J. Plant Production, Mansoura Univ., Vol. 3 (2): 397 - 414, 2012

IMPACT OF MINERAL AND BIOFERTILIZATION OF NITROGEN ON YIELD AND YIELD ANALYSIS OF SOME FLAX GENOTYPES CULTIVATED IN NEW RECLAMATION LANDS

Hussein, M. M. M.
Fiber Crops Res. Sec., Field Crops Res. Institute, ARC, Giza, Egypt.

ABSTRACT

Two field experiments were conducted during 2008/2009 and 2009/2010 seasons under new irrigation system (Sprinkler irrigation) at the Experimental Farm of Ismailia Agric Res. Station, ARC, to investigate the impact of fertilization treatments (in terms of mineral N levels either alone or combined with Nitrobein (bio- N fertilizer) on yield quantity and its quality as well as analysis of some flax genotypes i.e. Sakha 3, Viking, Sakha 2 and the flax strain 2419/1. The main finds could be summarized as follows:

The results showed that flax Sakha 3 variety ranked first and surpassed the other three genotypes in straw yield characters. While, flax 2419/1 strain achieved highest estimates regarding seed yield characters.

There was gradual increments as increasing nitrogen levels either in alone case or combined with Nitrobein (bio-fertilizer) concerning all straw and seed yield characters except for fiber fineness which was decreased. The difference between nitrogen treatment at 60 kg mineral nitrogen /fad + Nitrobein and added 75 kg N/fad did not reach the level of significant in most characters especially fiber, seed and oil yields/fad.

The interaction between genotypes and nitrogenous fertilization treatments had significance effect on straw and fiber yield/fed, fiber fineness, 1000 seed weight as well as seed and oil yield/fad.

Results revealed positive and significant correlation values between straw yield/fad and each of technical length/ plant, straw yield/plant, fiber yield/fad as well as per plant, fiber length and long fiber%, also between seed yield/fad and each of seed yield/plant, No. of capsules/plant, No. of seeds/capsule, 1000 seed weight and seed oil%.

Path coefficient analysis indicated that the long fiber percentage, fiber yield/plant and their interaction considered as the most important characters to increase fiber yield/fad. In the same time, seed yield/plant, No. of seeds/capsule and their interaction had similar effect for increasing seed yield/fad within the studied four flax genotypes.

It could be summarized that for maximizing the productivity with best quality, minimizing the production cost of mineral fertilizer and environmental pollution for the tested flax genotypes, it could be recommended to inoculating Sakha 3 variety seed with 1.5kg/fad Nitrobein and fertilized their plants with 60kg/fad mineral nitrogen.

INTRODUCTION

Flax *(Linum usitatissimum, L.)* consider as one of the most important bast fiber crop in several regions of the world for its fiber and seed production. However, in Egypt, flax is cultivated for the production of both fibers and oil (dual purpose). Flax cultivating area in last few years become limited due to of great competition with the other winter crops, *vis*: wheat, clover and sugar beet in ancient valley lands. Also, fiber and seed production from such limited area was insufficient to provide the need of the increased demands of the growing people. Therefore, in recent time it is necessary to increase flax productivity from the limited area to narrowing the great gab between the consumption and the production by growing flax genotypes characterized with high yielding ability and improvement of agricultural treatments as well as carry out trails in new reclaimed lands which could be considered as the solution for increasing flax area and increase the pructivity of the soil by enhancing its fertility with different sources of fertilizers especially nitrogen. In this respect, many investigators recorded significant differences among flax genotypes in yield and its attributes (El-Farouk *et al.* 2003; Mourad *et al.* 2009 and El-Kady *et al.* 2010).

The pattern of nutrient uptake by flax plants as affected by N application has been studied by many investigators (El-Shimy *et al.* 1993; Tomar *et al.*, 1999; Hussein 2007and Moawed *et al.* 2008). Recently, much interest is focused on using N-biofertilizer to minimize the production cost of mineral fertilizers and environmental pollution. In this connection, El-Gazzar (2000) concluded that inoculation with Nitrobein (biofertilizer), increased straw yield/plant. Whereas inoculation with Cerealine increased technical length/plant, fiber length, no. of capsules/plant and seed yield/plant. In addition, El-Azzouni and El-Banna (2002), Mostafa *et al.* (2003), Salem *et al.*, (2006) Hussein (2007), and Moawed *et al.* (2008) indicated positive response of flax plants to biofertilization and recorded maximum values of the yield and quality.

Therefore, the main target of this work was to study the influence of mineral N fertilizer either alone or partially combined with Nitrobein (N-biofertilizer) for increasing yield quantity and quality as well as estimates of correlation coefficient and path analysis between some straw, fiber and seed characters for the four tested flax genotypes namely Sakha3, Viking, Sakha 2 and S.2419/1 under new reclamation lands.

MATERIALS AND METHODS

Two field trails were conducted at the Experimental Farm of Ismailia Agric. Res. Station, ARC, Egypt during the two consecutive winter seasons of 2008/2009 and 2009/2010 to study the influence of mineral N levels in presence and /or absence of biofertilizer (Nitrobein) on yield quantity and quality as well as yield analysis of four flax genotypes namely, Sakha 3, Viking, Sakha 2 and S.2419/1. The soil of the experiment was sandy in texture. Mechanical and chemical analysis of the experimental sites in both seasons determined before sowing according to the method described by Jackson (1973) and are given in Table (1a).

Table1a. Some of mechanical and chemical analysis of the experimental sites:

Variables	2008/2009 season	2009/2010 season
	Mechanical analysis	
Soil type	Sandy	Sandy
Coarse sand	64.84	66.06
Fine sand	33.49	32.18
Silt and clay	1.67	1.76
Organic matter	1.78	1.89
CaCo3	1.45	1.53
Field capacity	7.34	7.65
	Chemical analysis	
PH	8.52	8.34
EC (dsm^{-1})	0.13	0.18
Available N (ppm).	21.01	24.57
Available P (ppm).	2.48	2.78
Available K (ppm).	32.65	35.98

The treatments under study were laid out in a split plot design with four replications in both seasons, The four flax genotypes namely, Sakha3, Viking, Sakha2 and S.2419/1 located in main plots and the seven N fertilization treatments (30 kg N/fad, 30 kg N + Nitrobein, 45 kg N/fad, 45 kg N + Nitrobein, 60 kg N/fad, 60 kg N + Nitrobein, and 75 kg N/fad) were devoted as sub plots. Each plot area (experimental unit) was 6 m^2 in both seasons having rows (for seed drilling) of 3m in length and 20cm apart. The preceding crop was maize (Zea mays, L.) in the first season and peanut (*Arachis hypogaea*, L.) in the second one. The pedigree of the four tested flax genotypes, origin and classification are presented in Table 1**b**

Table 1b .The pedigree of the four tested flax genotypes, origin and classification (fiber type, dual type and oil type) .

No.	Genotypes	Pedigree	Origin	Type
1	Sakha 3	I. Blenika x I. 2569	Local variety	F
2	Viking	Introduced from Holand	Introduction	F
3	Sakha 2	I. 2348 (Hungary) x I. Hira (India)	Local variety	D
4	S. 2419/1	Selected from I. Humpata (Hungarian)	Local strain	O

The experimental fields were well prepared through two ploughings, leveling and divided into the required plots. Flax seeds were inoculated as previously mentioned with 1.5 kg Nitrobein/fad as according to the limited seeding rate of each tested genotypes. Seeds of the four tested flax genotypes were hand drilled into rows 20 cm apart at sowing rate of 50 kg seeds/fad for Sakha 3 and Viking cvs as fiber types and at sowing rate of 70 kg seeds/fad for Sakha 2 cv. and S.2419/1 as dual purpose and oil types, respectively. Sowing date were 15th and 18th November in the first and second seasons, respectively. Seeds of the four tested flax genotypes were obtained from Fiber Crops Research Section, Field Crops Res. Institute, ARC. To achieve a good natural status, common P and K fertilizer were pre-sowing added fully at the rate of 150 kg/fad calcium superphosphate (15.5% P_2O_5) and 50 kg/fad potassium sulphate (48.5% K_2O). After 15 days from sowing the winter prevailing between flax rows were hand pulled to minimize earlier competition between flax plants and weeds to the lowest level. Mineral nitrogen fertilizer at the above mentioned levels were applied as ammonium sulphate (20.5 %N) in four equal doses, the first dose was added before the first irrigation and after weed control, while the remainders were applied 15 days intervals. Nitrobein is also a commercial biofertilizer containing bionitrogen fixation bacteria (*Azotobacter* Spp. *Azospirillum* Spp.) produced by the General Organization for Agricultural Equalization, Fund, Ministry of Agriculture and Land Reclamation. New irrigation system (Spinkler irrigation) was used in the two seasons of the experimentation. All other agricultural practices for growing flax were conducted as recommended for the region.

At full maturity, ten guarded plants in each experimental unit in the four replicated were hand pulled carefully at random to determine yield components. Seed, straw and fiber yields/fad were estimated from an area of (3.6 m^2) from the central area of each subplot and then the yields of seed, straw and fiber/fad were calculated. The retting process made in Fiber Crops Research Section, Field Crops Research Institute, ARC to extract flax fiber for studying its quantity and quality parameters.

Studied characters:

I -Straw yield and its attributes:

Total length/plant (cm), technical length/plant (cm), straw yield/plant (g), straw yield /fad (ton), fiber yield /plant (g), fiber yield /fad (ton), long fiber percentage: was estimated as follows: long fiber %= $\frac{the\,long\;\, fiber\;\, yield\;/\;fad}{the\,retted\;\, straw\, yield\;/\;fad} x100$, fiber length (cm): was measured as average of ten fiber ribbons (bundles from each subplot), fiber fineness in N.m: was determined according to Radwan and Momtaz (1966) as follows: $N.m = \frac{NxL}{G}$ where N.m = metrical number, N = number of 20 fibers in mm (2000), G = weight of fibers in mg.

II- Seed yield and its attributes:

No. of capsules/plant, no. of seeds/capsule, 1000 seed weight (g), seed yield/plant (g), seed yield/fad (kg), seed oil percentage: was determined as described by the A.O.A.C. Methods (1995), using a Soxhlet apparatus and petroleum either (60-80ºC) as a solvent, oil yield/fad (kg): was determined by multiplying seed yield/fad x seed oil%.

Statistical analysis:

Data obtained were subjected to the analysis of variance (ANOVA). Significance of differences among treatments were judged with the help of the least significant differences (LSD) at 5% and 1% level of probability according to Snedecor and Cochran (1982). Moreover, Bartlett's test for heterogeneity was done concerning the error variances using plot means indicated that error terms were homogenous. Combined analysis of variance over the two seasons was undertaken for each trait according to LeClerg *et al.* (1966).

III- Yield analysis :

1- Correlation coefficient study:

Combined data over the two seasons, a simple correlation coefficient as well as calculated. Relationships between straw, fiber and seed yields/fad and most of their attributes were subjected to simple correlation coefficient according to Svab (1973) using the following equation: $r = \frac{SPxy}{\sqrt{SSx.SSY}}$,

where: $SPxy = \sum xy - \sum x \,.\, \sum y/n$, $SSx = \sum x^2 - (\sum x)^2/n$, $SSy = \sum y^2 - (\sum y)^2/n$. SPxy is the phenotypic covariance between the two traits, SSx is the phenotypic standard deviation of the first character and SSy is the phenotypic standard deviation of the second character. The r test was used the significant of r (value).

2- Path coefficient analysis study:

Calculated from the combined data over the two seasons, the path coefficient analysis was utilized by partitioning the simple correlation coefficient between:

- Fiber yield/fad and its components i.e. fiber yield/plant, fiber length and long fiber percentage.
- Seed yield/fad and its components i.e. seed yield/plant, no. of capsules/plant and no. of seeds/capsule.

The path analysis study was computed by using the method mentioned by Li (1975).

RESULTS AND DISCUSSION

I- Straw yield and its attributes:

Analysis of variance for data presented in Table (2) showed that the four tested flax genotypes differed significantly with regard to all straw yield characters i.e. total length/plant, technical length/plant, straw yield/plant, straw yield/fad, fiber yield/plant, fiber yield/fad, long fiber percentage, fiber length and fiber fineness in the two seasons and their combined. Sakha 3 cv. ranked the first and surpassed significantly the other three flax genotypes and recorded the highest mean values with regard to the all abovementioned characters, followed by Viking cv., Sakha 2 cv. and the lowest one was S.2419/1. The differences between the four flax genotypes as regards straw characters could be attributed to the genetical background. These results in good agreement with those reported by El-Farouk *et al.* (2003), Salem *et al.* (2006), Hussein (2007), Mourad *et al.* (2009), and El-Kady *et al* (2010).

Statistical analysis of variance for data presented in Table (2) showed significant differences in all straw yield characters studied in both seasons and their combined due to the influence of mineral and bio-nitrogen fertilization treatments.

2

2

Results revealed that the eight straw characters i.e. total length/plant, technical length/plant, straw yield/plant, straw yield/fad, fiber yield/plant, fiber yield/fad, long fiber percentage and fiber length were increased in their mean values as N level increased from 30 up to 75 kg N/fad, without significant differences between applying 60 kg N/fad+Nitrobein and 75 kg N/fad. However, fiber fineness trait was decreased as a result of increasing N level from 30 up to 75 kg/fad. These results may be due to that nitrogen fertilizer caused an increase in the amount of metabolites synthesized by the plant, so the dry weight of the different parts of plant become great. This in turn, might contribute much to the increase basal branches and hence caused more, straw yield/plant, straw yield/fad, fiber yield/plant, fiber yield/fad, long fiber% and fiber length. It is well known that nitrogen is an essential element for flax growth to build up protoplasm and proteins which induced cell division and meristematic activity, such effect resulted in an increase in cells number and size with an over all increase in flax growth and its yields. While, fiber fineness decreased and the fiber become course with increasing N level up to 75 kg/fad, this behavior due to more number of cellulose layers accumulate on the inner surface of the primary wall for fiber cell. These results are in similar with those obtained by Hella *et al.* (1988), EL-Shimy *et al* (1993), Zedan *et al.* (1997), Tomar *et al.* (1999), El-Gazzar 2000), El-Azzouni and El-Banna (2002), Hussein (2007), Salem *et al.* (2006), Hussein and Zedan (2008) and Moawed *et al.* (2008).

II- Seed yield and its attributes:

Results presented in Table (3) show that the four tested flax genotypes exhibited significant differences in all seed yield characters i.e. No. of capsules/plant, No. of seeds/capsule, 1000 seed weight, seed yield/plant, seed yield/fad, seed oil percentage and oil yield/fad in both seasons and their combined. The flax strain 2419/1 ranked the first over all the other genotypes in all seed characters, followed by Sakha 2, Viking and the fewest ones Sakha 3 cv. in descending orders. The differences between the four tested flax genotypes as regards seed characters could be attributed to the genetical background. These results in accordance with those reported by El-Farouk *et al.* (2003), Mourad *et al.* (2009), Hussein (2007), and El-Kady *et al.* (2010).

Results in Table (3) revealed that nitrogen fertilization treatments caused significant increase in all seed traits under study in each season and their combined, without significant differences between the treatment of 60 kg N/fad+ Nitrobein and the highest dose of mineral N (75 kg N/fad). These results could be due to the favorable effect of nitrogen fertilization in enhancing vegetative growth as well as the metabolism process in the plant which caused an increase in dry matter accumulation and that was the logical results to the defected increase in all traits previously noted. Also, the superiority in seed yield/plant under these conditions could be due to the increase in number of mature capsules and seed index. These findings are confirmed with those obtained by Hella *et al.* (1988), El-Shimy *et al.* (1993) Zedan *et al*. (1997), Tomar *et al.* (1999), El-Gazzar (2000), , El-Azzouni and El-Banna (2002), Hussein (2007), Hussein and Zedan (2008) and Moawed *et al.* (2008).

3

3

Also these results revealed no significant differences between 60 kg N level when combined with Nitrobein and highest N level of 75 kg/fad in great economical seed characters. It could be concluded that the 60 kg N level when combined with Nitrobein treatment improved no. of capsules/plant, no. of seeds/capsule, seed index and seed yield/plant. The increase in seed yield characters may be due to the important role of Nitrobein fertilizer, which helped in producing hormonal effect and increased nutrients uptake in root media and possibly played a considerable role in metabolites accumulation inside flax seeds which created heavier seed weight/plant and seed index. These results are confirmed with those obtained by Hussein (2007) and Moawed *et al.* (2008). On the other hand, El-Gazzar (2000) reported that inoculation with Nitrobein biofertilizer increased seed and oil yields/fad. Similar results in good agreement with those recorded by, Abdel-Samie *et al.* (2002), Mostafa *et al.* (2003), and Salem *et al.* (2006).

As combined for both seasons, statistical analysis of variance for data presented in Table (4) revealed that the GxF interaction had significant effect on straw and fiber yield /fad., fiber fineness, 1000 seed weight, seed and oil yields/fad.

Table 4: The significant interaction between the tested flax genotypes and N fertilization treatments on straw yield/fad. fiber yield/fad. fiber fineness, 1000 seed weight, seed and oil yields/fad. (combined data of 2008/2009 and 2009 /2010 seasons).

Genotypes	N fertilization treatments							L.S.D at 5%
	30 kg N/fad	30 kg N + Nitrobein/fad	45 kg N/fad	45 kg N + Nitrobein/fad	60 kg N/fad	60 kg N + Nitrobein/fad	75 kg N/fad	
	Straw yield/fad. (ton)							
Sakha 3	3.473	4.169	4.976	5.307	5.356	5.529	5.583	
Viking	2.871	3.482	4.147	4.610	4.834	4.863	4.907	
Sakha 2	2.517	3.326	3.370	4.408	4.367	4.386	4.457	0.198
S.2419/1	2.339	2.907	3.175	4.171	4.143	4.202	4.273	
L.S.D at 5%	0.175							
	Fiber yield/fad. (ton)							
Sakha 3	0.513	0.582	0.670	0.898	0.910	0.933	0.970	
Viking	0.374	0.535	0.648	0.775	0.782	0.822	0.836	
Sakha 2	0.290	0.411	0.528	0.719	0.732	0.744	0.765	0.046
S.2419/1	0.206	0.359	0.479	0.685	0.715	0.735	0.750	
L.S.D at 5%	0.044							
	Fiber fineness (N.m)							
Sakha 3	222.14	201.67	192.20	181.31	174.69	172.13	168.80	
Viking	212.76	194.56	181.05	176.82	171.29	165.98	162.53	
Sakha 2	189.47	185.51	178.55	169.34	164.75	158.68	154.60	6.47
S.2419/1	185.01	180.42	173.55	166.48	162.24	155.40	151.32	
L.S.D at 5%	6.04							
	1000 seed weight (g)							
Sakha 3	3.20	6.43	6.88	6.90	7.12	7.26	7.35	
Viking	6.27	6.68	7.42	7.58	7.90	8.02	8.10	
Sakha 2	6.90	7.79	8.06	8.65	8.72	8.96	9.15	0.29
S.2419/1	7.54	7.94	8.12	8.88	8.95	9.19	9.25	
L.S.D at 5%	0.28							
	Seed yield/fad (kg)							
Sakha 3	229.06	328.07	338.53	415.65	422.93	435.26	441.47	
Viking	352.20	384.64	449.99	531.39	553.39	560.78	570.23	49.70
Sakha 2	467.88	547.32	613.54	708.64	717.06	735.17	745.13	
S.2419/1	519.45	625.77	693.91	749.07	757.23	771.14	786.97	
L.S.D at 5%	43.95							
	Oil yield/fad (kg)							
Sakha 3	68.64	99.82	104.37	131.90	135.18	139.59	142.61	
Viking	108.01	120.94	146.70	174.81	182.07	185.46	189.37	18.87
Sakha 2	182.05	216.96	246.16	288.03	291.70	300.87	305.72	
S.2419/1	206.97	255.42	289.38	319.36	324.15	331.41	338.56	
L.S.D at 5%	16.10							

The finest fibers (222.14 N.m) was registered from Sakha3 variety when fertilized its plants with 30 kg chemical N/fad. However the highest values of straw yield/fad. (5.583 ton) and fiber yield/fad. (0.970 ton) were recorded for Sakha 3 cv. when fertilized with 75 kg N/fad. Moreover the maximum values of 1000 seed weight (9.25 g), seed yield/fad (786.97 kg) and oil yield/fad (338.56 kg) were obtained from S.2419/1 when fertilized with 75 kg chemical N/fad, without significant differences between 60 kg N/fad + Nitrobein and 75 kg N/fad in this respect. These results means that Nitrobein as bio fertilizer can replace partly mineral nitrogen fertilizer recording the same effect which reflects the production cost of mineral fertilizers and environmental pollution. Similar results were recorded by Abdel-Samie *et al.* (2002), Salem *et al.* (2006), Hussein (2007), Hussein and Zedan (2008) and Moawed *et al.* (2008).

III- Yield analysis:

A-Correlation coefficient study:

Simple correlation coefficient between straw, fiber and seed yields/fad and some of their attributing variables are presented in Table (5). Relevant results showed that straw yield/fad was positively and significantly correlated with technical length/ plant, straw yield/plant, fiber yield/fad, fiber yield/plant, fiber length and long fiber percentage. There was negative and significant correlation between straw yield/fad and seed oil percentage. Also, technical length/plant was positively and high significantly tied with straw yield/plant, fiber yield/fad, fiber yield/plant, fiber length and long fiber percentage. Positive and highly significant correlation was recorded between straw yield/plant and the following variables i.e. fiber yield/fad, fiber yield/plant, fiber length and long fiber percentage. However, negative and significant relevance was detected between straw yield/plant and each of seed yield/plant and seed oil%. Similar observations were found by El-Shaer *et al.* (1983), and Hussein (2007).

The correlation coefficient value between fiber yield/fad and each of fiber yield/plant, fiber length and long fiber% were positive and highly significant but it was negative correlated with seed oil%. The correlation coefficient between fiber length and only long fiber% was highly significant and positive, while this character was correlated negatively with No. of capsules/plant.

5

The correlation values were found to be highly significant and positive between seed yield/fad and each of seed yield/plant, no. of capsules/plant, No. of seeds/capsule, 1000 seed weight and seed oil%, also between seed yield/plant and each of No. of capsules/plant, No. of seeds/capsule, 1000-seed weight and seed oil% and between No. of seeds/capsule and each of 1000 seed weight and seed oil%, finally between 1000 seed weight and seed oil %. Momtaz *et al.* (1977), Hussein (2007), and Mourad *et al.* (2009) recorded positive and significant relation between seed yield/fad and its attributes.

B- Path coefficient analysis study:

1- Path coefficient analysis study related to fiber yield/fad:

Results in Table (6) revealed that fiber yield/plant, long fiber% and the interactions between fiber yield/plant and long fiber% considered as the main sources of fiber yield/fad variation having the relative contribution of 14.58, 24.79 and 33.43%, respectively. Also R^2 reached 96.79% of the total fiber yield/fad variation. However the residual effect of fiber yield components included in the present study was 3.21%. According to the relative importance, the studied characters in Table 7 could be arranged as follows, long fiber% (37.78), fiber length (35.31), fiber yield/plant (23.70), and. These results are in good agreement with those reported by Aly and Awaad (1997), Al-Kaddoussi and Moawed (2001), and Hussein (2007).

Table 6. Direct and joint effects of fiber yield/plant, fiber length and long fiber% as well as their interactions of fiber yield/fad variation of flax (combined data of 2008/2009 and 2009/2010 seasons).

Variables	C.D	%
Fiber yield/plant	0.1458	14.58
Fiber length	0.0188	1.88
Long fiber%	0.2479	24.79
Fiber yield/plant x fiber length	0.0912	9.12
Fiber yield/plant x long fiber%	0.3343	33.43
Fiber length x long fiber%	0.1299	12.99
R^2	0.9679	96.79
Residual	0.0321	3.21
Total	1.0000	100.00

Where: C.D and are symbols allude to coefficient of determination and contribution percentage

Table 7. Total contribution of fiber yield/fad and its components.

Sources of variation	Direct	Indirect	Total
Fiber yield/plant	14.58	9.12	23.70
Fiber length	1.88	33.43	35.31
Long fiber%	24.79	12.99	37.78
Total	41.25	55.54	96.79

2- Path coefficient analysis study related to seed yield/fad:

Relevant results in Table (8) show that No. of seeds/capsule, seed yield/plant and the interaction between them were the main sources of seed yield/fad variation having the relative contribution of 26.73, 13.33 and 33.52%, respectively. These results indicated that those components played a great role in seed yield/fad. Also, R^2 recorded 96.29% of the total seed yield variation. However, the residual effect of the other seed yield components was (3.71%) of the total yield variation. According to the relative importance, the studied traits could be arranged as follows, no. of seeds/capsule (39.49), No. of capsules/plant (35.05) and seed yield/plant (21.84) (Table 9). Similar results were expressed by Aly and Awaad (1997), Al-Kaddoussi and Moawed (2001), and Hussein (2007). Finally, N fertilization treatments affected noticeably by the final flax yield/fad for Sakha3, Viking, Sakha2 and S.2419/1 through fiber yield/plant, long fiber percentage, fiber length , No. of capsules /plant, No. of seeds/capsule and seed yield/plant, successively.

Table 8: Direct and joint effects of seed yield/plant, No. of capsules/plant and No. of seeds/capsule as well as their interactions recorded of seed yield/fad variation of flax (combined data of 2008/2009 and 2009/2010 seasons).

Variables	C.D	%
Seed yield/plant	0.1333	13.33
No. of capsules/plant	0.0153	1.53
No. of seeds/capsule	0.2673	26.73
Seed yield/plant x No. of capsules/plant	0.0851	8.51
Seed yield/plant x No. of seeds/capsule	0.3352	33.52
No. of capsules/plant x No. of seeds/capsule	0.1267	12.67
R^2	0.9629	96.29
Residual	0.0371	3.71
Total	1.0000	100.00

Where: C.D and are symbols allude to coefficient of determination and contribution percentage.

Table 9. Total contribution of seed yield/fad and its components.

Sources of variation	Direct	Indirect	Total
Seed yield/plant	13.33	8.51	21.84
No. of capsules/plant	1.53	33.52	35.05
No. of seeds/capsule	26.73	12.67	39.40
Total	41.59	54.70	96.29

Conclusion

Under the condition of the present study, for maximizing the productivity, quality, minimizing the production cost of mineral fertilizers and environmental pollution for flax genotypes being, Sakha 3, Viking, Sakha 2 and S.2419/1 in new reclamation lands, its recommended to inoculating their seeds with Nitrobein biofertilizer at the rate of 1.5 kg/fad and fertilized their plants with 60 kg chemical N/fad.

Also, plant breeder could be focalize his attention on fiber yield/plant, fiber length, long fiber%, seed yield/plant, No. of capsules/plant and No. of seeds/capsule to improve and maximize the final fiber and seed yields per unit area of the land.

REFERENCES

Abdel-Samie, F.S.; M.A. Abdel-Dayem and S.Z.A. Zedan (2002). Response of some flax genotypes to bacterial inoculation and nitrogen levels under newly reclaimed lands. Annals of Agric. Sci., Moshtohor, 40(2) : 713 – 722.

Al-Kaddoussi, A.R. and E.A. Moawed (2001). Yield analysis of seed and straw yield components under three row spacing for some genotypes of flax (*Linum usitatissiumum*, L.). Egypt. J. Appl. Sci., 16(21) : 426 – 441.

Aly, R.M. and H.A. Awaad (1997). Yield ability and yield analysis of some flax genotypes grown under different sowing dates in sandy soils. Zagazig J. Agric. Res., 24(2) : 199 – 211.

A.O.A.C. (1995). Official Methods of Analysis 16th ed. Association of Official Analytical Chemist's. Washington, D.C., U.S.A.

El-Azzouni, A.M.A. and A.A. El-Banna (2002). Response of flax crop to biofertilizer and nitrogen levels under new reclaimed land soil condition. Egypt. J. Appl. Sci., 17(3) : 134 – 149.

El-Farouk, M.; E.A.F. El-Kady; A.M. Hella; M.E.A. Kineber; N.K.M. Mourad; S.H.A. Mostafa; S.Z .Zedan; Eman A. El-Kady and T.A. Abou-Zaid (2003). Releasing of two flax varieties Sakha1 and Sakha2. Fayoum J. Agric. Res., Dev., 17(2) : 1 – 8.

El-Gazzar, A.A.M. (2000). Effect of nitrogen rates and some N biofertilizer sources on growth, yield and quality of flax. Alex. Sci., Exch., 21(4) : 281 – 292.

El-Kady, E.A.F.; M.E.A. Kineber,; S.H.A. Mostafa,; A.M. Hella,; Eman, A.E. El-Kady; A.A. Abdel-Fatah,; T.A. Abou-Zaied,; I.E. El-Deeb,; A.M. Mousa,; S.Z.A. Zedan,; H.M.H. Abo-Kaied,; E.E. Lotfy,; A.M.A. El-Azzouni,; A.A. El-Gazzar,; G.H. El-Shimy,; Amany, M.M. El-Refaie; A.H.H. El-Sweify,; T.A. Omar,; Afaf, E.A. Zahana; E.A. Moawed,; N.K.M. Mourad,; Nasr T. El-Din,; S.M.S. Gaafar,; M. El-Farouk,; M.M.M. Hussein, and Sanai, S. Hassan. (2010). Studies in stability in two row new flax varieties Sakha 3 and Sakha 4. J. Agric. Res. Kafer El-Sheikh Univ,. 36 (2) : 182 – 192.

El-Shaer, M.H.; A. Momtaz; M.M. Samia and A.M. Hella (1983). The association among straw, seed and fiber yields and other characters in flax growth at Giza, A.R.E. Annals of Agric. Sci. Moshtohor, 20 : 195 – 209.

El-Shimy, G.H.; E.A.F. El-Kady and N.K.M. Mourad (1993). Effect of seeding rates and nitrogen fertilizer levels on yield and anatomical manifestation on some flax genotypes. J. Agric. Res., Tanta Univ,. 19(1) : 92 – 104.

Hella, A.M.A.; N.K.M. Mourad and S.M.S. Gaafar (1988). Effect of NPK fertilizer application on yield and its components in flax (*Linum usitatissimum*, L.). Egypt. J. Agron., 66 (3) : 1 – 13.

Hussein, M.M.M. (2007). Response of some flax genotypes to bio and nitrogen fertilization. Zagazig J. Agric. Res., 34 (5) : 815 – 844.

Hussein, M.M.M. and S.Z.A. Zedan (2008). Yield and quality of two flax varieties as affected by folair spraying with potassin rates and nitrogen levels under sandy soil conditions. J. Agric. Sci., Mansoura Univ., 33(6) : 3937 – 3952.

Jackson, M.L. (1973). Soil chemical analysis. Prentice Hall of Indian, Private. New Delhi.

LeClerg, E.W.; E. Leonard and A.G. Clark (1966). Field pto technique Burgross publishing Co.Minn-Co-polis. Minnesota, U.S.A.

Li. C.C. (1975). Path analysis primer. The Boxwool press pacific Grove Calefornia, U.S.A.

Moawed, E.A.; M.M.M. Hussein and E.E. Lotfy (2008). Effect of nitrogen fertilizer levels and biofertilization on yield and quality of two new flax varieties under saline soil conditions. Annals of Agric. Sci., Moshtohor, 46(2) : 105 – 120.

Momtaz, A.; A.K.A. Salim and G.H. El-Shimy (1977). Correlation studies on some flax crosses and their reciprocal in Egypt. Association studies between flax seeds yield and some other characters. Agric. Res. Rev., Egypt, 55 : 45–55.

Mostafa, S.H.A.; M.E.A. Kineber and A.A.E. Mahmoud (2003). Effect of inoculation with phosphorin and Nitrobein on flax yield and some anatomical characters under different nitrogen levels. J. Agric. Sci., Mansoura Univ., 28 (6) : 4307 – 4323.

Mourad, N.K.M.; H.M.H. Abo-Kaied; E.A.F. El-Kady; M.E.A. Kineber; Eman, A.A. El-Kady; E.E. Lotfy; G.H. El-Shimy; Amna H.H. El-Sweify; S.H.A. Mostafa; T.A. Abou-Zaied; I.E. El-Deeb and S.Z.A Zedan (2009). Performance and stability of the new flax varieties "Giza 9" and "Giza 10". Egypt. J. Appl. Sci., 24 (11) : 136 – 147.

Radwan, S.R. and A. Momtaz (1966). The technological properties of flax fiber and methods of estimating them. El-Felaha J. 46(5):466– 476 (In Arabic).

Salem, M.S.A.; S.Z.A. Zedan and M.M. Esmail (2006). Effect of some biological and mineral fertilizers on some growth and yield characters of two flax cultivars. Bulletin of Faculty of Agriculture, Cairo Univ., 57 (2) : 261 – 276.

Snedecor, G.W. and W.G. Cochran (1982). Statistical methods 7th Ed. The Iowa State Press. Ainess Iowa. U.S.A.

Svab, J. (1973). Biometric modszerek a kutatasban, Mezogazdasagi Kiado Budapest.

Tomar, P.S.; J.K. Sharma and A. Upudhy (1999). Response of linseed (*Linum usitatissimum*, L.) varieties to different levels of nitrogen in black clay loam soil. Crop Res., (Hisar), 17 (3) : 313 – 315.

Zedan, S.Z.A; M.E.A. Kineber and S.H.A. Mostafa (1997). Response of flax to potassium and nitrogen fertilization under sandy soil conditions. Egypt. J. Agric. Res., 27(2) : 729 – 743.

تأثير التسميد النيتروجيني المعدنى والحيوي على محصول الكتان وتحليل المحصول لبعض التراكيب الوراثية المنزرعة بالأراضي المستصلحة حديثا

مهدي محمد مهدي حسين

قسم بحوث محاصيل الألياف – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – الجيزة مصر.

أجريت تجربتان حقليتان فى تصميم القطع المنشقة مرة واحدة فى كل من الموسمين ٢٠٠٨/٢٠٠٩, ٢٠٠٩/٢٠١٠ تحت نظام الري الحديث (الري بالرش) بالمزرعة البحثية بمحطة البحوث الزراعية بالإسماعيلية وذلك بهدف دراسة تأثير مستويات التسميد النيتروجينى منفردة أو مخلوطة مع النيتروبين وتأثيرها على المحصول كما" ونوعا" كما تتضمن دراسة تحليل المحصول لبعض التراكيب الوراثية من الكتان

"سخا٣, فايكنج, سخا٢ والسلالة الزيتية ١/٢٤١٩. بالإضافة إلى تقدير معاملي الارتباط البسيط والمرور بين صفات القش والألياف والبذرة.

وكانت اهم النتائج المتحصل عليها فيما يلى:

- اظهرت النتائج وجود اختلافات معنوية بين الأربعة أصناف تحت الدراسة لجميع الصفات المدروسة. وقد احتل صنف الكتان سخا٣ المركز الأول وتفوق على التراكيب الوراثية الثلاثة الأخرى في صفات الطول الكلى /نبات, الطول الفعال/نبات, محصول القش والألياف للنبات وكذلك للفدان النسبة المئوية للألياف الطويلة, وطول الألياف وكذلك نعومتها. بينما سجلت السلالة الزيتية ١/٢٤١٩ اعلي تقديراتها فيما يتعلق بصفات عدد كبسولات النبات, عدد بذور الكبسولة, وزن الألف بذرة, محصولي البذرة للنبات وكذلك للفدان, النسبة المئوية للزيت في البذرة وكذلك محصول الزيت للفدان.
- أظهرت النتائج وجود زيادة متدرجة بزيادة مستوى التسميد النيتروجيني سواء كانت الإضافة منفردة أو مخلوطة بالنيتروبين (السماد الحيوي) وذلك فيما يختص بصفات القش جميعها فيما عدا صفة نعومة الألياف والتي انخفضت بزيادة مستوى التسميد النيتروجيني المضاف. فقد حدث نفس السلوك فيما يتعلق بصفات البذرة. ومن الجدير بالذكر فان الاختلاف ما بين المعاملة السمادية ٦٠ كجم نيتروجين + النيتروبين (السماد الحيوي) وبين مستوى التسميد النيتروجيني المضاف (٧٥ كجم نيتروجين كيماوي/فدان) لم تصل إلى حد المعنوية في معظم الصفات وبصفة خاصة محاصيل الألياف والبذرة والزيت للفدان.
- اشارت نتائج التفاعل ما بين التراكيب الوراثية المختبرة ومعاملات التسميد النيتروجيني المضافة تاثيرا" معنويا" فقط فيما يختص بصفات محصولي القش و الألياف للفدان، نعومة الألياف ، وزن الألف بذرة، و محصولي البذرة والزيت للفدان.
- أوضحت النتائج أن معامل الارتباط كانت موجبا" ومعنويا" مابين محصول القش للفدان وكل من الطول الفعال/نبات, محصول القش/نبات, محصول الألياف/فدان, محصول الألياف للنبات وطول الألياف ونسبة الألياف الطويلة. أيضا" كانت قيم معامل الارتباط موجبة و معنوية بين محصول البذرة للفدان وكل من محصول البذرة/نبات, عدد كبسولات النبات, عدد بذور الكبسولة, وزن الألف بذرة والنسبة المئوية للزيت.
- أظهرت نتائج تحليل معامل المرور أن كل من النسبة المئوية للألياف الطويلة, محصول الألياف/نبات والتداخل بين تلك الصفتين كان له اثر كبير في زيادة إنتاجية محصول الألياف للفدانو كما , كان لمحصول البذرة للنبات وعدد بذور الكبسولة وكذلك التداخل بينهما كان له اثر كبير في زيادة محصول البذرة للفدان لجميع التراكيب الوراثية المختبرة. وهذه الصفات يمكن للمربى الاعتماد عليها كمعايير انتخابية فى برامج التربية لزيادة وتحسين إنتاجية محصولي الألياف والبذرة لوحدة المساحة.

ومن وجهة نظر مربى النبات وبقدر من الاهمية يجب التركيز على الصفات التالية : محصول ألياف للنبات وطول الألياف والنسبة المئوية للألياف الطويلة وكذلك محصول البذرة للنبات وعدد بذور الكبسولة وذلك لتحسين ومعظمة إنتاجية محصولي الألياف والبذور لوحدة المساحة من الأرض.

توصى هذه الدراسة لتعظيم انتاجية الكتان كما" ونوعا" وتقليل التلوث الناتج عن الاسراف فى التسميد المعدنى وذلك بزراعة الصنف سخا ٣ ومعاملة بذوره بالتسميد الحيوى بالنيتروبين بمعدل ١,٥ كجم للفدان والتسميد النيتروجينى المعدنى بمعدل ٦٠ كجم ن/ فدان وذلك تحت ظروف الاراضى الجديدة.

قام بتحكيم البحث

أ.د / احمد ابو النجا قنديل	**كلية الزراعة – جامعة المنصورة**
أ.د / حسن عوده عواد	**كلية الزراعة – جامعة الزقازيق**

Table 2. Straw yield and its attributes of the tested flax genotypes as influenced by N fertilization treatments as well as their interaction in 2008/2009 and 2009/2010 seasons and their combined.

Characters	Total length/plant (cm)			Technical length /plant (cm)			Straw yield/plant (g)			Straw yield/fad (ton)		
Seasons / Treatments	1st	2nd	Comb	1st	2nd	Comb	1st	2nd	Comb	1st	2nd	Comb
Genotypes (G):												
Sakha 3	92.93	99.46	96.20	85.17	90.38	87.78	1.700	1.928	1.814	4.778	5.052	4.915
Viking	88.43	92.95	90.69	77.03	81.22	79.13	1.541	1.802	1.672	3.904	4.691	4.298
Sakha 2	83.84	87.18	85.51	70.95	73.26	72.11	1.224	1.334	1.279	3.326	4.324	3.825
S.2419/1	80.10	83.99	82.05	66.74	69.02	67.88	0.941	0.993	0.967	2.976	4.134	3.555
F. test	**	**	**	**	**	**	**	*	**	**	**	**
L.S.D at 5%	2.12	2.46	1.26	2.40	3.28	1.58	0.257	0.175	0.121	0.139	0.205	0.177
L.S.D at 1%	3.21	3.72	1.75	3.68	4.97	2.19	0.390	—	0.168	0.211	0.362	0.245
N fertilization treat. (F):												
30 kg N/fad	62.85	69.23	66.04	49.95	55.32	52.64	0.936	1.028	0.982	2.384	3.216	2.800
30 kg N/fad + Nitrobein	69.08	75.14	72.11	56.70	62.71	59.71	1.021	1.147	1.084	3.067	3.874	3.741
45 kg N/fad	89.25	93.85	91.55	77.44	80.87	79.16	1.265	1.389	1.327	3.417	4.417	3.917
45 kg N/fad + Nitrobein	94.60	98.65	96.63	83.31	85.26	84.29	1.460	1.696	1.578	4.274	4.973	4.624
60 kg N/fad	95.38	99.25	97.32	84.43	87.29	85.86	1.547	1.714	1.631	4.301	5.049	4.675
60 kg N/fad + Nitrobein	96.24	99.76	98.00	85.85	88.38	87.12	1.571	1.740	1.656	4.381	5.109	4.745
75 kg N/fad	96.89	100.40	98.65	87.13	89.46	88.30	1.665	1.885	1.775	4.398	5.212	4.805
F.test	**	*	**	**	*	**	*	*	**	**	*	**
L.S.D at 5%	1.56	1.96	1.09	1.42	2.35	1.22	0.115	0.147	0.112	0.123	0.187	0.119
L.S.D at 1%	2.08	—	1.45	1.92	—	1.61	—	–	0.148	0.210	–	0.197
Interactions:												
(GxF)	N.S	*	N.S	N.S	*	N.S	*	N.S	N.S	*	*	*

***, ** and N.S indicate significant at 5%, 1% levels and insignificant, respectively.**

Table 2. Cont.

Characters	Fiber yield/plant (g)			Fiber yield/fad (ton)			Long fiber %			Fiber length (cm)			Fiber fineness (N.m)		
Seasons / Treatments	1st	2nd	Comb	1st	2nd	Comb	1st	2nd	Comb	1st	2nd	Comb	1st	2nd	Comb
Genotypes (G):															
Sakha 3	0.276	0.325	0.300	0.776	0.853	0.815	15.91	16.62	16.26	87.89	93.93	90.91	185.50	189.63	187.56
Viking	0.236	0.294	0.265	0.591	0.762	0.676	14.81	16.04	15.42	80.02	88.53	84.28	178.54	184.39	181.46
Sakha 2	0.180	0.215	0.197	0.487	0.691	0.589	14.27	15.58	14.93	77.17	83.25	80.21	169.25	173.86	171.55
S.2419/1	0.121	0.139	0.130	0.424	0.658	0.541	13.86	15.15	14.51	75.14	79.26	77.20	165.92	169.82	167.87
F. test	*	**	**	**	**	**	**	*	**	**	**	**	**	**	**
L.S.D at 5%	0.044	0.029	0.021	0.070	0.087	0.064	0.29	0.43	0.34	3.55	3.85	2.56	7.61	8.29	6.64
L.S.D at 1%	0.066	0.045	0.028	0.081	0.116	0.077	0.43	—	0.50	5.38	5.81	3.14	8.96	9.99	7.27
N fertilization treat. (F):															
30 kg N/fad	0.097	0.129	0.113	0.276	0.416	0.346	11.38	12.98	12.18	56.28	63.73	60.01	197.33	207.37	202.35
30 kg N/fad + Nitrobein	0.135	0.161	0.148	0.404	0.539	0.472	12.96	13.90	13.43	63.40	70.40	66.90	186.99	194.08	190.54
45 kg N/fad	0.182	0.211	0.196	0.488	0.674	0.581	14.12	14.92	14.52	83.68	88.97	86.33	180.09	185.02	182.56
45 kg N/fad + Nitrobein	0.233	0.288	0.260	0.678	0.861	0.769	15.80	16.80	16.30	88.98	94.20	91.59	172.03	174.95	173.49
60 kg N/fad	0.253	0.296	0.274	0.690	0.873	0.781	15.92	17.05	16.49	89.18	95.20	92.19	166.76	169.73	168.25
60 kg N/fad + Nitrobein	0.257	0.307	0.282	0.717	0.901	0.809	16.22	17.51	16.86	89.33	95.48	92.41	161.43	164.67	163.05
75 kg N/fad	0.265	0.311	0.288	0.736	0.924	0.830	16.58	17.76	17.17	89.55	95.72	92.64	158.96	160.16	159.56
F.test	*	**	**	**	**	**	**	*	**	*	*	*	**	**	**
L.S.D at 5%	0.021	0.024	0.014	0.048	0.063	0.038	0.26	0.40	0.25	2.80	2.99	2.03	6.24	7.63	5.38
L.S.D at 1%	—	0.032	0.018	0.065	0.087	0.057	0.39	—	0.34	—	—	—	7.42	8.86	7.15
Interactions:															
(GxF)	N.S	N.S	N.S	*	*	*	N.S	N.S	N.S	N.S	*	N.S	*	*	*

***,** and N.S indicate significant at 5%, 1% level of probability and insignificant, respectively**

Table 3: Seed yield and its attributes of the tested flax genotypes as influenced by N fertilization treatments as well as their interaction in 2008/2009 and 2009/2010 seasons and their combined.

Characters	No. of capsules/plant			No. of seeds/capsule			1000 seed weight (g)		
Seasons / Treatments	1st	2nd	Comb	1st	2nd	Comb	1st	2nd	Comb
Genotypes (G):									
Sakha 3	10.71	11.31	11.01	6.90	7.23	7.06	5.77	6.27	6.02
Viking	11.58	12.28	11.93	7.58	8.24	7.90	6.40	7.01	6.71
Sakha 2	12.71	13.72	13.22	8.81	9.29	9.05	8.50	9.49	8.99
S.2419/1	13.52	14.21	13.86	9.49	9.92	9.71	9.16	9.77	9.46
F. test	**	*	**	*	*	**	*	*	**
L.S.D at 5%	0.58	0.94	0.58	0.43	0.54	0.38	0.64	0.51	0.38
L.S.D at 1%	0.78	-	0.64	-	—	0.49	—	—	0.49
N fertilization treat. (F):									
30 kg N/fad	10.41	11.11	10.76	6.56	6.81	6.68	6.40	7.06	6.73
30 kg N/fad + Nitrobein	11.17	11.96	11.57	7.28	7.80	7.54	6.90	7.51	7.21
45 kg N/fad	11.82	12.49	12.15	7.99	8.27	8.13	7.24	8.00	7.62
45 kg N/fad + Nitrobein	12.64	13.42	13.03	8.70	9.08	8.89	7.65	8.41	8.03
60 kg N/fad	12.77	13.57	13.17	8.78	9.37	9.08	7.82	8.51	8.17
60 kg N/fad + Nitrobein	12.98	13.72	13.35	8.95	9.63	9.29	8.03	8.68	8.36
75 kg N/fad	13.13	13.89	13.51	9.10	9.74	9.42	8.16	8.80	8.46
F.test	**	*	**	*	*	**	**	*	**
L.S.D at 5%	0.49	0.47	0.37	0.38	0.44	0.26	0.42	0.44	0.30
L.S.D at 1%	0.69	—	0.43	—	-	0.41	0.53	—	0.47
Interactions:									
(GxF)	N.S	*	N.S	N.S	N.S	N.S	*	*	*

***, ** and N.S indicate significant at 5%, 1% level of probability and insignificant, respectively.**

Table 3: Cont.

Characters	Seed yield/plant (g)			Seed yield/fad. (kg)			Seed oil %			Oil yield/fad. (kg)		
Seasons / Treatments	1st	2nd	Comb	1st	2nd	Comb	1st	2nd	Comb	1st	2nd	Comb
Genotypes (G):												
Sakha 3	0.290	0.318	0.304	348.17	397.83	373.00	30.93	31.67	31.30	108.23	126.65	117.44
Viking	0.326	0.369	0.348	481.52	490.77	486.15	32.02	32.77	32.40	155.07	161.31	158.19
Sakha 2	0.486	0.545	0.526	622.37	673.26	647.82	39.72	40.78	40.25	247.99	275.28	261.64
S.2419/1	0.537	0.592	0.565	668.38	732.58	700.48	41.60	42.31	41.96	279.19	310.87	295.03
F. test	*	*	*	**	**	**	**	**	**	**	**	**
L.S.D at 5%	0.029	0.044	0.031	44.27	55.04	39.81	0.43	0.52	0.36	14.72	30.94	18.78
L.S.D at 1%	-	-	-	59.07	67.94	57.40	0.60	0.75	0.57	24.87	36.58	22.15
N fertilization treat. (F):												
30 kg N/fad	0.292	0.345	0.319	367.37	416.91	392.14	34.37	35.25	34.81	131.30	151.53	141.42
30 kg N/fad + Nitrobein	0.353	0.390	0.372	440.02	502.87	471.45	35.13	35.97	35.55	159.35	187.22	173.29
45 kg N/fad	0.381	0.438	0.410	487.97	560.01	523.99	35.85	36.70	36.28	180.31	212.99	146.65
45 kg N/fad + Nitrobein	0.437	0.480	0.459	593.87	608.72	601.30	36.59	37.35	36.97	223.23	233.82	228.53
60 kg N/fad	0.458	0.492	0.486	598.21	627.09	612.65	36.72	37.46	37.09	225.64	240.90	233.27
60 kg N/fad + Nitrobein	0.468	0.514	0.491	607.86	643.30	625.58	36.87	37.64	37.26	230.14	248.52	239.33
75 kg N/fad	0.484	0.530	0.507	615.46	656.36	635.91	36.94	37.81	37.38	233.41	254.72	244.07
F.test	**	**	**	**	**	**	**	**	**	**	**	**
L.S.D at 5%	0.027	0.036	0.029	46.90	47.81	39.06	0.33	0.41	0.26	17.93	20.29	15.69
L.S.D at 1%	0.033	0.046	0.033	51.47	57.21	48.06	0.48	0.55	0.35	20.61	23.77	17.52
Interactions:												
(GxF)	N.S	*	N.S	*	*	*	N.S	*	N.S	*	*	*

***, ** and N.S indicate significant at 5%, 1% level of probability and insignificant, respectively.**

Table 5: Simple correlation coefficient among yields of straw, fiber and seeds/fad as well as some of their attributes for the tested flax genotypes as influenced by N fertilization treatments and their interaction (combined data of 2008/2009 and 2009/2010 seasons).

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Straw yield/fad	–	0.945**	0.898**	0.973**	0.941**	0.912**	0.907**	-0.150	-0.136	0.072	0.110	-0.230	-0.412
2	Technical length/plant		–	0.881**	0.966**	0.925**	0.989**	0.950**	0.058	-0.074	0.181	0.219	-0.115	-0.291
3	Straw yield/plant			–	0.883**	0.987**	0.817**	0.813**	-0.295	-0.399	-0.186	-0.154	-0.469	-0.631
4	Fiber yield/fad				–	0.939**	0.944**	0.967**	0.047	-0.035	0.185	0.218	-0.121	-0.299
5	Fiber yield/plant					–	0.872**	0.879**	-0.183	-0.281	-0.059	-0.030	-0.355	-0.532
6	Fiber length						–	0.952**	0.181	0.092	-0.984	0.335	0.010	-0.166
7	Long fiber%							–	0.232	0.138	0.338	0.364	0.042	-0.135
8	Seed yield/fad								–	0.973**	0.969**	0.977**	0.960**	0.897**
9	Seed yield/plant									–	0.942**	0.941**	0.603**	0.955**
10	No. of capsules/plant										–	0.990**	0.925**	0.829**
11	No. of seeds/capsule											–	0.921**	0.825**
12	1000 seed weight												–	0.993**
13	Seed oil%													–