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The Effect of N Source on Chemical Analysis of Green Bean Grown under Different Water Levels

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THE EXPERIMENT was carried out during two successive growth seasons 1999-2000 and 2000-2001 in the experimental farm of the arid land laboratory, Department of Horticulture, Faculty of Agriculture, Ain Shams University, Cairo, Egypt. This work aimed to study the effect of N source [$(NH_4)_2$ SO_4 and Ca $(NO_3)_2$] on chemical analysis of green bean (*Phaseolus vulgaris* L.) grown under different water regime (100%, 80% and 60% of field capacity). The results reported that chemical analysis (total-N and nitrate nitrogen) percentage in leaves and pods of bean plants increased with low irrigation level (60% of field capacity) in comparison with high irrigation levels. Low irrigation level (60% of field capacity) recorded the highest nitrate and protein content (%) in pods. The results in this study indicated that nitrate nitrogen (%) and total-N (%) in leaves and pods and nitrate content (%) in pods were higher for plants supplied with NO_3-N compared with NH_4-N. Protein content (%) in pods increased with 25% NH_4-N + 75% NO_3-N.

Water requirement and N fertilizer are two factors affect yield of snap bean plants (*Phaseolus vulgaris* L.), whereas frequent or excessive amounts of water and nitrogen fertilizer would lead to unfavourite effect on the growth and yield of snap bean plants and will lead to increasing losses amounts of water and nitrogen fertilizer.

Leaf NO_3-N increased with increasing NO_3 concentration in the nutrient solution has been reported by Ikeda & Osawa (1983). They indicated that fertilization with NH_4-N reduced leaf, shoots and roots concentration of NO_3-N compared with plants supplied with NO_3-N. Raikova *et al.* (1986) reported that

bean plants grown in summer-autumn had higher nitrate content than bean plants grown in spring-summer. On the other hand, Veiga & Ruschel (1987) reported that the high concentration of ammonium sulphate caused leaf drop.rose. The reduction in N accumulation was greatest with the NH_4-N treatment as reported by Nathan *et al.* (1989), Zou-ChunQin *et al.* (1996), Sarro *et al.* (1998) and Vale *et al.* (1998). They reported that total-N in blades of recently fully expanded leaves was higher when N was supplied as Ca $(NO_3)_2$ than as $(NH_4)_2$ SO_4 . On the contrary, Macleod & Ormrod (1985) found that nitrate-treated plants had lower total-N than ammonium-treated plants.

Researches also indicated that the highest percentage of protein content when treated with (75% and 65%) of field capacity compared to high water levels (100%) and (125%-excessive water) of field capacity as reported by Karas (1997). Costa *et al.* (1988) and Durge *et al.* (1988) found that N promoted a marked plant adaptation to water stress by reducing its effect. Castrillo *et al.* (1990) found that nitrate reductase activity in leaves decreased in non-watered plants from 40% of the activity in control plants. On the contrary, Hegde & Srinivas (1990) found that nitrogen application increased water use efficiency but had no marked effect on water relations and canopy temperature.

Material and Methods

Two experiments were carried out during two successive growth seasons of 1999/2000 and 2000/2001 at the farm of the arid land laboratory, Department of Horticulture, Faculty of Agriculture, Ain Shams University, Shobra El-Khima, Kalubia Governorate, Egypt. Seeds of snap bean (*Phaseolus vulgaris* L.) cv. Bronco were sown on September 15^{th} in autumn season and on February 15^{th} in summer season. Plastic pots, 30 cm in diameter were used. Each pot contained 10 kg of sandy soil. Field capacity (F.C) of used soil was 13% and (EC) 0.4 mmhos/cm. Each pot contains three plants. Irrigation treatments were started four weeks after seed sowing, while nitrogen treatments were started once the first true leaf appeared.

Treatments of irrigation

Plants of both seasons were subjected to different levels of irrigation as follows : -

- 60 % of field capacity. - 80 % of field capacity. - 100 % of field capacity.

Treatments started after four weeks from sowing of seeds.

Treatments of nitrogen fertilization

The amounts of nitrogen fertilizers were applied to each pot in treatments as follows: -

- 100 % of $(NH_4)_2 SO_4$ [4 g of $(NH_4)_2SO_4$ / pot].
- 100 % of Ca $(NO_3)_2$ [5.42 g of Ca $(NO_3)_2$/ pot].
- 75% of $(NH_4)_2SO_4$ + 25 % of Ca $(NO_3)_2$ [3 g of $(NH_4)_2SO_4$ and 1.36 g of Ca $(NO_3)_2$/ pot].
- 50 % of $(NH_4)_2SO_4$ + 50 % of Ca $(NO_3)_2$ [2 g of $(NH_4)_2SO_4$ and 2.71 g of Ca $(NO_3)_2$/ pot].
- 25 % of $(NH_4)_2SO_4$ + 75 % of Ca $(NO_3)_2$[1 g of $(NH_4)_2SO_4$ and 4.07 g of Ca $(NO_3)_2$/ pot].

Blades of five recently fully expended trifoliate leaves were taken from each replicate for chemical analysis according to Nathan *et al.* (1989). Samples of leaves were taken three times on 45, 60 and 75 days after sowing. The samples were oven dried at 70°C then ground in a blender and stored in glass vials for chemical analysis. The following measurements were recorded in leaves and pods: Total nitrogen content (%) was determined by Kjeldahel method according to Chappman *et al.* (1961). Nitrate content (%) was determined by extracting NO_3 from the sample using 0.04 $\underline{N}$ $CuSO_4$. $5H_2O$ according to Cottenie (1980) and then determining the NO_3 concentration of extract colorimetrically by Brucine method reported by Holty & Potworowski (1972). Total protein content (%) of pods was determined as g/100g dry weight using Micro-Kjeldahel method according to Chappman *et al.* (1961) . The experimental design was arranged in split plots design (three treatments of irrigation levels and five sub-treatments of nitrogen levels) with four replicates. All data were subjected to statistical analysis according to Snedicor & Cochran (1980).

Results

Total nitrogen and nitrate nitrogen (%)

The effect of irrigation levels on total nitrogen (%) and nitrate nitrogen (%) in leaves and pods of bean plants shown in Tables (1A, 2A and 3A). Results reported that total-N (%) and nitrate nitrogen (%) increased with decreasing the amount of irrigation level. Low irrigation level (60% of field capacity) recorded the highest total -N content and nitrate nitrogen content, while the lowest total-N and nitrate nitrogen recorded with irrigation high level of 100% of field capacity. Generally, the results in Tables (1B, 2B and 3B) indicated that total-N (%) and nitrate nitrogen (%) in leaves and pods increased with 100% NO_3-N followed by 25% NH_4-N + 75% NO_3-N and the lowest total-N (%) and nitrate nitrogen (%) in leaves and pods was obtained 100% NH_4-N treatment.

Regarding the effect of interaction between irrigation levels and nitrogen treatments on total-N (%) and nitrate nitrogen (%) in leaves and pods it had been shown in Tables (1C, 2C and 3C). The combination between low irrigation (60% of field capacity) level with 100% NO_3-N and 25% NH_4-N + 75% NO_3-N had the highest total-N (%) and nitrate nitrogen (%) in bean leaves and pods followed by low irrigation with 50% NH_4-N + 50% NO_3-N. The lowest total-N and nitrate nitrogen was recorded when high irrigation level was combined with 100% NH_4-N treatment. Also, the results showed an increase in total-N and nitrate nitrogen in leaves and pods of plants grown at summer season compared to those grown at autumn season.

Total protein and nitrate content of pods (%)

It is clear from Table 4A that total protein (%) and nitrate content (%) in pods of snap bean plants increased with decreasing the amount of irrigation level. The results reported that total protein and nitrate content in pods increased with plants grown at low levels of irrigation (60% and 80% of field capacity) relative to those grown at high level (100% of field capacity). Generally, results in Table 4B showed the total protein (%) and nitrate content (%) in pods increased with 25% NH_4-N + 75% NO_3-N followed by 50% NH_4-N + 50% NO_3-N, while the lowest value recorded with 100% NH_4-N treatment.

TABLE 1. Effect of different treatments on total-N (%) in leaves of snap bean plants at 45, 60 and 75 days after sowing.

(a) :- Effect of irrigation treatments.

Treatments	Summer season						Autumn season					
% of field	First season			Second season			First season			Second season		
capacity	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days
60%	4.137	3.749	3.877	3.367	3.641	4.373	5.422	3.638	3.417	3.239	2.739	2.543
80%	4.243	3.488	3.603	3.693	3.108	4.011	4.647	3.766	3.336	3.109	2.567	2.421
100%	3.144	3.287	3.045	3.683	2.490	3.169	4.091	3.559	3.188	2.878	2.338	2.160
L.S.D at 0.05	0.154	0.128	0.189	0.273	0.229	0.288	0.112	0.058	0.081	0.102	0.133	0.095

(b) :- Effect of nitrogen treatments.

Treatments	Summer season						Autumn season					
N	First season			Second season			First season			Second season		
source	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days
100% NH4-N	3.432	2.869	3.124	3.253	2.576	3.038	4.220	3.457	3.016	2.580	1.997	1.912
100% NO3-N	3.931	3.714	3.559	3.687	3.319	3.958	4.900	3.803	3.632	3.183	2.669	2.574
75% NH4-N + 25% NO3-N	3.714	3.123	3.244	3.559	2.732	3.626	4.611	3.520	3.138	2.751	2.527	2.182
50% NH4-N + 50% NO3-N	4.096	3.843	3.769	3.784	3.299	4.491	4.919	3.723	3.332	3.261	2.702	2.568
25% NH4-N + 75% NO3-N	4.033	3.990	3.845	3.622	3.472	4.143	4.948	3.767	3.451	3.602	2.847	2.616
L.S.D at 0.05	0.256	0.221	0.222	0.178	0.140	0.226	0.195	0.125	0.134	0.180	0.102	0.125

(c) :- Effect of interaction between irrigation and nitrogen treatments.

Treatments		Summer season						Autumn season					
% of fileld	N	First season			Second season			First season			Second season		
capacty	source	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days
	100% NH4-N	3.983	3.340	3.483	3.297	3.100	3.217	4.403	3.026	2.847	2.617	1.983	1.873
	100% NO3-N	4.197	3.267	3.867	3.460	3.957	4.447	5.882	3.799	3.682	3.327	2.883	2.670
60%	75% NH4-N + 25% NO3-N	4.013	3.240	3.033	3.457	3.490	3.880	5.432	3.453	2.938	3.180	2.783	2.363
	50% NH4-N + 50% NO3-N	4.460	4.200	4.460	3.430	3.470	5.507	5.698	3.958	3.644	3.443	2.980	2.840
	25% NH4-N + 75% NO3-N	4.030	4.700	4.543	3.190	4.187	4.817	5.692	3.952	3.976	3.630	3.063	2.967
	100% NH4-N	3.653	2.600	3.100	3.163	2.437	2.997	4.559	3.841	2.928	2.837	1.937	1.933
	100% NO3-N	4.027	4.260	3.433	3.373	3.427	3.870	4.681	3.913	3.759	3.287	2.713	2.560
80%	75% NH4-N + 25% NO3-N	4.333	3.167	3.500	3.660	2.810	4.220	4.539	3.577	3.030	2.703	2.363	2.180
	50% NH4-N + 50% NO3-N	4.873	3.627	3.973	4.197	3.500	4.780	4.863	3.751	3.570	3.190	2.933	2.820
	25% NH4-N + 75% NO3-N	4.330	3.787	4.007	4.073	3.367	4.187	4.592	3.750	3.393	3.530	2.890	2.610
	100% NH4-N	2.660	2.667	2.790	3.300	2.190	2.900	3.698	3.505	3.273	2.287	2.070	1.930
	100% NO3-N	3.570	3.617	3.377	4.227	2.573	3.557	4.136	3.699	3.453	2.937	2.410	2.493
100%	75% NH4-N + 25% NO3-N	2.797	2.963	3.200	3.560	1.897	2.777	3.862	3.530	3.447	2.370	2.433	2.003
	50% NH4-N + 50% NO3-N	2.953	3.703	2.873	3.727	2.927	3.187	4.196	3.460	2.782	3.150	2.193	2.103
	25% NH4-N + 75% NO3-N	3.740	3.483	2.985	3.603	2.863	3.427	4.561	3.598	2.984	3.647	2.587	2.270
L.S.D at 0.05		0.443	0.383	0.385	0.308	0.243	0.394	0.337	0.216	0.232	0.312	0.176	0.217

TABLE 2. Effect of different treatments on NO_3-N (%) in leaves of snap bean plants at 45, 60 and 75 days after sowing.

(a) :- Effect of irrigation treatments.

Treatments	Summer season						Autumn season					
% of field	First season			Second season			First season			Second season		
capacity	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days
60%	0.339	0.364	0.254	1.426	1.804	1.625	0.075	0.052	0.028	0.060	0.063	0.041
80%	0.247	0.291	0.306	1.001	1.732	1.454	0.046	0.033	0.020	0.050	0.054	0.031
100%	0.195	0.250	0.307	0.474	1.029	1.429	0.045	0.028	0.018	0.049	0.044	0.029
L.S.D at 0.05	0.026	0.038	0.018	0.109	0.099	0.063	0.015	0.008	0.006	0.001	0.008	0.004

(b) :- Effect of nitrogen treatments.

Treatments	Summer season						Autumn season					
N	First season			Second season			First season			Second season		
source	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days
100% NH4-N	0.057	0.062	0.106	0.718	1.188	1.230	0.002	0.005	0.005	0.005	0.005	0.002
100% NO3-N	0.451	0.513	0.511	1.236	1.895	1.858	0.155	0.083	0.036	0.104	0.101	0.072
75% NH4-N + 25% NO3-N	0.102	0.149	0.138	0.894	1.266	1.290	0.005	0.013	0.008	0.007	0.005	0.003
50% NH4-N + 50% NO3-N	0.279	0.349	0.292	0.946	1.543	1.498	0.039	0.035	0.028	0.069	0.072	0.035
25% NH4-N + 75% NO3-N	0.414	0.437	0.397	1.041	1.696	1.639	0.077	0.053	0.033	0.079	0.084	0.056
L.S.D at 0.05	0.034	0.039	0.047	0.166	0.168	0.154	0.028	0.009	0.007	0.006	0.007	0.007

(c) :- Effect of interaction between irrigation and nitrogen treatments.

Treatments		Summer season						Autumn season					
% of field	N	First season			Second season			First season			Second season		
capacity	source	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days
	100% NH4-N	0.063	0.044	0.098	1.314	1.369	1.424	0.004	0.007	0.004	0.007	0.008	0.004
	100% NO3-N	0.562	0.618	0.408	1.784	2.089	2.192	0.185	0.108	0.078	0.123	0.126	0.092
60%	75% NH4-N + 25% NO3-N	0.147	0.188	0.153	1.389	1.382	1.457	0.002	0.032	0.006	0.008	0.007	0.004
	50% NH4-N + 50% NO3-N	0.410	0.455	0.269	1.157	2.010	1.504	0.035	0.042	0.018	0.076	0.076	0.040
	25% NH4-N + 75% NO3-N	0.513	0.514	0.342	1.487	2.171	1.549	0.150	0.072	0.034	0.085	0.097	0.063
	100% NH4-N	0.070	0.051	0.076	0.485	1.357	1.384	0.002	0.006	0.005	0.005	0.005	0.002
	100% NO3-N	0.407	0.525	0.521	1.352	2.248	1.691	0.191	0.068	0.015	0.100	0.098	0.065
80%	75% NH4-N + 25% NO3-N	0.077	0.140	0.115	0.854	1.644	1.238	0.004	0.006	0.007	0.006	0.005	0.003
	50% NH4-N + 50% NO3-N	0.304	0.317	0.352	1.193	1.622	1.313	0.031	0.035	0.037	0.063	0.079	0.030
	25% NH4-N + 75% NO3-N	0.378	0.424	0.465	1.120	1.790	1.644	0.003	0.052	0.034	0.076	0.084	0.055
	100% NH4-N	0.038	0.091	0.145	0.355	0.839	0.880	0.001	0.003	0.006	0.004	0.002	0.002
	100% NO3-N	0.384	0.394	0.604	0.571	1.349	1.690	0.087	0.071	0.014	0.088	0.078	0.058
100%	75% NH4-N + 25% NO3-N	0.082	0.119	0.148	0.440	0.833	1.174	0.008	0.002	0.009	0.006	0.004	0.002
	50% NH4-N + 50% NO3-N	0.121	0.274	0.254	0.487	0.998	1.676	0.050	0.030	0.031	0.069	0.061	0.034
	25% NH4-N + 75% NO3-N	0.351	0.374	0.385	0.517	1.125	1.724	0.078	0.035	0.031	0.077	0.072	0.050
L.S.D at 0.05		0.059	0.067	0.082	0.287	0.292	0.267	0.048	0.015	0.013	0.009	0.011	0.012

TABLE 3. Effect of different treatments on total-N (%) and NO_3-N (%) in pods of snap bean plants.

(a) :- Effect of irrigation treatments.

Treatments	Summer season				Autumn season			
	First season		Second season		First season		Second season	
% of field capacity	Total-N (%)	NO_3-N (%)	Total-N (%)	NO_3-N (%)	Total-N (%)	NO_3-N (%)	Total-N (%)	NO_3-N (%)
60%	3.641	0.285	2.457	0.658	3.409	0.058	3.187	0.050
80%	3.349	0.235	2.802	0.521	3.053	0.050	2.891	0.040
100%	3.049	0.192	2.383	0.469	2.630	0.032	2.797	0.031
L.S.D at 0.05	0.167	0.030	0.188	0.046	0.147	0.001	0.140	0.002

(b) :- Effect of nitrogen treatments.

Treatments	Summer season				Autumn season			
	First season		Second season		First season		Second season	
N source	Total-N (%)	NO_3-N (%)	Total-N (%)	NO_3-N (%)	Total-N (%)	NO_3-N (%)	Total-N (%)	NO_3-N (%)
100% NH4-N	2.836	0.119	2.343	0.239	2.753	0.034	2.467	0.005
100% NO3-N	3.420	0.341	2.578	0.751	3.171	0.070	3.131	0.072
75% NH4-N + 25% NO3-N	3.101	0.154	2.449	0.408	2.844	0.035	2.828	0.006
50% NH4-N + 50% NO3-N	3.631	0.263	2.714	0.640	3.155	0.045	3.118	0.053
25% NH4-N + 75% NO3-N	3.744	0.311	2.652	0.707	3.229	0.049	3.247	0.066
L.S.D at 0.05	0.152	0.040	0.213	0.057	0.222	0.005	0.210	0.006

(c) :- Effect of interaction between irrigation and nitrogen treatments.

Treatments		Summer season				Autumn season			
		First season		Second season		First season		Second season	
% of field capacty	N source	Total-N (%)	NO_3-N (%)	Total-N (%)	NO_3-N (%)	Total-N (%)	NO_3-N (%)	Total-N (%)	NO_3-N (%)
	100% NH4-N	3.053	0.134	2.203	0.332	3.372	0.049	2.527	0.008
	100% NO3-N	3.467	0.432	2.557	0.942	3.745	0.078	3.633	0.086
60%	75% NH4-N + 25% NO3-N	3.477	0.149	2.890	0.437	3.199	0.043	3.240	0.008
	50% NH4-N + 50% NO3-N	3.933	0.304	2.090	0.683	3.167	0.062	3.207	0.072
	25% NH4-N + 75% NO3-N	4.273	0.408	2.543	0.894	3.561	0.057	3.327	0.076
	100% NH4-N	2.753	0.141	2.530	0.227	2.462	0.031	2.457	0.004
	100% NO3-N	3.693	0.311	3.033	0.691	3.133	0.085	3.107	0.069
80%	75% NH4-N + 25% NO3-N	2.963	0.162	2.050	0.409	2.800	0.036	2.633	0.005
	50% NH4-N + 50% NO3-N	3.510	0.280	3.803	0.667	3.415	0.042	3.040	0.054
	25% NH4-N + 75% NO3-N	3.827	0.282	2.593	0.611	3.456	0.056	3.217	0.069
	100% NH4-N	2.700	0.081	2.297	0.159	2.427	0.024	2.417	0.003
	100% NO3-N	3.100	0.280	2.143	0.620	2.637	0.047	2.653	0.060
100%	75% NH4-N + 25% NO3-N	2.863	0.152	2.407	0.377	2.532	0.026	2.610	0.004
	50% NH4-N + 50% NO3-N	3.450	0.206	2.250	0.570	2.883	0.031	3.107	0.034
	25% NH4-N + 75% NO3-N	3.133	0.242	2.820	0.616	2.669	0.034	3.197	0.052
L.S.D at 0.05		0.262	0.069	0.368	0.098	0.384	0.009	0.363	0.011

TABLE 4. Effect of different treatments on total protein (%) and nitrate content (%) in pods of snap bean plants.

(a) :- Effect of irrigation treatments.

Treatments	Summer season				Autumn season			
	First season		Second season		First season		Second season	
% of field capacity	Total protein (%)	Nitrate content (%)	Total protein (%)	Nitrate content (%)	Total protein (%)	Nitrate content (%)	Total protein (%)	Nitrate content (%)
60%	23.300	1.264	15.723	2.912	21.815	0.255	20.395	0.221
80%	21.436	1.041	17.933	2.307	19.540	0.222	18.500	0.178
100%	19.516	0.852	15.253	2.075	16.829	0.143	17.899	0.136
L.S.D at 0.05	1.069	0.132	1.203	0.206	0.938	0.005	0.898	0.010

(b) :- Effect of nitrogen treatments.

Treatments	Summer season				Autumn season			
	First season		Second season		First season		Second season	
N source	Total protein (%)	Nitrate content (%)	Total protein (%)	Nitrate content (%)	Total protein (%)	Nitrate content (%)	Total protein (%)	Nitrate content (%)
100% NH4-N	18.148	0.525	14.997	1.060	17.621	0.153	15.787	0.023
100% NO3-N	21.888	1.510	16.498	3.326	20.297	0.310	20 039	0.318
75% NH4-N + 25% NO3-N	19.647	0.683	15.673	1.806	18.199	0.156	18.098	0.026
50% NH4-N + 50% NO3-N	23.239	1.167	17.372	2.835	20.193	0.199	19.954	0.236
25% NH4-N + 75% NO3-N	23.964	1.376	16.974	3.131	20.663	0.216	20.779	0.291
L.S.D at 0.05	0.969	0.179	1.361	0.251	1.418	0.024	1.342	0.029

(c) :- Effect of interaction between irrigation and nitrogen treatments.

Treatments		Summer season				Autumn season			
		First season		Second season		First season		Second season	
% of fileld capacty	N source	Total protein (%)	Nitrate content (%)	Total protein (%)	Nitrate content (%)	Total protein (%)	Nitrate content (%)	Total protein (%)	Nitrate content (%)
60%	100% NH4-N	19.541	0.592	14.101	1.472	21.579	0.216	16.171	0.034
	100% NO3-N	22.187	1.915	16.363	4.170	23.968	0.345	23.253	0.380
	75% NH4-N + 25% NO3-N	22.251	0.659	18.496	1.937	20.474	0.192	20 736	0.036
	50% NH4-N + 50% NO3-N	25.173	1.347	13.376	3.025	20.267	0.274	20.523	0.318
	25% NH4-N + 75% NO3-N	27.349	1.806	16.277	3.958	22.788	0.251	21.291	0.338
80%	100% NH4-N	17.621	0.623	16.192	1.005	15.755	0.138	15.723	0.018
	100% NO3-N	23.637	1.375	19.413	3.062	20.049	0.375	19.883	0.306
	75% NH4-N + 25% NO3-N	18.965	0.716	13.120	1.811	17.920	0.160	16.853	0.024
	50% NH4-N + 50% NO3-N	22.464	1.242	24.341	2.954	21.858	0.188	19.456	0.239
	25% NH4-N + 75% NO3-N	24.491	1.248	16.597	2.704	22.116	0.248	20.587	0.304
100%	100% NH4-N	17.280	0.360	14.699	0.704	15.531	0.104	15.467	0.015
	100% NO3-N	19.840	1.239	13.717	2 746	16.875	0.209	16.981	0.267
	75% NH4-N + 25% NO3-N	18 325	0.674	15.403	1 671	16.203	0.116	16.704	0.017
	50% NH4-N + 50% NO3-N	22.080	0.911	14.400	2 526	18.453	0 135	19 883	0.150
	25% NH4-N + 75% NO3-N	20.053	1.074	18.048	2.730	17.084	0.149	20.459	0.231
L.S.D at 0.05		1.679	0.309	2.358	0.434	2.455	0.042	2.324	0.050

Results in Table 4C indicated that the effect of interaction between irrigation and nitrogen treatments was clear with low irrigation levels (60% and 80% of field capacity) and 100% NO_3-N followed by 25% NH_4-N + 75% NO_3-N. The lowest total protein (%) and nitrate content (%) in pods were recorded when high irrigation level was combined 100% NH_4-N.

Generally, the results showed that the increase in chemical contents in leaves and pods of bean plants grown at summer season was higher compared to those grown at autumn season.

Discussion

Results in this study reported that total-N (%) in leaves increased with 25% NH_4-N+75% NO_3-N followed by 50% NH_4-N + 50% NO_3-N compared to other treatments, these results agree with Nathan *et al.* (1989). On the contrary, Macleod & Ormrod (1985) found that the nitrate-treated plants had lower total-N concentration than ammonium-treated plants. Also, the results showed that nitrate nitrogen (%) in leaves and pods was higher with 100% NO_3-N followed by 25% NH_4-N + 75% NO_3-N. This was agreement with Ikeda & Osawa (1983), they reported that leaf NO_3-N increased with increasing NO_3 concentration in the nutrient solution.

The results indicated that total nitrogen (%) and nitrate content (%) in pods was higher for plants supplied with NO_3-N compared with NH_4-N. Also, the results showed that the increase in total-N (%) and nitrate content (%) in pods of plants grown at summer season was higher compared to those grown at autumn season and that agrees with Raikova *et al.* (1986). Also, the differences between temperature degrees in two seasons (temperature degrees were higher with summer than autumn season) lead to encouraging the absorption of NO_3-N compared to NH_4-N. So pods quality was higher with plants grown at autumn season compared to those grown at summer season. These results are in contradiction with that obtained by Macleod & Ormrod (1985) they found that temperature had little effect on plant responses to N source in controlled environments at three temperatures.

Generally, this relationship was also clear between low irrigation levels (60% and 80% of field capacity) and 100% NO_3-N and 25% NH_4-N + 75% NO_3-N on chemical contents in leaves and pods of snap bean plants. For example, total nitrogen was higher with low water level as mentioned by Costa *et al.* (1988), Hegde & Srinivas (1990) and Durge *et al.* (1998). They found that N promoted a marked plant adaptation to water stress by reducing the effect of water stress and increased water use efficiency (WUE). On the other hand, results indicated that nitrate nitrogen content in leaves increased with low water level. This result agrees with Castrillo *et al.* (1990) who found that that nitrate reductase activity in leaves decreased in non-watered plants from 40% of the activity in watered plants (control), so decrease in nitrate reductase activity lead to increase in nitrate content in leaves.

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تـأثير مصـدر النيتروجـين على التحليـلات الكيماوية لنباتات الفاصوليا الخضـراء النامية تحت مستويات رى مختلفة

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أجريت هذه الدراسة في عامي ١٩٩٩/٢٠٠٠ و ٢٠٠٠ / ٢٠٠١ وذلك في مزرعة التجارب التابعة لمعمل الأراضي القاحلة بقسم البساتين - كلية الزراعة - جامعة عين شمس - شبرا الخيمة - محافظة القليوبية. الهدف من هذه التجربة دراسة تأثير المستويات المختلفة للرى وكذلك دراسة تأثير مصادر التسميد النيتروجيني باستخدام مصدرين هما النيتروجين النتراتى في صورة نترات كالسيوم $Ca(NO_3)_2$ والنيتروجين الأمونيومى في صورة سلفات الأمونيوم $(NH_4)_2SO_4$ على المكونات الكيماوية لكل من أوراق وقرون نباتات الفاصوليا.

أظهرت النتائج وجود زيادات معنوية في المحتوى الكيماوي (النيتروجين الكلى - النيتروجين النتراتى) وذلك كنسبة مئوية في كل من الأوراق والقرون لنباتات الفاصوليا وكذلك (البروتين الكلى - المحتوى من النترات) في قرون الفاصوليا مع أقل معاملة للرى (٦٠ % من السعة الحقلية) تليها معاملة (٨٠ % من السعة الحقلية) مقارنة بمعاملة الري الأعلى (١٠٠ % من السعة الحقلية). بصفة عامة نجد المحتوى من النيتروجين الكلى (%) والنيتروجين النتراتى (%) فى كل من الأوراق والقرون وكذلك المحتوى من البروتين الكلى (%) للقرون قد زادت زيادة معنوية مع المعاملة (١٠٠ % نترات الكالسيوم) تليها المعاملة (٢٥ % سلفات الأمونيوم

+ ٧٥ % نترات الكالسيوم) بينما كان اقل محتوى مع المعاملة (١٠٠ % سلفات الأمونيوم). وجد أن تأثير التفاعل بصفة عامة كان واضحا ما بين معاملات الري الأقل (٦٠ % ، ٨٠ % من السعة الحقلية) مع معاملات التسميد النيتروجيني (١٠٠ % نترات الكالسيوم) تليها المعاملة (٢٥ % سلفات الأمونيوم + ٧٥ % نترات الكالسيوم). أظهرت النتائج أيضاً وجود زيادة في المحتوى الكيماوي لكلا من الأوراق والقرون لنباتات الفاصوليا النامية في العروة الصيفية بدرجة أعلى عن مثيلاتها النامية في العروة الخريفية.