RESULTS AND DISCUSSION

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I. Nitrogen Fertilization Experiment:

I.A. Effect of Foliar Application of Nitrogen on the Vegetative Growth and Cemical Analysis of Nicotiana sp. Plants during 1993-1994 seasons:

a) Vegetative Growth:

I.a. *Nicotiana Rustica*:

I.a.1. Number of branches/plant:

Data in Table (1) indicated that main effect of nitrogen as foliar fertilization sprays of urea or ammonium sulphate has significant response in increasing number of branches of Nicotiana plant. The maximum response was concomitant to the hight level of urea as (3.7 gm/L) or ammonium sulphate as (8.62 gm/L). The least number of branches/plant as (6.67) was produced with control plants. While urea at (2.5 gm/L) or ammonium sulphate at (5.75 gr/L) gave the next values in this concern as (8.67, 8.56 branches/plant, respectively.

Data of (1993/1994) season in Table (2) shows similar trend of results to those obtained in (1992/1993). In this concern El-Tawil (1993) obtained similar response in branching of vinca rosa plant by using ammonium sulphate, ammonium nitrate or calcium nitrate **Hamouda (1995)** found that the branches of *Ruta graveolens* L. increased by urea, calcium nitrate and ammonium sulphate at the high concentration as 80 Kg N/fed.

Table (1): Effect of foliar application of nitrogen as urea and ammonium sulphate on vegetative growth of *Nicotiana rustica* in the first season 1992/1993.

Treatments	Number of branches/ plant	Plant height/ cm	Fresh weight of stem gm	Dry weight of stem/gm	Number of leaves/ plant	Fresh weight of leaves/ plant g.	Dry weight of leaves/ plant g.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Control	6.67	42.09	130.33	23.67	60.04	62.0	9.67	10.00	7.50	11.00	7.50	7.83	5.67
2.5 g/L urea	8.67	54.50	264.00	35.67	105.00	70.0	13.67	14.50	10.50	11.33	8.09	10.00	7.37
3.75 g/L urea	11.09	51.00	165.33	42.09	173.67	119.00	26.0	14.08	9.33	13.88	10.33	12.17	8.17
5.7 g/L Ammonium sulphate	8.56	54.67	155.00	33.33	88.33	97.00	13.0	14.17	10.08	11.50	10.01	12.10	9.29
8.62 g/L Ammonium sulphate	11.12	59.09	245.67	42.64	125.67	115.00	22.33	14.28	13.10	13.31	10.17	13.17	10.08
L.S..D. at 5%	0.97	1.45	9.09	0.79	7.01	1.50	2.69	0.92	0.93	0.94	1.15	0.70	0.88
L..S.D. at 1%	1.40	2.09	14.31	1.14	13.30	2.18	3.91	1.33	1.34	1.35	N.S	1.01	1.27

Table (2): Effect of foliar application of nitrogen as urea and ammonium sulphate on vegetative growth of *Nicotiana rustica* in the second season 1993/1994.

Treatments	Number of branches/ plant	Plant height / cm	Fresh weight of stem gm	Dry weight of stem/g	Number of leaves/ plant	Fresh weight of leaves/ plant g.	Dry weight of leaves/ plant g.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Control	7.67	43.33	104.00	20.33	62.11	65.33	8.19	9.17	7.17	10.67	9.17	9.01	6.83
2.5 g/L urea	8.00	48.13	206.67	33.33	108.87	89.33	15.33	13.83	10.67	11.98	8.50	11.17	7.17
3.75 g/L urea	10.67	48.00	169.33	38.67	159.32	161.08	19.67	14.67	10.10	15.17	9.85	12.0	9.16
5.7 g/L Ammonium sulphate	7.83	51.34	122.37	32.33	90.33	107.67	13.08	14.16	10.48	12.83	8.67	11.83	9.67
8.62 g/L Ammonium sulphate	9.78	54.30	225.0	47.67	141.33	132.09	17.10	13.96	11.67	14.83	12.33	12.67	11.15
L.S..D. at 5%	1.14	1.31	11.82	3.92	1.19	1.28	0.56	0.95	0.84	1.19	1.23	N.S	1.24
L..S.D. at 1%	N.S	1.85	16.74	5.70	1.73	1.86	0.81	1.38	1.22	1.72	N.S	N.S	1.80

However the enhancement of nitrogen fertilization on branching habit of *Nicotiana rustica* plant could be consider as stimulating to the development of lateral buds growth to branches with synergism of the needed nitrogen compounds to this process. Similar results were obtained by **Safea and Khalil (1992)** on *Pelargonium zonal* and **Hassan *et al* (1976)** on Rosa c.v. Roga, Meilland.

I.a.2. Plant height in cms:

Data presented in Tables (1 & 2) show that foliar sprays of nitrogen fertilizers as urea or ammonium sulphate at low or high concentration increased significantly plant height of *Nicoriana rustica* plant. The most effective treatment in this respect was that of ammonium sulphate at the concentration of (8.62 g/L) which gave plants of 59.09 and 54.30 cm height veresus to 42.09 and 43.33 for control in both seasons of experiments respectively.

As for nitrogen fertilization sources it is clear that the higher level of ammonium sulphate was of high significant effect in increasing plant height than any other application in both seasons Table (1 & 2), while high level of urea was of no effect in increasing plant height over the lower one.

The positive effect of nitrogen fertilization on plant height was mentioned by many investigators on many medicinal and aromatic plants, **Hassan *et al* (1976)** on *Rouge meilland rose*, **Eid and Mohamed (1988)** on *Catharanthus rosous* and **Safaa and Khalil (1992)** on *Palargonium zonal*.

I.a.3. Fresh and dry weights of stem in gms:

Application of urea at (2.5 gm/L) and ammonium sulphate at (8.62 gm/L) were effective in increasing the fresh weight of stem as 264.00 and

245.00 gms compared to 165.33 and 155.00 gms with (3.7 gm/L) urea and (5.75 g/L) ammonium sulphate, respectively as shown in Table (1). The least fresh weight as 130.33 gm was noticed with untreated plants. Statistical analysis showed significant differences among these treatments during the two seasons Tables (1 & 2).

As for dry weight of stem, data in Tables (1 & 2) indicate that nitrogen fertilization was of main effect on stem dry weight of Nicotiana plant, since most nitrogen levels from the different sources, urea and ammonium sulphate resulted in significant increase in dry weight of stem in both seasons. The maximum increase was recorded with the high level of both urea and ammonium sulphate in the first and second seasons. The control plants gave lowest dry weight of stem as 23.67, 20.33 gm in the first and second season, respectively.

I.a.4. Number of leaves/plant:

It is clear from the results shown in Table (1) that nitrogen has a great effect on the mean number of leaves/plant. The two concentrations of both sources of nitrogen increased significantly the mean number of leaves/plant over control, although the high concentrations were of more effect.

Also, urea concentrations were superior those of ammonium sulphate in this concern. The data of the two seasons Tables (1 & 2) confermed the same trend. The mean number of leaves recorded were; 60.04, 105.00, 173.67, 88.33 and 125.67 for control, urea 2.5 gm/L,urea 3.7 g/L), ammonium sulphate 5.75 gm/L and ammonium sulphate 8.62 g/L, respectively in the first season, and it were: 62.11, 108.87, 159.32, 90.33 and 141.33 for the prementioned treatments in the second season.

The obtained results are in agreement with many workers as **Eid and Mohamed (1988)** on *Catharunthus roseus* and **Majernik and Lejko (1987)** on tobacco cv. V-6.

I.a.5. Fresh and dry weight of leaves/plant in gm:

The data recorded for the frsh weight of leaves of *Nicotiana rustica* plant presented in Tables (1,2), show clearly that the mean fresh weight was increased significantly by nitrogen fertilization in both seasons. In this respect the increases over control plants were: 19.3%, 91.9%, for urea concentrations of 2.5 and 3.7 g/L and it were 56.6% and 85.5% fo ammonium sulphate concentratons 5.75 and 8.62 g/L respectively in the first season.

Data of the next season showed also nearly similar trend of result. Concerning the dry weight, the data in the same Tables clear that the treatments which increased fresh weight of leaves were the same which gave the heaviest dry weight, while the unfertilized plants with nitrogen produce the least dry weight of leaves as 9.67 gms and 8.19 gms for both seasons, respectively as shown in Tables (1,2) the differences among the treatments were significant in both seasons of the experiments. These results are in accordance with those reported by **Majernik and Lejko (1987)** on tobacco cv. V-6, and **Eid and Mohamed (1988)** on *Catharanthus roseus*.

I.a.6. Mean length and width of lower leaf in cms:

Data in Table (1) clear that all nitrogen fertilization sources at different concentrations increased the length of lower leaf without significant differences between them, but these increases reached the significant range over control plants. The data of the second season (1993-

1994) Table (2) confermed the same trend obtained in the first season (1992-1993).

As for the main effect of nitrogen levels and source on width of lower leaf, data presented in Table (1) clear that the higher rate of ammonium sulphate (8.62 gm/L) was of most effect in increasing the width of lower leaf as 13.10 cm comparing with unfertilized plants which produced the minimum width of lower leaf as 7.50 cm. Statistical analysis cleared also significant increases for all treated plants over control. Data in the second season shown in Table (2) appear similar trend of results to those obtained in the first one. Similar results was obtained on *Cutharanthus rosa* by **Eid and Mohamed (1988).**

I.a.7. Mean length and width of middle leaf in cm:

Spraying urea or ammonium sulphate at the high concentrations produced more length of middle leaf as 13.88, 13.31 Cms, respectively as shown from Table (1) while the lower concentration of both nitrogen sources was of no clear effect on the mean width of middle leaf over control plants in the first season. Data of the second season Table (2) show nearly similar trend for the high concentrations of nitrogen, while it reflect significant increase in this character regard to the lower concentrations of the two nitrogen sources over control plant.

Concerning width of middle leaf the data presented in Table (1) show slight increase due to all the fertilization treatments over control plants without clear differences between the different concentrations of the two sources of nitrogen in the first season. While with the second season there was significant increase in this character resulted from the high concentration of ammonium sulphate over all other treatments or control plant, Table (2).

Generally the effect of spraying nitrogen with different concentration or sources was of less noticable effect on increasing the mean width of the middle leaf than its effect with the lower leaf.

I.a.8. Mean length and width of upper leaf in cms:

Nitrogen fertilizer had a stimulating effect on upper leaf length of tobacco plants. Upper leaf length tended to increase with increasing level of nitrogen. The unfertilized plants gave the least length as 7.83 and 9.01 cms in the first and second seasons, respectively Tables (1 & 2).

The higher level of ammonium sulphate (8.62 gm/L) prodced the largest, length of upper leaf as 13.17 cms, 12.67 cms in the first and second seasons. On the other side, urea at 3.7 gm/L and ammonium sulphate at 5.72 gm/L gave the next value as 12.17, 12.10 cms in this respect statistical analysis showed significant differences among these treatments during the first season and unsignificant in the second one.

The effect of nitrogen sources and concentrations on the width of upper leaf, Table (1) clear that ammonium sulphate at 5.7.5 and 8.62 gm/L) gave the largest width of upper leaf as 9.29 and 10.08 cm, respectively the least width as 5.67 cm produced with untreated plants. While urea at 2.5 or 3.7 gm/L produced the next value in this concern as 7.37 and 8.17 cm respectively.

Data of (1993/1994) in Table (2) revealed that the maximum width of upper leaf produced also with the higher level of ammonium sulphate (8.62 gm/L) as 11.15 cm, while ammonium sulphate at (5.75 gm/L) or urea at (3.7 gm/L) gave the next value as 9.67 and 9.16 cm, respectively.

These results were agree with those obtained by **Gupta *et al* (1961)** on Hookah tobacco and **Pritchett *et al* (1961)** on *Nicotiana rustica*.

Generally it can be concluded that the high level of nitrogen fertilizer as (3.7 gm/L) urea and (8.62 gm/L) of ammonium sulphate increased significantly the vegetative growth of *Nicotiana rustica*. Moreover the low level produced plants of higher growth parameters than the unfertilized one. These results confermed with those obtained by **Eid and Mohamed (1988)** on *Catharanthus roseus*.

I.a.9. Number of fibrous roots/plant:

In both seasons of experiments no significant increases could be observed between all the treatments of nitrogen, concerning the number of fibrous roots/plant as shown in Table (3). Data indicate that (3.7 gm/L) of urea and (5.75 g/L) ammonium sulphate increased the number of fibrous roots/plant as 19.86, 18.98 fibrous roots respectively compared to 15.67 for control plant. Also (2.5 gm/L) urea and (8.62 gm/L) ammonium sulphate gave the next value in this concern. While the lowest number of fibrous roots/plant was produced with control plant as 15.67 fibrous roots/plant.

Similar trend of results was obtained in second season as shown in Table (3).

I.a.10. Mean length of fibrous roots in cms:

Data of both seasons recorded in Table (3) show that spraying nitrogen as urea or ammonium sulphate increased significantly the mean length of fibrous roots/plant, and that this number increased as the concentration of nitrogen increased, although nitrogen as ammonium sulphate was superior in this concern. The mean length of fibrous roots/plant recorded for the treatments were 32.35, 36.67, 41.56 and 43.09 cm for urea (2.5 gm/L), urea (3.7 gm/L), ammonium sulphate (5.75 gm/L)

and ammonium sulphate (8.62 gm/L) respectively compared to 27.33 cm for control plant in the first season and they were 29.01, 32.33, 37.09, 42.07 for the second season compared to 26.67 cm for contol.

It can be concluded that nitrogen fertilization especially ammonium sulphate increased the length of fibrous roots of nicotiana plants and such increase might be due to the inhancement in cell division and cell growth resulting in taller fibrous roots.

I.a.11. Fresh and dry weights of fibrous roots in gms:

Results of the first season in Table (3) show that the fresh and dry weight of fibrous roots were greatly affected by different concentrations and sources of nitrogen fertilizers. The lowest heaviest fresh weight of roots as 89.50 gms was produced by 3.7 gm/L of urea compared to 30.67 gms with control plants. While (2.5 gm/L) urea and (8.62 gm/L) of ammonium sulphate gave the next values in this concern as 69.70 and 68.81 gms, respectively similar trend was true in the second season (1993/1994) Table (3). Also all differences were highly significant in both seasons.

The dry weight of roots show similar trend of results as the fresh weight in both seasons Table (3).

Generally it appears that (3.7 gm/L) of urea or (8.62 gm/L) of ammonium sulphate resulted in the highest increase in both vegetative growth and root parameters. These results may be interpreted the suitable concentration and source of nitrogen, which in turn, increased building metabolites and resulted in more growth due to the activation of the anabolic processes in plant, which were translocated from the leaves and or the roots leading to more growth and rooting.

Table (3): Effect of foliar application of Nitrogen on roots parameters of *Nicotiana rustica* during 1992-1993 & 1993-1994 seasons.

Treatments	Number of fibrous roots		Mean length of fibrous roots/cm		Fresh weight of fibrous roots/g.		Dry weight of fribrous roots/g.	
	92-93	93-94	92-93	93-94	92-93	93-94	92-93	93-94
Control	15.67	11.67	27.33	26.67	30.67	29.33	8.01	7.86
2.5 g/L urea	17.10	13.67	32.35	29.01	69.70	59.41	19.03	13.83
3.75 g/L urea	19.86	16.590	36.67	32.33	89.50	78.03	25.67	18.33
5.74 g/L annoniuum sulphate	18.98	14.37	41.56	37.09	59.00	57.09	14.33	15.63
8.62 g/L. annoniuum sulphate	16.97	15.18	43.09	42.07	68.81	62.67	20.33	19.14
L.S.D. at 5%	N.S	N.S	1.19	1.24	6.23	7.65	1.11	0.78
L.S.D. at 1%	N.S	N.S	1.72	1.83	8.79	9.46	1.62	1.14

2.a. *Nicotiana alata*:

2.a.1. Number of branches/plant:

Concerning number of branches/plant as affected by foliar application of nitrogen it is clear from the data of both seasons, Tables (4 & 5) that there was an increase in this character due to nitrogen treatments specially with ammonium sulphate at high concentration of 8.62 gm/L, although the differences between treatments were not significant in the first season as shown in Table (4). The next treatment which gave high number of branches/plant as 3.76 was that of 3.7 gm/L urea. The least noticed with control plants. The differences between treatments were significant in the second season. These results are in accordance with those attained by **Hassan *et al* (1976)** on *Rosa* cv. Rog meilland, **Hamouda (1995)** on *Ruta graveolens*, L.

2.a.2. Plant height in cms:

Data in Tables (4 & 5) show that the hight of *Nicotiana alata* plant was significantly increased as nitrogen concentration increased with both sources of nitrogen. At the meantime the highest level of ammonium sulphate (8.62 gm/L) was more effective in increasing plant height than the other levels of urea or ammonium sulphate. The control plants produced the shortest plants as 84.01, 79.33 cms in the first and second season, respectively.

At this regard several investigators pointed to the enhancement effect of different nitrogen fertilization sources on plant height among them, **Lomprechsaymen (1971)** on tobacco and **Hamouda (1995)** on *Ruta graveolens*.

Table (4): Effect of foliar application of nitrogen as urea and ammonium sulphate on vegetative growth of *Nicotiana alata* in the first season 1992/1993.

Treatments	Number of branches/ plant	Plant height/ cm	Fresh weight of stem/ gm	Dry weight of stem/g	Number of leaves/ plant	Fresh weight of leaves/ plant g.	Dry weight of leaves plant g.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Control	3.67	84.01	148.50	31.07	20.31	100.67	25.08	32.67	9.67	29.08	9.67	22.67	6.67
2.5 g/L urea	4.02	88.33	174.67	38.10	23.38	104.33	30.09	38.17	13.00	36.33	13.0	21.33	8.33
3.75 g/L urea	4.41	94.33	175.08	49.83	24.67	111.00	33.50	38.01	14.67	42.00	13.73	36.07	10.33
5.7 g/L Ammonium sulphate	4.20	99.87	161.67	39.67	32.33	143.84	36.86	41.87	13.67	41.67	14.00	31.33	11.05
8.62 g/L Ammonium sulphate	4.38	103.59	160.37	52.33	42.09	176.33	41.67	39.97	13.98	34.33	11.33	29.67	9.33
L.S..D. at 5%	N.S	1.83	7.40	1.72	0.87	3.99	1.66	1.19	1.51	1.28	1.15	1.02	1.18
L..S.D. at 1%	N.S	2.65	9.03	2.56	1.26	4.43	2.41	1.73	N.S	1.86	1.66	1.48	1.72

Table (5): Effect of foliar application of nitrogen as urea and ammonium sulphate on vegetative growth of *Nicotiana alata* in the second season 1993/1994.

Treatments	Number of branches/ plant	Plant height/ cm	Fresh weight of stem/ gm	Dry weight of stem/g	Number of leaves/ plant	Fresh weight of leaves/ plant g.	Dry weight of leaves/ plant g.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Control	2.33	79.33	135.87	26.00	16.00	81.03	23.57	38.47	11.05	31.67	10.33	21.33	7.05
2.5 g/L urea	3.31	83.67	194.67	45.33	20.67	96.67	28.03	39.57	12.43	32.33	11.67	22.34	7.87
3.75 g/L urea	3.76	85.67	195.33	45.87	25.67	140.33	32.67	41.03	14.09	38.00	12.97	24.68	8.67
5.7 g/L Ammonium sulphate	3.08	90.83	187.33	41.00	29.89	123.07	34.67	41.90	12.17	36.00	13.53	23.87	8.50
8.62 g/L Ammonium sulphate	4.34	97.68	206.33	50.17	40.11	138.67	39.87	44.13	13.23	33.00	12.59	32.67	8.33
L.S..D. at 5%	0.86	1.09	8.72	1.08	1.14	5.01	0.93	0.58	0.66	1.01	0.79	1.09	0.59
L..S.D. at 1%	1.23	1.58	10.87	1.56	1.66	6.24	1.35	0.84	N.S	1.46	1.01	1.59	N.S

2.a.3. Fresh and dry weight of stem in gms:

Fresh weight of *Nicotiana alta* plant seems increased significantly by nitrogen applications over control plant in both seasons as shown in Tables (4 & 5). It is clear also that there was no significant difference between the high concentration and the low one with both urea or ammonium sulphate. Also the superiority of one source over the other was not constant in both seasons as shown in Tables (4 & 5). But generally there were remarkable and significant increases due to nitrogen applicatioon over untreated plants.

As for dry weight of stem, data in Table (4 & 5) indicate that the mean dry weight of *Nicotiana alata* plant stem increased significantly with nitrogen applications with both sources used, and the most effective treatment in this respect was that of ammonium sulphate at (8.62 gm/L) in both seasons. The mean values recorded for this character were: 38.10, 49.83, 39.67 and 52.33 gms for urea (2.5 gm/L) urea (3.7 gm/L) ammonium sulphate (5.75 gm/L) and ammonium sulphate (8.62 gm/L) respectively compared to 31.07 for control plant in the first season, while they were: 45.33, 45.87, 41.0 and 50.17, respectively compared to 26.0 for control plants in the second season.

2.a.4. Number of leaves/plant:

Table (4 & 5) show that the effect of nitrogen on number of leaves/plant was of significant response in both seasons (1992/1993) and (1993/1994). The highest number of leaves was resulted from treating *N. alata* plant with ammonium sulphate at 8.62 gm/L followed by ammonium sulphate at 5.75 gm/L with means of 42.09 and 32.33 leaves/plant, respectively. At the meantime, urea at 2.5 or 3.7 gm/L

produced 24.67, 23.38 leaves/plant, respectively, while the control plants gave only 20.31 leaves/plants.

The results in the second season were in harmony with those obtained in the first one Table (5). These result are in agreement with those obtained by **Eid and Mohamed (1988)** on *Catharanthus roseus* and **Majernik and Ljko (1987)** on tobacco cv.v.6.

2.a.5. Fresh and dry weight of leaves/plant in gms:

Tables (4 & 5) presented the effect of different conentrations and different sources of nitrogen on the mean fresh weight of leaves/plant. It is clear that both sources at any concentration were significantly effective in increasing the mean fresh weight of leaves/plant over control. It is clear also that the higher concentration of both urea or ammonium sulphate was superior the lower one in this concern. The trend of result was nearly the same with the two seasons. The mean values of fresh weight of leaves/plant were: 104.33 and 111.00 gms for urea concentrations and 143.84 and 176.33 gms for ammonium sulphate concentrations, respectively compared to 100.67 gms for control plant in the first season and they were 96.67 and 140.33 gms for urea concentrations and they were 123.07 and 138.67 gms for ammonium sulphate concentrations compared to 81.03 gms for control plant in the second season.

As for dry weight of leaves, data in Tables (4 & 5) of the two seasons show that dry weight of leaves was significantly affected by nitrogen spraying. The higher values were obtained from using the high concentration of both urea or ammonium sulphte followed by the lower one, although ammonium sulphate as a source of nitrogen at both concentration was superior urea in this respect. It could be noticed that dry weight of leaves/plant, take the same trend as that of fresh weight in both

seasons of the experiments. These results are in agreement with **Majerink and Lejko (1987)** on tobacco cv.v.6.

2.a.6. Mean length and width of lower leaf in cms:

Data tabulated in Tables (4 & 5) show the effect of nitrogen tresatments on mean length of lower leaf. It is clear that, the highest value of mean length of lower leaf was obtained from treating plants with the lower rate of ammonium sulphatre (5.75 gm/L) in the first season whereas the higher level of ammonium sulphate (8.62 gm/L) gave the highest value with the second season.

Generally all concentrations of nitrogen with both sources increased significantly the mean length of lower leaf of *Nicotiana alata* over untreated plant and the trend of resuts was confermed in both seasons.

As for width of lower leaf, the highest values of mean width of lower leaf were obtained from nitrogen adding with highest rates of both sources in the first and second season, Tables (4 & 5).

Also all nitrogen concentration of different sources produced wider leaves than control plant significantly at the rate of 5% (Tables 4 & 5).

These results might be attributed to the stimulating effect of nitrogen on the number and or the size of cells. The increase in leaves parameters (length or width) reflect healthy growth owing to adequate amount of nitrogen fertilization. Many investigators such as **Eid and Mohamed (1988)** on *Catharanthus roseus* and **Safaa and Khalil (1992)** on *Pelorgonium zonal* came to similar results.

2.a.7. Mean length and width of middle leaf in cms:

Data of mean length of middle leaf Tables (4 & 5) show significant increase in this character due to all treatments of spraying nitrogen as urea

or ammonium sulphate at any concentration, while urea at high concentration and ammonium sulphate at low concentration obtained significantly taller middle leaves over all other treatments in both seasons. The shortest middle leaves were obtained with control plant. These results are concordance with those obtained by **Eweida *et al* (1979) and El-Mihi (1980)** on tobacco plants.

As for width of middle leaf, larger width was obtained at 5.75 gm/L of ammonium sulphate and urea at 3.7 gm/L in the first and second seasons as 14.00, 13.53, 13.73 and 12, 97 cms respectively as shown in Tables (4 & 5). The control plants gave the minimum width of middle leaf as 9.67 and 10.33 cms in the first and second seasons, respectively. Also, all other treatments increased significantly the width of middle leaf. Similar results were obtained by **Eid and Mohamed (1988)** on *Catharanths roseus*.

2.a.8. Mean length and width of upper leaf in cms:

The mean length of upper leaf of tobacco *Nicotiana alata* plant tended to increase by spraying nitrogen with any source, and this increase was more clearer with the higher concentration especially with the data of second season Table (5).

The effect of nitrogen fertilizer on width of upper leaf presented in Tables (4 & 5) show that both sources of nitrogen at low or high concentration increased significantly the mean width of upper leaf than untreated one.

The high concentration of urea and the low concentration of ammonium sulphate were the most effective in this respect over all other treatments during both seasons, although the differences between

treatments were not significant with the second season (1993-94). These results conferned by those obtained by **Eid and Mohamed (1988)** on *Catharanthus roses*.

I.A.d.9. Number of fibrous roots/plant:

Mean number of fibrous roots of *Nicotiana alata* plants as affected by sprasying nitrogen in the first and second seasons recorded in Table (6) show generally that all nitrogen concentrations produced plant with highly significant increases in their fibrous roots number over control. The trend of results was not constant in both seasons, since the superiority over all treatments was for urea at low concentrations in the first season (1992-93), while it was for ammonium sulphate in the next one (1993-1994) as shown in Table (6).

2.a.10. Mean length of fibrous roots in cms:

The mean length of fibrous roots of *N. alata* plant in cms recorded high significant increases due to spraying nitrogen as urea or ammonium sulphate at low or high concentrations over untreated plants as shown in table (6) for both seasons of the experiments. The most effective treatment was that of urea at low concentration of 2.5 gm/L in the first season, while the superiority in the second season was for urea at 3.7 gm/L.

2.a.11. Fresh and dry weight of fibrous roots in gms:

It is clear from the data tabulated in Table (6) that the fresh weight of roots showed high response to the nitrogen as urea or ammonium sulphate spraying in both seasons (1992-93), (1993-94). The application of ammonium sulphate at 8.62 gm/L gave the heaviest fresh weight of roots as 102.33 and 79.55 gms in the first and second seasons respectively, while ammonium sulphate at 5.75 or urea at 3.7 gm/L produced the next

Table (6): Effect of foliar application of nitrogen on roots parameters of *Nicotiana alata* during 1992-1993 & 1993-1994 seasons.

Treatments	Number of fibrous roots		Mean length of fibrous roots/cm		Fresh weight of fibrous roots/g.		Dry weight of fibrous roots/g.	
	92-93	93-94	92-93	93-94	92-93	93-94	92-93	93-94
Control	9.09	12.67	34.38	29.61	20.33	48.05	13.67	15.07
2.5 g/L urea	15.02	14.17	48.33	36.06	64.91	55.67	20.38	20.05
3.75 g/L urea	13.61	14.05	48.09	44.67	54.33	69.01	21.39	26.33
5.75 g/L ammonium sulphate	11.65	16.33	36.67	38.87	49.00	69.33	16.87	24.17
8.62 g/L. ammonium sulphate	14.67	14.06	40.08	39.10	102.33	79.85	31.33	29.67
L.S.D. at 5%	1.13	0.80	1.52	1.61	0.97	1.22	1.09	1.38
L.S.D. at 1%	1.63	1.64	2.21	2.45	1.40	1.77	1.59	2.01

value in this concern in the first season as 69.01, 69.33 gms, respectively. But urea at 2.5 gm/L gave the next value in the second season as 64.91 gms. On the other hand unfertilized plants with nitrogen produced the least fresh weight of roots/plant as 20.33 and 48.05 gms for the first and second season respectively.

Concerning dry weight of roots nearly similar trend of results was obtained as that of fresh weight of root, ammonium sulphate at 8.62 gm/L produced the heaviest dry weight of roots/plant in the first and second season Table (6). But unfertilized plant with nitrogen gave the minimum dry weight of roots/plant. While urea at 3.7 gm/L produced the next value in this respect during both seasons. The differences between treatments were significant in both seasons.

Such increase in roots characters due to the nitrogen fertilization could be attributed to the promoting effects of these treatments on vegetative growth. Since nitrogen treatments play direct or indirect role in accumulation of dry matter in roots leading to the increase in root parameters. These accumulated of dry matter might be formed in the above ground parts by the activation of the anabolic processes in these organs which encouraged by nitrogen application and reflect on increase in the growth of all plant organs such as fibrous roots.

b) Chemical Analysis of Plant leaves:

I.b. *Nicotiana rustica*:

I.b.1. Nitrogen content:

Data in Table (7) show that there were no significant increase in the mean percentage of nitrogen in plant leaves due to different nitrogen conentrations sprayed on plant in both seasons. Although the trend of results clear that nitrogen applications at any concentration of both soruces

Table (7): Effect of foliar application of nitrogen on the chemical analysis of *Nicotiana rustica* leaves.

Treatment	N %	P %	K %	Nicotin %	Chlorophyll A (mg/100 gm)	Chlorophyll B (mg/100 gm)
Control	1.60	0.27	6.39	4.55	3.76	1.47
2.5 gm/L urea	1.76	0.33	8.67	7.40	4.03	1.78
3.75 gm/L urea	2.03	0.28	6.96	10.47	5.48	2.22
5.75 gm/L ammonium sulphate	1.97	0.23	7.70	7.06	4.93	1.70
8.62 gm/L ammonium sulphate	1.80	0.19	5.74	6.17	4.80	1.49
L.S.D. at 5%	N.S	N.S	0.38	0.59	N.S	N.S
L.S.D. at 1%	N.S	N.S	0.56	0.86	N.S	N.S

increased slightly the mean percentage of nitrogen in leaves than untreated plants. The best treatment in this concern was that of 3.7 gm/L urea followed by that of 5.75 g/L ammonium sulpohate. The increase in nitrogen content in leaves due to nitrogen fertilization came in agreement with **Merker (1958)** on Nicotiana and **Sukumaran and Nair (1966)** on Chewing tobacco.

I.b.2. Phosphorus content:

Phosphorus percentage in dry matter of plant leaves as affected by nitrogen sprays tabulated in Table (7) show that sprayed plant with urea at concentration of 2.5 gm/L produced the highest content of phosphorus in plant leaves. While the high concentration of urea as 3.7 gm/L produced lower content of phosphorus although still over control; plants sprayed with ammonium sulphate produced lower content of phosphorus in leaves under control, and the lower concentration was most effective in decreasing phosphorus content, since it gave the lowest value in this concern as shown in Table (7).

This may be due to the acidity resulted by ammonium sulphate which encourage metabolic processes concern phosphorus. These results are in accordance with those obtained by **Kurup and Sartry (1961)** on Cigar tobacco.

I.b.3. Potassium content:

Potassium percentages in plant leaves as affected by nitrogen spraying with both sources presented in Table (7) clear that the lowest levels of both urea and ammonium sulphate resulted in significant increases in potassium content of leaves over control plant at the level of 5% only. The high concentration of urea also increased potassium content

without significance. But the high concentration of ammonium sulphate resulted in significant decrease in potassium content under control plants, similar result was recorded by **Hamouda (1995)** on *Rota graveulens*.

I.b.4. Nicotine content:

Data in Table (7) show that all nitrogen treatments signficantly increased the mean percentage of nicotine in *Nicotiana rustica* leaves over control. The low levels of urea and ammonium sulphate resulted in an increase in nicotine content reached more than 50% over control, while high level of urea gave an increase reached more than 100% over control. The mean values of nicotine percentages were: 10.47%, 7.40%, 7.06% and 6.17% for urea 3.7 gm/L, urea at 2.5 gm/L. ammonium sulphate at 5.75% respectively compared to 4.55% for control.

These results are conseptable since nitrogen is essential for composing of any alkaloids such as nicotine. These results are in accordance with those recorded by **Merker (1958)** on tobacco, **Chandnani *et al* (1960)** on *Nicotiana rustica* how found that nitrogen increased the nicotine content of *N. rustica*,

I.b.5. Chlorophell A and B:

Nitrogen applications as sprays increased significantly at the level of 5% the mean percentage of chlorophyll A & B in *Nicotiana rustica* leaves over untreated plants as shown in Table (7). The most effective treatment in this concern was that of urea at 3.7 gm/L concentration followed by ammonium sulphate at concentration of 5.75 gm/L, then ammonium sulphate at 8.62 gm/L while urea at low concentration was of the lowest effect. The promocing effect of nitrogen on increasing chlorophyll content is expected since it has an important role in cell devition and cell growth

moreover its activation of most vital processes in plant organs especially in leaves. These results are in agreement with those reported by **Barakat (1987)** on potato and **Zhagloul (1988)** on pea noticed that content of photosynthetic pigments increased with the increase in the level of nitrogen fertilizer.

2.b. *Nicotiana alata:*

2.b.1. Nitrogen content:

Data presented in Table (8) clear that spraying plants with urea or ammonium sulphate resulted in an increase in nitrogen percent in plant leaves. The increasing effect was unsignificant over control or among the treatments. The trend of results showed that ammonium sulphate was superior urea as a source of nitrogen in this concern, since low or high concentration of it produced higher nitrogen percentages than both low or high concentration of urea. But with both sources the high concentration was more effective than the lower one. Many investigators cleared the role of nitrogen on the vital processes in plant among them: **Kurup and Sastry (1961)** on Cigar tobacco and **Merker (1958)** on Nicotiana sp.

2.b.2. Phosphorus content:

Phosphorus percent in *Nicotiana alata* plant seemed to be affected slightly by spraying nitrogen. Data in Table (8) show slight increases in phosphorus percentages due to nitrogen sprayings. The differences among the treatments were unsignificant. Urea as a source of nitrogen was of more effect than ammonium sulphate at low or high concentration of each.

These results are in harmony with those obtained by **Moseley (1967)** on *Nicotiana* sp.

2.b.3. Potassium content:

Data in Table (8) indicate that all nitrogen treatments resulted an increase potassium percentage in plant leaves with significant differences over untreated plants. Also, the high concentration of both urea and ammonium sulphate was superior the lower one in this concern with significant increase at the level 3.7 gm/L urea.

The increasing effect of nitrogen sprays on the percentages of phosphorus and potassium in plant leaves may be attributed to its promoting effect on the absorption of them

2.b.4. Nicotine content:

Nicotine percent in *Nicotiana alata* plant affected greatly and significantly by all nitrogen applications as shown in Table (8). Urea as a source of nitrogen with low or high concentration used produced doubled value of nicotine percentage in leaves compared to untreated plants. Also ammonium sulphate increased nicotine percent significantly, the increase over control plants reached more than 50% over control with the high concentration and about 30% with low one. The increase of nicotine percentage as a result of nitrogen application is conceptable since nitrogen make the alkylation of all the alkaloides. Also, the superiority of urea over ammonium sulphate in increasing nicotine may be due to the acidity produced with using ammonium sulphate which promotes composition of alkaloides salts.

Many investigators recorded the role of nitrogen in promoting alkaloids content among them **Merker (1958)** on tobacco and **Samules (1961)** on tobacco plant.

Table (8): Effect of foliar application of nitrogen on the chemical analysis of *Nicotiana alata* leaves.

Treatment	N %	P %	K %	Nicotin %	Chlorophyll A (mg/100 gm)	Chlorophyll B (mg/100 gm)
Control	1.06	1.08	6.81	3.06	4.19	7.21
2.5 gm/L urea	1.27	1.18	7.15	7.16	5.27	9.39
3.75 gm/L urea	1.33	1.13	8.55	7.38	3.61	6.43
5.75 gm/L ammonium sulphate	1.43	1.11	7.04	4.80	4.70	7.67
8.62 gm/L ammonium sulphate	1.53	1.12	8.71	3.97	4.74	8.08
L.S.D. at 5%	N.S	N.S	0.91	0.35	0.26	0.66
L.S.D. at 1%	N.S	N.S	N.S	0.50	0.37	0.96

2.b.5. Chlorophyll A & B:

Chlorophyll A & B percentages in *Nicotiana alata* leaves increased significantly by nitrogen application. It is clear from data tobulated in Table (8) that both chlorophyll A & B increased with the application of both nitrogen sources and concentrations except that of urea 3.7 gm/L which decreased chlorophyll A & B. These results are in agreement with those reported by **Barakat (1987)** on potato and **Zaghloul *et al* (1988)** on pea who noticed that content of photosynthetic pigments increased with the increase in the level of nitrogen fertilizer.

I.B. Effect of Soil Application of Nitrogen on Vegetative Growth and Chemical Analysis:

a) Vegetative Growth:

1.a. *Nicotiana rustica*:

I.a.1. Number of branches/plant:

Data represent the effect of nitrogen applications as urea or ammonium sulphate with nearly the same dose of nitrogen Table (9) indicated that nitrogen fertilization with both sources significantly increased the mean number of branches/plant over control plant. It is clear also that urea as a source of nitrogen was superior in this concern over ammonium sulphate in both season as shown in Tables (9 & 10) although the differences in the second season were unsignificant. In this regard several investigators pointed to the enhancement effect of different nitrogen fertilization sources on plant branching among them **Gupta *et al* (1961) and Pretchett *et al* (1961)** on nicotiana.

I.a.2. Plant height in cms:

Data in Tables (9 & 10) for both seasons of the experiments show that the height of *Nicotiana rustica* plant was significantly increased by nitrogen fertilization treatments in both seasons. It is clear also that urea produced plant significantly higher than those fertilized by ammonium sulphate, the trend of results was constant in the two seasons of the experiments (1992-93 & 1993-94).

This results are in agreement with those obtained by **White (1965) and Cousins (1966)** on Nicotiana sp.

Table (9): Effect of soil application of nitrogen as urea and ammonium sulphate on vegetative growth of *Nicotiana rustica* during 1992/1993 seasons.

Treatments	Number of branches/ plant	Plant height/ cm	Fresh weight of stem gm	Dry weight of stem/g	Number of leaves/ plant	Fresh weight of leaves/ plant g.	Dry weight of leaves/ plant g.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Control	6.33	42.0	106.67	20.67	60.07	62.01	9.67	9.17	6.87	9.07	7.08	7.87	5.67
9.0 gm/plant urea	9.67	50.67	141.08	38.33	111.03	88.67	14.33	15.33	8.33	13.50	9.83	10.83	8.17
20.8 g/plant Ammonium sulphate	8.01	49.67	132.01	26.67	90.05	87.09	14.68	13.08	9.06	12.85	9.50	10.67	6.83
L.S..D. at 5%	1.13	2.05	6.89	2.48	12.26	3.16	1.90	2.33	0.96	2.23	0.77	1.03	0.98
L..S.D. at 1%	1.88	3.53	7.73	3.12	13.76	5.26	3.16	3.87	N.S	N.S	1.27	N.S	1.35

Table (10): Effect of soil application of nitrogen as urea and ammonium sulphate on vegetative growth of *Nicotiana rustica* during 1993/1994 season.

Treatments	Number of branches/ plant	Plant height/ cm	Fresh weight of stem gm	Dry weight of stem/g	Number of leaves/ plant	Fresh weight of leaves/ plant g.	Dry weight of leaves/ plant g.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Control	6.87	38.33	91.58	18.59	69.67	62.67	8.67	9.50	7.07	10.67	7.67	8.86	6.83
9.0 g/plant urea	8.71	51.99	158.67	41.09	127.00	119.67	15.09	14.67	9.10	11.83	9.17	10.67	8.60
20.8 g/plant Ammonium sulphate	8.33	43.87	138.00	32.33	105.33	85.33	12.16	13.36	3.56	12.87	9.89	9.88	7.33
L.S..D. at 5%	1.13	2.21	7.06	3.51	13.19	3.06	0.65	1.14	0.89	1.75	0.79	0.91	0.53
L..S.D. at 1%	N.S	3.68	8.43	4.16	15.31	5.09	1.08	1.96	N.S	N.S	1.31	1.56	N.S

I.a.3. Fresh and dry weight of stem gms:

Data in Table (9 & 10) for the first and second seasons show that urea as a source of nitrogen produced the heaviest fresh and dry weights of *Nicotiana rustica* stem with significant increase over those treated with ammonium sulphate. While ammonium sulphate increased also the fresh and dry weight of stem over control in both seasons. The superiority of plants treated with urea over control reached nearly twice dry weight in the first season and more than twice in the second season. The values of mean dry weight of stem/plant treated with urea were 38.33 and 41.09 gms compared to 20.67 and 18.59 gms for urea and control plants during the first and second season, respectively.

Hamouda (1995) observed that urea as a source of nitrogen proved to be as a nitrogen the effective source of (80 Kg N/fed) in most cuts of *Ruta graveolens*, L.

I.a.4. Number of leaves/plant:

It is clear from the data presented in Tables (9 & 10) that nitrogen fertilization as urea or ammonium sulphate at the same dose of nitrogen increased significantly the mean number of leaves/plant over untreated one in both seasons. However, urea as a source of nitrogen was of more effect in this concern, since urea treated plant produced higher number of leaves/plant which increased by 18.99% and 17% over the ammonium sulphate treated plant in the two seasons, respectively. The mean values in this concern were: 60.07, 111.03 and 90.05 in the first season and 69.67, 127.0 and 105.33 in the second seasons for control, urea and ammonium sulphate, respectively.

I.a.5. Fresh and dry weights of leaves/plant gms:

Data presented in Tables (9 & 10) show that application of urea at 9.0 gm/plant and ammonium sulphate at 20.8 gm/plant were effective in increasing the fresh and dry weight of leaves/plant significantly over control in both seasons of the experiments. No significant differences could be seen between plants treated with urea or ammonium sulphate concerning fresh or dry weight of leaves in the first season. While urea treated plant produced significantly heaviest fresh and dry weights of leaves over those treated with ammonium sulphate in the second season.

I.a.6. Men length and width of lower leaf in cms:

Tallest lower leaf was obtained from plants treated with urea at 9.0 gm/plant, the mean length was 15.33 cm in the first season and 14.67 cm in the second season Tables (9 & 10) while ammonium sulphate at 20.8 gm/plant produced the next value as 13.08 cms and 13.36 cm in the first and second seasons, respectively. On the other hand, the unfertilized plant showed significantly shortest lower leaf than the fertilized one.

Data recorded for mean width of lower leaf Tables (9 & 10) show nearly similar trend to that of mean length of lower leaf in both seasons.

Increasing length or width of leaves due to adding nitrogen had been recorded by many investigators among them **Cibes and Samuels (1958), Moursi *et al* (1971), Mahadik (1972), Eweida *et al* (1979) and El-Mihi (1980)** on tobacco.

I.a.7. Mean length and width of middle leaf in cms:

The mean length and width of middle leaf seems to be increase by adding nitrogen with both sources urea or ammonium sulphate as shown in Tables (9 & 10) for both seasons of the experiments. The differenes

between the treated plants and the untreated one were significant during both seasons. While the difference between the plant treated with the two sources of nitrogen can not rise to the level of significance in the two seasons. Also the trend was not constant concerning the mean length of middle leaf since urea was superior in the first season and ammonium sulphate was the best in the second one.

I.a.8. Mean length and width of upper leaf in cms:

Nitrogen fertilization affected greatly and significantly the mean length and width of upper leaf as it is clear from Tables (9 & 10) for both seasons. No clear difference could be notice between plant treated with urea and those treated with ammonium sulphate concerning mean length of upper leaf in the first season, although urea resulted significant increase in the mean width of upper leaf in both seasons. The values of mean length of upper leaf due to the treatments were 10.81, 10.67 and 7.59 for urea, ammonium sulphate and control, respectively in the first season, and it were 10.69, 9.88 and 8.86 for the second season. While values of mean width of upper leaf were 8.17, 6.83 and 5.69 for plant treated with urea, ammonium sulphate and control, respectively in the first season and it were 8.60, 7.33 and 6.33 for the second season.

Generally it could be concluded that nitrogen fertilization as urea or ammonium sulphate increased significantly vegetative growth characters of tobacco plants as mean length of stem, fresh and dry weight of stem, leaves number, fresh and dry weight of leaves and leaf measurments.

Although urea was superior ammonium sulphate sometimes and with most of characters under studying.

Table (11): Effect of soil application of nitrogen on roots parameters of *Nicotiana rustica* during 1992-1993 & 1993-1994 seasons.

Treatments	Number of fibrous roots		Mean length of fibrous roots/cm		Fresh weight of fibrous roots/g.		Dry weight of fibrous roots/g.	
	92-93	93-94	92-93	93-94	92-93	93-94	92-93	93-94
Control	14.06	10.33	28.01	27.33	26.08	29.13	13.61	11.33
9.0 g/plant urea	22.10	20.67	31.67	33.14	41.06	40.10	18.03	17.09
20.8 g/plant Ammonium sulphate	19.33	18.67	36.67	35.36	41.33	34.67	16.97	16.67
L.S.D. at 5%	2.06	3.89	2.21	4.52	2.35	1.59	1.73	2.12
L.S.D. at 1%	3.43	6.46	3.68	N.S	3.91	2.66	2.86	3.51

I.a.9. Number of fibrous roots/plant:

Mean number of fibrous roots/plant affected greatly by treating *Nicotiana rustica* with nitrogen as urea or ammonium sulphate as shown from Table (11) the most great effect in this concern was due to treating with urea as a source of nitrogen which increased significantly the mean number of fibrous roots/plant over control or plants treated with ammonium sulphate in both seasons. Plants treated with urea produced number of fibrous roots reached nearly twice as that of control in the first season and completely twice it in the second season while ammonium sulphate treated plants produced mean number of fibrous roots increased over control by 19.33% in the first season and 18.67% in the second season as shown in Table (11).

This results are in agreement with those obtained by **Mckee and Street (1964)** on Maryland tobacco and **Moursi *et al* (1971)** on Flue-cured tobacco.

I.a.10. Mean length of fibrous roots in cms:

Also mean length of fibrous roots of *Nicotiana rustica* enhanced by adding nitrogen with both sources urea or ammonium sulphate during the two seasons as shown in Table (11). Data of the two seasons clear that ammonium sulphate was of great and significant effect on increasing the mean length of fibrous roots than urea, since the mean values of fibrous roots were 36.67, 31.67 and 28.91 for plant treated with ammonium sulphate, urea and control respectively in the first season, while these values were 35.36, 33.14 and 27.33 in the second season for the premantioned treatments, respectively.

I.a.11. Fresh and dry weights of fibrous roots in gms:

Data Table (11) presented the mean fresh and dry weight of fibrous roots/plant as affected by adding nitrogen by two different sources show that there was a great effect for adding nitrogen by both its sources on increasing the mean fresh and dry weight of roots/plant over control during the two seasons.

Although there was no clear difference between plants treated with urea and ammonium sulphate concerning fresh weight in the first season, while in the second season urea produced heaviest fresh roots.

Concerning dry weight urea treated plants produced significantly heaviest dry roots than plants treated with ammonium sulphate in the firrst season. While the difference was rat signficant in the second season.

Also both sorces increased dry weight of roots over control.

Generally it can be said that nitrogen fertilization increased the parameters of roots since nitrogen play direct or indirect role in accumulation of dry matter in roots leading to the increase in root parameters. These accumulation of dry matter might be formed in the upper ground parts by the activation of the anabolic processes in plant organs resulting from the improving effect of nitrogen on the vegetative growth.

2.a. *Nicotiana alata* :

2.a.1. Number of branches/plant:

For both seasons of the experiments, statical analysis of the data in Tables (12 & 13) indicated that number of branches/plant of *Nicotiana alata* had slight response to nitrogen fertilizer adding as soil drench, since no significant differences could be observed between treated plants and

control ones. The trend of results shows slight increases in the mean numbers of branches/plant due to nitrogen treatments over control although it was unsignificant.

Also there was no considerable difference between the two nitrogen sources concerning number of branches/plant as shown in Tables (12 & 13).

2.a.2. Plant height in cms:

The mean hight of *Nicotiana alata* plants as affected by nitrogen addition to soil shown in Tables (12 & 13) indicated that nitrogen added as ammonium sulphate was of a great effect on plant height, since it produced significant increase in this character over control in both seasons. While nitrogen added as urea increased mean hight of plant significantly only in the first season, the values recorded for mean height of plants were 108.33, 99.67 and 80.69 cms for ammonium sulphte, urea and control respectively in the first season, and it were: 105.0, 97.67 and 101.33 for the second season. The results were agree with those obtained by **Shaw (1955) and Wallace (1958)** on Nicotiana sp.

2.a.3. Fresh and dry weights of stem in gms:

The data in Tables (12 & 13) indicate that both sources of nitrogen were of great and significant effect on increasing fresh or dry weight of *Nicotiana alata* stem over untreated plants. It is evident that ammonium sulphate as a source of nitrogen was of more effect in this concern, since it produced significantly heaviest dry weight of stem than those produced by urea treated plant in both seasons of experiments (1992 - 1993) and (1993-1994).

Table (12): Effect of soil application of nitrogen as urea and ammonium sulphate on vegetative growth of *Nicotiana alata* during 1992/1993 seasons.

Treatments	Number of branches/ plant	Plant height/ cm	Fresh weight of stem gm	Dry weight of stem/gm	Number of leaves/ plant	Fresh weight of leaves/ plant gm.	Dry weight of leaves/ plant gm.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Control	3.89	80.69	145.67	33.67	22.38	96.27	19.09	32.01	9.33	28.67	9.33	22.67	6.67
9.0 g/plant urea	4.17	99.67	185.07	61.07	29.67	170.06	32.67	39.67	12.47	31.67	12.03	28.33	8.67
20.8 g/plant Ammonium sulphate	4.06	108.33	162.60	66.33	24.33	100.65	24.67	41.87	14.39	39.67	14.09	31.32	10.66
L.S..D. at 5%	N.S	3.06	3.26	2.11	1.90	3.45	3.81	1.73	0.97	1.96	1.49	2.61	1.13
L..S.D. at 1%	N.S	5.09	5.42	3.51	3.16	5.74	6.32	2.87	1.35	N.S	N.S	4.34	1.88

Table (13): Effect of soil application of nitrogen as urea and ammonium sulphate on vegetative growth of *Nicotiana alata* during 1993/1994 seasons.

Treatments	Number of branches/ plant	Plant height/ cm	Fresh weight of stem/ g	Dry weight of stem/g	Number of leaves/ plant	Fresh weight of leaves/ plant g	Dry weight of leaves/ plant g	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Control	3.13	101.33	117.09	25.02	28.39	81.01	23.43	37.33	12.51	32.33	11.11	26.33	8.89
9.0 g/plant urea	3.67	97.67	151.67	39.98	37.73	122.33	33.67	39.33	12.67	33.33	11.83	26.37	9.13
20.8 g/plant Ammonium sulphate	3.43	105.0	192.07	44.67	34.09	128.09	35.83	41.23	13.33	34.08	12.07	28.10	9.35
L.S..D. at 5%	N.S	2.12	3.72	1.72	1.31	2.35	2.03	1.33	0.78	N.S	N.S	1.39	N.S
L..S.D. at 1%	N.S	3.51	5.89	2.86	2.97	3.91	3.36	2.21	N.S	N.S	N.S	N.S	N.S

These results are in agreement with those obtained by **Moursi *et al* (1971)** on Full-cured tobacco and **Barham *et al* (1983)** on *Viola adorata* and **Majernik and Lejko (1987)** on tobacco cv.v-6.

2.a.4. Number of leaves/plant:

All nitrogen treatments significantly increased the number of leaves/plant over control in both seasons as shown in Tables (12 & 13). The data indicate that urea as a source of nitrogen was superior ammonium sulphate concerning mean number of leaves/plant, since the mean number of leaves/plant produced with urea was significantly higher than that produced with ammonium sulphate treated one in both seasons. The mean number of leaves/plant was 29.67, 24.33 and 22.38 for urea, ammonium sulphate and control, respectively in the first season, and it was: 37.71, 34.73 and 28.39 in the second season.

The results agree with those reported by **Chandnoni *et al* (1960)** on *Nicotiana rustica*, **Shaw (1963)** on Burley tobacco and **Majernik and Lejko (1987)** on tobacco cv.v-6.

2.a.5. Fresh and dry weights of leaves/plant in gms:

Data presented in Tables (12 & 13) concern fresh and dry weights of leaves/plant clear that both sources of nitrogen affected greatly and significantly fresh and dry weight of *Nicotiana alata* leaves, since in both seasons of the experiments the treated plants with any source produced mean fresh and dry weights of leaves with significant increase over control. Among the two sources of nitrogen the trend of results was not constant, although urea was superior over ammonium sulphate in the first season, the oposite trend was observed in the second season.

2.a.6. Mean length and width of lower leaf in cms:

Data recorded for mean length and width of lower leaf and presented in Tables (12 & 13) show clearly that nitrogen addition by both sources, urea or ammonium sulphate increased significantly these parameters of lower leaf over untreated plants. Among the two sources of nitrogen also there was a significant difference, since ammonium sulphate gave best results in this concern over plants treated with urea in both seasoons of the experiments.

These results are in agreement with those reported by **Moursi *et al* (1971)** on Flue-cured tobacco.

2.a.7. Mean length and width of middle leaf in cms:

It is clearly noticed from data in Tables (12 & 13) for both season (1992/1993) and (1993/1994) that ammonium sulphate was the best treatment for increasing mean length and width of middle leaf of *Nicotiana alata*. Ammonium sulphate increased significantly middle leaf parameters over urea or control plant in both seasons. Also, urea increased middle leaf length and width significantly over control in the first season. While the increase did not rise to the level of significance in the second season.

It could be seen that the trend of results obtained with the parameters of lower leaf take nearly the same line observed with the parameters of middle leaf. This led to say that leaf length and width of lower or middle leaf increased by adding both nitrogen sources which influence indirectly carbohydrates consistency in plant organic.

2.a.8. Mean length and width of upper leaf in cms:

The parameters of upper leaf of *Nicotiana alata* in Tables (12 & 13) show similar trend obtained with both lower or middle leaf. The mean

length and width of upper leaf increased significantly by adding both sources of nitrogen in the first season, while this increase was not significant in the second season. Ammonium sulphate treated plants rise over urea treated one in upper leaf parameters with significant difference in the first season only. In the second season the differences in mean length and width of upper leaf between plants treated with urea and ammonium sulphate were not significant.

Generally from all the vegetative growth parameters considered in this work, it could be concluded that nitrogen in any source increased vegetative growth parameters of *Nicotiana alata* plant. This may be due to the important role of nitrogen in metabolic process and its role in cell division and cell growth.

2.a.9. Number of fibrous roots/plant:

It is clear from the data in Table (14) that the number of fibrous roots showed response to nitrogen fertilization in both seasons. So the two sources of nitrogen significantly increased number of fibrous roots/plant over control. The most effective source of nitrogen in this concern was that of urea, since it increased significantly the number of fibrous roots/plant over that treated with ammonium sulphate in the two seasons of the experiments. The values recorded for number of fibrous roots/plant were 20.03 for urea and 15.94 for ammonium sulphate compared to 11.07 for control plants in the first season and it were 21.60, 14.67 compared to 13.67 for the prementioned treatments respectively in the second season.

2.a. 10. Mean length of fibrous roots:

Data recorded for mean length of fibrous roots showed also great response to the addition of both sources of nitrogen as shown in Table

(14). There were significant increases due to treating with both urea and ammonium sulphate in the mean length of roots over control in both seasons (1992-1993) and (1993-1994). It is also clear from the data in the same Table (14) that ammonium sulphate was more effective in this concern than urea. The results were confirmed with both seasons of the experiments.

2.a.11. Mean fresh and dry weights of roots in gms:

Data presented in Table (14) show that mean fresh and dry weights of *Nicotiana alata* plant affected significantly by adding nitrogen fertilizers. Adding urea or ammonium sulphate produced significant increase in fresh and dry weight of plant roots over control in both seasons. Urea was of more response than ammonium sulphate in increasing fresh and dry weight of roots. The trend of results was confirmed in both seasons of the experiments.

Generally it is evident that all root parameters affected significantly by adding nitrogen in both sources of urea or ammonium sulphate, All root parameters increased significantly by adding both sources of nitrogen, although urea was the superior in increasing number, fresh and dry weight of roots while ammonium sulphate had superiority in increasing mean length of roots of *nicotiana alata* plant.

Table (14): Effect of soil application of nitrogen on roots parameters of *Nicotiana alata* during 1992-1993 & 1993-1994 seasons.

Treatments	Number of fibrous roots		Mean length of fibrous roots/cm		Fresh weight of fibrous roots/g.		Dry weight of fibrous roots/g.	
	92-93	93-94	92-93	93-94	92-93	93-94	92-93	93-94
Control	11.07	13.67	32.68	36.66	20.33	48.09	16.67	14.0
9.0 g/plant urea	20.03	21.60	35.93	38.09	117.67	95.33	35.50	38.0
20.8 g/plant Ammonium sulphate	15.94	14.67	40.07	43.01	102.59	77.05	24.33	28.33
L.S.D. at 5%	2.26	1.73	2.35	2.26	1.88	2.06	1.26	2.06
L.S.D. at 1%	3.75	2.86	3.91	3.76	3.11	3.43	2.09	3.43

b) Chemical Analysis:

1.b. *Nicotiana rustica*:

1.b.1. Nitrogen content:

It is clear from the data presented in Table (15) that nitrogen dressing as urea or ammonium sulphate increased significantly nitrogen percentage in plant leaves over untreated plant. It is also clearly noticed that ammonium sulphate was significantly superior urea in this concern. The mean values of nitrogen percentages were: 2.47, 1.87 and 1.60 for plants treated with ammonium sulphate, urea and control respectively. These results were in agreement with those obtained by **Clark and Mayers (1957)** on Flue cured tobacco.

1.b.2. Phosphorus content:

Phosphorus content in *Nicotiana rustica* plant slightly affected by nitrogen applications as urea or ammonium sulphate, although the differences between fertilized and unfertilized plants were unsignificant as shown in Table (15). It could be noticed that the trend of results pointed that urea was of an effective in increasing phosphorus content than ammonium sulphate. **Kurup and Sastroy (1961)** on Cigar Tobacco recorded that high levels of nitrogen lowered phosphorus concentrations in the leaves and increased nitrogen.

1.b.3. Potassium content:

Potassium content of leaves increased significantly by adding nitrogen fertilizers as urea or ammonium sulphate over control plant as shown in Table (15) the trend of results concern potassium percentage was similarly to that of phosphorus since urea as a source of nitrogen was

superior ammonium sulphate at the same rate of nitrogen in increasing the percentage of potassium in plant leaves.

Generally from the previous results it is clear that nitogen fertilization as dressing, increased minerals content in plant leaves, since it has an important role in protein metabolism which reflects on all vital activities such absorption, growth and flowering.

1.b.4. Nicotine content:

Concerning nicotine content in *Nicotiana rustica* as affected by nitrogen applications in different sources, it is clear from the data tabulated in Table (15) that plants fertilized with ammonium sulphate significantly increased nicotine percentages than urea or unfertilized one. The mean values of nicotine in *Nicotiana rustics* plants were 7.18, 4.09 and 4.38 for plants treated with ammonium sulphate, urea and control plants, respectively.

Generally, it could be concluded that nicotene as other alkaloids affected by nitrogen content in plant, since it considered one of alkaloids componant, and the lateral affects by the available nitrogen to obsorption. **Merker (1958)** on nicotiana, **Chandnani *et al* (1960)** on *Nicotiana rustica* and **Samuels (1961)** on nicotine s. who concluded that higher rates up to 150 Ib./acre of nitrogen didn't cnse further improvement in quality.

1.b.5. Chlorophyll A & B:

Chlorophyll A and B percentages in *Nicotiana rustica* leaves slightly affected by dressing both sources of nitrogen as urea or ammonium sulphate with the same rate of nitrogen, although no significant differences could be observed between treatments, ammonium sulphate was of slightly

Table (15): Effect of soil application of nitrogen on the chemical analysis of *Nicotiana rustica* leaves.

Treatment	N %	P %	K %	Nicotin %	Chlorophyll A (mg/100 gm)	Chlorophyll B (mg/100 gm)
Control	1.60	0.25	5.27	4.38	2.95	1.13
9.0 gm /plant urea	1.87	0.26	9.97	4.09	4.46	1.37
20.8 gm/plant ammonium sulphate	2.47	0.24	7.66	7.18	4.66	1.46
L.S.D. at 5%	0.39	N.S	1.73	0.78	N.S	N.S
L.S.D. at 1%	N.S	N.S	2.86	1.29	N.S	N.S

more effect in this concern. Since it produced the highest percentage of both chlorophyll A & B.

Similar results were obtained by **Zaghloul *et al* (1988)** who indicated that chlorophyll content of pea plant leaves were not affected by fertilizer at any of the used levels.

2.b. *Nicoriana alata*:

2.b.1. Nitrogen contents:

Nitrogen percentage in *Nicotiana alata* leaves increased significantly by adding nitrogen fertilizer as urea or ammonium sulphate as it clear from the data in Table (16). Urea as a source of nitrogen with the same rate was superior ammonium sulphate in increasing nitrogen content in plant leaves. The mean values of nitrogen in plant leaves were 2,26,1.27 and 1.03 for plants treated with urea, ammonium sulphate and control plants respectively. These results are in accordance with **Oweida *et al* (1979)** on burley tobacco.

2.b.2. Phosphorus content :

Also phosphorus percentage increased in plant leaves as a result of addition of nitrogen fertilizer with each of its sources as shown in Table (16). But the increase over control was not significant. The highest value was also recorded with plants treated with urea.

2.b.3. Potassium content:

Potassium percentage in *Nicotiana alata* leaves showed similar trend of results previously obtained with nitrogen and phosphorus percentages in leaves as a result to trreating plants with the two sources of nitrogen. Since potassium percentages increased significantly with both sources of nitrogen than control plants, and still urea superior ammonium

Table (16): Effect of soil application of nitrogen on the chemical analysis of *Nicotiana alata* leaves.

Treatment	N %	P %	K %	Nicotin %	Chlorophyll A (mg/100 gm)	Chlorophyll B (mg/100 gm)
Control	1.03	0.28	6.70	3.85	4.84	1.23
9.0 gm /plant urea	2.26	0.34	10.33	4.61	5.38	1.72
20.8 gm/plant ammonium sulphate	1.27	0.32	8.75	3.91	4.84	1.61
L.S.D. at 5%	0.48	N.S	1.78	0.46	N.S	N.S
L.S.D. at 1%	N.S	N.S	N.S	N.S	N.S	N.S

sulphate in its effect on increasing minerals percentages in *Nicotiana alata* plants as shown from the data illustrated in Table (16).

Similar results were obtained by **Hamouda (1995)** on *Ruta graveolens*.

2.b.4. Nicotine content:

Nicotine percentage in *Nicotiana alata* leaves as affected by adding different sources of nitrogen tabulated in Table (16) and indicate that this percentage increased with plants treated with both sources of nitrogen and the increase was significant at 5% level. It is clear also that the highest percentage of nicotine was obtained with plants treated with urea.

It could be noticed that nicotine percentage follow the trend of results previously observed with minerals content of leaves, which cleared an increasing effect in the mean percentages of N,P and K due to adding nitrogen which encourage growth and all vital and chemical reactions in plant cells reflect these increases in chemical constituents in plant leaves.

These results are in harmony with those recorded by **Samuels (1961)** on tobacco and **Wirowski (1971)** on Nicotiana sp.

2.b.5. Chlorophyll A and B:

Data in Table (16) represented chlorophyll a & b percentages, show that nitrogen applications to *Nicotiana alata* plants increased chlorophyll a & b over untreated plants although the differences were not significant. The highest percntages of chlorophyll a & b were obtained with urea as a source of nitrogen than ammonium sulphate at the same level of nitrogen. The present results are in accordance with **Kurup and Sastory (1961)** on cigar tobacco.

Generally it could be concluded that nitrogen fertilizer as any sources as urea or ammonium sulphate played an important role in plant

growth which reflects high percentages of chemical constituents such as minerals (N.P.K), nicotine and chlorophyll. The superiority of one sources over the other differ from *N. rustica* to *N. alata*; since urea was the best with the former while ammonium sulphate was the best with the least.

It could be recorded that urea as a source of nitrogen was of less effects on minerals and chlorophyll content of plant leaves of both *Nicotiana rustica* or *Nicotiana alata* than ammonium sulphate at the same rate of nitrogen. But it differ with nicotine content of plant leaves, since ammonium sulphate as a source of nitrogen was superior urea with *Nicotiana rustica*, while urea was the best source with *Nicotiana alata* concerning nicotine content. Although both increased nicotine percentage over control.

TOPPING EXPERIMENT

II. Effect of Topping on Vegetative Growth and Chemical Analysis of Nicotiana Plants:

1. *Nicotiana rustica*:

1.a. Vegetative Growth:

1.a.1. Number of branches:

Number of branches/plant affeected clearly by topping processes as shown in Tables (17 & 18). Topping increased the number of branches/plant significantly in both season of the experiments. The increasing effect was more clearer with topping once than twice. This increase in the number of branches due to topping process was excepted, since removing the terminal bud of the plants through topping process inhebts the apical dominance and encourage the lateral buds to grow, especially with topping once, since it was done 40 day after transplanting at the maximum growth period. While with topping twice the second process occur 70 days after transplanting at the end of the maximum growth period, so it was of less effect on increasing the mean number of branches as topping once.

1.a.2. Plant height:

Mean plant height reduced significantly due to topping *Niotiana rustica* plants during the two seasons of the experiment as shown in Table (17 & 18). This decrease was more higher by topping twice than topping plants once. This results also was excepted since topping process itself decreased plant height and enhanced branching.

Table (17): Effect of topping on vegetative growth of *Nicotiana rustica* during first season 1992/1993.

Treatments	Number of branches/ plant	Plant height/ cm	Fresh weight of stem gm	Dry weight of stem/g	Number of leaves/ plant	Fresh weight of leaves/ plant g.	Dry weight of leaves/ plant g.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Without topping	21.36	61.37	106.67	20.67	52.01	34.03	8.01	4.67	3.09	6.03	2.83	3.80	1.67
Topping once after (40) days	31.67	51.33	115.08	33.33	60.33	40.67	8.33	8.83	5.31	8.33	5.01	4.53	2.17
Topping twice a0fter (40 and 30) days	38.33	42.10	92.67	17.17	54.87	62.01	9.67	9.17	6.67	9.67	7.05	7.67	5.67
L.S..D. at 5%	1.90	3.27	2.07	1.99	1.60	2.62	N.S	2.03	1.27	1.03	0.77	0.90	0.98
L..S.D. at 1%	3.16	5.42	3.42	3.29	2.65	4.33	N.S	3.63	2.10	1.59	1.28	1.09	1.62

Table (18): Effect of Topping on vegetative growth of *Nicotiana rustica* in the second season 1993/1994.

Treatments	Number of branches/ plant	Plant height/ cm	Fresh weight of stem gm	Dry weight of stem/g	Number of leaves/ plant	Fresh weight of leaves/ plant g.	Dry weight of leaves/ plant g.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Without topping	23.67	60.03	91.50	20.36	53.33	36.01	6.33	4.17	2.17	5.00	2.33	3.67	1.67
Topping once after (40) days	30.67	50.93	108.33	33.31	61.67	39.67	7.33	9.33	5.09	8.33	4.17	4.17	2.17
Topping twice after 40 and 30) days	37.09	43.03	75.83	17.38	59.00	60.17	8.67	9.50	7.01	10.67	8.00	8.83	6.83
L.S..D. at 5%	2.07	2.26	1.72	2.65	3.21	3.47	2.35	1.50	1.49	1.31	2.34	1.03	0.94
L..S.D. at 1%	3.43	3.75	2.85	4.40	5.31	4.32	3.90	2.49	2.47	2.16	3.87	1.71	1.57

1.a.3. Fresh & dry weight of stem:

Data presented in Tables (17 & 18) show that the mean fresh and dry weight of *Nicotiana rustica* stems increased significantly by topping plants once after 40 day. The oposits effect could be notice with topping plants twice, since the mean fresh and dry weight decreased also significantly under control plants. This may be due to the removal of many tops of the branches during fist and second topping. While with plants topped once the branches take more time to grow and accumulate more metabolites.

1.a.4. Number of leaves/plant:

The mean number of leaves/plant increased significantly by topping nicotiana plants than untopped one as shown in Tables (17 & 18). The increase in the mean number of leaves/plant over control was more announced with topping once than twice. These results were confirmed during both seasons of the experiments.

1.a.5. Fresh and dry weight of leaves:

Data presented in Tables (17 & 18) show the mean fresh and dry weights of leaves/plant clear that the mean fresh weight of leaves increased significantly by topping both once or twice over control and that the increase was more higher with topping twice than topping once in both seasons. While with dry weight of leaves it tended to increase with topping than untopped plants although the differences were not significant in both seasons. Also topping twice still superior topping once in this concern, since it resulted in more number of leaves of higher fresh and dry weights.

1.a.6. Mean length and width of lower leaf in cms:

The parameters of lower leaf tabulated in Tables (17 & 18) show that the mean length of lower leaf increased significantly with topped plant than untopped one. Also, plants topped twice were superior those topped once in this concern. The same trend was observed also with mean width of the lower leaf, since these measurement were 6.67, 5.31 cms and 3.09 cms for plants topped twice, once and control in the first season and it was 7.01, 5.04 and 2.17 cms for the prementioned treatments, respectively in the second season.

1.a.7. Mean length and width of middle leaf In cms:

Mean length and width of middle leaf increased by highly significant differences with topped plants over untopped ones as shown in Tables (17 & 18). It is clear that topping twice was of more effect on increasing the mean length of middle leaf than topping once. The trend of results was nearly the same with both seasons of the experiments.

Also, mean width of middle leaf affected greatly and significantly by topping process. So the mean width of middle leaf of plants topped twice reached more than three times that of control plants (without topping) in both seasons. The mean width of middle leaf was 7.05, 5.01 and 2.83 cms in the first season and it was: 8.0, 4.17 and 2.33 cms in the second season for plants topped twice, once and untopped plants, respectively.

1.a.8. Mean length and width of upper leaf in cms:

Measurements of upper leaf tabulated in Tables (17 & 18) show that the mean length and width of upper leaf take the same trend of that previously observed with both lower and middle leaf. Since the mean

length and width of upper leaf increased significantly by topping plants. Also, topping twice was of more effect than topping once.

It could be generally concluded that topping *Nicotiana rustica* plants was of improving effects on the vegetative growth especially with the growth of leaves and branches which reflect an increase in the used parts which contains the active substances aimed to be obtained from this plant and considered as valiable or economic yield of it. The results are in harmony with **Sulyman *et al* (1968)** on tobacco cv. Harrison special and chattam, he found that topping at 12 leaves stage increased leaf area/plant.

1.a.9. Number of fibrous roots:

Data presented in Table (19) clear that the mean number of fibrous roots decreased significantly at 5% level under control due to topping *Nicotiana rustica* plant once, and this result came true in both season. While with topping plants twice the number of fibrous roots increased significantly over untopped plants, and this result also came true in both seasons of the experiments. Plants topped twice produced number of fibrous roots increased with high significant difference over plant topped once only. The high number of fibrous roots resulted from topping plants twice may be attributed to the more of growth parameter such as number of branches and leaves previously mentioned.

1.a.10. Mean length of fibrous roots in cms:

Mean length of fibrous roots decreased significantly by topping plant once or twice as shown in Table (19). The decreasing effect occur due to topping twice was less than that resulted from topping once, since the mean length of fibrous roots was 21.93, 19.04 and 25.00 cms for

Table (19): Effect of topping *Nicotiana alata* plants on root parameters during 1992-1993 & 1993-1994.

Treatments	Number of fibrous roots		Mean length of fibrous roots/cm		Fresh weight of fibrous roots/g.		Dry weight of fibrous roots/g.	
Seasons	93	94	93	94	93	94	93	94
Without topping	14.02	9.33	25.09	23.33	26.05	13.06	8.47	6.83
Topping once after 40 days	12.69	7.81	19.04	17.67	29.86	18.87	9.76	7.31
Topping twice after 40 and 30 days	15.67	10.39	21.93	19.98	41.07	29.33	10.67	9.00
L.S.D. at 5%	1.73	1.39	2.07	2.73	2.26	2.97	1.14	N.S
L.S.D. at 1%	2.86	2.30	3.42	4.53	3.75	4.92	N.S	N.S

plants topped twice, once and control respectively in the first season, and it was 19.98, 17.67 and 23.33 cms for the same treatments, respectively in the second season.

1.a.11. Fresh and dry weights of fibrous roots/plant in gms:

Mean fresh and dry weights of fibrous roots tended to increase by topping *Nicotiana rustica* plants as shown in Table (19). Topping plants once increased significantly the mean fresh and dry weights of plant roots over control in the first season, while this increase was unsignificant in second season. Twice topping resulted in significant increases in fresh and dry weights over control during the first season. Data of the second season confermed that of the first one although the increases in the dry weight of roots over control were not significant. The mean values of fresh and dry weights of roots for plants topped twice, once and control were 41.07, 29.86 and 26.05 gms, and 10.67, 9.76 and 8.47 gms, respectively in the first season and it were: 29.33, 18.87 and 13.06 gms for fresh weight and 9.00, 7.31 and 6.83 gms for dry weight for the same treatments during the second season, respectively

It could be concluded that topping twice was of the most positive effect on most of vegetative growth or root parameters followed by topping once especially leaves number, fresh and dry weight of leaves, leaf mesurments, and then fresh and dry weight of roots.

1.b. Chemical Analysis of *Nicotiana rustica*:

1.b.1. Nitrogen percent in plant leaves:

Data presented in Table (20) show no significant differences between topped plants and untopped one concerning nitrogen percent in *Nicotiana rustica* leaves, although the highest percentage of nitrogen

produced by plants topped only once followed by that topped twice and control (without topping). The results came in harmony with those recorded by **Primast *et al* (1971)** on tobacco plant who mentioned that the nitrogen and nicotine contents increased significantly by topping.

1.b.2. Phosphorus percentage:

Phosphorus percent seemed to increase in plant leaves as a result to topping plants although the increase was unsignificant. The increase in phosphorus percent due to topping was more clearer with plants topped twice than those topped once. The least phosphorus percentage was obtained with untopped plants, as shown in Table (20). **Primost *et al* (1971)** on nicotiana plant found that phosphorus was not affected by topping of tobacco cv. Burley.

1.b.3. Potassium percentage:

It is clear from the data tabulated in Table (20) that potassium percentage increased significanty with topped plants over untopped ones. The increase in potassium percent due to topping plants once reached more than 50% over untopped one. Also the increase in potassium percentage due to topping twice reached nearly about 100% that of control plants (without topping).

The increase in mineral content of *Nicotiana rustica* plant resulted due to topping may be attributed to the enhancement effect of this process on the growth of plant organs which reflect more metabolites and consequently absorption of minerals.

1.b.4. Nicotine content:

Nicoten percentage in *Nicotiana rustica* leaves increased when plants were topped twice only. No clear effect could be considered

Table (20): Effect of topping *Nicotiana rustica* plannts on the mean percent of N,P,K nicotine and chlorophyll A,B in plant leaves.

Treatment	N %	P %	K %	Nicotin %	Chlorophyll A (mg/100 gm)	Chlorophyll (mg/100 gm
Without topping	1.37	0.26	5.07	4.38	4.36	1.63
Topping once after (40) days	1.68	0.36	8.12	4.32	4.04	1.69
Topping twice after 40 and 30 days	1.51	0.41	9.20	7.70	4.84	2.53
L.S.D. at 5%	N.S	N.S	0.50	0.89	0.51	N.S
L.S.D. at 1%	N.S	N.S	0.84	1.47	N.S	N.S

due to topping once. While the increase in nicotine content due to topping twice was highly significant over both control plant or plants topped once as shown from Table (20).

This may be due to the increase occure in the vegetative of plant organs and root growth previously noticed with growth parameters which reflect an increase in minerals and nicotine as a result to the activation of growth and metabolic processes.

1.b.5. Chlorophyll content:

Data concerning chlorophyll A & B content in *Nicotiana rustica* leaves tabulated in Table (20) show that there are no significant differences between chlorophyll percentages due to treating with topping. Chlorophyll A percentage seems to be unaffected by these treatments while chlorophyll B percentage tended to increase as a resul' to topping especially with topping twice.

This slight increase in chlorophyll may be combined with the increase of the metabolites compounds due to the higher growth resulted from topping plants twice.

2. *Nicotiana alat*:

2.a. Vegetative Growth:

2.a.1. Mean number of branches:

Data presented in Tables (21 & 22) clear that the mean number of branches/plant affected by topping process. Topping plants once or twice increased significantly the mean number of branches of *Nicotiana alata* plant over untopped one. But, the difference between the two topping treatments was not constant in both seasons.

2.a.2. Plant height:

The mean plant height of *Nicotiana alata* plant decreased greatly and significantly by topping process as shown in Tables (21 & 22). It is clear that topping twice resulted in a great decrease in plant height than control plants, since the mean height of plants topped twice reached half that untopped one. Also, topping once decreased the mean hight of plant by more than 25% less than control. The trend of data was nearly constant in both seasons of the experiments.

The as resuts came in harmony with those recorded by **Bhat and Chitkora (1987)** who reported that pinching of Tagetes erecta reduced plant height the effect of pinching was most marked when pinching was done 30 days after transplanting.

2.a.3. Fresh and dry weight of stems/plant:

The data of stems fresh weight tabulated in Tables (21 & 22) clear that fresh weight of stems decreased due to topping of *Nicotiana alata* plants once or twice, and that topping twice was more effective in this decrease. So, the decrease in the mean fresh weight of plant reached about 50% under control in both seasons for plants topped twice.

Concerning dry weight of stems the same trend of results could be noticed. The mean dry weight of stems/plant reached 12.07, 20.83 and 33.67 in the first season and it reached 7.83, 11.23 and 25.93 gms in the second season for plants topped twice, once and untopped plants respectively.

2.a.4. Number of leaves/plant:

Data presented in Tables (21 & 22) show the mean number of leaves/plant clear that topping plants resulted in an increase in the mean

number of leaves/plant over control (without topping) the increasing effect of leaves by topping was more clear with topping twice than topping once in the first season. This may be due to the increase of branching resulted from topping which carry more leaves on these branches.

2.a.5. Fresh and dry weight of leaves gms:

The mean fresh and dry weight of leaves seemed to be increased due to topping *Nicotiana alata* plants as it is clear from the data presented in Tables (21 & 22). The plants topped once produced the highest fresh and dry weights of leaves/plant over both control or plants topped twice with significant differences. Plants topped twice also produced heavier fresh and dry weights of leaves/plant although without significant increase over control plants. The trend of results was constant in both seasons 1992-93 & 1993-94.

2.a.6. Mean length and width of lower leaf:

The measurements of lower leaf presented in Tables (21 & 22) show that topping of *Nicotiana alata* plants increased significantly the mean length of lower leaf and that topping twice was more effect in this increase, so the mean length of lower leaf was 32.08, 22.34 and 20.36 cm for plants topped twice, once and untopped one in the first season. And it was 37.33, 24.0 and 22.33 cm for the prementioned treatments, respectively in the second season.

The same trend of results was obtained with the mean width of lower leaf since, the widest lower leaf was produced with plants topped twice, followed by that topped once than plants without topping as it is clear from data in Tables (21 & 22).

Table (21): Effect of Topping on vegetative growth of *Nicotiana alata* durimg first season 1992/1993.

Treatments	Number of bran-ches/ plant	Plant height/ cm	Fresh weight of stem gm	Dry weight of stem/g	Number of leaves/ plant	Fresh weight of leaves/ plant g.	Dry weight of leaves/ plant g.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Without topping	2.36	80.67	165.67	33.67	26.33	88.67	19.01	20.36	6.59	17.11	4.67	11.09	3.53
Ttopping once after (40) days	4.33	61.03	134.33	20.83	34.83	110.03	24.17	22.34	6.67	20.33	5.67	13.67	3.17
Topping twice after (40 and 30) days	5.09	40.33	82.61	12.07	40.01	96.67	20.03	32.08	9.31	28.67	9.33	22.67	6.67
L.S..D. at 5%	1.73	2.66	6.91	2.44	1.63	3.46	2.36	1.73	1.26	2.27	1.63	2.22	1.12
L..S.D. at 1%	2.86	4.40	8.16	3.39	2.70	5.73	3.91	2.86	2.10	3.75	2.71	3.67	1.84

Table (22): Effect of Topping on vegetative growth of *Nicotiana alata* during second season 1993/1994.

Treatments	Number of branches/ plant	Plant height/ cm	Fresh weight of stem/ gm	Dry weight of stem/g	Number of leaves/ plant	Fresh weight of leaves/ plant g.	Dry weight of leaves/ plant g.	Mean length of lower leaf/cm	Mean width of lower leaf/cm	Mean length of middle leaf/cm	Mean width of middle leaf/cm	Mean length of upper leaf/cm	Mean width of upper leaf.cm
Without topping	3.33	101.33	117.05	25.98	24.18	68.33	20.05	22.33	6.51	16.00	5.06	13.00	3.67
Topping once after (40) days	4.01	66.67	83.37	11.23	38.67	106.67	28.83	24.00	7.04	19.33	6.09	15.33	5.00
Topping twice after (40 and 30) days	5.12	50.13	53.33	7.83	30.98	81.01	21.43	37.33	12.58	31.33	11.17	26.33	8.83
L.S..D. at 5%	N.S	2.73	4.22	2.14	1.17	1.60	1.90	1.33	1.30	2.72	1.48	1.72	0.41
L..S.D. at 1%	N.S	4.53	6.67	3.37	1.94	2.65	3.32	2.20	2.16	4.51	2.45	2.85	0.67

2.a.7. Mean length and width of meddle leaf:

Mean length of middle leaf reflects same trend was observed with lower leaf of *Nicotiana alata* plant due to topping process. So, mean length of middle leaf increased significantly due to topping process, and topping plants twice was of more effective in this concern over topping once or control.

Mean width of middle leaf affected also greatly and significantly by topping process as shown in Tables (21 & 22) for both seasons. The mean width of meddle leaf of plant topped twice reached twice its value for control plant in both seasons.

Also, there were noticeable and significant increase in mean width of middle leaf due to topping once over untopped plants. The trend of results was nearly constant in both seasons.

2.a.8. Mean length and width of upper leaf:

Mean length of upper leaf of *Nicotiana alata* plants also take the same trend previously observed with lower or middle leaf, since the mean length of upper leaf of plants topped twice reached more than twice the value of control plant as shown in Tables (21 & 22). It is also clear that the mean length of upper leaf of plant topped once increased significantly than that of untopped plants (control).

Concerning the mean width of upper leaf it is clear also that topped plants were superior than untopped one. So plants topped twice also produced plants with mean width of upper leaf nearly double that of control in both seasons. The values of mean width of upper leaves were: 6.67, 3.17 and 3.53 for plants topped twice, once and control, respectively

in the first season and it were 8.83, 5.00 and 3.67 for the prementioned treatments during the second season.

It could be concluded that topping process resulted in more branches carry more number of leaves with heaviest dry weight and with larger measurements of leaves which reflect more yield of dry leaves that consedered as a source of active substances such as nicotine.

These results are in harmony with **Sulyman *et al* (1968)** on tobacco cv. Harrison special and Ghatham, found that topping increased leaf size and **Mahdik (1972)** found that topping nicotiana plant variety 20 at 12 leaf stage increased the leaf area/plant.

2.a.9. Number of fibrous roots/plant:

The effect of topping on root growth of *Nicotiana alata* plants was less than its effect on *Nicotiana rustica*. Since all root parameters decreased clearly with the two treatments of topping as shown from the data presented in Table (23).

Mean number of fibrous roots decreased clearly by topping once or twice although the differences between topped plants and untopped one were not significant. Also, there was no clear differences between plants topped once and those topped twice. The data was confermed in both seasons of the experiments.

2.a.10. Mean length of fibrous roots cms:

The mean length of fibrous roots of *Nicotiana alata* affected significantly by topping process as shown in Table (23) Topping plants once or twice decreased mean length of fibrous roots significantly under control plants. Also topping twice was of more effect on decreasing root

Table (23): Effect of topping *Nicotiana alata* plant on root parameters during 1992-1993 & 1993-1994 seasons.

Treatments	Number of fibrous roots		Mean length of fibrous roots/cm		Fresh weight of fibrous roots/g.		Dry weight of fibrous roots/g.	
Seasons	93	94	93	94	93	94	93	94
Without topping	7.03	13.07	32.67	29.03	20.06	48.09	7.67	14.05
Topping once after 40 days	5.35	9.69	22.07	20.67	17.33	34.38	4.35	11.07
Topping twice after 40 and 30 days	5.01	9.03	20.33	19.64	13.01	21.67	2.87	4.17
L.S.D. at 5%	N.S	1.73	2.53	1.31	2.22	2.53	1.25	1.95
L.S.D. at 1%	N.S	2.87	4.19	2.17	3.67	4.20	2.07	3.23

length of *Nicotiana alata* plant. The mean length of fibrous roots of plants under treatments was 20.33, 22.07 and 32.67 cms for plants topped twice, once and untopped respectively in the first season and it was: 19.64, 20.67 and 29.03 cms for the same treatments respectively in the second season.

2.a.11. Fresh and dry weights of fibrous roots gms:

Data presented in Table (23) repesent mean fresh and dry weights of *Nicotiana alata* plant roots as affected by topping process clear that topping plants once or twice decreased significantly the fresh and dry weights of fibrous roots during both seasons of the experiments. The decrease in fresh and dry weight of roots was of great difference under control with topping twice than topping once. Also there was significant decrease between plants topped twice under plants topped once. These results were confirmed in both seasons 1992-93 and 1993-94.

It is clear also that *Nicotiana rustica* and *Nicotiana alata* plants showed nearly the same effect by topping process concerning the over ground growth parts. But with root parameter it is clear that there were great differences, since topping once or twice increased fresh and dry weight of *Nicotiana rustica*, while it decreased the same characters with *Nicotiana alata*.

2.b. Chemical Analysis of *Nicotiana alata*:

2.b.1. Nitrogen percent in plant leaves:

Nitrogen percent in *Nicotiana alata* leaves significantly affected by topping plants as shown in Table (24). Topping plants once resulted in the highest increase over both topping twice or without topping control. The increase in nitrogen content due to topping process may be due to the

activation of the vital processes inside plant according to the higher growth of the plants after removing the terminal buds through topping process. These result came in accordance with those recorded by **Primost *et al* (1971)** they demonstrated that the nitrogen and nicotine content increased significantly by topping.

2.b.2. Phosphorus percentage:

Data concern phosphorus percentage presented in Table (24) show similar trend to that of nitrogen percentage, since plant topped once produced the highest percent of phospohorus over both plants topped twice or untopped plants, although no significant differences could be observed.

2.b.3. Potassium percent:

Potassium percent increased significantly over control with plants topped once or twice. But topping once was of more effect in this concern. Since plants topped once only produced significantly higher percentage over those topped twice.

All minerals percentage in *Nicotiana alata* tended to increase with topped plant. This was also cleared with *Nicotiana rustica*. It seems that this process enhance most of growth parameters which effect in turn on vital processes resulting in higher chemical constituents in plant leaves. Many investigators recorded the effect of topping on chemical constituents among them. **Primost *et al* (1971)** and **Chouteon and Loche (1969)** on nicotiana plant.

Table (24): Effect of topping *Nicotiana alata* on N,P,K, nicotine and chlorophyll A,B in plant leaves.

Treatment	N %	P %	K %	Nicotin %	Chlorophyll A (mg/100 gm)	Chlorophyll B (mg/100 gm)
Without topping	1.03	0.28	6.70	3.85	4.84	3.23
Topping once after (40) days	1.73	0.33	8.45	4.70	4.72	2.99
Topping twice after 40 and 30 days	1.37	0.32	7.69	8.11	4.55	6.02
L.S.D. at 5%	0.27	N.S	0.98	0.19	0.69	0.36
L.S.D. at 1%	0.46	N.S	1.62	0.32	1.15	0.60

2.b.4. Nicotine percentage:

Concerning nicotine content in leaves of *Nicotiana alata* plants is it clear from the data in Table (24) that nicotine content in plant leaves increased significantly by topping process. The increase was of highly significant differences over untopped plants in both casses of topping. Also topping twice resulted in a significantly higher percentage of nicotine over topping once. The mean percent of nicotine of plant topped twice reached nearly twice that topped once and nearly three times of control plants. The increase in nicotine content due to topping plant may be attributed to higher growth of vegetative parts as it resulted in more number of leaves with higher fresh and dry weight and more content of minerals. It also resulted in higher growth of fibrous roots which promoted stronger plants with higher chemical constituents such as nicotine and other chemical componant.

2.b.5. Chlorophyll content:

Data concerning chlorophyll A & B content in *Nicotiana alata* leaves tabulated in Table (24) show that there are no significant differences between chlorophyll percentages due to treating with topping. Chlorophyll A percentage seams to be unaffected by these treatments. While chlorophell B percentage tended of increase as a result of topping especially with topping twice.

This slight increase in chlorophyll may be combined with the increased of the metabolites compounds due to the higher growth resulted from topping plants twice.