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INFLUENCE OF CHEMICAL AND BIO-FERTILIZER ON *DATURA INNOXIA* ALKALOIDES

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ABSTRACT: *In order to determine the influence of chemical and bio-fertilizers on total alkaloids contents of datura (Datura innoxia Mill.) plants, an experiment was conducted in 2010-2011 at Research Farm, Faculty of Agriculture, Fayoum University, Demo Province, Fayoum Governorate, Egypt. Chemical nitrogen fertilizer levels included (0, 3, 6 and 9 g/plant) provided from ammonium nitrate source (33% pure N) and nitrogen bio-fertilizer (containing one strain of Azotobacter chroococcum) levels included (0, 5, 10 and 15 cm^3/plant). Treated datura plants with mineral and bio-fertilizers or their combinations increase dry weight of different parts (i.e. roots, stems and leaves) and total alkaloids contents in different plant parts, as compared to untreated plants during different growth stages.*

Leaves are the most organs contain the highest values of total alkaloids contents along different growth stages, except fruiting stage which had the lowest values in this respect as compared to the other plant parts.

Key words: *Datura innoxia, nitrogen fertilizer, bio-fertilizer and Azotobacter chroococcum.*

INTRODUCTION

Datura (*Datura innoxia* Mill.) is an annual wild plant belonging to the family *Solanaceae* and it is considered one of the most important medicinal plants, known as a main source of a variety of alkaloids required for pharmaceutical industries. Several compounds important for drug manufactory are present in datura plants. Daturine, hyoscyamine, atropine, scopolamine and essence materials used as antispasmodic, narcotic, neuro-sedative and antiasthmatic drugs were found in datura (Chiej, 1984 and Dethier *et al*., 1992). The economic importance of hyoscyamine and scopolamine relies on their medicinal applications. Both alkaloids are used as parasympathicolitics because of their ability to suppress the activity of the parasympathic nerve system (Sikuli and Demeyer 1997). Until now, plant material remains the sole source for these compounds (Evans 1989). The present work aimed to study the influence of ammonium nitrate (NH_4NO_3) and bio-fertilizer (containing one strain of nitrogen fixing bacteria, *Azotobacter chroococcum*) on total alkaloids content of datura (*Datura innoxia* Mill.) plants in different plant parts *i.e.* roots, stems and leaves at different growth stages, in addition seeds produced from fruiting growth stage under Fayoum newly reclaimed soil conditions. Many investigators studied the effect chemical nitrogen fertilizer and bio-fertilizer as nitrogen fixing bacteria on some medicinal plants. In this respect, Afsharypuor *et al.,* (1997) on *Datura stramonium* reported that the amounts of alkaloids (atropine and scopolamine) in all plant parts have some fluctuations at different developmental stages resulted in using chemical nitrogen fertilizer. Selim and Magd El-Din (2007) investigated the effect of ammonium sulphate fertilizer on total alkaloids content of datura (*Datura innoxia* Mill.) plants. They found that, generally, means of total alkaloids increased in leaves and decreased in roots as the plant age increased. In all growth stages, the stems contained the lowest mean values of total alkaloids. The results may indicate that the first biosynthesis of alkaloids occurs in roots of datura seedling and trans-located to leaves and fruits developed. Amdoun *et al.,* (2009) studied the influence of minerals on tropane alkaloids production in *Datura stramonium* L. They demonstrated that the highest alkaloids rate was found with hairy root cultures also pointed the effect of NO_3^- plays a metabolic role on tropane alkaloids biosynthesis, especially on hyoscyamine.

Balathandayutham *et al.,* (2010) studied the effect of plant growth promoting rhizobacteria such as *Azotobacter,* in *Catharanthus roseus*. They found that alkaloids content significantly increased by the bacterial treatment in all sampling days. Rajasekar and Elango (2011) investigated the effect of *Azospirillum* or *Azotobacter*) on *Withania somnifera* plants. They found that roots inoculated with rhizobacteria promoted significant increase in alkaloids content as compared to the control. Mohammadali *et al.*, (2012) on (*Nicotiana tabacum* L.) plants. They found that both N fertilization and *Azotobacter chroococcum* inoculation had a significant effect on nicotine content in leaves.

MATERIALS AND METHODS

The present work was carried out at Demo Experimental Farm, Faculty of Agriculture, Fayoum University during the two successive seasons 2010 and 2011. This work aimed to investigate the effect of chemical and bio-fertilizers and their interacion on total alkaloids content in different parts of datura (*Datura innoxia* Mill.) plants during different growth stages.

Experimental Materials:

Seeds of datura (*Datura innoxia* Mill.) were obtained from the wild plants were grown in the Farm of Agric. Fac. at Demo, Fayoum Univ., and identified by staff of Floriculture, Horticulture department. After the seeds were soaked in tab water for 12th hours, then sown at the nursery on 17th February during the two successive seasons, when the seedlings had two pairs of true leaves were transplanted at 4th April in both seasons.

Studied treatments:

1-Mineral fertilizer treatments:

The plants received a basic dose from nitrogen fertilizer inform of ammonium nitrate (33.5% N) at rates of (0, 3, 6 and 9 g/plant) divided into two equal portions, and applied after 4th and 6th weeks from transplanting in both seasons.

2-Bio-fertilizer treatments:

Datura plants were inoculated with nitrogen bio-fertilizer (containing efficient strain of nitrogen fixing bacteria namely, *Azotobacter chrocooccum,* that which available in liquid (1×10^9 bacterial cells/ml) formulation. The nitrogen bio-fertilizer strain was provided by the Unit of Bio-fertilizer, Research of Agriculture Center, Giza, Egypt. The strains were characterized by a good ability to infect its specific host plant and its high efficiency in N fixation. The plants received the suspension of bio-fertilizer two times after 30 and 45 days from transplanting as a soil injection at different three places around the plant roots. The strains bio-fertilizer were added at the rates (0, 5, 10, 15 cm^3/plant).

Experimental design:

Experimental layout used was a factorial experiment in randomized complete block design with sixteen treatments, each treatment have three replicates. The area of each plot was (2.4×2.5 m^2). The growing soil was prepared and each plot divided into four rows, (60 cm) apart. The distance between plants was 50 cm with 5 plants\row. The obtained data were statistically analyzed according to the different treatments were achieved using Least Significant Difference test (L.S.D.) at p= 0.05 (Snedecor and Cochran, 1980).

Site of experiment:

Site of experiment was prepared and fertilized with (20 m^3/feddan) farmyard manure and (200 kg/feddan) of calcium super phosphate (15.5% P_2O_5) were added before seedlings transplanting, while, potash (50 kg/feddan) as K_2O 48.5% fertilizer was applied with the latest dose of nitrogen treatment. The other normal agricultural practices for plants were done according to its needs.

Some mechanical and chemical properties of used soil during (2010 and 2011) seasons presented in Table (1) carried out according to Klute (1986) and Page *et al.,* (1982).

Data recorded:

At different growth stages vegetative, flowering and fruiting growth stages (after 8,12 and 17 weeks from transplanting,

respectively) the following records were determined.

1- Dry weight (g/plant) of different parts (roots, stems and leaves) at all growth stages (*i.e.* vegetative, flowering and fruiting growth stages).
2- Seeds weight g/ plant.
3-Total alkaloids (mg/g d.w.) were determined in leaves, stems and roots at all the above mentioned growth stages in addition seeds produced from fruiting stage. For the determination of total alkaloids, the vitally color reaction method given by Fish (1960) and modified by Ali (2000) was used.

The alkaloid content of each sample calculated from the means of triplicate readings using a conversion factor (K) determined from color density figures obtained, using 1 to 5 ml a quantities of (0.1%) chloroformic solution of atropine.

$$K = \frac{Color\ density}{mg.atropine} \times \frac{\text{Dilution level}}{\text{dry weight of t□sted sample}} = \left(\frac{\text{mg}}{\text{g}}\text{d.w.}\right)$$

Table (1): Some physical and chemical properties of used soil of the experiment during (2010 – 2011) seasons.

Physical characters		
Mechanical analysis	Values	
Clay %	11.34	
Course sand %	51.7	
Fine sand %	25.8	
Silt %	13.5	
Soil texture	Sand loamy	
Chemical characters		
Chemical analysis	1st season	2nd season
pH	7.76	7.53
EC (dS/m)	7.55	5.35
$CaCO_3$ %	14.5	14.1
HCO_3 (mg/L)	671	488
Organic mater	4.5	4.2
N %	0.15	0.14
P (mg/kg)	89	78
K (mg/kg)	169	172

RESULTS AND DISCUSSION

Dry weight of roots (gm/plant) at different growth stages:

Statistically data in Table (2) show that the moderate and the highest level (6&9 g/plant) of ammonium nitrate gave the highest significant records of root dry weight of datura plants as compared with the other nitrogen levels, as well as, untreated plants during the two respective seasons at vegetative and flowering growth stages. Meanwhile, at fruiting growth stage the highest significant record of datura roots dry weight obtained from plants treated with ammonium nitrate at 6 g/plant in both seasons. This increment can be due to the positive effects of nitrogen on the dry matter changes and increasing the plant leaf area that reflected positively on amounts of photo-assimilates and their trans-located. Harmony results are obtained on (*Achillea collina* Becker ex Rchb.) plants by Annamaria *et al.,* (2009). They noticed that dry weight of roots affected positively by using nitrogen fertilization levels, compared with control plants.

Data in the same Table (2) show that roots dry weight of datura increased significantly by raising the nitrogen bio-fertilizer level as compared with un-inoculated plants during the two growing seasons of study at different growth stages. The most effective treatment in this regard was 15 cm^3/plant of nitrogen bio-fertilizer with significant differences as compared with the other treatments, as well as, un-inoculated plants in both seasons at vegetative and fruiting growth stages. While, at flowering growth stage the most effective treatments were 10 and 15cm^3/plant at the two respective seasons with significant differences as compared with the other treatments. These results are in accordance with those obtained by Lenin and Jayanthi (2012) on *Catharanthus roseus* L. plants. They indicated that inoculated plants with plant growth promoting rhizo-bacteria (PGPR) increased the root dry weight of plants.

Concerning to the effect of the interaction between chemical N fertilizer and N bio-fertilizer at different growth stages it could be noticed that in both seasons of study treated datura plants with ammonium nitrate fertilizer combined with nitrogen bio-fertilizer at any level, in general, produced the highest records of datura roots dry weight with significant or insignificant differences compared with control plants, Table (2).

Dry weight of stems (gm/plant) at different growth stages:

Data presented in Table (3) clarified that at different growth stages treated datura plant with any level of ammonium nitrate fertilizer affected significantly on stems dry weight as compared with unfertilized plants, at the two growing seasons of study. The heaviest dry weights of datura stems produced due to treated the plants with ammonium nitrate at 6 or 9 g/plant in the first or second seasons, respectively, at vegetative and fruiting growth stages.

On the other hand, in both seasons of study the moderate level (6 g /plant) of ammonium nitrate gave the highest significant records of stem dry weight of datura plants as compared with the other nitrogen levels, as well as, untreated plants at flowering growth stages.

The increase in stems dry weight may be due to the increase in size of successive leaves, which improved translocation and accumulation of photo-assimilates. These results are in accordance with those obtained by Wander and Bouwmeester (1998) on *Anethum graveolens* L. plants. They found that fertilizing the plants with nitrogen fertilizer was more affective in increasing plants dry weight compared with control plants.

Data in the same Table (3) show that at different growth stages the addition of nitrogen bio-fertilizer at different rates (5, 10 and 15 cm^3/plant) had a significant or insignificant effect on increasing stem dry weight of datura plants compared with un-inoculated plants in both seasons. The highest stems dry weight obtained from plants inoculated with nitrogen bio-fertilizer at 15 cm^3/plant during the two growing

seasons at flowering and fruiting growth stages. At vegetative growth stage the highest records promoted due to inoculated the plants with nitrogen bio-fertilizer at 10 or 15 cm^3/plant during the two respective seasons. These results are in accordance with those obtained by Lenin and Jayanthi (2012) on *Catharanthus roseus* L. plants. They indicated that inoculated plants with plant growth promoting rhizobacteria (PGPR) increased the shoot dry weight of plants.

Table (2): Effect of nitrogen fertilizer and bio-fertilizer on root dry weight (gm/plant) of datura (*Datura innoxia* Mill.) plant at different growth stages during (2010 – 2011) seasons.

Vegetative growth stage										
Nitrogen g/plant (N)	First season (2010)					Second season (2011)				
	Bio. cm^3/plant (B)					Bio. cm^3/plant (B)				
	0	5	10	15	Mean	0	5	10	15	Mean
0	2.27	2.97	5.63	5.17	4.01	8.80	10.83	11.53	13.40	11.14
3	2.97	5.87	7.37	3.37	4.89	12.2	10.67	12.63	12.77	12.07
6	1.77	6.37	9.50	4.13	5.44	12.23	13.00	10.53	13.93	12.43
9	2.50	7.73	4.90	6.20	5.33	18.90	11.40	11.67	12.60	13.64
Mean	2.38	5.73	6.85	4.72		13.03	11.48	11.59	13.18	
L.S.D 5%										
N	1.37					2.65				
B	1.37					2.65				
NB	2.37					5.30				
Flowering growth stage										
0	23.06	28.83	23.00	34.70	27.40	29.55	22.75	22.97	34.72	27.5
3	28.17	33.70	35.55	21.96	29.84	25.15	30.27	40.00	40.12	33.88
6	25.32	25.68	39.15	50.52	35.17	34.24	28.37	36.77	48.23	36.90
9	34.47	25.91	46.78	27.56	33.68	21.57	29.63	44.29	54.42	37.47
Mean	27.76	28.53	36.12	33.68	27.76	27.63	27.76	36.00	44.37	
L.S.D 5%										
N	6.87					8.19				
B	6.87					8.19				
NB	13.74					16.38				
Fruiting growth stage										
0	47.06	55.34	60.9	84.64	61.98	66.13	72.12	74.8	84.72	74.44
3	59.46	67.42	75.13	84.70	71.68	73.97	81.44	87.62	92.49	83.88
6	66.72	73.68	80.44	83.59	76.11	77.30	78.76	93.33	98.23	86.90
9	48.45	62.05	67.40	73.81	62.93	72.75	70.37	85.13	88.04	79.07
Mean	55.42	64.62	70.97	81.69		72.54	75.67	85.22	90.87	
L.S.D 5%										
N	5.09					3.73				
B	5.09					3.73				
NB	10.18					7.46				

Table (3): Effect of nitrogen fertilizer and bio-fertilizer on stem dry weight (gm/plant) of datura (*Datura innoxia* Mill.) plant at different growth stages during (2010 – 2011) seasons.

Vegetative growth stage										
Nitrogen g/plant (N)	First season (2010)					Second season (2011)				
	Bio. cm^3/plant (B)					Bio. cm^3/plant (B)				
	0	5	10	15	Mean	0	5	10	15	Mean
0	5.80	3.00	5.00	8.40	5.55	12.00	12.90	12.90	15.20	13.25
3	2.33	6.20	13.17	3.73	6.36	11.53	13.40	14.13	13.93	13.25
6	3.23	7.63	11.4	3.97	6.56	11.83	14.00	15.00	17.13	14.49
9	2.80	8.90	5.80	6.83	6.08	11.97	12.43	13.47	23.07	15.23
Mean	3.54	6.43	8.84	5.73		11.83	13.18	13.88	17.33	
L.S.D 5%										
N	2.9					2.41				
B	2.9					2.41				
NB	5.79					4.82				
Flowering growth stage										
0	32.4	53.63	53.86	141.27	70.29	43.63	48.45	62.8	94.53	62.35
3	27.97	76.55	99.92	130.97	83.85	69.88	87.58	112.4	134.39	101.07
6	22.47	138.11	106.80	78.94	86.58	79.21	109.18	138.08	191.71	129.55
9	45.10	62.46	98.78	114.71	80.26	70.97	89.38	103.13	121.92	96.35
Mean	31.99	82.69	89.84	116.47		65.92	83.65	104.10	135.64	
L.S.D 5%										
N	31.64					16.42				
B	31.64					16.42				
NB	63.29					32.84				
Fruiting growth stage										
0	274.22	228.19	262.97	244.45	252.46	274.22	394.44	296.3	311.11	319.02
3	319.58	335.01	358.22	423.3	359.03	419.58	302.09	458.22	523.3	425.8
6	344.44	388.13	407.58	431.01	392.79	431.11	438.13	457.58	491.01	454.46
9	335.42	381.8	380.68	416.92	378.7	435.42	481.8	480.68	516.92	478.7
Mean	318.42	333.28	352.36	378.92		390.08	404.11	423.2	460.59	
L.S.D 5%										
N	25.54					35.42				
B	25.54					35.42				
NB	51.08					70.84				

Effect of interaction between N chemical fertilizer and bio-fertilizer varied between the two successive seasons of study and different growth stages. Differences between mean values were significantly in both seasons. At vegetative growth stage the highest significant records of stem dry weight produced from plants treated with ammonium nitrate at 3g/plant combined with bio-fertilizer at 10 cm^3/plant or ammonium nitrate at 9g/plant combined with bio-fertilizer at 15 cm^3/plant at the two respective seasons. At flowering growth stage plants fertilized with ammonium nitrate at 6g/plant combined with 5 or 15 cm^3/plant bio-fertilizers produced the heaviest stem dry weight in the first or second seasons, respectively. The highest significant records of stem dry weight produced due to treated datura plants with nitrogen bio-fertilizer at 15 cm^3/plant combined with ammonium nitrate at 6 or 3/plant at fruiting stage at the two respective seasons, Table (3).

Dry weight of leaves (gm/plant) at different growth stages:

As seen in Table (4) data revealed that applying ammonium nitrate fertilizer at different rates 3, 6 and 9 g /plant significantly increased leaf dry weight of datura plants compared with control plants during the two growing seasons of study at different growth stages. At vegetative growth stage, plants treated with N fertilizer at 6 or 9 g /plant gave the highest records of leaves dry weight, in the first and second seasons, respectively. The highest leaves dry weight recorded from plants treated with N fertilizer at 6 or 9 g /plant at flowering or fruiting growth stages, respectively, in both seasons. This increment in leaf dry weight might be due to when there was adequate N supply in the soil, photosynthesis rate increased and enabled the plant to grow rapidly and produce considerable biomass. These results are in accordance with those obtained by Selim and Magd El-Din (2007) on *Datura innoxia* Mill. plants and Annamaria *et al.,* (2009) on *Achillea collina* Becker ex Rchb. plants. They found that leaves dry weight increased by raising the nitrogen fertilization level compared with untreated plants.

Concerning to the effect of bio-fertilizer on leaves dry weight/plant data in the same Table (4) show that the addition of nitrogen bio-fertilizer at different rates (5, 10 and 15 cm^3/plant) affected positively and significantly on leaves dry weights of datura plants over the un-inoculated plants during the two growing seasons of study, as well as, different growth stages. Plants inoculated with nitrogen bio-fertilizer at 10 or15 cm^3/plant at vegetative growth stage produced the highest values of leaves dry weight in the first and second seasons, respectively. Whereas, at the other growth stages (flowering and fruiting stages) inoculated the plants with nitrogen bio-fertilizer at 15 cm^3/plant gave the highest records of leaf dry weight in both seasons of study. These results are in harmony with those obtained by Gharib *et al.,* (2008) on *Majorana hortensis* L. plants, Shehata *et al.,* (2010) on *Apium graveolens* L. plants and Lenin and Jayanthi (2012) on *Catharanthus roseus* L. plants. They found that the inoculation with bio-fertilizer affected significantly on leaf dry weight.

The interaction between nitrogen and bio-fertilizer on leaves dry weight presented in Table (4) show that using bio-fertilizer at any level with different rates of mineral N fertilizer increased leaves dry weight/plant in both seasons with significant or insignificant effect compared with control plants at all growth stages. The highest leaves dry weight obtained from plants received mineral N fertilizer at 9 g /plant combined with nitrogen bio-fertilizer at 15 cm^3/plant, in both seasons at fruiting growth stage or at the second season for the other growth stages. On the other hand, in the second season of study plants received N fertilizer at 6 g /plant combined with bio-fertilizer at 10 cm^3/plant or N fertilizer at 3 g /plant combined with bio-fertilizer at 15 or cm^3/plant gave the highest leaves dry weight at vegetative or flowering growth stages, respectively. It could be concluded that the increment in plant dry weight may be attributed to the increase in both plant height, number of branches/plant and plant

fresh weight. In this respect Shehata *et al.,* (2010) on *Apium graveolens* L. and Hellal *et al.,* (2011) on *Anethum graveolens* L. plants. They mentioned that using bio-fertilizer combined with different levels of N fertilizer increased leaves dry weight compared to using each of them as individually.

Generally, the aforementioned results might be attributed to the favorable effects of bio-fertilizers on vegetative growth. Bio-fertilizers are microbial inoculates used for application to either seed or soil for increasing soil fertility with the objective of increasing the number of such microorganisms and to accelerate certain microbial processes in the rhizosphere of inoculated plants or soil. Such microbiological processes can change unavailable forms of nutrients into available ones that can be easily assimilated by plants, and then increased herb fresh and dry weight of plants (SubbaRao, 1993).

Table (4): Effect of nitrogen fertilizer and bio-fertilizer on leaves dry weight (gm/plant) of datura (*Datura innoxia* Mill.) plant at different growth stages during (2010 – 2011) seasons.

Vegetative growth stage										
Nitrogen g/plant (N)	First season (2010)					Second season (2011)				
	Bio. cm^3/plant (B)					Bio. cm^3/plant (B)				
	0	5	10	15	Mean	0	5	10	15	Mean
0	5.23	7.73	15.20	26.17	13.58	18.63	26.30	31.13	34.60	27.67
3	8.87	21.63	27.50	14.80	18.20	26.00	28.00	30.40	36.47	30.22
6	13.23	19.93	30.50	13.43	19.28	24.30	28.70	32.23	39.10	31.08
9	20.57	18.77	16.70	20.00	19.01	24.87	30.80	33.57	42.30	32.88
Mean	11.98	17.02	22.48	18.60		23.45	28.45	31.83	38.12	
L.S.D 5% N B NB	5.94 5.94 11.88					4.90 4.90 9.18				
Flowering growth stage										
0	75.91	150.23	93.06	133.51	113.18	64.19	74.39	101.41	124.93	91.23
3	140.81	61.92	140.19	148.78	122.92	111.59	136.4	149.72	164.22	140.49
6	74.61	161.68	130.73	144.72	127.94	120.71	147.96	167.36	174.33	152.59
9	130.63	97.80	139.51	135.09	125.76	92.31	137.46	173.77	201.38	151.23
Mean	105.49	117.91	125.87	140.53		97.2	124.05	148.07	166.22	
N B NB	32.05 32.05 64.11					13.73 13.73 27.46				
Fruiting growth stage										
0	80.22	125.4	134.27	196.15	134.01	165.93	174.88	216.37	201.94	189.78
3	165.79	172.72	187.91	254.72	195.29	194.61	230.75	338.87	361.33	281.39
6	233.06	282.74	310.88	348.08	293.69	208	290.35	363.21	420.89	320.61
9	188.33	265.86	287.42	459.09	300.18	275.86	294.77	379.63	463.75	353.5
Mean	166.85	211.68	230.12	314.51		211.1	247.69	324.52	361.98	
N B NB	51.94 51.94 103.88					35.88 35.88 71.76				

From the abovementioned results it could be noticed that treated datura plants with ammonium nitrate, N bio-fertilizer or their combination gave the highest dry weight of different parts (roots, stems and leaves) at fruiting growth stage compared with the other growth stages.

Weight of seeds (gm/plant):

As shown in Table (5) it could notice that in both seasons, treated the plants with different levels of N fertilizer affected positively and significantly on weight of seeds/plant as compared with unfertilized plants during the two growing seasons of study. The highest significant records of seeds weight/plant obtained from plants treated with ammonium nitrate at (9 g/plant), during the two growing seasons. Similar results are obtained by Osman and Awed (2010) and Wajid *et al.,* (2012) on *Helianthus annuus* L. plants, They found that increasing nitrogen fertilizer levels followed by increasing in seed yield.

Data presented in the same Table (5) show that different levels of nitrogen bio-fertilizer affected positively on weight of seeds/plant, as compared with untreated plants at the two growing seasons of study. The maximum records resulted from plants inoculated with bio-fertilizer at (15cm^3/plant), during the two growing seasons. Agreed results are obtained by Adel *et al.,* (2012) on *Coriandrum sativum* plants, and Mohammad & Mohammadreza (2012) on *Anethum graveolens* L. plants. They indicated that treated the plants with bio-fertilizer application affected positively on seed weight.

According to the interaction between N fertilizer and bio-fertilizer at the different rates, data presented in Table (5) revealed that the highest records of seeds weight/plant resulted from plant treated with nitrogen fertilizer at 9 g/plant and combined with bio-fertilizer at 15 or10 cm^3/plant, at the two respective seasons. Differences between mean values were significant compared with untreated plant in both seasons. In this respect Hellal *et al*., (2011) on *Anethum graveolens* L. plants and Mahboobeh and Jahanfar (2012) on *Brassica napus* L. plants. They found that using bio-fertilizer coupled by N fertilizer had a positive effect on seed yield of plants.

Table (5): Effect of nitrogen fertilizer and bio-fertilizer on seeds weight (gm/plant) of datura (*Datura innoxia* Mill.) plant during (2010 – 2011) seasons.

Nitrogen g/plant (N)	First season (2010)					Second season (2011)				
	Bio. cm3/plant (B)					Bio. cm3/plant (B)				
	0	5	10	15	Mean	0	5	10	15	Mean
0	60.53	91.71	118.90	161.67	108.20	60.62	145.23	145.95	210.96	140.69
3	123.43	197.82	202.24	267.84	197.83	138.59	252.75	278.92	322.20	248.11
6	169.15	240.51	259.77	297.03	241.62	229.47	327.93	377.86	363.04	324.57
9	172.18	218.39	232.43	352.38	243.85	278.38	360.40	388.99	343.82	342.90
Mean	131.32	187.11	203.34	269.73		176.76	271.58	297.93	310.01	
L.S.D 5%										
N	22.81					40.75				
B	22.81					40.75				
NB	45.62					81.51				

Total alkaloids content at vegetative growth stage:

1-Roots:

Tabulated results in Table (6) clarified that in the first season of study the highest significant records of total alkaloids content in datura roots obtained from plants fertilized with ammonium nitrate at (6 g/plant) followed by (3 g /plant) as compared to the other nitrogen fertilization treatments. In the second season of study N fertilizer had no significant effect on total alkaloids content, the highest record obtained from treating the plants with the moderate nitrogen fertilizer (6 g/plant). Similar results were reported by Afsharypuor *et al.,* (1997) on (*Datura stramonium* L.) plants, Baricevic *et al.,* (1999) on (*Atropa belladonna* L.) plants and Selim and Magd El-Din (2007) on (*Datura innoxia* Mill.) plants. They indicated that plants treated with N fertilizer increased alkaloids percentage.

Also data in the same Table (6) indicate that the addition of nitrogen bio-fertilizer at rates (5, 10 and 15 cm^3/plant) gradually increased total alkaloids content of datura roots over the un-inoculated plants in the two growing seasons. Treatments 10 and 15 cm^3/plant had a significant effect in this respect compared with the other treatments in the first season. While in the second season, bio-fertilizer had no significant effect in this respect. The highest value obtained from plants inoculated with bio-fertilizer at 10 cm^3/plant. These results are in harmony with those obtained by Balathandayutham *et al.,* (2010) on (*Catharanthus roseus* L.) plants and Rajasekar and Elango (2011) on (*Withania somnifera* L.) plants. They found that soil inoculation with bio-fertilizer increased alkaloids content in roots compared with untreated plants.

The obtained data in the same Table (6) show the interaction between nitrogen and bio-fertilizer on total alkaloids content of datura roots. These results showed that the highest significant records of total alkaloids of datura roots obtained from plants treated with N fertilizer at 6 g/plant combined with bio-fertilizer at 10 cm^3/plant in both seasons of study. While, the lowest values in this aspect were (7.10 and 7.24 mg/g d.w.) obtained from untreated plants at the two respective seasons.

2-Stems:

Data listed in Table (6) show that in both seasons of study treated datura plants with nitrogen fertilizer at any level affected positively on stems total alkaloids content. The highest significant records obtained from plants fertilized with ammonium nitrate at the moderate level (6 g/plant) during the first and second seasons. While, the lowest values in this respect obtained from plants treated with 9 g /plant and untreated plants in the first and second seasons, respectively. These results are in accordance with those obtained by Selim and Magd El-Din (2007) on *Datura innoxia* Mill. plants. They found that fertilizing the plants at seedling stage with nitrogen fertilizer at all rates significantly increased total alkaloids in stems of datura plants compared with control plants.

Data in the same Table (6) also indicate that the addition of bio-fertilizer at rates (5, 10, and 15 cm^3/plant) significantly increased total alkaloids content of datura stems as compared with un-inoculated plants.

The increase of total alkaloids of datura stems increased as bio-fertilizer rates increased and reached its maximum values when plants inoculated with 10 cm^3/plant, then tended to decline at 15 cm^3/plant of nitrogen bio-fertilizer, in both seasons.

Data presented in the same Table (6) revealed that the effect of interaction between N fertilizer and bio-fertilizer treatments on total alkaloids content in daura stems fluctuated significantly or insignificantly compared with untreated plants in both seasons of study. The highest significant contents were (17.79 and 18.14 mg/g d.w.) resulted from treated datura plants with N fertilizer at (6 g/plant) combined with bio-fertilizer at (10 or 15 cm^3/plant) in the first and second seasons, respectively.

Table (6): Effect of nitrogen fertilizer and bio-fertilizer on total alkaloids (mg/g/dw) in different parts of datura (*Datura innoxia* Mill.) plant at vegetative growth stage during (2010 – 2011) seasons.

Nitrogen g/plant (N)	First season (2010)					Second season (2011)				
	Bio. cm^3/plant (B)					Bio. cm^3/plant (B)				
	ROOTS									
	0	5	10	15	Mean	0	5	10	15	Mean
0	7.10	7.88	8.26	8.46	7.93	7.24	8.26	8.61	7.80	7.98
3	8.26	8.26	7.90	8.46	8.22	8.26	8.10	7.80	7.95	8.03
6	7.86	8.07	8.83	8.25	8.25	7.80	7.86	8.63	8.36	8.16
9	7.95	7.49	7.80	7.80	7.76	7.95	7.90	7.85	8.46	8.04
Mean	7.79	7.93	8.20	8.24		7.81	8.03	8.22	8.14	
L.S.D 5%										
N			0.26					N.S.		
B			0.26					N.S.		
NB			0.52					0.98		
STEMS										
0	14.6	13.58	17.81	14.27	15.07	14.98	14.42	14.22	14.42	10.77
3	15.85	14.42	15.14	16.06	15.37	15.85	15.09	17.79	13.2	15.48
6	12.69	15.75	17.79	17.59	15.95	12.84	15.75	16.06	18.14	15.70
9	12.84	15.09	14.22	16.87	14.76	12.69	15.14	16.87	14.27	14.74
Mean	14	14.71	16.24	16.2		14.09	15.1	16.23	15.01	
N			0.61					0.98		
B			0.61					0.98		
NB			1.22					1.95		
LEAVES										
0	27.57	36.9	37.26	31.39	33.28	27.57	41.28	38.12	37.72	36.17
3	18.4	41.28	56.07	38.63	38.6	18.40	63.66	40.93	36.9	39.97
6	39.14	63.66	38.12	41.64	45.64	47.91	56.07	41.64	24.72	42.58
9	47.91	28.59	40.93	37.72	38.79	28.59	39.14	39.97	43.92	37.91
Mean	33.26	42.61	43.09	37.34		30.62	50.04	40.17	35.82	
N			2.64					1.37		
B			2.64					1.37		
NB			5.27					2.74		

3-Leaves:

From illustrated data in Table (6) it could be noticed that treated datura plants with chemical nitrogen fertilizer at any rate increased the contents of total alkaloids in datura leaves compared with control plants during the two growing seasons. The highest significant records were (45.64 and 42.58 mg/g d.w.) resulted from plants treated with moderate rate of nitrogen fertilizer (6 g/plant) in the first and second seasons, respectively. While, the lowest values in this aspect were recorded from untreated plants in both seasons. These results are in harmony with those obtained by Selim and Magd El-Din (2007) on datura (*Datura innoxia* Mill.) plants. They revealed that treated the plants with nitrogen fertilizer at seedling stage increased total alkaloids in leaves of datura plants compared with control.

Data in the same Table (6) also indicate that the addition of bio-fertilizer (Nitrobein) at the rates (5, 10, and 15 cm^3/plant) significantly increased total alkaloids content of datura leaves as compared to un-inoculated plants. The increase of total alkaloids content of datura leaves increased as bio-fertilizer rates increased and reached its maximum value when plants inoculated with bio-fertilizer at 10 cm^3/plant then tended to decline at 15 cm^3/plant in the first season. While, in the second season the maximum value obtained from 5 cm^3/plant treatment then tended to decline at 10 and 15 cm^3/plant, but it had a significant effect in this aspect as compared to un-inoculated plants.

The interaction between nitrogen and bio-fertilizer on total alkaloids content of datura leaves presented in Table (6) revealed that highest significant record of total alkaloids content in datura leaves resulted from plants treated with nitrogen bio-fertilizer at 5 cm^3/plant and combined with nitrogen fertilizer at 6 or 3 g /plant in the first and second seasons, respectively. In this respect Mohammadali *et al.*, (2012) on *Nicotiana tabacum* L. plants. They found that both N fertilization and *Azotobacter chroococcum* inoculation had a significant effect on nicotine content in leaves.

In conclusion, results of this study revealed that treatments of both chemical and bio-fertilizer increased total alkaloids content in different plants parts (*i.e.* roots, stems and leaves) during vegetative growth stage in both seasons. The highest total alkaloids content were recorded in leaves followed in descending order by stems and roots, respectively under all levels of nitrogen as compared to control in both seasons of study. This might be due to alkaloids is synthesized in the roots of datura (*Datura innoxia* Mill.) plants and is then translocated to the upper plant parts to accumulate their (Romeike, 1961).

Total alkaloids content at flowering growth stage:

1-Roots:

Data listed in Table (7) show that treated datura plants with chemical nitrogen fertilizer had no significant or significant effect on total alkaloids content of datura roots in the first or second seasons, respectively. The highest records were (5.35 and 6.05 mg/g d.w.) recorded from plants fertilized with ammonium nitrate at (6 g/plant) at the two respective seasons. Similar results were reported by Afsharypuor *et al.,* (1997) on datura (*Datura stramonium* L.) plants and Selim and Magd El-Din (2007) on datura (*Datura innoxia* Mill.) plants. They indicated that at flowering stage, leaves contain higher alkaloids as resulted in fertilizing the plants with nitrogen.

Data in the same Table (7) also indicate that the addition of bio-fertilizer at rates (5, 10, and 15 cm^3/plant) had no effect on total alkaloids content of datura roots at the two growing seasons. The highest contents of total alkaloids were produced from un-inoculated plants with insignificant effect compared with the other treatments at the two respective seasons. These results are not agreed with Balathandayutham *et al.,* (2010) on *Catharanthus roseus* L. plants and Rajasekar and Elango (2011) on *Withania somnifera* L. plants. They found that inoculated with bio-fertilizer affected positively on plant total alkaloids compared with un-inoculated plants.

The interaction between nitrogen and bio-fertilizer on total alkaloids content of datura roots presented in Table (7). These results revealed that the highest values were (6.63 and 7.08 mg/g d.w.) obtained from plants treated with N fertilizer at (3 g/plant) and un-inoculated with bio-fertilizer in the first and second seasons, respectively. Differences between mean values were insignificant or significant at the two respective seasons.

2-Stems:

Data listed in Table (7) show that ammonium nitrate fertilizer at different rates (3, 6, and 9 gm/plant) increased total alkaloids content of datura stems over untreated plants during the two growing seasons. The highest total alkaloids content of datura stems recorded from plants fertilized with ammonium nitrate at 6 g /plant and then tended to decline at 9 g /plant during the two growing seasons. Also, this result showed that there were no significant effect existed between all treatments in the first seasons, while treatment (6 g /plant) only had a significant effect in this aspect as compared to the other treatments in the second season. These results are in accordance with Selim and Magd El-Din (2007) on *Datura innoxia* Mill. plants. They indicated that at flowering stage the highest dose of N fertilizer cause no significant effect on stem total alkaloids content.

Data in the same Table (7) also indicate that the addition of bio-fertilizer at rates (5, 10, and 15 cm^3/plant) had no significant effect on total alkaloids content of datura

stems in the two growing seasons. In the first season of study the highest total alkaloids content in datura stem was (5.54 mg/g d.w.) obtained from plants inoculated with 15 cm^3/plant bio-fertilizer. While, in the second season of study inoculated datura plants with any rate of nitrogen bio-fertilizer produced the lowest content of total alkaloids compared with un-inoculated plants.

The interaction between nitrogen and bio-fertilizer on total alkaloids content of datura stems presented in Table (7) revealed that the highest values were (7.39 and 8.26 mg/g d.w.) obtained from plants treated with N fertilizer at (6 g /plant) and un-inoculated with bio-fertilizer treatment in the first and second seasons, respectively. While, the lowest content of stem total alkaloides obtained from untreated plants or plants fertilized with nitrogen at 9 g /plant combined with bio-fertilizer at (5 cm^3/plant), in the first and second seasons, respectively. There were significant differences between mean values in both seasons of study.

Table (7): Effect of nitrogen fertilizer and bio-fertilizer on total alkaloids (mg/g/dw) in different parts of datura (*Datura innoxia* Mill.) plants at flowering growth stage during (2010 – 2011) seasons.

Nitrogen g/plant (N)	First season (2010)					Second season (2011)				
	Bio. cm3/plant (B)					Bio. cm3/plant (B)				
	ROOTS									
	0	5	10	15	Mean	0	5	10	15	Mean
0	5.68	4.74	4.79	4.77	4.99	6.83	4.64	4.64	4.38	5.12
3	6.63	4.28	4.64	4.99	5.14	7.08	4.94	5.15	4.89	5.52
6	6.37	4.84	4.82	5.38	5.35	6.12	5.79	6.33	5.97	6.05
9	4.77	4.36	5.05	4.99	4.79	5.15	4.79	4.89	3.82	4.66
Mean	5.86	4.56	4.82	5.03		6.29	5.04	5.25	4.77	
L.S.D 5%										
N	N.S.					0.93				
B	N.S.					N.S.				
NB	N.S.					1.86				
STEMS										
0	3.72	3.75	5.25	5.76	4.62	4.43	4.18	4.43	3.77	4.20
3	4.41	4.01	5.07	6.73	5.05	5.40	4.38	5.81	3.06	4.66
6	7.39	4.33	4.61	5.53	5.47	8.26	3.57	6.78	5.50	6.03
9	5.48	3.77	6.75	4.13	5.03	6.98	2.29	4.79	5.71	4.94
Mean	5.25	3.96	5.42	5.54		6.27	3.61	5.45	4.51	
N	N.S.					1.05				
B	N.S.					N.S.				
NB	3.74					2.10				
LEAVES										
0	8.84	15.95	18.50	18.60	15.47	14.22	16.21	15.95	20.64	16.76
3	17.84	15.29	12.95	20.90	16.74	17.84	13.20	18.45	18.50	17.00
6	19.01	15.29	18.45	17.23	17.49	17.84	15.29	20.90	16.72	17.69
9	17.84	13.20	15.90	17.69	16.16	19.01	12.95	17.69	8.07	14.43
Mean	15.88	14.93	16.45	18.60		17.23	14.41	18.25	15.98	
N	N.S.					N.S.				
B	2.05					N.S.				
NB	4.11					8.41				

3- Leaves:

From data listed in Table (7) it could be concluded that treated datura plants with ammonium nitrate fertilizer at any level affected positively on total alkaloids content of datura leaves compared with unfertilized plants in both seasons, with one exception, in the second season the lowest value obtained from plants fertilized with nitrogen at (9 g/plant). The highest significant records of total alkaloids content obtained due to treated the plants with the moderate rate of N fertilizer (6 g /plant) in the first and second seasons, respectively. In this respect Sreevalli *et al.,* (2004) on *Catharanthus roseus* plants and Selim and Magd El-Din (2007) on *Datura innoxia* Mill. plants. They indicated that N fertilizer treatments significantly increased the contents of alkaloids in leaves.

Data in the same Table (7) show that the effect of bio-fertilizer (Nitrobein) on total alkaloids content of datura leaves varied as the two seasons of study. In the first season the highest significant content of total alkaloids was (18.60 mg/g d.w.) produced from plants inoculated with bio-fertilizer at (15 cm^3/plant). While, in the second season of study inoculated datura plants with nitrogen bio-fertilizer had no significant effect on leaves total alkaloids contents, whereas, the highest value was (18.25 mg/g d.w.) obtained due to inoculated the plants with bio-fertilizer at (10 cm^3/plant). These results are in accordance with those obtained by Mohammadali *et al.,* (2012) on *Nicotiana tabacum* L. plants. They indicated that *Azotobacter chroococcum* inoculation had a significant effect on nicotine content in leaves.

Data presented in the same Table (7) revealed that the effect of the interaction between nitrogen fertilizer and bio-fertilizer on leaves total alkaloids contents varied between the two successive seasons of study. The highest significant contents of total alkaloids produced from plants treated with N fertilizer at 3 g /plant combined with bio-fertilizer at 15 cm^3/plant or 6 g /plant combined with 10 cm^3/plant in the first or second seasons, respectively.

In conclusion, at flowering growth stage leaves contained also the higher alkaloids content than roots and stems. However, roots recorded higher total alkaloid content than stems in this regard. At this stage total alkaloids content in different parts were decreased as compared to total alkaloid content in different parts at vegetative growth stages. This decrease possibly due to beginning an accumulation of the alkaloids in the seeds during this period as almost the total amount of alkaloids that disappeared from the vegetative parts was found back in the seeds Demeyer and Dejeager (1989).

Total alkaloids content at fruiting growth stage:

1-Roots:

Data presented in Table (8) show that applying ammonium nitrate fertilizer at different rates (3, 6, and 9 g/plant) gradually increased total alkaloids content of datura roots over the unfertilized plants. The increase of total alkaloids content of datura roots increased as nitrogen fertilizer rates increased and reached its maximum values (8.91 and 9.09 mg/g d.w.) when plants treated with ammonium nitrate at (9 g /plant) with significant or insignificant differences at the two respective seasons. Similar results are in accordance with those obtained by Selim and Magd El-Din (2007) on datura (*Datura innoxia* Mill.) plants. They mentioned that alkaloids content in the roots significantly increased with nitrogen fertilizer application.

Data in the same Table (8) indicate that the addition of bio-fertilizer at different rates (5, 10, and 15 cm^3/plant) gradually increased total alkaloids content of datura roots over the un-inoculated plants and reached its maximum values (10.00 and 9.12 mg/g d.w.) when plants inoculated with bio-fertilizer at (15 or 10 cm^3/plant) in the first or second seasons, respectively. Differences between mean values were significant or not significant at the two respective seasons. The obtained data in the same Table (8) show the interaction between nitrogen and bio-fertilizer on total

alkaloids content of datura roots. The results showed that the highest significant record of total alkaloids of datura roots was (13.81 mg/g d.w.) obtained from plants fertilized with ammonium nitrate at (6 g /plant) combined with bio-fertilizer at (15 cm^3/plant) and (9 g/plant) combined with (10 cm^3/plant) in the first or second seasons, respectively.

2-Stems:

Data presented in Table (8) show that treated datura plants with N fertilizer at different rates (3, 6, and 9 g/plant) increased total alkaloids contents of datura stems over untreated plants (control) during the two growing seasons of study. The highest significant or insignificant contents were (10.09 and 10.07 mg/g d.w.) obtained from plants fertilized with ammonium nitrate at (6 or 9 g /plant) in the first and second seasons, respectively.

Data in the same Table (8) indicate that inoculated the plants with nitrogen bio-fertilizer affected significantly or insignificantly on the contents of total alkaloids in datura stems in the first or second seasons, respectively. Plants inoculated with bio-fertilizer at (15 or 10 cm^3/plant) produced the highest contents of total alkaloids as compared to the other concentrations, as well as, un-inoculated plants at the two respective seasons.

The obtained data in the same Table (8) show the interaction between nitrogen and bio-fertilizer on total alkaloids content of datura stems. These results showed that the highest total alkaloids content of datura stems was (14.93 mg/g d.w.) obtained from plants treated with N fertilizer at (6 g/plant) combined with bio-fertilizer at (15 cm^3/plant) in the first season. While, in the second season the highest record was (16.51 mg/g d.w.) obtained from plants treated with N fertilizer at (9 g/plant) combined with bio-fertilizer at (10 cm^3/plant). Differences between mean values were significant in both seasons of study.

3-Leaves:

Data presented in Table (8) show that applying ammonium nitrate fertilizer at different rates (3, 6, and 9 g/plant) increased total alkaloids content of datura leaves over un-fertilized plants (control) during the two growing seasons. These results showed that there were no significant effect existed between all treatments as compared to control in the first season, while, treatment (6 g/plant) only had significant effect on this aspect in the second season. The highest values of total alkaloids content of datura leaves were (3.94 and 4.08 mg/g d.w.) obtained from plants treated with ammonium nitrate at (6 g N/plant) in the first and second seasons, respectively. Similar results are in accordance with those obtained by Selim and Magd El-Din (2007) on *Datura innoxia* Mill. plants. They revealed that addition of N fertilizer at the rates (2 or 4 g/plant) significantly increased total alkaloids in leaves compared with 8 g/plant treatment and control.

Data in the same Table (8) indicated that addition of bio-fertilizer at different rates (5, 10, and 15 cm^3/plant) had no significant effect on total alkaloids content of datura leaves in the two growing seasons. The highest contents were produced from plants inoculated with bio-fertilizer at (15 or 10 cm^3/plant) in the first or second seasons, respectively.

The obtained data in the same Table (8) show the interaction between nitrogen and bio-fertilizer on total alkaloids contents of datura leaves. These results showed that the highest contents of total alkaloids of datura leaves were (4.59 and 4.84 mg/g d.w.) obtained from plants treated with N fertilizer at (6 g/plant) combined with bio-fertilizer at (10 cm^3/plant) in the first and second seasons, respectively. While the lowest values in this aspect were (2.85 and 2.96 mg/g d.w.) obtained from untreated plants (control) during the two growing seasons, respectively. Differences between mean values were not significant or significant at the two respective seasons.

In conclusion, at fruiting growth stage total alkaloids content of leaves were lower than roots and stems. This result may be due to reallocation of alkaloids from leaves to seeds in particularly fruits and seeds

formation. Finally, as it is well known that alkaloids, like most nitrogenous compounds, are translocate from older to younger leaves before the former are dropped (Nowacki *et al.,* 1976), the observed differences can also not be explained by differences in leaf shedding which may have occurred during this period.

Table (8): Effect of nitrogen fertilizer and bio-fertilizer on total alkaloids (mg/g/dw) in different parts of datura (*Datura innoxia* Mill.) plants at fruiting growth stage during (2010 – 2011) seasons.

Nitrogen g/plant (N)	First season (2010)					Second season (2011)				
	Bio. cm^3/plant (B)					Bio. cm^3/plant (B)				
	ROOTS									
	0	5	10	15	Mean	0	5	10	15	Mean
0	6.50	6.47	6.32	6.40	6.42	6.22	6.57	7.67	6.47	6.73
3	6.22	6.73	9.02	8.31	7.57	6.73	6.39	6.68	10.70	7.63
6	8.15	6.57	6.52	13.81	8.77	8.77	9.48	8.31	6.32	8.22
9	7.14	9.38	7.65	11.47	8.91	7.34	9.02	13.81	6.17	9.09
Mean	7.00	7.29	7.38	10.00		7.26	7.87	9.12	7.42	
L.S.D 5% N B NB	1.56 1.56 3.12					N.S. N.S. 5.11				
STEMS										
0	6.47	5.76	6.35	5.63	06.05	5.76	6.63	7.08	5.71	06.29
3	5.76	6.63	10.19	6.68	07.31	8.51	10.45	6.57	5.86	07.85
6	7.9	10.45	7.08	14.93	10.09	6.98	6.73	4.59	14.93	08.31
9	7.31	6.63	7.93	14.37	09.06	7.9	10.19	16.51	5.66	10.07
Mean	6.86	7.36	7.89	10.40		7.29	8.50	8.69	8.04	
N B NB	1.93 1.93 3.86					N.S. N.S. 9.93				
LEAVES										
0	2.85	3.11	2.85	3.67	3.12	2.96	3.06	3.41	3.57	3.25
3	3.54	3.08	3.52	4.29	3.61	3.62	3.62	3.52	3.11	3.47
6	4.03	3.21	4.59	3.92	3.94	4.54	3.87	4.84	3.09	4.08
9	3.63	3.7	3.8	3.47	3.65	2.98	3.47	3.52	3.67	3.41
Mean	3.51	3.27	3.69	3.84		3.52	3.5	3.82	3.36	
N B NB	N.S. N.S. N.S.					0.58 N.S. 1.16				

4-Seeds

Data presented in Table (9) show that fertilized datura plants at different rates of ammonium nitrate increased total alkaloids contents of datura seeds over the unfertilized plants during the two growing seasons. This result indicated that the maximum increment in total alkaloids of datura seeds were (7.47 and 8.01 mg/g d.w.) observed at (6 g/plant) at the two

respective seasons. In the first seasons, treatments (6 and 9 g/plant) had a significant effect on this respect as compared to the other treatments, while, in the second one only treatment (6 g/plant) had significant effect on this respect. Untreated plants (control) had the lowest values of total alkaloids of datura seeds during the two growing seasons. Similar results were recorded by Selim and Magd El-Din (2007) on *Datura innoxia* Mill. plants. They revealed that addition of N fertilizer at (2 or 4 g/plant) significantly increased total alkaloids in fruits compared with control plants.

Data in the same Table (9) indicate that gradual increase of bio-fertilizer levels followed by gradual and significant increase of total alkaloids content in datura seeds in both seasons of study. The highest content of total alkaloids corresponding with inoculated the plants with the highest level of nitrogen bio-fertilizer (15cm^3/plant) at the two growing seasons.

Data listed in the same Table (9) show the interaction effect between nitrogen and bio-fertilizer on total alkaloids contents of datura seeds. These results showed that the highest significant contents of total alkaloids of datura seeds were recorded from plants inoculated with bio-fertilizer at (15 cm^3/plant) combined with N fertilizer at (6 or 9 g/plant) at the two respective seasons. While, the lowest values (6.08 and 6.20 mg/g d.w.) obtained from untreated plants (control) during the two respective seasons.

CONCLUSION

From the abovementioned results it could be concluded that the highest contents of total alkaloids at any level of ammonium nitrate fertilizer, nitrogen bio-fertilizer or interaction between them were observed from all organs of datura plants, as well as, seeds during fruiting growth stage compared with the other growth stages. So it could be recommended that fruiting growth stage is the suitable stage for datura harvesting.

Table (9): Effect of nitrogen fertilizer and bio-fertilizer on total alkaloids in seeds of datura (*Datura innoxia* Mill.) plant during (2010 – 2011) seasons.

Nitrogen g/plant (N)	First season (2010)					Second season (2011)				
	Bio. cm^3/plant (B)					Bio. cm^3/plant (B)				
	0	5	10	15	Mean	0	5	10	15	Mean
0	6.08	6.21	6.50	7.25	6.51	6.20	6.49	6.90	8.08	6.92
3	6.59	6.83	6.97	7.39	6.94	7.53	7.17	8.06	7.57	7.58
6	6.39	6.67	7.97	8.85	7.47	7.37	7.91	8.70	8.05	8.01
9	6.52	6.78	7.55	7.76	7.15	6.35	6.70	7.24	9.63	7.48
Mean	6.40	6.62	7.25	7.81		6.86	7.07	7.72	8.33	
L.S.D 5%										
N	0.45					0.69				
B	0.45					0.69				
NB	0.91					1.38				

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تأثير التسميد النيتروجينى والنيتروبين على قلويدات الداتورة

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الملخص العربى

أجريت تجربة حقلية من أجل دراسة تأثير كل من التسميد الكيماوى والحيوى على محتوى نبات الداتورة (*Datura innoxia* Mill.) من القلويدات الكلية، وذلك خلال الموسمين 2011، 2012 فى مزرعة دمو التابعة لكلية الزراعة بجامعة الفيوم. أستخدمت نترات الأمونيوم (33%) كمصدر للتسميد النيتروجينى الكيماوى وذلك بمعدلات صفر، 3، 6، 9 جرام/ نبات، وأستخدم النيتروبين كمصدر للتسميد الحيوى وذلك بمعدلات صفر، 5، 10، 15 سم^3 /نبات.

من الدراسة التى أجريت وجد أن معاملة نباتات الداتورة بكل من التسميد النيتروجينى والنيتروبين منفردين أو التفاعل بينهما أدى إلى زيادة محتوى الأجزاء المختلفة لنبات الداتورة (الجذور، السيقان، الأوراق، البذور) من القلويدات الكلية وذلك خلال مراحل النمو المختلفة (مرحلة النمو الخضرى، مرحلة النمو الزهرى، مرحلة النمو الثمرى) مقارنة بنباتات الكنترول.

ومن جهة أخرى نجد أن أعلى محتوى من القلويدات الكلية كان فى الأوراق خلال مراحل النمو المختلفة مقارنة بباقى أجزاء النبات فيما عدا مرحلة النمو الثمرى إحتوت الأوراق على أقل محتوى من القلويدات الكلية.