RESULTS AND DISCUSSION

4- RESULTS AND DISCUSSION

4-1. Experiment- I: EFFECT OF GROWTH REGULATOR SPRAYS ON GROWTH OF 2-YEAR-OLD PECAN SEEDLINGS.

Data reported in **Table (2- a)** show the growth of pecan seedlings to some growth regulator sprays.

Regarding shoot length , it is quite evident that 500 ppm 6- furfuryle amino purine , 1000 and 2000 ppm SADH treatments caused a highly significant reduction in shoot elongation in both seasons. Beside , 50 ppm TIBA caused a reduction in shoot length increase mainly in 1987 from the statistical point of view. In addition , CCC treatments (1000 & 2000 ppm) and 50 ppm 6- benzyle amino purine did not significantly affect shoot length increment when used in the first and secend seasons , respectively. On the other hand , PP_{333} treatments (100 & 200 ppm) showed a high imhibitory effect in 1988 .

Concerning number of lateral shoots per seedling , tabulated data show that 50 ppm TIBA significantly increased number of lateral shoots per seedling in 1987 and 1988. Beside , 1000 and 2000 ppm SADH treatments stimulated lateral buds opening. This effect was

Table (2-a): Effect of growth regulator sprays on vegetative growth of 2- year- old pecan seedlings during 1987 and 1988 seasons.

Treatment	Shoot length increase (cm)	No. of lateral shoots / seedling	Branching angle	No. of leaves / seedling
		(1987)		
Control (Tap water)	12.67 c	1.76 a	28.60°	14.33 bc
TIBA, 50 ppm	8.40 a	3.33 d	50.10°	15.83 cd
6- furfuryle amino purine, 500 ppm	9.47 ab	2.73 bcd	34.30°	10.50 ab
CCC, 1000 ppm	11.77 bc	2.53 bc	29.70°	13.87 bc
CCC, 2000 ppm	11.13 bc	3.10 cd	31.90°	18.57 d
SADH, 1000 ppm	11.13 bc	2.20 ab	31.80°	9.17 a
SADH, 2000 ppm	9.47 ab	2.10 ab	24.50°	10.43 ab
		(1988)		
Control (Tap water)	5.97 c	1.67 a	35.00°	13.00 bcd
TIBA, 50 ppm	5.67 c	3.40 b	48.67°	15.20 d
6- benzyle amino purine, 50 ppm	3.00 ab	2.17 a	40.00°	12.50 bcd
6- furfuryle amine purine, 500 ppm	5.63 c	1.90 a	41.00°	10.53 ab
SADH, 1000 ppm	3.93 b	1.90 a	32.67°	8.33 a
SADH, 2000 ppm	3.03 ab	1.33 a	27.50°	11.00 ab
PP_{333}, 100 ppm	3.90 b	2.17 a	43.20°	14.40 cd
PP_{333}, 200 ppm	2.53 a	3.33 b	50.00°	12.23 bc

Means followed by same letter(s), within each column, are not significantly different from each other at 1% level insignificant in both seasons. Moreover, 500 ppm 6- furfuryle amino purine produced higher number of lateral shoots. The effect was significant in the first season but the reverse was true in the second one. Furthermore, in 1987 1000 and 2000 ppm CCC - sprayed seedlings produced higher number of lateral shoots. In addition, in 1988, 50 ppm 6- benzyle amino purine and 100 ppm PP_{333} did not statistically affect lateral shoots develepment, whereas, 200 ppm PP_{333} greatly enhanced lateral shoots development.

As for branching angles, it is obvious that 50 ppm TIBA - sprayed seedlings produced shoots with wider angles in both seasons. Meanwhile, 2000 ppm SADH - sprayed seedlings produced shoots with narrow angles. Moreover, 1000 ppm SADH and 500 ppm 6- furfuryle amino purine treatments did not exert a combarable effect in this concern in both seasons. Furthermore, in 1987 CCC treatments (1000 & 2000 ppm) did not affect shoot branching angles. On the other hand, in 1988, spraying pecan seedlings either with PP_{333} at 100 and 200 ppm or 6- benzyle amino purine at 50 ppm highly increased branching angles.

With respect to number of leaves per seedling, it is clear that 50 ppm TIBA treatment increased number of leaves. This increase was in significant in both seasons. On the contrary, 1000 ppm SADH - sprays significantly decreased number of leaves produced per seedling in both seasons.

Moreover, 2000 ppm SADH and 500 ppm 6- furfuryle amino purine had a relatively decreasing effect on the number of leaves in both seasons. In addition, in 1987, the high CCC concentration (2000 ppm) increased number of leaves. This effect was insignificant under low concentration. On the other hand, in 1988 neither, 50 ppm 6- benzyle amino purine nor PP_{333} treatments affect number of leaves.

Furthermore , **Table (2- b)** shows the effect of some growth regulator sprays on root growth and seedling dry weight parameters of 2 - year - old pecan seedlings.

As for root length it is clear that 50 ppm TIBA and 2000 ppm SADH treatments showed an oscillating effects in both seasons , as they did not statistically affect root length in 1987 , but they significantly increased root elongation in 1988. Meanwhile , 500 ppm 6- furfuryle amino purine and 1000 ppm SADH treatments did not significantly affect root length in both seasons. Furthermore , in 1987 CCC at 1000 or 2000 ppm did not exert a significant effect. On the other hand , in 1988 season both 50 ppm 6- Benzyle amino purine and 100 ppm PP_{333} treatments resulted in statistical increase in root length over the control. Meamwhile , the difference due to 200 ppm PP_{333} was negligible.

Concerning number of lateral roots per seedling , it is obvious that 50 ppm TIBA and 2000 ppm SADH treatments caused an insignificant increase in number of lateral roots per seedling in both seasons. Meanwhile , 500 ppm 6- furfuryle amino purine did not significantly affect number of lateral roots per seedling in 1987 , but it caused a highly significant increase in the second season. Furthermore in 1987 , 1000 and 2000 ppm CCC treatments highly increased number of lateral roots per seedling , whilst , in 1988 , 50 ppm 6- benzyle amino purine and 100 & 200 ppm PP_{333} treatments did not exert a significant effect.

Regarding total seedling dry weight , tabulated data show that 500 ppm 6- furfuryle amino purine , 50 ppm TIBA and 1000 & 2000 ppm SADH - sprayed seedlings had higher total seedling dry weight in both seasons. Furthermore , CCC either at 1000 or 2000 ppm did not affect seedling dry weight in the first season. Also , in 1988 , 50 ppm 6- benzyle amino purine treatment failed to affect seedling dry weight. Meanwhile , PP_{333} at 100 and 200 ppm concentrations caused a high increase in total seedling dry weight.

With respect to shoot dry weight , it is quite evident that 500 ppm 6- furfuryle amino purine , 50 ppm TIBA caused high significant increase in shoot dry weight in both seasons. Moreover , 1000 ppm SADH treatment succeeded in increasing shoot dry weight , whereas high concentration of SADH failed to induce such increase. Furthermore , 1000 and 2000 ppm CCC treatments did not exert a significant increase in shoot dry weight in 1987. On the other hand , in 1988 50 ppm 6- benzyle amino purine and PP_{333} at 100 ppm did not affect shoot dry weight , while , PP_{333} at 200 ppm highly increased shoot dry weight.

Considering root dry weight , **Table (2- b)** shows that 500 ppm 6- furfuryle amino purine , 50 ppm TIBA , 2000 and 1000 ppm SADH- sprayed seedlings had higher root dry weight values in both seasons. Moreover , in 1987 CCC at 1000 or 2000 ppm did not affect root dry weight. Meanwhile , in 1988 spraying pecan seedlings with PP_{333} either at 100 or 200 ppm as well as 50 ppm 6- benzyle amino purine caused significant increase in root dry weight.

Referring root : shoot ratio it is clear that 2000 ppm SADH and 500 ppm 6- furfuryle amino purine - sprayed seedlings had higher

Table (2-b) : Effect of growth regulator sprays on root growth and seedling dry weight parameters of 2-year- old pecan seedlings.

Treatment	Root length (cm)	No. of lateral roots/ seedling	Total seedling dry wt. (g.)	Shoot dry wt. (g.)	Root dry wt. (g.)	Root : shoot ratio
			(1987)			
Control (Tap water)	73.20 ab	1.10 a	9.13 a	3.10 ab	6.03 a	1.94 a
T IBA , 50 ppm	75.93 ab	1.17 ab	25.90 cd	6.67 d	19.23 cd	2.88 bc
6- furfuryle amino purine , 500 ppm ...	67.33 a	1.53 abc	29.63 d	7.37 d	22.27 d	3.02 cd
CCC , 1000 ppm	82.73 b	1.90 c	8.73 a	2.83 a	5.90 a	2.08 a
CCC , 2000 ppm	72.60 ab	1.73 c	13.20 a	4.80 bc	8.40 a	1.75 a
SADH , 1000 ppm	71.53 ab	1.67 bc	18.17 b	5.77 cd	12.40 b	2.14 ab
SADH , 2000 ppm	69.53 a	1.53 abc	22.56 bc	4.83 bc	17.73 c	3.67 d
			(1988)			
Control (Tap water)	40.23 ab	1.67 a	11.90 a	4.07 a	7.83 a	1.92 ab
TI BA , 50 ppm	63.33 d	2.33 a	24.63 cd	6.73 bc	17.90 c	2.65 bc
6- furfuryle amino purine 500 ppm	38.17 a	2.67 b	29.16 de	6.83 bc	22.33 d	3.27 c
6- benzyle amino purine , 50 ppm ...	53.33 c	2.00 a	15.90 ab	5.33 ab	10.57 b	1.98 ab
SADH , 1000 ppm	44.83 ab	1.67 a	18.70 bc	6.53 bc	12.17 b	1.86 a
SADH , 2000 ppm	55.17 c	2.10 a	22.33 bc	5.07 ab	17.26 c	3.40 c
PP_{333} , 100 ppm	66.00 d	1.67 a	33.00 e	6.20 abc	26.80 e	4.32 d
PP_{333} , 200 ppm	45.57 b	2.60 ab	44.97 f	8.07 c	36.90 f	4.57 e

Means followed by same letter(s),within each column,are not significantly different from each other at 1% level root : shoot ratios in both seasons. Moreover , 50 ppm TIBA sprays caused highly significant increase in root : shoot ratio in the first season , but such effect was insignificant in the second one. Also , 1000 ppm SADH sprays failed to exert a significant effect in both seasons. Furthermore , in 1987 , CCC treatments did not affect that ratio. In 1988 , PP_{333} not only at 200 ppm but also at 100 ppm caused high root : shoot ratio. Meanwhile , 50 ppm benzyle amino purine treatment did not affect root : shoot ratio.

The aforementioned results partially agree with earlier reports by **Lee and Looney (1977) and Hassan et al (1984)** on effect of TIBA , **Runkova (1985)** on effect of 6- furfuryle amino purine , **Boswell et al (1981) and Runkova (1985)** on effect of 6- benzyle amino purine , **Wang and Faust** on effect of CCC , **Kovaleva and Cherrke (1986)** on effect of SADH , and **Swietlik and Miller (1984) and Marquard (1985)** on effect of PP_{333}.

Furthermore , the obtained results indicat that spraying pecan seedlings with 2 , 3 , 5. triiodobenzoic acid (TIBA) reduced stem elongation , increased number of lateral shoots , branching angles , number of leaves per seedling , root length , total seedling dry weight, shoot and root dry weights and root : shoot ratio.

Anyhow , sprouting of axillary buds could be interpreted with one of the following :-

1- TIBA induced sprouting of axillary buds through reducing IAA and ABA concertrations in the stems (**Hassan et al 1985**) or ;

2- TIBA inhibited auxin transport hence inhibition of stem elongation may reflect reduced auxin level in tissues below the apical meristem. This compound usually alter geotropic responses , causes axillary bud break and reduces stem elongation (**Sach and Hackett 1972**).

Meanwhile , 6- furfuryle amino purine increased pecan seedling growth through increasing number of shoots , total seedling dry weight , shoot and root dry weights and root : shoot ratio. Furthermore , 6- benzyle amino purine (BA) did not affect growth except root dry weight and root length , where they were increased.

Such effect of 6- furfuryle amino purine (Kinitin) on growth might be due to that growth substances overcome the apical dominance and consequently increase seedling growth. In this concern , **Schieffer and Sharpe (1969)** found that when the apical dominance is destroyed the control over the quiescent axillary bud changes the net synthesis of deoxyribonucleic acid (DNA) with the elaboration of new metabolic products associated with rapid growth and development. The cytokinin release of auxin - induce axillary bud inhibition appears to be due to stimulation of xylem differentiation and vascular strand development. Beside , the effect of cytokinins on growth of pecan seedlings depend on the kind used. In this respect , 6- furfuryle amino purine surpassed 6- benzyle amino purine in its effect on pecan seedlings growth. **Boswell et al (1981)** found that PBA and BA were more effective in sprouting of axillary buds than PP_{528}.

On the other hand , spraying pecan seedlings with Cycocel (CCC) increased branching of shoots and roots at both concentrations , number of leaves per seedling (especially , 2000 ppm). Other growth parameters were not affeced by CCC sprays.

In addition , the present results show that spraying pecan seedlings with Alar (SADH) reduced shoot length , increased total seedling dry weight , shoot and root dry weights.

Anyhow , the effect of Alar on growth of pecan seedlings could be explained by that the application of SADH induced a reduction in plant growth through inducing inhibition effect in height , internode length as result of reducing subapical meristematic activity via decreasing gibberellin synthesis (**Sach and Hackett , 1972**).

Moreover , spraying pecan seedlings with paclobutrazol (PP_{333}) reduced stem elongation , increased number of lateral shoots per seedling , branching angles , total seedling dry weight , shoot and root dry weights and root : shoot ratio.

Anyhow , the effect of Paclobutrazol on growth of pecan seedlings was noticed in reducing plant height and increasing shoot branching could be explained with the application of pp_{333} inhibited gibberallin biosynthesis which is necessary for increasing shoot extension and internode length.

4-2. Experiment- II: EFFECT OF NUTRITIONAL SPRAYS ON GROWTH OF PECAN SEEDLINGS.

Data presented in **Table (3- a)** and illustrated graphically in **Fig. (1 and 2)** show the effect of nutritional sprays on growth of pecan seedlings expressed as shoot length increase , number of lateral shoots per seedling , branching angles , number of leaves per seedling, stem girth , root length , number of lateral roots per seedling , total seedling dry weight , shoot and root dry weights as well as root : shoot ratio.

It is obvious from **Table (3- a)** and **Fig (1)** that , shoot length increase of both untreated seedlings (control) and 500 ppm zinc sulphate - sprayed seedlings were statistically similar. However , they were significantly higher than those sprayed with 5000 ppm potassium sulphate and 5000 ppm urea. Anyhow , the latter treatments were more or less similar from the statistical point of view in this respect.

Referring to number of lateral shoots per seedling , it is quite evident from **Fig. (1)** that all treatments used significantly increased branching of pecan seedlings as compared with the control. However, seedlings sprayed with 500 ppm potassium sulphate surpassed all other treatments in increasing the number of lateral shoots followed by 500 ppm zinc sulphate and 5000 ppm urea treatments in a descending order. Nevertheless, significant

Table (3-a) : Effect of nutritional sprays on growth of 2-year-old pecan seedlings.

Treatments	Shoot length increase (cm.)	No. of lateral shoots/ seedling	Branching angle	No. of leaves/ seedling	Stem girth (cm.)	Root length (cm.)	No. of lateral roots/ seedling	Total seedling dry wt. (g.)	Shoot dry wt. (g.)	Root dry wt. (g.)	Root : shoot ratio
Control	14.37 b	1.67 a	28.60°	14.33 a	0.63 a	73.30 a	1.10 a	9.13 a	3.10 a	6.03 a	1.95 a
Zinc sulphate, 500 ppm	12.07 b	2.73 bc	32.80°	15.13 a	0.70 a	71.53 a	1.67 a	29.07 b	5.77 ab	23.30 b	4.04 b
Urea, 5000 ppm	7.07 a	2.23 b	25.30°	16.43 a	1.40 b	73.03 a	1.40 a	36.40 c	8.00 b	28.40 b	3.55 b
Potassium sulphate 5000 ppm	6.47 a	3.03 c	37.50°	17.63 a	0.77 a	71.63 a	1.17 a	32.03 bc	6.40 b	25.63 b	4.00 b

Means followed by same letter(s), within each column,are not significantly different from each other at 1% level.

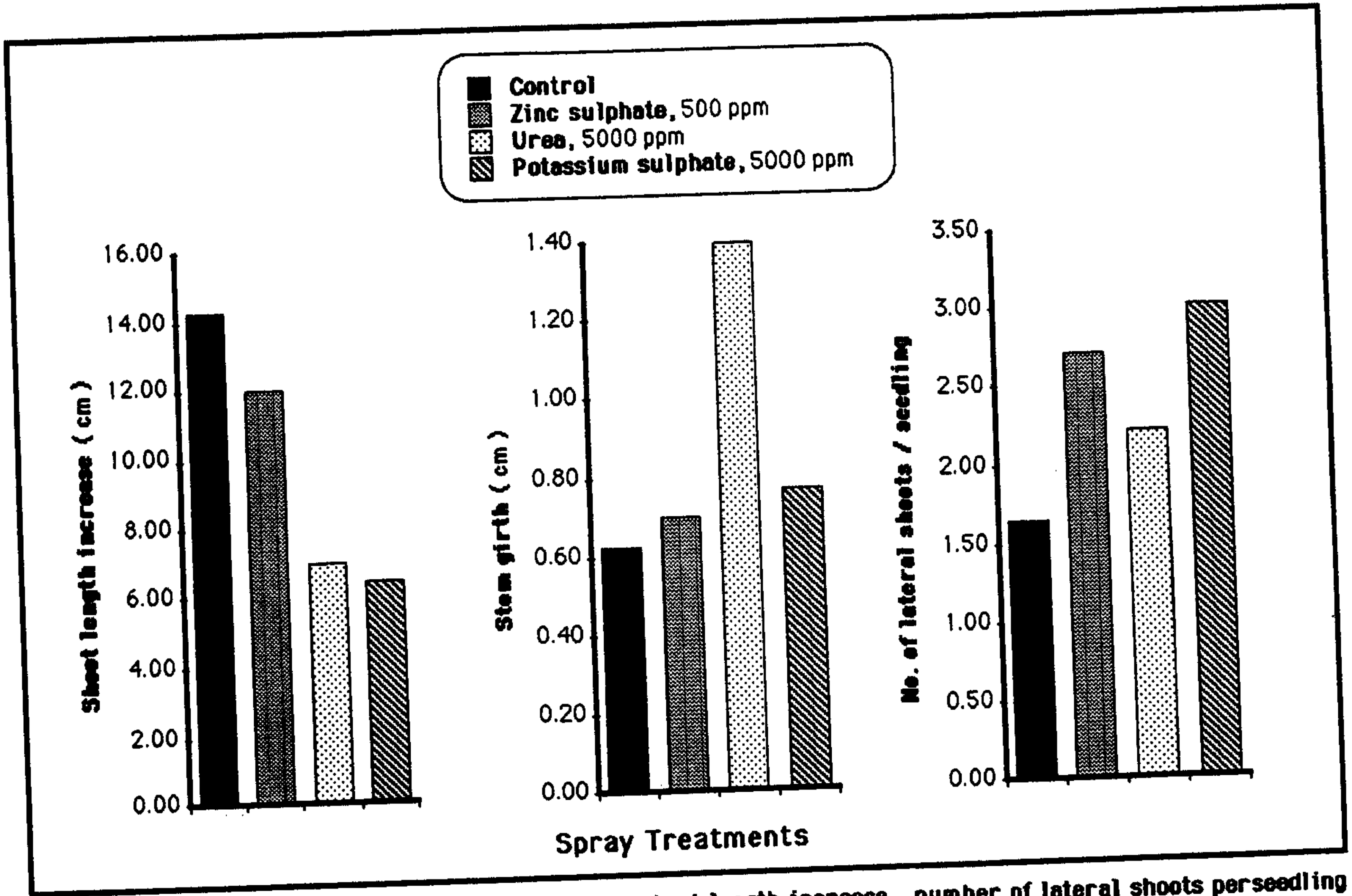

Fig. (1): Effect of nutritional spray treatments on shoot length increase , number of lateral shoots perseedling , and stem girth , of pecan seedlings.

difference between both latter treatments was so little to be statistically significant.

Regarding the branching angles , it is obvious that 5000 ppm potassium sulphate and 500 ppm zinc sulphate sprays gave the widest branching angles. Meanwhile , 5000 ppm urea sprayed seedlings and the control gave an opposite trend in this respect.

Concerning number of leaves per seedling it is interesting to notice that spray treatments had no statistical effect on the number of leaves per seedling. However , seedlings sprayed with 5000 ppm potassium sulphate were superior in this sphere.

Considering , stem girth it is quite evident from **Table (3- a)** and **Fig. (1)** that 5000 ppm urea - sprayed seedlings had the highest values of stem girth. In addition , 5000 ppm potassium sulphate and 500 ppm zinc sulphate treatments had statistically no significant effect in this respect.

As for root length , and number of lateral roots per seedling , it is obvious that all treatments failed statistically to induce any effect.

Concerning total seedling dry weight tabulated data in **Table (3- a)** and illustrated in **Fig. (2)** declare that all treatments used significantly increased total seedling dry weight of pecan over the control. However , 5000 ppm urea sprayed seedlings had the highest total seedling dry weight , followed by 5000 ppm potassium sulphate and 500 ppm zinc sulphate treatments in a descending order. Nevertheless , differences between either urea and potassium sulphate or between potassium sulphate and zinc sulphate sprayed seedlings were so small to reach the significant level.

Regarding shoot dry weight, it is well noticed from **Table(3- a)** and **Fig. (2)** that all treatments increased shoot dry weight as compared with unsprayed seedlings (control). The highest shoot dry weight value was obtained from 5000 ppm urea and 500 ppm potassium sulphate - sprayed seedlings. In the meantime , shoot dry weight of 5000 ppm zinc sulphate treatment was statistically similar to that of the previously mentioned two treatments and the control.

As for root dry weight , **Table (3- a)** and **Fig. (2)** show that all nutritional spray treatments caused an increas in seedling root dry weight over that of the control. However , significant differences between nutritianal spray treatments were lacking. Anyhow , 5000 ppm Urea- sprayed seedlings had the highest root dry weight value, followed by potassium sulphate and zinc sulphate treatments in a descending order.

With respect to root : shoot ratio disclosed data in **Table (3- a)** and illustrated in **Fig. (2)** reveal that seedlings sprayed with different spray treatments had higher values of root shoot : ratio as compared with the control. The highest ratio was for 500 ppm Zinc sulphate and 5000 ppm potassium sulphate treatments followed by 5000 ppm urea treatment in a descending order.

The aforementioned results indicate that spraying pecan seedlings with urea increased significantly stem girth number of lateral shoots , total seedling dry weight , shoot and root dry weights and root shoot : ratio. On the other hand , potassium sulphate sprays gave the same effect dealing with number of lateral shoots per seedling and branching angles. These results confirm the earlier findings of **Neilsen and Hougue (1983)** who sprayed zinc sulphate

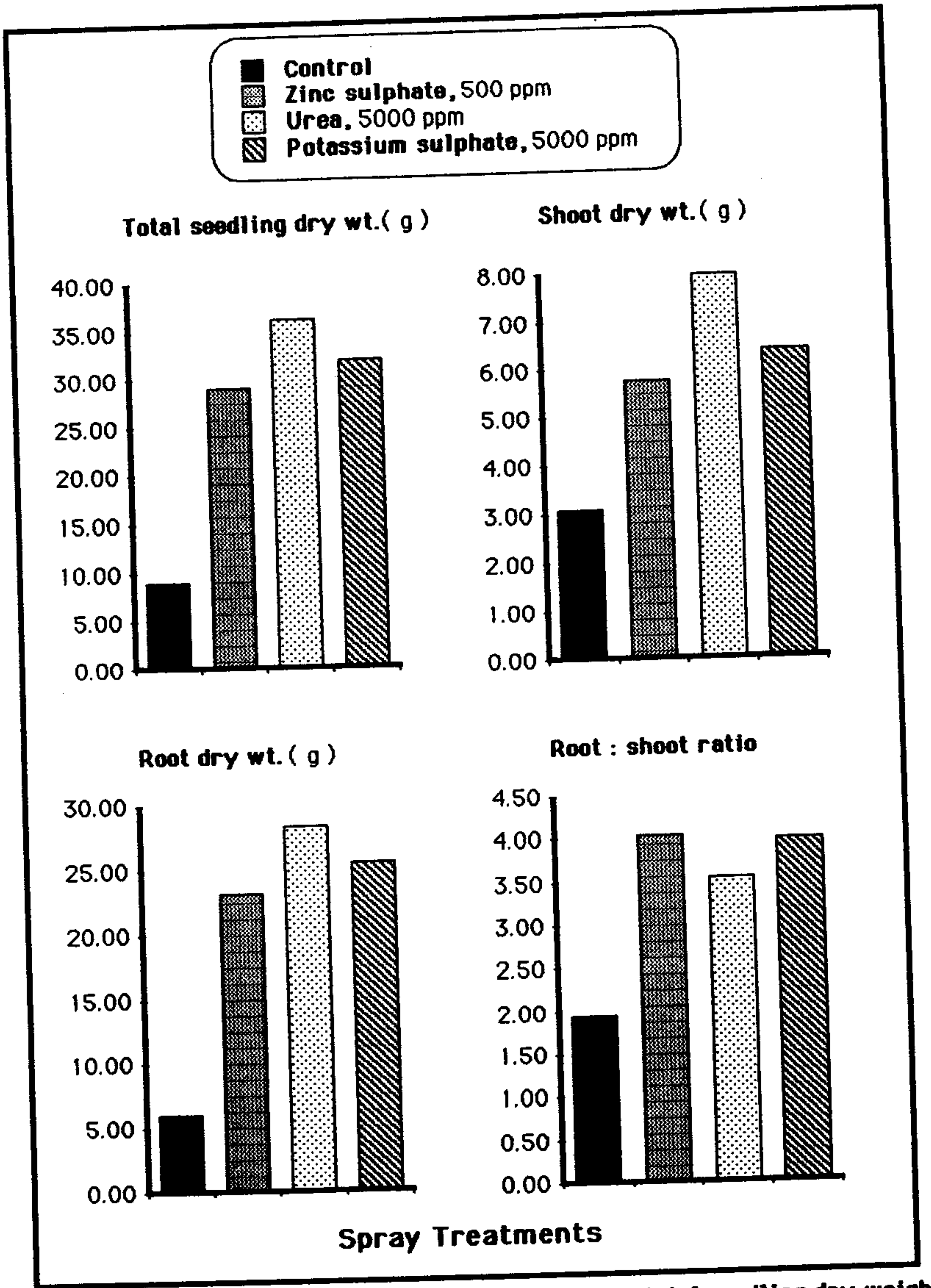

Fig. (2): Effect of nutritional spray treatments on total seedling dry weight, shoot and root dry weights and root : shoot ratio of pecan seedlings

on apple seedlings. Meanwhile, our results contradict the findings of **smith et al (1987)** on adult pecan trees. Morover, **Kamal (1981)**, **Sharaf et al (1985) and Youssef et al (1985)** in citrus plants pointed out similar results in this respect.

The effect of nutritional sprays on leaf minerals content of pecan seedlings is presented in **Table (3- b)**.

Refferring to leaf N content, it is quite evident that 5000 ppm urea treatment significantly increased leaf N content. Simlarly 500 ppm zinc sulphate and 5000 ppm potassium sulphate increased leaf N level, without any significancy.

Regarding leaf P and Ca contents, it is obvious that nutritional spray treatments had no statistical effect in this concern.

Concerning leaf K. and Mg. contents, it is well noticed that, both urea and potassium sulphate treatments significantly increased leaf K and Mg contents. Zinc sulphate treatment caused insignificant increase in leaf K and Mg contents.

Concerning leaf zn content, it is quite clear that all treatments used significantly increased leaf zn concentration of pecan seedlings. However, seedlings sprayed with zinc sulphate treatment were superior in this respect.

In general, spraying pecan seedlings with urea statistically raised up leaf N content while potassium sulphate sprays increased leaf K and Mg contents. Zinc sulphate sprays, on the other hand, increased leaf zn content. Other studied nutrients i-e. P and Ca were not affected statistically by the nutritional spray treatments used.

Table (3-b) : Effect of nutritional sprays on leaf nutrient contents of 2-year-old pecan seedlings.

Treatment	Element concentration in dry leaves					
	N %	P %	K %	Ca %	Mg %	Zn ppm
Control	1.89 a	0.07 a	0.71 a	2.22 a	0.64 a	49.00 a
Zinc sulphate, 500 ppm	2.08 a	0.08 a	0.86 ab	2.25 a	0.67 ab	259.00 c
Urea, 5000 ppm	2.23 b	0.08 a	0.96 b	2.17 a	1.09 bc	77.00 b
Potassium sulphate, 5000 ppm	1.93 a	0.07 a	1.33 c	1.86 a	1.31 c	97.00 b

Means followed by same letter(s),within each column,are not significantly different from each other at1% level

The same findings were obtained by **Diver, et al (1985)** on pecan seedlings , **Neilsen and Houge (1983)** on apple seedlings and **Smith and Story (1979)** on pecan trees.

4-3. Experiment- III: EFFECT OF SOIL INOCULATION BY MYCORRHIZAE FUNGI ON GROWTH OF PECAN SEEDLINGS.

Data reported in **Table (4- a)** and illustrated graphically in **Fig. (3)** show the effect of soil inoculation by mycorrhizae fungi on growth of pecan seedlings expressed as shoot length increase , number of lateral shoots per seedling and number of leaves per seedling.

Tabulated data show that rate of shoot length increase in the sterilized soil was higher than that of unsterilized soil " control ". *Glomus macrocarpus* fungi induced a further increase in shoot length as compared with either sterilized soil or soil sterilized and inoculated by *Glomus australe*. However , significant differences were lacking.

Referring to number of lateral shoots per seedling it is quite evident from **Table (4- a) and Fig. (3)** that soil sterilization induced a slight inhibition of lateral shoots formation that was not significant in both seasons. Sterilized soil and inoculated by mycorrhizae generally promoted lateral shoots formation. Such promotion was highly significant in soils inoculated with *Glomus australe*

As for number of leaves per seedling . **Table (4- a) and Fig. (3)** show that soil sterilization reduced number of developed leavs per seedling. Such effect was highly significant only in the second season. Soil inoculation with mycorrhizae increased number of leaves per

Table (4-a) : Effect of soil inoculation by mycorrhizae fungi on vegetative growth of pecan seedlings.

Treatment	Shoot length increase (cm.)			No. of lateral shoots / seedling			No. of leaves / seedling		
	1987	1988	Mean	1987	1988	Mean	1987	1988	Mean
Control	2.03 a	4.70 a	3.37 a	1.67 ab	1.57 a	1.62 ab	4.00 a	7.33 b	5.67 a
Sterilized soil (St. S.)	2.47 ab	5.00 a	3.74 ab	1.30 a	1.43 a	1.37 a	3.80 a	6.33 a	5.07 a
St. S. + G. m.	3.53 b	4.37 a	3.95 b	1.90 ab	1.80 a	1.85 ab	4.53 a	8.00 c	6.27 a
St. S. + G. a.	2.43 ab	4.40 a	3.42 a	2.43 b	2.67 b	2.55 b	7.46 b	14.23 d	10.85 b

G. m. = *Glomus macrocarpus*

G. a. = *Glomus australe*

Means followed by same letter(s), within each column, are not significantly different from each other at 1% level.

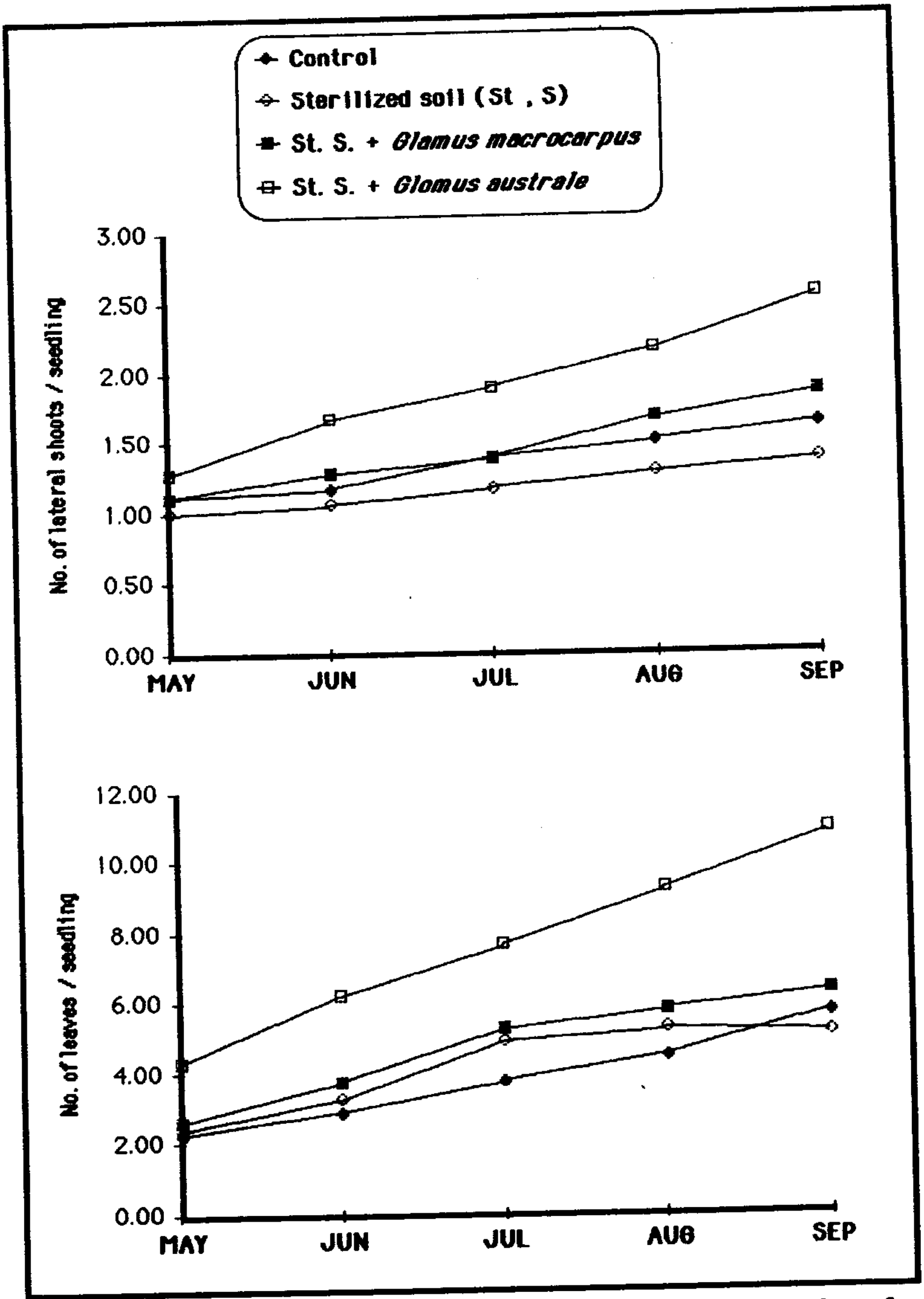

Fig. (3): Effect of soil inoculation by mycorrhizae fungi on number of lateral shoots and leaves per seedling.

seedling. Such increase was highly significant for soil inoculated with *Glomus australe* in both seasons. The same effect was noticed when seedlings were treated with *Glomus macrocarpus* fungi in 1988. Meanwhile , it is quite clear that sterilized soil reduced the number of developed leaves per seedling , as an average of the two seasons. However , no statistical difference was noticed. Furthermore , inoculating the sterilized soil with mycorrhizae fungi increased number of leaves per seedling more than sterilized soil without innoculation. Such increase was highly significant for soil inoculated with *Glomus australe* . These results confirm earlier reports by **Gilmore (1971)** on peach seedlings . **Hattingh and Gerdemann (1975)** on citrus with *Glomusfasciculatus* **Crews et al (1978)** on woody ornamentals. **Maronek and Hendrix (1979)** on pin oak seedlings. **Maronek , et al (1981)** on roots of many species of horticultural plants , **Edrees , (1982)** on rough lemon , sour orange and Cleopatra mandarin seedlings with *Glomusfasciculatus* fungi and **Geddeda et al (1984)** on apple seedlings.

The effect of soil inoculation by mycorrhizae on growth of pecan seedlings expressed as root length , number of feeder roots per seedling , total seedling dry weight , shoot and root dry weights as well as root : shoot ratio are presented in **Table (4- b).**

Tabulated data show that soil sterilization significantly reduced elongation , as compared with the control , inoculating sterilized soil by mycorrhizae , significantly promoted root elongation as compared with sterilized soil only. Furthermore , effect of *Glomus australe* in enhancing root elongation was significantly more pronounced than those seedlings treated with *Glomus macrocarpus* fungi.

Table (4-b) : Effect of soil inoculation by mycorrhizae fungi on root growth and seedling dry weight parameters of pecan seedlings.

Treatment	Root length (cm.)	No. of lateral roots/ seedling	No. of feeder roots/ seedling	Total seedling dry wt. (g.)	Shoot dry wt. (g.)	Root dry wt. (g.)	Root : shoot ratio
Control	40.97 b	1.00 a	16.10 b	5.06 a	0.73 a	4.33 a	5.63 b
Sterilized soil (St. S.)	19.37 a	1.00 a	9.90 a	5.77 a	1.00 a	4.77 a	4.79 b
St. S. + G. m.	52.23 c	1.00 a	28.53 c	9.30 b	1.67 b	7.63 b	4.59 ab
St. S. + G. a.	62.33 d	1.16 a	36.77 d	11.56 c	2.63 c	8.93 c	3.40 a

G. m. = *Glomus macrocarpus*

G. a. = *Glomus australe*

Means followed by same letter (s), within each column, are not significantly different from each other at 1% level.

With respect to number of lateral roots per seedling data show that neither soil sterilization nor soil sterilization combined with inoculation by mycorrhizae fungi treatments had any effect on number of developed lateral roots per seedling.

Referring to number of feeder roots per seedling , it is obvious that soil sterilization induced statistically an inhibiting effect on the formation of feeder roots as compared with the control. Soil sterilized and inoculated with mycorrhizae showed a greater increase in number of feeder roots per seedling. The differences were highly significant. *Glomus australe* fungi induced a significant effect in this respect as compared with *Glomus macrocarpus*.

Moreover data concerning total seedling dry weight indicate that pecan seedlings grown on sterilized soil had slightly higher total seedling dry weight values than those of the control. However , soil inoculated by mycorrhizae fungi , induced statistically a marked increase in seedling dry weight over that grown in the sterilized soil. In the meantime , *Glomus australe* fungi showed significantly a superior effect as compared with the analogous plants inoculated by *Glomus macrocarpus*.

Results concerning shoot and root dry weights of 2 - year - old pecan seedlings showed a similar trend to that of total seedling dry weight for different treatments.In addition , soil sterilization slightly reduced root : shoot ratio. Such ratio was further reduced when the soil was inoculated with mycorrhizae fungi. Anyhow, a significant effect was observed when the soil was inoculated by *Glomus australe* fungi.

These findings confirm those reported by **Linderman and Call (1977)** on bearberry and huckleberry with mycorrhizae , **Edrees**

(1982) on Cleopatra mandarin seedlings with *Glomus fasiculatus* , *Glomus macrocarpus* and *Glomus mosseae* fungi , **Strong and Davies (1982)** on *Solhora secundiflora* seedlings with mycorrhizae fungi and **Edrees et al (1984)** on five citrus rootstocks with four mycorrhizae fungi.

Earlier reports explained the effect of mycorrhizae fungi on growth of pecan seedlings as follows :

1- Vesicular arbuscular mycorrhizae may improve host plant growth through increasing the uptake of P , Zn and other minerals , reducing incidence of soil born plant diseases and increasing tolerance to drought stress. **(Maronek et al 1981).**

2- Adding *Glomus macrocarpus* or *Glomus australe* fungi to unfertilized soil may increase soil available nutrients. **(Gendiah 1987).**

Moreover , obtained results indicate also that th effect of mycorrhizae on roots of pecan seedlings growth depends on the species used. *Glomus australe* fungi surpassed *Glomus macrocarpus* in its effect. In this respect , **Gendiah , (1987)** pointed out that *Glomus australe* fungi enhanced root growth of citrus. Moreover , **Menge and Zentmyer , (1977)** found that *Glomus fasiculatus* increased total weight of avocado seedlings more than *Glomus Calospora* fungi. Beside , Cleopatra mandarin seedlings grown in soil inoculated by *Glomus fasiculatus* , *Glomus macrocarpus* and *Glomus mossaea* species had greater root dry matter when inoculated with *Glomus mosseae* than did the other two fungi species used **(Edrees , 1982).**

4-4. Experiment- IV: RESPONSE OF PECAN SEEDLINGS TO SOIL TREATMENT WITH SOME CHEMICALS.

Data reported in **Table (5- a)** and illustrated graphically in **Fig. (4)** show the effect of soil treatments on growth of pecan seedlings expressed as shoot length increase , number of lateral shoots and number of leaves per seedling.

Referring to shoot length increase , it is obvious that both silver nitrate and zinc sulphate soil treatments caused a reduction in shoot elongation as compared with the control. Such trend was similar in both 1987 and 1988 seasons. However , significant difference was observed in the average of two seasons for both silver nitrate and zinc sulphate soil treatments , as well as zinc sulphate treatment in the second season.

As for number of lateral shoots per seedling , it is quite evident from **Table (5- a)** and **Fig. (4)** that both silver nitrate and zinc sulphate soil treatments caused a slight increase in this respect. Anyhow , the differences were so small to reach the significant level.

Regarding number of leaves per seedling it is found that both silver nitrate and zinc sulphate soil treatments increased number of leaves per seedling , **Table (5- a)** and **Fig. (4).** Such increase was highly significant with zinc sulphate in 1987. On the contrary , in 1988 , as well as , the average of two seasons , the differences between

Table (5-a) : Effect of soil treatment with some chemicals on vegetative growth of pecan seedlings.

Treatment	Shoot length increase (cm.)			No. of lateral shoots / seedling			No. of leaves / seedling		
	1987	1988	Mean	1987	1988	Mean	1987	1988	Mean
Control	2.03 a	4.30 b	3.17 b	1.67 a	1.57 a	1.62 a	4.03 a	6.33 a	5.18 a
Silver nitrate, 0.07 mole/m^2	1.53 a	3.20 ab	2.37 a	2.11 a	2.00 a	2.06 a	4.80 a	9.70 b	7.25 b
Zinc sulphate, 2 mole/m^2	1.57 a	2.40 a	1.98 a	2.10 a	2.10 a	2.10 a	6.43 b	10.00 b	8.22 b

Means followed by same letter (s), within each column are, not significantly different from each other at 1% level.

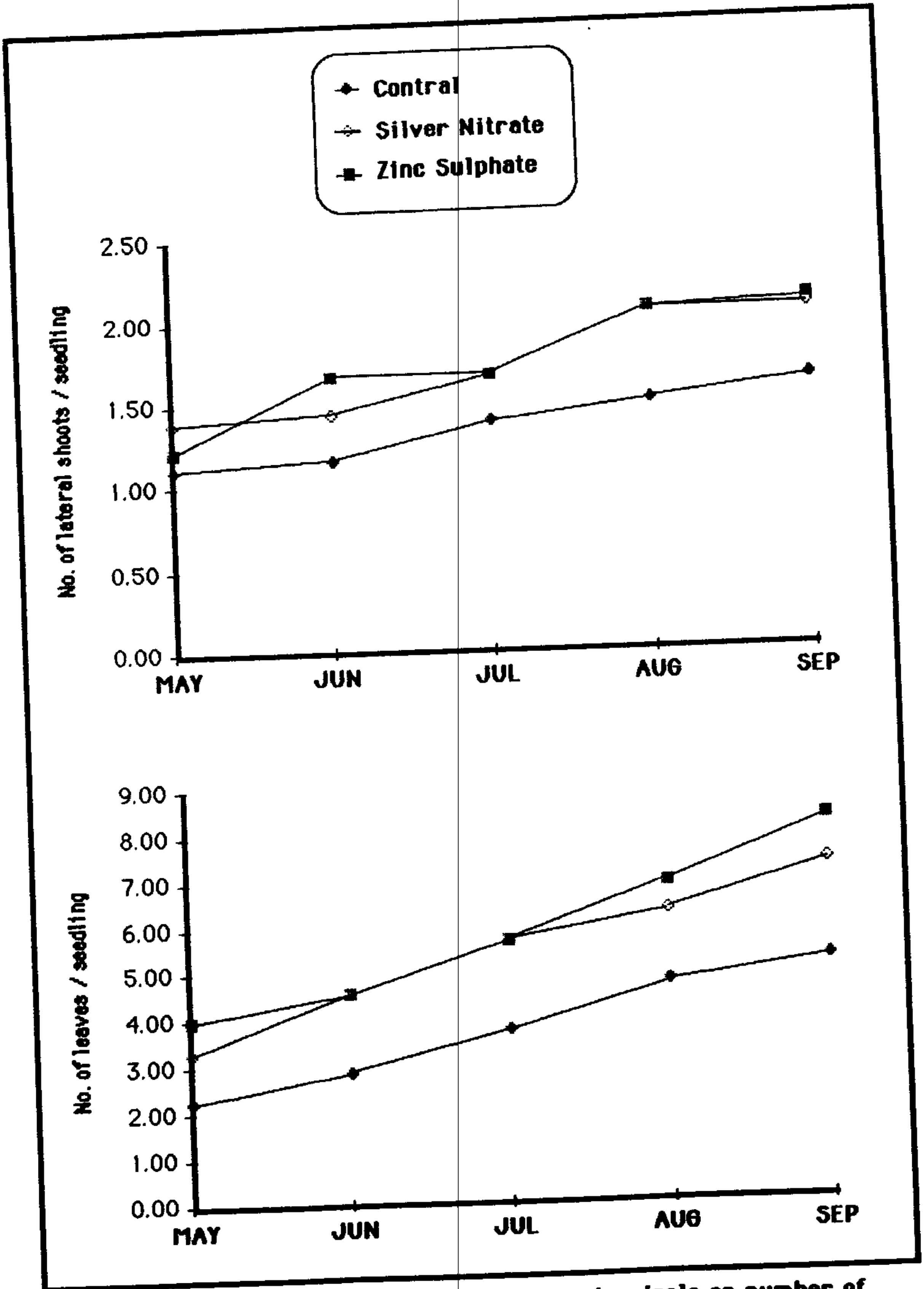

Fig. (4): Effect of soil treatment with some chemicals on number of lateral shoots and leaves per seedling.

the previous two treatments were so small to reach the significant level.

Furthermore , **Table (5- b)** show roots response of pecan seedlings to soil treatment with some chemicals expressed as root length , number of lateral roots and number of feeder roots per seedling , total seedling dry weight , shoot and root dry weights and root : shoot ratio.

At all events , root length was increased by soil treatments used mainly , zinc sulphate treatment which caused a highly significant effect in this respect.

Referring to number of lateral roots per seedling , it is obvious that all treatments failed to induce statistical effect in this sphere.

As for number of feeder roots per seedling , it is noticeable that 0.07 mole / m^2 silver nitrate soil treatment had the lowest value of number of feeder roots per seedling. However , either 2 moles / m^2 zinc sulphate or untreated soil (control) were more or less similar in their values.

Furthermore , total seedling dry weight , showed an increase in response to both soil treatments used. Such increase was highly significant , without any appreciable difference between these two treatments.

Considering shoot dry weight , it is clear that all treatments had no statistical effect in this respect.

Table (5-b) : Effect of soil treatment with some chemicals on root growth and seedling dry weight parameters of pecan seedlings.

Treatment	Root length (cm.)	No. of lateral roots/ seedling	No. of feeder roots/ seedling	Total seedling dry wt. (g.)	Shoot dry wt. (g.)	Root dry wt. (g.)	Root : shoot ratio
Control	52.23 a	1.00 a	16.10 b	5.06 a	0.73 a	4.33 a	6.53 a
Silver nitrate , 0.07 mole/m^2	54.90 a	1.30 a	14.53 a	7.00 b	1.00 a	6.00 ab	6.00 a
Zinc sulphate , 2 mole/m^2	63.97 b	1.53 a	15.57 b	8.40 b	1.10 a	7.30 b	6.69 a

Means followed by same letter (s), within each column , are not significantly different from each other at 1% level.

In addition , root dry weight was increased in response to both soil treatments used. The difference between zinc sulphate treatment and the control was highly significant.

Regarding root : shoot ratio , it is interesting to notice that zinc sulphate soil treatment was superior as compared with other treatments. Nevertheless , significant differences were lacking either within treatments or between treatments and the control.

From the aforementioned results it is safe to conclude that applying zinc sulphate to the soil increased significantly root length , root dry weight , total seedling dry weight , and number of leaves per seedling of pecan. On the other hand , treating soil with silver nitrate reduced shoot length increase and number of feeder roots per seedling but increased total seedling dry weight and number of leaves per seedling , simultaneously.

These results disagree with those obtained by **Pellett et al (1980)**. They reported that silver nitrate , and zinc sulphate were effective in killing root tips of squash , Lima been , and kentucky coffee seedlings without damaging the rest of the plant in greenhouse trials.

However , in the present study , it seems that metal concentrations used were not high enough to kill the root tip of pecan seedlings.

4-5. Experiment- V: RESPONSE OF ONE - YEAR - OLD PECAN SEEDLLNGS TO SOME ROOT TREATMENTS.

Table (6- a) shows the effect of some root treatments on one -year - old pecan seedlings expressed as shoot length increase , number of lateral shoots and leaves per seedling during 1987 and 1988 seasons.

As for shoot length increase , it is obvious that roots of pecan seedlings - shortened and wounded by two vertical cuts at both sides gave statistically longer shoots , in 1987 , as compared with roots shortened only. But , data of 1988 and the mean of two seasons revealed that the stimulating effect of wounding treatment was nil. On the other hand , in the first season , treating the shortened and wounded pecan roots with IBA , NAA and Benomyl greatly reduced shoot length than either those shortened or shortened and wounded treatments in 1987. Anyhow , 2000 and 1000 ppm IBA , as well as , 500 and 1000 ppm NAA treatments gave the shortest shoots , respectively followed by 600 ppm Benomyl. Moreover , in 1988 , treating shortened and wounded pecan roots either with 1000 ppm IBA , or 1000 ppm NAA as well as 600 ppm Benomyl caused insignificant reduction in shoot length ; whereas the opposite was true when pecan roots were treated with 2000 ppm IBA. Beside , average of two seasons show that treating the shortened and wounded pecan roots with 500 and 1000 ppm NAA as well as 1000 ppm IBA + 600 ppm Benomyl significantly inhibited shoot growth as compared with shortening and wounding seedling roots. Meanwhile , 2000 ppm IBA treatment caused slight reduction in shoot length. On the other hand , in 1987 , treating shortened and wounded pecan roots with 600 ppm Benomyl gave insignificantly longer shoots than those seedlings of shortened and wounded roots treated with either 1000 ppm IBA or 500 ppm NAA. In the second season , 1000 ppm IBA + (Treatment 7) gave the shortest shoots as compared with Treatment 7 only or (1000 ppm IBA + 500 ppm NAA + Treatment 7) treatment , whereas (500 ppm NAA + Treatment 7) treatment significantly stimulated shoot growth.

Briefly, it is easy to conclude that both IBA and NAA application either alone or combind with Benomyl resulted in reducing stem length , espeailly at the lower concentration i. e 500 and 1000 ppm for NAA and IBA , respectivly.

Similar results were mentioned by **Hartman and Kester (1972)** on the effect of root shortening and wounding. Meanwhile , the results of IBA and NAA treatments disagree with those reported by **Kelly and Moser (1983- a)** and **Kathiravetpillac et al (1983).**

Concerning number of lateral shoots per seedling , it is clear that neither root wounding nor growth regulators i.e. IBA , NAA and Benomyl as well as their combinations had any effect on number of lateral shoots per seedling. However , **Kelly and Moser (1983- a)** reported contrasting results on the effect of IBA on *Liriodron tulipifera*, L .

Concerning number of leaves per seedling , tabulated data of 1987 , 1988 seasons and their mean , show that wounding the

Table (6-a) : Effect of some root treatments on vegetative growth of 1- year - old pecan seedlings.

Treatment	Shoots length increase (cm)			No. of lateral shoots / seedling			No. of leaves / seedling		
	1987	1988	Mean	1987	1988	Mean	1987	1988	Mean
1- Root shortening (Rs)	2.37 cd	4.07 cd	3.22 cd	2.00 a	2.33 a	2.17 a	3.07 a	4.03 a	3.55 a
2- R.S. +Wounding (W)	3.13 e	3.83 bcd	3.48 d	2.37 a	2.53 a	2.45 a	5.03 bc	8.97 de	7.00 de
3- R.S. +W+ IBA,1000 ppm	1.57 ab	3.87 bcd	2.72 abc	2.27 a	2.50 a	2.39 a	5.33 bc	7.57 cd	6.45 bcde
4- R.s. +W+ IBA, 2000 ppm	1.17 a	5.00 e	3.08 bcd	2.00 a	1.83 a	1.92 a	4.90 abc	6.33 bc	5.62 bc
5- R.S. +W+ NAA, 500 ppm	1.43 ab	3.37 ab	2.40 a	2.37 a	2.43 a	2.40 a	5.23 bc	9.43 e	7.33 e
6- R.S. +W+ NAA, 1000 ppm	1.53 ab	3.57 bc	2.55 ab	1.80 a	2.37 a	2.09 a	4.00 ab	6.83 bc	5.42 b
7- R.S. +W+ Benomyl,600 ppm	2.03 bcd	3.73 bc	2.88 abc	1.96 a	2.17 a	2.07 a	5.10 bc	7.70 cd	6.27 bcde
8- (7)+ IBA, 1000 ppm	1.87 bc	2.80 a	2.33 a	2.26 a	2.20 a	2.23 a	5.47 bc	6.50 bc	5.98 bcd
9- (7)+ NAA, 500 ppm	1.63 ab	4.17 d	2.90 abc	2.10 a	2.33 a	2.22 a	6.50 c	7.27 cd	6.88 cde
10- (7)+IBA, 1000 ppm+NAA, 500 ppm	2.53 d	3.57 bc	3.05 bcd	2.33 a	2.00 a	2.17 a	5.43 bc	5.07 ab	5.25 b

Means followed by same letter(s), within each column , are not significantly different from each other at 1% level.

shortened pecan roots caused a highly significant increase in the number of leaves per seedling than when roots were shortened only. Moreover , treating shortened and wounded pecan roots with 1000 or 2000 ppm IBA , 500 or 1000 ppm NAA and 600 ppm Benomyl did not statistically affect the number of leaves per seedling as compared with the root shortening + wounding treatment. Meanwhile , the trend of the previously mentioned growth regulator treatments took the other way around in 1988 and the mean of two seasons. This was more obvious when shortened and wounded pecan roots were treated with 2000 ppm IBA or 1000 ppm NAA. Such treatments greatly decreased the number of leaves per seedling , whereas , treating shortened pecan roots with 500 ppm NAA caused the reverse without significancy. Beside , treating shortened and wounded pecan roots with 1000 ppm IBA or 600 ppm Benomyl did not statistically affect number of leaves per seedling. On the other hand , as shortened and wounded pecan roots treated with 600 ppm Benomyl (Treatment 7) were compared with aftermentioned treatments i.e. 8 , 9 and 10 , in the table it is clear that the addition of 1000 ppm IBA , 500 ppm NAA or their combinations to Treatment 7 did not statistically affect the number of leaves per seedling except in 1988 , since the addition of the mixture of 1000 ppm IBA and 500 ppm NAA to treatment 7 caused a highly significant increase in number of leaves per seedling. In this respect , **Bolt (1982)** pointed out similar results on the effect of wounding. However , **Kathiravetpillai et al (1983)** reported opposite results on the effect of NAA + IBA.

Furthermore , **Table (6- b)** and **Fig. (5)** show the response of one - year - old pecan seedlings to some root treatments expressed as root length , number of lateral roots per seedling , total seedling dry weight , shoot and root dry weight as well as root : shoot ratio during 1987 and 1988 seasons.

Considering root length , tabulated data revealed that in both seasons , shortening and wounding pecan roots significantly reduced root length than those shortened only. Meanwhile , in 1987 season , treating shortened and wounded pecan roots with IBA , NAA and Benomyl greatly stimulated root growth. This was highly significant when the seedlings received 1000 ppm NAA , 1000 , 2000 ppm IBA and 500 ppm NAA treatments.

Anyhow , wounding pecan roots most likely increased number of lateral roots per seedling , root dry weight and root : shoot ratio. Such increment could be attributed to the presence of wound hormone (Trumatine) which is formed in the crushed tissues **(Bonner and English , 1938).**

Otherwise , shortened and wounded pecan roots treated with 600 ppm Benomyl were statistically similar in their lengths to those shortened and wounded only. Moreover , in 1988 , treating shortened and wounded pecan roots with 1000 or 2000 ppm IBA and 500 or 1000 ppm NAA significantly increased root length. On the contrary , 600 ppm Benomyl treatment had insignificant effect in this respect. The average of two seasons declare that , the treatments that stimulated root elongation could be descendingly arranged as follows : 1000 ppm IBA , 1000 ppm NAA , 2000 ppm IBA , 500 ppm NAA and 600 ppm Benomyl as compared with shortening and wounding pecan roots.

As for shortned and wounded roots , treated with growth regulators as well as with their combinations , it is easy to conclude that in 1987 , 1988 and the average of two seasons , treating shortened and wounded roots + 600 ppm Benomyl i.e. (Treatment 7) with 500 ppm NAA gave the longest roots as compared with treatment (7) only. Other treatments i. e. treatment (7) + 1000 ppm IBA and treatment (7) + 1000 ppm IBA + 500 ppm NAA had root length values statistically similar to each other as well as to those of treatment (7) and 500 ppm NAA. This was more obvious in both 1987 and the mean of two seasons. Similar results were mentioned by **Greene et al (1982) , Struve (1984) and Moser (1984) and Cappiello and Kling (1987)** on the effect of IBA , and NAA , and Benomyl alone or in their combinations. Meanwhile , **Hocking and Thomas (1981 a and b)** reported opposite results on the effect of Benomyl.

Regarding the number of lateral roots per seedling it is obvious that shortening and wounding pecan roots increased number of lateral roots per seedling as compared with root shortening only. This was highly significant in 1988 season as well as the mean of two seasons , while was insignificant in 1987.

On the other hand , treating shortened and wounded roots with IBA , NAA and Benomyl did not statistically affect number of lateral roots per seedling as compared with untreated ones , except those treated with 1000 ppm IBA which had the highest number of lateral roots. Nevertheless , the mean of two seasons , showed another picture , since , treating shortened and wounded pecan roots with 1000 ppm NAA or 600 ppm Benomyl caused a significant reduction in number of lateral roots as compared with untreated ones. Meanwhile, treating shortened and wounded pecan roots with 1000 ppm IBA significantly increased number of lateral roots per seedling. In contrast , other treatments had insignificant effect. Moreover , when shortening + wounding + 600 ppm Benomyl i.e. treatment 7 was

Table (6-b) : Effect of some root treatments on root growth and seedling dry weight parameters of 1 - year - old pecan seedlings.

Treatment	Root length (cm)			No. of lateral roots / seedling			Total seedling dry wt. (g)			Shoot dry wt. (g)			Root dry wt. (g)			Root / shoot ratio		
	1987	1988	Mean	1987	1988	Mean	1987	1988	Mean	1987	1988	Mean	1987	1988	Mean	1987	1988	Mean
1- Root shortening (Rs)	32.60 bc	32.90 bc	32.75 bc	1.17 a	1.17 a	1.17 a	2.63 a	2.86 ab	2.75 ab	0.83 a	0.93 a	0.88 a	1.80 a	1.96 a	1.88 a	2.17 a	2.07 d	2.15 cd
2- R.S. +Wounding (W)	19.23 a	21.80 a	20.52 a	1.50 ab	1.90 bc	1.70 cd	4.53 bc	3.83 cde	4.18 c	1.30 ab	1.43 abc	1.37 ab	3.23 bc	2.40 bcd	2.82 ab	2.48 a	1.68 bcd	2.08 bcd
3- R.S. +W+ IBA,1000 ppm	39.60 cde	46.10 d	42.85 e	2.07 cd	2.33 d	2.20 e	6.20 cd	4.73 ef	5.47 d	1.80 bc	1.77 c	1.78 bc	4.40 cd	2.97 de	3.68 c	2.44 a	1.67 bcd	2.06 bcd
4- R.s. +W+ IBA, 2000 ppm	36.57 cde	39.83 cd	38.20 cde	1.83 bcd	1.83 bcd	1.83 d	8.54 f	4.76 f	6.65 f	2.57 e	2.63 d	2.60 d	5.97 f	2.13 abc	4.05 cd	2.32 a	0.81 a	1.57 a
5- R.S. +W+ NAA, 500 ppm	33.93 bcd	37.00 bc	35.47 cd	1.10 a	1.77 abc	1.43 abc	3.23 ab	3.77 bcd	3.50 bc	1.03 a	1.70 bc	1.37 ab	2.20 ab	2.07 abc	2.13 a	2.13 a	1.22 abc	1.68 ab
6- R.S. +W+ NAA, 1000 ppm	43.40 e	35.83 bc	39.62 de	1.10 a	1.50 ab	1.30 ab	3.67 ab	3.40 abc	3.53 bc	1.20 a	1.40 abc	1.30 ab	2.47 ab	2.00 abc	2.47 ab	2.06 a	1.43 abc	1.74 abc
7- R.S. +W+ Benomyl,600 ppm	27.56 ab	28.23 ab	27.90 ab	1.37 ab	1.35 ab	1.36 ab	2.33 a	2.63 a	2.48 a	0.80 a	0.93 a	0.87 a	1.53 a	1.70 a	1.62 a	1.91 a	1.83 cd	1.87 abcd
8- (7) + IBA, 1000 ppm	33.33 bcd	36.27 bc	34.80 bcd	1.57 abc	1.83 bcd	1.70 cd	6.64 de	5.00 f	5.82 de	1.97 cd	1.63 abc	1.80 bc	4.67 de	3.37 e	4.02 cd	2.37 a	2.07 d	2.22 d
9- (7) + NAA, 500 ppm	41.10 bc	33.10 bc	37.10 cde	2.17 d	2.20 ed	2.18 e	8.03 ef	4.70 def	6.37 ef	2.40 de	1.73 c	2.07 cd	5.63 ef	2.97 de	4.30 d	2.35 a	1.71 bcd	2.03 abcd
10- (7) + IBA, 1000 ppm + NAA, 500 ppm	36.00 cde	33.77 bc	34.88 bcd	1.50 ab	1.57 ab	1.53 bc	6.66 de	5.20 f	5.93 def	2.13 cde	2.53 d	2.33 cd	4.53 de	2.67 cd	3.60 c	2.13 a	1.06 ab	1.59 a

Means followed by same letter(s), within each column , are not significantly different from each other at 1% level.

compared with thereafter treatments in **Table (6- b)** it is clear that in 1987 , 1988 and the mean of two seasons , treatment (7) + 1000 ppm IBA + 500 ppm NAA and treatment (7) + 1000 ppm IBA did not statistically affect number of lateral roots per seedling. Meanwhile , treatment (7) + 500 ppm NAA treatment significantly increased number of lateral roots. **Satyanarayana (1982) , Kelly (1985) , Linton et al (1985)** pointed out analogous results on the effect of wounding. Also , **Hocking and Thomas (1981- b)** pointed out similar results on the effect of Benomyl. In addition , **Gustafson and Miles (1978) , Fordhan (1978) , Moser (1984) , Struve (1984) , Shim (1985) , Blyth (1986) , Simpson (1987) , Boser et al (1987) and Perkins and Kling (1987)** mentioned similar results on the effect of NAA , IBA and Benomyl alone or in combinations.

Concerning total seedling dry weight , it is quite evident from **Table (6- b) and Fig. (5)** that in 1987 , 1988 and the mean of two seasons, wounding the shortened pecan roots increased seedling dry weight as compared with shortened roots only. In addition , treating shortened and wounded pecan roots with 1000 ppm IBA , 500 and 1000 ppm NAA did not statistically affect seedling dry weight. On the contrary , treating shortened and wounded roots with 2000 ppm IBA significantlyincreased seedling dry weight. Meanwhile , substituting 1000 ppm IBA by 600 ppm Benomyl statistically increased total seedling dry weight. However , 1000 and 2000 ppm IBA treatments took the same trend as the mean of the two seasons was concerned.

On the other hand , treatment 7 as compared with aftermentioned treatments , data indicated that treatment 7 + 1000 ppm IBA , treatment " 7 " + 500 ppm NAA resulted in highly

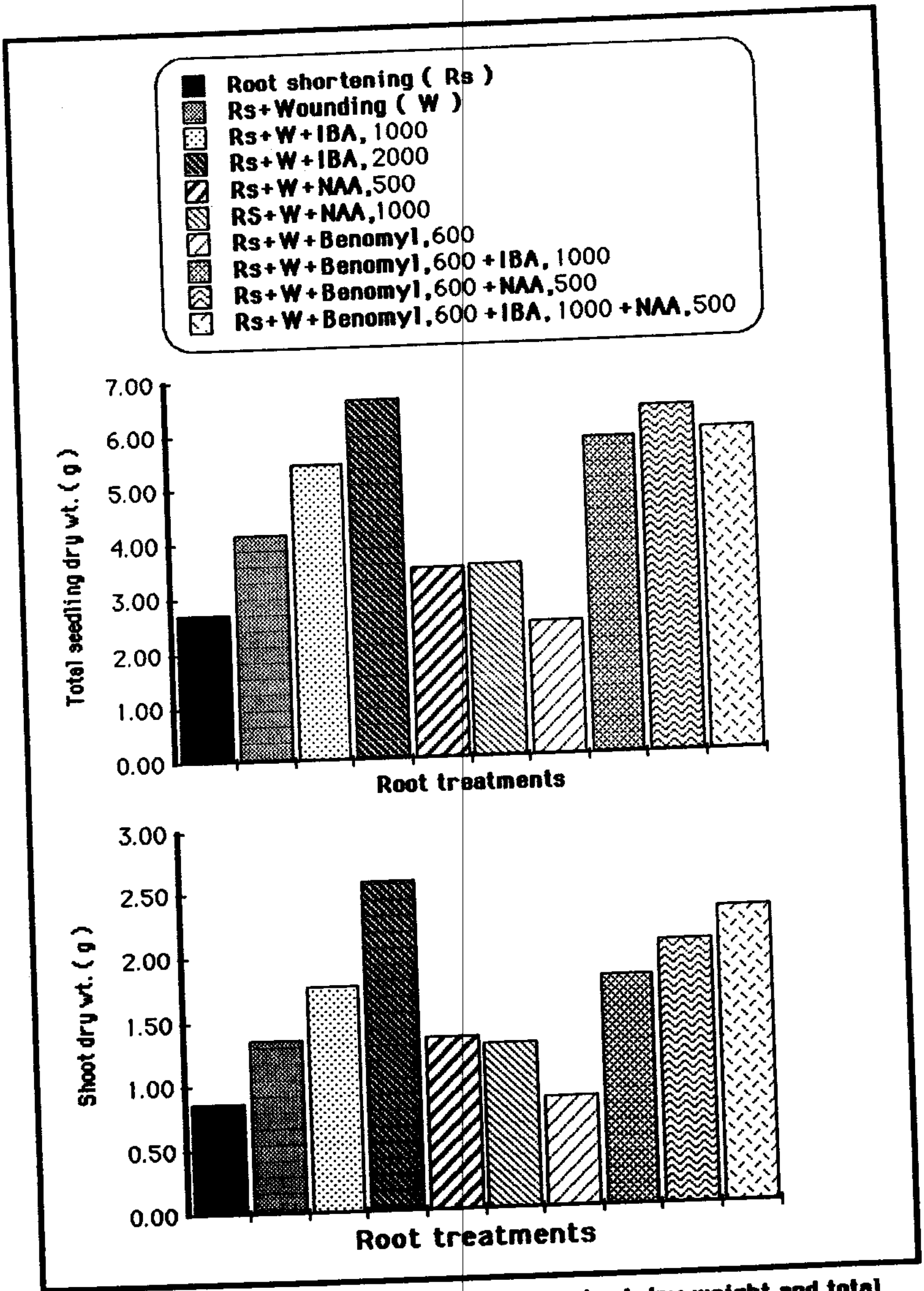

Fig. (5): Effect of some root treatments on shoot dry weight and total seedling dry weight of 1-year-old pecan seedlings.

significant increase in this respect. **Lee et al (1983)** reported similar findings on the effect of Benomyl + IBA.

Regarding shoot dry weight, illustrated data in **Table (6- b) and Fig. (5)** show that in 1987, 1988 and the mean of two seasons, wounding shortened pecan roots caused an insignificant increase as compared with shortened pecan roots only. Moreover, treating shortened and wounded pecan roots with 1000 ppm IBA, 500 or 1000 ppm NAA and 600 ppm Benomyl did not significantly affect shoot dry weight as compared with untreated ones. In addition, the highest value of shoot dry weight was observed with shortened and wounded pecan roots and treated with 2000 ppm IBA. On the other hand, treatment (7) i.e. root shortening and wounding + 600 ppm Benomyl supplied with 1000 ppm IBA or 500 ppm NAA or a mixture of 1000 ppm IBA + 500 ppm NAA significantly increased shoot dry weight than when it was left without supplying with those previously mentioned growth regulators.

Concerning root dry weight, disclosed data in **Table (6- b)** and graphed in **Fig. (6)** declare that shortening and wounding pecan roots gave higher root dry weight values than those shortened only. The effect was highly significant in 1987 and 1988 seasons but insignificant in the mean of two seasons. On the other hand, as for the effect of IBA, NAA and Benomyl on shortened and wounded pecan roots, it is clear that 600 Benomyl caused a high reduction in root dry weight value. On the contrary, 2000 ppm IBA only significantly increased root dry weight in 1987 and the mean of two seasons. Anyhow, 500 or 1000 ppm NAA and 1000 ppm IBA treatments did not statistically affect this character, except 1000 ppm IBA which significantly increased root dry weight in the mean of two seasons. Moreover, comparing treatment (7) with aftermentioned treatments

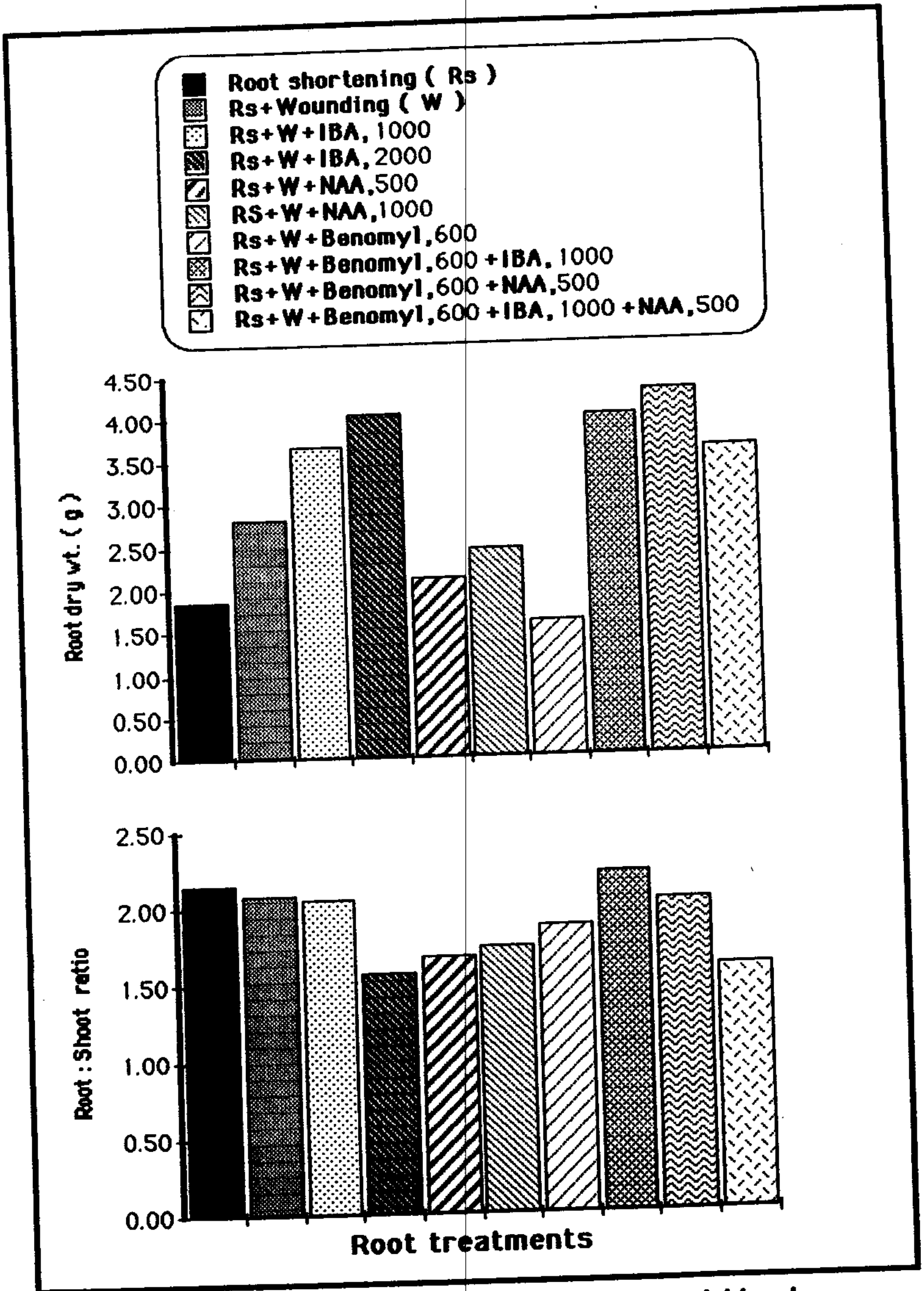

Fig. (6): Effect of different treatments on root dry weight and root : shoot ratio of 1-year-old pecan seedlings.

it is found that the addition of 1000 ppm IBA , 500 ppm NAA or their combinations to treatment 7 significantly increased root dry weight. Similar results were obtained by **Lee et al (1983)** on the effect of Benomyl + IBA and **Simpson (1986)** on the effect of IBA alone.

As for root : shoot ratio , it is clear from **Table (6- a) and Fig. (6)** that all root treatments used failed to exert a statistical effect on root : shoot ratio in 1987. Moreover , data of 1988 and mean of the two seasons show that wounding the shortened roots did not affect root : shoot ratio. Moreover , dipping shortened and wounded pecan roots in 2000 ppm IBA , 500 and 1000 ppm NAA solutions significantly reduced root : shoots ratio. Furthermore , treating 600 ppm Benomyl previously treated seedlings with 500 ppm or 1000 ppm IBA did not added significant affect. Beside , the addition of IBA and NAA in combination to 600 ppm benomyl , treated seedlings caused a highly decrease in root : shoot ratio.

Unfortunately , the effect of some root treatments on root : shoot ratio of pecan seedlings was not enough in the literature to cover our findings.