristalone		0.46				0.054				0.35			
		2008 season											
0	0	2.53	2.69	2.59	2.60	0.377	0.381	0.369	0.367	1.26	1.37	1.31	1.31
	100	2.92	3.21	3.11	3.08	0.405	0.407	0.371	0.394	1.37	1.53	1.35	1.42
	means	2.73	2.95	2.85	2.84	0.391	0.394	0.370	0.385	1.32	1.45	1.33	1.37
5	0	2.91	3.51	3.28	3.23	0.420	0.405	0.399	0.408	1.35	1.48	1.39	1.41
	100	3.	3.	3.	3.4	0.4	0.4	0.3	0.4	1.	1.	1.	1.5

		51	58	36	8	69	46	96	37	49	66	53	6
	means	3.21	3.55	3.32	3.36	0.445	0.426	0.397	0.423	1.42	1.57	1.46	1.48
10	0	2.85	2.92	2.79	2.85	0.405	0.397	0.384	0.394	1.38	1.52	1.37	1.42
	100	3.36	3.45	3.12	3.30	0.431	0.419	0.389	0.413	1.61	1.82	1.51	1.65
	means	3.11	3.17	2.96	3.08	0.416	0.408	0.387	0.404	1.50	1.67	1.44	1.54
Means of Gibberellic acid	0	2.76	3.04	2.89	2.90	0.401	0.394	0.384	0.393	1.33	1.46	1.36	1.38
	100	3.26	3.40	3.20	3.28	0.435	0.424	0.385	0.415	1.49	1.67	1.46	1.54
Means of Cycocel		3.01	3.22	3.04	3.09	0.417	0.409	0.385	0.404	1.41	1.56	1.41	1.46
L.S.D. at 5% of													
Kristalone		0.33				0.028				0.23			
GA3		0.59				0.049				0.40			
Cycocel x GA3		0.47				0.039				0.32			
Cycocel		0.33				0.028				0.23			
Cycocel x		0.42				0.035				0.29			
Kristalone		0.47				0.039				0.32			
GA3 x Kristalone		0.59				0.050				0.40			
Kristalone x GA3 xCycocel													

Table (5) Effect of GA3, cycocel Applications and kristalone fertilizer on calcium and magnesium contents in leaves of *Cupressus macrocarpa* during 2007/2008 seasons.

Kristalone (gm)/ plant	Gibberellic acid rates (ppm / plant)	Ca %				Mg %			
		Cycocel (ppm)/ plant							
		0	500	1000	Means	0	500	1000	Means
		2007 season							
0	0	3.01	3.05	3.07	3.04	1.74	1.91	1.82	1.82
	100	2.84	2.91	3.03	2.93	2.10	2.35	1.89	2.11
	means	2.95	2.98	3.05	2.99	1.92	2.13	1.86	1.97
5	0	3.14	3.17	3.21	3.17	1.78	1.94	2.15	1.96
	100	2.96	3.05	3.16	3.06	2.17	2.43	2.17	2.26
	means	3.05	3.11	3.19	3.12	1.98	2.19	2.16	2.11
10	0	3.07	3.15	3.13	3.12	1.84	2.01	2.30	2.05
	100	3.01	3.19	3.21	3.14	2.35	2.63	2.23	2.40
	means	3.04	3.17	3.17	3.13	2.10	2.32	2.27	2.23
Means of Gibberellic acid	0	3.07	3.12	3.14	3.11	1.79	1.95	2.09	1.94
	100	2.94	3.05	3.13	3.04	2.21	2.47	2.10	2.26
Means of Cycocel		3.01	3.09	3.14	3.08	2.00	2.21	2.09	2.10
L.S.D. at 5% of									
Kristalone				0.28				0.26	
GA3				0.50				0.46	
Cycocel x GA3				0.40				0.37	
Cycocel				0.28				0.26	

Cycocel x Kristalone				0.36			0.33		
GA3 x Kristalone				0.40			0.37		
Kristalone x GA3 x Cycocel				0.50			0.47		
					2008 season				
0	0 100	2.98 2.82	3.02 2.89	3.06 3.02	3.02 2.91	1.76 2.13	1.93 2.37	1.84 1.91	1.84 2.14
	means	2.90	2.96	3.04	2.97	1.95	2.15	1.88	1.99
5	0 100	3.15 2.91	3.18 3.01	3.20 3.14	3.18 3.02	1.81 2.21	1.97 2.45	2.17 2.15	1.98 2.27
	means	3.03	3.10	3.17	3.10	2.01	2.21	2.16	2.13
10	0 100	3.09 2.99	3.16 3.18	3.15 3.19	3.13 3.12	1.87 2.32	2.05 2.61	2.32 2.25	2.08 2.39
	means	3.04	3.17	3.17	3.13	2.10	2.33	2.29	2.24
Means of Gibberellic cid	0 100	3.07 2.91	3.12 3.03	3.14 3.12	3.11 3.02	1.81 2.22	1.98 2.48	2.11 2.10	1.97 2.27
Means of Cycocel		2.99	3.07	3.13	3.07	2.02	2.23	2.11	2.12
L.S.D. at 5% of									
Kristalone		0.24				0.21			
GA3		0.43				0.37			
Cycocel x GA3		0.36				0.30			
Cycocel		0.24				0.21			
Cycocel x Kristalone		0.31				0.26			
GA3 x Kristalone		0.35				0.30			
Kristalone x GA3 x Cycocel		0.44				0.37			

Table (6) Effect of cycocel, GA3 applications and kristalone fertilizer on total carbohydrate and Protein content of *Cupressus macrocarpa* during 2007 season

Kristalone (gm)/ plant	Gibberel-lic acid rates (ppm / plant)	Total Carbohydrate				Protein Content			
		Cycocel (ppm)/ plant							
		0	500	1000	Means	0	500	1000	Means
		2007 season							
0	0	20.7	23.6	21.5	21.9	15.6	16.6	16.1	16.1
	100	19.3	20.3	18.4	19.3	18.5	20.2	19.5	19.4
	means	20.0	22.0	20.0	20.6	17.1	18.4	17.8	17.8
5	0	31.1	34.9	31.3	32.4	18.7	21.5	20.8	20.3
	100	27.3	28.4	26.1	27.2	22.1	22.5	21.1	21.9
	means	29.2	31.7	28.7	29.8	20.4	22.0	20.9	21.1
10	0	26.2	28.8	27.2	27.4	17.9	18.4	17.6	18.0
	100	23.7	24.9	22.6	23.7	21.1	21.6	19.7	20.8
	means	25.0	26.9	24.9	25.6	19.5	20.0	18.7	19.4
Means of Gibberellicacid	0	26.0	29.1	26.7	27.3	17.4	18.9	18.2	18.1
	100	23.4	24.5	22.4	23.4	20.6	21.4	20.1	20.7
Means of Cycocel		24.7	26.8	24.5	25.4	19.0	20.1	19.1	19.4
L.S.D. at 5% of									
Kristalone		2.030				1.61			
GA3		3.585				2.84			
Cycocel x GA3		2.871				2.27			
Cycocel		2.030				1.61			
Cycocel x Kristalone		2.568				2.30			
GA3 x Kristalone		2.871				2.27			
Kristalone x GA3 x Cycocel		3.631				2.87			
2008 season									
0	0	21.6	23.1	21.9	22.2	15.8	16.8	16.2	16.3
	100	20.5	20.5	19.1	20.1	18.3	20.1	19.4	19.3
	means	21.1	21.8	20.5	21.2	17.1	18.5	17.8	17.7
5	0	29.3	35.2	32.4	32.3	18.2	21.9	20.5	20.2
	100	27.	29.1		28.0	21.		21.	21.0

		6		27.2		9	22.4	5	
	means	28.5	32.2	29.8	30.2	20.1	22.2	21.0	21.1
10	0 100	27.4 25.1	27.9 24.3	27.1 21.9	27.5 32.8	17.8 21.0	18.3 19.3	17.5 21.2	17.8 19.5
	means	26.3	26.1	24.5	25.7	19.4	18.8	19.3	19.2
Means of Gibberellic acid	0 100	26.2 24.4	28.7 24.6	27.1 22.7	27.5 23.8	17.3 20.4	19.0 20.6	18.1 20.7	18.1 20.6
Means of Cycocel		25.3	26.7	24.9	25.6	18.8	19.8	19.4	19.4
L.S.D. at 5% of									
Kristalone		1.815				2.03			
GA3		3.204				3.59			
Cycocel x GA3		2.567				2.88			
Cycocel		1.815				2.03			
Cycocel x Kristalone		2.295				2.57			
GA3 x Kristalone		2.567				2.88			
Kristalone x GA3 x Cycocel		3.246				3.64			

الملخص العربي

محاولات لتنظيم نمو السرو الليمونى صنف "جولد كريست"

عن طريق منظمات نمو واسمدة كيماوية

ان اشجار السرو الليمونى والمعروفه ايضا باسم السرو المونتيرى اشجار جميلة الشكل ومتناسقه وتستخدم على نطاق واسع كنباتات زينه. وإذا ما اردنا الحصول على نباتات سريعة النمو ذات لون اخضر ذهبى ،وهى المواصفات المطلوبه فى الانتاج التجارى لنباتات السرو فاننا نحتاج الى المعاملة بسماد متكامل وبعض منظمات النمو. وبناءً على ذلك فقد أجريت التجربة الحالية لدراسة تاثير التفاعل بين المعاملة بحمض الجبريليك،

السيكوسيل وسماد الكريستالون بتركيزات مختلفة لتحقيق خصائص نمو النبات المطلوب. وأظهرت النتائج التي تم التوصل لها تأثير إيجابي كبير للمعاملة بالجبريلين عند مستوى ١٠٠ جزء في المليون مقارنة بالنباتات غير المعاملة "الكنترول" مع جميع المواصفات الخضريه والكيميائية باستثناء الكالسيوم والكربوهيدرات الكلية والتى انخفض محتواها في النباتات المعاملة بمستوى الجبريلين عند ١٠٠ جزء في المليون.
كذلك فقد تحسن نمو النبات من خلال استعمال السيكوسيل عند ٥٠٠ أو ١٠٠٠ جزء في المليون. في حين أن المعاملة بالتركيزات الاعلى من السيكوسيل(١٠٠٠ جزء فى المليون) أدت إلى انخفاض ملحوظ فى جميع مواصفات النمو الخضرى والكيميائيى مقارنة مع المستوى المنخفض (٥٠٠ جزء في المليون) من السيكوسيل.
تسميد نباتات السرو مع الكريستالون بأي من التركيزات المستخدمة أدى الى تحسين مواصفات النموالمدروسة. ويمكن التوصية باستخدام المعاملة المشتركة بين بالجبريلين عند ١٠٠ جزءا في المليون والسيكوسيل عند ٥٠٠ جزء في المليون والكريستالون عند ١٠ جم / نبات للحصول على أفضل مواصفات نمو لشجرة السرو الليموني.