Barley Productivity and Protein Content as Effected by fertilization Treatments under Calcareous Soil Conditions

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ABSTRACT

Two field experiments were carried- out at Nubaria Agriculture Research Station, North Tahrir, in the two successive growing seasons of 2013-2014 and 2014-2015.The experiments were a randomized complete block design (RCBD) with three replicates. Treatments were: (T1) cerealine bio-Fertilizer, (T2) Mineral nitrogen (45 kg.fad^{-1}), (T3) Organic compost (10m^3 fad^{-1}), (T4) 50% mineral nitrogen+ 50% organic compost, (T5) 1/3 organic compost +cerealine bio- Fertilizer+1/3 mineral nitrogen, (T6) 50% organic compost + cerealine bio-fertilization and(T7) 50% mineral nitrogen + cerealine bio-Fertilizer. All studied traits (days to heading, days to maturity, filling period, plant height, number of spike.m^{-2}, spike length, grain yield, biological yield, straw yield, 1000 kernel weight and protein content)were significantly affected by fertilization treatments, except for harvest index and yield efficiency. Also, results showed that T2(mineral nitrogen) and T7(50% mineral nitrogen + cerealine bio-fertilizer) treatments produced the highest values of grain, biological and straw yields, while treatments T4 (50% mineral nitrogen+ 50%organic compost) and T7 (50% mineral nitrogen + cerealine bio. Fertilizer)had the highest values of protein content.

Keywords: Barley, Protein content, grain yield, biological yield, harvest index

INTRODUCTION

Barley (*Hordiumvulgare, L.)*is grown in a wide rangeof environmental pressures including arid and poor or saline soils (Abd El-Hady, 2007). It is grown in the North Coastal region, newly reclaimedLandsoutside the Nile Valley where the irrigation water quality is limited and the production of other strategic crops is uneconomic.

Nitrogen is one of the primary plant nutrients which play a major role in maximizing the economic returns of production. Nitrogen management, and other essential nutrients, are part of a balanced fertilization program. Plants absorb the largest amounts as nitrogen among other essential nutrients. In order to achieve maximum yield potential, nitrogen must be balanced with other micro nutrients.

The use of chemical fertilizers has been increased worldwide for cereal production (Abril et. al., 2007) due to availability of inexpensive fertilizers (Graham and Vance 2000). The continuous use of chemical fertilizers leads to health and environmental hazards through contamination of ground and surface water due to nitrate leaching (Pimentel 1996). Therefore, reducing the amount of applied nitrogen fertilizers to the field without nitrogen deficiency will be the main challenge in field management. One possible option would be recycling organic waste. Compost is a valuable and inexpensive source of fertilizer and plant nutrients. Positive role of organic Fertilizers includes soil aggregation and improve water-holding capacity (Jedidi et al. 2004; Odler et al., 2008) and (Palm *et al.,* 2001). In addition, compost has concentrations of nitrogen, phosphorus and potassium, with a very low the contamination of heavy metals and other toxic substances is (Asghar et al. 2006). The combination of compost and chemical fertilizers further enhanced the biomass and grain yield of crops (Sarwar et al. 2007; Sarwar et al. 2008).

Bio-fertilizer is a broad term used for products containing living or dormant micro-organisms such as bacteria, fungi, actinomycetes and algae (Rai, 2006; Salem *et al*., 2010). Application of bio-fertilizers has become an essential practice to obtain high-quality yield and avoid environmental pollution (Shevananda, 2008).Bio-fertilizer usually contains microorganisms having specific function such as Azospirillumthat fix nitrogen and other solubilizing bacteria that solubilizephosphor to be plants available (Saraswati & Sumarno, 2008). Further research are still needed in this concern. Application of manure with the recommended dose of nitrogen and bio-fertilizers has led to increased growth, yield and water use efficiency of wheat under limited water supply (Youssef, 2011). Sarwar (2005), found that, grain yield and yield components of wheat significantly increased with the application of different organic materials, including compost as the most superior one. Matter *et al*.,(2007) showed that wheat yields increased with using the organic fertilization. In addition, Youssef (2011) concluded that the use of bio-fertilizers in the presence of organic and mineral nitrogen resulted in an increase in the grain yield of wheat.

The objectives of this present research aimed to study the effect of different fertilization treatments on productivity and protein content of barley *Hordeumvulgare, L*. cv. Giza 126 undercalcareous soil.

MATERIALS AND METHODS

A field study was carried-out during 2013/2014 and 2014/2015 growing seasons at Nubaria Agriculture Research Station, at North Tahrir, Egypt. The geographical location of the experimental site is (Latitude 30-22N, Longitude 30-21 E).Before starting the field experiments, a soil sample was taken for physical and chemical analysis, by the methods described by Ryan *et al.* (1996). Results of Soil physical and chemical properties were presented in Table 1. Sowing dates of the experiments were on November in both seasons. All normal agricultural practices recommended for the region were applied.

The lay-out of this study was a randomized complete block design (RCBD) with three replicates. Each plot consisted of seven rows, 20 cm apart and 3.5m long. Seven Fertilization treatments were applied as below in addition to different combinations between them:

1. (T_1) Cerealine bio-fertilizer.
2. (T_2) Mineral nitrogen (45 kg.fad $^{-1}$).
3. (T_3) Organic compost (10 m^3.fad $^{-1}$).
4. (T_4) 50% mineral nitrogen + 50% organic compost.
5. (T_5) 1/3 organic compost + cerealine bio-fertilizer+ 1/3 mineral nitrogen.
6. (T_6) 50% organic compost +cerealine bio-fertilizer.
7. (T_7) 50% mineral nitrogen + Cerealine bio-fertilizer

Mineral nitrogen was added as (urea), compost was added and thoroughly incorporated in the soil before planting at the rate of 10m^3.fad^{-1}. Chemical analysis of the compost are shown in Table 2. Barley seeds were inoculated with *cerealine* (0.4 kg.fad^{-1})a commercial product obtained from Bio-fertilizer Unit, Agriculture Research Center (ARC), Giza, Egypt. Cerealine has a free- living nitrogen-fixing bacteria which has activity in N_2 fixation in the soil.

The barley genotype used in this study was Giza 126, a six-rowed spring barley (*Hordeum vulgare, L*) developed by the Barley Research Department, ARC.

The recorded data included: days to heading; determined as the number of days from sowing to emergence of the 50% heads from the boots in each plot, days to maturity; determined as the number of days from sowing to physiological maturity (total loss of plants green color),plant height (cm); measured at maturity from the soil surface to the tip of the main spike excluding owns, number of spike per m^2; recorded as the number of tillers bearing fertile spikes (two randomly taken rows in each plot) and the average number of spikes per square meter. Grain yield was determined as the weight of grains harvested from the middle rows and converted to Ton.fad^{-1}.Thousand kernel weights were calculated as the weight of 1000 grains. Biological yield was determined as the total above ground dry matter of each plot and converted to ton.fad^{-1}. Straw yield was recorded as the total above ground dry matter minus grain yield of each plot and converted toton.fad^{-1}.Yield efficiency % were calculated as grain yield/ straw yield x 100. Harvest Index% was calculated as grain yield/ biological yield x 100. Filling period was calculated as maturity date – heading date.Total protein content was determined by multiplying grain nitrogen content by 5.83 (Baker, 1979).

Statistical analysis:combined analysis of variance for the two growing seasons was made according to the methods proposed by Steel and Torrie (1980) using SAS program (2007).

RESULTS AND DISCUSSION

Differences due to season's effects were significant for all traits, except number of days to maturity, spike length, yield efficiency and protein content. The combined analysis of variances also revealed significant differences among the seven Fertilization treatments for all studied traits, except for, yield efficiency and harvest index.

Table1: Soil physical and chemical properties of the investigated site.

Properties	Value
Soil Texture	Sandy loam
EC (dSm-1)	3.2
pH	8.3
Organic matter (O.M %)	0.22
$CaCO_3$%	22.5
Available macro and micronutrients (ppm)	
N	33.6
P	2.7
K	110
Zn	0.21
Fe	0.64
Mn	0.32
Cu	0.11

Table 2: Chemical properties of the compost used in the study.

Property	Saturation percent	O.C %	C/N ratio	O.M %	Total macronutrients			Total micronutrients (ppm)			
					N %	P %	K %	Fe	Mn	Zn	Cu
Compost	17%	19.6	1:25.7	22.91	0.522%	0.016	0.61%	19.3	7.92	4.7	0.74

O.C: OrganicCarbon, C/N: Carbon/ Nitrogen and O.M: Organicmatter

The interaction between years and Fertilization treatments was significantly affected for heading date, maturity date, filling period, spike length and 1000 kernel weight. On the other hand, interaction between years and Fertilization treatments showed insignificant effect for plant height, number of spike.m^{-2}, biological yield, grain yield as well as straw yield. Yield efficiency, harvest index and protein content showed insignificant effect (Tables 3, 4 and 5). Salvatore *et al*., (2013) on durum wheat, reported that, season x Fertilization treatments interactions were significance for all evaluated parameters, except for, protein content.

Data in Table 3 showed that,T_1 (cerealine bio-fertilizer) and T_7 (50% mineral nitrogen+ cerealine bio-fertilizer) gave the least number of days to heading,with average of 87.5 and 87.67 days, respectively. While the treatment T1 (cerealine bio-fertilizer), T2 (50% mineral nitrogen) and T4(50% organic compost) showed the earlier maturity (125.5 day). As for on plant height, T2 (Mineral nitrogen)andT5 (combination between1/3 organic compost + cerealine bio-fertilization +1/3 mineral nitrogen) gave the highest values (96.83cm). However, the tallest spike was obtained by T4 (50% mineral nitrogen+ 50% organic compost) treatment with an average of 9.167 cm.

Concerning the effect of treatments on yield and other attributes i.e., number of spike.m^{-2}, 1000 grain weight, biological yield, grain yield and straw weight, data in Table (4) showed that, all yield and other attributes recorded significant effect. The comparison of the mean values of the number of spike.m^{-2} showed that among the different fertilizer treatments, T_3 (organic compost), T_2 (Mineral nitrogen)and T_7(50% mineral nitrogen + cerealine bio-fertilizer) treatments have the highest number of spike.m^{-2} (464.17, 461.67 and 460.83, respectively). While T6 (50% organic compost + cerealine bio-fertilizer) treatment has the lowest number of spike.m^{-2} with average of 410.

As for the effect of fertilizer treatments on grain yield, the highest values forgrain yield was obtained from the T_2 treatment (mineral nitrogen)with anaverage of 3.101 ton.fad^{-1}, while the lowest yield was obtained from the cerealine bio–fertilizer (2.19 ton.fed^{-1}).

Table 3: Effects of season (S), fertilization treatments (T), and their interactions for agronomical traits evaluated in the study.

Factors	Days to heading (days)	Daysto maturity (days)	Filling period (days)	Plant height (cm)	Spike length (cm)
Season					
First	87.81 B	126.57	38.76 A	95.14 B	7.43
second	88.57 A	125.90	37.33 B	95.90 A	7.76
L.S.D (0.05)	0.69	n.s	1.11	0.62	n.s
Fertilization treatments					
T_1(Cerealine bio-fertilizer)	87.50 C	125.50 B	38.0 B	95.67 B	7.33 BC
T_2 (Mineral nitrogen)	88.33 CAB	125.83 B	37.50 B	96.83 A	7.67 B
T_3 (Organic compost)	88.00 CB	126.0 B	38.0 B	95.83 AB	7.17 BC
T_4 (50% mineral nitrogen + 50% compost)	88.83 AB	125.5 B	36.67 B	91.33 C	9.17 A
T_5 (1/3 organic compost + bio-fertilizer + 1/3 mineral nitrogen)	89.00 A	126.0 B	37.0 B	96.83 A	7.33 BC
T_6 (50% organic compost + bio-fertilizer)	88.00 CB	127.50 A	39.50 A	96.00 AB	7.67 B
T_7 (50% mineral nitrogen + bio-fertilizer)	87.67 C	127.33 A	39.67 A	96.17 AB	6.83 C
L.S.D (0.05)	0.95	1.03	1.36	1.14	0.74
Significant interaction					
S X N	*	**	**	n.s	*

The highest 1000 grain weight, biological and straw yields were obtained from the mineral nitrogen (T_2) with an averages of 52.98 g, 9.71 and 7.08 ton.fed^{-1}, respectively. Generally, data showed that, the treatments of mineral nitrogen or its combination with cerealine bio-fertilizer or organic compost gave the highest grain yield and other traits. While, the lowest values were obtained from plotsthat did not receive mineral nitrogen fertilization. In this connection Elham (2013) found that application of 100 and 150 Kg ammonium nitrate.fed^{-1}gave the maximum significant effect in all studied growth characters of Quinoa plant. But nitrogen alone decreased significantly all vegetative growth characters except, for plant height, where, the difference was not significant). Previous studies justified the positive effects of nitrogen application, Piccinin *et al.,* (2013) found that, the grain yield of wheat improved when wheat plants were treated with a combination of chemical nitrogen and bio-fertilizer. The Obtained results are in agreement with those obtained by Berhanu*et al.* (2013) and Namvar and Teymur (2013).

With respect to the yield efficiency and harvest index,different fertilizer treatments had insignificant effects(Table 5).The highest protein content was obtained underT4 treatment (50% mineral nitrogen + 50% organic compost) and T7 (50% mineralnitrogen + cerealine bio-fertilizer) with an averages of 11.92 and 11.69 with insignificant difference between the two values. Significant lower values were expressed byT5 (1/3 organic compost + cerealine bio-fertilizer + 1/3 mineralnitrogen) and T2 (Mineral nitrogen) with an averages of 10.54 and 10.18, with insignificant difference, respectively. Moreover, plants treated with cerealine bio-fertilizer or organic compost only showed less protein content than others. These results are in accordance with those reportedby Sary*et al.* (2009) and Abedi*et al.* (2010).Rana*etal.* (2012) obtained an enhancement of 18.6% in protein content with bio-fertilizer inoculation in wheat. It was found that in case of an adequate supply of soil nitrogen, leaf senescence was slower and the plant supply seeds with nitrogen and photo assimilate for longer period, which results in higher protein and grain yield (Azeez, 2009; Abedi*et al.*, 2010).

Data of agronomical characters of barley were presented in Table 6. It No specific trend was observed in those traits in both growing seasons. Asfor heading date, the different treatments have showed similar mean values ranged between 86.67 to 88.67 days in the first season and 87.33 to 89.67 days in the second one. These results are in agreement with those obtained by Salvatore *et al.* (2013).For maturity date, the different treatments have showed similar mean values quite similar ranged from 126 to 127.33 day in the first season. While, in the second study- season (2014-2015) the earliest days to maturity were recorded with average 124.67 day when plant received cerealine bio-Fertilization treatment. While the latest plants was recorded from plots received 50% organic compost + cerealine bio-fertilizer with an average of 128.67 day .Concerning to filling period, values varied between 38- 40 day in the first season and 35.33-40.33 day in the second one.

Table 4: Effects of seasons (S), fertilization treatments(T), and their interactions for yield traits evaluated in the study.

Factors	Number of spike m^{-2}	1000 kernel weight (g)	Biological yield (Ton. fad^{-1})	Grain yield (Ton. fad^{-1})	Straw yield (Ton. fad^{-1})
Seasons (S)					
First	452.38 A	48.20 B	7.64 B	2.46 B	5.55 B
second	436.43 B	51.16 A	8.79 A	2.76 A	6.46 A
L.S.D(0.05)	13.37	1.98	0.40	0.21	0.22
Fertilization treatments (T)					
T_1Cerealine bio-fertilizer	421.67 BC	46.08 C	6.95 D	2.19 D	5.23 D
T_2 (Mineral nitrogen)	461.67 A	52.98 A	9.71 A	3.10 A	7.08 A
T_3 (Organic compost)	464.17 A	49.18 B	7.66 CD	2.43 DC	5.60 CD
T_4 (50% mineral nitrogen + 50% compost)	442.50 AB	50.42 AB	8.45 BC	2.72 B	6.13 BC
T_5 (1/3 organic (compost) + bio fertilizer + 1/3 mineral- N)	450.00 A	49.74 B	8.60 B	2.68 BC	6.34 B
T_6 (50% compost (organic) + bio.fertilizer)	410.00 C	48.55 BC	7.14 D	2.26 D	5.23 D
T_7 (50% mineral nitrogen+ bio. fertilizer)	460.83 A	50.78 AB	8.98 AB	2.85 AB	6.57 AB
L.S.D(0.05)	26.79	3.05	0.81	0.27	0.63
Significant interaction					
S X N	n.s	*	n.s	n.s	n.s

Table 5: Effects of seasons (S), Fertilization treatments (T), and their interactions for Yield Efficiency, Harvest Index and protein content.

Factors	Yield efficiency (%)	Harvest Index (HI) %	Protein content %
Season (S)			
First	47.34	32.45 A	10.16
Second	45.76	31.37 B	9.99
L.S.D(0.05)	ns	0.94	ns
Fertilization treatments (T)			
$_{T1}$Cerealine bio-fertilizer	45.94	31.72	8.16 D
$_{T2}$ (Mineral nitrogen)	47.07	32.06	10.18 B
$_{T3}$ (Organic, compost)	46.58	32.03	9.08 C
$_{T4}$ (50% mineral nitrogen + 50% compost)	47.89	32.38	11.92 A
$_{T5}$ (1/3 organic (compost) + bio. fertilizer + 1/3 mineral- N)	45.48	31.45	10.54 B
T_6 (50% compost (organic) + bio. fertilizer)	46.38	31.85	9.00 C
$_{T7}$ (50% mineral nitrogen + bio. fertilizer)	46.53	31.88	11.69 A
L.S.D(0.05)	ns	ns	0.43
Significant interaction			
S X N	n.s	n.s	n.s

Table 6: Effects of fertilization treatments(T) on agronomical traits of barley during 2013/2014 and 2014/2015 seasons.

Fertilization treatments	days to heading		days to maturity		Filling period (days)		Plant height (cm)		Spike length (cm)	
	First season	second season	First season	second season	First season	second season	First season	second season	First season	second season
$_{T1}$ (cerealine bio-fertilizer)	87.33	87.67	126.33	124.67	39.00	37.00	95.33	96.00	6.67	8.00
$_{T2}$ (Mineral nitrogen)	88.33	88.33	126.67	125.00	38.33	36.67	96.67	97.00	7.67	7.67
$_{T3}$ (Organic compost)	86.67	89.33	126.67	125.33	40.00	36.00	95.67	96.00	6.67	7.67
$_{T4}$ (50% mineral nitrogen+ 50% organic compost)	88.00	89.67	126.00	12.005	38.00	35.33	90.67	92.00	9.67	8.67
$_{T5}$ (1/3 organic compost + cerealine bio-fertilizer + 1/3 mineral nitrogen)	88.67	89.33	126.67	125.33	38.00	36.00	96.33	97.33	6.67	8.00
T_6 (50% compost(organic + cerealine bio-fertilizer)	87.67	88.33	126.33	128.67	38.67	40.33	95.33	96.67	7.67	7.67
TN_7 (50% mineral nitrogen+ cerealine bio-fertilizer)	88.00	87.33	127.33	127.33	39.33	40.00	96.00	96.33	7.00	6.67
L.S.D (0.05)	1.35		1.45		1.92		1.61		1.04	

With respect to plant height, plots receivingonly mineral nitrogen gave the tallest plants with an averages of 96.67 cm in the first season and 97.33cm when plants treated with1/3 organic compost +cerealine bio-fertilizer + 1/3 mineral nitrogen in the second season. On the other hand, application of 50% mineral nitrogen+ 50% organic compost recorded the shortest plants in the two growing seasons with averages of 90.67 and 92cm, respectively. Moreover, the previous treatment (50% mineral nitrogen+ 50% organic compost) gave plants with the longest spikes in two growing seasons with averages of 9.67 and 8.67 cm, respectively.

Yield and its components:

Regarding spike number m^{-2}, data indicated that, the highest values were recorded in the plants treated with Organic nitrogen (compost 10 m^3 fad $^{-1}$) in the first season with an average value of 481.67. Whereas, the combination between 1/3 organic compost + cerealine bio-fertilizer + 1/3 mineral nitrogen treatment recorded the highest value (450) in second season. The lowest spike number.m^{-2} were obtained when cerealine bio-fertilizer applied (T1) with averages of 433.33 and 410 in the two successive seasons. For 1000- grain weight, data indicated that, the highest 1000- grains weight was recorded in plants treated with mineral nitrogen only with averages of 50.63 and 55.33 g in both seasons, respectively. These results were supported by those obtained by Helmy *et al* (2013)who reported that, application of 119 kg N. ha^{-1} and 179 kg N. ha^{-1} increased1000-grain weight by 22.0% and 35.8% in 2011/2012 and18.6% and 30.7% in 2012/2013, respectively. These results showed the positive effect of urea, which stimulates the decomposers of organic matter thereby, releases the nutrients in an available form. Previous studies supported the positive effects of nitrogen application (Shendy et al., 2015, Mohamed and Abdel- Rahman 2015 and Daneshmand *et al.,* 2012) and bio-fertilizer inoculation and Kandil*et al.,* 2011).

The highest values of biological yield, grain and straw yields were obtained from treatmentT_2 (mineral nitrogen) followed by T_7 (50% mineral nitrogen+ cerealine bio-fertilizer) in both seasons, while the lowest values were obtained by applying T_1(cerealine bio-fertilization). Also, data in Table (7) showed that, the highest values were recorded in the mineral nitrogen treatment with an averages of 2.99 and 3.22 ton.$fad^{-1}$for grain yield, 9.18 and 10.24 ton.fad^{-1} for biological yield and 6.63 and 7.52 ton.fed^{-1} for straw yield in the first and second seasons, respectively Table 7. Treatments gave descending order according to their effects on biological and straw yields, T2 (Mineral nitrogen),T7 (50% mineral nitrogen + cerealine bio-fertilization),T5 (1/3 organic compost + cerealine bio-fertilization + 1/3 mineral nitrogen),T4 (50% mineral nitrogen + 50% organic compost,T3 (organic compost),T6 (50% organic compost + cerealine bio-fertilization) and T1 (cerealine bio-fertilization),this trend was found in both growing seasons. The above mentioned results are in harmony with those obtained by Chandrasekar *et al.,* (2005) who reported that both morphological and yield parameters showed a better results through the combination of bio-Fertilizers and chemical fertilizers than using either method alone. They also reported that, the addition of *Azospirillum* with 100% urea, produced the highest yield compared with 100% chemical fertilizer alone. This result could be attributed to the role of nitrogen on barley growth and yield components which in turn reflected on straw and grain yields fad^{-1}. Helmy *et al*. (2013) noticed that the treated Quinoa plants with nitrobin alone induced significant decreases in seed yield/plant in both growing seasons. These results were supported by Filho *et al.,* (2013)whose reported that, *A*. *brasilense* alone was not effective enough to replace the entire nitrogen fertilization but, combination with nitrogen fertilization, made it possible to give the highest yields of wheat grains. Wheat yield and yield components had a strong association with the nitrogen fertilization, bio-fertilizer inoculation. Higher rates of nitrogen fertilization and bio-fertilizer inoculation increased plant height, spike number per unit of area, grains number per spike,1000-grains weight, grain yield, biological yield (Namvar and Teymur, 2013). Nitrogen is known to be an essential nutrient for plant growth and development involved in vital plant functions such as DNA synthesis, photosynthesis, protein formation and respiration (Rana*et al.*, 2012)

Grain yield efficiency and harvest index

The comparisons of the mean values of yield efficiency as affected by mineral, bio and organic nitrogen whether applied separately or in combinations are shown in Table 8. Grain yield efficiency, which is the ratio of grain yield to straw yield at maturity varied between 46.17% to 49.15% in the first growing season and 44.25% -46.9% in second growing season. The treatment50% mineral nitrogen+ 50% organic compost gave the highest yield efficiency (49.15%)in the first season. While, theorganic compost and 50% mineral nitrogen+ 50% organic compost showed the highest yield efficiency (46.9% and 46.62%) for the second season, respectively. Treatment 50% mineralnitrogen + 50% organic compost had the highest ratio of harvest index(33%)in first season, while the value was 31.96% fororganic compostat the second season.These results are in line with the findings of (Abedi et *al.*,2010 and Helmy*et al.*,2013).

Protein content:

Data presented in Table 8 show thatthe highest protein contents were obtained from the treatments T_4 (50% mineral nitrogen + 50% organic compost) followed by T_7 (50% mineral nitrogen + cerealine bio-fertilizer) in both growing seasons. The average values of protein content were 12.36 and 11.86 in the first season,while the values in the second season were 11.47 and 11.52. On the other hand, the lowest protein content was observed in the application of cerealine bio-fertilization only (T_1) with averages of 8.23 and 8.09 in the first and second seasons, respectively. Organic compost material and cerealine bio-fertilizer in combination with mineral nitrogen fertilization showed highest protein content.Similar results were obtained

byMabrouk (2002)who found that bio-mineral and organic-mineral fertilization treatmentshad a positive effect in increasing protein content. The effect of combination of compost and chemical fertilizers on seed protein was positive, because of more nutrients availability.As the level of nitrogen supply increases, the extra protein produced allows the plant leaves to grow larger and consequent increase in photosynthesis; so the increase in nitrogen fertilization level led to an increase in metabolic processes and physiological activities needed for further formation of plant organs, more dry matter accumulation, which ultimately increases the amount of protein in grain. These results are in accordance with the reports of Khan *et al*., (2007), Sary*et al*., (2009),Abedi*et al*., (2010) and Rana*et al*., (2012).

Table 7: Effects of fertilization treatments (T) on yield and yield components traits of barley during 2013/2014 and 2014/2015 seasons.

Fertilization treatments	Number of spike.m^{-2}		1000 kernel weight (g)		Biological yield (Ton. fad^{-1})		Grain yield (Ton. fad^{-1})		Straw yield (Ton. fad^{-1})	
	First season	second season	First season	second season	First season	second season	First season	second season	First season	second season
T_1 (cerealine bio-fertilizer)	433.33	410	48.53	43.63	6.66	7.45	2.11	2.26	4.87	5.34
T_2 (Mineral nitrogen)	475.00	448.33	50.63	55.33	9.18	10.24	2.99	3.22	6.63	7.52
T_3 (Organic compost)	481.67	446.67	47.53	50.83	7.14	8.18	2.26	2.61	5.23	5.96
T_4 (50% mineral nitrogen + 50% organic compost)	448.33	436.67	48.00	52.83	7.75	9.15	2.55	2.89	5.57	6.70
T_5 (1/3 organic compost) + cerealine bio-fertilizer + 1/3 mineral- N)	450.00	450.00	48.40	51.07	7.87	9.33	2.50	2.86	5.75	6.93
T_6 (50% organic compost + cerealine bio-fertilizer)	398.33	421.67	45.03	52.06	6.72	7.56	2.16	2.36	4.89	5.57
T_7 (50% mineral nitrogen + cerealine bio-fertilizer)	480.00	441.67	49.23	52.33	8.17	9.80	2.62	3.08	5.94	7.20
L.S.D (0.05)	37.81		4.30		1.15		0.38		0.88	

Table 8: Effects offertilization treatments (T) on yield Efficiency%, harvest Index % and protein content%of barley during 2013/2014 and 2014/2015 seasons.

Fertilization treatments	Yield efficiency (%)		Harvest Index (HI) %		Protein content %	
	First season	second season	First season	second season	First season	second season
T_1 (cerealine bio-.fertilizer)	46.55	45.32	32.2	31.20	8.23	8.09
T_2 (Mineral nitrogen)	48.26	45.89	32.7	31.43	10.26	10.09
T_3 (Organic compost)	46.17	46.99	32.01	31.96	8.98	9.18
T_4 (50% mineral nitrogen+ 50% organic compost)	49.15	46.62	33.00	31.73	12.36	11.47
T_5 (1/3 organic compost) + cerealine bio- fertilizer + 1/3 mineral nitrogen)	46.71	44.25	32.20	30.66	10.39	10.68
T_6 (50% organic compost) + cerealine bio-fertilizer)	47.28	45.49	32.46	31.23	9.06	8.94
T_7 (50% mineral nitrogen + cerealine bio- fertilizer)	47.27	45.79	32.40	31.36	11.86	11.52
L.S.D (0.05)	4.24		0.18		0.60	

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الملخص العربي

تأثر إنتاجية محصول الشعير ومحتواه من البروتين بمعاملات التسميد تحت ظروف الأراضي الجيرية

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أُجريت تجربتان حقليتان بمحطة بحوث النوبارية بشمال التحرير خـلال موسـمى ٢٠١٣-٢٠١٤ و ٢٠١٤-٢٠١٥. نفذت التجارب كقطاعات كاملة العشوائية بثلاث مكررات.

المعاملات المدروسة شملت: (T1) سماد حيوي سيريالين، (T2) أزوت معدني ٤٥ وحده للفـدان، (T3) سـماد عضوي ١٠ م^{٣} للفدان، (T4) ٥٠% سماد معدني + ٥٠% سماد عضوى، (T5) ٣/١ كمية السماد العضوي+ السماد الحيوي، (T6) ٣/١ السماد المعدني + ٢/١ السماد العضوي، (T7) ٥٠% سماد معدني + السماد الحيـوي. تـأثرت جميع الصفات المدروسة (عدد الأيام حتى طرد السنابل، عدد الايام حتى النضج، فترة امـتلاء الحبـوب، ارتفـاع النبات، عدد السنابل فى المتر المربع، طول السنبلة، محصول الحبوب، المحصول البيولوجي، محصول القش، وزن ١٠٠٠ حبة، والمحتوى من البروتين) معنوياً بمعاملات التسميد فيما عدا معامل الحصاد و وكفاءة المحصول.

كما اظهرت النتائج أن المعاملة (T1)، (التسميد المعدني) والمعاملة (T7) (٥٠% من التسميد المعدني + السماد الحيوي) اعطت أعلى قيم لمحصول الحبوب والمحصول البيولوجي ومحصول القش، بينما نتج عن المعاملات (T4) (٥٠% من السماد المعدنى + ٥٠% من السماد العضوى) والمعاملة (T7) (٥٠% من الـسماد المعـدني + الـسماد الحيوي) أعلى قيم من محتوى البروتين.