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EFFECT OF INOCULATION WITH PHOSPHORINE AND NITROBIN ON FLAX YIELD AND SOME ANATOMICAL CHARACTERS UNDER DIFFERENT NITROGEN LEVELS

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ABSTRACT

The present investigation was carried out at Sakha Agricultural Research Station- Kafr El-Sheikh during the two growing seasons of 2000/2001 and 2001/2002. Two field experiments were performed to study the response of flax yield and its components as well as some anatomical characters to seed inoculation with two boi-fertilizers, i.e., Phosphorine and Nnitrobin under defferent rates of nitrogen fertilizer i.e., 20, 30, 40 and 50 kg N/fed. This study was laid out in a split plot design with four replications. The obtained results could be summarized as follows:

Increasing N- level from 20 up to 50 kg N/fed. significantly increased technical stem length, main stem diameter, straw yield/plant, total fiber parcentage as well as straw and fiber yields/fed. The application of 50 kg N/fed. significantly increased upper branching zone length, number of capsules and seeds/plant, 1000-seed weight, seed yield/plant as well as seed and oil yields/fed. Each increment of applied nitrogen resulted in a significant reduction in seed oil content in both seasons. Increasing N-level from 40 up to 50 kg N/fed. gave insignificant increase in all these caharacters, except straw yield/fed. Results showed gradual and significant increments for all anatomical characters due to increasing nitrogen level from 20 up to 50 kg N/fed., except pith area, which decreased significantly with increasing N- level.

Seed inoculation with Phosphorine + Nitrobin or with Nitrobin alone significantly increased technical stem length, straw yield/plant, straw and fiber yields/fed. as well as upper branching zone length, number of capsules/plant, seed yield/plant, seed and oil yields/fed. The highest seed oil content was recorded when seed inoculated with Phosphorine. Results showed that all bio- fertilizer treatments significantly increased all anatomical characters compared with control, except xylem area and xylem area percentage, which reduced significantly with bio- fertilizer. On the other hand, bio- fertilizer did not affect pith area character.

INTRODUCTION

Flax (*Linum usitatissmum* L.) is grown in Egypt since long time as a dual purpose crop for oil seed ad fiber production. It plays an effective role in the national economy due to local industry and may contribute in increasing exports. The cultivated area in Egypt is very limited. Therefor, increasing flax yield per unit area is very important. This could be achieved through improving the agronomic practices such as nitrogen fertilizer levels and bio-fertilizers.

Several workers investigated the effect of nitrogen fertilizer on flax yield and its attributes and reported a postive response of flax plant to nitrogen fertilizer levels. Under Egyptian conditions, Mohamed (1996); Salama (1996); El-Sweify *et al.* (1997) and Kineber *et al.* (1997) reported that application of 45 kg N/fed. gave a significant increase in technical stem *length, main stem diameter, straw yield per plant and per feddan, fiber* percentage, fiber yield/fed., upper branching zone length, number of capsules/plant, seed index as well as seed yield per plant and per feddan. They stated also that increasing nitrogen level significantly decreased seed oil content. Kineber *et al.* (1998); El-Gazzar (2000); El-Gazzar and El-Kady (2000); El-Shimy and Moawed (2000); Abou-Zaied (2001); El-Gazzar and Abou-Zaied (2001) and El-Gazzar and Kineber (2002) observed that increasing of nitrogen level from 40 up to 50 or 60 kg Kg/fed. caused a significant increase in flax straw and seed yields as well as its related characters.

The cost of mineral fertilizers increased day after day. Recently, nitrogen fixation and converse the insoluble treicalcium phosphate to soluble mono- calcium phosphate by microbes in many field crops has been established, which effectively supplement the requirements of nitrogen and phosphorous and minimizing the costs of production as well as environmental pollution through reducing doses of mineral fertilizers. In this connection, Afify *et al.* (1994) reported maximum values for technical length, stem diameter, straw and seed yields/fed., length of top capsule, number of capsules/plant, seed yield/plant due to dual fertilization of flax with NPK as well as *Azotobacter* and *Bacillues* as free N_2- fixers. El-Gazzar (1997) concluded that application of 60 kg N/fed and 15 kg P_2O_5/fed. or Phosphorine followed by 45 kg N and 15 kg P_2O_5/fed. or Phosphorine gave the highest straw and seed yields as well as its components. Hamed (1998) reveal that incoulation with *Azotobacter* significantly increased stem yield/fed. compared to uninoculated treatment. He also found that inoculation with *Azotobacter* and application of urea fertilizer at rate of 35 kg N/fed. gave the highest values of straw, seed and oil yields. El-Gazzar (2000) reported that inoculation with Nitrobin increased straw, seed and oil yields/ha., while inoculation with Rhizobactrin increased straw yield/plant. Whereas, inoculation with Cerealin increased technical length, stem diameter, fiber length, number of capsules and seeds/plant and seed yield/plant. But all these increases did not reach the level of significant in both seasons.

Anatomical features of flax plants which response to several treatments had been studied by many investigators such as El-Shimy *et al.* (1988 & 1993); Afify *et al.* (1994); Mostafa (1994); Hamed (1998); El-Deeb (2000), in addition to El-Swiey (2003) for jute as a bast fiber crop. They reported early evaluation of flax fibers quality by estimating different tissues area in cross section of middle regions for flax stems.

Therefore, the main objective of this investigation was to study the effect of nitrogen level and seed inoculation with two bio- fertilizers on yield, yield components and some anatomical characters of flax.

MATERIALS AND METHODS

Two field experiments were performed at the Exerimental Farm, Agric. Res. Station, Sakha, Kafr El-Sheikh Governorate, Egypt during the two growing seasons of 2000/2001 and 2001/2002. The soil of the experiments fields were clay in texture. The chemical analysis of the experimental soil are given in Table (1). The preceding crop was maize (*Zea mays*, L.) in both seasons. The experiments were laid out in a split plot design with four replications. The main plots were assigned to the four nitrogen fertilizer levels i.e., 20, 30, 40 and 50 kg N/fed. The sub plots were devoted to the four seed inoculation treatments i.e., seed inoculation with Phosphorine, seed inoculation with Nitrobin and seed inoculation with Phosphorine + Nitrobin as well as without inoculation (control).

Table (1): Chemical analysis of the experimental soil fields in the two growing seasons.

Variable	Season	
	2000/2001	2001/2002
pH	8.11	8.09
Orgaic matter %	1.78	1.70
Available N ppm	33.60	32.70
Available P ppm	16.90	17.50
Available K ppm	509.00	502.00

Seed of flax cultivar "Sakha 1" were sown on Nov. 5^{th} and 8^{th} in both seasons, respectively. The sub plot size was 10.5 m^2 (3 X 3.5 m). Calcium super phosphate (15.5% P_2O_5) at the rate of 100 kg was added during seedbed preparation. Nitrogen fertilizer at the above mentioned levels was fully given as Urea (46.5% N) just before the first irrigation. Phosphorine is a commercial biofertilizer containing active phosphate dissolving bactria and Nitrobin is also a commercial biofertilizer containing bio- nitrogen fixation bactria (*Azotobacter* spp + *Azospirillum* spp), produced by the General Organization for Agricultural Equalization Fund, Ministry of Agricultre and Land Reclamation. The wetted flax seed was thoroughly inoculated with different inoculation treatments just before planting at the rate of 0.8 kg/fed. from each of Phosphorine and Nitrobin. All other agronomic practices for growing flax were conducted as recommended.

At harvest time, ten guarded plants were taken at random from each sub plot to determine yield components. Seed and Straw yields of flax/fed. were estimated from an area of 4 m^2 from the central area of each sub plot.

Data collected included:

I- Straw yield and its related characters:

1- Technical stem length in (cm)
2- Main stem diameter in (mm).
3- Straw yield (g/plant).
4- Straw yield (t/fed.).
5- Total fiber percentage.
6- Fiber yield (kg/fed.).

II- Seed yield and its related characters:

1- Upper branching zone length in (cm).
2- Number of capsules/plant.
3- Number of seeds/plant.
4- Seed yield (g/plant).
5- 1000- seed weight in (g).
6- Seed yield (kg/fed.).

7- Seed oil content: Oil was extracted using solvent ether in a soxhlet apparatus on the dry weight basis as mentioned by A.O.A.C. (1980).
8- Oil yield (kg/fed.): It was determined by multiplying seed yield (kg/fed.) by seed oil content.

III. Anatomical studies:

At blooming stage (95 days after sowing), samples of five plants were chosen from each treatments at the middle part of the technical length of the main flax stem length. Paraffin wax method was used for obtaining flax stem cross section, it stained with 0.5% of safranin and 1% light green solutions. Measurements of total cross section, cortex, phloem, fiber, xylem, pith areas (mm^2) in addition to fiber area percent, xylem area percent were measured. Fiber index (mm^3), which represents fiber content/plant, was calculated from the following formula:

Fiber index (mm^3) = fiber area/cross section (mm^2) x technical stem length (mm).

All data were subjected to the analysis of variance according to the procedures outlined by Snedecor and Cochran (1980). The mean value of treatments were compared according to Duncan's multiple range test (Duncan, 1955). All statistical analysis were performed using analysis of variance technique by means of "IRRISTIAT" computer software package.

RESULTS AND DISCUSSION

I. Straw yield and its related characters:

I.1. Effect of nitrogen level:

Data presented in Tables (2 and 3) show clearly that straw yield and its components as well as total fiber percentage and fiber yield/fed. were significantly affected by nitrogen fertilizer levels in both seasons. Increasing nitrogen level from 20 to 50 kg N/fed. significantly increased technical stem length, main stem diameter, straw yield per plant and per feddan, total fiber percentage and fiber yield/fed. Meanwhile, the difference between 40 ad 50 kg N/fed. did not reach the level of significance in most cases. These results might be due to the fact that nitrogen hastens growth of flax plants and it is well known that nitrogen is an essential element for flax to build up protoplasm and proteins, which induce cell division and meristematic activity, such effect resulted in an increase in cell number and size with overall increase in flax growth. There results are in acceptance with those obtained by Mohamed (1996); Salama (1996); El-Sweify *et al.* (1997); Kineber *et al.* (1997); Kineber *et al.* (1998); El-Gazzar (2000); Abou-Zaied (2001) and El-Gazzar and Kineber (2002).

I.2. Effect of seed inoculation:

Data in Tables (2 and 3) reveal that, there were significant effects for seed inoculation on technical stem length, straw yield per plant and per feddan as well as fiber yield/fed. in the two seasons of study. Seed inoculation with Nitrobin alone or with Phosphorine + Nitrobin gave the highest values of all mentioned traits. Also, seed inoculation with Phosphorine alone resulted in a significant increase in these traits over the

Table (2): Straw yield and its related characters as affected by N- level and seed inoculation with two biofertilizers during 2000/2001 season.

Factor	Techni-cal length, (cm)	Stem diame-ter, (mm)	Straw yield (g/plant)	Straw yield (t/fed.)	Total fiber %	Fiber yield (kg/fed.)
N- level (kg N/fed.):						
20	85.01c	2.30d	3.12b	3.187c	35.46c	275.20c
30	99.28b	2.99c	3.36b	3.599b	37.79b	339.29b
40	107.04a	3.16b	3.63ab	3.852b	38.54a	375.34a
50	108.78a	3.25a	3.97a	4.841a	38.64a	383.38a
F- test	**	*	*	**	*	*
Inoculation:						
Uninoculated	90.98c	2.79	2.47c	2.566c	37.30	290.24c
Phosphorine	99.79b	2.90	3.27b	3.548b	37.53	337.18bc
Nitrobin	103.71a	2.99	4.01a	4.473a	37.71	360.54ab
Phos. + Nitr.	105.64a	3.00	4.34a	4.894a	37.90	385.25a
F-test	*	NS	*	**	NS	*
Interaction	NS	NS	NS	**	NS	NS

*, ** and NS indicate P<0.05, P<0.01 and not significant, respectively.
Means followed by the same letter within columns are not significantly different at the 5% level, using Duncan's multiple range test.

Table (3): Straw yield and its related characters as affected by N- level and seed inoculation with two biofertilizers during 2001/2002 season.

Factor	Techni-cal length, (cm)	Stem diame-ter, (mm)	Straw yield (g/plant)	Straw yield (t/fed.)	Total fiber %	Fiber yield (kg/fed.)
N- level (kg N/fed.):						
20	88.49c	2.71c	3.38b	3.210c	36.04c	300.58c
30	99.69b	2.97b	3.63b	3.640b	38.59b	372.11b
40	106.16a	3.37a	3.98a	3.727b	40.35a	386.3ab
50	107.21a	3.42a	4.23a	4.611a	40.83a	396.72a
F- test	**	*	**	**	**	*
Inoculation:						
Uninoculated	89.66c	2.95	2.88c	2.602c	38.54	300.94c
Phosphorine	100.43b	3.16	3.42b	3.269b	38.91	363.26b
Nitrobin	104.74a	3.18	4.28a	4.543ab	39.16	383.25ab
Phos. + Nitr.	106.73a	3.19	4.65a	4.774a	39.21	408.25a
F-test	*	NS	**	**	NS	*
Interaction	NS	NS	NS	**	NS	NS

*, ** and NS indicate P<0.05, P<0.01 and not significant, respectively.
Means followed by the same letter within columns are not significantly different at the 5% level, using Duncan's multiple range test.

Control (uninoculated). The beneficial effect of seed inoculation on straw and fiber yields and some components obtained herin, may be attributed to the nitrogen fixation and/or to the production of certain plant growth promoting substances by the bacteria. Similar stimulatory effect of seed inoculation on straw and fiber yields as well as its related characters were reported by Afify *et al.* (1994); Hamed (1998) and El- Gazzar (2000).

II. Seed yield and its related characters:

II.1. Effect of nitrogen level

Upper branching zone length, number of mature capsules and seeds/plant, 1000- seed weight and seed yield/plant were significantly increased by increasing nitrogen fertilizer rate up to 50 kg N/fed. in both seasons (Tables 4 and 5). The differences between the two highest N-Level (40 ad 50 kg N/fed.) did not reach the level of significant for all these characters. Nitrogen application as it is well known, ehances vegetative growth as well as all the metabolism process in the plant, which caused an increase in dry matter accumulation and that was the logical results to the detected increase in the 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 seeds/plant as well as seed index. These findings are confirmed with those obtained by Mohamed (1996); Kineber *et al.* (1997); El-Gazzar and El-Kady (2000) and El-Shimy and Moawed (2000).

Seed oil content was significantly and negatively affected by the rate of nitrogen fertilizer in the two seasons (Table 4 and 5). Each increment of applied nitrogen resulted in a significant reduction in seed oil content. These results are in harmony with those of Mohamed (1996); Salama (1996) and El-Gazzar and Abou-Zaied (2001).

Increasing nitrogen level up to 50 kg N/fed. significantly increased seed and oil yields/fed. without significant difference between 40 and 50 kg N/fed. in both seasons (Table 4 and 5). The increase in seed yield/fed. due to nitrogen application could be attributed to the cotributio of higher number of mature capsules and seeds/plant, higher seed yield/plant and heavier 1000-seed weight. Whereas the increase in oil yield, despite the decrease in seed oil content could be ascribed to the increase in seed yield/fed. These findings are in agreement with those obtained by Mohamed (1996); Kineber *et al.* (1998); El-Gazzar (2000); Abou-Zaied (2001) and El-Gazzar and Kineber (2002).

II.2. Effect of seed inoculation:

The obtained results in Tables (4 and 5) show that upper branching zone length, number of capsules/plant, seed yield/plant, seed oil content as well as seed and oil yields/fed. were significantly affected by seed inoculation in both seasons. Seed inoculation with Phosphorine + Nitrobin or with Nitrobin alone gave the highest values of all these traits, except seed oil content, which was superior when seed inoculated with Phosphorine alone.

Table (4): Seed yield and its related characters as affected by N- level and seed inoculation with two biofertilizers during 2000/2001 season.

Factor	Upp. bra. zone length, (cm)	No. of capsules/ plant	No. of seeds/ plant	Seed yield		Seed index, (g)	Seed oil content	Oil yield (kg/fed.)
				(g/plant)	(kg/ fed.)			
N- level (kg N/fed.):								
20	16.20c	14.16c	105.26c	1.00c	505.89c	8.18c	40.85a	250.78b
30	20.79b	15.25bc	116.96b	1.22bc	577.82b	9.21b	40.33b	278.78b
40	21.92ab	16 83ab	122.34a	1.40ab	634.17a	9.62a	39.70c	289.39ab
50	22.40a	17.60a	124.78a	1.59a	669.67a	9.85a	39.05d	294.18a
F- test	**	*	*	*	**	*	*	*
Inoculation:								
Uninoculated	17.91b	10.66c	114.21	0.66b	508.31c	9.11	39.07c	260.40b
Phosphorine	19.43b	13.84b	115.20	1.00b	577 49b	9 13	40 83a	276.55ab
Nitrobin	21.59a	19.05a	119.07	1.88a	639.11a	9.17	40.00b	285.46a
Phos. + Nitr.	22.37a	20.56a	120.86	1.89a	662.63a	9.25	40.03b	290.71a
F-test	*	**	NS	**	**	NS	*	*
Interaction	NS	*	NS	**	**	NS	NS	NS

*, ** and NS indicate P<0.05, P<0.01 and not significant, respectively.
Means followed by the same letter within columns are not significantly different at the 5% level, using Duncan's multiple range test.

Table (5): Seed yield and its related characters as affected by N- level and seed inoculation with two biofertilizers during 2001/2002 season.

Factor	Upp. bra. zone length, (cm)	No. of capsules/ plant	No. of seeds/ plant	Seed yield		Seed index, (g)	Seed oil content	Oil yield (kg/fed.)
				(g/plant)	(kg/fed.)			
N- level (kg N/fed.):								
20	18.40c	13.67c	112.35c	0.91c	605.29b	8.26c	41.45a	288.84c
30	21.94b	14.86bc	122.48b	1.17b	631.46b	9.44b	40.80b	347.08b
40	23.98ab	16.42ab	132.08a	1.40ab	683.31a	9.68ab	39.78c	361.96ab
50	24.17a	17.65a	133.56a	1.54a	724.92a	9.80a	39.19d	364.75a
F- test	**	*	*	*	**	*	**	*
Inoculation:								
Uninoculated	19.71c	10.66c	120.63	0.67b	571.31c	9.22	39.11c	300.71b
Phosphorine	21.77b	13.37b	122.57	0.97b	627.78b	9.25	41.50a	342.25a
Nitrobin	23.00ab	16.57a	128.38	1.57a	699.81a	9.30	40.36b	353.29a
Phos. + Nitr.	24.00a	20.01a	128.91	1.82a	746.09a	9 41	40.26b	360.39a
F-test	**	**	NS	**	**	NS	*	*
Interaction	NS	NS	NS	**	**	NS	NS	NS

*, ** and NS indicate P<0.05, P<0.01 and not significant, respectively.
Means followed by the same letter within columns are not significantly different at the 5% level, using Duncan's multiple range test.

No significant differences were obtained in number of seeds/plant and seed index due to seed inoculation in the two seasons (Tables 4 and 5). These significant increase due to seed inoculation compared to a check (uninonculated seed) may be attributed to the role of Nitrobin and Phosphorine in fixing nitrogen and release of phosphorous, which plays an important role in plant development and its productivity. In this respect, El-Gazzar, 2000 reported that inoculation of flax seed with some biofertilizer i.e. Nitrobin, Biogin, Rhizobactrin and Cerealin inceased straw, seed and oil yields as well as its related characters, but all these icreases did not reach the level of significance. Meanwhile, Hamed (1998) reveal that inoculation with Azotobacter and application of urea fertilizer at 35 kg N/fed. gave the highest values of seed and oil yields. Also, Hamissa *et al.* (2000) found that inoculation of cotton seed with some biofertilizers i.e., Rhizobacterein, Microbein and Nitrobin had significant effects on number of open bolls/plant, lint percentage, boll weight, seed cotton yield per plant and per feddan as well as increasing N and K uptake by cotton plant, which is known to promote photosynthesis and plant development and consequently the productivity per unit area.

II.3. Interaction effect:

A summary of the significant interaction effects is given in Table (6). In this Table, the highest values of the interaction between N- level and bio-fertilizer on some characters of flax are shown. The presnted results in Table (6) show clearly that flax plants produced the highest number of capsules/plant, the highest seed yield/plant as well as the straw and seed yields/fed. When it recived the higher N- level (50 kg N/fed.) and the bio-fertilizer was applied as seed inoculation with Phosphorine and Nitrobin.

III. Anatomical studies:

Mean values of cross sections of different tissues as affected by nitrogen levels and bio- fertilizer are presented in Tables (7 and 8).

III.1. Effect of N- level:

Results in Tables (7 and 8) showed gradual and significant increments due to increasing nitrogen level from 20 up to 50 kg N/fed., except pith area, which decreased significantly with increasing N- level. The mean values ranged between 23.35-25.42 and 24.20-27.53 mm^2 regarding total cross section; 3.35-5.34 and 3.95-6.63 mm^2 for cortex area; 2.90-4.83 and 3.15-6.28 mm^2 for phloem area; 1.08-1.81 and 1.21-2.08 mm^2 for fiber area; 4.63-7.13 and 5.00-7.56% for fiber area percentage; 4.89-6.07 and 4.11-6.59 mm^2 for xylem area; 20.94-23.88 and 16.98-24.30% for xylem area percentage; 9.95-8.55 and 10.51-8.43 mm^2 and finely between 918.11-1969.28 and 1070.25-2229.76 mm^3 for fiber index in the first an second season, respectively. The same trend had occurred in relation to the main stem diameter, technical stem length, total fiber percentage and total fiber yield/fed. It is clear that the cross section of higher N- level (50 kg N/fed.) was greater in the above mentioned traits than in the lowest N- level (20 kg N/fed.) in all cases. The present results are in full agreement with those of El-Shimy *et al.* (1988 & 1993) and Mostafa (1994).

Table (6): Highest values of number of capsules/plant, seed yield/plant as well as straw and seed yields/fed. as affected by N- level and bio- fertilizer in 2000/2001 and 2001/2002 seasons.

Variable	Season	Highest value	F-test	Treatment
Number of capsules/plant	2000/2001	22.13	*	50 kg N/fed. x Nitrobin + Phosphorin
	2001/2002	------	NS	--
Straw yield (t/fed.)	2000/2001	6.585	**	50 kg N/fed. x Nitrobin + Phosphorin
	2001/2002	6.158	**	50 kg N/fed. x Nitrobin + Phosphorin
Seed yield (g/plant)	2000/2001	2.09	**	50 kg N/fed. x Nitrobin + Phosphorin
	2001/2002	2.10	**	50 kg N/fed. x Nitrobin + Phosphorin
Seed yield (kg/fed.)	2000/2001	753.75	**	50 kg N/fed. x Nitrobin + Phosphorin
	2001/2002	802.58	**	50 kg N/fed. x Nitrobin + Phosphorin

*, ** and NS indicate $P<0.05$, $P<0.01$ and not significant, respectively.

III.2. Effect of seed inoculation:

Data in Tables (7 and 8) reveal that, all bio- fertilizer treatments significantly increased total cross section, cortex, phloem, fiber areas, fiber area percentage/cross section, pith area and fiber index compared with control treatment. On the other hand, bio-fertilizer reduced xylem area and xylem area percentage/cross section and had no significant effect on pith area in both seasons. Treatment of Nitrobin + Phosphorin overcome control treatment in the first and second season by 17.04, 14.95% for total cross section area, 62.14, 46.27% for cortex area, 48.71 and 56.64% for phloem area, 69.31 and 79.05 for fiber area, 44.56 and 56.10% for fiber area percentage, 49.71 and 41.55% for pith area, 96.47 and 112.98% for fiber index, respectively. On the other hand, control treatment surpassed Phosphorin .+ Nitrobin by 15.33 and 29.24% for xylem area, 51.60 and 48.89% for xylem area percentage in the first and second season, respectively. It is clear to noticed that the treatment of Nitrobin + Phosphorin gave the highest estimates of the above mentioned anatomical features. This treatment followed the same trend for corresponding traits as did for main stem diameter, technical length and total fiber percentage. Similar results were obtained by Afify *et al.* (1994); Hamed (1998); El-Deeb (2002) and El-Sweify *et al.* (2003).

In general, mineral nitrogen fertilization surpassed bio- fertilizer in fiber index, which consider as the most important character for fiber content in flax plants and the superiority ratio being 1.15 and 5.07% for first and second season, respectively.

III.3. Interaction effect:

Summary of the significant interaction effects of N- level and bio-fertilizer on anatomical characters are given in Table (9); see also Fig. (1- 6).

Table (7): Mean values of different tissues area in cross section of flax stems as affected by N-level and seed inoculation with two bio- fertilizers during 2000/2001 season.

Factor	Total cross area, mm^2	Cortex area, mm^2	Phloem area, mm^2	Fiber area, mm^2	Fiber area %	Xylem area, mm^2	Xylem area %	Pith area, mm^2	Fiber index, mm^3
N- level (kg N/fed.):									
20	22.88b	3.35b	2.83c	1.07b	4.68b	9.24b	38.90b	5.48a	902.51c
30	23.48ab	4.17ab	3.26bc	1.21a	5.14b	9.46a	39.30a	5.05a	1195.86b
40	24.16ab	4.82ab	4.10ab	1.27a	5.25b	10.06a	41.14a	4.78a	1354.51b
50	24.95a	5.34a	4.76a	1.80a	7.17a	10.42a	41.84a	4.08b	1953.68a
F-test	*	*	*	*	*	*	*	*	*
Inoculation:									
Uninoculated	21.54b	3.46b	3.10b	1.01b	4.69b	10.53a	48.89a	3.44b	919.10d
Phosphorine	24.01ab	3.63b	3.16b	1.17b	4.87b	10.08ab	41.98b	5.97a	1167.66c
Nitrobin	24.73a	4.98ab	4.03ab	1.46ab	5.90ab	9.44ab	38.17b	4.82a	1514.02b
Phos. + Nitr.	25.21a	5.61a	4.61a	1.71a	6.78a	9.13b	32.25c	5.15a	1805.76a
F-test	*	*	*	*	*	*	*	*	*
Interaction:	*	*	*	*	*	*	*	NS	*

* and NS indicate $P<0.05$and not significant, respectively.
Means followed by the same letter within columns are not significantly different at the 5% level, using Duncan's multiple range test.

Table (8): Mean values of different tissues area in cross section of flax stems as affected by N- level and seed inoculation with two bio- fertilizers during 2001/2002 season.

Factor	Total cross area, mm^2	Cortex area, mm^2	Phloem area, mm^2	Fiber area, mm^2	Fiber area %	Xylem area, mm^2	Xylem area %	Pith area, mm^2	Fiber index, mm^3
N- level (kg N/fed.):									
20	22.87b	3.97b	2.73c	1.14b	5.00b	8.61b	36.79b	4.65a	995.11c
30	23.68b	4.36b	3.67bc	1.28ab	5.40b	9.94ab	41.56a	4.35a	1270.81b
40	25.42a	5.30ab	4.90ab	1.42ab	5.61b	10.55a	42.43a	3.18b	1507.24b
50	26.20a	6.65a	5.86a	2.01a	7.56a	11.09a	44.11a	2.57b	2154.62a
F-test	*	*	*	*	*	*	*	*	*
Inoculation:									
Uninoculated	22.48b	4.15c	3.39c	1.05b	4.67b	11.05a	49.15a	2.84b	941.85d
Phosphorine	24.79ab	4.21bc	3.58bc	1.31ab	5.28ab	10.68a	43.08ab	5.01a	1315.24c
Nitrobin	25.06ab	5.83ab	4.86ab	1.59ab	6.34ab	9.91ab	39.55b	2.87b	1664.73b
Phos. + Nitr.	25.83a	6.07a	5.31a	1.88a	7.29a	8.55b	33.10c	4.02ab	2005.96a
F-test	*	*	*	*	*	*	*	*	*
Interaction:	*	*	*	*	*	*	*	NS	*

* and NS indicate $P<0.05$and not significant, respectively.

Means followed by the same letter within columns are not significantly different at the 5% level, using Duncan's multiple range test.

Fig.(1): The highest value of cross section as affected by the interaction between 50 kg N/fed. and Nitrobin + Phosphorin in 2000/2001 season (X 52).

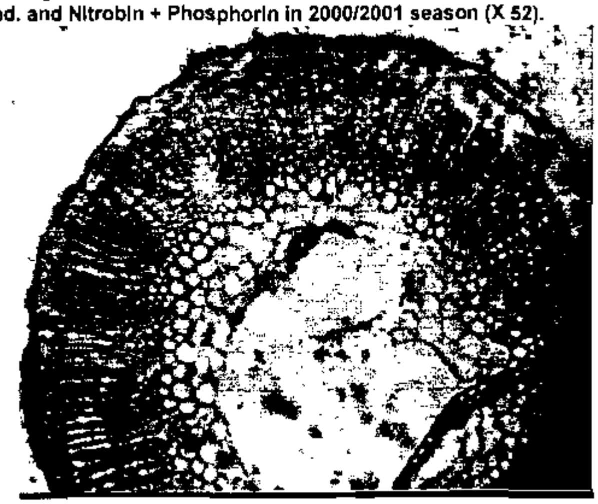

Fig.(2): The highest value of cross section as affected by the interaction between 50 kg N/fed. and Nitrobin + Phosphorin in 2001/2002 season (X 52).

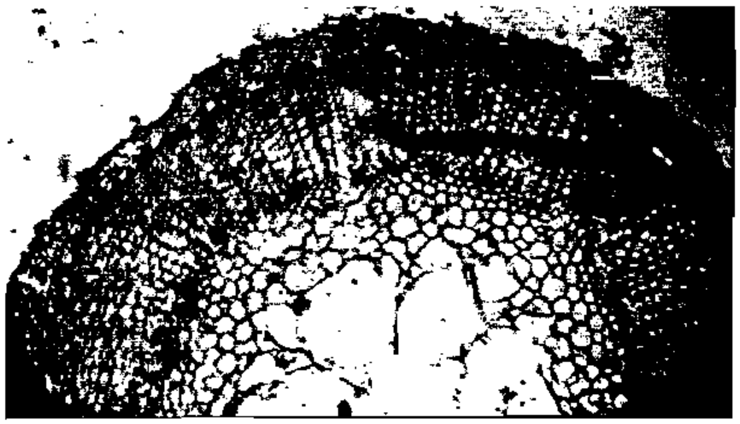

Fig.(3): The intermediate value of cross section as affected by the interaction between 50 kg N/fed. and Nitrobin+Phosphorin in 2000/2001 season (X 52).

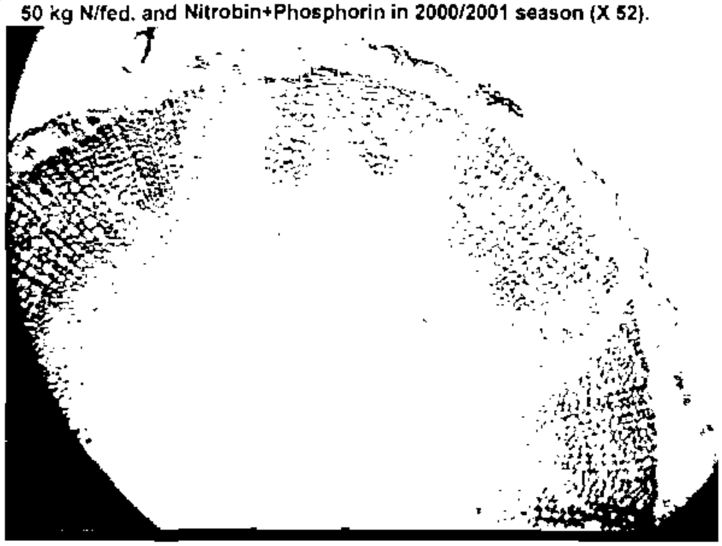

Fig.(4): The intermediate value of cross section as affected by the interaction between 50 kg N/fed. and Nitrobin+Phosphorin in 2001/2002 season (X 52).

Fig.(5): *The lowest value of cross section* as affected by the interaction between 50 kg N/fed. and Nitrobin+Phosphorin in 2000/2001 season (X 52).

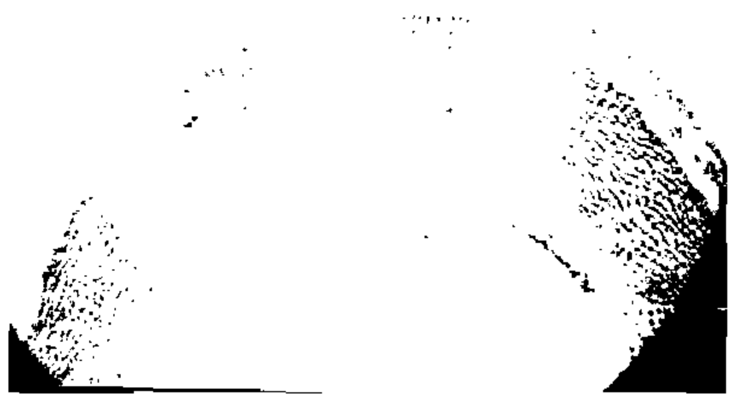

Fig.(6): The lowest value of cross section as affected by the interaction between 50 kg N/fed. and Nitrobin+Phosphorin in 2001/2002 season (X 52).

Analysis of variance showed that all tissues area, percentages and fiber index were significantly affected by the interaction between nitrogen levels x bio- fertilization except pith area. The highest values of total cross section and cortex area were obtained by applying 50 kg N/fed. with Phosphorin. Regarding phloem, fiber areas, fiber area % as well as fiber index, it is clear that the best combination to get maximum estimates of this characters was applying 50 kg N/fed. with Nitrobin + Phosphorin. Finely, the greater xylem area and xylem area percentage were recorded by 50 kg N/fed. x control (without inoculation).

Table (9): Highest significant values of anatomical characters of flax as affected by N- level and bio- fertilizer.

Variable	Highest value		Treatment
	1st	2nd	
	Season		
Total cross area (mm^2)	56.65	26.82	50 kg N/fed. x Phosphorin
Cortex area (mm^2)	5.48	6.15	50 kg N/fed. x Phosphorin
Phloem area (mm^2)	4 66	5.75	50 kg N/fed. x Nitrobin + Phosphorin
Fiber area (mm^2)	1.85	1.92	50 kg N/fed. x Nitrobin + Phosphorin
Fiber area %	7.33	7.62	50 kg N/fed. x Nitrobin + Phosphorin
Xylem area (mm^2)	11.07	11.60	50 kg N/fed. x control
Xylem area %	48.50	48.98	50 kg N/fed. x control
Fiber index (mm^3)	1806.40	2235.73	50 kg N/fed. x Nitrobin + Phosphorin

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تأثير التلقيح بالفسفورين والنيتروبين على محصــول الكتـــان وبعـض الصفـات التشريحية تحت مستويات مختلفة من السماد الأزوتى

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أجرى هذا البحث بمحطة البحوث الزراعية بسخا- مركز البحوث الزراعية- كفرالشـيخ خلال موسمى ٢٠٠٠/٢٠٠١، ٢٠٠١/٢٠٠٢. أجريت تجربتان حقليتان بهدف دراســة اســتجابة محصول الكتان ومكوناته وكذلك بعض الصفات التشريحية للتلقيح بالسمادين الحيويين (الفسفورين، النيتروبين) تحت مستويات مختلفة من السماد الأزوتى وهى ٢٠، ٣٠، ٤٠، ٥٠ كجم أزوت/فدان. استخدام تصميم القطع المنشقة فى أربع مكررات فى تنفيذ التجارب. ويمكن تلخيص أهم النتــائج المتحصل عليها فيما يلى:

أدت زيادة معدل السماد الأزوتى من ٢٠ الى ٥٠ كجم أزوت/فدان الى زيادة معنوية فى كل من الطول الفعال، قطر الساق الرئيسى، محصول القش للنبات، النسبة المئوية الكلية للأليــاف وكذلك محصول القش والألياف للفدان. كما أدت إضافة ٥٠ كجم أزوت/فدان الى زيادة معنوية فى كل من طول المنطقة الثمرية، عدد الكبسولات والبذور للنبات، وزن الـ ١٠٠٠ بذرة، محصــول البذرة للنبات وكذلك محصول البذرة والزيت للفدان. وقد أدت كل زيــادة فــى معــدلات الأزوت المضافة الى نقص معنوى فى محتوى البذور من الزيت بكلا موسمى الدراسة. وقد أعطت زيــادة معدل السماد الأزوتى من ٤٠ الى ٥٠ كجم أزوت/فدان زيادة غير معنوية فى كل الصفات السابق ذكرها فيما عدا محصول القش للفدان فى كلا موسمى الدراسة. وقد أوضحت النتــائج أن هنــاك زيادة تدريجية ومعنوية لكل الصفات التشريحية كنتيجة لزيادة معدلات الأزوت من ٢٠ الـــى ٥٠ كجم أزوت/فدان فيما عدا صفة مساحة اللب والتى نقصت معنويا بزيادة معدلات السماد الأزوتى.

أدى تلقيح البذرة بكل من الفسفورين والنيتروبين أو بالنيتروبين فقط الى زيادة معنويــة فى كل من الطول الفعال، محصول القش للنبات، محصول القش والألياف للفدان وكذلــك طــول المنطقة الثمرية، عدد الكبسولات للنبات، محصول البذرة للنبات، محصول البذرة والزيت للفــدان. وقد سجل أعلى محتوى للبذور من الزيت عندما تم تلقيح البذور بالفسفورين فى كلا الموســمين. وقد أوضحت النتائج أن معاملات التسميد الحيوى أدت الى زيادة معنويــة فــى كــل الصفــات التشريحية مقارنة بمعاملة بدون تلقيح (المقارنة) فيما عدا صفتى مساحة الخشــب ونســبتها فــى القطاع العرضى واللتان نقصتا معنويا نتيجة التسميد الحيوى. ومن ناحية أخرى لم يؤثر التســميد الحيوى على صفة مساحة اللب بكلا الموسمين.