Zagazig J. Agric. Res., Vol. 35 No. (5) 2008 1083 - 1105

NITROGEN FERTILIZATION MANAGEMENT FOR WHEAT *(TRITICUM AESTIVURM)* IRRIGATED WITH EL-SALAM CANAL WATER, SOUTH EAST QANTRA, SINAI

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Accepted 15 / 9 / 2008

ABSTRACT: **Two field experiments were carried out at the area irrigated by El-Salam Canal, water during 2005-2006 season at two locations of South-East Qantara, Sinai Governorate, to study the effect of farmyard manure (FYM), mineral N- "sources, rates and the splitting of mineral N-" using on wheat (*Triticum aestivurm*, c.v. Satha 69). The first experiment was located at South East Qantara and the second one was performed at El-tena. The main results could be summarized as follows:**

1) **Yield of grains, and straw were increased by application of FYM experiments.**
2) **Application of ammonium nitrate 125 kg. fed^{-1} in 8 splits along with FYM increased grain and straw yields under sprinkler irrigation system.**
3) **The 1000-grains weight increased by increasing nitrogen rate, using FYM and splitting application.**
4) **Grain protein yield increased by 22.7% up on using FYM under sprinkler irrigation system and 37.5% under surface irrigation system.**
5) **Using 8 splits of ammonium nitrate using 125 kg. fed^{-1} gave by least increase in protein yield under sprinkler system.**
6) **Using 4 splits of calcium nitrate increased protein yield under surface irrigation system.**

Key words: Wheat, FYM. nitrogen fertilization splitting, sprinkler irrigation.

INTRODUCTION

Wheat is the main cared crop for bread making in Egypt. There is a wide gap, between the amount of wheat produced in Egypt and that needed for consumption, and the deference must be imported from foreign countries. Some of these countries use cereal crops to produce fuel to face the increase in the prices of fuel. The Egyptian government decided to increase wheat production of as well as cultivation more land by cereal crops particularly on reclaimed lands.

One of the largest projects of land reclamation in the east bank of Suies Canal depends on El-Salam Canal water. Such land in this area needs a efficient programmes of fertilization mainly with nitrogen.

Organic manures are recommended for enhancement of soil properties mainly the physical ones and for increasing soil fertility. On the other land, mineral N fertilizers, mainly nitrate N carriers, are costly and my lead to pollution of ground water.

The consumption of N fertilizers is using year after year due to the reclamation of new areas and/or using high yield varieties. One of the main ways to overcome the shortage in the production of N fertilizers is using the organic manures such as farmyard manure

One of the most important and practical practices to increase the efficiency of N fertilizers is the addition of the recommended amounts as splits.

The current study was carried out to investigate the effect of nitrogen fertilizers rates, sources, splitting with and without adding farmyard manure under two irrigation systems sprinkler and surface.

MATERIALS AND METHODS

Two field experiments were carried out at the area irrigated by El-Salam Canal water during, 2005/2006 season at two locations to study the effect of farmyard manure "FYM"; nitrogen fertilizer, (sources, rates and splitting of nitrogen) using wheat (Triticum aestivam c.v., Sakha 69). The first experiment (under sprinkler irrigation) was located at El-Tena Plain region and the second one (under surface irrigation) was performed at South East Qantara area, Sinai Governorate.

Soil samples were collected before executing the experiments to asses soil characteristics and results are shown in Table 1,A Water for irrigation was from El-Salam canal (a rather saline water) with the chemical composition recorded in Table 1b.

The experimental design was a randomized complete block, involving 4 factors, executed with three replicates. The plot area was 20 m^2 (4 ×5 m) in the first experiment and 30 m^2 (5 × 6 m) in the second one. The studied factors were as fallows:

1) Factor "A": Farmyard manure FYM at two rates 0 and 20m^3/feddan.
2) Factor "B": Nitrogen source fertilizer: 3 sources; ammonium sulphate (AS), ammonium nitrate (AN) and calcium nitrate (CN).
3) Factor "C": Nitrogen rates; 75, 100 and 125 kg N fad^{-1} in the first, experiment and 100, 125 and 150 kg N fed^{-1} in the second experiment.
4) Factor "D": the number of splits of mineral N: 6,8 and 10 splits in the first experiment. 3,4 and 5 splits at the second experiment.

Thus the total number of treatment combinations were 54 (2 FYM × 3 Source × 3 Rates × 3 spillitings), executed in 3 replicates.

Seeding rate was 70 kg seeds fed^{-1} executed on 15 November, 2005. All normal agricultural practices were performed. The schedule of applying the N splits was as follows: (Splitting done after 1^{st}, irrigation).

For the First Experiment (sprinkler irrigation)

1) 6 splits: every 10 days.
2) 8 splits: every 8 days.
3) 10 splits: every 6 days.

For the Second Experiment (surface irrigation)

1) 3 splits: every 20 days
2) 4 splits: every 15 days.
3) 5 splits: every 10 days.

After complete maturity, wheat were harvested and the yield of grains and straw were estimated by weighing the yield of 0.25 m^2 area.

Plant Analysis

Plant samples were taken to determine their content of N,P and K after drying at 70°C till constant weight. (Chapman and Pratt 1961).

Soil Analysis

1) Particle size distribution was carried out by the international pipette methods described by Piper (1950).
2) Calcium carbonate was volumetrically determined using the calcimeter according to Piper (1950).

Table 1. Properties of the soils of the sites (locations), of the experiments farmyard manure and irrigation water.

(a) Soil.

Location	Particle size distribution (%)			Soil texture	pH	EC* dS/m	Soluble ions me/100 soil							
	Sand	Silt	Clay				Ca^{++}	Mg^{++}	K^{+}	Na^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
1	89.16	0.16	9.68	sand	8.68	1.90	2.5	2.5	0.1	2.00	0.0	0.2	2.5	4.40
2	79.02	1.78	19.20	Sand loam	8.33	1.12	5.5	2.5	0.1	9.15	0.0	0.2	10.3	6.75

*pH: 1: 2.5 soil water suspension; EC in 1: 2.5: water extract; Location 1 and 2 are El-Tena plain and South Qantara, Sinai

(b) Irrigation water.

Soluble ions me/L								EC ds/m
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	
3.0	5.0	3.1	0.2	0.0	2.4	6.0	2.9	1.13

(c) Farmyard manure.

pH 1:25	EC dS/m	TSS (%)	Soluble ions me/L							
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
8.02	3.32	1.06	4.5	3.0	8.95	0.15	0.0	0.4	8.0	8.2

3) Organic matter content was determined by method of Walkley and Black (Black, *et al.*, 1965).
4) Soil reaction pH was determined in 1: 2.5 water suspensions by pH meter (Jackson, 1973).
5) Electrical conductivity EC, as well as soluble ions of the soil was done to 1: 2.5 soil: water $^{w}/_{v}$ extract according to Richards (1969).

RESULTS AND DISCUSSION

The experiments were conducted during the season 2005/2006 at two locations of South-East Qantara Sinai Governorate to study the effect of Farmyard manure "FYM", nitrogen fertilizer sources "ammonium sulfate (AS), ammonium nitrate (AN) and calcium nitrate (CN)", nitrogen rates and splits. The first experiment was under sprinkler and the second was under surface irrigation.

Grain Yield:

Under sprinklers irrigation system

The majority of effects proved no stastical significance, However, results are discussed on the bases of comparing means.

The grain yield is recorded in Table "2-a". The grain yield ranged between 953 and 3249 kg.fed^{-1}, the highest grain yield was obtained under the application of 125 kg N.fed^{-1} as ammonium nitrate at 8 splits in combination with FYM. The lowest value was obtained under application treatment of 100 kg N. fed^{-1} as ammonium sulphate and 6 splits without application of FYM . This means that the positive effect of FYM augmented the positive effect N mineral N-fertilizer. These results are similar to results obtained by Moselhy, (1995).

The obtained data revealed that FYM application as a general trend, increased grain yield by 38.4% . For nitrogen sources, the data indicated that ammonium nitrate increased the grain yield by 5.6% and 10.8% as compared by ammonium sulphate and calcium nitrate, respectively.

For nitrogen fertilizer rate, the data indicated that increasing nitrogen fertilizer application from 100 to 125 kg N.fed^{-1} increased the grain yield by 16.9%, while increasing it from 100 to 150 kg N.fed^{-1} decreased the grain yield by 2.6% and increasing the nitrogen rate from 125 to 150 N.fed^{-1} decreased the grain yield by 9.7%.

For nitrogen rate splitting, the data indicate that increasing N splitting from 6 to 8 and 10 splits increased the grain yield by 8.4% and 1.9%, respectively.

In general, it may be recommended that the most effective treatment in application of ammonium nitrate at 125 and 8 splits combined with FYM.

Under surface irrigation system

Under this irrigation system, the N rates were 75, 100 and 125 kg $N.fed^{-1}$ and splitting by 3,4 and 5 splits. The only significant affect was due to N rate; the main effects of FYM, N-source, or splitting were not significant.

The grain yield was recorded in Table 2-b. The grain yield ranged between 2800 and 4788 kg fed^{-1}. The highest yield was obtained under application of 100 kg $N.fed^{-1}$ as calcium nitrate in 3 splits without FYM. The lowest was obtained by application of 100 kg N. fed^{-1} as ammonium nitrate, 4 splits with FYM.

The obtained data revealed that the main effect of FYM application gave a non-significant decrease of 7.4% in grain yield.

For nitrogen sources, the data indicated that calcium nitrate application gave slight greater yields of 3.5 and 6.0% as compared with ammonium sulphate and ammonium nitrate, respectively.

For nitrogen fertilizer rates, the data indicate that the main effect of increasing nitrogen rate from 75 to 100 and to 125 kg N. fed^{-1} increased the grain yield significantly by 2.9 and 8.0, respectively.

For nitrogen splitting, the data showed no significant effect and the 6.2 and 7.4% increase given by the 5 splits over the 3 and 4 splits, respectively were not statistically significant. In general, there was a trend of apositive significant increase in grain yield of wheat due to increasing N fertilizer rates these results are in full agreement with those results of (Abdul Galil *et al.* 1980 and Abd El-Latif and El-Tuhamy 1986; El-Ghareib and El-Monoufi, 1988 and El-Bana and Aly, 1993, Maha Abd-Alla and Bassiouny, 1994. El-Naggar (1999), Metwally (2000), Abd El-Maksoud (2002), Rabei (2003), Abd El-Hameed (2004), Mostafa *et al.* (2004), Nassar *et al.* (2004), Salem *et al.* (2004), Mengel *et al.* (2006), Shaban and Helmy (2006) and Shaban and Abd El-Rhman (2007).

Table 2. *Grain yield (kg fed^{-1}) as influenced by application of FYM, inorganic N sources, N rates and No of N-splits*

(a) Sprinkler irrigation system

N* Source	N rate kg. fed^{-1}	Without FYM N splits 6	8	10	Mean	With FYM N splits 6	8	10	Mean	Mean FYM N splits 6	8	10	Mean
AS	100	953	1734	1639	1442	2139	2607	2213	2320	1546	2171	1926	1881
	125	1525	2186	1760	1824	2643	2970	2380	2664	2084	2578	2070	2244
	150	1334	1612	1760	1569	1853	2116	1718	1896	1594	1864	1739	1732
Mean		1271	1844	1720	1611	2212	2564	2103	2293	1741	2204	1912	1952
AN	100	1609	1747	2113	1823	2235	1969	1677	1960	1922	1858	1895	1892
	125	2031	1968	2431	2144	2535	3249	2366	2717	2283	2609	2399	2430
	150	1543	1654	1713	1637	2379	2156	1740	2092	1961	1905	1727	1864
Mean		1728	1790	2086	1868	2383	2458	1928	2256	2055	2124	2007	2062
CN	100	1044	1463	1506	1338	2453	2021	2606	2360	1749	1742	2056	1849
	125	1537	1895	1680	1704	2034	2191	1796	2007	1786	2043	1738	1856
	150	1539	1718	1612	1623	2599	1891	1904	2131	2069	1805	1758	1877
Mean		1373	1692	1599	1565	2362	2034	2102	2166	1868	1863	1851	1861
Mean of N rate													
100		1202	1648	1753	1611	2276	2199	2165	2283	1739	1924	1959	1874
125		1698	2017	1957	1868	2404	2804	2181	2256	2051	2410	2069	2177
150		1472	1661	1695	2293	2277	2054	1787	2166	1875	1858	1741	1825
G. Mean		1457	1775	1802	1678	2319	2352	2044	2239	1888	2046	1923	1958

L.S.D at 0.05: (A: FYM; B: N-Source; C: N-rate; D: N-splitting)

A	*NS*	BC	*NS*	ABD	*NS*
B	*NS*	ABC	*NS*	CD	5.9
AB	*NS*	D	*NS*	ACD	*NS*
C	*NS*	AD	*NS*	BCD	47.0
AC	*NS*	BD	*NS*	ABCD	46.0

*: AS = Ammonium sulphate, AN = Ammonium nitrate CN = Calcium nitrate

Table 2. Cont.

(b) Surface irrigation system.

N* Source	N rate kg. fed^{-1}	Without FYM N splits 3	4	5	Mean	With FYM N splits 3	4	5	Mean	Mean FYM N splits 3	4	5	Mean
AS	75	3322	2542	3738	3201	4119	4568	3917	4201	3721	3555	3828	3701
	100	2672	3600	4690	3655	3277	3180	3654	3370	2976	3390	4172	3713
	125	3702	3306	3663	3557	4454	4324	4435	4404	4078	3815	4049	3981
Mean		3233	3150	4030	3471	3930	4024	4002	3992	3591	3587	4016	3732
AN	75	3738	3493	2875	3369	3415	3875	3589	3627	3576	3684	3232	3498
	100	3053	4187	4551	3930	3663	2800	3801	3421	3358	3493	4176	3676
	125	3565	3344	4047	3652	3650	4056	3916	3874	3608	370	3981	3763
Mean		3452	3675	3825	3650	3576	3577	3769	3641	3514	3626	3797	3646
CN	75	3863	2861	4122	3615	3344	3899	3785	3676	3604	3380	3954	3646
	100	4788	3657	4439	4295	3489	4070	3398	3652	4138	3864	3919	3974
	125	4360	4335	3677	4124	3858	3468	4136	3821	4109	3902	3907	3972
Mean		4337	3618	4079	4011	3564	3813	3773	3716	3950	3715	3926	3864
Mean of N rate													
75		3641	2966	3579	3395	3626	4114	3764	3835	3634	3540	3671	3615
100		3505	3815	4560	3960	3476	3350	3618	3481	3491	3582	4089	3721
125		3876	3662	3796	3778	3987	3950	4162	4033	3932	3806	3979	3905
G. Mean		3674	3481	3978	3711	3697	3805	3848	3783	3685	3643	3913	3747

L.S.D at 0.05: (A: FYM; B: N-Source; C: N-rate; D: N-splitting)

A	*NS*	BC	*NS*	ABD	*NS*
B	*NS*	ABC	*NS*	CD	*NS*
AB	002.4	D	*NS*	ACD	*NS*
C	014.9	AD	*NS*	BCD	*NS*
AC	032.6	BD	*NS*	ABCD	*NS*

*: AS = Ammonium sulphate, AN = Ammonium nitrate CN = Calcium nitrate

The increase in wheat grain yield due to splitting the added N doses was mentioned by (Eid *et al.,* 1981; Baker *et al.*, 1983, Abd El-All 986, Abdel-Raouf *et al.*, 1988; Abd El-Maaboud 1991 and Megahed 1991), Basilious (1992), Dawood (1994), El-Sherbieny *et al.* (1998), Hanna and Abd El-El-Mottaleb (1998) and Mwafy (1999).

Straw yield:

Under sprinkler irrigation system

The straw yield was recorded and tabulated in Table 3-a. The straw yield ranged between 1199 and 3238 kg N fed^{-1}, The highest straw yield was obtained by application of 125 kg fed^{-1} as ammonium nitrate in 10 splits in combination with of FYM. The lowest value was obtained under application treatment of 150 kg N.fad^{-1} as ammonium sulphate in 10 splits without application of FYM.

The obtained data revealed that FYM application as a general trend, increased straw yield by 18.5%.

For nitrogen sources, the data indicated that ammonium nitrate application increased straw yield by 4.9 and 6.1% over yields given by ammonium sulphate and calcium nitrate, respectively.

For nitrogen fertilizer rate, data indicate that increasing N rate from 100 to 125 kg N. fed^{-1} increased straw yield by 1.9%, while increasing the rate from 100 to 150 kg N. fed^{-1} decreased straw yield by 8.4%.

For nitrogen splitting, the data showed that 8 splits increased the straw yield by 2.9 and 6.4% as compared by 6 and 10 splits, respectively.

As a general trend, the application of ammonium nitrate by the rate of 125, 8 kg N fed^{-1} and splits under using FYM increased the straw yield. These results are similar to results obtained by Moselhy (1995).

Under surface irrigation system

The straw yield was recorded in Table (3-b). The straw yield ranged between 3594 and 6558 kg N.fed^{-1} . The highest straw yield was obtained by application of 100 kg N.fed^{-1} as ammonium sulphate and 5 splits without application of FYM. The lowest straw yield was obtained under application of 75 kg N.fed^{-1} as calcium nitrate and 4 splits without application of FYM.

Table 3. Straw yield (kg fed^{-1}) as influenced by application of FYM, inorganic N sources, N rates and No of N-splits
(a) Sprinkler irrigation system

N* Source	N rate kg. fed^{-1}	Without FYM N splits 6	8	10	Mean	With FYM N splits 6	8	10	Mean	Mean FYM N splits 6	8	10	Mean
AS	100	1435	2195	2566	2065	3060	2904	2743	2902	2248	2549	2654	2484
	125	2319	2045	2284	2216	2610	2971	2984	2855	2465	2508	2636	2535
	150	2678	2363	1199	2080	2436	2791	2061	2429	2557	2577	1630	2255
Mean		2144	2201	2016	2120	2702	2889	2596	2729	2423	2545	2306	2425
AN	100	2439	2944	2009	2464	2645	2543	2393	2527	2542	2744	2201	2496
	125	2310	2736	2000	2349	2815	2568	3238	2873	2563	2652	2619	2611
	150	2463	2062	2840	2455	3080	2567	2162	2603	2771	2315	2501	2529
Mean		2404	2581	2283	2423	2847	2559	2598	2668	2625	2570	2440	2545
CN	100	1711	2250	2865	2275	2499	2512	3117	2709	2105	2381	2991	2492
	125	2284	2631	1857	2257	2427	2712	2877	2672	2355	2672	2367	2465
	150	2151	2500	1511	2054	2916	2559	2098	2424	2533	2379	1805	2239
Mean		2048	2460	2078	2195	2614	2494	2697	2602	2331	2477	2388	2399
Mean of N rate													
100		1862	2463	2480	2268	2735	2653	2751	2713	2298	2558	2615	2490
125		2304	2470	2047	2274	2617	2750	3033	2800	2461	2610	2540	2537
150		2431	2309	1850	2197	2810	2539	2107	2486	2621	2424	1979	2341
G. Mean		2199	2414	2126	2216	2721	2647	2630	2666	2460	2531	2378	2456

L.S.D at 0.05: (A: FYM; B: N-Source; C: N-rate; D: N-splitting)

A	*NS*	BC	0.0394	ABD	0.0404
B	0.0005	ABC	*NS*	CD	0.0012
AB	0.0509	D	0.0005	ACD	*NS*
C	*NS*	AD	*NS*	BCD	*NS*
AC	*NS*	BD	0.0153	ABCD	0.0042

*: AS = Ammonium sulphate, AN = Ammonium nitrate CN = Calcium nitrate

Table 3. Cont.

(b) Surface irrigation system

N* Source	N rate kg. fed^{-1}	Without FYM N splits 3	4	5	Mean	With FYM N splits 3	4	5	Mean	Mean FYM N splits 3	4	5	Mean
AS	75	5077	3886	4776	4580	4702	4847	5784	5111	4889	4367	5280	4845
	100	3750	4792	6558	5034	5259	5320	5261	5280	4504	5056	5910	5157
	125	4176	5329	4860	4788	5824	5804	5832	5820	5000	5566	5346	5304
Mean		4335	4669	5398	4801	5261	5324	5626	5404	4798	4996	5512	5102
AN	75	5300	4386	4337	4674	4550	4493	4775	4606	4925	4439	4556	4640
	100	4625	5362	5159	5049	5352	4116	4948	4805	4988	4739	5054	4927
	125	4832	5353	5091	5092	4786	5420	5659	5289	4809	5386	5375	5190
Mean		4919	5033	4862	4938	4896	4676	5128	4900	4908	4855	4995	4919
CN	75	4477	3594	5273	4448	4913	4236	4830	4659	4695	3915	5052	4554
	100	6335	6436	5258	6010	4377	4093	4430	4300	5356	5265	4844	5155
	125	5148	5442	5131	5240	5154	4326	4843	4774	5151	4884	4987	5007
Mean		5320	5157	5221	5233	4815	4218	4701	4578	5067	4688	4961	4905
Mean of N rate													
75		4951	3955	4795	4567	4721	4525	5129	4722	4836	4240	4962	4680
100		4904	5530	5659	5364	4996	4510	4880	4795	4950	5020	5269	5080
125		4719	5374	5028	5040	5255	5183	5445	5294	4987	5279	5236	5167
G. Mean		4858	4953	5160	4991	4991	4739	5151	4961	4924	4846	5156	4976

D at 0.05: (A: FYM; B: N-Source; C: N-rate; D: N-splitting)

A	NS	BC	NS	ABD	NS
B	*NS*	ABC	*NS*	CD	*NS*
AB	002.4	D	*NS*	ACD	*NS*
C	014.9	AD	NS	BCD	NS
AC	032.6	BD	*NS*	ABCD	*NS*

*: AS = Ammonium sulphate, AN = Ammonium nitrate CN = Calcium nitrate

For nitrogen sources, the data indicated that ammonium sulphate increased the straw yield as compared with ammonium nitrate and calcium nitrate.

Regarding nitrogen rate, the data indicated that increasing nitrogen rate increased straw yield.

For nitrogen splitting, the data indicate that splitting N rate to 5 splits increased straw yield greater than 3 or 4 splits, Moselhy, (1995), reported increased straw yield by increasing N rate. Also The results obtained by Gaber (1988) and Aly and Maha Abd-Alla and Bassiouny (1994) Moselhy (1995) showed an increase in wheat straw yield as a result of at increasing rates. Eid (1977), Abdel-Raouf *et al.* (1988) and Abd-Maaboud (1991), reported that splitting of N fertilizer increased straw yield of wheat.

1000-grains weight

Under sprinkler irrigation system

Data for the 1000-grain weight are in Table 4a. The 1000-grain weight ranged between 38.83 and 56.67 g. The greatest value was obtained by application of 150 kg N/fed^{-1} of calcium nitrate in 10 splits without using FYM; and the lowest value was obtained by 100 kg N/fed^{-1} as ammonium sulphate in 6 splits with using FYM.

Application of FYM increased the 1000-grains weight by 3.3%.

For nitrogen sources, the data indicated that ammonium nitrate application increased the 1000-grain weight by 5.6% and 1.3% as compared with ammonium sulphate or calcium nitrate, respectively. For N fertilization rate, the data indicated that increasing N rate from 100 to 125 and 150 kg N/fed^{-1} increased the 1000-grain weight by 3% and 2.9, respectively.

Regarding splitting of N, the data indicated that increasing N splitting from 6 to 8 and 10 splits increased the 1000-grain weight by 3.3% and 5.8%, respectively.

Under surface irrigation system

Data regarding the 1000-grain weight under surface irrigation system are tabulated in Table 4b. The 1000-grain weight ranged between 27.03 and 56.9. The greatest value was obtained under application of 100 kg N/fed^{-1} of ammonium sulphate as 5 splits without suing FYM; and the lowest value was obtained under application of 75 kg N/fad^{-1} and as ammonium sulphate as 4 splits without using FYM. Application of FYM increased the 1000-grains weight by an average 2.4%.

Table 4. 1000-grain weight (g.) as influenced by application of FYM, inorganic N sources, N rates and No of N-splits.

(a) Sprinkler irrigation system

N* Source	N rate kg. fed^{-1}	Without FYM N splits 6	8	10	Mean	With FYM N splits 6	8	10	Mean	Mean FYM N splits 6	8	10	Mean
AS	100	41.47	49.80	45.90	45.72	38.83	50.37	56.30	48.41	40.15	50.08	50.79	47.07
	125	47.73	47.17	54.50	49.80	50.33	53.67	47.40	50.47	49.03	50.42	50.95	50.13
	150	48.47	52.33	51.37	50.72	48.93	49.80	53.57	50.77	48.70	51.07	52.47	50.74
Mean		45.89	49.77	50.59	48.75	46.03	51.28	52.33	49.88	45.96	50.52	51.46	49.32
AN	100	50.63	52.60	52.90	52.04	50.83	49.57	56.33	52.24	50.73	51.08	54.62	52.14
	125	57.00	52.47	53.23	54.23	52.03	49.93	54.77	52.24	54.52	51.20	54.00	53.24
	150	51.80	52.83	52.80	52.48	49.37	47.50	51.23	49.37	50.58	50.17	52.02	50.92
Mean		53.14	52.63	52.98	52.92	50.74	49.00	54.11	51.29	51.94	50.82	53.54	52.10
CN	100	45.23	53.47	52.23	50.31	49.50	51.70	51.67	50.96	47.37	52.58	51.95	50.63
	125	49.67	51.80	48.40	49.96	55.67	49.13	51.57	52.12	52.67	50.47	49.98	51.04
	150	48.07	49.67	56.67	51.47	54.33	55.53	51.33	53.73	51.20	52.60	54.00	52.60
Mean		47.66	51.64	52.43	50.58	53.17	52.12	51.52	52.27	50.41	51.88	51.97	51.42
Mean of N rate													
100		45.78	51.96	50.34	49.36	46.39	50.54	54.68	50.54	46.08	51.52	49.95	49.95
125		51.47	50.48	52.04	51.33	52.68	50.91	51.24	51.61	52.07	50.69	51.64	51.47
150		49.44	51.61	53.61	51.56	50.88	50.94	52.04	51.29	50.16	51.28	52.83	51.42
G. Mean		48.80	51.35	52.00	50.75	49.98	50.80	52.66	51.15	49.44	51.07	52.33	50.95

L.S.D at 0.05: (A: FYM; B: N-Source; C: N-rate; D: N-splitting)

A	NS	BC	0.0394	ABD	0.0404
B	0.0005	ABC	NS	CD	0.0012
AB	0.0509	D	0.0005	ACD	NS
C	NS	AD	NS	BCD	NS
AC	NS	BD	0.0153	ABCD	0.0042

*: AS = Ammonium sulphate, AN = Ammonium nitrate CN = Calcium nitrate

Table 4. Cont.

(b) Surface irrigation system

N* Source	N rate kg. fed^{-1}	Without FYM N splits 3	4	5	Mean	With FYM N splits 3	4	5	Mean	Mean FYM N splits 3	4	5	Mean
AS	75	52.57	27.03	51.47	43.69	51.03	49.23	51.30	50.52	51.80	38.13	51.38	47.11
	100	49.20	55.10	56.57	53.62	52.07	51.07	55.20	52.78	50.63	53.08	55.88	53.20
	125	49.27	58.17	53.03	53.59	54.13	56.07	48.87	53.02	51.70	57.27	50.95	53.31
Mean		50.34	46.87	53.69	50.30	52.41	52.12	51.79	52.11	51.38	49.49	52.27	51.20
AN	75	52.50	47.40	51.17	50.36	53.73	56.13	59.07	56.31	53.12	51.77	55.12	53.33
	100	54.30	49.40	54.50	52.73	52.80	51.87	51.60	52.29	53.55	50.63	53.05	52.41
	125	53.17	47.17	56.23	52.19	53.10	52.57	51.90	52.52	53.13	94.87	54.07	52.36
Mean		53.32	47.99	53.97	51.76	53.21	53.52	54.19	53.64	53.27	50.76	54.08	52.70
CN	75	53.53	52.37	55.77	53.89	50.90	48.87	54.30	51.36	52.22	50.62	55.03	52.62
	100	52.40	44.07	52.57	49.68	53.17	52.07	54.77	53.33	52.78	48.07	53.67	51.51
	125	52.37	56.40	51.03	53.27	54.38	48.00	54.17	52.18	53.38	52.20	52.60	52.73
Mean		52.77	50.94	53.12	52.28	52.82	49.64	54.41	52.29	52.79	50.29	53.77	52.28
Mean of N rate													
75		52.87	42.27	52.80	49.31	51.89	51.41	54.89	52.73	52.38	46.84	53.84	51.02
100		51.97	49.52	54.54	52.01	52.68	51.67	53.86	52.73	52.32	50.59	54.20	52.37
125		51.60	54.01	53.43	53.02	53.87	52.21	51.64	52.78	52.74	53.11	52.54	52.80
G. Mean		52.14	48.60	53.59	51.45	52.81	51.76	53.46	52.68	52.48	50.18	3.53	52.06

L.S.D at 0.05: (A: FYM; B: N-Source; C: N-rate; D: N-splitting)

A	*NS*	BC	0.0089	ABD	*NS*
B	*NS*	ABC	0.0454	CD	0.0334
AB	*NS*	D	0.0039	ACD	*NS*
C	*NS*	AD	*NS*	BCD	0.0057
AC	*NS*	BD	*NS*	ABCD.	0.0255

*: AS = Ammonium sulphate, AN = Ammonium nitrate CN = Calcium nitrate

For nitrogen sources, the data indicated that ammonium nitrate application increased the 1000-grain weight by 2.9 and 0.3% as compared by ammonium sulphate and calcium nitrate, respectively.

Concerning N fertilization rate, the data indicated that increasing N rate from 75 to 100 and 125 kg N/fed^{-1} increased the 1000-grain weight by 2.6% and 3.5%, respectively.

Regarding N splitting, the data indicated that using 5 splits increased the 1000-grain weight than 3 or 4 splits.

As a general trend, the obtained data indicated that increasing the effect of N application confirm the results obtained by Khalil (1979) Baker *et al.* (1983) Salem (1984), Comaa and Ghanem (1985) Adel-Latif and Tuuhamy (1986); Maha & Basiouny (1994).

Also, Sedan *et al.* (1975), Eid (1977); Abd All (1986), Gaber (1988), Sadik (1990); Abd El-Maaboud (1991); Sajo *et al.* (1992); and Moselhy (1995) reported increased value of 1000-grain weight due to splitting N.

For N carriers, the results agree with those obtained by Eid (1977) who mentioned that 1000-grain weight of wheat was significantly increased due to N additions as AS or U compared by AN.

Grains protein content

Under sprinklers irrigation system

Data for grain protein yield are recorded in Table 5a. The grain protein yield ranged between 20.02 and 82.83 $kg.fed^{-1}$. The greatest value of protein was obtained by the application of 125 kg fed^{-1} of calcium nitrate in 8 splits using FYM. On the other hand, the lowest value was obtained under application of 100 kg fed^{-1} as ammonium sulphate in 6 splits without using FYM.

With regard to the effect of FYM application, the data showed that using FYM increased grain protein by 22.7%.

Studying the effect of nitrogen sources, the data indicated that application of ammonium nitrate increased the grain protein yield by 16.8% and 27.06% as compared by ammonium sulphate and calcium nitrate, respectively. Application of ammonium nitrate increased the protein yield by 8% as compared by calcium nitrate.

For clarifying to the effect of nitrogen fertilization rate, the data indicated that application rate of 125 kg N/fad increased grain protein by 7.7% and 107% as compared with the rates 100 and 150 $kg.fed^{-1}$, respectively.

Table 5. Grain protein yield (kg fed^{-1}) as influenced by application of FYM, inorganic ` sources, N rates and No of N-splits.

(a) Sprinkler irrigation system

N* Source	N rate kg. fed^{-1}	Without FYM N splits 6	8	10	Mean	With FYM N splits 6	8	10	Mean	Mean FYM N splits 6	8	10	Mean
AS	100	125.1	254.7	250.6	210.1	223.1	303.1	296.1	274.1	174.12	278.87	273.33	242.11
	125	139.1	288.4	242.0	223.2	252.7	339.2	242.3	278.1	195.94	313.80	242.14	250.63
	150	142.0	267.2	291.6	233.6	247.5	282.1	207.5	245.7	194.74	274.66	249.52	239.64
Mean		135.4	270.1	261.4	222.3	241.1	308.1	248.6	265.9	188.27	289.11	255.00	244.12
AN	100	247.1	212.3	314.3	257.9	272.4	287.2	263.1	274.2	259.76	249.73	288.66	266.04
	125	237.1	193.8	386.0	272.3	344.3	515.8	346.0	402.7	290.73	355.77	366.03	337.51
	150	191.0	181.9	222.1	198.4	267.1	438.3	212.8	306.1	229.05	310.14	217.47	252.22
Mean		225.1	196.0	307.5	242.8	292.6	414.4	274.0	327.7	259.84	305.21	290.72	285.26
CN	100	148.3	247.8	194.4	196.8	257.7	216.0	335.4	269.7	203.01	231.90	264.92	233.28
	125	236.4	178.0	212.6	209.0	163.6	261.5	211.4	212.2	200.01	219.75	212.01	210.59
	150	132.3	226.6	238.2	199.0	322.2	243.6	214.6	260.1	227.28	235.05	226.41	229.58
Mean		172.3	217.5	215.1	201.6	247.9	240.3	253.8	247.3	210.10	228.90	234.45	224.48
Mean of N rate													
100		173.5	238.2	253.1	221.6	251.1	268.8	298.2	272.7	212.29	253.50	275.64	247.14
125		204.2	220.1	280.2	234.8	253.6	372.8	266.6	297.7	228.89	296.44	273.39	266.24
150		155.1	225.3	250.6	210.3	270.0	321.3	211.6	270.6	217.02	273.28	231.13	240.48
G. Mean		177.6	227.9	261.3	222.3	261.2	320.9	258.8	280.3	219.40	274.41	260.05	251.29

L.S.D at 0.05: (A: FYM; B: N-Source; C: N-rate; D: N-splitting)

A	0.0000	BC	0.0000	ABD	0.0000
B	0.0000	ABC	0.0000	CD	0.0005
AB	0.0013	D	0.0000	ACD	0.0000
C	0.0002	AD	0.0000	BCD	0.0009
AC	0.0000	BD	0.0000	ABCD	0.0000

*: AS = Ammonium sulphate, AN = Ammonium nitrate CN = Calcium nitrate

Table 5. Cont.

(b) Surface irrigation system

N* Source	N rate kg. fed^{-1}	Without FYM N splits 3	4	5	Mean	With FYM N splits 3	4	5	Mean	Mean FYM N splits 3	4	5	Mean
AS	75	322.5	230.1	321.3	291.3	548.0	575.6	483.9	535.8	435.3	402.9	402.9	413.6
	100	207.2	365.6	175.4	249.4	280.1	338.6	299.1	305.9	243.7	352.1	237.3	277.7
	125	336.2	284.5	350.2	323.6	355.0	385.6	415.8	385.4	345.6	335.1	383.0	354.6
Mean		288.6	293.4	282.3	288.1	394.4	433.2	399.6	409.1	341.6	363.4	341.0	348.6
AN	75	310.6	422.0	299.0	364.9	323.9	356.8	392.5	357.7	317.3	424.4	342.3	361.3
	100	239.2	375.9	448.1	354.4	326.4	223.1	380.1	309.9	282.8	299.6	414.1	332.2
	125	301.0	292.6	294.4	296.0	371.8	219.8	291.1	294.2	336.5	256.2	292.8	295.2
Mean		283.6	386.8	344.8	338.4	340.7	266.5	354.5	320.6	312.2	326.7	349.7	329.6
CN	75	421.4	241.3	315.5	326.1	178.3	356.5	384.0	306.3	299.9	298.9	349.8	316.2
	100	411.5	371.4	397.9	393.6	360.4	363.7	261.2	498.4	386.0	622.5	329.6	446.0
	125	333.8	453.3	285.9	357.6	550.5	335.4	580.8	488.9	492.2	394.4	433.3	423.3
Mean		388.9	355.3	333.1	359.1	363.1	521.8	408.6	431.2	376.0	438.6	370.9	395.2
Mean of N rate													
75		358.5	321.1	309.6	327.4	350.1	429.6	420.1	399.9	350.8	375.4	364.9	363.7
100		286.0	371.0	340.5	332.5	322.3	478.4	313.5	371.4	304.2	424.7	327.0	352.0
125		323.7	343.5	310.2	325.8	425.8	313.6	429.2	389.5	374.8	328.6	369.7	357.7
G. Mean		320.4	345.2	320.1	328.5	366.0	407.2	387.6	386.9	343.3	376.2	353.9	357.8

L.S.D at 0.05: (A: FYM; B: N-Source; C: N-rate; D: N-splitting)

A	0.0006	BC	0.0000	ABD	0.0089
B	0.0051	ABC	0.0089	CD	0.0140
AB	0.0033	D	NS	ACD	0.0210
C	NS	AD	NS	BCD	0.0038
AC	NS	BD	NS	ABCD	0.0000

*: AS = Ammonium sulphate, AN = Ammonium nitrate CN = Calcium nitrate

Regarding the effect of nitrogen splits, the data showed that using 8 splits increased protein yield by 25.1% and 5.5% as compared with 6 splits and 10 splits, respectively. Using 10 splits increased the protein yield by 18.5% as compared with 6 splits.

Under surface irrigation system

Value for grain protein yield shown in Table 5b ranged between 28.08 and 92.93 kg.fed^{-1}. The greatest value was obtained by application of 125 kg fed^{-1} in the form of calcium nitrate in 5 splits with using FYM, and the lowest one was obtained under application of 100 kg.fed^{-1} as ammonium sulphate in 5 splits without using FYM.

Regarding the effect of FYM application, the data showed that using FYM increased grain protein yield by 37.5%.

Concerning the effect of nitrogen source, the data indicated that application of calcium nitrate increased the protein yield by 13.8% and 19.9% as compared with ammonium sulphate and ammonium nitrate, respectively. Application of ammonium sulphate increased protein yield by 5.4% as compared with ammonium nitrate.

Studying the effect of nitrogen fertilization rate, the data indicated that application rates of 100 kg fed^{-1} gave that highest values that given by 75 or 125 kg N/fed^{-1}.

With regard to the effect of nitrogen splitting, the data showed that using 5 splits increased protein yield by 3.1% as compared with 3 splits and 4 splits increased protein by 9.6% and 6.3% as compared with 3 and 5 splits, respectively.

The results obtained in this experiment showing the effect of N levels are in agreement with those obtained by Russel (1973), Below *et al.* (1981), Moselhy (1995), Kotb (1998), and Menget *et al.* (2006). Comparing the different N carriers effect on the grain protein content, similar results were obtained by Hassan and El-Soliti (1973), Eid (1977), El-Baisary *et al.* (1982) and Nour *et al.* (1989) and Mostly (1995).

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خدمة الأسمدة النتروجينية للقمح المروي بمياه ترعة السلام جنوب القنطرة شرق سيناء

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أجريت تجربتان حقليتان خلال موسم ٢٠٠٥-٢٠٠٦ بمنطقة القنطرة شرق بمحافظة شمال سيناء والتي تروي بمياه ترعة السلام لدراسة تأثير السماد البلدي ومصادر النتروجين ومعدل التسميد وتجزئته علي محصول القش والحبوب للقمح وكذلك وزن ١٠٠٠ حبه ومحتوي النتروجين فيه وذلك تحت نظامي ري ، ري رش وري غمر.

وقد أشارت النتائج المتحصل عليها إلي النقاط التالية:

١) تأثر كل من الحبوب والقش ايجابيا باستخدام السماد البلدي في التجربتين.

٢) باستخدام سماد نترات الامونيوم بمعدل ١٢٥كجم/فدان علي ٨ جرعات مع استخدام السماد البلدي زاد محصول الحبوب والقش تحت استخدام نظام الري بالرش.

٣) وزن الـ ١٠٠٠ حبه زاد بزيادة معدل النتروجين واستخدام السماد البلدي والتجزئة

٤) محتوي البروتين زاد بنسبة ٢٢,٧٪ باستخدام السماد البلدي تحت الري بالرش وبنسبة ٣٧,٥٪ تحت الري بالغمر.

٥) استخدام نترات الامونيوم بمعدل ١٢٥ كجم/فدان في ٨ جرعات رفع محتوي النتروجين تحت الري بالرش.

٦) استخدام ٨ جرعات من نترات الكالسيوم زوّد محتوي النتروجين تحت الري بالغمر.