RESULTS AND DISCUSSION

The Field Experiment

This experiment was designed and implemented to study the effect of different Nitrogen, Phosphors and Potassium combinations on the quantitative and qualitative characters of some alfalfa cultivars grown on sandy soil at Ismailia experimental station.

Results will be presented and discussed under the following topics:-

Fresh and dry forage yield:

Results will be presented and discussed in two items as follows:-

1- Yearly and total fresh forage yield for the 3-year duration of the stand.

2- Seasonal total fresh and dry forage yield for stand duration of 3 years.

Whereas, results of fresh and dry forage yield for each season of the three years duration of the stand will be presented in the appendices and will be refered to in the discussion wherever necessary.

Yearly and total fresh forage yield for the stand duration:-

Results in Table (4, A 1, 2 and 3) indicate that fresh forage yield each of the 3 respective individual year, over the applied fertilization treatments was 30.19, 36.03 and 37.21 ton/fed. out of 10, 11 and 11 cuts, respectively with significant differences. So, fresh forage yield productivity for each of the first, second and the third year represents 29, 35 and 36%, respectively of the total fresh forage yield (103.43 ton/fed.).

Such data represent slight variation of the yearly production due to the progressive development of the stand.

Total fresh yield of alfalfa cultivars for the whole duration (3 years) behaved in a similar manner as that of each of its individual year as affected by each of the applied factors and their interaction (Table 4, A 1, 2 and 3).

Over the applied fertilization treatments cultivars showed significant differences in their yearly and total fresh forage yield with different magnitudes. Results indicated that each of the 3 exotic alfalfa cultivar (Hallma, Melesia, and Siriver) was inferior in its total and yearly fresh forage yield as compared with any of the other two local cultivars

Table (4): yearly and total fresh forage yield of several alfalfa cultivars as affected by various levels of NPK.

	Cultivar (c)	Fertilization treatment				
		T1	T2	T3	T4	Mean
		...(ton/fed.)...				
1 st year establishment (10 cuts)	Hallma (Ex)	16.00	19.80	26.29	28.43	22.63
	Melesia(Ex)	15.34	18.67	23.85	30.10	21.99
	Siriver (Ex)	16.35	23.66	33.58	40.98	28.64
	Sewa (L)	22.13	29.63	41.02	52.93	36.43
	Ismailia-1(L)	25.41	35.28	47.11	57.15	41.24
	Mean	19.05	25.41	34.37	41.92	30.19
	LSD 0.05:	T = 1.7, C = 1.0 and T x C = 2.0				
2 nd year (11cuts)	Hallma (Ex)	21.62	28.24	30.13	35.73	28.93
	Melesia(Ex)	22.62	27.20	31.21	49.23	30.06
	Siriver (Ex)	25.23	31.18	37.09	45.71	34.80
	Sewa (L)	28.25	35.99	44.12	56.15	41.13
	Ismailia-1(L)	30.78	40.30	49.36	60.48	45.23
	Mean	25.70	32.58	38.38	47.46	36.03
	LSD 0.05:	T = 1.3, C = 0.9 and T x C = 1.8				
3rd year (11cuts)	Hallma (Ex)	23.69	29.48	35.96	40.34	32.37
	Melesia(Ex)	22.66	30.50	35.12	43.41	32.92
	Siriver (Ex)	27.25	33.98	38.02	48.28	36.88
	Sewa (L)	30.54	37.01	41.16	54.40	40.78
	Ismailia-1(L)	31.34	37.31	44.90	58.90	43.12
	Mean	27.10	33.66	39.03	49.07	37.21
	LSD 0.05:	T = 1.8, C = 1.2 and T x C = 2.4				
Total yields (32 cuts)	Hallma (Ex)	61.31	77.51	92.28	104.51	83.93
	Melesia(Ex)	60.61	76.37	90.18	112.74	84.97
	Siriver (Ex)	68.83	88.82	108.70	134.97	100.33
	Sewa (L)	80.92	102.63	126.29	163.48	118.33
	Ismailia-1(L)	87.54	112.89	141.37	176.54	129.58
	Mean	71.84	91.64	111.79	138.45	103.43
	LSD 0.05:	T = 3.7, C = 2.2 and T x C = 4.4				

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

(Ismailia-1 and Sewa) with significant differences. Moreover, there were significant differences in the yearly and total fresh forage between any of the studied cultivars under investigation.

It should be noted that such obtained results were more or less similar to the yearly and total yield as well. The obtained fresh forage yield showed the following descending order for the cultivars under study was as follows:- Ismailia-1, Sewa, Siriver, Melesia and Hallma with a respective fresh forage yield of 41.24, 36.43, 28.64, 21.99 and 22.63 ton/fed in the first year; and 45.23, 41.13, 34.80, 30.06 and 28.93 ton/fed. in the second year; being 43.12, 40.78, 36.88, 32.92 and 32.37 ton/fed. in the third year, with a respective total yield of 129.58, 118.33, 100.33, 84.97 and 83.93 ton/fed.

Over the applied fertilization treatments each of the three exotic alfalfa cultivars were significantly lower in yearly and total fresh forage yield than any of the grown local cultivars (Ismailia-1 and Sewa). Also, among the exotic alfalfa cultivar Siriver was of the highest yearly and total fresh forage yield, followed by Melesia then Hallma cv. which was of the lowest production. Among the local cultivars, Ismailia-1 was the higher yearly and total fresh forage yield compared to Sewa. This trend was noticed with significant differences of various magnitudes in each of the 3-years of the stand duration and the total yield as well.

The obtained variations in the productivity of the different alfalfa cultivars could be due to its unique genetical make up which interact with the prevailing environmental condition in exerting such productivity features. Similar results concerning the various productivity of the different alfalfa cultivars were previously reported by **Moursi et al. (1977), Ghobrial (1978), Mousa (1982), Rammah et al. (1988), Geweifel (1997) and Nasr (1998).**

Over the grown alfalfa cultivars, the applied fertilization treatments caused significant increase in the yearly and total fresh forage yield compared to the control (without fertilization) having various magnitudes.

The obtained increase in fresh forage yield when comparing between applying the highest fertilization treatment (T4) and the control (T1) was about 120% for the first year, 85% in the second year and 81% in the third year. Whereas, the corresponding increases were 65, 46 and 46% when using the lowest fertilization treatment (T2).

However, when comparing the effect of the applied medium (T3) with the lowest fertilization treatments (T2) in increasing fresh forage yield, it was 35, 18 and 16% for the respective 3year of the stand duration, being 22, 24 and 26% when comparing between the highest (T4) and medium (T3) fertilization treatments.

Such increases in fresh forage yield due to the applied fertilization treatments were significant with variable magnitudes among each year of the stand duration. These referred increases in yield were reflected on the accumulated total production of the 3-year of the stand duration.

It should be noted that effect of any of the applied fertilization treatments (over the grown cultivars) on fresh alfalfa forage yield could be due to the important and essential role of the components of the applied fertilizers treatments (NPK) and their quantities (low, medium and high) on enhancing the physiological and biological processes which all affect the growing rates of the vegetative growth and the subsequent regrowth due to the appropriate storaged carbohydrate and other materials that could be used for the regrowth of the subsequent cuttings.

Among these physiological and biological activities, nitrogen is one of the major nutrient element and considered to be the most important factor that affect the vegetative growth and productivity of alfalfa.

In conclusion the combination of the above minerals (N, P and K) in their different levels exerted the synergetic effect on the impact of forage production of alfalfa.

The effect of the applied fertilization treatments in increasing fresh forage yield of alfalfa was in harmony with those reported by **Ilieva and Radeva (1992) and Wang Shiping et al. (2005)** for nitrogen fertilization, **Malhi et al. (2001) Diaz-Zorita and Buschiazzo (2004) Berrada and Wesfall (2005)** for phosphorus fertilization, **Haby and Leonard (2005)** for potassium fertilization and **Bhilare and Dessale (2003) Fang Rejun et al. (2004) Kalashnikov (2004) Sharma and Sharma (2004)** for combinations of N, P and K treatments.

Results in Table (4, A 1, 2, 3) indicate significant interaction effect for the applied fertilization treatments and the grown alfalfa cultivars on their yearly and total fresh forage production.

For either the local and/or the exotic alfalfa cultivars, increasing the rate of applied fertilization treatments caused substantial increase in yearly and total fresh forage yield. However, such differences in increasing fresh forage yield were obviously magnified as the fertilization level increased from the low (T2) to medium (T3) and up to the highest (T4) level. This result was true for all of the grown alfalfa cultivars with significantly higher magnitudes for the local than the exotic alfalfa cultivars.

Evenmore, the local Ismailia-1 cultivar was relatively higher in fresh yield as compared with the Sewa alfalfa cultivar. It was also clear that the highest response of the grown alfalfa cultivars to increasing the applied fertilization levels in respect to fresh forage yield was more pronounced in the second growing year rather than the first or the third year of the stand duration.

It could be generally concluded that the highest fresh alfalfa forage yield was produced by either one of the grown local cultivars using the highest fertilization treatments with relatively more production for Ismailia-1 than Sewa cultivars. Whereas, the lowest fresh alfalfa yield was noticed for any of the grown exotic cultivars without or with the lower fertilization treatments.

The above presented results were in more or less similar trend for the total production as well as for each of the three individual years of the stand duration with relatively slight different magnitudes.

It is also clear that such presented interaction effect of the applied fertilization treatments and the grown cultivars on increasing the fresh yield of alfalfa cultivars is reasonably accepted. This is due to the variations of the genetically makeup formation of the cultivars under study which interact with the applied fertilization treatments in relative different response of growth and production under the prevailing environmental conditions.

Seasonal total fresh alfalfa yield:

Results in Table (5, A 1, 2, 3 and 4) represent the seasonal total fresh forage yield of different alfalfa cultivars as affected by various combined fertilization treatments of N, P, and K. Seasonal total forage yield was estimated from 5 cuts in winter, 9 cuts in each of spring, summer and autumn.

Table (5): Seasonal total fresh forage yield of several alfalfa cultivars as affected by various levels of NPK.

Cultivar(C)	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Fertilization treatment					Fertilization treatment				
	Winter seasons (5 cuts)					Spring seasons (9 cuts)				
	........(ton/fed.)........									
Hallma(Ex)	7.82	10.19	12.50	13.42	10.98	17.54	23.00	27.14	31.26	24.73
Melesia(Ex)	7.47	9.69	12.39	15.60	11.29	18.27	22.54	27.27	33.16	25.31
Siriver (Ex)	9.05	12.40	14.56	20.30	14.08	20.23	26.72	32.59	39.71	29.81
Sewa (L)	11.67	15.15	19.51	26.42	18.19	24.28	31.48	37.47	46.80	35.01
Ismailia1(L)	13.56	16.77	22.26	28.45	20.26	26.65	33.50	42.82	51.54	38.63
Mean	9.92	12.84	16.24	20.84	14.96	21.40	27.45	33.46	40.49	30.70
LSD 0.05:	T = 0.7, C = 0.7 and T x C = 1.3					T = 1.3, C = 0.8 and T x C = 1.7				
	Summer seasons (9 cuts)					Autumn seasons (9 cuts)				
Hallma Ex)	18.20	23.20	27.60	31.50	25.10	17.80	21.12	25.11	28.33	23.09
Melesia(Ex)	18.70	23.10	25.90	33.72	25.40	16.10	21.05	24.66	3.26	23.03
Siriver (Ex)	20.30	26.20	31.60	39.45	29.40	19.20	23.50	29.92	35.52	27.04
Sewa (L)	23.40	29.10	35.10	45.40	33.23	21.60	26.91	34.23	44.87	31.91
Ismailia1(L)	24.90	32.50	38.90	49.07	36.34	22.40	30.16	37.39	47.48	34.36
Mean	21.10	26.80	31.80	39.83	29.89	19.40	24.55	30.26	37.29	27.88
LSD 0.05:	T = 1.5, C = 0.9 and T x C = 1.8					T = 1.2, C = 0.9 and T x C = 1.8				

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

It is clear that over the applied fertilization treatments and grown cultivars, total alfalfa fresh forage yield was 30.7 ton/fed. during spring season followed by 29.89 ton/fed. in summer, 27.88 ton/fed. for autumn and 14.96 ton/fed. winter season. Differences among the seasonal production were significant. This clarify the importance of the environmental factors on the growth rate and forage yield that is accumulated on the seasonal total fresh forage production of the whole stand duration (3 years). These results are in agreement with those obtained by **Abd El-Halim et al. (1992) and Oushy et al. (1999a)** who reported that the growing seasons affected the productivity of plants and also showed that fresh forage yield of the winter growth was markedly lower than that of the other seasons.

Data presented in Table (5, A 1, 2, 3 and 4) show the effect of various alfalfa cultivars over the applied fertilization treatments on the differences in the total production of fresh forage yield among the four tested growing seasons (over the whole stand duration of the 3 years). It is interesting to note the 20.26, 38.63, 36.34 and 34.36 ton/fed. in winter obtained by Ismailia-1, spring, summer and autumn seasons, respectively, being followed by Sewa (L) cultivar 18.19, 35.01, 33.23 and 31.91 ton/fed., then Siriver (Ex) 14.08, 29.81, 29.40 and 27.04 ton/fed. followed by Melesia (Ex) 11.29, 25.31, 25.35 and 23.03 ton/fed. then and Hallma (Ex) 10.98, 24.73, 25.10 and 23.09 ton/fed.

Results in Table (5, A 1, 2, 3 and 4) show that the seasonal differences among the other four cultivars (Sewa, Siriver, Melesia and Hallma) were significant. But, the local cultivars Ismailia-1 proved to produce the highest seasonal total fresh forage yield with highly significant differences as compared with the other tested four alfalfa cultivars. These results were true over the various fertilization treatments and different growing seasons.

Data presented in Table (5, A 1, 2, 3 and 4) indicate that there were significant differences among all of the applied fertilization treatments which were positively affected by the seasonal total fresh forage alfalfa yield compared to the control (T1) with various magnitudes. Similar trend was found during the four growing seasons. Seasonal total fresh forage yield under each fertilization treatment was higher in spring season followed by summer then autumn where the lowest fresh forage yield was forage yield was produced in winter season as affected by the unfavorable cool environmental temperature that prevail at such season. These results are in agreement with those of **Abd-El-Halim et al. (1992) and Oushy et al. (1999a).**

Over the grown alfalfa cultivars, the highest combined fertilization treatment (T4) significantly enhanced the growth rate of alfalfa plants which produced the highest seasonal total fresh forage yield which was 20.84 ton/fed. out of 5 cuts; 40.49 ton/fed. out of 9 cuts; 39.83 ton/fed. out of 9 cuts; and 37.29 ton/fed. out of 9 cuts for the subsequent winter, spring, summer and autumn seasons as compared with their control (T1) which produced 9.92, 21.4, 21.1 and 19.4 ton/fed. for the respective corresponding seasons.

It is generally noticed that spring season was superior among the other seasonal total fresh forage yield (30.70 ton/fed.) when using high (T4), medium (T3) and low (T2) fertilization treatments which caused an increase in fresh forage yield as compared with their relevant control treatment by 89, 56 and 28% respectively in this particular season.

Such presented increases in fresh forage yield due to increasing the applied fertilization levels were significant with variable magnitudes among each of the seasonal durations of the stand duration. These obtained increases in yield were reflected for the total production over the stand duration. These obtained results are in harmony with those reported by **Kalashnikov (2004), Fang Rejun et al. (2004), Sharma and Sharma (2004), Berrada and Westfall (2005) and Haby and Leonard (2005).**

Significant interaction effect of the tested alfalfa cultivars and the applied fertilization treatment on the produced fresh forage yield is shown in Table (5, A 1, 2, 3 and 4). This effect indicated that fresh forage yield increased as the fertilization treatments rates increased.

However, such differences in increasing fresh yield were magnified as the fertilization level increased from low (T2) to medium (T3) and up to the highest level (T4). This result was true for all of the grown alfalfa cultivars with significantly higher magnitudes for the local than the exotic alfalfa cultivars and the applied fertilization levels in relative different response of growth and production under the prevailing various environmental conditions of the different seasons of the year.

It is generally concluded that the lowest fresh alfalfa yield was noticed by the grown exotic cultivars at any of the applied NPK fertilization treatments. Whereas, the highest fresh alfalfa forage yield was produced by any of the grown local cultivars using the NPK fertilization treatments with relatively more production for Ismailia-1 than Sewa cultivars.

3- Yearly and total dry alfalfa forage yield:

Yearly and total dry forage yield of the grown alfalfa cultivars and the applied of N P K treatments showed a trend almost similar to the obtained fresh forage yield previously presented and discussed with slight variable magnitudes.

Data in Table (6, A 5, 6 and 7) represent the total dry forage yield of the grown alfalfa cultivars as affected by the applied 3 fertilization treatments and their control.

Results will be presented for each of the 3 growing years and the total yield as well. It is well noticed that (over the fertilization treatments and alfalfa cultivars) total dry forage yield was 6.37 ton/ fed. out of 10 cuts during the first

Table (6): Yearly and total dry forage yield of several alfalfa cultivars as affected by various levels of NPK.

	Cultivar (c)	Fertilization treatment				
		T1	T2	T3	T4	Mean
	..........(ton/fed.)..........					
1 st year establishment (10 cuts)	Hallma (Ex)	3.14	4.00	5.44	5.98	4.64
	Melesia(Ex)	3.04	3.79	4.99	6.29	4.53
	Siriver (Ex)	3.30	4.90	7.28	8.76	6.06
	Sewa (L)	4.51	6.31	8.30	11.65	7.69
	Ismailia-1(L)	5.20	7.65	10.26	12.53	8.91
	Mean	3.84	5.33		9.04	6.37
	LSD 0.05:	T = 0.3, C = 0.2 and T x C = 0.4				
2 nd year (11cuts)	Hallma (Ex)	4.73	6.32	6.58	8.02	6.41
	Melesia(Ex)	4.97	6.20	7.01	8.87	6.76
	Siriver (Ex)	5.58	7.06	8.41	10.37	7.85
	Sewa (L)	6.41	8.21	10.07	12.87	9.39
	Ismailia-1(L)	7.05	9.27	11.41	14.10	10.46
	Mean	5.75	7.41	8.70	10.84	8.18
	LSD 0.05:	T = 0.3, C = 0.2 and T x C = 0.4				
3rd year (11cuts)	Hallma (Ex)	5.38	6.70	8.24	9.26	7.39
	Melesia(Ex)	5.09	6.99	7.99	10.00	7.52
	Siriver (Ex)	6.23	7.76	8.86	11.20	8.51
	Sewa (L)	6.93	8.50	9.51	12.77	9.43
	Ismailia-1(L)	7.19	8.67	10.44	13.85	10.04
	Mean	6.16	7.72	9.01	11.42	8.58
	LSD 0.05:	T = 0.4, C = 0.3 and T x C = 0.6				
Total yields (32 cuts)	Hallma (Ex)	13.24	17.02	20.26	23.26	18.44
	Melesia(Ex)	13.10	16.99	20.00	25.16	18.81
	Siriver (Ex)	15.10	19.71	24.55	30.32	22.42
	Sewa (L)	17.85	23.02	27.87	37.28	26.51
	Ismailia-1(L)	19.44	25.58	32.11	40.47	29.40
	Mean	15.75	20.46	24.96	31.30	23.12
	LSD 0.05:	T = 0.8, C = 0.5 and T x C = 1.0				

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

established year, being higher during the 2nd year which was 8.18 out of 11 cuts and the third growing year as well which was 8.58 out of 11 cuts, with a respective contribution of 28, 35 and 37% of the total dry forage of alfalfa production (23.12 ton/fed./ 3years).

Maximum total dry forage yield was obtained during the third year followed by second year then the first year. This result may clarify the interaction effect of the Genotype X environment interaction which was significant.

Results in Table (6, A 5, 6 and 7) show that over the applied NPK treatments, the grown alfalfa cultivars exerted significant differences in their dry forage production. This trend was clear in each of the three years of stand-duration and on the total yield as well with noticeable variable magnitudes.

It is obviously clear that the top highest productive alfalfa cultivars was the local alfalfa one Ismailia-1 followed by Sewa with significant differences. This trend was noticed for each of the first (8.91 ton/ fed. out of 10 cuts), second (10.46 ton/fed, out of 11 cuts) and the third year (10.04 ton / fed. out of 11 cuts), and the total year (29.40 ton / fed. out of 32 cuts) as well.

It is also noticed that each of the other 3 exotic alfalfa cultivars (Siriver, Melesia and Hallma) was inferior in dry forage production compared with the local alfalfa cultivars (Ismailia-1 and Sewa) with significant differences during each of the 3 years duration and their total yield.

Results in Table (6, A 5, 6 and 7) also clarified significant differences among the 3 exotic alfalfa cultivars during each year and their total yield as it clear from the comparative set of data derived from Table (6) :-

Cultivars	1st year	2nd year	3rd year	total year
Siriver	6.06	7.85	8.51	22.42
Melesia	4.53	6.76	7.52	18.81
Hallma	4.64	6.41	7.39	18.44
LSD at 5%	0.21	0.20	0.28	0.51

This comparative set of data showed the behaviors of the grown exotic cultivar during 3 years and their total yield. Where Siriver the exotic cultivars was the highest in dry yield then Melesia followed by Hallma with significant variable magnitudes as it is clear in the above set of comparative data.

It could be generally concluded the local Ismailia-1 cultivar was of the top highest dry forage yield than Sewa (L), Siriver (Ex), Melesia (Ex) and Hallma (Ex) by a respective increase of 11, 31, 56 and 59% regarding the total yield of the 3 years. This trend was noticed in each of the 3 years with different significant magnitudes over all of the other applied fertilizer treatments.

Results show that the application NPK fertilizer treatments enhanced the growth of alfalfa plants significantly as compared with the control during each of the three years and their total yield as well. Data of the yearly and total dry forage yield during the stand duration as affected by the applied treatments are presented in Table (6, A 5, 6 and 7). Results indicate that (over the grown alfalfa cultivars) alfalfa significantly responded to highest level (T4) of combined fertilization treatment. There was greater response such for treatment in the third year compared with the first and the second year.

It is obviously clear from the obtained data that the highest rate of NPK application (T4) produced the highest dry forage yield which was 9.04 ton/ fed. out of 10 cuts, 10.84 ton/ fed. out of 11 cuts and 11.42 ton / fed. out of 11 cuts during the first, second and the third year, respectively, corresponding to their control of 3.84 ton/ fed. out of 10 cuts, 5.75 ton / fed. out of 11 cuts and 6.16 ton/ fed. out of 11 cuts in the same years.

In the first year, the highest total dry forage yield was 9.04, 7.25, 5.33 and 3.84 ton/fed, for the highest (T4), medium (T3) and lowest (T2) fertilizer treatment and control, respectability. It is well noticed that the high, medium and low fertilizer treatments caused substantial increase in dry alfalfa forage yield compared to the control by 135, 89, and 39% in the first year, being 89, 51 and 29% in the second year and 85, 46 and 25% in the third year.

Results in Table (6, A 5, 6 and 7) show significant interaction effect between the grown alfalfa cultivars and the received fertilization treatments on dry forage yield. This result was noticed in each of the 3 years and their total yield as well.

Such interaction generally showed that dry forage yield increased as the fertilization treatments increased. Meanwhile, the grown cultivars showed similar descending order in total dry forage yield as follows: Ismailia-1, Sewa > Sirive r> Melesia > Hallma. This trend was noticed during each individual year and their total dry forage yield with different significant magnitudes (Table 6, A 5, 6 and 7).

So, it could be concluded that the two local alfalfa cultivars (Ismailia-1 and Sewa) produced significantly higher total dry forage yield at the highest level of the applied fertilization treatment (T4), being higher for Ismailia-1 than Sewa cultivar. Similar trend was noticed for the exotic cultivars being highest for Siriver than Mellesia followed by Hallma. Meanwhile, the highest total dry forage alfalfa yield was obtained for Ismailia-1 that was fertilized by the highest fertilization level with significant interaction which as compared with Halma who produced lowest total dry forage yield even at the same applied highest fertilization level.

Also, it is noticed the lowest dry forage production was produced for the three exotic alfalfa cultivars when they were unfertilized (control).

Seasonal total dry alfalfa yield:

Data presented in Table (7, A 5, 6, 7 and 8) show the seasonal total dry forage yield of different alfalfa cultivars as affected by the various fertilization treatments. It is clear that (over the applied fertilization treatments) the seasonal

Table (7): Seasonal total dry forage yield of several alfalfa cultivars as affected by various levels of NPK.

Cultivar (C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter seasons (5 cuts)					Spring seasons (9 cuts)				
	....(ton/fed..									
Hallma(Ex)	1.70	2.19	2.66	2.92	2.37	3.77	5.04	5.80	6.79	5.35
Melesia(Ex)	1.60	2.20	2.66	3.43	2.47	3.87	4.94	5.92	7.29	5.51
Siriver (Ex)	1.95	2.69	3.19	4.50	3.08	4.36	5.87	7.10	8.81	6.54
Sewa (L)	2.54	3.31	4.14	5.89	3.97	5.27	7.01	8.02	10.60	7.72
Ismailia1(L)	2.98	3.71	4.97	6.41	4.52	5.86	7.60	9.63	11.72	8.70
Mean	2.15	2.82	3.52	4.63	3.28	4.63	6.09	7.30	9.04	6.76
LSD 0.05:	T = 0.1, C = 0.2 and T x C =0.3					T = 0.3, C = 0.2 and T x C = 0.4				
	Summer seasons (9 cuts)					Autumn seasons (9 cuts)				
Hallma (Ex)	3.90	5.10	6.15	7.04	5.55	3.87	4.70	5.64	6.50	5.18
Melesia(Ex)	4.09	5.12	5.79	7.59	5.65	3.55	4.73	5.62	6.84	5.19
Siriver (Ex)	4.51	5.84	7.33	8.95	6.66	4.28	5.31	6.93	8.06	6.15
Sewa (L)	5.19	6.57	7.85	10.46	7.52	4.84	6.13	7.86	10.33	7.29
Ismailia1(L)	5.56	7.36	8.90	11.32	8.29	5.04	6.92	8.61	11.03	7.90
Mean	4.65	6.00	7.20	9.07	6.73	4.32	5.56	6.93	8.55	6.34
LSD 0.05:	T = 0.3, C = 0.2 and T x C = 0.4					T = 0.3, C = 0.2 and T x C = 0.4				

T1= control, T2 (low)= $N_{10} P_{10} K_{10}$, T3 (medium)= $N_{20} P_{20} K_{20}$, T4 (high)= $N_{30} P_{30} K_{40}$

total dry forage productivity during the stand duration indicated the superiority of spring season (6.76 ton/fed, out of 9 cuts); being slightly decreased during summer season (6.73 ton/fed, out of 9 cuts); followed by autumn (6.34 ton/fed, out of 9 cuts); then winter seasons (3.28 ton/fed. 5cuts) where the lowest dry alfalfa yield was produced.

The respective seasonal total dry forage yield out of the total production of stand duration was 23.12 ton/fed, out of 32 cuts, being 14.20, 29.23, 29.13 and 27.4% for the subsequent winter, spring, summer and autumn seasons. Such differences among the seasonal production were significant. These results might be due to the differences among the environmental conditions of the various seasons regarding the temperature (day/night), day length and dark period as well as relative humidity and soil temperature and its effect on the soil-microflora activities. All of these and other factors strongly interact with the biological and physiological processes of vegetative growth and regrowth. These results are in agreement with those of **Abd El-Halim et al.(1992) and Oushyetal. (1999b).**

Data in Table (7, A 5, 6, 7 and 8) show the dry alfalfa forage yield as affected by to seasonal variations. Data show that the performance of alfalfa cultivars over all the applied fertilization treatments in seasonal total dry yield were significantly different among the four seasonal durations. Significant differences were detected between alfalfa cultivars over the growing seasons of the whole stand duration (3-year).

The local alfalfa cultivar Ismailia-1 produced the highest seasonal total dry forage yield which was 4.52 ton/fed, out of 5 cuts; 8.70 ton/fed, out of 9 cuts; 8.29 ton/fed, out of 9 cuts; and 7.9 ton/ fed. out of 9 cuts during winter, spring, summer and autumn seasons, respectively. Whereas, the exotic cultivar Hallma produced the lowest dry forage yield which was 2.4, 5.35, 5.55 and 5.18 ton/fed, in the same respective corresponding seasons.

Differences in dry forage production between the local alfalfa cultivars during the various seasons could be due to the interaction between unique genetic make up of each of the grown alfalfa cultivar with the prevailing environment seasonal variation during the stand duration.

Results also show that the differences in dry forage yield among the 3 exotic cultivars (Siriver, Melesia and Hallma) were significant. But the exotic cultivars Siriver produced the highest seasonal total dry forage yield with highly significant differences as compared with the other two exotic cultivars. These results were true over the applied fertilization treatments and the different growing seasons. These results are in general agreement with those reported by **Moursi et al. (1977), Ghobrial (1978), Mousa (1982), Rammah et al. (1988), Geweifel (1997) and Nasr (1998).**

Data recorded in Table (7, A 5, 6, 7 and 8) show that there were significant differences in dry forage yield due to the applied fertilization treatments during the various seasonal production of the whole stand duration. Over the grown alfalfa cultivars, there was greater response to the highest NPK fertilization level in summer season (9.07 ton/fed, out of 9 cuts); then spring (9.04 ton/fed, out of 9 cuts); followed by autumn (8.55 ton/fed, out of 9 cuts). Whereas, the lowest dry forage yield was produced during winter seasons (4.63 ton/fed. out of 5 cuts) as compared with their relevant control received the lowest NPK fertilization levels which were 2.15, 4.63, 4.65 and 4.32 ton/fed.

During winter season, the highest, medium and lowest fertilization treatments relatively increased seasonal total dry forage yield as compared with their relevant control treatments by 115, 64 and 31%, respectively.

And during spring season, the highest, medium and lowest fertilization treatments relatively increased dry forage yield as compared with their relevant control treatments by 95, 58 and 32%, respectively.

Meanwhile, during summer season, the highest, medium and lowest fertilization treatments relatively increased dry forage yield as compared with their relevant control treatments by 95, 55 and 29%, respectively.

And during autumn season, the highest, medium and lowest fertilization treatments relatively increased dry forage yield as compared with their relevant control treatments by 98, 60 and 29%, respectively.

The interaction effect between alfalfa cultivars and the applied fertilization treatments was significant on the dry forage yield (Table 7, A5, 6, 7, 8). This significant effect showed that dry alfalfa forage yield increased as the applied fertilization levels increased. So, the highest seasonal total dry forage alfalfa yield was obtained for Ismailia-1 (L) cultivar which was fertilized by the highest fertilization treatments (T4). Whereas, the lowest dry forage yield was produced by Hallma (Ex) cultivar receiving the lowest fertilization treatment (T2). This result was true for the studied seasonal total yield during the whole stand duration (3-year). Results also indicate that Ismailia-1 (L) cultivar was significantly higher in seasonal total dry forage yield at any of the applied fertilization levels and even for the control. This result was true at any of the studied 4 growing seasons during the stand duration (3-year)

Yearly leaf/stem ratio on dry matter basis:-

Results in Table (8, A 9, 10, 11) show dry leaf/stem ratio of alfalfa plants for each of the 3 respective individual year, over the applied fertilization treatments. It was 65.26% average out of 10 cuts during the first established year; being 63.99% out of 11 cuts during the 2^{nd} year; and 62.81% out of 11 cuts in the third year. Data in the same Table show that there were remarkable decrease in leaf/stem ratio on dry matter basis from the first up to the third year of the stand duration.

Table (8): Yearly Leaf/stem ratio of several alfalfa cultivars as affected by various levels of NPK.

	Cultiva (c)	Fertilization treatment				
		T1	T2	T3	T4	Mean
	............................%............................					
1 st year establishment (10 cuts)	Hallma(Ex)	53.99	58.13	64.37	71.54	62.01
	Melesia (Ex)	54.65	59.03	64.34	72.90	62.73
	Siriver (Ex)	56.92	60.47	69.13	73.99	65.13
	Sewa (L)	58.07	63.77	72.84	76.13	67.70
	Ismailia1(L)	59.70	64.60	73.43	77.22	68.74
	Mean	56.67	61.20	68.82	74.36	65.26
	LSD 0.05:	T = 0.7, C = 0.6 and T x C = 1.2				
2 nd year (11 cuts)	Hallma (Ex)	54.05	56.26	60.66	64.63	58.90
	Melesia (Ex)	55.08	56.57	60.69	65.20	59.39
	Siriver (Ex)	55.85	59.53	69.25	73.15	64.52
	Sewa (L)	57.98	62.77	73.04	77.38	67.79
	Ismailia-1(L)	59.39	65.96	73.08	78.39	69.35
	Mean	56.47	60.28	67.46	71.75	63.99
	LSD 0.05:	T = 0.6, C = 0.6 and T x C = 1.2				
3rd year (11 cuts)	Hallma (Ex)	54.56	57.90	61.40	65.18	59.76
	Melesia (Ex)	55.15	57.96	61.53	65.85	60.12
	Siriver (Ex)	56.33	58.71	63.68	70.37	62.27
	Sewa (L)	57.69	61.01	67.82	75.13	65.41
	Ismailia-1(L)	58.38	61.70	69.13	76.65	66.46
	Mean	56.42	59.46	64.71	70.63	62.81
	LSD 0.05:	T = 0.6, C = 0.7 and T x C = 1.4				

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

Over the applied fertilization treatments, results in Table (8, A 9, 10, 11) indicate that the grown alfalfa cultivars showed significant differences in their dry leaf/stem ratio with different magnitudes. The two local cultivars Ismailia-1 and Sewa produced the highest dry leaf/stem ratio at all years of the stand duration, followed by the exotic cultivar Siriver. Significant differences in this trait were noticed among the 3 exotic alfalfa cultivars during each year of the stand duration as it is clear from the comparative set of data derived from Table (8, A 9, 10,11).

Years	Siriver >	Melesia >	Hallma	LSD
1st year	65.13 >	62.73 >	62.01%	0.60
2nd year	64.52 >	59.39 >	58.90%	0.57
3rd year	62.20 >	60.12 >	59.76%	0.68

This comparative set of data clarified the behavior of the grown exotic alfalfa cultivars during the 3 years. Siriver the exotic cultivar was of the highest dry leaf/stem ratio than Melesia followed by Hallma with significant variable magnitudes.

It could be generally concluded that the highest dry leaf/stem ratio of the grown alfalfa cultivars were obtained for the tow local cultivars Ismailia-1 (69.35%) and Sewa

(67.79%) of the second year. This trend was noticed in each of 3 years with slight different significant magnitudes over all the applied fertilization treatments.

The obtained differences in dry leaf/stem ratio of the different alfalfa cultivars could be due to their unique genetical make-up which interact differently with the prevailing environmental condition in exerting their effect on this studied trait as a foliage productivity features. Similar results concerning the various productivity of the different alfalfa cultivars were previously reported by **Moursi et al. (1977), Ghobrial (1978), Mousa (1982), Rammah et al. (1988), Geweifel (1997) and Nasr (1998).**

Data of the yearly dry leaf/stem ratio during the stand duration as affected by the applied treatments are presented in Table (8, A 9, 10, 11). Results show that the application NPK fertilizer treatments enhanced the growth of alfalfa plants significantly as compared with their control during each of the three growing years.

Over the grown alfalfa cultivars, as the applied fertilization levels treatments increased, there was significant increase in dry leaf/stem ratio of alfalfa plants compared to their control (without fertilization) having various magnitudes during each of the 3 years of the stand duration.

Results indicate that over the grown alfalfa cultivars, alfalfa dry leaf/stem ratio significantly responded to the highest level of (T4) fertilization treatment. There was greater response to such highest fertilization treatment in the first (74.36%), second (71.75%) and the third year (70.63%) compared with their relevant control of 56.67, 56.47, 56.42% for the respective three years.

The obtained increase in dry leaf/stem ratio when comparing between applying the highest fertilization treatment (T4) and the control (T1) was about 31% for the 1st year, 27% in the 2nd year and 25% in the 3rd year of the stand duration. Whereas, the corresponding increases were 22, 19 and 19% when using the lowest fertilization treatment (T2).

Results in Table (8, A 9, 10, 11) indicate significant interaction effect for the applied fertilization treatments and the grown alfalfa cultivars on their yearly dry leaf/stem ratio.

For either the local or the exotic alfalfa cultivars, increasing the applied fertilization treatments caused substantial increase in dry leaf/stem ratio. However, such differences in increasing dry leaf/stem ratio were magnified as the fertilization level increased from the low (T2) to medium (T3) and up to the highest (T4) level. This result was true for all of the grown alfalfa cultivars with significantly higher magnitudes for the local than the exotic alfalfa cultivars.

Evenmore, the local Ismailia-1 cultivar was relatively higher in dry leaf/stem ratio as compared with the local Sewa alfalfa cultivar.

It could be generally concluded that the highest dry leaf/stem ratio was produced by either one of the studied local cultivars using the highest fertilization treatment (T4) with relatively more production for Ismailia-1 than Sewa cultivars. Whereas, the lowest dry leaf/stem ratio was noticed for any of the grown exotic cultivars without or with the lower fertilization treatments. It was also clear that the highest response of the grown alfalfa cultivars to increasing the applied fertilization levels in respect to dry leaf/stem ratio was more pronounced in the first growing year rather than the second or the third year of the stand duration.

The above presented results were more or less in a similar trend for each of the three individual years of the stand duration with relatively slight different magnitudes.

It should be also clear that such presented interaction effect of the applied fertilization treatments and the grown cultivars on increasing the dry leaf/stem ratio of alfalfa cultivars is reasonably accepted. This is due to the variation of the unique genetically makeup formation of the grown cultivars which interact with the applied fertilization treatments in relative different response of growth and production of the dry leaf/stem ratio of alfalfa as an indicator for productivity and quality under the prevailing environmental conditions.

Seasonal leaf/stem ratio (combined over 3-year):

Data presented in Table (9, A 9, 10, 11) evidentiate the seasonal dry leaf/stem ratio of different alfalfa cultivars as affected by the applied fertilization treatments. It is clear that (over the applied fertilization) dry leaf/stem ratio during the stand duration indicated the superiority of summer seasons (64.96% over 9 cuts); being the slightly decreased during autumn season

Table (9): Seasonal leaf/stem ratio of several alfalfa cultivars as affected by various levels of NPK (combined over 3 years).

Cultivar (C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter seasons					Spring seasons				
	....................(%)....................									
Hallma(Ex)	53.38	56.53	63.22	67.54	60.17	53.02	56.28	60.94	65.26	58.88
Melesia(Ex)	53.45	57.20	63.08	67.40	60.28	54.10	56.06	60.65	66.79	59.40
Siriver (Ex)	55.47	59.33	66.86	71.47	53.28	55.40	57.99	66.32	72.08	62.95
Sewa (L)	57.18	63.12	71.43	75.45	66.79	57.17	61.50	70.89	76.34	66.48
Ismailia1(L)	58.91	64.39	71.39	75.69	67.59	58.21	64.81	71.76	77.87	68.16
Mean	55.68	60.11	67.20	71.51	63.62	55.58	59.33	66.11	71.67	63.17
LSD 0.05:	T = 0.73, C = 0.84 and T x C = 1.7					T = 0,49, C = 0.60 and T x C = 1.2				
	Summer seasons					Autumn seasons				
Hallma (Ex)	55.31	58.69	62.18	67.98	61.04	55.10	58.22	62.23	67.68	60.81
Melesia(Ex)	56.17	58.87	62.56	64.41	61.50	56.12	59.28	62.46	69.34	61.80
Siriver (Ex)	57.68	60.02	68.86	73.16	64.93	56.93	61.33	67.36	73.29	64.73
Sewa (L)	59.36	63.62	72.02	77.20	68.05	57.93	61.84	70.58	75.86	66.55
Ismailia1(L)	60.29	65.11	73.33	78.47	69.30	59.19	62.04	71.84	77.64	67.08
Mean	57.76	61.26	67.79	73.04	64.96	57.06	60.54	66.89	72.76	64.31
LSD 0.05:	T = 0.51, C = 0.66 and T x C = 1.3					T = 0.46, C = 0.60 and T x C = 1.2				

T1= control, T2 (low)= $N_{10} P_{10} K_{10}$, T3 (medium)= $N_{20} P_{20} K_{20}$, T4 (high)= $N_{30} P_{30} K_{40}$

(64.31% over 9 cuts); followed by winter (63.62% over 5 cuts); then spring seasons (63.17% out of 9cuts).

In conclusion summer seasons gave the highest values 64.69 of dry leaf/stem ratio, while the lowest values resulted during spring seasons (63.17%) of the whole stand duration of 3 years. These results might be due to the differences in the environmental conditions of the various four seasons of the 3 years. These results are in agreement with those obtained by **Oliveira et al (1993) and Oushy et al (1999b).**

The effect of various alfalfa cultivars on the obtained dry leaf/stem ratio over the applied fertilization treatments is presented in Table (9, A 9, 10, 11). It is clear that the local alfalfa cultivar Ismailia-1 produced the highest dry leaf/stem ratio being 67.59, 68.16, 69.30 and 67.68% in winter, spring, summer and autumn seasons, respectively. This was followed by Sewa the local cultivar of 66.79, 66.48, 68.05 and 66.55%, then Shiver of 63.28, 62.95, 64.93 and 64.73% followed by Melesia of 60.28, 59.40, 61.50 and 61.80% then Hallma of 60.17, 58.88, 61.04 and 60.81% dry leaf/stem ratio during the formerly respective seasons of the years.

Differences in dry leaf/stem ratios among the four alfalfa cultivars (Sewa, Siriver, Melesia and Hallma) during the stand duration of 3 years were significant. The local cultivars Ismailia-1 proved to produce the highest dry leaf/stem ratio with highly significant differences as compared with the other tested four alfalfa cultivars. These results were true in all seasons of the 3 years of stand duration (over the applied fertilization treatments). The second high rank cultivar in dry leaf/stem ratio was the local Sewa alfalfa (Table 9, A 9, 10, 11).

Over the applied fertilization treatments, each of the three exotic alfalfa cultivars was significantly lower in dry leaf/stem ratio than any of the grown local cultivars (Ismalia-1 and Sewa) this result was noticed in each of the 4 seasons during the stand duration of 3 years.

Also, among the exotic alfalfa cultivar, Siriver was of the highest dry leaf/stem ratio, followed by Melesia then Hallama cv which was of the lowest dry leaf/stem ratio. This trend was noticed for dry leaf/stem ratio with significant differences and various magnitudes during each of the 4 growing seasons of the stand duration (3 years).

Over the applied fertilization treatments, each of the three exotic alfalfa cultivars was significantly lower in dry leaf/stem ratio than any of the grown local cultivars (Ismalia-1 and Sewa). Also, among the exotic alfalfa cultivars, Siriver was of the highest dry leaf/stem ratio, followed by Melesia then Hallama which was of the lowest value.

And among the local cultivars, Ismailia-1 was of the highest dry leaf/stem ratio, followed by Sewa. This trend was noticed with significant differences and slight various magnitudes in each of the growing 4 seasons of the stand duration.

The obtained differences in dry leaf/stem ratio of the different alfalfa cultivars could be due to their unique genetical make-up which interact differently with the prevailing environmental conditions in exerting their dry leaf/stem ratio features.

Data recorded in Table (9, A 9, 10, 11) show significant differences in dry leaf/stem ratio of forage yield due to the applied fertilization treatments during the various seasons over the grown cultivars. The greatest response to the highest fertilization level (T4) in the summer seasonal

(73.04%); then in autumn (72.76%); followed by spring (71.67%). Whereas, the lowest dry leaf/stem ratio was produced in winter seasons (71.51) compared with their respective relevant control of 57.76, 57.06, 55.58 and 55.68%, respectively.

Such presented increase in dry leaf/stem ratio due to the increase in the applied fertilization levels was significant with slight variable magnitudes during each of the 4 seasons of the stand duration (3 years). It should be noted that the effect of any of the applied fertilization treatments (over the grown cultivars) on dry leaf/stem ratio of cultivar yield could be due to the important and essential role of the components of the applied fertilization treatments (NPK) and their quantities (low, medium and high) on enhancing the physiological and biological processes which all affect the growing rates of the vegetative growth and the subsequent regrowth due to the appropriate storage and accumulation of carbohydrate and other materials that could be used for the regrowth of the subsequent cuttings. These will be reflected on the dry leaf/stem ratio of alfalfa plants.

Significant interaction effect of the tested alfalfa cultivars and the applied fertilization treatments on the produced dry leaf/stem ratio of forage yield is shown in (Table 9, A 9, 10, 11). Such effect indicates that dry leaf/stem ratio of forage yield increased as the rates of fertilization treatments increased.

However, such differences in increasing dry leaf/stem ratio of forage yield were magnified as the fertilization level increased from low to medium and up to the highest level. This result was true for all of the grown alfalfa cultivars with significantly higher magnitudes for the local than the exotic alfalfa cultivars and the applied fertilization levels in relative different response of growth and production of dry leaf/stem ratio under the prevailing environmental conditions.

It is generally concluded that the lowest dry leaf/stem ratio of alfalfa yield was noticed by the grown exotic cultivars at any of the applied NPK fertilization treatments. Whereas, the highest dry leaf/stem ratio of alfalfa forage yield was produced by the grown local cultivars using with relatively more production for Ismalia-1 than Sewa cultivar.

Yearly effect on alfalfa plant height:-

Results show that alfalfa plant height for each of the 3 respective individual year, over the applied fertilization treatments was 33.79, 38.23 and 39.50 cm out of 10, 11 and 11 cuts, respectively with significant differences. The increase in plant heights was about 12% if we compared the first with the first year, being 17% if compared the third with the first year of stand duration, whereas the difference in plant heights was only 3% between the second and third year Table (10, A 12, 13, 14).

So, it could be noticed that over the applied fertilization treatment and the grown alfalfa cultivars, plant heights were increased in subsequent years of the stand duration with slightly higher magnitude for the third year of the stand duration.

Results in Table (10, A 12, 13, 14) show that over the applied NPK treatments, the grown alfalfa cultivars exerted significant differences in their plant heights. This trend was clear in each of the three years of stand duration years with noticeable slight variable magnitudes.

It is obviously clear that the tallest plant height of alfalfa cultivars was for the local alfalfa one Ismailia-1

Table (10): Yearly plant height of several alfalfa cultivars as affected by various levels of NPK.

	Cultivar (c)	Fertilization treatment				
		T1	T2	T3	T4	Mean
	..................................(cm.)................................					
1 st year establishment (10 cuts)	Hallma (Ex)	21.04	26.35	30.67	35.82	28.47
	Melesia(Ex)	20.29	28.12	31.12	36.64	29.04
	Siriver (Ex)	22.47	31.74	36.46	39.39	32.52
	Sewa (L)	30.94	35.88	39.99	44.46	37.82
	Ismailia-1(L)	34.37	39.34	43.89	46.89	41.12
	Mean	25.82	32.29	36.43	40.64	33.79
	LSD 0.05:	T = 0.86, C = 0.65 and T x C = 1.3				
2 nd year (11cuts)	Hallma (Ex)	28.23	32.49	36.28	38.61	33.90
	Melesia(Ex)	28.52	33.64	37.69	39.74	34.90
	Siriver (Ex)	33.90	35.92	39.34	41.29	37.61
	Sewa (L)	36.31	40.83	43.49	44.80	41.36
	Ismailia-1(L)	37.78	43.14	44.81	47.81	43.38
	Mean	32.95	37.20	40.32	42.45	38.23
	LSD 0.05:	T = 0.7, C = 0.65 and T x C = 1.3				
3rd year (11cuts)	Hallma (Ex)	33.13	36.04	39.21	41.11	37.37
	Melesia(Ex)	34.22	36.72	39.73	41.07	37.93
	Siriver (Ex)	35.68	38.24	40.97	42.49	39.34
	Sewa (L)	37.20	40.26	42.72	45.45	41.41
	Ismailia-1(L)	36.44	40.16	43.04	46.12	41.44
	Mean	35.33	38.28	41.13	43.25	39.50
	LSD 0.05:	T = 1.0, C = 0.76 and T x C = 1.5				

T1 = control, T2 (low) = $N_{10}P_{10}K_{10}$, T3 (medium) = $N_{20}P_{20}K_{20}$, T4 (high) = $N_{30}P_{30}K_{40}$

followed by Sewa with significant differences. This trend was noticed during the first (41.12 cm out of 10 cuts), second (43.38 cm out of 11 cuts) and the third year (41.44 cm out of 11 cuts) for Ismailia-1 cultivar.

It is also noticed that each of the other 3 exotic alfalfa cultivars (Siriver, Melesia and Hallma) were inferior in plant height compared with either of the local alfalfa cultivars (Ismailia-1 and Sewa) with significant differences during each of the 3 years duration.

It is also noticed that significant differences among the 3 exotic alfalfa cultivars during each year as it is clear from the comparative set of data derived from Table (10, A 12, 13, 14):-

Years	Siriver >	Melesia >	Hallma	LSD at 5 %
1^{st} year	32.52	29.04	28.47	0.65
2^{nd} year	37.61	34.90	33.90	0.65
3^{rd} year	39.34	37.93	37.37	0.76

This comparative set of plant height showed the behaviors of the grown exotic cultivar during 3 years. Where Siriver the exotic cultivar was the tallest plant compared to Melesia followed by Hallma with slight significant variable magnitudes.

Results indicate that the tallest alfalfa cultivars were noticed for the two local cultivars Ismailia-1 and Sewa This trend was noticed in each of the 3 years with different slight significant magnitudes over all the applied fertilization treatments.

It is generally noticed that heights of the grown alfalfa cultivars (over the applied fertilization treatments) could be arranged in the following descending order : Ismailia-l> Sewa (locals) > Siriver >Mellsia.> Halma (exotic). This trend was more or less similar in each of the three growing seasons of the stand duration.

The obtained varities in the heights of plants as an indicator of alfalfa productivity of the different alfalfa cultivars could be due to their unique genetical make-up which interact with the prevailing environmental condition in exerting their relevant productivity features were previously reported by **Moursi et al. (1977), Ghobrial (1978), Mousa (1982), Rammah et al. (1988),** Geweifel **(1997) and Nasr (1998).**

Over the grown alfalfa cultivars, the applied fertilization treatments caused significant differences in the plant height of alfalfa plants compared to the control (without fertilization) having slight various magnitudes (Table 10, A 12, 13, 14).

It is generally noticed that over the grown cultivars, height of alfalfa plants substantially increased as the fertilization levels increased from the control up to the highest fertilization treatments with various magnitudes as presented previously.

The obtained increase in alfalfa plant height of plants when comparing between applying the highest fertilization treatment (T4) and the control (T1) was about 57% for the first year, 29% in the 2nd year and 22% in the third year. Whereas the corresponding increases were 26, 14 and 13% when comparing the highest fertilization treatment (T4) with the lowest fertilization treatment (T2)

However, when comparing the effect of the applied medium (T3) with the lowest fertilization treatment (T2) in increasing plant height of alfalfa plants, it was 13, 8 and 7% for the respective 3-year of the stand duration; being 12, 5 and 5% when comparing between the highest and medium fertilization treatments. So, the increase in heights of alfalfa plants was relatively very small as compared between the medium and the highest fertilization levels.

It should be noted that the effect of any of the applied fertilization treatments (over the grown cultivars) on plant height of alfalfa plants was due to the important and essential role of the components of the applied fertilization treatments (NPK) and their quantities (low, medium and high) on enhancing the physiological and biological processes which affect the growing rates of the vegetative growth and the subsequent regrowth in plant height as an effective indicator of foliage productivity is due to the appropriate storaged carbohydrate and other materials that could be used for the regrowth of the subsequent cuttings.

Significant interaction effect was detected between the applied fertilization treatments and the grown alfalfa cultivars on their heights in each of the 3 years of the stand duration as it is clear in Table (10, A 12, 13, 14). For either the local or the exotic alfalfa cultivar, increasing the applied fertilization treatments caused substantial increase in plant height during each year of stand duration.

It could be generally concluded that the tallest plants of alfalfa forage yield was produced by both of the grown local cultivars (Ismailia-1 and Sewa) using the highest fertilization treatments with (T4) relatively more effect for

Ismalia-1 than Sewa cultivars. Whereas, the shortest alfalfa plants were noticed for any of the grown exotic cultivars (Siriver, Melesia and Hallma) without or with the lowest fertilization treatments.

However, such differences in increasing plant height were magnified as the fertilization level increased from low (T2) to medium (T3) and up to the highest (T4) level. This result was true for all of the grown alfalfa cultivars with significantly higher magnitudes for the local than the exotic cultivars.

Evenmore, the local Ismailia-1 cultivar was relatively taller in plant height as compared with Sewa cultivar. It is also clear that the highest response of the grown alfalfa cultivars to increasing the applied fertilization levels in respect to plant height was more pronounced in the third growing year rather than the first or the second year of the stand duration.

It should be also noted that such presented interaction effect of the applied fertilization treatments and the grown cultivars in increasing the plant heights of alfalfa cultivars is reasonably accepted. This is due to the variation of the unique genetically makeup formation of each specific cultivars which interact with the applied fertilization treatments in relative different response of growth under the prevailing environmental conditions and the circumstances of this study as well.

Seasonal plant height:-

Data presented in Table (11, A 12, 13, 14) show the seasonal plant height of different alfalfa cultivars as affected by various fertilization treatments. Seasonal plant heights were estimated from 5 cuts during winter seasons, 9 cuts during spring seasons, 9 cuts during summer seasons and 9 cuts during autumn seasons.

It is clear that over the applied fertilization treatments the tallest seasonal plant heights during the stand duration indicated the superiority of summer season (39.61cm over 9 cuts); being slightly decreased during spring seasons (37.83cm over 9 cuts); followed by autumn (37.24cm over 9 cuts); then winter seasons (34.02cm over 5 cuts).

Differences among the seasonal effect on plant height was significant. This clarify the importance of the environmental effect on plant heights as an indicator of vegetative growth and forage productivity. These results are

Table (11): Seasonal plant height of several alfalfa cultivars as affected by various levels of NPK (combined over 3 years).

Cultivar(C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter seasons					**Spring seasons**				
	..................(cm.)..................									
Hallma(Ex)	23.28	26.99	31.94	35.66	29.47	28.49	32.44	36.13	38.03	33.77
Melesia(Ex)	22.38	28.89	31.88	35.43	29.64	30.44	35.35	38.00	39.81	35.90
Siriver (Ex)	27.55	31.45	36.05	38.29	33.33	31.54	35.32	38.35	41.21	36.60
Sewa (L)	31.90	36.38	40.62	42.46	37.84	34.93	38.39	40.92	45.29	39.88
Ismailia1(L)	32.93	38.63	42.35	45.43	39.84	37.71	41.86	45.48	46.85	42.97
Mean	27.61	32.47	36.57	39.45	34.02	32.62	36.67	39.77	42.24	37.83
LSD 0.05:	T = 0.87, C = 0.82 and T x C = n.s					T = 1.2, C = 0.96 and T x C = n.s				
	Summer seasons					**Autumn seasons**				
Hallma (Ex)	31.27	33.72	36.91	40.27	35.54	26.84	33.35	36.56	40.09	34.21
Melesia(Ex)	30.31	34.15	38.38	40.89	35.93	27.57	32.93	36.46	40.47	34.36
Siriver (Ex)	33.47	38.98	41.97	42.81	39.31	30.16	35.45	39.33	41.92	36.72
Sewa (L)	38.92	42.91	44.48	46.69	43.25	33.52	38.28	42.26	45.18	39.81
Ismailia1(L)	38.97	43.52	44.91	48.73	44.03	35.18	39.50	42.92	46.75	41.09
Mean	34.59	38.66	41.33	43.88	39.61	30.65	35.90	39.51	42.88	37.24
LSD 0.05:	T = 0.7, C = 0.7 and T x C = 1.5					T = 0.7, C = 0.8 and T x C = n.s				

T1 = control, T2 (low) = $N_{10}P_{10}K_{10}$, T3 (medium) = $N_{20}P_{20}K_{20}$, T4 (high) = $N_{30}P_{30}K_{40}$

in agreement with those obtained by **Abd El-Halim et al. (1992) and Oushy et al. (1999a).**

Data in Table Table (11, A 12, 13, 14) show plant heights of alfalfa as affected by seasonal variation. Data show that the performance of alfalfa cultivars over all the applied fertilization treatments was significantly different among the four seasonal durations (combined over 3-year). Significant differences were detected between alfalfa cultivars over the growing seasons of the whole stand durations (3-year).

Among the local alfalfa cultivars, Ismailia-1 produced the tallest plants which were 39.84cm over 5 cuts; 42.97cm over 9 cuts; 44.03 cm over 9 cuts; and 41.09cm average of 9 cuts during winter, spring, summer and autumn seasons, respectively. Whereas, the exotic cultivar Hallma produced the shortest plants which were 29.47, 33.77, 35.54 and 34.21cm in the corresponding seasons.

Meanwhile, among the two local cultivars, Ismalia-1 was of significant taller plants as compared with Sewa. This result was noticed over the growing seasons of the whole stand duration with slight different magnitudes.

The differences in plant height between the local alfalfa cultivars during the various season, could be due to interaction between unique genetic makeup of the grown alfalfa cultivar and the prevailing environmental seasonal variations.

Results also show that the differences in plant height between the 3 exotic cultivars (Siriver, Melesia and Hallma) were significant. But concerning the exotic cultivars, Siriver produced the tallest plants with highly significant differences as compared with the other two exotic cultivars. Such results were true over the applied fertilization treatments and the different growing seasons. Similar results were reported by **Moursi et al. (1977), Ghobrial (1978), Mousa (1982), Rammali et al. (1988), Geweifel (1997) and Nasr(1998).**

Data presented in Table Table (11, A 12, 13, 14) indicate that there were significant differences in plant heights of alfalfa due to the applied fertilization treatments which were positively affected by the seasonal variations during the stand duration compared to their relevant control (T1) with various magnitudes. Similar trend was found within the four growing seasons of the stand duration (3-

year). Seasonal plant heights under each fertilization treatment was higher in summer season followed by spring then autumn, followed by winter season where the shortest plants were produced. Due to the lowest temperature during winter seasons. These results are in agreement with those of **Abd- El-Halim et al. (1992) and Oushy et al. (1999a).**

Over the grown alfalfa cultivars, the highest fertilization treatment (T4) significantly enhanced the growth rate of alfalfa plants which was reflected on plant heights which were 39.45cm average of 5 cuts; 42.24 over of 9 cuts; 43.88 over of 9 cuts; and 42.88 over of 9 cuts during the subsequent winter, spring, summer and autumn seasons of the 3 years of the stand duration compared with their relevant control (T1) which produced plant heights of 27.61, 32.62, 34.59 and 30.65cm for the corresponding seasons.

It is generally noticed that summer season was superior compared to the other 3 growing seasons of the stand duration in respect of plant heights. In this particular season, using high (T4), medium (T3) and low (T2) fertilization treatments caused substantial significant increase in plant height as compared with their relevant control treatments (T1) by 27, 19 and 12%, respectively.

Such presented increases in alfalfa plant heights as indicator of the vegetative growth, due to the applied fertilization treatments were significant with variable magnitudes within each of the four seasons during of the stand duration. These results are in harmony with those reported by **Sharma and Sharma (2004), Berrada and Westfall (2005) and Haby and Leonard (2005).**

The interaction effect between alfalfa cultivars and the applied fertilization treatments was significant on the plant heights (Table 11, A 12, 13, 14) this significant effect showed that plant height of alfalfa plants increased as the applied fertilization levels increased. So, the average tallest alfalfa plants was obtained for Ismailia-1 (L) cultivar which was fertilized by the highest fertilization treatments (T4). Whereas, the lowest plant height was produced by Hallma cultivar receiving the lowest fertilization treatment (T2). This result was true during the different seasons of the stand duration. Results also indicated that Ismailia (L) cultivar was significantly the tallest in plant heights at any of the applied fertilization treatments (Table 11, A 12, 13, 14).

Yearly performance of number of shoots/m^2 :-

Results in Table (12, A 15, 16, 17) show the number of shoots/m^2 of alfalfa plants for each of the 3 respective individual year as affected by cultivars and the applied fertilization treatments. Over the applied fertilization treatments number of shoots/m^2 was 230.2 out of 10 cuts during the first established year; being 230.12 out of 11 cuts during the 2nd year; and 221.34 out of 11 cuts in the third year. It is also clear that there was substantial decrease in number of shoots/m^2 from the first up to the third year.

Over the applied fertilization treatments, alfalfa cultivars showed significant differences in their yearly number of shoots/m^2 with slight different magnitudes.

Results indicate that each of the 3 exotic alfalfa cultivars (Hallma, Meesia, and Siriver) was inferior in their yearly number of shoots/m^2 as compared with any of the other two local alfalfa cultivars (Ismalia-1 and Sewa) with significant differences. Moreover, there were significant differences among the studied cultivars at each of the three growing years.

Table (12): Yearly of number of shoots/m^2 of several alfalfa cultivars as affected by various levels of NPK.

	Cultivar (c)	Fertilization treatment				
		T1	T2	T3	T4	Mean
		...........(no/ m^2)...........				
1 st year establishment (10 cuts)	Hallma (Ex)	136.2	147.6	211.7	248.3	185.9
	Melesia (Ex)	120.7	139.5	193.5	247.0	175.2
	Siriver (Ex)	133.5	187.8	217.4	285.4	206.0
	Sewa (L)	208.8	244.6	304.2	355.5	278.3
	Ismailia-1(L)	220.8	286.3	331.5	383.0	305.4
	Mean	164.0	201.1	251.6	303.8	230.2
	LSD 0.05:	T = 1.2, C = 0.8 and T x C = 1.6				
2 nd year (11cuts)	Hallma (Ex)	136.4	163.7	199.8	232.9	183.2
	Melesia(Ex)	130.6	169.7	188.5	211.7	175.1
	Siriver (Ex)	138.6	197.1	227.2	282.4	211.3
	Sewa (L)	189.5	234.8	292.1	364.0	270.1
	Ismailia-1(L)	217.5	260.9	354.8	410.4	310.9
	Mean	162.5	205.2	252.5	300.3	230.1
	LSD 0.05:	T = 5.9, C = 5.6 and T x C = 11.3				
3 rd year (11 cuts)	Hallma (Ex)	133.7	135.0	175.3	213.5	164.4
	Melesia(Ex)	140.9	150.2	172.8	192.6	164.1
	Siriver (Ex)	141.0	170.2	226.3	258.5	199.0
	Sewa (L)	210.9	229.4	308.6	376.7	281.4
	Ismailia-1(L)	224.0	247.2	349.4	370.7	297.8
	Mean	170.1	186.4	246.5	282.4	221.3
	LSD 0.05:	T = 2.7, C = 3.8 and T x C = 7.6				

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

The obtained number of shoots/m^2 for the cultivars under study could be ranked in the following descending order : Ismailia-1, Sewa, Siriver, Hallma and Melesia with a respective number of shoot/m of 305.4, 278.3, 206.0, 185.9 and 175.2 in the first year ; being 310.9, 270.1, 211.3, 183.2 and 175.1 in the second year ; and 297.81, 281.40, 198.98, 164.36 and 164.12 in the third year.

It is also obviously clear that each of the other 3 exotic alfalfa cultivars (Siriver, Melesia and Hallma) were inferior in number of shoots/m^2 compared with the local alfalfa cultivars (Ismalia-1 and Sewa) with significant differences during each of the 3 years of the stand duration.

Results in Table (12, A 15, 16, 17) also clarified significant differences among the 3 exotic alfalfa cultivars during each year as it clear from the following comparative set of data :-

Cultivars	1st year	2nd year	3rd year
Siriver	206.0	211.3	198.98
Melesia	185.9	183.2	164.36
Hallma	175.2	175.1	164.12
LSD at 5%	0.78	5.6	3.8

This comparative set of data showed the behaviors of the grown exotic cultivar during 3 year, where Siriver the exotic cultivar was the highest in number of shoots/m^2, then Hallma followed by Melesia with significant variable magnitudes. Similar results concerning the variation in number of shoots/m^2 for the different alfalfa cultivars were previously reported by **Moursi et al. (1977), Ghobrial (1978), Mousa (1982), Rammah et al. (1988), Geweifel (1997) and Nasr (1998).**

Results show that the application NPK fertilizer levels enhanced the growth of alfalfa plants significantly as compared with the control treatment during each of the three years of the stand duration. Data of the yearly number of shoots/m^2 during the stand duration as affected by the applied fertilization treatments are presented in Table (12, A 15, 16, 17).

Also, results indicated that over the grown alfalfa cultivars, alfalfa plants significantly responded to the highest level of (T4) to this studied trail. There was greater response of such treatment in the first year compared with the second and the third year. It is obviously clear from the obtained data that the highest rate of NPK application produced the highest number of shoots/m^2 which was 303.8 over 10 cuts, 300.3 over 11 cuts and 282.38 over 11 cuts for the first, second and third years, corresponding with their control of 164.0 over 10 cuts, 162.5 over 11 cuts and 170.1 over 11 cuts.

During the first year, the highest number of shoots/m^2 was 303.89, 251.6, 201.1 and 164.0 for the highest (T4), medium (T3) and lowest (T2) fertilizer treatment and control (T1), respectability.

It is well noticed that the high, medium and low fertilizer treatments caused substantial increase in number of shoots/m^2 of alfalfa plants compared to their relevant control by 85, 53 and 23% in the first year, being 85, 55 and 26% in the second year and 66, 45 and 10% in the third year.

Results in Table (12, A 15, 16, 17) show significant interaction effect between the grown alfalfa cultivars and the received fertilization treatments on number of shoots/m^2. this result was noticed in each of the 3 year of the stand duration.

Such interaction generally showed that number of shoots/m^2 increased as the fertilization treatments increased.

Meanwhile, the grown cultivar showed similar descending ranking order in the number of shoots/m^2 of alfalfa plants as follows: Ismailia-1, Sewa, Siriver, Hallma and Melesia. This trend was noticed for each of the individual year with different significant magnitudes (Table 12, A 15, 16, 17).

So, it could be concluded that the two local alfalfa cultivars (Ismailia-1 and Sewa) significantly produced the highest number of shoots/m^2 at the highest level of the applied fertilization treatment, being higher for Ismailia-1 than Sewa cultivar.

Similar trend was noticed for the exotic alfalfa cultivars being highest for Siriver than Hallma followed by Melesia. Meanwhile the highest value of shoot/m^2 was obtained for Ismailia-1 that was fertilized by the highest fertilization level with significant interaction effect. Whereas, Melesia the exotic alfalfa cultivar produced the lowest value of shoots/m^2 even at the same applied highest fertilization treatment.

Also, it is well noticed that the lowest number of shoots/m^2 was produced for each of the three exotic alfalfa cultivars when they were unfertilized (control) with significant difference than the other alfalfa cultivars receiving similar fertilization treatments.

Seasonal variation number of shoots/m^2 (combined over 3-year):-

Data presented in Table (13, A15, 16, 17) show the seasonal number of shoot/m^2 of different alfalfa cultivars as affected by various fertilization treatments.

It is clear that (over the applied fertilization treatments cultivars), the highest seasonal number of shoot/m during the stand duration indicated the superiority of winter season (237.9 out of 5 cuts); being slightly decreased during spring season (235.9 out of 9 cuts); followed by autumn (233.65 out of 9 cuts); then summer season (201.36 out of 9 cuts). This clarify the importance of the environmental effect on the number of shoots/m^2 through carbohydrates and other metabolites accumulation during the seasonal variation of the whole stand duration (3 years). These results are in agreement with those of **Abd El-Halim et al.(1992) and Oushy et al. (1999b).**

Data presented in Table (13, A 15, 16, 17) show the effect of various alfalfa cultivars (over the applied fertilization treatments) on the number of shoot/m^2 among

Table (13): Seasonal number of shoots/m^2 of several alfalfa cultivars as affected by various levels of NPK (combined over 3 years).

Cultivar(C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter seasons					Spring seasons				
	....................(no/m^2)...................									
Hallma(Ex)	147.0	165.5	205.2	241.5	189.8	143.5	158.6	198.7	246.1	186.7
Melesia(Ex)	128.8	158.8	186.0	230.0	175.9	136.3	159.0	19.30	234.1	180.6
Siriver (Ex)	144.1	192.0	237.0	291.5	216.1	139.5	189.2	238.4	289.1	214.0
Sewa (L)	216.4	246.9	310.3	387.8	290.3	207.5	246.4	313.3	376.4	285.9
Ismailia1(L)	235.3	273.9	350.9	408.7	317.2	228.8	273.0	347.9	399.8	312.4
Mean	174.3	207.4	257.9	311.9	237.9	171.1	205.2	258.3	309.1	235.9
LSD 0.05:										
	Summer seasons					Autumn seasons				
Hallma (Ex)	117.86	131.89	183.69	203.0	159.11	133.33	139.03	194.69	235.64	175.67
Melesia(Ex)	120.28	142.94	168.33	188.06	154.90	137.56	151.89	192.31	216.14	174.47
Siriver (Ex)	125.63	173.86	189.92	231.89	180.32	141.47	185.03	229.11	289.25	211.22
Sewa (L)	176.50	214.17	267.17	304.33	240.54	211.94	237.47	315.81	393.06	289.57
Ismailia-(L)	192.44	243.31	312.94	339.06	271.94	226.56	268.86	369.28	404.64	317.33
Mean	146.54	181.23	224.41	253.27	201.36	170.17	196.46	260.24	307.74	233.65
LSD 0.05:	T = 5.8, C = 7.1 and T x C = 14.2					T = 3.0, C = 3.1 and T x C = 6.1				

T1= contr ol, T2 (low)= $N_{10} P_{10} K_{10}$, T3 (medium)= $N_{20} P_{20} K_{20}$, T4 (high)= $N_{30} P_{30} K_{40}$

the four studied growing seasons of the stand duration (3 years).

The local alfalfa cultivar Ismailia-1 produced -the highest number of shoots/m^2 317.2 out of 5 cuts; 312.4 out of 9 cuts; 271.94 out of 9 cuts; and 317.33 out of 9 cuts during winter, spring, summer and autumn seasons, respectively. Whereas, the exotic alfalfa cultivar Melesia produced the lowest

number of shoots/m^2 which was 175.9, 180.6, 154.9 and 174.47 during the corresponding seasons.

The seasonal differences among the other four cultivar (Sewa, Siriver, Melesia and Hållma) were significant. But, the local cultivar Ismailia-1 proved to produce the highest number of shoots/m^2 with highly significant differences as compared with the other tested four alfalfa cultivars. These results were true over the various fertilization treatments and different growing seasons.

Over the grown alfalfa cultivars, the highest combined fertilization treatment (T4) significantly enhanced the growth rate of alfalfa plants which in turn produced the highest number of shoot/m^2 which was 31 1.9 out of 5 cuts;

309.1 out of 9 cuts; 253.27 out of 9 cuts; and 307.74 out of 9 cuts for the subsequent winter, spring, summer and autumn seasons compared with their relevant control which produced 174.3, 171.1, 146.54 and 170.17 shoot/m^2 for the respective corresponding seasons.

It is generally noticed that winter season was superior in number of shoots/m^2 among the other seasons which produced (237.9 shoot/m^2). Using high, medium and low fertilization treatments caused an increase in number of shoots/m^2 as compared with their relevant control treatments by 44, 32 and 1 6%, respectively.

Significant interaction effect of the tested alfalfa cultivars and the applied fertilization treatments on the produced number of shoots/m is noticed in Table (13, A 15, 16,17). This effect indicates that number of shoots/m^2 increased as the fertilization levels increased.

However, such differences in increasing number of shoots/m^2 were magnified as the fertilization level increased from low (T2) to medium (T3) and up to the highest (T4) level. This result was true for all of the grown alfalfa cultivars with significantly higher magnitudes for the local than the exotic alfalfa cultivars and the applied fertilization levels in relative different response to number of shoots/m^2 under the prevailing environmental conditions.

It is generally concluded that the lowest number of shoots/m^2 was noticed for the grown exotic cultivars at any of the applied NPK fertilization levels. Whereas, the highest number of shoots/m^2 was produced from the grown local cultivars.

Yearly dry shoot/root ratio :-

Results in Table (14, A 18, 19, 20) show plant's dry shoot/ratio of alfalfa cultivars for each of the 3 respective individual year, over the applied fertilization treatments. It was 86.32% on the average out of 10 cuts during the first established year; being 49.06% out of 11 cuts during the 2nd year; and 54.53% out of 11 cuts in the third year. The highest shoot/root ratio of alfalfa plants (over the obtained cuts and fertilization treatments) was noticed during the first year of establishment (74.67%) then decreased during the second year (50.20%).

Over the applied fertilization treatments, results in Table (14, A 18, 19, 20) indicate that the grown alfalfa cultivars showed non significant differences in their dry

Table (14): Yearly shoot / root ratio of several alfalfa cultivars as affected by various levels of NPK.

	Cultivar (c)	Fertilization treatment				
		T1	T2	T3	T4	Mean
		(%)				
1st year establishment (10 cuts)	Hallma(Ex)	66.26	99.71	79.96	73.31	79.81
	Melesia(Ex)	88.93	99.43	80.04	76.37	86.19
	Siriver(Ex)	103.87	102.86	82.14	56.77	86.41
	Sewa (L)	111.51	104.80	81.35	53.61	87.82
	Ismailia1(L)	126.39	114.43	72.48	52.16	91.37
	Mean	99.39	104.25	79.19	62.44	86.32
	LSD 0.05:	T = 10.1, C = n.s and TxC = 17.6				
2nd year (11cuts)	Hallma(Ex)	45.28	56.06	50.03	43.81	48.79
	Melesia(Ex)	44.54	51.71	45.90	45.71	46.96
	Siriver(Ex)	52.23	58.70	41.02	42.68	48.66
	Sewa (L)	53.44	59.36	44.79	44.34	50.46
	Ismailia1(L)	58.63	56.55	41.31	45.21	50.43
	Mean	50.82	56.47	44.61	44.33	49.06
	LSD 0.05:	T = 3.1, C = 2.4 and TxC = 4.9				
3rd year (11 cuts)	Hallma(Ex)	51.69	59.65	52.27	48.07	52.92
	Melesia(Ex)	53.01	58.79	50.84	51.22	53.46
	Siriver(Ex)	58.09	63.59	50.39	50.93	55.75
	Sewa (L)	59.12	61.81	49.13	50.38	55.11
	Ismailia1(L)	62.82	58.87	48.25	51.76	55.43
	Mean	56.95	60.54	50.18	50.47	54.53
	LSD: 0.05	T = 2.3 , C = 2.1 and TxC = 4.3				

T1= control, T2 (low)=N_{10} P_{10} K_{10}. T3 (medium)= N_{20} P_{20} K_{20} and T4 (high)= N_{30} P_{30} K_{40} kg/ fed.

shoot/root ratio during the 1st year but its showed significant differences at the 2nd and 3rd years with different magnitudes. The two local cultivars Ismailia-1 and Sewa produced highest dry shoot/root ratios at all years of the stand duration, followed by the exotic cultivar Siriver. Significant differences in this trait were noticed among the 3 exotic alfalfa cultivars during the 2nd and 3rd years of the stand duration as it clear from the comparative set of data derived from Table (14, A 18, 19, 20):

Cultivars	1st year	2nd year	3rd year
Siriver	86.41	48.66	55.75
Melesia	86.19	46.96	53.46
Hallma	79.81	48.79	52.92
LSD at 5%	n.s	2.4	2.1

Such comparative set of data clarified the specific behavior of the three grown exotic alfalfa cultivars during the 3 years of the stand duration. Siriver the exotic cultivar was of the highest dry shoot/root ratio than Melesia followed by Hallma with significant variable magnitudes during the 2nd and 3rd years.

It could be generally concluded that the highest dry shoot/root ratio of the grown alfalfa cultivars were obtained for the tow local cultivars Ismailia-1 and Sewa during the first year with significant difference. This trend was noticed in each of the 2nd and 3rd years with slight different significant magnitudes over all the applied fertilization treatments.

The obtained differences in dry shoot/root ratio of the different alfalfa cultivars could be due to their unique genetical make-up which interacted differently with the prevailing environmental condition in exerting their effect on this studied trait as a foliage productivity features. Similar results concerning the productivity of the different alfalfa cultivars were previously reported by **Moursi et al. (1977), Ghobrial (1978), Mousa (1982), Rammah et al. (1988), Geweifel (1997) and Nasr (1998).**

Data of the yearly dry shoot/root ratio during the stand duration as affected by the applied treatments are presented in Table (14, A 18, 19, 20). Results show that the application NPK fertilizer treatments enhanced the growth of alfalfa plants significantly as compared with their control during each of the three growing years.

Over the grown alfalfa cultivars, as the applied fertilization levels treatments increased, there was significant decrease in dry shoot/root ratio alfalfa plants compared to the control (without fertilization) with various magnitudes during each of the 3 years of the stand duration. This result could be due to the increase in moisture content of the proliferated increase in fresh forage production as compared with the control.

Results indicate that over the grown alfalfa cultivars, alfalfa dry shoot/root ratio significantly responded to lowest level of T2 fertilization treatment. There was greater response to such lowest fertilization treatment in the first (104.25%), second (56.47%) and the third year (6.54%) compared with their relevant control of 99.39, 50.82, 56.95% during the respective three years.

The obtained decrease in dry shoot/root ratio when comparing between applying the highest fertilization treatment (T4) and the control (T1) was about 37% for the 1st year, 12% in the 2nd year and 13% in the 3rd year of the stand duration. Whereas, the corresponding decreases were 41, 21 and 17% when using the lowest fertilization treatment (T2).

However, when comparing the effect of the applied medium rate (T3) with the lowest fertilization treatment

(T1) in decreasing dry shoot/root, it was 24, 21 and 17% during the respective 3year of the stand duration, being 21, 0.6 and -1% when comparing between the highest (T4) and medium (T3) fertilization treatments.

Results in Table (14, A 18, 19, 20) indicate significant interaction effect for the applied fertilization treatments and the grown alfalfa cultivars on their yearly dry shoot/root ratio.

For either the local or the exotic alfalfa cultivars, decreasing the applied fertilization treatments caused substantial decrease in dry shoot/root ratio. However, such differences in decreasing dry shoot/root ratio were magnified as the fertilization level increased from the low (T2) to medium (T3) and up to the highest (T4) level. This result was true for all of the grown alfalfa cultivars with significantly lower magnitudes for the local than the exotic alfalfa cultivars of the medium and high fertilization treatment.

Evenmore, the local Ismailia-1 cultivar was relatively higher in dry shoot/root ratio as compared with the local Sewa alfalfa cultivar.

It could be generally concluded that the lowest dry shoot/root ratio was produced by the studied local cultivars using the highest fertilization treatments (T4) with relatively more production for the exotic cultivars. It is also clear that the highest response of the grown alfalfa cultivars to decreasing the applied fertilization levels in respect to dry shoot/root was more pronounced in the first growing year rather than the second or the third year of the stand duration.

The above presented results were more or less in a similar trend during each of the three individual years of the stand duration with relatively slight different magnitudes.

It should be also clear that such presented interaction effect of the applied fertilization treatments and the grown cultivars on decreasing the dry shoot/root ratio of alfalfa cultivars is reasonably accepted. This is due to the variations of the genetically makeup formation of the grown cultivars and their interaction with the applied fertilization treatments in relative different response of growth and produced of the dry shoot/root ratio of alfalfa as an indicator for productivity and quality under the prevailing environmental conditions.

Seasonal dry shoot/root ratio:

Data presented in Table (15, A 18, 19, 20) show the seasonal shoot/root ratio of different alfalfa cultivars as affected by various fertilization treatments. Seasonal shoots/root ratio were estimated from cut 2 during winter, spring, summer and autumn seasons.

It is clear that over the applied fertilization treatments, the highest seasonal shoot/root ratio during the stand duration indicated the superiority of summer seasons (98.68%); being slightly decreased during autumn seasons (64.27%); followed by spring (45.85%); then winter seasons (45.46%).

Differences among the seasonal effect on shoot/root ratio were significant. This clarify the importance of the environmental effect on shoot/root ratio as an important indicator of the vegetative growth and forage productivity. These results are in agreement with those obtained by **Abd El-Halim et al. (1992) and Oushy et al. (1999a).**

Data in Table (15, A 18, 19, 20) present shoot/root ratio of alfalfa as affect by the seasonal variations. Data show that the performance of alfalfa cultivars over all the applied fertilization treatments were significantly different

Table (15): Seasonal shoot/root ratio of several alfalfa cultivars as affected by various levels of NPK (combined over 3 years).

Cultivar(C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter seasons					Spring seasons				
	...(%)...									
Hallma(Ex)	52.43	53.63	43.49	36.36	44.29	52.96	56.43	42.07	30.58	45.76
Melesia(Ex)	51.17	53.81	38.16	38.45	45.28	67.17	60.55	36.22	32.72	49.17
Siriver (Ex)	56.28	49.80	38.03	39.36	46.48	63.33	55.90	36.79	31.15	46.79
Sewa (L)	52.59	37.98	39.90	38.45	45.40	56.33	55.94	34.71	31.60	44.64
Ismailia1(L)	52.52	38.73	41.56	39.36	45.87	61.31	46.43	32.98	30.76	42.87
Mean	50.98	52.47	39.28	39.13	45.46	60.22	55.25	36.55	31.36	45.85
LSD 0.05:	T = 2.6, C = n.s and T x C = 5.5					T = 4.7, C = 3.0 and T x C = 6.1				
	Summer seasons					Autumn seasons				
Hallma (Ex)	73.43	116.34	91.19	73.95	88.73	71.79	75.81	60.86	44.56	63.25
Melesia(Ex)	85.38	108.70	90.29	76.48	90.22	70.47	80.30	58.13	47.76	64.16
Siriver (Ex)	116.36	127.67	86.21	58.98	97.31	64.91	74.00	63.00	53.48	63.85
Sewa (L)	130.44	131.39	86.18	61.00	10.25	74.64	66.58	60.15	60.81	65.55
Ismailia1(L)	153.59	145.75	79.81	59.60	109.69	65.22	69.12	64.48	59.30	64.53
Mean	111.84	125.97	86.74	66.00	98.68	69.41	73.16	61.33	53.18	64.27
LSD 0.05:	T = 12.2, C = 9.8 and T x C = 19.6					T = 5.4, C = 4.6 and T x C = 9.3				

T1= control, T2 (low)= $N_{10} P_{10} K_{10}$, T3 (medium)= $N_{20} P_{20} K_{20}$, T4 (high)= $N_{30} P_{30} K_{40}$

among the four seasonal durations (combined over 3-year).Significant differences were detected between alfalfa cultivars over the growing seasons of the whole stand duration (3-year).

Among the local alfalfa cultivars, Ismailia-1 produced the highest shoot/root ratio of plants which was 109.69% during summer seasons. Whereas, the exotic cultivar Hallma produced the lowest value which was 88.73% in the same season.

Meanwhile, among the two local cultivars, Ismailia-1 was of significant higher shoot/root ratio as compared with Sewa. This result was noticed over the growing seasons of the whole stand duration with slight different magnitudes.

The differences on shoot/root ratio between the local alfalfa cultivars during the various season, could be due to interaction between each of their genetic makeup with the prevailing environmental seasonal variations.

Results also show that differences in shoot/root ratio between the 3 exotic cultivars (Siriver, Melesia and Hallma) were significant. But concerning the exotic cultivars, Siriver produced the highest ratio with highly significant differences as compared with the other two exotic cultivars during winter and summer seasons. Such results were true over the applied fertilization treatments and the different growing seasons. Similar results were reported by **Moursi et al. (1977), Ghobrial (1978), Mousa (1982), Rammah et al. (1988), Geweifel (1997) and Nasr (1998).**

Data presented in Table (15, A 18, 19, 20) indicate that there were significant differences in shoot/root ratio among the studied alfalfa cultivars due to the applied fertilization treatments which were positively affected by the seasonal variations during the stand duration compared to their relevant control (T1) with different magnitudes. Similar trend was found within the four growing seasons of the stand duration (3-year).

Seasonal shoot/root ratio under each fertilization treatment was higher in summer season followed by autumn then spring followed by winter season where the lowest values were recorded. These results are in agreement with those of **Abd-El-Halim et al. (1992) and Oushy et al. (1999a).** The lowest shoot/root ratio during winter seasons could be due to the lowest prevailing temperature which in turn induce sort of dormancy- like effect on the vegetative growth.

Over the grown alfalfa cultivars, the lowest fertilization treatment (T2) significantly enhanced the growth rate of alfalfa plants which was reflected on shoot/root ratio alfalfa plants which were 52.47%; 55.25%; 125.97%; and 61.33% during the subsequent winter, spring, summer and autumn seasons of the 3 years of the stand duration compared with their relevant control (T1) which produced shoot/root ratio of 50.98, 60.22, 111.84 and 53.18% for the respective corresponding seasons.

It is generally noticed that summer season was superior among the other 3 growing seasons of the stand duration in respect of shoot/root ratio. In this particular season, using high (T4), medium (T3) and low (T2) fertilization treatments caused substantial significant decrease in shoot/root ratio.

Such decreases in alfalfa plants shoot/root ratio as indicator of the vegetative growth due to the applied fertilization treatments were significant with variable magnitudes within each of the four seasons during of the stand duration.

The interaction effect between alfalfa cultivars and applied fertilization treatments on the shoot/root ratio was significant (Table 15, A 18, 19, 20) such significant effect showed that shoot/ root ratio of alfalfa plants decreased as the applied fertilization levels increased. So, the average shoot/root ratio of alfalfa plants was obtained for Ismailia-1 (L) cultivar which was fertilized by the lowest fertilization treatments (T2). Whereas, the lowest shoot/root ratio was produced by Hallma cultivar receiving the lowest fertilization treatment (T2). This result was true during the different seasons of the stand duration.

Chemical composition:

Chemical analysis was conducted for the second cuts of each of the 4 seasons during each of the 3 years of the stand duration. Mean-seasonal contents of the analyzed chemical components of the obtained forage materials was determined and presented over the 3 years of stand duration. The analysis was done for the grown alfalfa cultivar (on dry matter basis) as affected by the applied fertilization treatments.

This was done for the sake of obtaining accurate results through standardizing the sequence of the obtained cuts during each season and representing the average real status of the cuts for each season as well as minimize the enormous number of samples for cuts of the grown alfalfa cultivars during the 4 seasons for each of the three years of stand duration.

Results for the chemical components of alfalfa cultivars as affected by the applied fertilization treatments are presented in Table (16 and 17) and will be discussed in the following chronological order according to its importance:-

1-crude protein content (CP):

It is well noticed that CP content of the grown alfalfa cultivar varied due to season, cultivar and the applied fertilization treatment through the 3 years of the stand duration (Tables 16 and 17). The following comparative set of data summarize the seasonal variations in CP content of alfalfa forage (over the grown cultivars during 3 years of stand duration) as affected by the applied fertilization treatments:

Fertilization Treatments	winter	Spring	Summer	Autumn	Mean
	......................Seasons......				
	......................CP%......				
Control	22.9	20.3	17.0	17.4	19.4
Low	24.8	21.9	17.9	18.6	20.8
Medium	25.7	22.9	18.6	19.6	21.7
High	27.1	23.9	19.2	20.8	22.8
Mean	25.1	22.3	18.2	19.1	21.2
Min.	22.9	20.3	17.0	17.4	19.4
Max.	27.7	23.9	19.2	20.8	22.8
Range	4.8	3.6	2.2	3.4	3.4

Results clarify that the highest crude protein content of alfalfa forage was during winter (25.1%), then spring (22.3%) season with 11% lower in spring than in winter season. Meanwhile summer season produced alfalfa plants of the lowest CP content (18.2%) which slightly increased in autumn (19.2%). These results were obtained over the fertilization treatments and the grown alfalfa cultivars.

It is generally concluded that over the grown cultivars and the applied fertilization treatments, alfalfa forage

Table (16): Seasonal variation in nutrient contents (on dry matter basic) of the grown alfalfa cultivars as affected by the applied fertilizer levels.

Season / Cultivar	Winter						Spring					
	CP	NFE	CF	Ash	Oil	TDN	CP	NFE	CF	Ash	Oil	TDN
Control	%											
Hallma	23.5	42.05	21.5	11.17	1.78	66.9	19.8	42.1	25.3	11.0	1.80	62.9
Melesia	24.3	42.05	20.7	11.05	1.90	67.8	20.3	42.5	24.4	11.1	1.70	63.8
Siriver	23.3	42.30	22.0	10.92	1.48	66.5	21.2	43.2	23.0	11.0	1.65	65.1
Sewa	21.0	43.24	23.1	10.93	1.73	64.9	19.6	42.2	26.0	10.6	1.62	62.3
Ismailia-1	22.3	42.81	22.1	10.96	1.83	66.1	20.5	46.0	21.1	10.9	1.50	66.2
Mean	**22.9**	**42.49**	**21.9**	**11.01**	**1.75**	**66.5**	**20.3**	**43.18**	**24.0**	**10.9**	**1.65**	**64.0**
Low												
Hallma	25.1	40.85	20.4	11.62	2.03	68.3	21.5	43.4	22.0	11.2	1.87	65.9
Melesia	25.2	41.95	19.5	11.40	1.95	69.0	22.1	43.7	20.8	11.6	1.83	67.0
Siriver	25.2	40.40	21.2	11.27	1.93	67.8	23.0	42.0	21.8	11.2	1.95	66.6
Sewa	23.8	42.15	21.0	11.18	1.87	67.4	21.4	42.1	23.7	11.0	1.78	64.6
Ismailia-1	24.8	40.57	21.4	11.33	1.90	67.5	21.6	42.7	22.7	11.2	1.80	65.4
Mean	**24.8**	**41.18**	**20.8**	**11.36**	**1.99**	**68.0**	**21.9**	**42.8**	**22.2**	**11.3**	**1.85**	**65.9**
Medium												
Hallma	25.8	41.01	19.0	12.12	2.07	69.6	22.8	43.8	19.8	11.7	1.97	68.0
Melesia	26.0	41.55	18.5	11.82	2.13	70.1	23.1	44.8	18.2	11.8	2.12	69.3
Siriver	25.8	40.97	19.5	11.73	2.00	69.2	23.5	42.5	20.6	11.5	2.00	67.6
Sewa	25.2	41.05	20.5	11.30	1.95	68.3	22.3	45.0	22.7	8.22	1.83	65.7
Ismailia-1	25.5	41.05	19.9	11.57	1.98	68.8	22.9	41.6	22.0	11.5	2.10	66.4
Mean	**25.7**	**41.13**	**19.5**	**11.71**	**2.03**	**69.2**	**22.9**	**43.5**	**20.7**	**10.9**	**1.99**	**67.4**
High												
Hallma	27.8	39.82	17.4	12.80	2.18	71.5	23.6	42.3	20.1	11.9	2.13	68.0
Melesia	28.2	40.25	16.8	12.35	2.43	72.1	24.0	41.5	19.9	12.2	2.38	68.3
Siriver	27.5	39.96	18.2	12.12	2.22	70.8	24.8	44.2	17.0	11.8	2.18	70.7
Sewa	25.9	41.05	19.3	11.58	2.17	69.4	23.1	42.0	21.3	11.5	2.07	67.0
Ismailia-1	25.9	41.66	18.5	11.82	2.12	70.0	23.9	44.0	18.4	11.6	2.17	69.4
Mean	**27.1**	**40.55**	**18.04**	**12.13**	**2.22**	**70.7**	**23.9**	**42.8**	**19.3**	**11.8**	**2.19**	**68.7**
G Mean												
Hallma	25.6	40.90	19.6	11.9	2.00	69.1	21.9	42.9	21.8	11.4	1.94	66.2
Melesia	25.9	41.50	18.9	11.7	2.10	69.8	22.4	43.1	20.8	11.7	2.01	67.1
Siriver	25.5	40.90	20.2	11.5	1.90	68.6	23.1	43.0	20.6	11.4	1.95	67.5
Sewa	24.0	41.90	21.0	11.2	1.90	67.5	21.6	43.6	23.4	10.3	1.83	64.9
Ismailia-1	24.6	41.50	20.5	11.4	2.00	68.1	22.2	43.6	21.1	11.3	1.89	66.9
Mean	**25.1**	**41.34**	**20.0**	**11.5**	**1.98**	**68.6**	**22.2**	**43.2**	**21.5**	**11.4**	**1.92**	**66.5**

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

Table (17): Seasonal variation in nutrient contents (on dry matter basic) of the grown alfalfa cultivars as affected by the applied fertilizer levels.

Season / Cultivar	Summer						Autumn					
	CP	NFE	CF	Ash	Oil	TDN	CP	NFE	CF	Ash	Oil	TDN
Control	%											
Hallma	16.6	47.2	26.4	8.58	1.20	60.9	18.1	48.2	22.6	9.97	1.15	64.3
Melesia	16.1	46.2	28.1	8.30	1.32	59.6	18.1	48.7	21.4	10.5	1.28	65.1
Siriver	16.9	47.4	26.1	8.33	1.23	61.3	18.0	47.0	23.8	10.1	1.15	63.4
Sewa	17.5	45.6	27.0	8.72	1.15	6.9	16.2	46.5	26.6	9.87	0.87	60.7
Ismailia-1	17.7	47.4	24.8	8.90	1.18	62.5	16.4	48.8	25.6	10.2	0.97	61.5
Mean	**17.0**	**46.8**	**26.5**	**8.57**	**1.22**	**61.0**	**17.4**	**47.4**	**24.0**	**10.1**	**1.08**	**63.0**
Low												
Hallma	17.4	47.8	24.7	8.83	1.32	62.5	18.8	48.8	20.7	10.5	1.25	65.9
Melesia	17.2	46.5	26.2	8.73	1.35	61.3	19.1	48.0	20.6	11.0	1.33	66.1
Siriver	17.7	47.6	24.4	8.98	1.32	62.8	18.8	48.0	21.4	10.7	1.12	65.4
Sewa	18.1	46.3	25.3	9.00	1.27	62.3	17.9	47.3	23.3	10.3	1.23	63.7
Ismailia-1	19.0	47.2	23.1	9.28	1.47	64.2	18.3	46.4	23.0	10.8	1.47	64.1
Mean	**17.9**	**47.1**	**24.7**	**8.96**	**1.35**	**62.6**	**18.6**	**48.1**	**21.8**	**10.7**	**1.28**	**65.0**
Medium												
Hallma	18.6	48.1	22.6	9.32	1.42	64.3	20.0	48.4	19.3	10.9	1.38	67.4
Melesia	18.0	45.8	25.3	9.27	1.68	62.2	19.8	49.8	17.4	11.4	1.62	68.7
Siriver	18.6	48.6	22.3	9.02	1.45	64.6	20.2	47.4	20.1	10.8	1.50	66.8
Sewa	18.9	46.0	24.3	9.43	1.38	63.3	18.9	47.0	21.9	11.0	1.23	65.1
Ismailia-1	19.5	49.2	20.2	9.68	1.40	66.5	19.2	46.9	21.5	11.0	1.37	66.5
Mean	**18.6**	**47.6**	**23.0**	**9.34**	**1.47**	**64.2**	**19.6**	**47.9**	**20.0**	**11.0**	**1.42**	**66.7**
High												
Hallma	18.5	51.1	19.1	9.67	1.60	67.0	19.6	47.9	19.5	11.4	1.60	67.1
Melesia	18.6	47.3	22.8	9.53	1.82	64.3	21.6	50.8	15.7	11.9	1.73	70.5
Siriver	19.1	49.4	20.5	9.50	1.53	66.2	20.4	47.7	19.2	11.1	1.57	67.5
Sewa	19.5	48.1	21.1	9.80	1.53	65.9	21.4	47.2	18.6	11.5	1.33	68.4
Ismailia-1	20.1	51.5	16.7	10.1	1.52	69.3	21.1	48.1	17.9	11.4	1.55	68.8
Mean	**19.2**	**49.5**	**20.0**	**9.73**	**1.60**	**66.5**	**2.8**	**48.3**	**18.2**	**11.5**	**1.56**	**68.5**
G Mean												
Hallma	17.8	48.5	23.2	9.10	1.40	63.7	19.1	48.4	20.5	10.7	1.35	66.2
Melesia	17.5	46.4	25.6	8.96	1.50	61.9	19.7	49.3	18.8	12.2	1.49	67.6
Siriver	18.1	48.3	23.3	8.96	1.40	63.7	19.4	47.5	21.1	10.7	1.34	65.8
Sewa	18.5	46.5	24.4	9.24	1.30	63.1	18.6	47.0	22.6	10.7	1.16	64.5
Ismailia-1	19.1	48.8	21.2	9.50	1.40	65.6	18.8	47.6	22.0	10.9	1.34	65.2
Mean	**18.2**	**47.8**	**23.5**	**9.15**	**1.40**	**63.6**	**19.1**	**48.3**	**21.0**	**10.8**	**1.34**	**65.9**

T1= control, T2 (low)= $N_{10} P_{10} K_{10}$, T3 (medium)= $N_{20} P_{20} K_{20}$, T4 (high)= $N_{30} P_{30} K_{40}$

showed the highest CP content in winter and spring as compared with autumn and summer. Also, there was slight decrease of CP content in spring than winter and in autumn than summer. So the lowest CP content of alfalfa forage was noticed in summer. It is also clear the range between the highest and the lowest CP content of alfalfa foliage was the largest in winter and slightly less in spring than autumn with minimum narrow range in summer seasons.

Such obtained results could be explained by the higher yield of more cuts and growth in summer than winter where most of metabolized energy expenditure used to be for growth rather than for CP accumulation. Whereas, in winter seasons, alfalfa plants used to be in semidormant conditions of slower growth and less number of cuts which reduce the expenditure energy of CP to be used in future summer growth.

Regarding the effect of the applied fertilization treatments on the CP content of the produced alfalfa, it obviously clear that as the applied fertilization treatments increased from low (T2) to medium (T3) and up to the highest level (T4), CP content substantially increased. The respective increase compared to the control was about 7.2%, 11.8% and 18%, respectively.

Such increase in CP content (on dry matter basis) of alfalfa forage is more likely due to the integrated role for each fertilizer component (N, P and K) and the level of the applied major nutrients on the phosiobiological processes of alfalfa plants. These processes are responsible for synthesis, accumulation and growth of the treated alfalfa forage plants. **Soegaard (1990) Burton and DeVane (1992) Stringer et al. (1996) Rubio et al.(1999).**

Results also show that each of the grown alfalfa cultivars have its owen identify in its CP content under the various growing seasons (over the applied fertilization treatments). During winter seasons, the exotic cultivars (Hallma, Melesia, and Siriver) contained almost similar CP content which are relatively higher than those of the two local Sewa and Ismailia-1 with slight higher CP for the later than the earlier cultivar. Meanwhile, the highest CP content among the grown alfalfa cultivars was Siriver in spring, Ismalia-1 in summer and Melesia in winter and autumn. Whereas, the lowest CP content was for Sewa in winter, spring and autumn ; Melesia in summer season.

It seems to be true that none of the tested alfalfa cultivars performed in the same manner within seasons in its crude protein percentage. These results indicate that genetic variability in crude protein content exists among the tested alfalfa cultivars. Such results are in agreement with those obtained **Paul et al (1970). Abd-El-Halim et al (1992) and Mousa et al (1996).**

2- Crude fiber content (CF):

It is well noticed that CF content of the grown alfalfa cultivar varied among seasons, cultivars and the applied fertilization treatments through the 3 years of the stand duration (Tables 16 and 17). The following comparative set of data summarize the seasonal variations in CF content (over the grown cultivars and 3 years of stand duration) as affected by the applied fertilization treatments:

Fertilization Treatments	Seasons: winter	Spring	Summer	Autumn	Mean
	CF%				
Control	21.9	24.0	26.5	24.0	24.1
Low	20.8	22.2	24.7	21.3	22.3
Medium	19.5	20.6	23.0	20.0	20.8
High	18.1	19.3	20.0	18.2	18.9
Mean	20.1	21.5	23.6	20.9	21.5
Min.	22.9	19.3	20.0	18.2	18.9
Max.	27.7	24.0	26.5	24.0	24.1
Range	4.8	4.7	6.5	5.8	5.2

Results clarify that the highest crude fiber content of alfalfa was during summer (23.6%) then spring (21.5%) season with 9 % lower in spring than during summer season. Meanwhile, autumn season produced alfalfa plant of the lowest CF content (20.9%) which very slightly decreased in winter (20.1%). These results were obtained over the applied fertilization treatments and the grown alfalfa cultivars.

It could be generally concluded that (over the grown cultivars and the applied fertilization treatments) alfalfa forage was of the lowest CF content in winter and autumn as compared with spring and summer. Also, there was slight increase in CF content in summer than spring and in autumn than winter. So, the lowest CF content of alfalfa forage was noticed during winter. It is also clear the range between the highest and the lowest CF content of alfalfa foliage was the highest during summer slightly less in autumn than spring and of minimum narrow range in winter season.

Such obtained results could be explained by the higher forage yield of more cuts and growth during summer than winter season where most of metabolized energy expenditure used to be oriented for growth and regrowth rather than for CF production and accumulation. Whereas, in winter seasons, alfalfa plants used to be in semidormant stage of slower growth and less number of cuts where no need fore more CF content to support the limited winter growth.

Regarding the effect of the applied fertilization treatments on the CF content of the produced alfalfa foliage (over cultivars and seasonal variations), it obviously clear that as the applied fertilization treatments decreased from low (T2) to medium (T3) and up to the highest level (T4). CF content substantially decreased. The respective decreased compared the control treatment (no fertilization applied) was about 7.5%, 13.7% and 21.6%, respectively.

Such decreased in CF content (on dry matter basis) of alfalfa forage is due to the integrated role for each component and level (N, P and K) of the applied major nutrients on the physiobiological processes of alfalfa plants. These processes are responsible for synthesis, accumulation and growth of the fertilization treated alfalfa forage.

Results also show that each of the grown alfalfa cultivars have its owen identity in its CF content under the various seasons over the applied fertilization treatments. During winter seasons, the exotic cultivars (Hallma, Melesia, and Siriver) contained almost similar CF content which are relatively lower than those of the two local Sewa and Ismailia-1 cultivars with slight higher CF for the later than the earlier cultivar.

Meanwhile, the lowest CF content among the grown alfalfa cultivars was Melesia in winter and autumn; and Siriver in spring and Ismailia-1 in winter. Whereas, the highest CF content was for Sewa in winter, spring and autumn; and Melesia in summer season.

It seems that none of the tested alfalfa cultivars performed in the same manner during each season in its crude fiber content. These results indicate that genetic variability in crude fiber percentage exists among the tested alfalfa cultivars (Tables 16 and 17). Results are in agreement what was recorded by with **Paul et al (1970). Abd-El-Halim et al (1992) and Mousa et al (1996).**

3- Ash content:

It is well noticed that ash content of the grown alfalfa cultivars varied among seasons, cultivars and the applied fertilization treatment through the 3 years of the stand duration (Tables 16 and 17). The following set of comparative data summarize the seasonal variations in ash content (over the grown cultivars and 3 years of stand duration) as affected by the applied fertilization treatments:

		Seasons				
		winter	Spring	Summer	Autumn	Mean
		Ash%				
Fertilization Treatments	Control	11.01	10.93	8.57	10.1	10.15
	Low	11.36	11.25	8.97	10.7	10.57
	Medium	11.71	11.52	9.34	11.0	10.89
	High	12.13	11.78	9.73	11.5	11.29
	Mean	11.6	11.37	9.15	10.8	10.72
	Min.	11.01	10.93	8.57	10.1	10.15
	Max.	12.13	11.78	9.73	11.5	11.29
	Range	1.12	0.85	1.16	1.4	1.14

Results indicate that highest ash content 4of alfalfa was obtained during winter (11.6%) then spring (11.37%) season with 2 % lower in spring than in winter season. Meanwhile, summer season produced alfalfa plants of the lowest ash content (9.15%) which very slightly decreased in autumn (10.8%). These results were obtained over the fertilization treatments and the grown alfalfa cultivars.

It is generally noticed that alfalfa forage was of the lowest ash content during summer and autumn as compared with winter and spring seasons. Also, there was slight increase of ash content in winter than spring and in autumn than summer. So the lowest ash content of alfalfa forage was noticed in summer. It is also clear the range between the highest and the lowest ash content of alfalfa foliage was higher in autumn slightly less in summer than winter and of minimum narrow range in spring season.

Such obtained results could be explained by the higher yield of more cuts and growth in summer than winter where most of metabolized energy used to be devoted for growth rather than for ash accumulation. Moreover, the lowest ash content in such large summer vegetative growth could be due to the extreme distribution and dilution of ash content within that high summer forage growth.

Regarding the effect of the applied fertilization treatments (over cultivars and seasonal variations) on the ash content of the produced alfalfa foliage, it obviously clear that as the applied fertilization treatments increased from low (T2) to medium (T3) and up to the highest level (T4), ash content substantially increased. Such respective increase in ash content compared the control was about 4.13%, 7.3% and 11.2%.

This obtained increase in ash content (on dry matter basis) of alfalfa forage is more likely due to the integrated potent role for each component (N, P and K) and level of such applied major nutrients on the absorption of the essential and functions physiological processes of alfalfa plants. These processes are responsible for enhancing the growth of the treated alfalfa forage plants.

Results also show that each of the grown alfalfa cultivars have its owen identity in its ash content during the various seasons over the applied fertilization treatments. During winter seasons, the exotic cultivars (Hallma, Melesia, and Siriver) contained almost similar ash content that is relatively higher than those of the two local ones Sewa and Ismailia-1 with slight lower ash for the later than the earlier cultivar.

Meanwhile, the lowest ash content among the grown alfalfa cultivars was for Sewa in winter and spring as well as Melesia and siriver in summer and Melesia in autumn. Whereas, the highest ash content was for Hallama cultivar in winter, Melesia in spring, and Ismailia-1 in summer and autumn season. It seems that none of the tested alfalfa cultivars performed in the same manner within each season in its ash content. These results indicate specific genetic variability in ash percentage content among the studied alfalfa cultivars (Tables 16 and 17). Results are in agreement with **Paul et al (1970). Abd-El-Halim et al (1992) and Mousa et al (1996).**

<u>4- Ether extract (EE) content:</u>

It is well noticed that oil content of the grown alfalfa cultivar varied among seasons, cultivars and the applied fertilization treatments through the 3 years of the stand duration (Tables 16 and 17). The following set of comparative data summarize the seasonal variations in EE content of alfalfa foliage (over the grown cultivars and fertilization treatments during 3 years of stand duration) as affected by the applied fertilization treatments:

Fertilization Treatments	...Seasons... winter	Spring	Summer	Autumn	Mean
	...EE%...				
Control	1.75	1.65	1.21	1.08	1.42
Low	1.99	1.85	1.34	1.28	1.62
Medium	2.03	1.99	1.47	1.42	1.73
High	2.22	2.19	1.60	1.56	1.89
Mean	2.0	1.92	1.40	1.34	1.67
Min.	1.75	1.65	1.21	1.08	1.42
Max.	2.22	2.19	1.60	1.56	1.89
Range	0.47	0.54	0.39	0.48	0.47

Results clarify that highest EE content of alfalfa was in winter (2.0%) then spring (1.92%) season with 4% lower in spring than in winter season. Meanwhile, autumn season produced alfalfa plants of the lowest EE content (1.34%) which slightly increased in summer (1.4%). These results were obtained over the seasonal variation and the grown alfalfa cultivars and fertilization treatments.

It is generally noticed that over the grown cultivars and the applied fertilization treatments, alfalfa forage was of the lowest EE content in summer and autumn as compared with winter and spring seasons. Also, there was slight increased of EE content in winter than spring and in summer than during autumn season. So, the lowest EE content of alfalfa forage was recorded in autumn. It is also clear that the range between the highest and lowest EE content of alfalfa forage was the larger in spring slightly less in autumn than winter and of minimum narrow range in summer season.

Such obtained results could be explained by the higher yield of more cuts and growth in summer than winter where most of metabolized materials used to be consumed in the largest summer growth and no much left to be stored in form of EE content which require high energy. Such energy used to be devoted for growth rather than for EE formation and accumulation.

Whereas, in winter seasons, alfalfa plants used to be in semidormant conditions of slower growth and less number of cuts which retain some of energy in form of EE accumulation.

Regarding the effect of the applied fertilization treatments (over cultivars and seasonal variations) on the EE content of the produced alfalfa foliage, it obviously clear that as the applied fertilization treatments increased from low (T2) to medium (T3) and up to the highest level (T4), EE content substantially increased. The respective increased compared the control was about 14%, 21.8% and 33%.

Such increase in EE content (on dry matter basis) of alfalfa forage is due to essential role of each nutrient component (N, P and K) of the applied major nutrients as well as their quantity and their integration on the major biological processes of growth on alfalfa plants. These physiological processes are responsible for synthesis, accumulation of the essential components required for growth and regrowth of the treated alfalfa forage.

Results also show that each of the grown alfalfa cultivars represent its owen behavior in its ash content during the various seasons over the applied fertilization treatments. During winter seasons, the cultivars Hallma, Melesia, and Ismalia-1 contained almost similar EE content as for the two cultivars Sewa and Siriver. Meanwhile, the lowest EE content among the grown alfalfa cultivars was Sewa and Siriver in winter, Sewa and Ismailia-1 in spring and Sewa during summer and autumns. Whereas, the highest EE content was for Melesia in winter, spring, summer and autumn season.

It looks to be true that the tested alfalfa cultivars did not perform a like within each season in their EE content. These results indicate specific variability in EE content which exists among each of the studied alfalfa cultivars (Tables 16 and 17). Results are in agreement with those obtained by **Paul et al. (1970). Abd-El-Halim et al. (1992) and Mousa et al. (1996).**

5- Nitrogen free extract (NFE) content:

It is well noticed that NFE content of the grown alfalfa cultivar varied with various seasons, cultivars and the applied fertilization treatments through the 3 years of the stand duration (Tables 16 and 17). The following comparative set of data identify the seasonal variations in nitrogen free extract (NFE) content (over the grown cultivars and fertilization treatments) during 3 years of stand duration as affected by the applied fertilization treatments:

		winter	Spring	Summer	Autumn	Mean
		...........Seasons...........				
		...........NFE%...........				
Fertilization Treatments	**Control**	42.49	43.18	46.78	47.42	44.97
	Low	41.18	42.78	47.07	47.68	44.66
	Medium	41.13	43.50	47.59	49.90	45.03
	High	40.55	42.81	49.47	48.33	45.29
	Mean	41.34	43.07	47.73	47.83	44.99
	Min.	40.55	42.78	46.78	47.42	44.66
	Max.	42.49	43.18	49.47	48.33	45.29
	Range	1.94	0.40	2.69	0.91	0.63

Results show that (over the grown cultivars and fertilization treatments) highest NFE content of alfalfa was recorded in autumn (47.83%) then summer (47.71%) season with only 0.2 % lower in summer than in autumn season. Meanwhile, winter season produced alfalfa plant of the lowest NFE content (41.44%) which very slightly increased spring (43.07%).

It is generally concluded that over the grown cultivars and the applied fertilization treatments, alfalfa forage was of the lowest NFE content in winter and spring as compared with summer and autumn. Also, there was slight increased of NFE content in autumn than summer and in spring than winter. So, the lowest NFE content of alfalfa forage was noticed in winter. It is also clear the range between the highest and the lowest NFE content of alfalfa foliage was the largest in summer than during winter and of minimum narrow range in spring season.

These obtained results could be explained by the higher yield of more cuts and growth in summer than winter where most of metabolized energy used to be devoted for growth and regrowth rather than for NFE accumulation. Whereas, in winter seasons, alfalfa plants used to be in semidormant conditions of minimum growth and long duration intervals of cuts this will decrease the synthesis and accumulation of NFE content of plants. In addition more NFE contents used to be consumed in respiration on the expense of the available NFE content in order this is to keep plants surviving and to resist cooling temperature during winter.

Regarding the effect of the applied fertilization treatments on the NFE content of the produced alfalfa, it obviously clear that as the applied fertilization treatments increased from low (T2) to medium (T3) and up to the highest level (T4) concomitant with substantially decrease in NFE content.

Such increased in nitrogen free extract (NFE) content (on dry matter basis) of alfalfa forage is due to the integrated role for each component (N, P and K) of the applied major nutrients on the physiological processes of alfalfa plants. These processes are responsible for synthesis, accumulation and growth of the treated alfalfa forage material.

Results also show that each of the grown alfalfa cultivars have its owen identify in its NFE content under the various seasons over the applied fertilization treatments. During winter seasons, the exotic cultivars Hallma, Melesia, and Siriver contained almost similar NFE content which is relatively lower than those of the two local ones Sewa and Ismailia-1 in winter season. The highest NFE content among the grown alfalfa cultivars was Melesia in winter, Ismalia-1 in spring and summer, Ismailia-1 and Melesia in autumn. Whereas, the lowest NFE content was for Hallma and Siriver in spring, Sewa in spring, Melesia in summer and autumn season.

It seems that none of the tested alfalfa cultivars performed in the same manner within each season in its NFE content. These results indicate that genetic variability in NFE content exists among the tested alfalfa cultivars (Tables 16 and 17). Results are in agreement with those of **Paul et al. (1970). Abd-El-Halim et al. (1992) and Mousa et al. (1996).**

6- Total digestible nutrients (TDN):

It is well noticed that the total digestible nutrient (TDN) content of the grown alfalfa cultivar varied among seasons, cultivars and the applied fertilization treatment through the 3 years of the stand duration (Tables 16 and 17) as it is clear from the following set of data that summarize the seasonal variations in total digestible nutrient (TDN) content of the obtained alfalfa foliage (over the grown cultivars and 3 years of stand duration) as affected by the applied fertilization treatments:

		......Seasons......				
		winter	Spring	Summer	Autumn	Mean
		......NFE%......				
Fertilization Treatments	Control	70.7	68.7	66.5	68.5	68.6
	Low	69.2	67.4	64.2	66.7	66.9
	Medium	68.0	65.9	62.6	65.0	65.4
	High	66.5	64.0	61.0	63.0	63.6
	Mean	68.6	66.5	63.58	65.8	66.1
	Min.	66.5	64.0	61.0	63.0	63.6
	Max.	70.7	68.7	66.5	68.5	68.6
	Range	4.2	4.7	5.5	5.5	4.97

Over the grown cultivars and fertilization treatments, results indicate that highest TDN content of alfalfa was obtained in winter (68.6%) then spring (66.5%) season with 3.2 % lower in spring than in winter. Meanwhile, summer season produced alfalfa plants of the lowest total digestible nutrient (TDN) (63.58%) which very slightly decreased in autumn (65.8%).

It is generally concluded that over the grown cultivars and the applied fertilization treatments, alfalfa forage was of the lowest TDN during summer and autumn as compared with winter and spring. Also, there was slight increased of TDN content in winter than spring and in autumn than summer. So, the lowest TDN content of alfalfa forage was noticed in summer. It is also clear the range between the highest and the lowest TDN content of alfalfa foliage was the larger in autumn and summer than spring and of minimum narrow range in winter season.

Regarding the effect of the applied fertilization treatments on the TDN content of the produced alfalfa, it obviously clear that as the applied fertilization treatments decreased from low (T2) to medium (T3) and up to the highest level (T4), TDN content substantially decreased. The respective decreased compared the control was about 2.6%, 4.7% and 7.2%.

Such decreased in TDN content (on dry matter basis) of alfalfa forage could be due to synthesis and formation of other components essential for plant growth and development rather than TDN sources and/or more of the metabplic products are strongly consumed for the stimulated' vegetative growth and regrowth as a final effect of the increase in fertilization treatments

Results also show that each of the grown alfalfa cultivars represented its owen behavior in its TDN content under the various seasons (over the applied fertilization treatments). During winter seasons, the exotic cultivars (Hallma, Melesia, and Siriver) contained almost similar TDN content which is relatively higher than those of the two local ones Sewa and Ismailia-1 with slight lower TDN for the later than the earlier cultivar. Meanwhile, the lowest TDN content among the grown alfalfa cultivars was for Sewa in winter and spring, Melesia in summer and Sewa in autumn. Whereas, the highest TDN content was for Melesia in winter and autumn; Siriver in spring and Ismailia-1 in summer season. These results indicate specific genetic variability in TDN percentage within the tested alfalfa cultivars (Tables 16 and 17). Results are in agreement with what was recorded by **Paul et al. (1970). Abd-El-Halim et al. (1992) and Mousa et al. (1996).**

Nitrogen uptake :-

Results in Table (18 and A, 21) represent the seasonal (combined over the two first years) N uptake for different alfalfa cultivars as affected by various combined fertilization treatments of N, P and K. Seasonal combined over the first two years was estimated for winter, spring, summer and autumn.

It is clear that over the applied fertilization treatments, the highest seasonal (combined over the first two years) N uptake during the stand duration indicated the superiority of winter (60.68kg/fed,); decreased slightly during autumn season to be 49.89kg/fed.; followed by spring (45.71kg/fed.) and summer seasons (43.18kg/fed.).

Data also show that the performance of alfalfa cultivars over all the applied fertilization treatments was significantly different among the four seasonal durations (combined over the first two years) as significant differences were detected between alfalfa cultivars over the growing seasons of the stand durations (the first two years). During winter seasons, N contents of the exotic cultivars (Hallma, Melesia and Siriver) were significantly lower than those of the two local ones (Sewa and Ismailia-1) with slight

Table (18): Nitrogen uptake by several alfalfa cultivars as affected by various levels of NPK (combined over the first and the second years).

Cultivar (C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter seasons					Spring seasons				
	.....(kg/fed.).....									
Hallma(Ex)	33.68	40.22	45.49	62.47	45.46	19.18	30.54	36.96	44.97	32.91
Melesia(Ex)	25.90	41.07	53.57	75.61	49.04	21.57	28.93	44.35	67.78	40.66
Siriver (Ex)	26.96	46.70	59.17	89.26	55.52	20.84	34.23	45.87	61.67	40.65
Sewa (L)	29.65	56.05	76.50	111.91	68.53	25.25	43.49	56.80	84.82	52.59
Ismailia1(L)	39.00	68.21	93.32	138.88	84.85	33.19	50.25	69.88	93.72	61.76
Mean	31.04	50.45	65.61	95.62	60.68	24.40	37.49	50.77	70.59	45.71
LSD 0.05:	T = 4.6, C = 4.4 and T x C = 8.9					T =3.5, C = 2.7 and T x C = 5.3				
	Summer seasons					Autumn seasons				
Hallma (Ex)	17.00	27.39	36.86	43.71	31.24	19.22	33.15	40.25	52.41	36.26
Melesia(Ex)	20.56	29.14	40.47	69.99	40.04	23.57	33.39	41.83	63.01	40.45
Siriver (Ex)	19.99	31.70	46.84	61.17	39.93	24.55	38.82	52.52	70.40	46.57
Sewa (L)	25.13	37.67	52.99	79.28	48.77	25.93	45.98	66.44	101.75	60.03
Ismailia1(L)	29.94	45.51	63.24	85.07	55.94	33.46	56.32	70.36	104.40	66.14
Mean	22.53	34.28	48.08	67.84	43.18	25.35	41.53	54.28	78.39	49.89
LSD 0.05:	T = 3.8, C = 2.5 and T x C = 5.0					T = 4.5, C = 3.8 and T x C = 7.5				

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

higher N uptake for the later (Ismailia-1) than the former (Sewa) cultivar. Meanwhile, the highest N content among the grown alfalfa cultivars was in Ismailia-1 in winter, spring, summer and autumn seasons. Whereas, the lowest N content was for Hallma in winter, spring, summer and autumn seasons. It seems-that none of the tested alfalfa cultivars performed the same within each season in its N uptake.

Data presented in Table (18 and A, 21) indicate that there were significant differences among all of the applied fertilization treatments which positively affect the seasonal N content of alfalfa plants compared to the control (T1) having various magnitudes. Seasonal N uptake under each fertilization treatment was higher in winter season followed by autumn then spring where the lowest N uptake was produced in summer season.

Over the grown alfalfa cultivars, the high combined fertilization treatment (T4) significantly enhanced alfalfa plants which produced the highest N uptake values of 95.62, 70.59, 43.18 and 78.39 in winter, spring, summer and autumn seasons compared with their control values of

31.037, 24.40, 22.53 and 25.35 for the same corresponding seasons.

It is generally noticed that winter was superior among the seasons with using high, medium and low fertilization treatments which was accompanied with increasing percentages in N uptake, compared with, their relevant control treatment by 208, 111 and 63 %, respectively.

Such presented increases in N uptake due to the applied fertilization treatments were significant with variable magnitudes among each of the seasonal durations of the stand.

N uptake recorded the highest values in winter seasons with all cultivars, while the lowest values were shown in summer seasons. This could be interpreted as the high yield production was in summer which accompanied with the low concentration of N (Table 18 and A, 21) resulted from the dilution effect.

The interaction effect on N uptake between alfalfa cultivars and the applied fertilization treatments was significant (Tables 18 and A, 21). This significant effect shows that generally N uptake by alfalfa plants increased with increasing the applied fertilization levels and the response of different cultivars to N was not consistent in the same growing seasons, such inconsistency may be due to the varital differences among cultivars.

The environmental effects played an important role in plant growth and nutrient uptake by the tested populations. These results are in agreement with those reported by **Sharma and Sharma (2004), Berrada and Westfall (2005) and Haby and Haby and Leonard (2005).**

In contrast, there is a discrepancy between these results and those reported by **Koorgak (1997) Fajri (2001) and Wang Sniping et al. (2005).**

Phosphorus uptake:

Results in Table (19 and A, 22) present the seasonal (combined over the two first years) of P uptake for different alfalfa cultivars as affected by various combined fertilization treatments of N, P and K. Seasonal combined over the two first years was estimated in winter, spring, summer and autumn.

Over the applied fertilization treatments, the highest seasonal (combined over the two first years) P uptake during the stand duration indicated the superiority of spring seasonal (5.82kg/fed.); decreased slightly during autumn

Table (19): Phosphorus uptake by several alfalfa cultivars as affected by various levels of NPK (combined over the first and the second years).

Cultivar(C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter seasons					Spring seasons				
	....................(kg/fed.)........									
Hallma(Ex)	1.60	2.07	2.42	4.44	2.63	2.05	3.65	4.39	6.98	4.27
Melesia(Ex)	1.18	1.90	2.83	4.30	2.55	2.21	3.14	5.01	6.58	4.23
Siriver (Ex)	1.16	2.35	3.35	5.99	3.21	2.20	3.96	6.44	10.62	5.81
Sewa (L)	1.55	3.06	4.97	7.98	4.39	2.92	5.11	7.28	12.39	6.93
Ismailia1(L)	1.75	3.70	5.82	8.85	5.03	3.42	5.80	8.66	13.59	7.87
Mean	1.45	2.62	3.88	6.31	3.56	2.86	4.33	6.35	10.03	5.82
LSD 0.05:	T = 58.5, C = n.s and T x C = n.s					T = 0.89, C = 0.45 and T x C = 0.55				
	Summer seasons					Autumn seasons				
Hallma (Ex)	1.06	2.44	3.67	5.19	3.09	2.82	3.25	4.45	8.26	4.70
Melesia(Ex)	1.50	2.19	3.19	6.39	3.32	1.54	3.38	4.40	6.69	4.00
Siriver (Ex)	1.37	2.31	3.74	6.91	3.58	1.69	3.84	5.53	7.32	4.60
Sewa (L)	1.60	2.91	4.54	7.86	4.23	1.98	4.36	6.95	11.09	6.09
Ismailia1(L)	2.04	3.69	5.79	8.96	5.12	2.21	4.74	7.75	12.10	6.70
Mean	1.51	2.71	4.18	7.06	3.87	2.05	3.92	5.82	9.09	5.22
LSD 0.05:	T = 0.67, C = 0.41 and T x C = 0.50					T = 1.1, C = 0.5 and T x C = 0.6				

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

seasonal to be 5.22kg/fed.; followed by summer (3.867kg/fed.) and winter seasons (3.562 kg/fed.).

Data also show that the performance of alfalfa cultivars over all the applied fertilization treatments was significantly different among the four seasonal durations (combined over the first two years) as significant differences were detected between alfalfa cultivars over the growing seasons of the stand durations (the first two years). During spring seasons, the local cultivars (Ismailia-land Sewa) were significantly higher than those of the three exotic cultivars (Hallma, Melesia and Siriver). Meanwhile, the highest P content among the grown alfalfa cultivars was of Ismalia-1 in winter, spring, summer and autumn. Whereas, the lowest P content was for Melesia in winter, spring; Hallma in summer and autumn seasons. It seems that none of the tested alfalfa cultivars performed the same within each season in its P uptake.

Data presented in Table (19 and A, 22) indicate that there were significant differences among all of the applied fertilization treatments which positively affect the seasonal P uptake (combined over the first two years) of alfalfa plants compared to the control (T1) having various magnitudes. Similar trend was found during the four growing seasons. Seasonal P uptake under each fertilization treatment was higher in spring season followed by autumn then summer where the lowest P uptake was produced in winter season.

Over the grown alfalfa cultivars, the highest combined fertilization treatment (T4) significantly enhanced alfalfa plants which produced the highest P uptake values of 6.31, 10.03, 7.06 and 9.09 kg/fed. in winter, spring, summer and autumn season compared with their control values of 1.45, 2.86, 1.51 and 2.05 for the same corresponding seasons.

It is generally noticed that winter season was superior among the seasons in P uptake with using high, medium and low fertilization treatments which accompanied with the highest percentage of increase in P uptake compared with their relevant control treatment of 251, 123 and 52 %, respectively.

Such presented increases in P uptake due to the applied fertilization treatments were significant with variable magnitudes among each of the seasonal durations of the stand.

The interaction effect between alfalfa cultivars and the applied fertilization treatments significantly affected P uptake (Tables 19 and A, 22). This significant effect shows that generally P uptake by alfalfa plants increased with increasing the applied fertilization levels and the response of different cultivars to P was not consistent in the same growing seasons.

Meanwhile, phosphorus fertilization is generally important for leguminous crops, particularly the forage ones **(Khader et al., 1987, Kabesh et al., 1989 and Mohammed, 1998)**. This, in fact is due to the fundamental role of P in a large number of enzymatic activities as phosphorylation and synthesis of various organic compounds in the plant. For this reason, meristeic tissues in plants take up much of P in the early stages of their growth which become vigorous **(Abd El-Kader et al., 1989 and Mohammed, 1998)** having long and strong roots producing an increase in N, P and K uptake by the plants **(Kabeash et al., 1989 and El- Koumey et al., 1993).**

Potassium uptake :-

Results in Table (20 and A, 23) represent the seasonal (combined over the two first years) K uptake for different alfalfa cultivars as affected by various combined fertilization treatments of N, P and K. Seasonal combined over the first two years was estimated in winter, spring, summer and autumn seasons.

Over the applied fertilization treatments and cultivars, the highest seasonal (combined over the two first years) K uptake during the stand duration indicated the superiority of spring season (47.70 kg/fed.); decreased slightly during autumn season to be 43.11 kg/fed.); followed by summer (40.239 kg/fed.) and winter seasons (25.77 kg/fed.).

Data also show that the performance of alfalfa cultivars over all the applied fertilization treatments was significantly different among the four seasonal durations (combined over the first two years) as significant differences were noticed between alfalfa cultivars over the growing seasons of the stand durations (the first two years). The highest K content among the grown alfalfa cultivars was in Ismaila-1 in winter, spring, summer and autumn seasons. Whereas, the lowest K content was in Melesia in winter, spring, summer and autumn seasons. It seems that none of the tested alfalfa cultivars performed in the same manner within each season in its K uptake.

Table (20): Potassium uptake by several alfalfa cultivars as affected by various levels of NPK (combined over the first and the second years).

Cultivar (C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter seasons					Spring seasons				
	……………………………………(kg/fed.)……………………………………									
Hallma(Ex)	9.22	17.67	21.51	35.87	21.07	19.61	31.93	38.95	59.12	37.40
Melesia(Ex)	7.40	15.34	19.97	31.70	18.60	22.66	27.39	38.79	52.16	35,25
Siriver (Ex)	7.08	19.01	24.69	41.57	23.09	23.13	36.49	48.90	69.31	44.46
Sewa (L)	11.23	24.83	34.94	55.46	31.61	29.80	44.37	60.41	97.55	58:03
Ismailia1(L)	12.00	29.51	39.18	57.28	34.49	33.40	51.04	72.63	96.29	63.34
Mean	9.39	21.27	28.06	44.38	25.77	25.72	38.24	51.94	74.89	47.70
LSD 0.05:	T = 8.1, C = 3.2 and T x C = 6.4					T = 5.7, C = 3.5 and T x C = 7.0				
	Summer seasons					Autumn seasons				
Hallma (Ex)	13.76	25.28	34.37	47.55	30.24	32.05	26.79	40.73	62.03	40.40
Melesia(Ex)	17.75	25.65	30.10	44.51	29.50	17.72	28.49	34.92	47.22	32.09
Siriver (Ex)	22.27	34.58	45.51	58.65	40.25	21.60	32.09	42.48	50.80	36.74
Sewa (L)	28.68	36.44	52.58	75.41	48.28	25.00	38.72	53.07	85.50	50.57
Ismailia1(L)	27.04	43.30	59.86	81.51	52.93	26.40	40.92	62.00	93.60	55.73
Mean	21.90	33.05	44.49	61.52	40.24	24.55	33.40	46.64	67.83	43.11
LSD 0.05:	T = 3.8, C = 3.9 and T x C = 7.9					T = 6.3, C = 7.4 and T x C = 14.8				

T1 = control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

Data presented in Table (20 and A, 23) indicate that there were significant differences among all of the applied fertilization treatments which positively affected the seasonal (combined over the first' two years) K uptake of alfalfa plants compared to the control (T1) having various magnitudes. Similar trend was found during the four growing seasons. Seasonal (combined over the first two years) K uptake under each fertilization treatment was higher in spring season followed by autumn then summer where the lowest K uptake was produced in winter season.

Over the grown alfalfa cultivars, the highest combined fertilization treatment (T4) significantly enhanced alfalfa plants which produced the highest K uptake values of 44.38, 74.89, 61.52 and 67.83 kg/fed. in winter, spring, summer and autumn season compared with their control values of 9.39, 25.72, 21.90 and 24.55 kg/fed. for the same corresponding seasons.

It is generally noticed that spring season was superior among the seasons (combined over the first two years) with using high, medium and low fertilization treatments which associated with the highest percentages of increase in K uptake compared with their relevant control treatment by 191, 102 and 49 %, respectively.

Such presented increases in K uptake due to the applied fertilization treatments were significant with variable magnitudes among each of the seasonal durations of the stand.

In case of P and K, spring season was superior in their contents in alfalfa cultivars, while winter was the inferior season. This may be due to that both elements depend mainly on the diffusion in their movement towards plant roots which is usually lower in winter as a result of decreasing soil temperature.

A high response to N, P, and K application was noticed with all levels of these nutrients. The highest N, P, and K uptake was with the highest combination of these elements (T4) followed by the medium and the low. This result could be attributed to the poverty of sandy soil fertility in such elements and others.

The interaction effect on K uptake between alfalfa cultivars and the applied fertilization treatments was significant (Table 20 and A, 23), this significant effect shows that generally K uptake by alfalfa plants increased with increasing of applied fertilization levels and the response of different cultivars to K was not consistent in the same growing seasons.

Moreover, potassium is an essential macro nutrient for all plants. Many enzymes are activated by potassium which is involved in photosynthesis and oxidative phosphorylation. Better energy status and intensification of anabolic reactions are also maintained in the plants by adequate K nutrition. Potassium is also important for osmoregulation.

The environmental effects may be played an important role in plant growth and nutrient uptake by the tested cultivars. These results are in agreement with those reported by **Fang Rejun et al. (2004), Sharma and Sharma (2004), Berrada and Westfall (2005) and Haby and Haby and Leonard (2005).**

<u>Zinc uptake:-</u>

Results in Table (21 and A,24) represent the seasons of the second year of Zn-uptake for different alfalfa cultivars as affected by various combined fertilization treatments of N, P, and K. Season of the second year was estimated in winter, spring, summer and autumn.

Table (21): Zink uptake by several alfalfa cultivars as affected by various levels of NPK during the second year (2003/2004).

Cultivar (C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter season					Spring season				
	......(kg/fed.)......									
Hallma(Ex)	0.101	0.066	0.062	0.053	0.071	0.054	0.101	0.040	0.024	0.055
Melesia(Ex)	0.126	0.071	0.054	0.034	0.071	0.056	0.085	0.042	0.029	0.053
Siriver (Ex)	0.161	0.096	0.065	0.048	0.093	0.058	0.092	0.042	0.026	0.054
Sewa (L)	0.221	0.136	0.079	0.055	0.123	0.107	0.156	0.064	0.040	0.092
Ismailia1(L)	0.221	0.147	0.088	0.052	0.127	0.097	0.135	0.066	0.042	0.085
Mean	0.166	0.103	0.070	0.049	0.097	0.114	0.074	0.051	0.032	0.068
LSD 0.05:	T = 0.05, C = 0.03 and T x C = 0.07					T = 0.05, C = 0.03 and T x C = n.s				
	Summer season					Autumn season				
Hallma (Ex)	0.039	0.066	0.025	0.012	0.035	0.094	0.063	0.052	0.028	0.059
Melesia(Ex)	0.043	0.091	0.030	0.020	0.046	0.093	0.064	0.056	0.034	0.062
Siriver (Ex)	0.049	0.097	0.035	0.021	0.051	0.106	0.077	0.061	.034	0.069
Sewa (L)	0.054	0.093	0.029	0.024	0.050	0.186	0.104	0.084	.041	0.104
Ismailia1(L)	0.057	0.100	0.037	0.023	0.054	0.175	0.110	0.075	0.047	0.102
Mean	0.090	0.048	0.031	0.020	0.047	0.131	0.084	0.065	0.037	0.079
LSD 0.05:	T = 0.05, C = 0.03 and T x C = n.s					T = 0.05, C = 0.03 and T x C = 0.07				

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

Over the applied fertilization treatments and cultivars, the highest seasons of Zn-uptake during the second year indicated the superiority of winter (0.097kg/fed.); decreased slightly during autumn season to be (0.079kg/fed.); followed by spring (0.068kg/fed.) and summer season (0.047kg/fed.).

Data also show that the performance of alfalfa cultivars over all the applied fertilization treatments was significantly different among the four seasons (of the second year) as significant differences were detected between alfalfa cultivars over the growing seasons of the stand duration (the first two years). During winter seasons, cultivars of Ismilia-1 contained Zn values higher than those of the three other cultivars (Hallma, Melesia and Siriver and Sewa). The highest Zn- uptake content in the growing alfalfa cultivars was in Ismailia-1 in winter and summer, Sewa in spring and autumn season. Whereas, the lowest Zn-uptake was for Hallma in winter, summer and autumn, Melesia in spring season. It seems that none of the tested alfalfa cultivars performed in the same manner within each season in its Zn- uptake.

Data presented in Table (21 and A, 24) reveal that there were significant differences in Zn uptake among all the applied fertilization treatments which significantly affected by the season (of the second year) of alfalfa plants compared to the control (T1) showing various magnitudes. Zinc-uptake in the seasons of the second year under each fertilization treatment was higher in winter season followed by autumn then spring where the lowest Zn- uptake was produced in summer season.

Over the grown alfalfa cultivars, the highest combined fertilization treatment (T4) significantly affected alfalfa plants which produced the lowest Zn-uptake values of 0.049 kg/fed. for the winter season compared with their control values of 0.0.103kg/fed. for the same corresponding seasons.

Large applications of phosphorus fertilizers to soils low in available zinc may induce zinc deficiency and increase the zinc requirement of plants. As summarized by **Loneragan et al. (1979).** Three different factors may be responsible for this: (a) "dilution of zinc in plants by the increase in growth induced by phosphorus fertilizers, (b) inhibition of zinc uptake by the cations (Ca^{2+} in particular) added with phosphorus fertilizers, and (c) phosphorus-enhanced zinc adsorption in the soil to hydroxides and oxides of iron and aluminum and to $CaCO_3$.

It is generally noticed that winter season was superior among the seasons of the second years with using medium and low fertilization treatments.

Such presented decreases in Zn-uptake due to the applied fertilization treatments were significant with variable magnitudes among seasons of the second year.

The interaction effect between alfalfa cultivars and the applied fertilization treatments showed non-significant on the Zn-uptake (Table 21 and A, 24). This non- significant effect shows that generally Zn uptake by alfalfa plants decreased with increasing the applied fertilization levels and the response of different cultivars to Zn-uptake was inconsistent in the same growing seasons. Such inconsistency may be ascribed to the varital differences among cultivars.

Manganese uptake:-

Results in Table (22 and A, 25) represent the effect of seasons of the second year on Mn-uptake for different alfalfa cultivars as affected by various combined fertilization treatments of N, P and K.

Over the applied fertilization treatments and cultivars, values of the highest season of Mn-uptake during the second year indicated the superiority of summer season (0.07kg/fed.); decreased slightly during autumn (065kg/fed.), spring season to be 0.064kg/fed.; followed by winter season (0.055kg/fed.).

Data also show that the performance of alfalfa cultivars over all the applied fertilization treatments was significantly different among the four seasons of the second year as significant differences were detected between alfalfa cultivars over the growing seasons of the second year. During summer season, Ismalia-1cultivar contained Mn higher than those of the other cultivars (Hallma, Melesia, Siriver and Sewa). The highest Mn-uptake among the growing alfalfa cultivars was in Ismailia-1 in winter, spring, summer and autumn season. Whereas, the lowest Mn-uptake was for Melesia in winter, Hallma in spring, summer and autumn seasons. It is noticeable that none of the tested alfalfa cultivars performed in the same manner within each season in its Mn-uptake.

Table (22): Manganese uptake by several alfalfa cultivars as affected by various levels of NPK during the second year (2003/2004).

Cultivar (C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter season					Spring season				
	……………………………………(kg/fed.)……………………………………									
Hallma(Ex)	0.027	0.036	0.039	0.062	0.041	0.020	0.046	0.058	0.081	0.051
Melesia(Ex)	0.018	0.028	0.041	0.070	0.039	0.023	0.043	0.064	0.088	0.055
Siriver (Ex)	0.023	0.036	0.053	0.102	0.053	0.026	0.042	0.061	0.101	0.057
Sewa (L)	0.022	0.045	0.073	0.134	0.069	0.028	0.056	0.078	0.132	0.073
Ismailia1(L)	0.026	0.043	0.084	0.137	0.073	0.032	0.064	0.096	0.142	0.083
Mean	0.023	0.038	0.058	0.101	0.055	0.026	0.050	0.071	0.109	0.064
LSD 0.05:	T = 0.05, C = 0.03 and T x C = 0.07					T = 0.05, C = 0.03 and T x C = 0.07				
	Summer season					Autumn season				
Hallma (Ex)	0.021	0.043	0.061	0.075	0.050	0.022	0.041	0.053	0.082	0.049
Melesia(Ex)	0.038	0.048	0.063	0.084	0.058	0.021	0.037	0.051	0.090	0.050
Siriver (Ex)	0.041	0.058	0.075	0.102	0.069	0.028	0.055	0.070	0.092	0.061
Sewa (L)	0.045	0.059	0.078	0.108	0.073	0.028	0.056	0.090	0.139	0.078
Ismailia1(L)	0.043	0.066	0.094	0.130	0.083	0.035	0.058	0.099	0.146	0.084
Mean	0.037	0.074	0.055	0.100	0.067	0.027	0.049	0.073	0.110	0.065
LSD 0.05:	T = 0.05, C = 0.03 and T x C = n.s					T = 0.05, C = 0.03 and T x C = 0.07				

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= N[illegible] $P_{30}K_{40}$

Data presented in Table (22 and A, 25) indicate that there were significant differences among all of the applied fertilization treatments which were positively affected by the seasons of the second year of alfalfa plants compared to the control (T1). Mn-content in seasons of the second year under each fertilization treatment was higher in summer season followed by autumn and spring; where the lowest Mn-uptake was produced in winter season.

Over the grown alfalfa cultivars, the highest combined fertilization treatment (T4) significantly enhanced alfalfa plants which produced the highest Mn-uptake values of 0.101, 0.109, 0.100 and 0.110 kg/fed. in the winter, spring, summer and autumn seasons compared with their control values of 0.023, 0.026, 0.037 and 0.027kg/fed. for the same corresponding seasons.

It is generally noticed that summer season was superior among the seasons with using high, medium and low fertilization treatments which were associated with the highest percentage of increase in Mn-uptake compared with their relevant control treatment of 170, 100 and 49%, respectively.

Such presented increases in Mn-uptake due to the applied fertilization treatments were significant with variable magnitudes among each of the seasonal durations of the stand.

The interaction effect on Mn-uptake between alfalfa cultivars and the applied fertilization treatments was significant (Table 22 and A, 25). This significant effect shows that generally Mn-uptake by alfalfa plants increased with increasing of applied fertilization levels and the response of different cultivars to Mn was not consistent in the same growing seasons. Such inconsistency may be due to the varital differences among cultivars.

Copper uptake:-

Results in Table (23 and A, 26) represent Cu-uptake during the seasons of the second year by different alfalfa cultivars as affected by various combined fertilization treatments of N, P and K.

Over the applied fertilization treatments and cultivars, values of Cu-uptake during the second year indicated the superiority of spring season (0.064kg/fed.); decreased slightly during summer season to be 0.059kg/fed.; followed by autumn (0.058kg/fed.) and winter seasons (0.057kg/fed.).

Table (23): Copper uptake by several alfalfa cultivars as affected by various levels of NPK during the second year (2003/2004).

Cultivar ( )	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter season					Spring season				
	....(kg/fed.)..									
Hallma Ex)	0.048	0.046	0.036	0.046	0.044	0.030	0.050	0.041	0.072	0.048
Melesia(Ex)	0.027	0.044	0.043	0.082	0.049	0.033	0.054	0.061	0.072	0.055
Siriver (Ex)	0.035	0.047	0.059	0.087	0.057	0.037	0.066	0.062	0.081	0.062
Sewa (L)	0.040	0.056	0.072	0.096	0.066	0.041	0.075	0.088	0.101	0.076
Ismailia1(L)	0.044	0.056	0.064	0.111	0.069	0.048	0.059	0.084	0.117	0.077
Mean	0.039	0.050	0.055	0.084	0.057	0.038	0.061	0.067	0.089	0.064
LSD 0.05:	T = n.s, C = 0.03 and T x C = n.s					T = n.s, C = 0.03 and T x C = n.s				
	Summer season					Autumn season				
Hallma (Ex)	0.023	0.043	0.050	0.052	0.042	0.021	0.037	0.047	0.068	0.043
Melesia(Ex)	0.039	0.051	0.057	0.073	0.055	0.022	0.046	0.050	0.081	0.050
Siriver (Ex)	0.040	0.049	0.060	0.083	0.038	0.028	0.045	0.063	0.086	0.056
Sewa (L)	0.053	0.060	0.076	0.078	0.067	0.026	0.058	0.079	0.114	0.069
Ismailia-(L)	0.042	0.066	0.072	0.111	0.073	0.035	0.068	0.087	0.098	0.072
Mean	0.039	0.054	0.063	0.079	0.059	0.027	0.051	0.065	0.089	0.058
LSD 0.05:	T = 0.05, C = 0.03 and T x C = 0.07					T = n.s, C = 0.03 and T x C = n.s				

T1 = control, T2 (low)= $N_{10} P_{10} K_{10}$, T3 (medium)= $N_{20} P_{20} K_{20}$, T4 (high)= $N_{30} P_{30} K_{40}$

Data also show that the performance of alfalfa cultivars over all the applied fertilization treatments was significantly different among the four seasons of the second year. During spring season, Ismailia-1 cultivars contained Cu values higher than those of the other cultivars (Hallma, Melesia, Siriver and Sewa). The highest cultivar in its Cu-uptake among the grown alfalfa cultivars was Ismaila-1 in winter, spring, summer and autumn seasons. Whereas, the lowest Cu-content was Hallma in winter, spring, summer and autumn seasons.

Data presented in Table (23 and A, 26) show that Cu-uptake under each fertilization treatment was higher in spring season followed by summer then autumn and winter where the lowest Cu-uptake was found in winter season.

Over the grown alfalfa cultivars, the highest combined fertilization treatment (T4) enhanced alfalfa plants and produced the highest Cu-uptake values of 0.084, 0.089, 0.079 and 0.089kg/fed. in winter, spring, summer and autumn seasons compared with their control values of 0.057, 0.064, 0.059 and 0.058kg/fed. for the same corresponding seasons.

It is generally noticed that spring season was superior among the seasons of the second year with using high, medium and low fertilization treatments which associated with percentages of increase in Cu-uptake compared with their relevant control treatment of 134, 76 and 61%, respectively.

Such presented increases in Cu-uptake due to the applied fertilization treatments were non-significant with variable magnitudes among each of the seasons of the second year.

The interaction effect between alfalfa cultivars and the applied fertilization treatments was of not significant effect on the Cu-uptake (Table 21). This non-significant effect shows that generally Cu-uptake by alfalfa plants increased with increasing the applied fertilization levels and the response of different cultivars to Cu-uptake was not consistent in the same growing seasons. Such inconsistency may be due to the varital differences among cultivars.

The environmental effects may be played an important role in plant growth and nutrient uptake by the tested cultivars. These results are in agreement with those reported by **Berrada and Westfall (2005) and Haby and Haby and Leonard (2005).**

Iron uptake:-

Data of Table (24 and A, 27) show Fe-uptake by different alfalfa cultivars as affected by seasons and various combined fertilization treatments of N, P and K.

Over the applied fertilization treatments and cultivars, the highest season of Fe-uptake during the second year indicated the superiority of autumn season (0.87kg/fed.); decreased slightly during winter season to be 0.78kg/fed.; followed by spring (0.629kg/fed.) and summer season (0.438kg/fed.).

The obtained results indicate that the performance of alfalfa cultivars over all the applied fertilization treatments was significantly different among the four seasons (of the second year) as significant differences were detected between alfalfa cultivars over the growing seasons of the second year. During autumn season, Ismailia-1 cultivar contained Fe higher than those of the other cultivars (Hallma, Melesia, Siriver and Sewa). The highest cultivar in its Fe-uptake among the grown alfalfa cultivars was Ismaila-1 in winter, spring, summer and autumn seasons. Whereas, Table (24): Iron uptake by several alfalfa cultivars as affected by various levels of NPK during the second year (2003/2004).

Cultivar(C)	Fertilization treatment					Fertilization treatment				
	T1	T2	T3	T4	Mean	T1	T2	T3	T4	Mean
	Winter season					Spring season				
	....................(kg/fed.)....................									
HallmaEx)	0.304	0.450	0.565	0.934	0.564	0.177	0.443	0.540	0.831	0.498
Melesia(Ex)	0.178	0.435	0.592	1.136	0.585	0.245	0.420	0.567	0.810	0.510
Siriver (Ex)	0.275	0.515	0.821	1.394	0.751	0.198	0.456	0.643	1.104	0.600
Sewa (L)	0.256	0.505	1.062	1.811	0.908	0.280	0.533	0.833	1.284	0.732
Ismailia1(L)	0.315	0.669	1.294	2.088	1.092	0.340	0.565	0.982	1.330	0.805
Mean	0.266	0.515	0.867	1.473	0.780	0.248	0.483	0.713	1.072	0.629
LSD 0.05:	T = 0.23, C = 0.05 and T x C = 0.09					T = 0.10, C = 0.09 and T x C = 0.18				
	Summer season					Autumn season				
Hallma (Ex)	0.087	0.202	0.476	0.604	0.342	0.343	0.587	0.775	1.109	0.703
Melesia(Ex)	0.155	0.254	0.486	0.660	0.389	0.371	0.576	0.747	1.265	0.740
Siriver (Ex)	0.155	0.344	0.546	0.770	0.454	0.372	0.646	0.821	1.265	0.776
Sewa (L)	0.165	0.319	0.575	0.831	0.472	0.439	0.793	1.143	1.844	1.055
Ismailia1(L)	0.168	0.354	0.636	0.969	0.532	0.475	0.868	1.243	1.889	1.118
Mean	0.146	0.295	0.544	0.767	0.438	0.400	0.694	0.946	1.474	0.878
LSD 0.05:	T = 0.12, C = 0.05 and T x C = 0.09					T = 0.23, C = 0.13 and T x C = 2.6				

T1= control, T2 (low)= $N_{10}P_{10}K_{10}$, T3 (medium)= $N_{20}P_{20}K_{20}$, T4 (high)= $N_{30}P_{30}K_{40}$

the lowest Fe-uptake was for Hallma in winter, spring, summer and autumn seasons. It seems that none of the tested alfalfa cultivars performed in the same manner within each season in its Fe-uptake.

Data presented in Table (24 and A, 27) obviously reveal significant differences in Fe-uptake among all of the applied fertilization treatments which positively affected by the seasons of the second year compared to the control (T1). Fe-uptake under each fertilization treatment was higher in autumn season followed by winter then spring where the lowest Fe-uptake was found in summer season.

Over the grown alfalfa cultivars, the highest combined fertilization treatment (T4) enhanced alfalfa plants which produced the highest Fe-uptake values of 1.473, 1.072, 0.0767 and 1.47kg/fed. in winter, spring, summer and autumn season compared with their control values of 0.266, 0.248, 0.146 and 0.4 kg/fed. for the same corresponding seasons.

It could be noticed that autumn season was superior among the seasons of the second year with using high, medium and low fertilization treatments which associated with percentages of increase in Fe-uptake compared with their relevant control treatment of 73, 58 and 42%, respectively.

Such presented increases in Fe-uptake ascribed to the applied fertilization treatments were significant with variable magnitudes among seasons of the second year. These results are in agreement with those reported by **Diaz-Zorita and Buschiazzo (2004), Kalashnikov (2004), Fang Rejun et al. (2004), Berrada and Westfall (2005)**

2- The pot experiment

Forage yield:

Yearly and seasonal fresh forage yield :

Total fresh forage production of 21 of alfalfa cuts distributed at the different four seasons, of the growing year of the stand duration are given in Tables (25 and 26). Data of fresh forage yield of the alfalfa grown on sandy and calcareous soils as affected by seasons, cultivars and molybdenum application are presented and discussed. It is well noticed that over all seasons, alfalfa cultivars fertilized with molybdenum produced the highest total forage yield of the grown alfalfa cultivars during the first year (2002-2003) where the yield in sandy soil was 2999.6 g/pot out of 10

Table (25): Fresh forage yield of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the first growing year (2002-2003).

Soil		Sandy						Calcareous					
		Season (S)						Season (S)					
Cultivar (C)	Mo	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Total seasons	Mean	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Total seasons	Mean
Hallma		......................(g/pot)......................											
	+Mo	74.30	953.3	1529.5	423.7	2980.7	745.2	176.9	533.7	581.0	823.2	2114.9	
	-Mo	41.00	529.0	899.0	215.9	1684.9	421.2	63.95	220.7	337.2	553.8	1175.7	
	Mean	57.63	741.1	1214.3	319.8	2332.8	583.2	120.4	377.3	459.1	688.5	1645.3	
Melesia	+Mo	56.00	842.3	1447.5	412.5	2758.3	689.6	179.7	571.7	663.0	831.0	2245.5	
	-Mo	23.00	542.0	815.0	266.6	1646.6	411.6	45.10	211.1	391.5	670.0	1317.7	
	Mean	39.50	692.1	1131.3	339.6	2202.4	550.6	112.4	391.4	527.3	750.5	1781.6	
Siriver	+Mo	80.80	870.5	1606.3	475.7	3033.2	758.3	184.1	698.1	826.1	914.9	2623.2	
	-Mo	39.00	639.8	999.5	280.8	1959.1	489.8	74.9	282.4	924.2	664.8	1446.3	
	Mean	59.90	755.1	1302.9	378.2	2496.1	624.0	129.5	490.3	625.1	789.9	2034.7	
Sewa	+Mo	88.50	1297.0	2315.0	659.4	4360.1	1090.0	203.5	694.9	822.1	994.8	2715.2	
	-Mo	45.50	823.5	1447.5	431.4	2747.9	687.0	148.7	533.5	635.2	764.9	2082.2	
	Mean	67.00	1060.4	1881.3	545.4	3554.0	888.5	176.1	614.2	728.6	879.8	2398.7	
Ismailial	+Mo	81.50	1564.0	3347.5	818.6	5812.1	1453.0	294.9	930.5	970.4	1117.0	3313.0	
	-Mo	43.50	853.8	1525.0	590.7	3013.0	753.2	139.6	446.5	609.9	831.3	2027.3	
	Mean	62.50	1209.1	2436.3	704.6	4412.5	1103.1	217.3	688.5	790.1	974.3	2670.1	
G Mean		57.30	891.6	1593.2	457.5	2999.6	749.9	151.1	512.3	626.1	816.6	2106.1	
Interaction of molybdenum X seasons													
+Mo		76.2	1106.0	2049.2	558.0	3788.9	947.2	207.8	685.8	772.5	936.2	2602.3	
-Mo		38.4	677.6	1137.2	357.1	2210.3	552.6	94.4	338.8	479.6	696.9	1609.8	
Mean		57.3	891.6	1593.2	457.5	2999.6	749.9	151.1	512.3	626.1	816.6	2106.1	

LSD 0.05: S: 3.4 Mo: 0.8 C: 1.3
S x Mo: 1.6 S x C: 2.5
Mo x C: 1.8 S x Mo x C: 3.6

S: 2.2 Mo: 1.5 C: 2.4
S x Mo: 3.1 S x C: 4.9
Mo x C: 3.5 S x Mo x C: 6.9

Table (26): Fresh forage yield of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the second growing year (2003-2004).

Soil		Sandy						Calcareous					
		Season (S)						Season (S)					
Cultivar (C)	Mo	Winter (2cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Total seasons	Mean	Winter (2 cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Total seasons	Mean
Hallma		……………………(g/pot)……………………											
	+Mo	253.25	391.45	445.05	563.03	1652.8	413.2	814.8	1227.9	1060.1	976.88	4079.6	1019.9
	-Mo	117.18	209.33	297.20	315.25	938.95	234.7	437.8	677.18	581.23	497.10	2193.3	548.3
	Mean	**185.21**	**300.40**	**371.13**	**439.14**	**1295.9**	**323.9**	**626.3**	**952.54**	**820.65**	**736.99**	**3136.4**	**784.1**
Melesia	+Mo	235.63	381.53	464.65	600.48	1682.3	420.6	672.5	1007.9	886.60	816.00	3382.9	845.7
	-Mo	119.05	212.10	289.30	367.70	988.15	247.0	506.8	768.03	635.18	553.60	2463.6	615.9
	Mean	**177.34**	**296.81**	**376.98**	**484.09**	**1335.2**	**333.8**	**589.6**	**887.96**	**760.86**	**684.78**	**2923.2**	**730.8**
Siriver	+Mo	261.83	457.80	599.35	728.70	2047.7	511.9	801.4	1247.4	1218.7	1191.7	4459.1	1114.8
	-Mo	117.75	221.63	306.23	393.78	1039.4	259.8	478.6	702.88	623.65	579.9	2385.1	596.3
	Mean	**189.79**	**339.71**	**452.79**	**561.24**	**1543.5**	**385.9**	**640.0**	**975.11**	**921.18**	**885.8**	**3422.1**	**855.5**
Sewa	+Mo	440.35	953.58	1175.65	1042.8	3612.3	903.1	877.1	1369.3	1556.9	1860.8	5664.0	1416.0
	-Mo	278.73	505.40	647.48	623.48	2055.1	513.8	634.7	978.30	1066.3	1150.0	3829.2	957.3
	Mean	**359.54**	**729.49**	**911.56**	**833.11**	**2833.7**	**708.4**	**755.9**	**1173.8**	**1311.6**	**1505.4**	**4746.6**	**1186.7**
Ismailial	+Mo	502.98	1017.50	1337.0	1368.7	4226.1	1056.0	1013.0	1575.2	1960.0	2541.8	7090.7	1772.7
	-Mo	337.08	699.33	801.15	630.45	2468.0	617.0	669.0	1063.5	1210.4	1440.5	4383.4	1095.8
	Mean	**420.03**	**858.43**	**1069.1**	**999.55**	**3347.1**	**836.8**	**841.3**	**1319.3**	**1585.2**	**1991.1**	**5737.0**	**1434.3**
G Mean		**266.38**	**504.97**	**636.30**	**663.43**	**2071.1**	**517.8**	**690.6**	**1061.8**	**1079.9**	**1160.8**	**3993.1**	**998.3**
Interaction of molybdenum X seasons													
+Mo		338.81	64.38	804.33	860.72	2644.0	661.06	835.86	1285.5	1336.5	1477.4	4935.3	1233.8
-Mo		193.96	369.56	469.27	466.13	1497.0	374.48	545.37	837.96	823.34	844.22	3050.9	762.7
Mean		**266.38**	**504.97**	**636.30**	**663.43**	**2071.0**	**517.77**	**690.61**	**1061.8**	**1079.9**	**1160.8**	**3993.0**	**998.3**

LSD 0.05: S: 14.2 Mo: 10.0 C: 15.8 S x Mo: 20.0 S x C: 31.7 Mo x C: 22.4 S x Mo x C: 44.8

S: 14.2 Mo: 10.0 C: 15.9 S x Mo: 20.1 S x C: 31.7 Mo x C: 22.5 S x Mo x C: 44.9

cuts and the corresponding forage yield in calcareous soil was 2106.6.

In the second year of stand duration (2003-2004), the obtained fresh forage yield was 2071.1 g/pot out of 11 cuts and 3993.1 g/pot out of 11 cuts for sandy and calcareous soils, respectively.

The obtained data show remarkable increase in-fresh forage yield from first to the second year on the calcareous soil. Whereas, in sandy soil a noticeable decrease was observed in fresh forage yield from first to the second year.

Also, significant differences in fresh forage yield of alfalfa cultivars were recorded among the growing seasons. Fresh forage yield was significantly increased with increasing the number of cuts which were three in spring, summer and autumn. This trend was clear in each of the two tested soils in the first year with noticeable variable magnitudes.

In the first year with noticeable variable magnitudes between soils, sandy soil produced plants of high fresh weight as compared with calcareous one particularly in spring and summer seasons, while in winter and autumn the calcareous soil produced plants of higher fresh weight. The inferiority of calcareous soil in spring and summer seasons may be due to the negative effect of $CaCO_3$ on the growing plants, as it is almost

associated with unfavorable soil physical and chemical conditions. It is obviously clear that in the first year the highest productive seasons were summer season (1593.2 g/plot) followed by spring season (891.6 g/plot) with significant differences in the sandy soil, while, in the calcareous soil the highest productive seasons were autumn season (816.6 g/plot) followed by summer season (626.1 g/plot) with significant differences as well. Whereas, in the second year the autumn season was the superior in sandy and calcareous soils with total value of 663.4 and 1160.8 g/pot, respectively with significant differences. These results are in agreement with those reported by **Mclaughlin et al. (2005).**

Also, the noticeable reduction of average winter yield of the first year (57.3 and 151.0 g/pot) of the two soils sandy and calcareous, respectively compared to the other seasons may be due to the number of cuts and differences in temperature, humidly and rainfall during the different seasons. These results are in agreement with those of **Abd**

El-Halim et al.(1992) and Oushy et al. (1999b) who reported that the growing seasons affected the productivity of plants and also showed that dry matter yield of the winter growth was markedly lower than that of the other seasons.

Cultivars:

Results in Tables (25 and 26) show that alfalfa cultivars exerted significant differences in fresh forage production. This trend was true in each soil during the successive years over all the growing seasons. The local cultivar Ismailia-1 was superior in its fresh forage yield followed by Sewa cultivar with significant differences among cultivars when grown on each of the studied soils.

It could be concluded that the highest forage productivity of Ismailia-1 was 1103.1 and 667.5 g/pot in the first year and 836.8 and 1434.3 g/pot in the second year for sandy and calcareous soils, respectively. These results may be partially attributed to the ability of such cultivars to produce more shoots, high leaf/stem ratio, taller plant height and rapid regrowth after cutting as compared with the other tested cultivars. These results are in general agreement with those reported by **Moursi et al. (1977), Ghobrial (1978),**

Mousa (1982), Rammah et al. (1988), Geweifel (1997) and Nasr (1998).

It is also noticed that the other three exotic alfalfa cultivars (Hallma, Melesia and Siriver) were inferior in their fresh forage production than the local alfalfa cultivars (Sewa and Ismailia-1) with significant differences among each other when grown on each of the two soils (sandy or calcareous) and during the two years of stand duration. Significant differences among the three exotic alfalfa cultivars grown on sandy soil were observed. The exotic cultivars proved that Siriver was the higher in fresh forage yield than Hallma which was followed by Melesia with significant variable magnitudes in the first year. Whereas, in calcareous soil the exotic cultivars Siriver was higher in fresh yield than Melesia which was followed by Hallma.

During the second year of stand duration, the superiority of exotic alfalfa cultivars could be ranked as follows: Siriver > Melesia > Hallma when grown in sandy soil, while in case of calcareous soil, the ranking order of productivity was Siriver > Hallma > Melesia.

The behavior of cultivars significantly differed from season to season where the local cultivars showed superiority over the exotic ones. The highest fresh forage yield of the studied cultivars was achieved in summer seasons and the lowest one was recorded in winter seasons.

The inferiority of production for the exotic cultivars in the winter season than the local cultivars was highly significant. These results indicate that the local cultivars Ismailia-1 and Sewa retained highly non-winter dormancy behavior that originated from the desert Oases of the New Vally in Egypt. These results are in agreement with **Smith et al. (1991). Rumbough et al. (1988) Marble et al. (1985) and Oushy et al.(1999b)** who concluded that long history of agriculture tracts in the vast arid region led to the evolution of many unique local ecotypes which may be an excellent candidates for breeding very nori .dormant varieties adapted to aired desert conditions.

In spring, summer and autumn seasons a similar trend was observed as in winter, where the local cultivars maintained their superiority and recorded the highest production of the total fresh forage yield than the exotic cultivars with significant differences in which none of them behaved in the same way over the four growing seasons. The noticed inconsistent behavior of cultivars could be due to significant differences from season to season, and the local cultivars showed superiority over the Exotic ones. This could be due to genetic potential of winter-active trait. However, its potentiality was slightly changed in the summer season in the year of establishment (the first year).

Molybdenum application:

Data of the seasonal fresh forage yield of the first year as affected by the applied Mo treatments are presented in Tables (25 and 26). Results show that application of Mo fertilizer significantly increased the forage yield of alfalfa compared to the control (without Mo) in each of the two types of soil.

There was a great response to Mo application in the summer season in sandy soil. Similar trend was observed in the calcareous soil particularly in the autumn season during the first year. Whereas in the second year, autumn season showed a great response to molybdenum in both of sandy and calcareous soils.

Application of molybdenum was accompanied with the highest fresh forage yield of 1233.8 g/pot for the calcareous soil in the second year. Whereas, in the first year the highest fresh forage yield of 947.2 g/pot was obtained in sandy soil.

The relative increases of fresh forage yield were 71.4 and 62% in the first year and 43.35 and 38.18% in the second year in sandy and calcareous soil, respectively. These results may be attributed to the role of Mo in stimulating and enhancing nitrogen fixation which encourages plant growth and nutrient uptake These results are in agreement with those reported by **Roy et al., 1981, Faiyed 1992 and Hafmert et al., 1992.** Results in Tables (25 and 26) show that during summer season, plants can absorb high quantities of nutrients and water which produce highest forage yield as compared with those grown in winter season.

In case of calcareous soil, both of exotic and local cultivars produced high fresh forage yields in autumn season, while the lowest forage yield was recorded during winter season. Differences among cultivars were significant in all seasons. This trend was true for both soils. These results are in agreement with those reported by **Hafner et al. (1992) and Singh et al. (1992) and Hazra and Tripathi (1998).**

Yearly and seasonal dry forage yield:

The dry forage yield of alfalfa plants was given in Tables (27 and 28). Statistical analysis of data showed that over all of the growing seasons, alfalfa cultivars with molybdenum fertilization produced total alfalfa yield in sandy soil was 310.2 g/pot out of 10 cuts, being 417.5 g/pot out of 10 cuts in calcareous soil during the first year. Whereas, in the second year the dry forage yield was 486.3 g/pot out of 11 cuts and 885.8 g/pot out of 11 cuts in sandy and calcareous soils, respectively. Results also show remarkable increase in dry forage yield from the first to the second year in both of sandy and calcareous soils.

Data in Tables (27 and 28) reveal that over the applied molybdenum treatments and alfalfa cultivars, significant differences in dry forage yield of alfalfa cultivars were noticed among the growing seasons. This trend was clear in each of the two tested soils (sandy or calcareous) in the first and second years. The highest dry forage yields were recorded during autumn season were 167.1 and 275.3 g/pot in the first and second years, respectively in calcareous soils. However, the lowest dry forage yield was

Table (27): Dry forage yield of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the first growing year (2002-2003).

Soil		Sandy						Calcareous					
		Season (S)						Season (S)					
Cultivar (C)	Mo	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Total seasons	Mean	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Total seasons	Mean
		..........(g/pot)..........											
Hallma	+Mo	13.74	82.32	101.24	96.53	293.43	73.46	34.50	103.42	115.88	193.01	320.89	104.2
	-Mo	7.64	35.78	52.01	48.92	144.35	36.09	12.02	41.00	64.88	107.10	416.79	56.25
	Mean	1.69	59.05	76.63	72.72	219.09	54.77	23.26	72.21	9.38	135.05	225.00	80.22
Melesia	+Mo	1.10	88.05	115.54	94.59	308.28	77.07	33.97	111.12	13.03	166.53	346.98	110.4
	-Mo	4.23	36.90	54.31	59.38	154.82	38.71	8.07	38.68	74.88	130.68	441.65	63.08
	Mean	7.17	62.48	84.92	76.98	231.55	57.89	21.02	74.90	102.46	148.60	252.32	86.75
Siriver	+Mo	15.02	115.35	150.62	108.27	389.26	97.32	35.52	137.77	161.42	192.91	403.53	131.9
	-Mo	7.22	43.55	60.43	76.97	188.17	47.04	13.40	51.97	82.17	131.90	527.62	69.86
	Mean	11.12	79.45	105.53	92.62	288.72	72.18	24.46	94.87	121.80	162.40	279.44	100.9
Sewa	+Mo	14.95	113.42	165.06	149.25	442.67	110.67	39.68	136.61	165.06	212.70	479.07	138.5
	-Mo	8.33	65.64	114.87	97.32	286.15	71.54	27.06	98.90	123.24	154.89	554.05	101.0
	Mean	11.64	89.53	139.96	123.28	364.41	91.10	33.37	117.76	144.15	183.79	404.09	119.8
Ismailia1	+Mo	14.67	143.42	193.61	190.89	542.59	135.65	58.10	184.54	193.61	242.58	537.17	169.7
	-Mo	8.14	80.29	126.70	136.78	351.90	87.98	25.27	83.34	118.26	168.63	678.83	98.9
	Mean	11.40	111.86	160.15	163.84	447.24	111.80	41.68	133.94	155.93	205.61	395.51	134.3
G Mean		10.40	80.47	113.44	105.89	310.20	77.55	28.76	98.74	122.94	167.09	417.53	104.4
Interaction of molybdenum X seasons													
+Mo		13.7	108.5	145.2	127.9	395.3	98.8	40.4	134.7	153.2	195.6	523.8	131.0
-Mo		7.11	52.4	81.7	83.9	225.1	56.3	17.2	62.8	92.7	138.6	311.3	77.8
Mean		10.4	80.5	113.4	105.9	310.2	77.6	28.8	98.7	122.9	167.1	417.5	104.4

LSD 0.05: Sandy — S: 1.7, Mo: 1.2, C: 1.9, S x Mo: 2.4, S x C: 3.7, Mo x C: 2.6, S x Mo x C: 5.3
Calcareous — S: 21.4, Mo: 15.1, C: 24.0, S x Mo: 30.3, S x C: 48.0, Mo x C: 33.9, S x Mo x C: 67.8

Table (28): Dry forage yield of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the second growing year (2003-2004).

Soil		Sandy						Calcareous					
		Season (S)						Season (S)					
Cultivar (C)	Mo	Winter (2cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Total seasons	Mean	Winter (2 cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Total seasons	Mean
Hallma		..................(g/pot)..................											
	+Mo	119.9	87.79	102.06	130.6	440.3	110.1	169.12	248.71	229.11	223.34	870.28	217.57
	-Mo	26.79	48.26	68.53	72.5	216.1	54.00	85.82	144.51	124.31	190.17	544.82	136.20
	Mean	73.33	68.02	85.30	101.5	328.2	82.00	127.47	196.61	176.71	206.76	707.55	176.89
Melesia	+Mo	53.38	85.66	114.65	140.2	393.9	98.50	140.24	211.17	194.80	186.61	732.81	183.20
	-Mo	27.20	49.46	68.58	85.7	230.9	57.70	101.12	160.27	136.57	123.67	521.63	130.41
	Mean	40.29	67.56	91.61	112.9	312.4	78.10	120.68	185.72	165.69	155.14	627.22	156.81
Siriver	+Mo	59.03	101.33	137.50	171.1	469.0	117.20	171.50	261.83	269.57	274.08	976.98	244.25
	-Mo	26.94	51.95	71.90	91.00	241.8	60.40	98.33	147.94	137.83	132.41	516.51	129.13
	Mean	42.98	76.64	104.70	131.00	355.4	88.80	134.92	204.89	203.70	203.25	746.75	186.69
Sewa	+Mo	10.4	215.74	268.34	242.30	826.8	206.70	190.75	30.36	350.09	432.37	1273.6	318.39
	-Mo	64.43	118.70	152.62	143.90	479.7	119.90	135.64	207.01	238.14	263.79	844.58	211.14
	Mean	82.44	167.22	210.78	193.1	653.2	163.30	163.20	253.68	294.12	348.08	1059.1	264.77
Ismailial	+Mo	115.8	230.29	320.06	321.0	987.1	246.80	221.49	349.72	437.18	595.64	1604.0	401.01
	-Mo	76.85	165.47	188.91	146.8	578.0	144.50	140.85	232.39	269.07	330.49	972.8	243.20
	Mean	96.32	197.88	254.48	233.9	782.6	195.60	181.17	291.05	353.12	463.07	1288.4	322.10
G Mean		67.07	115.46	149.31	154.5	486.3	121.60	145.49	226.39	238.67	275.26	885.8	221.45
Interaction of molybdenum X seasons													
+Mo		89.70	144.16	188.52	201.02	623.40	155.85	178.62	274.36	296.15	342.41	1091.5	272.88
-Mo		44.44	86.76	110.11	107.96	349.28	87.32	112.35	178.42	181.18	208.11	680.07	170.02
Mean		67.07	115.46	149.31	154.49	486.34	121.58	145.49	226.39	238.67	275.26	885.80	228.39

LSD 0.05: S: 9.0 Mo: 6.45 C: 10.1 — S x Mo: 12.8 S x C: 20.2 — Mo x C: 14.3 S x Mo x C: 28.6

S: 39.7 Mo: 28.1 C: 44.4 — S x Mo: n.s S x C: 88.8 — Mo x C: n.s S x Mo x C: n.s recorded during winter season in the first year in both of sandy and calcareous soils.

Cultivars:

Data of Tables (27 and 28) show that the grown alfalfa cultivars were significantly differed in their dry forage production. This trend was true in sandy soil during the first year over all of the growing seasons.

However, in case of calcareous soil there were significant differences between the exotic and local cultivars. In the second year similar trend to that obtained in calcareous soil was observed in sandy soil. \;

The local cultivars Ismailia-1 produced the highest dry forage yields in the first and second years in sandy soil, which was 111.8 and 195.6 g/pot, respectively. While the higher yield in calcareous soil was 134.3 and 322.1 g/pot, respectively. The exotic cultivar Hallma gave the lowest dry forage yield in both soils and first year (over all of the growing seasons) with Mo application,

The exotic cultivars showed that Siriver was of the highest dry yield than Hallma followed by Melesia with significant variable magnitudes during the second year in sandy soil. Whereas, in calcareous soil, the exotic cultivars

Siriver was higher in dry yield than Hallma followed by Melesia. Worthy to note that significant differences in dry forage yield were noticed between cultivars which (local and exotic).

During the first year, the superiority of exotic cultivars could be ranked as follows: Siriver > Melesia > Hallma in each soil (sandy or calcareous).

Differences in dry forage yield were significant between the tested local cultivars on one hand and the exotic cultivars on the other hand during the individual seasons except for winter. The behavior of cultivars significantly differed from season to season and the local cultivars showed the superiority over the exotic ones.

The highest dry forage yield of the studied cultivars was obtained in summer season, and the lowest one was recorded in winter season in sandy soil during the first year of stand duration. Whereas, in calcareous soil the highest dry yield of the tested cultivars was recorded in autumn and the lowest one was recorded in winter seasons with significant differences as well.

Also, the inferiority of the exotic cultivars in production during winter season as compared to the local cultivars was of highly significant differences. However, the low significant differences were noticed between the local and exotic cultivars during the summer and autumn seasons in sandy and calcareous soils, respectively. This could be due to the interaction between genetic composition and prevailing environmental conditions. These results are in agreement with those obtained by **Rammah et al. (1988), Geweifel (1990), Abdel-Halim et al (1992), Nasr (1998), Abdel-Galil et al (2000) and Abdel-Halim (2001).**

Molybdenum application:

Data on the seasonal dry forage yield during the first and the second years as affected by the applied Mo treatments are presented in Tables (27 and 28).

Results indicate that over cultivars and over all of the growing seasons, dry forage yield of alfalfa was significantly and positively responded to Mo application. The relative increases of dry forage yield were 76 and 68 % ; 78 and 60 % in sandy and calcareous soils during the first and second years, respectively.

There was a great response to Mo application in the autumn season in sandy and calcareous soils during the second year with no significant differences between seasons and Mo application. In the calcareous soil in the same year, the highest dry yield of the local cultivar (Ismalia-1) was 595.6 g/pot in autumn season and the lowest values of the exotic cultivar Melesia was 140.2 g/pot during winter season with no significant differences were obtained for the application of molybdenum. In sandy soil there was significant differences between alfalfa cultivars which grown in the different seasons under the application of molybdenum. These results are in agreement with those reported by **Hafner et al. (1992), Singh et al. (1992), Heuwinkel and Gutser (1997) and Hazra and Tripathi (1998).**

Vegetative growth characteristics:

Yearly and seasonal leaf/stem ratio:

Leaf/stem ratios of alfalfa plants (overall seasons, alfalfa cultivars and Mo application) were 55.5 and 58.10 % in sandy and calcareous soil, respectively during the first year, being 56.04 and 61.3% for the second year (Tables 29 and 30). Overall cultivars and Mo application, leaf/stem ratio (L/S %) was significantly differed among seasons in each of the two soils and for the successive two growing years, (Tables 29 and 30).

Table (29): Leaf/stem ratio of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the first growing year (2002-2003).

Soil		Sandy					Calcareous				
		Season (S)					Season (S)				
Cultivar (C)	Mo	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean
	.....................(cm).....................										
Hallma	+Mo	37.30	56.21	64.70	54.89	53.28	45.60	58.06	66.83	56.08	56.64
	-Mo	33.05	46.45	54.90	43.74	44.54	38.80	50.81	56.75	49.38	48.94
	Mean	35.18	51.33	59.80	49.32	48.91	42.20	54.43	61.79	52.73	52.79
Melesia	+Mo	40.50	57.02	67.46	57.42	55.60	48.05	59.51	70.68	56.83	58.77
	-Mo	34.10	47.08	55.93	45.11	45.55	39.88	53.33	58.28	49.50	50.24
	Mean	37.30	52.05	61.69	51.26	50.58	43.96	56.42	64.48	53.17	54.51
Siriver	+Mo	50.70	59.43	67.12	62.36	59.90	49.08	62.67	70.07	58.28	60.02
	-Mo	43.05	49.85	57.05	52.52	50.62	44.03	54.93	58.93	51.94	52.46
	Mean	46.88	54.64	62.08	57.44	55.26	46.55	58.80	64.50	55.11	56.24
Sewa	+Mo	63.70	67.93	70.66	67.97	67.57	60.85	68.54	72.06	68.72	67.54
	-Mo	55.55	53.00	58.25	55.43	55.56	57.35	50.51	59.27	58.63	58.69
	Mean	59.63	6.47	61.45	61.70	61.56	59.10	64.03	65.66	63.68	63.12
Ismailial	+Mo	64.78	67.85	68.59	68.38	67.40	64.13	69.97	71.39	70.03	68.88
	-Mo	54.48	55.44	55.71	55.72	55.34	58.90	59.52	58.08	58.78	58.82
	Mean	59.63	61.65	61.15	62.05	61.37	61.51	64.74	64.73	64.40	63.85
G Mean		47.72	56.3	62.04	56.35	55.53	50.67	59.68	64.23	58.82	58.10
Interaction of molybdenum X seasons											
+Mo		51.40	61.69	67.71	62.20	60.75	53.54	63.75	70.20	61.99	62.37
-Mo		44.05	50.37	56.37	50.50	50.32	47.79	55.62	58.26	53.65	53.83
Mean		47.72	56.03	62.04	56.35	55.53	50.67	59.68	64.23	57.82	58.10

LSD 0.05: S: 1.1 Mo: 0.8 C: 1.3 — S x Mo: 1.6 S x C: 2.5 — Mo x C: 1.78 SX Mo x C: 3.5 (Sandy)

S: 0.9 Mo: 0.6 C: 1.0 — S x Mo: 1.2 S x C: 2.0 — Mo x C: n.s SX Mo x C: n.s (Calcareous)

Table (30): Leaf/stem ratio of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the second growing year (2003-2004).

Soil		Sandy					Calcareous				
		Season (S)					Season (S)				
Cultivar (C)	Mo	Winter (2 uts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean	Winter (2cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean
		………………………………………(%)………………………………………									
Hallma	+Mo	47.21	62.73	64.58	45.64	55.04	52.39	59.11	66.59	67.87	61.49
	-Mo	40.04	52.38	54.51	39.02	46.49	44.38	51.74	58.18	56.99	52.82
	Mean	**43.63**	**57.55**	**59.54**	**42.33**	**50.76**	**48.38**	**55.43**	**62.39**	**62.43**	**57.16**
Melesia	+Mo	48.24	64.99	64.59	48.59	56.60	55.44	62.13	69.63	67.62	63.70
	-Mo	39.09	52.85	53.08	38.33	45.84	47.13	52.68	58.90	58.92	54.40
	Mean	**43.66**	**58.92**	**58.84**	**43.46**	**51.22**	**51.28**	**57.40**	**64.26**	**63.27**	**59.05**
Siriver	+Mo	56.21	66.34	67.90	56.01	61.62	55.90	63.48	69.98	69.09	64.61
	-Mo	44.95	55.90	57.43	45.19	50.87	50.25	55.14	58.48	57.36	55.31
	Mean	**50.58**	**61.13**	**62.67**	**50.6**	**56.24**	**53.08**	**59.31**	**64.23**	**63.23**	**59.96**
Sewa	+Mo	64.54	69.04	69.07	66.95	67.40	69.05	70.93	70.83	72.00	70.70
	-Mo	49.73	56.06	57.82	53.03	54.16	61.28	58.28	58.99	59.88	59.61
	Mean	**57.13**	**62.55**	**63.44**	**59.99**	**6.78**	**65.16**	**64.61**	**64.91**	**65.94**	**65.15**
Ismailial	+Mo	65.36	69.81	69.02	67.57	67.94	70.11	71.18	70.56	71.64	70.87
	-Mo	50.79	56.50	59.07	51.55	54.48	60.88	60.34	58.32	59.93	59.87
	Mean	**58.08**	**63.15**	**64.04**	**59.56**	**61.21**	**65.49**	**65.76**	**64.43**	**65.79**	**65.37**
G Mean		**50.62**	**60.66**	**61.71**	**51.19**	**56.04**	**56.68**	**60.50**	**64.05**	**64.13**	**61.34**
Interaction of molybdenum X seasons											
+Mo		56.31	66.59	67.3	56.95	61.72	60.58	65.37	69.52	69.64	66.28
-Mo		44.92	54.74	56.38	45.42	50.37	52.78	55.64	58.58	58.62	56.40
Mean		**50.62**	**60.66**	**61.71**	**51.19**	**56.04**	**56.68**	**60.50**	**64.05**	**64.13**	**61.34**

LSD 0.05: S: 0.9 Mo: 0.7 C: 1.0
S x Mo: n.s S x C: 2.1
Mo x C: 1.5 S x Mo x C: 2.9

S: 0.8 Mo: 1.1 C: 0.9
S x Mo: 1.1 S x C: 1.8
Mo x C: 1.3 S x Mo x C: n.s

It is also clear that there was a remarkable increase in dry leaf/stem ratio from the first to the second year. Meanwhile, summer season was superior in sandy soil in the first year with significant differences *I* compared with the other seasons. Whereas, the most higher leaf/stem ratio in the calcareous soil was in the summer and spring seasons. On the other hand, the lowest Ieaf7stem ratio during the first year was noticed during winter season of the two soils (sandy and calcareous). These results are in accordance with those found by **El-Saiaad (1981), Mousa (1982) and Nasr (1998).**

<u>Cultivars:</u>

The genotypic variation exerted its effect on the leaf/stem ratio of the tested alfalfa plants of various cultivars. Leaf/stem ratio was significantly different among alfalfa cultivars (overall seasons and Mo application) in each of the two soils and the two successive years (Tables 29 and 30). It is clear that the local alfalfa cultivars Ismalia-1 of leaf/stem ratio 65.4% and Sewa 65.15% were superior compared to the other cultivars. Whereas, the exotic cultivars Hallma recorded the lowest ratio of leaf stem ratio (57.16%) in the calcareous soil during the second year.

Ismalia-1 cultivar exceeded the other cultivars (Hallma, Melesia, Siriver, Sewa) in this study trait.

The growing seasons are greatly affected by the genotypic performance of the tested cultivars. The inconsistent behavior of cultivars in this trait could be due to the seasonal significant differences. Also, the local cultivars showed superiority over the exotic ones during winter season in the two soils and during the two years. This could be due to the genetic potentiality of this studied trait during winter season. However, this potentiality was slightly changed in the summer season. This may be due to the genotypic and environmental interaction. These results are in agreement with **vorachek (1973), Ghobrial (1978), Mousa (1982), Mousa et al (1996), Geweifel (1997) and Oushy et al (1999).**

<u>Molybdenum (Mo) application:</u>

Over all seasons and cultivars, application' .of Mo fertilizer significantly increased leaf/stem ratio of alfalfa plants compared to the control (without Mo application) in each of the two soils. There was a great response to Mo application where Leaf/stem ratios of 70.2 and 67.7% were achieved due to cultivars in the calcareous and sandy soil, respectively during the summer season of the first year, while in the second year autumn season showed great response to molybdenum in calcareous soil regarding Leaf/stem ratio of plants (69.6%). Similar trend was observed in the sandy soil particularly in the summer season.

Application of molybdenum was accompanied by the highest leaf/stem ratio of 61.34 and 58.10% for the calcareous soil in the second and first year, respectively. On the other hand, the lowest L/S ratios (over Mo application) were of 55.5 and 56.04% in the sandy soil during the first and second year, respectively.

Yearly and seasonal plant height:

Plant heights data of the first and second years are presented in Tables (31 and 32).

Significant differences in plant height were observed among the growing seasons (over alfalfa cultivars and Mo application). Regarding this trait, it could be concluded that summer cuts were superior in sandy soil of the two years, while autumn season was the best in the first and second years in the calcareous soil. The shortest plants were obtained from cuts taken in winter season in each soil

Table (32): Plant height of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the second growing year (2003-2004).

Soil		Sandy					Calcareous				
		Season (S)					Season (S)				
Cultivar (C)	Mo	Winter (2cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean	Winter (2cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean
	..........(cm)..........										
Hallma	+Mo	32.83	35.62	38.83	39.00	36.57	31.25	33.50	40.25	42.25	36.81
	-Mo	25.75	29.75	33.42	27.33	29.06	21.67	24.75	35.83	38.50	30.40
	Mean	**29.29**	**32.69**	**36.13**	**33.17**	**32.82**	**26.46**	**29.54**	**38.04**	**40.38**	**33.60**
Melesia	+Mo	31.75	33.63	39.08	38.67	35.78	28.50	32.67	39.67	43.75	36.15
	-Mo	25.25	30.88	30.92	31.92	29.74	21.17	36.42	33.50	36.88	29.07
	Mean	**28.50**	**32.25**	**35.00**	**35.29**	**32.76**	**24.83**	**28.71**	**36.58**	**40.31**	**32.61**
Siriver	+Mo	33.67	34.50	42.50	43.25	38.48	29.58	44.25	41.17	44.75	37.98
	-Mo	28.50	32.50	37.00	35.17	33.29	22.58	26.25	34.17	37.75	30.19
	Mean	**31.08**	**33.50**	**39.75**	**39.21**	**35.89**	**26.08**	**31.23**	**37.67**	**41.25**	**34.08**
Sewa	+Mo	43.67	42.00	46.00	44.42	44.02	44.50	44.83	43.92	45.63	44.57
	-Mo	32.42	36.00	37.58	36.75	35.69	35.25	36.17	37.83	38.88	37.03
	Mean	**38.04**	**39.00**	**41.79**	**40.58**	**39.85**	**39.88**	**40.21**	**40.88**	**42.25**	**40.80**
Ismailia1	+Mo	43.75	43.25	46.33	45.92	44.81	45.00	25.58	44.67	45.13	44.91
	-Mo	31.67	35.00	36.75	37.08	35.13	35.25	36.33	36.50	38.63	36.68
	Mean	**37.71**	**39.13**	**41.54**	**41.50**	**39.97**	**40.13**	**40.58**	**40.58**	**41.88**	**40.79**
G Mean		**32.93**	**35.31**	**38.84**	**37.95**	**36.26**	**31.48**	**34.08**	**38.75**	**41.21**	**36.38**
Interaction of molybdenum X seasons											
+Mo		37.13	37.80	42.55	42.25	39.93	35.77	38.33	41.93	44.30	40.08
-Mo		28.72	32.83	35.13	33.65	32.58	27.18	29.83	35.57	38.13	32.67
Mean		**32.93**	**35.31**	**38.84**	**37.95**	**36.26**	**31.48**	**34.08**	**38.75**	**41.21**	**36.38**

LSD 0.05: S: 0.90 Mo: 0.63 C: 1.0
S x Mo: 1.3 S x C: 2.0
Mo x C:1.4 SX Mo x C: n.s

S: 0.9 Mo: 0.7 C: 1.0
S x Mo: 1.3 S x C:2.04
Mo x C: n.s SX Mo x C: n.s

Table (31): Plant height of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the first growing year (2002-2003).

Soil		Sandy					Calcareous				
		Season (S)					Season (S)				
Cultivar (C)	Mo	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean
		(cm)									
Hallma	+Mo	36.75	36.50	41.58	42.08	39.23	33.50	30.33	40.33	42.50	36.67
	-Mo	27.00	31.42	36.42	30.83	31.42	23.75	23.83	30.92	36.25	28.69
	Mean	**31.88**	**33.96**	**39.00**	**36.46**	**35.32**	**28.63**	**27.08**	**35.63**	**39.38**	**32.68**
Melesia	+Mo	34.00	34.33	41.50	41.08	37.73	30.00	28.50	40.33	42.75	35.40
	-Mo	23.50	26.58	34.83	31.33	29.06	22.75	23.08	32.58	36.50	28.73
	Mean	**28.75**	**30.46**	**38.17**	**36.21**	**33.40**	**26.38**	**25.79**	**36.46**	**39.63**	**32.06**
Siriver	+Mo	36.50	36.58	43.67	40.92	39.42	44.00	41.25	42.00	43.92	42.79
	-Mo	27.50	29.42	36.58	34.25	31.94	34.50	31.75	37.00	36.50	34.94
	Mean	**32.00**	**33.00**	**40.13**	**37.58**	**35.68**	**39.25**	**36.50**	**39.50**	**40.21**	**38.87**
Sewa	+Mo	43.00	41.17	45.08	43.17	43.10	45.75	46.42	46.58	45.42	46.04
	-Mo	36.00	32.67	37.42	36.75	35.71	36.50	37.50	37.33	37.75	37.27
	Mean	**39.50**	**36.92**	**41.25**	**39.96**	**39.41**	**41.13**	**41.96**	**41.96**	**41.58**	**41.66**
Ismailial	+Mo	44.50	42.67	45.17	44.33	44.17	45.00	47.08	48.67	46.75	46.88
	-Mo	36.50	33.50	38.08	36.92	36.25	36.50	35.92	38.58	38.67	37.42
	Mean	**40.50**	**38.08**	**41.63**	**40.63**	**40.21**	**40.75**	**41.50**	**43.63**	**42.71**	**42.15**
G Mean		34.53	34.48	40.03	38.17	36.80	35.23	34.57	39.43	40.70	37.48
Interaction of molybdenum X seasons											
+Mo		38.95	38.25	43.40	42.32	40.73	39.65	38.72	43.58	44.27	41.55
-Mo		30.10	30.72	36.67	34.02	32.88	30.80	30.42	35.28	37.13	33.41
Mean		34.53	34.48	40.03	38.17	36.80	35.23	34.57	39.43	40.70	37.48

LSD 0.05: S: 1.0 Mo: 0.7 C: 1.1
S x Mo: n.s S x C: 2.2
Mo x C: n.s S x Mo x C: n.s

S: 1.0 Mo: 0.7 C: 1.1
S x Mo: n.s S x C:2.2
Mo x C: n.s S x Mo x C: n.s

(sandy or calcareous) and in each of the two duration years. The average plant height over the tested entries was relatively higher in summer and in autumn by 16% and 15.5% than during winter in the sandy and calcareous soils, respectively, during the first year of the stand duration. The percentage of increase was much higher (31%) in the second year of the same seasons in calcareous soil.

Cultivars:

Results of Tables (31 and 32) show that significant differences were observed among cultivars over the growing seasons and Mo application. This trend was true in each soil during the successive years. The two local cultivars produced the tallest plants in the two soils and years. Whereas the shortest plants were produced by the three exotic cultivars in each soil during the two years. It seems that tested cultivars could be arranged in two categories, according to their winter-growth activities. In the first year and sandy soil, the local Ismailia-1 (40.50cm) was of the tallest plants in winter season compared to the exotic Melesia cultivars (28.75cm) that produced the shortest plants. The same trend was observed in the calcareous soil where Sewa was of the tallest among the tested cultivars, while in the summer season the local Ismalia-1 (43.63cm) was of tallest plants as compared with the local cultivars. During the second year, Ismalia-1 was of the tallest plants in sandy soil and Sewa was the tallest one (40.58cm) in calcareous soil. These results have indicated that the interactions between the alfalfa genotypes and the environment was so obvious and the variations in plant heights overall the tested entries were greatly noticed. Moreover, the genotypic environmental interaction was statistically detected among the tested entries within each season in the two years period of the study. This could be accounted for yield as a one part of the yield component **(Mousa et al., 1996, Geweifel 1997 and Oushy et al., 1999b).**

Molybdenum (Mo) application:

Results in Tables (31 and 32) show that Mo application significantly increased plant heights of alfalfa plants compared to the control (without Mo application) in each of the two soils (sandy or calcareous).

Results indicate that over the growing alfalfa cultivars and seasons, plant heights were significantly and positively responded to Mo application. There was a great response to

Mo application on the height of plants during summer season in sandy soil. Similar trend was observed in calcareous soil particularly in autumn season during the first year. Whereas, during the second year, autumn season showed great response to Mo application for alfalfa grown in sandy and calcareous soils.

Application of molybdenum was accompanied, by producing the highest plant height of 41.55 and 40.08cm in the calcareous soil during the first and second years, respectively as compared to sandy soil. The relative increases of plant height were 23.9 and 24.4% in the first year being 22.6 and 22.7% in the second year in sandy and calcareous soils in prenence and absence of the Mo application, respectively.

Results in Tables (31 and 32) show that during summer season, plants can absorb high quantities of nutrients, water which produce the tallest plants as compared with those grown in winter season. In case of calcareous soil, both of exotic and local cultivars produced tallest plants in autumn season. The differences among cultivars were significant in all seasons. This trend was true in both of the sandy or calcareous soils. These results are in agreement with those reported by **Hafmert et al. (1992), Singh et al. (1992) and Hazra and Tripathi (1998).**

Crude protein (CP) content:

Seasonal variations reflected their effect on crude protein content (CP) of the obtained forage grasses and the applied molybdenum (Mo) treatment (Tables 33 and 34, A 34 and 35).

It is well noticed that for either Mo treatment or its control, the descending ranking order for CP content was winter, followed by spring, then autumn followed by summer in sandy soil, while in calcareous soil the descending ranking order for CP content was winter, followed by autumn, then spring followed by summer. This trend was true for either Mo treated or the control treatment.

Results indicate an active role for Mo in increasing CP content of the treated alfalfa cultivars as compared with the untreated ones. This
result was noticed when alfalfa grown in sandy and calcareous soil and in each of the four growing seasons with various magnitudes.

Differences in CP content when compars between the Mo-treated and the untreated alfalfa plants during winter was higher in calcareous soil (3.01) than in sandy soil (2.67); in spring it was higher in sandy soil (2.32) than in the calcareous soil (1.92); in summer, it was higher in calcareous soil (2.65) than in sandy soil (1.43); whereas, in autumn, the increase in CP content was almost similar in sandy (3.5) and calcareous soils (3.65).

In conclusion, Mo increased CP content in alfalfa plants than the untreated ones. This increase was noticed in each of the four growing seasons with various magnitudes. This results are in agreement with those reported by **Batishcher et al. (1989), Kvyatkowskii (1990) and Heuwinkel and Gutser (1997).**

Regarding alfalfa cultivars, the increases in their CP content were almost similar as a result of Mo treatment compared to the control with slightly higher magnitude in the calcareous than in the sandy soil. However, the highest increase in CP content was for Sewa and Hallma which were 2.74 and 3.05 in sandy and calcareous soil respectively.

Crude fiber (CF) content:

Results in Tables (33 and 35, A 34 and 35) indicate that application of Mo exerted significant effect in decreasing CF content of alfalfa forage (over the grown cultivars). This decrease in CF content was true in sandy and calcareous soils for all seasons (winter, spring, summer and autumn) with various magnitudes.

In sandy soil, the highest effect of Mo in decreasing CF content was in spring and summer seasons, where the decrease in CF content was 4.11 and 4.87%, respectively, as compared with the control. However, in calcareous soil, Mo extensively decreased CF content in winter and summer season where such decrease compared to the control was 3.54 and 4.53%, respectively. Meanwhile, Mo application showed the least decrease in CF content was during autumn in sandy and calcareous soil where the decreases were 2.53 and 2.38%, respectively.

Over seasons, there was a vast variation in CF content between the grown alfalfa cultivars as it is clear in Tables (33 and 35, A 34 and 35), Results clarify that applying Mo caused the deepest decrease in CF content for Sivirer and Melesia cultivars as compared with the control. This result was noticed in sandy and calcareous soils, respectively.

It is also clear that the less sensitive alfalfa cultivars to be affected by the decrease in CF content due to Mo

Table (33): Chemical constituents of alfalfa cultivars grown in sandy and calcareous soils as affected by seasons and molybdenum application.

Soil	Sandy								Calcareous							
Season	Winter (cut 2)		Spring (cut 2)		Summer (cut 2)		Autumn (cut 2)		Winter (cut 2)		Spring (cut 2)		Summer (cut 2)		Autumn (cut 2)	
Molybdenum (kg/fed.)	+ Mo	- Mo	+ Mo	- Mo	+ Mo	- Mo	+ Mo	- Mo	+ Mo	- Mo	+ Mo	- Mo	+ Mo	- Mo	+ Mo	- Mo
	……………………%															
Crude Protein (CP):																
Cultivar																
Hallma	19.24	17.35	17.10	14.90	11.39	10.15	17.33	13.34	23.95	19.44	15.99	14.72	13.72	10.53	16.30	13.07
Melesia	20.59	17.77	15.37	13.67	12.87	10.37	16.07	12.20	19.55	16.33	16.01	14.24	13.49	10.68	16.61	13.23
Siriver	19.25	16.31	16.29	13.95	12.19	10.92	15.37	12.42	20.54	18.34	17.52	15.49	12.52	10.48	19.37	14.71
Sewa	18.99	15.90	16.84	13.75	11.89	10.73	15.78	12.19	19.34	17.08	16.61	14.05	14.25	11.79	16.95	13.64
Ismailia-1	18.03	15.43	15.73	13.47	11.81	10.82	16.07	12.93	20.30	17.46	16.09	14.09	12.91	11.14	17.84	14.19
Mean	19.22	16.55	16.27	13.95	12.03	10.60	16.12	12.62	20.74	17.73	16.44	14.52	13.38	10.92	17.41	13.77
Crude Fiber (CF):																
Cultivar																
Hallma	15.47	18.09	14.80	19.47	22.09	27.43	18.58	22.70	13.93	16.58	16.92	19.30	22.35	25.65	17.93	19.88
Melesia	13.99	18.43	16.53	21.33	19.60	25.93	19.73	23.20	15.06	17.97	16.44	17.52	21.47	25.83	19.05	20.65
Siriver	15.94	18.75	16.09	19.72	21.45	23.93	21.13	24.09	14.20	18.40	15.21	18.56	20.39	25.65	16.99	19.54
Sewa	14.71	17.57	16.18	19.83	21.22	26.98	21.23	22.45	14.81	19.25	16.10	19.25	18.74	24.73	19.00	21.47
Ismailia-1	16.37	19.44	16.66	20.47	19.98	24.44	21.00	21.84	13.59	17.07	17.07	17.68	20.80	24.53	17.57	19.92
Mean	15.30	16.37	19.44	20.16	20.87	25.74	20.33	22.86	14.31	17.85	16.35	18.47	20.75	25.28	17.91	20.29
Ash:																
Cultivar																
Hallma	11.63	10.38	10.26	9.72	9.60	9.23	9.62	8.58	12.72	11.90	10.68	9.15	9.87	9.09	9.46	8.55
Melesia	10.99	10.54	10.34	9.67	9.97	9.13	9.17	8.25	12.45	10.75	1.24	9.99	10.08	9.33	9.62	8.57
Siriver	10.91	10.30	10.13	9.52	9.93	9.35	8.45	7.97	12.45	11.15	10.41	9.99	9.91	9.36	1.37	9.15
Sewa	11.25	10.52	10.05	9.24	9.97	9.34	9.44	8.38	11.58	10.83	10.25	9.57	9.94	9.29	9.60	8.62
Ismailia-1	10.78	10.04	9.90	9.07	9.59	9.07	9.65	8.67	12.19	11.19	10.41	9.95	9.79	8.93	9.74	8.64
Mean	11.11	10.35	10.14	9.44	9.81	9.23	9.27	8.37	12.28	11.16	10.40	9.73	9.95	9.20	9.76	8.71
Ether extract:																
Cultivar																
Hallma	1.51	1.10	2.10	1.73	1.28	1.10	1.48	1.02	1.77	1.47	2.17	1.78	1.35	1.13	1.48	0.99
Melesia	1.68	1.39	1.81	1.54	1.42	0.97	1.37	1.05	1.77	1.32	2.10	1.72	1.59	1.17	1.47	0.97
Siriver	1.47	0.93	1.93	1.52	1.32	1.08	1.20	0.94	1.63	1.42	2.33	2.06	1.57	1.20	1.84	1.26
Sewa	1.44	1.11	1.98	1.49	1.35	1.07	1.42	1.13	1.70	1.24	2.10	1.51	1.55	1.22	1.45	1.11
Ismailia-1	1.39	0.95	1.94	1.45	1.25	0.74	1.60	1.15	1.82	1.42	2.22	1.97	1.53	1.08	1.59	1.10
Mean	1.50	1.1	1.94	1.55	1.32	1.00	1.41	1.06	1.74	1.37	2.18	1.81	1.52	1.16	1.57	1.09
NFE:																
Cultivar																
Hallma	52.16	53.09	55.80	54.19	55.65	52.10	53.01	54.37	47.64	5.63	54.26	55.06	52.72	53.61	54.84	57.52
Melesia	52.76	51.89	55.97	53.81	56.16	53.62	53.68	55.30	51.18	53.65	54.23	56.55	53.39	53.01	53.26	56.60
Siriver	52.44	53.72	55.57	55.30	55.13	54.74	53.86	54.59	51.19	50.70	54.55	53.91	55.63	53.32	51.44	55.35
Sewa	53.62	54.91	54.96	55.70	55.58	51.90	52.15	55.87	52.58	51.61	54.95	55.93	54.53	52.99	53.00	55.17
Ismailia-1	53.45	54.15	55.78	55.56	57.38	54.94	51.69	55.42	52.12	52.87	55.22	56.32	54.98	54.34	53.27	56.17
Mean	52.87	53.55	55.61	52.41	55.98	53.44	52.88	55.11	48.68	51.89	54.64	55.49	54.23	53.46	53.36	56.16
TDN:																
Cultivar																
Hallma	67.92	66.07	67.21	64.45	61.87	59.29	65.88	62.52	70.63	67.59	65.91	64.43	62.82	60.13	65.66	63.46
Melesia	69.09	66.13	65.77	63.19	63.48	59.95	64.87	61.81	68.22	65.66	66.10	64.89	63.50	60.13	65.38	63.25
Siriver	67.74	65.35	66.36	63.92	62.47	60.96	64.3	61.57	68.98	66.40	67.24	65.06	63.03	60.11	67.40	64.33
Sewa	68.10	65.62	66.57	63.79	62.43	59.72	64.17	62.10	68.22	65.51	66.50	64.15	64.88	61.05	65.55	63.12
Ismailia-1	67.03	64.69	65.89	63.42	62.86	60.72	64.39	62.66	69.11	66.51	65.89	64.76	63.05	60.83	66.49	63.95
Mean	67.98	65.57	66.36	63.76	62.62	60.13	64.67	62.13	70.05	66.34	66.33	64.66	63.36	60.45	66.17	63.62

+ Mo = with molybdenum, - Mo = without molybdenum.

Table (34): Crude protein content of alfalfa cultivars grown in sandy and calcareous soils as affected by seasons and molybdenum application.

Soils	Sandy soil			Calcareous soil		
Treatment	+ Mo	- Mo	Range	+ Mo	- Mo	Range
	………………	………………	……………… %	………………	………………	………………
Season						
Winter	19.22	16.55	2.67	20.74	17.73	3.01
Spring	16.27	13.95	2.32	16.44	14.52	1.92
Summer	12.03	10.60	1.43	13.57	10.92	2.65
Autumn	16.12	12.62	3.50	17.42	13.77	3.65
Minimum	12.03	10.60	1.43	13.57	10.92	1.92
Maximum	19.22	16.55	3.50	20.74	17.73	3.65
Range	7.19	5.95	2.07	7.17	6.81	1.73
Culivar						
Hallma	16.27	13.94	2.33	17.49	14.44	3.05
Melesia	16.23	13.50	2.73	16.42	13.62	2.80
Siriver	15.78	13.40	2.38	17.49	14.76	2.73
Sewa	15.88	13.14	2.74	16.79	14.17	2.62
Ismailia-1	15.41	13.16	2.25	16.79	14.22	2.57
Minimum	15.41	13.14	2.25	16.42	13.62	2.57
Maximum	16.27	13.94	2.74	17.49	14.76	3.05
Rang	0.86	0.80	0.49	1.07	1.14	0.48

Table (35): Crude fiber content of alfalfa cultivars grown in sandy and calcareous soils as affected by seasons and molybdenum application.

Soils	Sandy soil			Calcareous soil		
Treatment	+ Mo	- Mo	Range	+ Mo	- Mo	Range
	………………	………………	……………… %	………………	………………	………………
Season						
Winter	15.3	18.46	3.46	14.31	17.85	3.54
Spring	16.05	20.16	4.11	16.35	18.47	2.12
Summer	20.87	25.74	4.87	20.75	25.28	4.53
Autumn	20.33	22.86	2.53	17.91	20.29	2.38
Minimum	20.87	25.74	4.87	20.75	25.28	4.53
Maximum	15.30	18.46	2.53	14.31	17.85	2.12
Range	5.57	7.28	2.34	6.44	7.43	2.41
Culivar						
Hallma	17.74	21.92	4.48	17.78	20.35	2.57
Melesia	17.46	22.22	4.76	18.01	20.49	2.48
Siriver	18.65	21.62	2.97	16.70	20.54	3.84
Sewa	18.34	21.71	3.37	17.16	21.18	4.02
Ismailia-1	18.50	21.55	3.05	17.26	19.80	2.54
Minimum	17.46	21.55	2.97	16.70	19.80	2.48
Maximum	18.65	22.22	4.76	18.01	21.18	4.02
Rang	1.20	1.67	1.79	1.31	1.38	1.54

treatment was Sirever in sandy soil and Melesia in calcareous soil.

The other cultivars under study were differently affected by the applied Mo treatments in respect to their CF content with different ranges (Tables 33 and 35, A 34 and 35).

Ash content:

The Mo treatment caused slight increase in ash content of alfalfa forage (over cultivars) in all seasons and soils with slight variable magnitudes (Tables 33 and 36, A 34 and 35).

Differences in ash content as a response of Mo in increasing in such parameter content compared to the control could be ranked in the following descending order as follows: autumn (0.90%), winter (0.76%), spring (0.70%) and summer (0.58%) in sandy soil arid winter (1.12%), autumn (1.05%), summer (0.75%) and spring (0.67%) in calcareous soil.

It is obviously clear that Mo treatment increased ash content for each of the grown alfalfa cultivars (over seasons) with a very slight variable ranges whether in sandy or calcareous soil (Tables 33 and 36, A 34 and 35). Where the

Table (36): Ash content of alfalfa cultivars grown in sandy and calcareous soils as affected by seasons and molybdenum application.

Soils	Sandy soil			Calcareous soil		
Treatment	+ Mo	- Mo	Range	+ Mo	- Mo	Range
	..................%					
Season						
Winter	11.11	10.35	0.76	12.28	11.16	1.12
Spring	10.14	9.44	0.70	10.40	9.73	0.67
Summer	9.81	9.23	0.58	9.95	9.20	0.75
Autumn	9.27	8.37	0.90	9.76	8.71	1.05
Minimum	9.27	8.37	0.58	9.76	8.71	0.67
Maximum	11.11	10.35	0.90	12.28	11.16	1.12
Range	1.84	1.98	0.32	2.52	2.45	0.45
Culivar						
Hallma	10.28	9.48	0.80	10.68	9.67	1.01
Melesia	10.12	9.40	0.72	10.60	9.66	0.94
Siriver	9.86	9.29	0.53	10.79	9.91	0.88
Sewa	9.86	9.37	0.49	10.34	9.58	0.76
Ismailia-1	10.18	9.21	0.97	10.53	9.68	0.85
Minimum	9.86	9.21	0.49	10.34	9.58	0.76
Maximum	10.28	9.48	0.97	10.79	9.91	1.01
Rang	0.42	0.27	0.48	0.45	0.33	0.25

Table (37): Ether extract content of alfalfa cultivars grown in sandy and calcareous soils as affected by seasons and molybdenum application.

Soils	Sandy soil			Calcareous soil		
Treatment	+ Mo	- Mo	Range	+ Mo	- Mo	Range
	..................%					
Season						
Winter	1.50	1.10	0.40	1.74	1.37	0.37
Spring	1.94	1.55	0.39	2.18	1.81	0.37
Summer	1.32	1.00	0.32	1.52	1.16	0.36
Autumn	1.41	1.06	0.35	1.57	1.09	0.48
Minimum	1.32	1.00	0.32	1.52	1.09	0.36
Maximum	1.94	1.55	0.40	2.18	1.81	0.48
Range	0.62	0.55	0.08	0.66	0.72	0.12
Culivar						
Hallma	1.24	1.59	0.35	1.34	1.69	0.35
Melesia	1.24	1.57	0.33	1.30	1.73	0.43
Siriver	1.12	1.48	0.36	1.49	1.84	0.35
Sewa	1.20	1.55	0.35	1.27	1.70	0.43
Ismailia-1	1.07	1.55	0.48	1.39	1.79	0.40
Minimum	1.12	1.48	0.33	1.27	1.69	0.35
Maximum	1.24	1.59	0.48	1.49	1.84	0.43
Rang	0.12	0.11	0.15	0.22	0.15	0.08

average range of invereus ash content was slightly higher (0.41%) in calcareous than in sandy soil (0.27%).

Results may indicate that the effect of Mo in increasing ash content was somewhat better for Ismailia-1 in sandy soil, and for Hallma in calcareous soil.

Ether Extract (EE) content:

The effect of Mo application and seasonal variations did not show wide noticeable differences in EE content of the obtained forage material (Tables 33 and 37, A 34 and 35). This is due to the very narrow values and range of EE content.

Also, no recognizable difference could be detected in EE content between the grown alfalfa cultivars as Mo treatment was applied compared to the control. This result was recorded in either sandy or calcareous soil (Tables 33 and 37, A 34 and 35).

Nitrogen Free Extract (NFE) content:

Data in Tables (33 and 38, A 34 and 35) evedentiate a wide variations in NFE content due to the applied Mo treatment in alfalfa forage (over cultivars) within the growing seasons and within the soil types of cultivation.

In sandy soil, the highest increase in NFE due to applying Mo was noticed in spring (3.2%) while the lowest increase was in winter season (0.68%). But, in calcareous soil, the highest increase in NFE content was noticed in winter (3.21%) and the lowest increase was recorded in summer (0.77%).

The increase in NFE as a result of applying Mo treatment was clear in all alfalfa cultivars (over seasons) and soils as it is clear from Table (33 and 38, A 34 and 35). Eventhough such obtained differences in NFE were slightly small in value and range between the Mo treated and the control, but varied among the type of soil (sandy or calcareous).

The highest increase in NFE due to the applied Mo was noticed for Melesia cultivar in sandy and calcareous soil which was 0.98 and 1.93% respectively. Also, such increase was the smallest in Shiver (0.44), (0.12) in sandy and calcareous soil. Other differences in NFE were recorded due to the applied Mo treatment and the soil type in Tables (33 and 38, A 34 and 35). However, the average difference of increase in NFE for alfalfa cultivars was higher in

Table (38): Nitrogen Free Extract content of alfalfa cultivars grown in sandy and calcareous soils as affected by seasons and molybdenum application.

Soils	Sandy soil			Calcareous soil		
Treatment	+ Mo	- Mo	Range	+ Mo	- Mo	Range
	.... %					
Season						
Winter	52.87	53.55	0.68	48.68	51.89	3.21
Spring	55.61	52.41	3.20	54.64	55.49	0.85
Summer	55.98	53.44	2.54	54.23	53.46	0.77
Autumn	52.88	55.11	2.23	53.36	56.16	2.80
Minimum	52.87	52.41	0.68	48.68	51.89	0.77
Maximum	55.98	55.11	3.20	54.64	56.16	3.21
Range	3.11	2.70	2.52	5.96	4.27	2.44
Culivar						
Hallma	54.16	53.44	0.72	52.37	54.20	1.83
Melesia	54.64	53.66	0.98	53.20	54.95	1.93
Siriver	54.25	54.59	0.34	53.20	53.32	0.12
Sewa	54.08	54.60	0.52	53.77	53.93	0.16
Ismailia-1	54.58	55.02	0.44	53.90	54.93	1.03
Minimum	54.08	53.44	0.34	52.37	53.32	0.12
Maximum	54.64	55.02	0.98	53.90	54.95	1.93
Rang	0.56	1.58	0.64	1.53	1.63	1.81

Table (39): Crude protein content of alfalfa cultivars grown in sandy and calcareous soils as affected by seasons and molybdenum application.

Soils	Sandy soil			Calcareous soil		
Treatment	+ Mo	- Mo	Range	+ Mo	- Mo	Range
	.... %					
Season						
Winter	67.98	65.57	2.41	70.05	66.34	3.71
Spring	66.36	63.76	2.60	66.33	64.66	1.67
Summer	62.62	60.13	2.49	63.36	60.45	2.91
Autumn	64.67	62.13	2.54	66.17	63.62	2.55
Minimum	62.62	60.13	2.49	63.36	60.45	1.67
Maximum	67.98	65.57	2.60	70.05	66.34	3.71
Range	5.36	5.44	0.11	6.69	5.89	2.04
Culivar						
Hallma	65.72	63.80	2.64	66.26	63.90	2.36
Melesia	65.80	62.77	3.30	65.80	63.48	2.32
Siriver	65.15	62.95	2.20	66.66	63.98	2.68
Sewa	65.32	62.81	2.51	66.29	63.46	2.83
Ismailia-1	65.04	62.87	2.17	66.14	64.01	2.13
Minimum	65.15	62.77	2.17	65.80	63.46	2.13
Maximum	65.80	63.08	3.03	66.66	64.01	2.83
Rang	0.65	0.31	0.86	0.86	0.55	0.70

calcareous soil (1.81) compared to sandy soil (0.64) as a response to Mo treatment.

Total Digestible Nutrients (TDN) content:

In sandy soil, results in Table (33 and 39, A 34 and 35) did not show appreciable differences in TDN contents of the obtained alfalfa forage (over the cultivars) as affected by seasonal variation. This is because the range among the differences in TDN content between the Mo treated and control over the four seasons was almost ignorable (0.11).

However, the situation was completely different in calcareous soil (Tables 33 and 39, A 34 and 35). Seasonal variation exerted a wide range of variation in the TDN of the obtained forage materials due to the applied Mo treatment. The increase in TDN content due to the applied Mo treatments could be ranked in a descending order as follows: winter, summer, autumn and spring where the decrease in TDN was 3.71, 2.91, 2.55 and 1.67%, respectively with a wide range of 2.04% over the four seasons.

Alfalfa cultivars responded to Mo treatment in respect to their TDN in an almost similar magnitude. This result was true in sandy and calcareous soil as well, since the average range of differences in TDN content over the grown alfalfa cultivars was 0.86 and 0.70% in sandy and calcareous soil, respectively (Tables 33 and 39, A 34 and 35).

Nutrients content:

Nitrogen:

Data of N-uptake of alfalfa grown on sandy and calcareous soils as affected by seasons, cultivars and molybdenum application are presented in Tables (40 and 41, A 30 and 31). Results show in the first and second years, noticeable variable magnitudes between soils. Calcareous soil produced the highest N-uptake of alfalfa cultivars as compared with sandy one in all seasons. The superiority of calcareous soil as compared with sandy may be due to the great losses of N fertilizer from sandy soil which is poor in its colloidal fraction via leaching. With sandy soil, the summer and autumn seasons gave the highest N-uptake in the first and the second years (2.226 and 3.368 g/pot, respectively); while the lowest N-uptake was in winter season during all growing seasons with the Mo application. Plants grown on the calcareous soil showed the highest values of N-uptake in the summer and autumn seasons

Table (40): Nitrogen uptake of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the first growing year (2002-2003).

Soil		Sandy					Calcareous				
		Season (S)					Season (S)				
Cultivar (C)	Mo	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean
Hallma	+Mo	0.393	1.644	1.493	1.986	1.379	0.902	4.843	6.113	3.537	3.849
	-Mo	0.125	0.676	0.493	0.705	0.500	0.204	2.125	3.319	1.980	1.907
	Mean	0.259	1.160	0.993	1.345	0.939	0.553	3.484	4.716	2.758	2.878
Melesia	+Mo	0.284	1.975	1.692	1.785	1.434	0.905	4.288	6.279	3.294	3.692
	-Mo	0.078	0.690	0.471	0.860	0.520	0.126	2.005	3.028	1.951	1.778
	Mean	0.181	1.322	1.082	1.322	0.977	0.516	3.147	4.654	2.623	2.735
Siriver	+Mo	0.372	2.366	2.008	2.192	1.735	0.897	4.497	6.980	3.479	3.963
	-Mo	0.136	0.756	0.422	1.043	0.589	0.231	2.508	2.597	2.001	1.834
	Mean	0.254	1.561	1.215	1.618	1.162	0.564	3.503	4.788	2.740	2.899
Sewa	+Mo	0.390	2.544	1.908	3.597	2.110	1.194	8.052	9.298	5.318	5.965
	-Mo	0.159	1.161	0.773	1.632	0.931	0.671	3.634	3.570	2.412	2.572
	Mean	0.274	1.852	1.341	2.615	1.520	0.933	5.843	6.434	3.865	4.269
Ismailia1	+Mo	0.390	3.136	2.788	3.759	2.518	1.961	6.991	13.776	2.656	6.846
	-Mo	0.156	1.392	1.070	2.130	1.187	0.561	2.927	5.845	2.858	3.048
	Mean	0.273	2.264	1.929	2.944	1.853	1.261	4.959	9.811	3.757	4.947
G Mean		0.248	1.632	1.312	1.969	1.290	0.765	4.187	6.080	3.149	3.545
Interaction of molybdenum X seasons											
+Mo		0.366	2.333	1.978	2.664	1.835	1.172	5.734	8.489	4.057	4.863
-Mo		0.131	0.931	0.646	1.274	0.745	0.359	2.640	3.672	2.240	2.228
Mean		0.248	1.632	1.312	1.969	1.290	0.765	4.187	6.080	3.149	3.545

LSD 0.05: S: 0.13 Mo: 0.09 C: 0.14
S x Mo: 0.18 S x C: 0.28
Mo x C: 0.20 S x Mo x C: n.s

S: 0.3 Mo: 0.22 C: 0.34
S x Mo: 0.43 S x C: 0.68
Mo x C: 0.48 S x Mo x C: 0.96

Table (41): Nitrogen uptake of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the second growing year (2003-2004).

Soil		Sandy					Calcareous				
		Season (S)					Season (S)				
Cultivar (C)	Mo	Winter (2cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean	Winter (2cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean
		..........(Kg/pot.)..........									
Hallma	+Mo	1.799	1.937	1.731	2.929	2.099	5.495	5.874	3.945	4.451	4.942
	-Mo	0.514	0.829	0.675	1.133	0.788	2.267	2.566	1.847	2.019	2.175
	Mean	1.156	1.383	1.203	2.031	1.443	3.881	4.220	2.896	3.235	3.558
Melesia	+Mo	1.546	1.840	1.884	2.843	2.028	4.491	4.836	3.525	3.565	4.104
	-Mo	0.556	0.845	0.542	1.528	0.868	2.246	2.697	1.960	1.854	2.189
	Mean	1.051	1.342	1.213	2.186	1.448	3.368	3.766	2.742	2.709	3.147
Siriver	+Mo	1.597	2.217	2.087	3.753	2.414	4.873	6.132	4.884	5.402	5.323
	-Mo	0.575	0.838	0.674	1.567	0.914	2.259	2.713	1.689	1.726	2.097
	Mean	1.086	1.528	1.380	2.660	1.664	3.566	4.422	3.287	3.564	3.710
Sewa	+Mo	2.475	4.760	2.828	4.850	3.728	5.830	8.823	8.068	10.102	8.206
	-Mo	1.167	2.325	1.163	2.246	1.725	3.120	4.107	2.967	4.146	3.585
	Mean	1.821	3.543	1.995	3.548	2.727	4.475	6.465	5.518	7.124	5.895
Ismailia1	+Mo	2.981	5.646	3.870	5.954	4.613	7.360	8.218	9.965	12.978	9.630
	-Mo	1.383	2.986	1.581	2.527	2.119	2.706	4.105	4.790	5.512	4.278
	Mean	2.182	4.316	2.725	4.240	3.366	5.033	6.162	7.377	9.245	6.954
G Mean		1.459	2.422	1.704	2.933	2.130	4.065	5.007	4.364	5.176	4.653
Interaction of molybdenum X seasons											
+Mo		2.080	3.280	2.480	4.066	2.976	5.610	6.777	6.077	7.300	6.441
-Mo		0.839	1.565	0.927	1.800	1.283	2.519	3.238	2.651	3.051	2.865
Mean		1.459	2.422	1.704	2.933	2.130	4.065	5.007	4.364	5.176	4.653

LSD 0.05: S: 0.18 Mo: 0.13 C: 20
S x Mo: 0.26 S x C: 0.41
Mo x C: 0.29 S x Mo x C: n.s

S: 0.44 Mo: 0.31 C:0.49
S x Mo: 0.62 S x C: 0.97
Mo x C: 0.69 S x Mo x C: n.s

(6.263 and 5.980 g/pot) of the first and the second years, respectively, while the lowest N-uptake was in winter seasons during all growing seasons with the Mo application. In summer season plants absorbed more water and consequently more nutrients and produced high dry matter yield.

Mo application increases N-uptake of alfalfa plants in all growing seasons in each soil during the first and second years. It was increased in autumn season with the sandy and calcareous soils by 625 and 621%; than in winter (114 and 33%) during the first and second years, respectively over all cultivars and Mo application These results are in agreement with those reported by **Khalil et al. (1990), Quaggio et al. (1991), Gupta (1995), Martin et al (1995) and Hanna and Eisa (1998).**

Cultivar:

Results show that alfalfa cultivars are different in their N-uptake and this was true in each soil during the successive years of the growing seasons. The local Ismailia-1 was the superior in its N-uptake followed by Sewa cultivars with and without Mo application, while the lowest N-uptake was accompanied with the exotic cultivars

Hallma, Melesia and Siriver in the growing seasons and on the sandy and calcareous soils.

It could be concluded that the highest value of the local Ismailia-1 cultivar with Mo application was 14.146 and 4.387 g/pot of the summer season in the first year of the calcareous and sandy soils, respectively, compared with the other tested cultivars. It is also noticed that each of the two local alfalfa cultivars was higher in its N-uptake value than the exotic alfalfa cultivars with significant difference among the others when grown on the two soils and during the two years. Differences among the three exotic alfalfa cultivars grown on sandy and calcareous soils were observed. The exotic cultivars showed that Siriver was higher in N-uptake than Hallma followed by Melesia with significant differences in the first year and calcareous soil.

Molybdenum application:

Data of N-uptake during seasons of the first year as affected by the applied Mo treatments are presented in Tables (40 and 41, A 30 and 31). Results show that application of Mo fertilizer increased N-uptake of alfalfa compared to without Mo application in each of the two soils. There was a great response to Mo application in the summer seasons in the calcareous and sandy soils. The relative increases with Mo application as compared to without Mo application of the summer seasons in N-uptake were 129 and 144% in the calcareous and sandy soils, respectively. These results may be attributed to the role of Mo in nitrogen fixation which encourages plant growth and nutrient uptake. This trend was true with both soils. It could be noticed that Mo has a positive effect on N absorption as it is necessary to Nitrogen reductase enzyme which has a responsibility of reducing NO_3^- to amid group (NH_2) and synthesis of amino acids from which protein is being formed. These results are in agreement with those reported by **Khalil et al. (1990), Quaggio et al. (1991), Gupta (1995), Martin et al. (1995) and Hanna and Eisa (1998).**

Phosphorus

Data of Tables (42 and 43, A 32 and 33) indicate clearly that there were slight differences among alfalfa cultivars in P-uptake with and without Mo application at all growing seasons in each of the two soils during the first and second years.

In the first year, alfalfa cultivars grown in winter season in presence and absence of Mo application, showed

Table (43): Phosphorus uptake of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the second growing year (2003-2004).

Soil		Sandy					Calcareous				
		Season (S)					Season (S)				
Cultivar (C)	Mo	Winter (2 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean	Winter (2 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean
		……………………………………(kg/pot)……………………………									
Hallma	+Mo	0.058	0.086	0.098	0.116	0.090	0.396	0.499	0.198	0.298	0.348
	-Mo	0.215	0.302	0.288	0.294	0.275	0.939	1.227	0.700	1.031	0.974
	Mean	**0.136**	**0.194**	**0.193**	**0.205**	**0.182**	**0.667**	**0.863**	**0.449**	**0.664**	**0.661**
Melesia	+Mo	0.034	0.072	0.102	0.127	0.084	0.460	0.589	0.281	0.363	0.423
	-Mo	0.228	0.326	0.287	0.348	0.297	0.817	1.012	0.839	0.846	0.878
	Mean	**0.131**	**0.199**	**0.195**	**0.238**	**0.191**	**0.638**	**.801**	**0.560**	**0.605**	**0.651**
Siriver	+Mo	0.070	0.097	0.107	0.137	0.103	0.445	0.537	0.294	0.443	0.430
	-Mo	0.242	0.393	0.358	0.458	0.363	0.994	1.361	0.880	1.284	1.130
	Mean	**0.156**	**0.245**	**0.233**	**0.297**	**0.233**	**0.720**	**0.949**	**0.589**	**0.864**	**0.780**
Sewa	+Mo	0.178	0.210	0.158	0.188	0.183	0.535	0.675	0.310	0.717	0.559
	-Mo	0.376	0.661	0.633	0.568	0.559	1.070	1.406	0.963	1.784	1.306
	Mean	**0.277**	**0.435**	**0.396**	**0.378**	**0.371**	**0.803**	**1.041**	**0.636**	**1.250**	**0.932**
Ismailia1	+Mo	0.172	0.276	0.234	0.193	0.219	0.538	0.764	0.389	0.769	0.615
	-Mo	0.449	0.762	0.861	0.680	0.688	1.261	1.726	1.066	2.918	1.743
	Mean	**0.311**	**0.519**	**0.548**	**0.437**	**0.453**	**0.899**	**1.245**	**0.728**	**1.844**	**1.179**
G Mean		**0.202**	**0.318**	**0.313**	**0.311**	**0.286**	**0.745**	**0.980**	**0.592**	**1.045**	**0.841**
Interaction of molybdenum X seasons											
+Mo		0.103	0.148	0.140	0.152	0.136	0.475	0.613	0.294	0.518	0.475
-Mo		0.302	0.489	0.485	0.470	0.437	1.016	1.346	0.889	1.573	1.206
Mean		**0.202**	**0.318**	**0.313**	**0.311**	**0.286**	**0.745**	**0.980**	**0.592**	**1.045**	**0.841**

LSD 0.05: Sandy — S: 0.05 Mo: 0.04 C: 0.06; S x Mo: 0.07 S x C: 0.11; Mo x C: 0.08 S x Mo x C: n.s

Calcareous — S: 0.07 Mo: 0.05 C: 0.08; S x Mo: 0.10 S x C: 0.16; Mo x C: 0.12 S x Mo x C: 0.23

the lowest P-uptake (0.012 g/pot) and (0.056 g/pot); (0.086 g/pot) and (0.264 g/pot) in winter season in sandy and calcareous soils respectively, whereas, in summer season cuts of alfalfa revealed the highest P-uptake (0.113 g/pot) and (0.326 g/pot) in the sandy soil, while in spring season and calcareous soil the highest P- uptake (0.608 g/pot) and (1.352 g/pot) occurred. While the lowest P-uptake of winter season over cultivars with and without Mo application was (0.103 g/pot) and (0.302 g/pot) ; (0.475 g/pot) and (1.016 g/pot) with the sandy and calcareous soil, respectively in the second year.

Molybdenum application significantly decreased P-uptake by plants grown under sandy and calcareous soils during the tested seasons. This negative effect could be attributed to the antagonistic effect between Mo and P as both of them absorbed as anion (PO_4^{-2} and MoO_4^{-2}) by plant roots.

Cultivar:

Results show that alfalfa cultivars are different in P-uptake, this was true in each soil during the successive years in the all growing seasons. The local Ismailia-1 was the highest in its P-uptake followed by Sewa cultivar with and without Mo application, while the lowest P-uptake was concomitant with the exotic cultivars, i.e., Siriver, Melesia and Hallma in the growing seasons with significant differences in sandy and calcareous soils of the first and second years. The local cultivars were higher in their P uptake as compared with the exotic ones this may be because they well adapted to the environmental conditions as compared with those imported from overseas.

Molybdenum application:

Data of the P-uptake during seasons of the first year as affected by the applied Mo treatments are presented in Tables (42 and 43, A32 and 33). Results show that application of Mo fertilizer decreases P-uptake of alfalfa compared to without Mo application in sandy and calcareous soil. The relative decreases with Mo application to without Mo application of the winter season for P-uptake were 79 and 67% in the first year and 66 and 53% in the second year with sandy and calcareous soils, respectively.

Results show that alfalfa cultivars are different in P-uptake, this was true in each soil during the successive years of the all growing seasons. The local Ismailia-1 was the highest in its P-uptake followed by Sewa cultivar with and without Mo application, while the lowest P-uptake was associated with the exotic cultivars, i.e., Siriver, Melesia and Hallma in the growing seasons. Significant differences in P-uptake were observed between sandy and calcareous soils in the first and second years. The local varieties were higher in their P uptake as compared with the exotic ones may be because they well adapted to the environmental conditions as compared with those imported from overseas.

Molybdenum application:

Data of the P-uptake during seasons of the first year as affected by the applied Mo treatments are presented in Tables (42 and 43, A32 and 33). Results show that application of Mo decreased P-uptake of alfalfa compared to without Mo application in sandy and calcareous soil. The relative decreases in P-uptake with Mo application to without Mo application of the winter season were 79 and 67% in the first year and 66 and 53% in the second year with sandy and calcareous soils, respectively.

Potassium:

Results in Tables (44 and 45, A 34 and 35) show that in the first and second years noticeable variable magnitudes between soils were existed. Calcareous soil produced the highest K-uptake of alfalfa cultivars as compared with sandy one during all seasons. Also, in the calcareous and sandy soils, the summer season gave the highest K-uptake of the first year (7.696 and 1.142 g/pot, respectively), while the lowest K-uptake was in winter season of the same soils with the Mo application. Increasing K uptake by plants may be due to increasing the dry matter yield which was concomitant with increasing N uptake.

Mo application increases K-uptake of alfalfa plants in all growing seasons with each soil during the first and second years. K-uptake was increased in summer with the sandy and calcareous soils by 957 and 1045% than in winter during the first year, and in the second year by 148 and 64% over all cultivars and Mo application. These results are in agreement with those reported by **Khalil et al. (1990), Quaggio et al. (1991), Gupta (1995), Martinet al. (1995) and Hanna and Eisa (1998).**

Cultivar:

Results show that alfalfa cultivars differed in their K-uptake, this was true in each soil during the successive years and all growing seasons. The lowest K-uptake of the alfalfa cultivars with Mo application was by the exotic cultivars

Table (44): Potassium uptake of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the first growing year (2002-2003).

Soil		Sandy					Calcareous				
		Season (S)					Season (S)				
Cultivar (C)	Mo	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean	Winter (1 cut)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean
		....(kg/pot.)..									
Hallma	+Mo	0.151	0.818	0.987	0.944	0.725	0.719	4.992	7.996	4.078	4.446
	-Mo	0.066	0.380	0.528	0.469	0.361	0.231	2.229	4.303	2.091	2.214
	Mean	**0.109**	**0.599**	**0.758**	**0.707**	**0.543**	**0.475**	**3.610**	**6.149**	**3.084**	**3.330**
Melesia	+Mo	0.111	0.909	1.159	0.952	0.783	0.802	4.854	6.968	3.718	4.085
	-Mo	0.040	0.357	0.530	0.582	0.378	0.160	2.185	3.565	2.297	2.052
	Mean	**0.076**	**0.633**	**0.845**	**0.767**	**0.580**	**0.481**	**3.520**	**5.267**	**3.007**	**3.069**
Siriver	+Mo	0.156	1.140	1.542	1.063	0.975	0.838	5.103	8.122	4.180	4.561
	-Mo	0.076	0.418	0.583	0.755	0.458	0.259	2.628	4.281	2.239	2.352
	Mean	**0.116**	**0.779**	**1.062**	**0.909**	**0.717**	**0.549**	**3.065**	**6.202**	**3.209**	**3.456**
Sewa	+Mo	0.155	1.156	1.680	1.489	1.120	1.030	7.080	11.241	5.135	6.122
	-Mo	0.086	0.655	1.149	0.974	0.716	0.583	3.798	5.564	3.021	3.241
	Mean	**0.120**	**0.906**	**1.414**	**1.231**	**0.918**	**0.806**	**5.439**	**8.402**	**4.078**	**4.682**
Ismailial	+Mo	0.157	1.425	1.999	1.906	1.372	1.528	8.470	17.359	6.379	8.434
	-Mo	0.082	0.789	1.268	1.386	0.882	0.573	4.810	7.561	4.170	4.278
	Mean	**0.120**	**1.107**	**1.633**	**1.646**	**1.127**	**1.050**	**6.640**	**12.460**	**5.275**	**6.356**
G Mean		**0.108**	**0.805**	**1.142**	**1.052**	**0.777**	**0.672**	**4.615**	**7.696**	**3.373**	**4.178**
Interaction of molybdenum X seasons											
+Mo		0.146	1.090	1.473	1.271	0.995	0.983	6.100	10.337	4.698	5.530
-Mo		0.070	0.520	0.812	0.833	0.559	0.361	3.130	5.055	2.764	2.827
Mean		**0.108**	**0.805**	**1.142**	**1.052**	**0.777**	**0.672**	**4.615**	**7.696**	**3.731**	**4.178**

LSD 0.05: S: 0.03 Mo: 0.07 C: 0.03
S x Mo: 0.04 S x C: 0.06
Mo x C: 0.05 S x Mo x C: 0.09

S: 0.24 Mo:0.24 C: 0.38
S x Mo: 0.48 S x C:0.76
Mo x C: 0.54 S x Mo x C:0.76

Table (45): Potassium uptake of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the second growing year (2003-2004).

Soil		Sandy					Calcareous				
		Season (S)					Season (S)				
Cultivar (C)	Mo	Winter (2cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean	Winter (2cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean
		....................................(Kg/pot)................................									
Hallma	+Mo	0.577	0.866	1.010	1.273	0.932	5.009	6.098	4.922	5.202	5.308
	-Mo	0.258	0.471	0.702	0.683	0.528	1.854	2.730	2.230	1.893	2.177
	Mean	**0.418**	**0.668**	**0.856**	**0.978**	**0.730**	**3.432**	**4.414**	**3.576**	**3.547**	**3.742**
Melesia	+Mo	0.527	0.850	1.170	1.370	0.979	3.998	4.950	4.199	4.178	4.331
	-Mo	0.281	0.488	0.677	0.857	0.576	2.054	3.338	2.335	2.029	2.439
	Mean	**0.404**	**0.669**	**0.924**	**1.113**	**0.777**	**3.026**	**4.144**	**3.267**	**3.104**	**3.385**
Siriver	+Mo	0.577	1.004	1.377	1.668	1.156	4.921	6.624	6.098	7.160	6.201
	-Mo	0.269	0.530	0.733	0.917	0.612	2.380	3.181	1.387	2.609	2.390
	Mean	**0.423**	**0.767**	**1.055**	**1.292**	**0.884**	**3.650**	**4.903**	**3.743**	**4.885**	**4.295**
Sewa	+Mo	0.970	2.153	2.650	2.316	2.022	5.292	6.570	8.271	10.775	7.727
	-Mo	0.662	1.219	1.535	1.342	1.189	3.164	4.075	4.554	5.070	4.216
	Mean	**0.816**	**1.686**	**2.092**	**1.829**	**1.606**	**4.228**	**5.323**	**6.413**	**7.923**	**5.971**
Ismailia1	+Mo	1.137	2.317	3.187	2.739	2.345	5.881	8.249	10.957	16.313	10.350
	-Mo	0.766	1.668	1.892	1.457	1.446	3.007	4.734	5.840	6.284	4.966
	Mean	**0.951**	**1.992**	**2.540**	**2.098**	**1.895**	**4.444**	**6.491**	**8.399**	**11.298**	**7.658**
G Mean		**0.602**	**1.157**	**1.493**	**1.462**	**1.179**	**3.756**	**5.055**	**5.079**	**6.151**	**5.010**
Interaction of molybdenum X seasons											
+Mo		0.758	1.438	1.879	1.873	1.487	5.020	6.498	6.890	8.725	6.783
-Mo		0.447	0.875	1.108	1.051	0.870	2.492	3.612	3.269	3.577	3.238
Mean		0.602	1.157	1.493	1.462	1.179	3.756	5.055	5.079	6.151	5.010

LSD 0.05: S: 0.0 Mo: 0.05 C: 0.09
S x Mo: 0.5 S x C: 0.76
Mo x C: 0.5 S x Mo x C: : 1.1

S: 0.34 Mo: 0.24 C: 0.38
S x Mo:0.5 S x C: 0.76
Mo x C: 0.5 S x Mo x C: 1.1

Siriver, Melesia and Hallma in the first and second years in sandy; and Siriver, Hallma and Melesia in the calcareous soils. While the highest K-uptake was found in the local cultivars Ismailia-1 followed by the Sewa with the sandy and calcareous soils.

Molybdenum application:

Data of the K-uptake during seasons of the first year as affected by the applied Mo treatments are presented in Tables (44 and 45, A 34 and 35). Results show that application of Mo-fertilizer increased the K-uptake by alfalfa compared to without Mo application in each of the two soils. There was a great response to Mo application in the summer season and sandy soil. Similar trend was observed in the summer and autumn seasons of the first and second years in the calcareous soil. The relative increases with Mo application to without Mo application in the summer season for K-uptake were 81 and 105% in the first year and 70 and 144% in the second year with sandy in spring and calcareous soils in autumn, respectively. These results are in agreement with those reported by **Hafmert et al. (1992) and Singh et al. (1992) and Hazra and Tripathi (1998).**

Molybdenum

Data in Table (46, A 36) show the positive effect of Mo application on Mo-uptake of alfalfa plants as compared to without Mo application, this trend was true in each of the two soils during the second year.

Data of Table (46, A 36) indicate clearly that there were slight differences among alfalfa cultivars in Mo-uptake with and without Mo application in all growing seasons in each of the two soils during the second year. Over cultivars with and without Mo application, plants of winter season showed the lowest Mo-uptake (0.89g/pot) and (0.22g/pot); (1.76 g/pot) and (0.45 g/pot) with sandy and calcareous soils respectively. However, plants of spring season showed the highest Mo-uptake (1.47g/pot) and (0.32 g/pot) of the sandy soil; as well as plants of autumn season were the highest in Mo-uptake (2.70 g/pot) and (0.47 g/pot) when grown on the calcareous soil. It could be concluded that Mo uptake was increased with Mo application in both soils. Calcareous soil showed higher amounts of Mo uptake resulted from increasing dry matter yield of plants not from increasing Mo concentration.

Table (46): Molybdenum uptake of alfalfa grown on sandy and calcareous soils as affected by cultivars, seasons, and molybdenum application during the second growing year (2003-2004).

Soil		Sandy					Calcareous				
		Season (S)					Season (S)				
Cultivar (C)	Mo	Winter (2 cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean	Winter (2 cuts)	Spring (3cuts)	Summer (3 cuts)	Autumn (3 cuts)	Mean
		..................................(Kg/pot)................................									
Hallma	+Mo	0.704	0.876	0.815	1.319	0.929	1.929	2.276	1.641	1.707	**1.889**
	-Mo	0.132	0.208	0.085	0.158	0.146	0.395	0.373	0.178	0.234	**0.295**
	Mean	**0.418**	**0.542**	**0.450**	**0.738**	**0.537**	**1.162**	**1.324**	**0.910**	**0.971**	**1.092**
Melesia	+Mo	0.647	0.879	0.885	0.144	0.889	1.302	1.894	1.627	1.535	**1.589**
	-Mo	0.160	0.208	0.096	0.150	0.153	0.427	0.485	0.264	0.273	**0.362**
	Mean	**0.403**	**0.544**	**0.491**	**0.647**	**0.521**	**0.864**	**1.189**	**0.945**	**0.904**	**0.976**
Siriver	+Mo	0.672	0.994	0.904	1.126	0.924	1.765	2.518	2.244	2.283	**2.203**
	-Mo	0.095	0.175	0.093	0.140	0.126	0.404	0.594	0.362	0.367	**0.432**
	Mean	**0.383**	**0.584**	**0.498**	**0.633**	**0.525**	**1.085**	**1.556**	**1.303**	**1.325**	**1.317**
Sewa	+Mo	1.082	2.245	1.732	1.496	1.639	1.560	2.227	2.505	3.058	**2.337**
	-Mo	0.331	0.522	0.495	0.447	0.449	0.422	0.618	0.378	0.697	**0.529**
	Mean	**0.706**	**1.383**	**1.114**	**0.971**	**1.044**	**0.991**	**1.422**	**1.442**	**1.877**	**1.433**
Ismailial	+Mo	1.333	2.359	2.148	1.956	1.949	2.217	3.021	3.460	4.900	**3.399**
	-Mo	0.368	0.491	0.356	0.305	0.380	0.572	0.873	0.418	0.780	**0.661**
	Mean	**0.851**	**1.425**	**1.252**	**1.130**	**1.165**	**1.395**	**1.947**	**1.939**	**2.840**	**2.030**
G Mean		**0.552**	**0.896**	**0.761**	**0.824**	**0.758**	**1.099**	**1.488**	**1.308**	**1.583**	**1.370**
Interaction of molybdenum X seasons											
+Mo		0.888	1.471	1.297	1.408	1.266	1.755	2.387	2.295	2.697	**2.283**
-Mo		0.217	0.321	0.225	0.240	0.251	0.444	0.587	0.320	0.470	**0.456**
Mean		0552	**0.896**	**0.761**	**0.824**	**0.758**	**1.099**	**1.488**	**1.308**	**1.583**	**1.370**

LSD 0.05: S: 0.7 Mo: 0.05 C: 0.08
S x Mo:0.10 S x C: 0.16
Mo x C: 0.12 S x Mo x C:0.23

S: 0.06 Mo: 0.05 C: 0.07
S x Mo: 0.09 S x C:0.14
Mo x C: 0.10 S x Mo x C:0.20

Cuitivar:

Results show that alfalfa cultivars are different in Mo-uptake in each soil during the second year in all growing seasons.

In the second year, with Mo application the highest Mo-uptake was obtained by the local alfalfa cultivars, i.e., Ismailia-1 in spring season, (1.43 g/pot) with sandy soil and in autumn (2.84 g/pot) with the calcareous soil. On the other hand, the exotic cultivars, i.e., Siriver, Melesia and Hallma contained the lowest Mo-uptake in the four seasons with the sandy and calcareous soils.

Molybdenum application:

Data of Mo-uptake during seasons of the second year as affected by the applied Mo treatments are presented in Table (46, A 36). Results show that Mo-uptake was increased with Mo application to alfalfa compared to without Mo application in each of the two soils. Comparing Mo-uptake with Mo application to without Mo application overall seasons revealed that the treatment of Mo application increased Mo uptake by 404 and 400% in the second year with sandy and calcareous soils, respectively.