Effect of Irrigation Frequency, N- Fertilizer Levels and Mixing Ratio of Egyptian Clover-oat on Forage Yield

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Abstract:

Effects of irrigation frequency, nitrogen fertilizer levels and mixing ratio of Egyptian clover-oat on forage yield were evaluated in a split split plot design with four replicates. Three irrigation intervals, 7, 14 and 21 days consuming 500, 650 and 800 m^3 ha^{-1} /irrigation with water consumption of 13000, 9200 and 7600 m^3 ha^{-1} in the season, respectively were assigned to the main plots. Four nitrogen fertilizer levels, 45, 90, 135 and 180 kg N ha^{-1} were assigned to the sub plots. The sub sub-plots were assigned to the following mixing ratio: solid Egyptian clover or oat (100%), 75% Egyptian clover + 25% oat, 50% Egyptian clover + 50% oat and 25% Egyptian clover + 75% oat. Combined analysis of data over all cuts in both seasons showed that irrigation every 7 days showed the highest fresh and dry forage yields ha^{-1}. Increasing nitrogen level (180 kg N ha^{-1}) produced the highest fresh and dry forage yields. The monoculture of Egyptian clover produced the highest fresh yield/ ha /season. However, the mixtures of 25 or 75 % Egyptian clover and 75 or 25 % oat produced the highest dry forage yields ha^{-1} in the season. The interaction between irrigation intervals X nitrogen levels, irrigation intervals X mixing ratio and nitrogen levels X mixing ratio had significant effects on forage fresh and dry yields. Mixing 25 % Egyptian clover with 75 % oat seeds and fertilizing with 180 kg N ha^{-1} under irrigating interval of 7 days showed the highest dry forage yield under Al-Hassa conditions, Saudi Arabia.

Introduction:

The sustainability of grass cropping system could be improved by adding legumes. Egyptian clover (*Trifolium alexandrinum* L.) is one of the most important forage legume crops in some world countries particularly that has long winter season with cold-moderate temperature. In the Kingdom of Saudi Arabia, Egyptian clover has been introduced with special emphasis to the agriculture sector as untraditional forage crop. The importance of this crop lies on its low irrigation water requirements and the high forage productivity and quality during winter and spring seasons (Al-Khateeb 2004). It can be grown during winter seasons to overcome the water shortage recently appeared in Saudi Arabia. Recent studies have been done under the Saudi Arabia conditions to evaluate the cultivation of Egyptian clover and grasses mixtures in terms of forage quality and quantity (Al-Khateeb *et al*. 2001 and Al-Khateeb 2004).

Water soil deficit reduced the productivity of legume-grass mixture (Lucero *et al.*1999; Al-Khateeb 2004). If the component of the mixture is different in responses to drought conditions, the response of mixtures productivity will be substantially disturbed (Lucero *et al.*1999).

Numerous investigators found advantages in forage yield and quality for mixing clover with oat (Ghaffarzadeh 1997; Holland and Brummer 1999; Thorsted *et al.* 2002; Bassal and Zahran 2003; Ross *et al.* 2003; McAnderws *et al.* 2004; Ross *et al.* 2004). Grass-clover mixtures have been reported to out yield clover or grass in solid planting (Ghaffarzadeh 1997; Al-Khateeb *et al.* 2001; McAnderws *et al.* 2004; Ross *et al.* 2004).

The grass/clover relationship is highly affected by nitrogen fertilization (Davidson and Robson 1986; Caradus *et al*.1993; Shareif *et al*. 1996). Frame (1992) reported that increasing level of nitrogen fertilization on grass/white clover sward increased total herbage production linearly up to N rates of 250–350 kg N ha^{-1}. However, 90 % of maximum herbage production was achieved with only 50-60 % of the nitrogen needed to attain the maximum production. Al-Khateeb (2004) showed that increasing nitrogen levels up to 180 kg N ha^{-1} was associated with marked increases in fresh and dry forage yields of Egyptian clover-ryegrass mixture.

This study was aimed to evaluate effects of irrigation frequency, nitrogen fertilizer levels and mixing ratio of Egyptian clover and oat on fresh and dry forage yields.

Materials and methods:

Two field experiments were conducted at the Agricultural and Veterinary Training and Research Station, King Faisal University, Al-Hassa (latitude 25° 21' and 25° 37' N and longitude 49° 33' and 49° 46' E) during the winter seasons of 2000/2001 and 2001/2002. A split split-plot in randomized complete block design with 4 replicates was used. Three irrigation intervals, 7, 14 and 21 days with 500, 650 and 800 m^3/ha/irrigation, consuming water of 13000, 9200 and 7600 m^3 ha^{-1}/season, respectively were assigned to the main plots. Four nitrogen fertilizer levels, 45, 90, 135 and 180 kg N ha^{-1}, were assigned to the sub plots. The sub sub-plots were assigned to the following mixing ratio: solid Egyptian clover or oat (100%), 75% Egyptian clover + 25% oat, 50% Egyptian clover + 50% oat and 25% Egyptian clover + 75% oat. The experimental unit dimension was 2.5 x 4.0 m.

Soil samples from the experimental site were taken at random from the upper 30 cm of the soil surface for physical and chemical analysis. Results of soil analysis showed that the soil was sandy loam in texture (sand= 55.2 %, silt = 36.0 %, clay = 8.3 %) with pH 7.5, ECe = 4.5 $dsm^{-1,}$ $CaCO_3$ = 20.8 % and organic matter= 0.11%. N, Na, K, and Ca contents were 15.8, 13.7, 20.4 and 10.4 meq L^{-1}, respectively.

Temperature, rainfall, relative humidity and transpiration rate readings at the experimental field site during the experiment period are shown in Table 1. Seedbed for the experimental field was well prepared and the field area was divided into experimental units by constructing alleys and shallow irrigation channels.

Seeds of the mixture with the aforementioned seeding rates were hand-sown in 10 cm apart rows. Seeds of Egyptian clover (*Trifolium alexandrinum* L.) cv. "Meskawi" at the rate of 75 kg ha^{-1} and oat (*Avena fatua* L.) cv. "Coker 227" at 120 kg ha^{-1} were used. Sowing took place during the last week of October in both seasons. After sowing, all plots were fertilized with 50 kg P_2O_5 ha^{-1}. Nitrogen in the form of urea (46 % N) with the previously mentioned rates was added into 4 equal portions, 30 days after sowing and after the first, second and third cuts. Four cuts were taken. The first cut was 60 days after sowing, while the other three cuts were taken at about 40 days between. In each cut, fresh forage yield in the inner 2.0 m^2 was estimated to the nearest gram and converted to record fresh yield (t/ha). Plant samples of forage yield were dried at 85 °C for 48 hours to determine dry matter content (DM %). The dry forage yield was estimated by multiplying fresh forage yield x DM %.

Data of each cut and their total in every season were statistically analysed using the technique of the Analysis of variance of the split split plot design (Gomez and Gomez 1984). Thereafter, the assumption of normality and the homogeneity of variance of the experimental errors was checked according to Bartlet method which showed an appropriate homogenous of errors variance. Therefore, the combined analysis over both seasons was done using the SAS version 8.0 (SAS, 2001). The treatment means were compared using the Baysian Least Significant Difference (BLSD) at 5 % level of probability (Waller and Duncan, 1969).

Table (1)

Temperature, Relative humidity, RH (%), rainfall (mm/month) and transpiration rate, TR (mm/day), over 2000/2001 and 2001/2002 seasons in Al-Hassa area.

Month	Temperature			RH%	Rainfall mm/month	TR mm/day
	Maximum	Minimum	Average			
October	38	22	30	52	0	12
November	32	17	25	60	0	8
December	26	12	19	66	6	6
January	21	9	15	65	9	5
February	24	12	18	64	12	7
March	29	16	23	55	15	10
April	34	20	27	48	3	14

Results and discussion:

Irrigation treatments:

Fresh and dry forage yields of Egyptian clover-oat mixture in all cuts and their total over both seasons were significantly affected by irrigation intervals (Tables 2 & 3). Irrigation every 7 days showed the highest fresh and dry forage yields in all cuts and their total. Total fresh forage yield decreased from 46.526 to 40.401 and 34.138 t ha^{-1}, with about 13.2 and 26.6 % reduction as water deficit increased due to increasing the irrigation intervals from 7 to 14 and 21 days, respectively. Also, increasing the irrigation frequency from 14 to 21 days resulted in 15.50 % reduction in the fresh forage yield. The dry forage yield in all cuts and total showed the same trend of the fresh forage yield which was significantly decreased from 7.825 to 6.283 t ha^{-1} with increasing irrigation intervals from 7 to 21 days (Table 3). The reduction in the total dry fodder yield was 10.53 and 19.71 % with increasing irrigation frequency from 7 to 14 and 21 days, respectively. The reduction in dry forage yield due to the increase of irrigation intervals was much pronounced with the increase of water deficit time. The reduction in dry forage yield under 21 days irrigation interval was 13% in the first cut compared with 40% in the fourth cut. Such effects were also noticed by other investigators on grass-clover mixture (Lucero *et al.* 1999; Al-Khateeb 2004).

Table (2)

Fresh forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons)

Treatments	Cut				*Total*
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	14.934	15.729	12.872	2.991	46.526
14 days	13.196	13.969	10.983	2.252	40.401
21 days	11.269	11.846	9.328	1.696	34.138
BLSD(5%)	1.285	1.217	1.134	0.895	1.761
B. Nitrogen Levels					
45 kg N/ha	12.561	13.024	10.234	2.188	38.006
90 kg N/ha	12.917	13.869	11.051	2.319	40.156
135 kg N/ha	13.439	13.726	11.103	2.310	40.578
180 kg N/ha	13.615	14.775	11.855	2.434	42.680
BLSD(5%)	0.608	0.594	0.542	0.457	0.772
C. Mixing rate					
Clover100%	6.053	16.444	16.762	4.373	43.632
Oat 100%	17.396	11.758	3.481	0.163	32.797
75% Clov+25% Oat	12.879	14.157	12.059	3.242	42.338
50% Clov+50% Oat	13.898	13.728	11.557	2.190	41.373
25% Clov+75% Oat	15.439	13.153	11.445	1.599	41.636
BLSD(5%)	0.458	0.418	0.311	0.289	0.512

Table (3)

Dry forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to irrigation intervals, N levels and seeding rates (Combined over both seasons)

Treatments	Cut				*Total*
	First	Second	Third	Fourth	
A. Irrigation intervals:					
7 days	2.200	2.675	2.360	0.590	7.825
14 days	2.055	2.411	2.077	0.457	7.001
21 days	1.907	2.151	1.868	0.356	6.283
BLSD(5%)	0.208	0.200	0.228	0.191	0.382
B. Nitrogen Levels					
45 kg N/ha	1.878	2.2	1.883	0.427	6.388
90 kg N/ha	1.970	2.372	2.076	0.467	6.885
135 kg N/ha	2.157	2.458	2.137	0.474	7.227
180 kg N/ha	2.212	2.619	2.310	0.503	7.644
BLSD(5%)	0.180	0.189	0.139	0.148	0.218
C. Mixing rate					
Clover100%	0.806	2.553	2.973	0.821	7.153
Oat 100%	2.946	2.247	0.732	0.036	5.961
75% Clov+25% Oat	1.924	2.462	2.300	0.676	7.363
50% Clov+50% Oat	2.145	2.426	2.235	0.461	7.267
25% Clov+75% Oat	2.450	2.373	2.270	0.345	7.437
BLSD(5%)	0.138	0.141	0.123	0.108	0.199

Nitrogen fertilizer levels:

Fresh and dry forage yields in all cuts and their total were significantly affected by nitrogen levels (Tables 2 & 3). Each increase in nitrogen level from 45 to 180 kg N ha^{-1} was associated with significant increases in fresh and dry forage yields in all cuts and their total. Total fresh yields also increased from 38.006 to 42.680 t ha^{-1}. This increase in fresh forage yield represented 12.3 %. Dry forage yield was increased from 6.388 to 7.644 t ha^{-1} as nitrogen level increased from 45 to 180 kg N ha^{-1} (Table 3). The corresponded increases in dry forage yield with an increase in nitrogen levels from 45 to 180 kg N ha^{-1} was 1.256 t ha^{-1}, representing an increase of 19.7 % in dry forage yield. The increase in forage yield might be attributed to the active role of nitrogen in enhancing mixture plants growth and development. The nitrogen supply to the plant increases the amount of protein, protoplasm and chlorophyll formed. In turn, this influences cell size and leaf area, and thus photosynthetic activity (Gardner *et al*. 1985; Salisbury and Ross 1994). Increasing forage yield of mixture under N fertilization have been reported by Frame (1992), Schenk *et al.* (1997) and Al-Khateeb (2004).

Mixing ratio:

Significant differences were found in the fresh and dry forage yields in all cuts and their total due to the variation in the evaluated mixing ratio of the Egyptian clover and oat mixture (Tables 2 & 3). The monoculture of oat recorded the highest fresh (17.396 t ha^{-1}) and dry (2.946 t ha^{-1}) forage yields in the first cut, while it recorded the lowest fresh and dry yields in the second, third and fourth cuts and in the total. Similar finding was observed by Ross *et al.* (2004). However, the monoculture of Egyptian clover produced the lowest fresh and dry forage yields in the first cut only, while it surpassed all tested mixing ratio in the second, third and fourth cuts as well as in the total fresh yield/ ha/ season. Mixing 25 % Egyptian clover with 75 % oat produced the highest dry forage yield (7.437 t ha^{-1}). While, mixing 75% clover with 25 % oat ranked the second in total fresh and dry forage yields (7.363 t ha^{-1}). However, fresh and dry forage yields of mixing Egyptian clover and oat with any ratio significantly surpassed the monoculture of oat. Holland and Brummer (1999) found that adding oat to clover increased total crop biomass and forage plant health. This trend was also noticed by other working with other grasses-clover mixtures (Bassal and Zahran 2003; Al-Khateeb 2004).

Interaction effects:

The interaction between irrigation intervals and nitrogen fertilizer levels had significant effects on fresh and dry forage yields in all cuts and their total (Tables 4 & 5). Shortening irrigation interval to 7 days with the addition of 180 kg N ha^{-1}, produced the highest fresh forage yield (49.321 t ha^{-1}) and dry forage yield (8.496 t ha^{-1}). On the contrary, the lowest fresh and dry forage yields (32.828 and 5.823 t ha^{-1}) were produced under 21 days irrigation interval and fertilizing with 45 kg N ha^{-1}. However, the increase in fresh and dry forage yields under 21 days intervals and 180 kg N ha^{-1} was lower compared with 7 days irrigation intervals and 180 kg N ha^{-1} which indicates a significant role of frequent irrigation in N absorption and utilization.

Fresh and dry forage yields were significantly affected by the interaction between irrigation intervals and seeding rates of Egyptian clover and oat mixture (Tables 6 & 7). The highest fresh forage yields in all cuts and their total was noticed with the mixture of 75 or 50 % Egyptian clover with 25 or 50 % oat under the irrigation period of 7 days. Monoculture of clover and oat was relatively equal in their response to water deficit. The reduction in forage yield in the monoculture of Egyptian clover and oat under water deficit (irrigation every 21 days) reached about 29.1 and 24.8 % in fresh forage yield and 18.4 and 16.7% in dry forage yield, respectively. This trend was also reported by Al-Khateeb (2004) on monoculture of clover and ryegrass. Therefore, it is expected that mixing Egyptian clover and oat will not be affected by drought probably due to the high rate of compatibility of both crops under drought conditions. However, Thomas (1984) reported that clover was much affected by drought in the mixture of clover and ryegrass.

The highest dry forage yield was obtained from the treatment of mixing clover with oat and from the monoculture of the Egyptian clover when irrigated every 7 days. The monoculture of oat with prolonging the irrigation intervals to 21 days showed the lowest dry yield, and this tend was noticed in all cuts (Table 7).

Fresh and dry forage yields were significantly affected by the interaction between nitrogen levels and seeding ratio of Egyptian clover and oat. The highest dry forage yields in all cuts and their total were produced from the mixture of 25 % Egyptian clover + 75% oat when fertilized by 180 kg N ha^{-1}. It was followed by the mixture of 50 % Egyptian clover + 50 % oat and monoculture of oat with the addition of 180 kg N ha^{-1}.

Table (4)

Fresh forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons)

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	14.240	14.857	11.651	2.765	43.514
7 days	90 kg N/ha	14.570	15.482	12.685	3.185	45.922
7 days	135 kg N/ha	15.257	15.891	13.170	3.029	47.348
7 days	180 kg N/ha	15.670	16.684	13.982	2.984	49.321
14 days	45 kg N/ha	12.459	13.013	10.079	2.125	37.677
14 days	90 kg N/ha	12.945	13.68	10.992	2.164	39.782
14 days	135 kg N/ha	13.663	14.297	11.219	2.293	41.472
14 days	180 kg N/ha	13.717	14.889	11.640	2.427	42.673
21 days	45 kg N/ha	10.983	11.200	8.970	1.674	32.828
21 days	90 kg N/ha	11.235	12.445	9.476	1.608	34.765
21 days	135 kg N/ha	11.398	10.989	8.921	1.608	32.916
21 days	180 kg N/ha	11.460	12.750	9.942	1.892	36.045
NLSD(5%)		1.063	1.022	0.935	0.798	1.338

Table (5)

Dry forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and nitrogen rates (Combined over both seasons)

Irrigation interval	Nitrogen Rate	Cut				Total
		First	Second	Third	Fourth	
7 days	45 kg N/ha	1.981	2.482	2.059	0.521	7.043
7 days	90 kg N/ha	2.098	2.601	2.277	0.628	7.605
7 days	135 kg N/ha	2.293	2.781	2.469	0.612	8.155
7 days	180 kg N/ha	2.428	2.834	2.635	0.599	8.496
14 days	45 kg N/ha	1.841	2.181	1.858	0.419	6.299
14 days	90 kg N/ha	1.940	2.315	2.076	0.440	6.772
14 days	135 kg N/ha	2.208	2.531	2.128	0.467	7.335
14 days	180 kg N/ha	2.232	2.617	2.247	0.501	7.598
21 days	45 kg N/ha	1.811	1.936	1.733	0.341	5.823
21 days	90 kg N/ha	1.872	2.201	1.876	0.331	6.280
21 days	135 kg N/ha	1.970	2.060	1.816	0.344	6.191
21 days	180 kg N/ha	1.977	2.405	2.047	0.408	6.838
NLSD(5%)		0.318	0.332	0.247	0.265	0.378

Table (6)

Fresh forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons)

Irrigation intervals	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
7	Clover100%	6.701	18.016	18.852	5.568	49.137
7	Oat 100%	19.111	13.009	4.024	0.219	36.363
7	75% Clov+25% Oat	15.495	16.369	14.285	4.124	50.272
7	50% Clov+50% Oat	16.005	15.856	13.635	2.857	48.354
7	25% Clov+75% Oat	17.360	15.394	13.564	2.186	48.505
14	Clover 100%	5.920	16.718	16.797	4.272	43.707
14	Oat 100%	17.725	11.686	3.327	0.156	32.895
14	75% Clov+25% Oat	12.817	14.551	12.035	3.208	42.610
14	50% Clov+50% Oat	13.910	13.921	11.493	2.064	41.388
14	25% Clov+75% Oat	15.607	12.974	11.261	1.563	41.404
21	Clover 100%	5.538	14.599	14.639	3.277	38.052
21	Oat 100%	15.351	10.579	3.091	0.113	29.135
21	75% Clov+25% Oat	10.327	11.554	9.857	2.393	34.131
21	50% Clov+50% Oat	11.780	11.406	9.541	1.647	34.376
21	25% Clov+75% Oat	13.348	11.093	9.509	1.049	34.999
NLSD(5%)		0.791	0.727	0.539	0.510	0.887

Table (7)

Dry forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons)

Irrigation intervals	Mixing rate	Cut				*Total*
		First	Second	Third	Fourth	
7	Clover100%	0.826	2.654	3.251	1.026	7.758
7	Oat 100%	3.095	2.430	0.828	0.047	6.400
7	75% Clov+25% Oat	2.149	2.807	2.590	0.827	8.374
7	50% Clov+50% Oat	2.320	2.765	2.528	0.587	8.202
7	25% Clov+75% Oat	2.608	2.717	2.603	0.461	8.390
14	Clover 100%	0.779	2.571	3.005	0.806	7.162
14	Oat 100%	3.015	2.248	0.700	0.034	5.997
14	75% Clov+25% Oat	1.917	2.499	2.262	0.678	7.357
14	50% Clov+50% Oat	2.127	2.416	2.203	0.431	7.176
14	25% Clov+75% Oat	2.437	2.323	2.216	0.336	7.312
21	Clover 100%	0.811	2.435	2.661	0.631	6.539
21	Oat 100%	2.729	2.063	0.667	0.026	5.486
21	75% Clov+25% Oat	1.706	2.079	2.049	0.524	6.359
21	50% Clov+50% Oat	1.988	2.098	1.972	0.363	6.422
21	25% Clov+75% Oat	2.296	2.074	1.987	0.236	6.594
NLSD(5%)		0.239	0.244	0.217	0.187	0.343

Table (8)

Fresh forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons)

N Rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	5.828	15.941	15.588	4.251	41.609
45	Oat 100%	16.450	11.044	3.200	0.111	30.806
45	75% Clov+25% Oat	12.800	13.219	11.427	3.371	40.817
45	50% Clov+50% Oat	13.491	12.552	10.727	2.146	38.917
45	25% Clov+75% Oat	14.235	12.362	10.225	1.062	37.884
90	Clover 100%	5.870	16.228	16.942	4.246	43.287
90	Oat 100%	17.109	11.502	3.359	0.141	32.111
90	75% Clov+25% Oat	12.973	14.988	11.983	3.308	43.254
90	50% Clov+50% Oat	13.764	13.891	11.530	2.261	41.446
90	25% Clov+75% Oat	14.867	12.735	11.440	1.640	40.682
135	Clover 100%	6.043	16.449	16.827	4.425	43.744
135	Oat 100%	17.708	11.886	3.535	0.186	33.316
135	75% Clov+25% Oat	13.276	13.388	12.141	2.943	41.750
135	50% Clov+50% Oat	14.280	13.567	11.556	2.04	41.444
135	25% Clov+75% Oat	15.888	13.337	11.456	1.957	42.639
180	Clover 100%	6.471	17.158	17.692	4.568	45.890
180	Oat 100%	18.316	12.600	3.828	0.212	34.956
180	75% Clov+25% Oat	12.468	15.034	12.684	3.344	43.531
180	50% Clov+50% Oat	14.058	14.901	12.412	2.311	43.683
180	25% Clov+75% Oat	16.764	14.180	12.658	1.736	45.338
NLSD(5%)		0.917	0.838	0.628	0.571	1.024

Table (9)

Dry forage yield (t ha^{-1}) of the Egyptian clover and oat mixture in response to the interaction between irrigation intervals and mixing rates (Combined over both seasons)

N Rate	Mixing rate	Cut				Total
		First	Second	Third	Fourth	
45	Clover100%	0.699	2.328	2.697	0.791	6.514
45	Oat 100%	1.712	2.237	1.800	0.416	6.166
45	75% Clov+25% Oat	2.319	2.225	1.397	0.371	6.312
45	50% Clov+50% Oat	1.966	2.190	2.032	0.578	6.767
45	25% Clov+75% Oat	2.093	2.181	1.938	0.296	6.507
90	Clover 100%	1.365	2.269	2.439	0.482	6.557
90	Oat 100%	1.800	2.322	1.908	0.414	6.444
90	75% Clov+25% Oat	2.359	2.374	1.515	0.400	6.649
90	50% Clov+50% Oat	2.047	2.519	2.199	0.551	7.317
90	25% Clov+75% Oat	2.207	2.337	2.191	0.405	7.140
135	Clover 100%	1.460	2.427	2.670	0.591	7.148
135	Oat 100%	1.971	2.471	1.918	0.449	6.810
135	75% Clov+25% Oat	2.561	2.495	1.581	0.312	6.949
135	50% Clov+50% Oat	2.168	2.364	2.263	0.554	7.350
135	25% Clov+75% Oat	2.537	2.406	2.205	0.413	7.561
180	Clover 100%	1.596	2.633	2.833	0.669	7.732
180	Oat 100%	2.062	2.627	2.018	0.461	7.169
180	75% Clov+25% Oat	2.548	2.563	1.708	0.431	7.252
180	50% Clov+50% Oat	2.110	2.595	2.422	0.554	7.682
180	25% Clov+75% Oat	2.580	2.598	2.471	0.455	8.104
NLSD(5%)		0.276	0.284	0.248	0.218	0.396

The stimulation effects of nitrogen fertilization in clover production may reflect the low nitrogen fixation under the hot climate area (Maheshwari and Anand 2003 and Huang *et al*. 2004). The monoculture of oat fertilized with 45 kg N ha-1 produced the lowest fresh forage yield in all cuts and their total which probably due to low nitrogen level of the soil (15.4 meq/L). Also, it had been reported that N fertilizer depressed clover content in the mixture (Davidson and Robson, 1986; Caradus *et al.* 1993). However, this trend was often reflected under the high level of N fertilizer as reported by Frame (1992) who used 250-350 kg N ha^{-1} which was not reached under the present study.

In the present study, the increase in dry forage yield with the addition of 180 kg N ha^{-1} in Egyptian clover was 13.8 %, compared with 45 kg N ha^{-1}, while in oat was 20.0 %. Since nitrogen fertilizers affected the growth of both Egyptian clover and oat differentially, it is expected that significant responses will be appear in their mixture due to N fertilization. Berdahl *et al*. (2001) reported that supplemental nitrogen fertilizers did not increase total forage yield of the grass–alfalfa mixture in all cuts, but they reported that N fertilizers favored the growth of grass components.

Generally, it is accepted that nitrogen fertilization stimulates the grass component of grass-legume mixtures (Nuttal *et al.* 1991; Caradus *et al.* 1993; Berdahl *et al.* 2001).

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الملخص :

استخدم تصميم القطع المنشقة ثنائيا بنظام القطاعات كاملة العشوائية في أربع مكررات لتقييم تأثير فترات الري ومستويات النيتروجين ونسب خلط بذور البرسيم المصري مع الشوفان على محصول العلف. وزعت فترات الري (الري كل ٧، ١٤، ٢١ يوم بمعدل ٥٠٠، ٦٥٠، ٨٠٠ م٣/ هكتار/ رية، باستهلاك مائي قدره ١٣٠٠٠، ٩٢٠٠، ٧٦٠٠ م٣/هكتار/ موسم) عشوائيا على القطع الرئيسية، ووزعت مستويات النيتروجين (٤٥، ٩٠، ١٣٥ و ١٨٠ كجم ن/ هكتار) على القطع الشقية الأولى، في حين وزعت عشوائيا نسب الخلط (١٠٠٪ برسيم أو شوفان، ٧٥٪ برسيم+ ٢٥ ٪ شوفان، ٥٠٪ برسيم + ٥٠ ٪ شوفان، ٢٥٪ برسيم+ ٧٥ ٪ شوفان) على القطع الشقية الثانية. وقد أشارت نتيجة التحليل التجميعي للبيانات على مدى موسمي الدراسة أن الري كل سبعة أيام أدي إلى الحصول على أكبر محصول علف طازج وجاف/ هكتار. كما أظهرت النتائج أن زيادة مستويات النيتروجين حتى ١٨٠ كجم/ هكتار أدت إلى زيادة محصول العلف الطازج والجاف / هكتار. كما أفادت النتائج أن زراعة البرسيم منفردا قد سجل أعلى محصول علف رطب، في حين أدى خلط ٢٥ أو ٧٥ ٪ برسيم مصري مع ٧٥ أو ٢٥ ٪ شوفان أعلى محاصيل علف جاف/ هكتار/ موسم. أشارت النتائج أن التفاعل بين فترات الري X مستويات النيتروجين وكذلك التفاعل بين فترات الري X نسب الخلط و أيضا التفاعل بين مستويات النيتروجين X نسب الخلط أثر معنويا على محصول العلف الرطب والجاف. وبصفة عامة، فقد أدت معاملة الري كل سبعة أيام و خلط ٢٥ ٪ من معدل بذر البرسيم مصري مع ٧٥ ٪ من معدل بذر الشوفان والتسميد بمعدل ١٨٠ كجم/ هكتار إلى الحصول على أعلى محصول علف من مخلوط البرسيم المصري والشوفان تحت ظروف محافظة الأحساء، المملكة العربية السعودية.