EFFECT OF BIO AND MINERAL NITROGEN FERTILIZATION ON BARLEY CROP GROWN ON A SANDY SOIL

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Abstract

A field experiment was conducted during 2000 / 2001 and 2001 / 2002 growing seasons at the Ismailia Agric. Exp. Station. The effect of 2 kinds of bio-fertilizer [N-fixer (BF1) and P-dissolving bacteria (BF2)] and three levels of N-fertilizer (30, 60 and 90 kg N/fed.) were studied. The experimental design used was a split plot with three replications. Nitrogen levels were arranged in the main plots, meanwhile the bio-fertilizers in the sub plots.

Results indicated that plant height, spike length, number of spikes/m^2, number of grains/spike, straw yield, grain yield as well as crude protein, phosphorus and potassium percentages in barley grains were significantly increased by increasing N rate. When raising N fertilizer from 30 to 90 kg/fed, 1000 grains weight was significantly decreased either in both seasons or in combined analysis. Weight of grains/spike was significantly increased with increasing N fertilizer in the first season, while in combined analysis this character responded only to higher dose of N-fertilizer.

The percentage increase in grain of barley due to raising N-fertilizer rate from 30 to 60, 60 to 90 and 30 to 90/fed. were respectively 31%, 30% and 71% for the first season, 20%, 22.6% and 47.4% for the second season and 25%, 26% and 59% for the combined analysis. Bio-fertilizer inoculation (BF1) significantly increased the plant height, spike length, number of spikes/m^2, number of grains/spike, weight of grains/spike, straw and grain yields compared to non-inoculated control. The percentage increases in grain yield of barley due to (BF1) application were about 28.4%, 17.5% and 22.9% for the first season, second season and their combined analysis, respectively, compared to non–inoculated control. On the other hand, most of studied characters were not influenced by bio-fertilizer (BF2). Moreover, the 1000–kernel weight along with crude protein, phosphorus and potassium percentages in barley grains were not influenced by bio-fertilizer in both seasons and their combined analysis.

The interaction effect between bio-fertilizer and N-fertilizer rates showed a significant effect on straw yield in the second season only. Straw yield gave the highest value with the use of 90 kg N/fed. combined with (BF1) and significantly exceeded the other treatments. However, a little increase in the straw yield was only significant in the first

season. The same trend was noticed with grain yield but the interaction was not significant. This behavior was true in both seasons and their combined analysis.

INTRODUCTION

Managing desert land, which is characterized by being mostly sand textural soil, has to start with selecting crops which suite such soil with low water requirement as a main characteristic. Barley is one of these crops. Barley is the main cereal crop grown along the Northern Coast of Egypt under rain-fed and under the new land conditions. It is the suitable crop to any soil suffering from a biotic stress. In this respect, Carleton (1916) stated that water requirements for the unit weight of barley grains is less than other cereals. Sandy soil is known to be poor in fertility. This is because of the very low cation exchange and water holding capacities. Generally, nutrients are essential for plant life; therefore nitrogen fertilization is a common agronomic practice that leads to improve productivity (El-Moselhy, 1994). Intensive crop cultivation requires high rates of N-fertilizer which are not only so expensive but also polluting agro-ecosystems, therefore the current trend is to reduce the use of mineral fertilizers and keep high productivity in the meantime. Nitrogen is required in higher quantities, Sarhan *et al.* (2002) found that grain yield of barley grown on sandy soil requires 90 kg N/fed. On the other hand, most of nitrogen fertilizers is of a potential pollution by the losses in the water of the drains, then to the rivers or to the underground water, which affected the human and animal health. The nature of this problem requires intensive efforts to increase efficiency of the biological fixation, not only through conventional symbiotic legume–*Rhizobium* associations but also through the non–Symbiotic N_2–fixation regimes observed in grasses in order to prevent physiogenic diseases caused by nitrogen deficiency (Madkour *et al.*, 1987). Okon (1982) stated that inoculated plants with biofertilizers exhibited about 30-50% greater uptake of nitrogen, phosphate and potassium than the non-inoculated plants. He suggested that associative nitrogen fixing enhanced the mineral absorption of the cell cortex, which is reflected on the plant growth and yield increases.

Several reports have affirmed positive plant growth responses after inoculation with different non–symbiotic N–fixing bacteria such as *Azotobactar spp* (Hassan *et al.*, 1985), *Azospirillum brasilense* (Baltensperger *et al.*, 1987) and *klebsiella pneumonias*

(Hassa *et al.*, 1985).

The objective of this work was to study the effects of bio-fertilizer and N – fertilizer on barley crop grown on a sandy soil.

METERIALS AND METHODS

A field experiment was conducted at Ismailia Agric. Exp. Station through two growing seasons 2000 /2001 and 2001 / 2002 to study the effect of two factors including bio-fertilizer and N-fertilizer. The experiment was laid out in a split plot design with three replications. N-fertilizer was placed in the main plots, while bio-fertilizer in the sub plots. Barley cultivar Giza 124 was seeded as the recommended seed rate (45 kg/fed.) Normal agricultural practices were applied. The plot area was 10.5 m^2 size (3m x 3.5m). All the experimental plots received 30 kg P_2O_5/fed. as ca-superphosphate (15% P_2O_5) and 24 kg K_2O as k–sulphate (48% K_2O) in one dose before sowing, while nitrogen was applied in the form of ammonium sulphate (20.6% N) with five equal intervals.

Bio–fertilizer treatments were:

1-non inoculated control 2-Bio-fertilizer 1 (BF1) 3-Bio-fertilizer 2 (BF2)

N-fertilizer treatments were: 1- 30 kg N/fed. 2- 60 kg N/fed. 3- 90 kg N/fed.

Bio- fertilizers (BF1 and BF2) are commercial multi–strains. BF1 is a composite of associative diazotrophs (*Bacillus polemical* and *Azospirillum brasilense*) and BF2 is a mixture of P- dissolving bacteria (*B. megatherium*) and N_2 fixing bacteria (*Azospirillum sp., Azotobaeter chroococum* and *B. polymyxa*). Arabic grum was melted in an amount of warm water to be added to the bio- fertilizers. Barley seeds were added and mixed carefully to be then spread over plastic sheets for s short time before sowing. The physical and chemical analysis of the soil in the two studied seasons were illustrated in Table 1.

Available N was extracted by K_2SO_4 (1% solution) and determined using Kjejdahl method (A.O.A.C, 1970). Available P was extracted by 0.5 N $NaHCO_3$ solution (pH 8.5) and determined according to Olsen method (Jackson, 1968), while available K was ex-

tracted by 1.0 N neutral ammonium actetate (Black, 1965) and determined by flame photometer.

Table 1. Physical and chemical analysis for the soil of the experimental site at Ismailia before planting.

Soil Characteristics	2000/2001	2001/2002
Mechanical analysis		
Sand%	90.0	90.4
Slit%	1.5	1.9
Clay%	6.0	5.5
Soil Texture	Sandy	
Chemical analysis		
PH (1:2.5 soil: water)	7.62	7.85
EC (mmhos/cm; 1:5 soil: water extract)	0.31	0.38
$CaCO_3$%	0.19	0.34
Available N (ppm)	48.00	20.00
Available P (ppm)	10.00	8.00
Available K (ppm)	98.00	70.00

Available N was extracted by $K_2 SO_4$ (1% solution) and determined using Kjeldahl method (A.O.A.C, 1970). Available P was extracted by 0.5 N $NaHC0_3$ SOLUTION (PH 8.5) and determined according to Olsen method (Jackson, 1968), while available K was extracted by 1.0 N neutral ammonium acetate (Black, 1965) and determined by flame photometer

Data recorded:

1- Plant height in cm 2- Spike length in cm 3-Number of spikes/m^2

4- Number of grains/spike 5- Weight of grains/spike in g 6- 1000 grains weight in g

7- Grain yield (GY) Kg/fed. 8- Straw yield (SY) ton/fed.

Protein, phosphorus and potassium contents of grains were also determined. Nitrogen percentage was determined by micro–Kjeldahl as described in A.O.A.C (1970). Nitrogen percentage was multiplied by 5.7 to obtain protein percentage. Phosphorus and potassium percentage was determined as described by Jackson (1968). Standard individual and combined analysis of variance over two seasons, using L S D, were performed to estimate the significant differences among treatments and interactions (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

1. Growth characters:

Data in Table 2 show the main effects of bio–fertilizer and N–fertilizer on plant height and spike length of barley.

A. Bio-fertilizer effect:

Using bio-fertilizers BF1 and BF2 significantly resulted in increasing plant height compared to non–inoculated control in both seasons and their combined analysis. For spike length, generally, it could be noticed that using bio–fertilizers resulted in increasing spike length compared to non–inoculated control in both seasons and their combined analysis, whereas, increases in spike length were significant when using BF1 only in the first season and combined analysis.

B. Mineral nitrogen effect:

Raising N fertilizer rate from 30 to 60 and to 90 kg/fed. was followed by a significant increase in plant height and spike length. This was a fact in both seasons and their combined analysis. The increase in both plant height and spike length with increasing nitrogen application might be due to its simulative effect on internodes elongation and subsequently stem length. These results are confirmed by the finding of Sarhan *et al.* (2002).

C. Interaction effect:

The interaction between bio–fertilizer and N–fertilizer did not exert any significant effect on plant height and spike length in both seasons and their combined analysis.

2. Yield components:

Data in Tables 3 and 4 show the mean effects of bio–fertilizer and N–fertilizer levels on number of spikes/m^2, number of grains/spike, weight of grains/spike and 1000 grains weight.

A. Bio–fertilizer effect:

Applying bio–fertilizer BF1 significantly resulted in increasing the number of spikes/m^2 compared to non–inoculated control. This was in both the first season and combined analysis. Number of grains/spike of barley were significantly affected by either bio–fertilizer BF1 or BF2 in both seasons and their combined analysis. Applying bio–fertilizers BF1 and BF2 significantly resulted in increasing the weight of grains/spike in the first season but these significantly increases were only obtained with BF1 in combined analysis. 1000 grains weight did not respond to the studied bio–fertilizers.

Table 2. Plant height and spike length of barley as affected by bio–fertilizer and N–fertilizer during both 200/2001 and 2001/2002 growing seasons.

Treatments	Plant height (cm)			Spike length (cm)		
	1st season	2nd season	combined	1st season	2nd season	combined
Bio - fertilization (A)						
non-inoculated control	72.6	78.9	75.7	7.7	5.9	6.8
BF1	75.3	89.4	82.4	8.7	6.7	7.7
BF2	76.7	83.7	80.2	8.0	6.3	7.2
F - Test	**	**	**	**	NS	**
Mineral N - Fertilization (B)						
30 Kg N/fed	66.9	75.6	71.2	7.2	5.4	6.3
60 Kg N/fed	74.5	81.8	78.0	8.4	5.9	7.1
90 Kg N/fed	83.0	94.7	88.9	8.9	7.7	8.3
F - Test	**	**	**	**	**	**
L S D 0.05 (A)	2.5	4.3	2.9	0.3	-	0.5
L S D 0.05 (B)	4.6	5.6	4.8	0.3	0.4	0.3
L S D 0.05 (AB)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

B. Mineral N–fertilizer effect:

Raising N fertilizer from 30 to 60 and to 90 kg/fed. was followed by a significant increase in number of spike/m^2 and number of grains/spike in both seasons and their combined analysis. Opposite trend was found in the 1000 grains weight in both seasons and their combined analysis. Weight of grains/spike was significantly increased with increment of N–fertilizer in the first season, while in combined analysis this character responded only to higher dose of N–fertilizer. These results are in agreement with those reported by Basha and El-Bana (1994).

C. Interaction effect:

The interaction between bio-fertilizer and N-fertilizer did not exert any significant effect on yield components of barley in both seasons and their combined analysis.

Table 3. Number of spikes/m^2 and number of grains/spike of barley as affected by both bio-fertilizer and N-fertilizer during both 2000/2001 and 2001/2002 growing seasons.

Treatments	Number of spikes/m^2			Number of grains/spike		
	1st season	2nd season	combined	1st season	2nd season	combined
Bio - fertilization (A)						
non-inoculated control	223.1	228.9	226.0	48.0	46.4	47.2
BF1	249.6	253.6	251.6	57.6	53.4	55.5
BF2	228.3	225.7	227.0	53.4	50.2	51.8
F - Test	*	N.S.	*	*	**	**
Mineral N - Fertilization (B)						
30 Kg N/fed	190.7	192.5	191.6	48.4	43.1	45.7
60 Kg N/fed	228.2	226.4	227.3	52.3	50.6	51.4
90 Kg N/fed	282.1	289.2	285.6	58.3	56.3	57.3
F - Test	**	**	**	**	**	**
L S D 0.05 (A)	14.7	-	21.5	4.5	1.9	2.9
L S D 0.05 (B)	9.9	21.9	16.1	2.4	2.1	2.1
L S D 0.05 (AB)	-	-	-	-	-	-

Table 4. Grain weight per spike and 1000 grains weight of barley as affected by both bio-fertilizer and N-fertilizer during 2000/2001 and 2001/2002 growing seasons.

Treatments	Grain weight per spike (g)			1000 grains weight (g)		
	1st season	2nd season	combined	1st season	2nd season	combined
Bio - fertilization (A)						
non-inoculated control	2.02	2.24	2.13	42.08	43.17	42.62
BF1	2.33	2.12	2.22	41.72	41.43	41.57
BF2	2.22	2.15	2.19	42.11	41.45	41.78
F - Test	*	N.S.	**	N.S.	N.S.	N.S.
Mineral N - Fertilization (B)						
30 Kg N/fed	1.99	2.24	2.12	43.66	43.71	43.68
60 Kg N/fed	2.20	2.16	2.18	41.85	41.93	41.89
90 Kg N/fed	2.37	2.10	2.23	40.40	40.42	40.41
F - Test	*	N.S.	**	**	**	**
L S D 0.05 (A)	0.18	-	0.08	-	-	-
L S D 0.05 (B)	0.14	-	0.09	0.87	1.02	0.90
L S D 0.05 (AB)	-	-	-	-	-	-

3. Grain and straw yields:

Data in Table 5 show grain yield and straw yield as affected by bio–fertilizer and N–fertilizer in two seasons and combined analysis. Analysis of variance revealed significant effects of bio–fertilizer (especially NF1) and nitrogen level.

A. Bio–fertilizer effect:

Applying bio–fertilizer BF1 significantly resulted in increasing grain and straw yields compared to the non–inoculated control in both studied seasons and their combined analysis. On the other hand, straw yield of barley was significantly affected by BF2 compared to non–inoculated control in combined analysis only. The obtained data indicated that application of BF1 increased grain yield with about 28.4%, 17.5% and 22.9% for the first season, second season and their combined analysis respectively, compared to non–inoculated control. These increases may be due to the ability of the microorganisms to produce growth regulators substances, i.e. Indole acetic acid (IAA), biggrelic acids (GAS) and cytokinones (Cks). These phytohormones play an important role in plant growth through promoting photosunthesis and translocation and accumulation of dry matter within different plant parts. This is in agreement with those obtained by Hassanein and Hassouna (1997).

B. Mineral N–fertilizer effect:

Grain and straw yield of barley were significantly increased with each increment of N–fertilizer in both seasons and their combined analysis. Increase percentages in grain yield of barley due to raising N–fertilizer rate from 30 to 60, 60 to 90 and 30 to 90 were, respectively, 31%, 30% and 71% for the first season, 20%, 22.6% and 47.4% for the second season and 25%, 26% and 59% for the combined analysis. This might be due to the fact that nitrogen, as an essential element plays a prominent role in building new cells, cell elongation and increasing photosynthesis activity, which in consequence enhances the growth and yield parameters. The present findings are in a good line with those reported by El-Moselhy, (1994).

Table 5. Grain and straw yield of barley as affected by bio-fertilizer and N-fertilizer during both 2000/2001 and 2001/2002 growing seasons.

Treatments	Grain yield (Kg/fed.)			Straw yield (ton/fed.)		
	1st season	2nd season	combined	1st season	2nd season	combined
Bio - fertilization (A)						
non-inoculated control	1548.7	1556.1	1552.4	8.2	6.3	7.3
BF1	1988.9	1829.8	1909.3	9.4	8.4	8.9
BF2	1651.8	1586.2	1619.0	8.6	7.3	7.9
F - Test	**	*	**	**	*	**
Mineral N - Fertilization (B)						
30 Kg N/fed	1287.2	1352.5	1319.8	6.4	4.9	5.7
60 Kg N/fed	1689.6	1625.8	1657.7	8.4	7.5	8.0
90 Kg N/fed	2212.6	1993.7	2103.1	11.4	9.6	10.5
F - Test	**	**	**	**	**	**
L S D 0.05 (A)	142.0	148.1	120.3	0.5	1.1	0.7
L S D 0.05 (B)	159.5	82.6	120.3	0.8	0.8	0.8
L S D 0.05 (AB)	-	-	-	-	1.4	-

C. Interaction effect:

The interaction between bio-fertilizer and N-fertilizer shows significant effect on straw yield in the second season only, Table 6. Straw yield gave the highest value with applying the highest rate of N fertilizer (90 kg/fed.) + BF1 which significantly exceeded the other treatments. The highest straw yield was obtained with (90 Kg N/fed. + BF1) for the first season and the combined analysis but the interaction was not significant. The same trend was encountered with grain yield whereas the highest grain yield was obtained with 90 Kg N/fed. + BF1. This was a fact in both seasons and their combined analysis.

4. Chemical contents of grains:

Data in Table 7 show crude protein, phosphorus and potassium percentages in barley grains as influenced by bio-fertilizer and N-fertilizer.

A. Bio-fertilizer effect:

Crude protein, phosphorus and potassium percentages were not influenced by bio-fertilizer in both seasons and their combined analysis.

Table 6. Effect fertilizer interaction on grain and straw yields of barley during both 2000/2001 and 2001/2002 growing seasons.

Treatments*	Grain yield (Kg/fed.)			Straw yield (ton/fed.)		
	1st season	2nd season	combined	1st season	2nd season	combined
A1B1	1159.2	1286.1	1222.6	6.3	4.9	5.6
A1B2	1517.1	1502.2	1509.6	7.8	6.4	7.1
A1B3	1969.8	1880.2	1925.0	10.5	7.76	9.1
A2B1	1468.1	1542.8	1505.4	7.0	5.2	6.1
A2B2	1897.4	1834.4	1865.9	9.1	8.9	9.0
A2B3	2601.2	2112.1	2356.6	12.1	11.2	11.7
A3B1	1234.3	1228.7	1231.5	6.0	4.8	5.4
A3B2	1654.3	1540.9	1597.6	8.4	7.2	7.8
A3B3	2066.8	1988.9	2027.8	11.5	9.8	10.6
F - Test	N.S.	N.S.	N.S.	N.S.	*	N.S.
L S D 0.05 (A)	142.0	148.1	120.3	0.6	1.1	0.7
L S D 0.05 (B)	159	82.6	120.3	0.8	0.8	0.8
L S D 0.05 (AB)	-	-	-	-	1.4	-

*A1= Non-inoculated control A2= BF1 A3= BF2
B1= 30 kg/fed. B2= 60 kg/fed. B3= 90 kg/fed.

B. Mineral N–fertilizer effect:

It is evident that crude protein was significantly increased by raising N fertilizer level from 30 to 60 and 60 to 90 Kg N/fed. This was a fact in both seasons and their combined analysis. This might be due to the important role of N in synthesis of proteins. These results are in agreement with those obtained by Gielah (1986). Phosphorus and potassium percentages in barley grains were also significantly increased in both seasons and their combined analysis.

C. Interaction effect:

Crude protein, phosphorus and potassium percentages in barley grains were not affected by the interaction between bio–fertilizer and N–fertilizer in both seasons and their combined analysis.

Table 7. Crude protein %, P% and K% in grains of barley as affected by bio-fertilizer and N-fertilizer during both 2000/2001 and 2001/2002 growing seasons.

Treatments	Crude protein % in grains			P % in grains			K % in grains		
	1st season	2nd season	comb.	1st season	2nd season	comb.	1st season	2nd season	combined
Bio - fertilization (A)									
non-inoculated control	10.73	10.39	10.56	0.267	0.292	0.279	0.437	0.456	0.446
BF1	11.02	11.09	11.05	0.268	0.292	0.280	0.432	0.460	0.401
BF2	10.88	11.10	10.99	0.281	0.299	0.290	0.439	0.447	0.443
F - Test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Mineral N - Fertilization (B)									
30 Kg N/fed	9.10	9.14	9.12	0.236	0.256	0.246	0.390	0.403	0.396
60 Kg N/fed	11.05	11.18	11.11	0.258	0.287	0.272	0.444	0.446	0.445
90 Kg N/fed	12.43	12.25	12.36	0.322	0.340	0.331	0.474	0.516	0.495
F - Test	**	**	**	**	**	**	**	**	**
L S D 0.05 (A)	-	-	-	-	-	-	-	-	-
L S D 0.05 (B)	1.36	0.75	1.04	0.018	0.017	0.012	0.035	0.034	0.023
L S D 0.05 (AB)	-	-	-	-	-	-	-	-	-

It is clear from this study that application of either bio-fertilizer (BF1) alone or mineral nitrogen fertilizer at different levels (especially 90 Kg N/fed.) enhanced yield production.

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تأثير السماد الحيوى والنتروجينى المعدنى على محصول الشعير فى الأراضى الرملية

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أقيمت تجربة حقلية فى موسمين زراعيين متتاليين هما ٢٠٠٠/٢٠٠١ و٢٠٠١/٢٠٠٢ بمحطة البحوث الزراعية بالاسماعلية لدراسة تأثير التسميد الحيوى والنتروجينى على صفات النمو الخضرى ومحصول الشعير.

استخدم للتصميم الاحصائى قطع منشقة من الدرجة الأولى حيث شغلت معدلات التسميد النتروجينى (٣ معدلات تسميد ٣٠، ٦٠، ٩٠ كجم أزوت/فدان) القطع الرئيسية وشغلت صور السماد الحيوى [بدون تسميد حيوى - المخصب الحيوى الأول (مثبت الأزوت الجوى) - المخصب الحيوى الثانى (مذيب للفوسفور ومثبت الأزوت الجوى)] القطع الشقية.

ويمكن تلخيص النتائج كالتالى:

- زاد طول النبات - طول السنبلة - وعدد السنابل/م٢ - عدد حبوب السنبلة - محصول القش - محصول حبوب ونسبة البروتين والفوسفور بالحبوب مع كل زيادة فى معدلات التسميد ولكن وزن ١٠٠٠ حبة أظهر اتجاه معاكس مع كل زيادة للنتروجين (من ٣٠ إلى ٦٠ ومن ٦٠ إلى ٩٠ كجم/فدان) و كان هناك نقص معنوى.

- زاد وزن حبوب السنبلة زيادة معنوية مع كل زيادة فى معدلات التسميد النتروجينى فى الموسم الأول بينما مع التحليل التجميعى وجد أن هذه الصفة استجابت للمعدل العالى من التسميد النتروجينى (٩٠ كجم ن/ف) فقط.

- نسب الزيادة فى محصول الحبوب نتيجة إلى زيادة معدلات التسميد من ٣٠ إلى ٦٠ ومن ٦٠ إلى ٩٠ ومن ٣٠ إلى ٩٠ كجم أزوت/فدان هى على الترتيب ٣١٪، ٣٠٪، ٧١٪ للموسم الأول و٢٠٪، ٢٢,٦٪، ٤٧,٤٪ للموسم الثانى و٢٥٪، ٢٦٪، ٥٩٪ للتحليل التجميعى.

- أدت إضافة المخصب الحيوى الأول (مثبت للآزوت الجوى) إلى زيادة طول النبات - طول السنبلة - عدد السنابل/م٢ - عدد وزن حبوب السنبلة - محصول القش - محصول الحبوب مقارنة مع معاملة الكنترول (بدون لقاح بكتيرى). كانت نسب الزيادة فى محصول الحبوب نتيجة إضافة المخصب الحيوى الأول (مثبت للأزوت الجوى) هى ٢٨,٤٪، ١٧,٥٪، ٢٢,٩٪ للموسم الأول والثانى والتحليل التجميعى على التوالى مقارنة مع معاملة الكنترول بدون سماد حيوى. من ناحية أخرى لم تتأثر معظم الصفات المدروسة بالمخصب الحيوى الثانى. كذلك لم يتأثر بالتسميد الحيوى كل من وزن

١٠٠٠ حبة ونسبة البروتين والفسفور والبوتاسيوم فى حبوب الشعير فى كلا الموسمين والتحليل التجميعى.

لم يكن هناك تأثير للتفاعل بين معدلات التسميد النتروجينى والسماد الحيوى إلاّ على محصول القش فى الموسم الثانى فقط حيث أعطى أعلى قيمة لمحصول القش مع إضافة المعدل النتروجينى العالى (٩٠ كجم ن/ف) مع المخصب الأول (مثبت للآزوت الجوى) وكانت الزيادة معنوية لهذه المعاملة مقارنة مع المعاملات الأخرى كما وجد أن هناك نفس الاتجاه لمحصول القش فى الموسم الأول والتحليل التجميعى ولكن بدون معنوية.

لوحظ أيضاً وجود نفس الاتجاه مع محصول الحبوب حيث أعطى أعلى محصول حبوب مع (٩٠ كجم ن/ف + المخصب الحيوى الأول (مثبت للآزوت الجوى) فى الموسمين والتحليل التجميعى ولكن التفاعل غير معنوى.