# EFFECT OF BIOFERTILIZER AND MINERAL NITROGEN LEVELS ON YIELD AND YIELD COMPONENTS OF TRITICALE

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## Abstract

Tow field experiments were carried out at Experimental Farm, Faculty of Agricultural, Omer AL-Mukhtar University, EL-Baida, Libya during 2011/2012 and 2012/2013 seasons to study the effect of biofertilizer treatments in four levels (Control, Phosphorin (P), Cerialin (C), Mixture (P+C)) and three levels of mineral nitrogen fertilizer (80, 100 and 120 kg N/ha) and their interactions on yield and yield components of triticale. A Split plot design in three replications was applied. The obtained results can be summarized as follows:

Plant height (in both seasons) and chlorophyll content (in 2011/2012 season), grain no./spike, 1000-grain weight and grain weight/spike (in both seasons) were significantly increased under biofertilizer treatments compared with control treatment. The use of Cerialin mixed with phosphorene gave the highest values of them compared with other treatments, and also the highest value of spike length, grain and biological yields (t/ha) of triticale (in both seasons) and spike weight (in the first season) was obtained under Cerialin alone or mixed with phosphorene treatment.

Increasing nitrogen levels lead to highly significant and significant increase in plant height in the first and second seasons. The highly significant differences were observed with chlorophyll a and chlorophyll b content (mg/ds) of triticale plant in 2011/2012 season. Also, data showed that highly significant differences existed among the nitrogen levels on spike length and weight (in 2011/2012 and 2012/2013 seasons) and significant differences on spike length and spikelets number/spike (in 2011/2012 season), as well as grains number/spike, grain weight/spike, protein content (%) (in 2012/2013 season) and 1000-grain weight, grain and biological yields (t/ha) of triticale (in both seasons). The level of 120 kg N/ha gave the highest values without significant differences when using 100 kg N/ha for some traits.

The interaction effect between biofertilizer and nitrogen levels was significant on spike weight, number of grains/spike and grain weight/spike (in 2012/2013 season) and biological yield of triticale (in both seasons). The highest values were recorded when using mixture of phosphorene and Cerialin treatment at the rate of 120 Kg N/ha.

## INTRODUCTION

The improving productivity and yield quality of triticale as a new crop in Libya can be achieved by using modern technique as

application of biofertilizer to save the amount of chemical nutrients. The beneficial effects of inoculation grains with biofertilizer on yield and yield components of wheat and triticale were confirmed by many workers (Kotb (1998), Sharshar *et al*. (2000), Megahed and Mohamed (2001), El-Kalla, *et al.* (2002), Basha, (2004), Ibrahim, *et al.* (2004) and Hafez, (2007). Also, many researchers reported that the inoculation with biofertilizers can save 25% of nitrogen and 50% of phosphorus fertilizer, as well as increased grain yield by inoculation and its decreased environmental pollution that cause many hazards to human health (Omar *et al*., 1991, Mitkees *et al*., 1996, Badawy *et al*., 1998 and Kotb, 1998)).

Suitable level of nitrogen fertilizer as essential element for growth and yield of plants and the promotive effective of nitrogen on yield and its component of triticale was reported by Grabinski, (1994), Ewert and Honermeier (1999), Alaru *et al.*, (2001a and b), Jaskiewicz, (2001), Jaskiewicz, (2002), Maecka, (2002), Soares and Restle, (2002), Lisova and Greimas, (2005), Mut *et al*., (2005), Shah *et al*. (2005), Yoshihira *et al*., (2006), Nance *et al*, (2007) and Janusauskaite, (2008). Grassi *et al.*, (2001) reported that nitrogen fertilizer application had positive, statistical and significant response effect for seeds per spike and seed weight. Maecka *et al*. (2004) found that the aboveground biomass, grain and protein yield significantly increased with an increase in N fertilizer rate. Mut *et al*., (2005). Voica *et al*., (2006) reported that grain yield of triticale genotypes was significantly influenced by nitrogen rate under optimum fertilizer application. A big and heavy grains, grain weight per ear and the highest grain yield were obtained when triticale was supplied with 90 kg N+80 kg P/ha. Saeid, (2013) evaluate the effects of varying nitrogen levels (0, 60, 120 and 180 kg/ha) on the yield and quality of triticale (x Triticosecale). They found that increasing nitrogen application increased grain yield, plant height, number of ears per $m^2$, number of kernels per ear, thousand grain weight, test weight and grain protein content.

The present study amid to evaluate the response of triticale (*Triticosecale* Wittmack)) cv. Bahteim to inoculation with cerialin and / or phosphorine under three levels of nitrogen.

## MATERIALS AND METHODS

Tow field experiments were carried out at the Experimental Farm, Faculty of Agricultural, Omer AL-Mukhtar University, EL-Baida, Libya during 2011/2012 and 2012/2013 seasons to study the effect of biofertilizer, nitrogen levels and their interactions on yield and yield components of triticale (*Tritico secale* Wittmack)) cv. Bahteim.

The mechanical and chemical analysis of soil samples taken to 30 cm depth in the experimental sits in the two seasons are given in Table (1). The micro–Kjeldahl method was used to determine the total nitrogen in the soil samples according to A.O.A.C. (1980). The procedure of soil analysis followed the methods of Olsen and Watanabe (1965) to determined available P and according to Hesse (1971) method to determined available K.

Table (1): The mechanical and chemical analysis of the experimental soil during 2011/2012 and 2012/2013 seasons

| Variable | Season | |
|---|---|---|
| | 2011/2012 | 2012/2013 |
| **Mechanical analysis** | | |
| Fine sand | 18 | 16 |
| Silt | 35 | 36 |
| Clay | 47 | 48 |
| Soil texture class | clay | clay |
| **Chemical analysis** | | |
| Soil reaction (pH) | 7.9 | 7.8 |
| Available N ppm | 30 | 31 |
| Available P ppm | 18 | 19 |
| Available K ppm | 261 | 232 |

The experiments were conducted using split plot design in three replications. The main plots were allocated with the four biofertilizer levels as fallow: - 1- Control, 2- Phosphorin (P), 3- Cerialin (C) and 4- Mixture (P+C). While, the sub-plots were occupied the three levels of nitrogen i.e. $N_1$ = 80 kg N $ha^{-1}$, $N_2$ = 100 kg N $ha^{-1}$ and $N_3$ =120 kg N $ha^{-1}$. The biofertilizers used in this study produced by the General Organization for Agricultural Equalization Fund, Ministry of Agriculture, Egypt. It consists of mixture of $N_2$-fixing bacteria and dissolving phosphate bacteria e.g., *Azospirillium*, *Azotobacter* and *Bacillus*. The biofertilizers at rate of 1kg/ha were added and mixed carefully with triticale grains before sowing according to treatments under study.

The area of sub-plot was 10.5 $m^2$ (3m width and 3.5 m length), each plot contains 20 rows with 15 cm apart. The sowing was done on 11$^{st}$ November in the first season and 2$^{nd}$ December in the second season. The seeding rate was 120 kg/ha in both seasons. Three nitrogen fertilizer levels (80, 100, 120 kg N/ha.) in the form of urea (46% N) were applied in two equal doses at tillering and before heading stages. The ordinary agricultural practices were applied during the growing seasons.

At 100 days from sowing, plant height was measured in cm. Also, photosynthetic pigments content i. e. chlorophyll a and

chlorophyll b content (mg/dsm) of triticale plants were determined in the flag leaves according to Wettestein (1957).

At harvest, from each sub plot 20 spikes were taken at random to determine the following characters: spike length (cm), spike weight (g), spikelets number/spike, grain number/spike, grain weight/spike (g) and 1000-grain weight (g). Also, from each sub plot the sixteen middle rows were harvested to determine grain and biological yields (t/ha). The micro–Kjeldahl method was used to determine the total nitrogen in the grains and multiplied by 6.25 to obtain the percentage of grain protein according to A.O.A.C. (1980).

All data collected were subjected to statistical analysis of variance as described by **Gomez and Gomez (1984)**. All statistical analysis was performed using analysis of variance technique by means of **Freed *et al.* (1989)** "MSTAT-C" computer software package. Significance was determined at $p<0.05$ and means were separated using least significant difference ($LSD_{0.05}$).

## RESLUTS AND DISCUSSION

### Plant height and chlorophyll content

The data concerning plant height, chlorophyll a and chlorophyll b content (mg/ds) of triticale plant are given in Table (2). Plant height (in 2011/2012 and 2012/2013 seasons) and chlorophyll content (in the 1$^{st}$ season) were significantly increased under biofertilizer treatments compared with the control treatment. The use of Cerialin mixed with phosphorene gave the highest values (76.13 and 77.73 cm) in plant height as well as chlorophyll a (0.485 mg/dsm) and chlorophyll b (0.761 mg/dsm) in 2011/2012 and 2012/2013 seasons, respectively as well as in 2011/2012 season compared with other treatments. The lowest values of plant height and chlorophyll content were obtained with control treatment in both seasons. The increase in plant height caused by treated plants by mixed from Cerialin and phosphorene may be due to increasing cell elongation and division which led to raising plant height. Also, it had the increase in chlorophyll a and b concentration. These results in harmony with those of **El-Kalla, *et al.* (2002), Basha, (2004) Ibrahim, *et al.* (2004), Tawfik and Gomaa (2005) and Hafez, (2007)** in wheat.

The results in Table (2) indicated that higher applied nitrogen lead to highly significant and significant increase in plant height in the first and second seasons, respectively. The tallest plants were recorded y applied nitrogen at the rate of 120 kg N $ha^{-1}$ in the both seasons. The highly significant differences were observed with chlorophyll a and chlorophyll b content (mg/dsm) of triticale plant in 2011/2012 season. As it is well known that the nitrogen nutrient is critical element for triticale crop. Thereby, increasing nitrogen fertilizer

might be promoted cell elongation and division resulting in long plants. Similar results were obtained by **Ewert and Honermeier (1999), Lisova and Greimas, (2005, ), Mut *et al*., (2005), Shah *et al*. (2005) and Saeid, (2013).**

Table (2): Effect of biofertilization, nitrogen levels and their interaction on plant height, chlorophyll a and chlorophyll b content of triticale in 2011/2012 and 2012/2013 seasons

| Treatment | | Plant height (cm) | | Chlorophyll a (mg/dsm) | | chlorophyll b (mg/dsm) | |
|---|---|---|---|---|---|---|---|
| | | 2011/2012 | 2012/2013 | 2011/2012 | 2012/2013 | 2011/2012 | 2012/2013 |
| Biofertilization | **Control** | 68.81 | 69.80 | 0.255 | 0.401 | 0.251 | 0.465 |
| | **Phosphorin (P)** | 76.07 | 76.73 | 0.266 | 0.515 | 0.498 | 0.566 |
| | **Cerialin (C)** | 72.92 | 73.87 | 0.445 | 0.647 | 0.610 | 0.529 |
| | **Mixture (P+C)** | 76. 13 | 77.73 | 0.485 | 0.525 | 0.761 | 0.642 |
| | **Sig** | * | ** | * | NS | ** | NS |
| | **L.S.D 0.05** | **6.10** | **4.90** | **0.058** | **-** | **0.046** | **-** |
| Kg N/ha | **80** | 64.10 | 69.40 | 0.253 | 0.478 | 0.495 | 0.520 |
| | **100** | 76.15 | 74.35 | 0.418 | 0.497 | 0.512 | 0.516 |
| | **120** | 80.12 | 79.85 | 0.419 | 0.583 | 0.584 | 0.615 |
| | **Sig** | ** | * | ** | NS | ** | NS |
| | **L.S.D 0.05** | **4.68** | **4.47** | **0.046** | **-** | **0.024** | - |
| | **Interaction** | NS | NS | NS | NS | NS | NS |

N.S. and *,** : Not significant and significant differences at 0.05 and 0.01 levels of probability.

The effect of the interaction between biofertilization and nitrogen levels on plant height, chlorophyll a and chlorophyll b content of triticale was not significant in both seasons (Table 2).

**Spike length, spike weight and spikelets number/spike**

The mean values of spike length, spike weight and spikelets number/spike of triticale as affected by biofertilization, nitrogen levels and their interactions in 2011/2012 and 2012/2013 seasons are presented in Table 3. Data in Table 3 indicated that highly significant and significant differences existed among the biofertilization treatments on spike weight in the first and second seasons, respectively and significantly affected spike length in 2011/2012 season only. The highest value of spike length (9.51 cm) in 2011/2012 season) and spike weight (2.63 and 2.90 g) were found with cerialin and mixed from cerialin and phosphorene in the first and second seasons, respectively. While, the lowest value was obtained at control treatment. Similar findings were found by **El-Kalla, *et al.* (2002), Basha, (2004) Ibrahim, *et al.* (2004) and Hafez, (2007)** in wheat. On the other hand, spikelets number/spike was not affected significantly due to biofertilizer treatments in both seasons (Table 3).

Table (3): Effect of biofertilization, nitrogen levels and their interaction on spike length, spike weight and spiklets no./spike of triticale in 2011/2012 and 2012/2013 seasons

| Treatment | | Spike length (cm) | | Spike weight (g) | | Spiklets no./spike | |
|---|---|---|---|---|---|---|---|
| | | 2011/2012 | 2012/2013 | 2011/2012 | 2012/2013 | 2011/2012 | 2012/2013 |
| Biofertilization | **Control** | 7.53 | 7.90 | 1.64 | 1.99 | 19.47 | 21.20 |
| | **Phosphorin (P)** | 8.23 | 8.10 | 2.52 | 2.59 | 21.87 | 21.60 |
| | **Cerialin (C)** | 8.63 | 8.27 | 2.63 | 2.49 | 22.13 | 22.13 |
| | **Mix. (P+C)** | 9.51 | 8.13 | 2.28 | 2.90 | 22.13 | 22.27 |
| | **Sig** | * | N.S. | ** | * | N.S. | N.S. |
| | **L.S.D 0.05** | 1.36 | - | 0.42 | 0.53 | - | - |
| Kg N/ha | **80** | 7.50 | 7.72 | 2.25 | 2.27 | 18.10 | 20.60 |
| | **100** | 8.40 | 8.12 | 2.30 | 2.41 | 21.60 | 22.00 |
| | **120** | 9.53 | 8.45 | 2.74 | 2.79 | 24.30 | 22.80 |
| | **Sig** | ** | N.S. | * | ** | * | N.S. |
| | **L.S.D 0.05** | 0.90 | - | 0.36 | 0.21 | 2.76 | - |
| | **Interaction** | N.S. | N.S. | N.S. | * | N.S. | N.S. |

N.S. and *,** : Not significant and significant differences at 0.05 and 0.01 levels of probability.

Data showed that highly significant differences existed among the nitrogen levels on spike length and weight (in 2011/2012 and 2012/2013 seasons) and significant differences on spike length and spikelets number/spike (2011/2012 season). Increasing nitrogen levels caused significant increases in spike length and weight and spikelets number/spike of triticale plants. The highest values were recorded at 120 kg N $ha^{-1}$. The nitrogen application distinctly improved triticale growth resulted in promoting cell elongation leading to tallest spike. Similar findings were obtained by **Ewert and Honermeier (1999)** and **Lisova and Greimas (2005)** in spike length and **Grassi *et al.*, (2001)** and **Saeid (2013)** in spike weight**.**

The effect of the interaction between biofertilizers and nitrogen levels on spike length and spikelets number/spike of triticale didn't exert any significant effect in both seasons (Table 3). That indicates the fact that each factor effected these traits independently.

While, the effect of the interaction between biofertilizers and nitrogen levels on spike weight of triticale was significant in 2012/2013 season (Tables 3 and 4). The heaviest spike (3.26 g) was recorded when using mixture of phosphorene and Cerialin treatment under the addition of 120 Kg N/ha. On the other hand, the lightest spike was registered when applied nitrogen at 80 Kg/ha without biofertilization treatment.

Table (4): Effect of interaction between biofertilization and nitrogen levels on spike weight (g) of triticale in 2012/2013 season

| Treatment | | Nitrogen levels (Kg N/ha) | | |
|---|---|---|---|---|
| | | 80 | 100 | 120 |
| Biofertilizers | Control | 1.89 | 1.95 | 2.12 |
| | Phosphorin (P) | 2.39 | 2.52 | 2.85 |
| | Cerialin (C) | 2.04 | 2.50 | 2.92 |
| | Mix. (P+C) | 2.77 | 2.68 | 3.26 |
| L.S.D $_{0.05}$ | | 0.46 | | |

## Grain no./spike, 1000-grain weight and grain weight/spike

Data presented in Table (5) showed that there were significant differences among biofertilizer treatments in grains number/spike, 1000-grain weight and grain weight/spike in both seasons. Mixture of phosphorene and cerialin treatment produced the highest values of these traits followed by cerialin and phosphorene separately. These increases might be attributed to increasing chlorophyll content in plant leaves caused increasing net assimilation rate translocated and stored in spike, thus increased yield components. Similar results in wheat of grains number/spike are obtained by **Kotb (1998), El-Kalla, *et al.* (2002), Basha, (2004) Ibrahim, *et al.* (2004) and Hafez, (2007).** For 1000 grains weight **Sharshar *et al*. (2000), Megahed and Mohamed (2001),** came the same results.

Data in table (5) showed that the effect of nitrogen levels had a significant difference in grains number/spike, grain weight/spike (in 2012/2013 season) and 1000-grain weight (in both seasons). The level 120kg N/ha gave the highest values of these characters. These results are in accordance with those obtained by **Alaru *et al.*, (2001a and b), Grassi *et al.*, (2001), Jaskiewicz, (2002), Lisova and Greimas, (2005) Mut *et al*., (2005), Shah *et al*., (2005), Voica *et al*., (2006), Janusauskaite, (2008)** and **Saeid, (2013).**

Table (5): Effect of biofertilization, nitrogen levels and their interaction on grains number/spike, 1000-grain weight and grain weight/spike of triticale in 2011/2012 and 2012/2013 seasons

| Treatment | | Grains no./spike | | 1000-grain weight (g) | | Grain weight/spike (g) | |
|---|---|---|---|---|---|---|---|
| | | 2011/2012 | 2012/2013 | 2011/2012 | 2012/2013 | 2011/2012 | 2012/2013 |
| Biofertilization | Control | 33.40 | 33.41 | 37.73 | 39.13 | 1.17 | 1.30 |
| | Phosphorin (P) | 37.47 | 38.53 | 39.98 | 40.54 | 1.53 | 1.66 |
| | Cerialin (C) | 45.70 | 43.87 | 41.90 | 41.44 | 1.77 | 1.67 |
| | Mix. (P+C) | 49.73 | 49.00 | 42.72 | 42.10 | 1.87 | 1.95 |
| | Sig | * | * | ** | * | * | * |
| | L.S.D 0.05 | **4.16** | **2.51** | **0.98** | **1.68** | **0.25** | **0.24** |
| Kg N/ha | 80 | 38.75 | 39.10 | 39.82 | 40.38 | 1.47 | 1.38 |
| | 100 | 42.40 | 40.10 | 40.31 | 40.56 | 1.58 | 1.65 |
| | 120 | 43.10 | 44.10 | 41.62 | 41.38 | 171 | 1.91 |
| | Sig | N.S. | * | * | * | N.S. | * |
| | L.S.D 0.05 | **2.59** | **2.86** | **096** | **0.79** | **-** | **0.21** |
| | Interaction | N.S. | * | N.S. | N.S. | N.S. | * |

N.S. and *,** : Not significant and significant differences at 0.05 and 0.01 levels of probability.

With respect to the interaction effect, the interaction between biofertilizer treatments and nitrogen levels had significant effect on number of grains/spike and grain weight/spike in 2012/2013 season (Tables 5 and 6). The best combination was mixture of phosphorene and Cerialin treatment with higher levels of nitrogen (120 kg/ha) which produced the highest values of grain number /spike (57.60) and grain eight /spike (2.46 g) compared to all other these interaction treatments.

Table (6): Effect of interaction between biofertilizers and nitrogen levels on spike weight and grain no./spike of triticale in 2012/2013 season

| Treatment | | Grain no./spike | | | Grain weight/spike (g) | | |
|---|---|---|---|---|---|---|---|
| | | Nitrogen levels (Kg N/ha) | | | Nitrogen levels (Kg N/ha) | | |
| | | 80 | 100 | 120 | 80 | 100 | 120 |
| Biofertilization | Control | 33.60 | 32.40 | 34.20 | 1.22 | 1.30 | 1.38 |
| | Phosphorin (P) | 37.20 | 38.80 | 39.60 | 1.48 | 1.63 | 1.87 |
| | Cerialin (C) | 41.80 | 44.80 | 45.00 | 1.24 | 1.84 | 1.92 |
| | Mix. (P+C) | 43.80 | 45.60 | 57.60 | 1.57 | 1.81 | 2.46 |
| L.S.D 0.05 | | 5.18 | | | 0.41 | | |

**Protein content (%)**

Data in Table (7) showed that on protein content (%) was insignificantly different among biofertilization treatments in 2012 and 2013 seasons.

Regarding, the effect of nitrogen levels on protein content (%), data in table 7 showed that the application of nitrogen had significant impact on protein content (%) in 2013 season. Increasing nitrogen levels up to 120 kg N/ha consistently promoted and increased protein content. The highest value of protein content was produced when the highest nitrogen level of 120 kg N/ha was applied. These results are in harmony with that obtained by **Alaru *et al.*, (2001c), Reddy *et al*. (2003), Maecka *et al*. (2004), Mut *et al*., (2005), Seiling *et al.* (2005)**, **Mahmoud *et al.* (2006), Voica *et al*., (2006)** and **Soliman (2009).**

The effect of the interaction between biofertilization treatments and nitrogen levels on protein content (%) was not significant in 2012 and 2013 seasons (Table 7).

Table (7): Effect of biofertilizers, nitrogen levels and their interaction on protein content (%) of triticale in 2011/2012 and 2012/2013 seasons

| Treatment | | Protein content (%) | |
|---|---|---|---|
| | | 2011/2012 | 2012/2013 |
| Biofertilization | **Control** | 12.33 | 12.23 |
| | **Phosphorin (P)** | 12.55 | 12.35 |
| | **Cerialin (C)** | 12.78 | 12.43 |
| | **Mix. (P+C)** | 12.79 | 12.59 |
| | **Sig** | N.S. | N.S. |
| Kg N/ha | **80** | 12.57 | 12.06 |
| | **100** | 12.57 | 12.41 |
| | **120** | 12.70 | 12.74 |
| | **Sig** | N.S. | * |
| | **L.S.D 0.05** | - | 0.30 |
| | **Interaction** | N.S. | N.S. |

N.S. and *: Not significant and significant differences at 0.05 level of probability.

## Grain and biological yields

The mean values of grain and biological yields (t/ha) of triticale as affected by biofertilizers, nitrogen levels and their interaction during 2011/2012 and 2012/2013 seasons are presented in Tables 8 and 9. The results showed that significant differences were existed between the biofertilizers treatments on grain yield in both seasons and on biological yield which was highly significant and significant differences in 2011/2012 and 2012/2013 seasons, respectively.

The results indicate that biofertilizer treatments had positive effect on grain and biological yields (t/ha) and caused significantly increased of them compared with control treatment. The highest value of grain (2.18 and 2.21 t/ha) and biological yields (4.66 and 4.65 t/ha) in the 1$^{st}$ and 2$^{nd}$ season, respectively was obtained under using mixture of phosphorene and cerialin treatment followed by cerialin alone (Table 8). While, the lowest value of these traits was obtained under control treatment in both seasons. These may be due to increasing the most studied yield attributes such as spike length, spike weight and spikelets number/spike, grains number/spike, 1000-grain weight and grain weight/spike which reflected on final dry matter accumulation per grain and biological yields. The present results are in similarity with those claimed by Hafez (2007) in wheat who reported that the active role in nitrogen fixation bacteria and increasing the endogenous phytohormones e.g. IAA, GAS and CKS which play an important roles of formation for big active root system and hence increasing the nutrients uptake, photosynthesis rate and translocation as well as accumulation within different plant parts. Many investigators

came to similar results **(Omar *et al*., 1991, Mitkees *et al*., 1996, Badawy *et al*., 1998, Sharshar *et al*. (2000), El-Kalla, *et al.* (2002), Basha, (2004) Ibrahim, *et al.* (2004) and Lisova and Greimas, (2005)**.

On the other hand, increasing nitrogen levels led to significant increase in grain and biological yields (t/ha) in both seasons (Table 8). The highest grain (1.73 and 1.80 t/ha) and biological yields (3.89 and 4.15 t/ha in the 1st and 2nd season, respectively) was obtained by added nitrogen fertilizer at the rate of 120 kg N/ha. It could be attributed to sufficient source and great sink (spike length, spike weight and spikelets number/spike, grains number/spike, 1000-grain weight and grain weight/spike) of triticale, consequently reflected on high grain and biological yields. Similar trend in increase grain and biological yields due to nitrogen fertilization was reported by **Grabinski, (1994), Grassi *et al.*, (2001)**, **Maecka, (2002), Soares and Restle, (2002), Jaskiewicz, (2001), Jaskiewicz, (2002), Jaskiewicz, (2004), Maecka *et al*. (2004), Mut *et al*., (2005), Shah *et al.* (2005), Voica *et al*., (2006), Yoshihira *et al*., (2006), Nance *et al*, (2007).**

Data showed also that there was no significant effect due to the interaction between the studied factors regarding to grain yield in both seasons (Table 8). While the biological yield was significantly affected by interaction between biofertilizer treatments and nitrogen levels. The highest values of biological yield were 5.54 and 5.41 t/ha in 2011/2012 and 2012/2013 seasons, respectively, were produced when the highest nitrogen level of 120 kg N/ha, was applied with using mixture of phosphorene and Cerialin treatment (Table 9). On the contrary, the lowest values of biological yield were obtained under 80 kg N/ha without application of biofertilizer in 2011/2012 and 2012/2013 seasons.

Table (8): Effect of biofertilization, nitrogen levels and their interaction on protein content (%), grain yield and biological yield of triticale in 2011/2012 and 2012/2013 seasons

| Treatment | | Grain yield (ton/ha) | | Biological yield (ton/ha) | |
|---|---|---|---|---|---|
| | | 2011/2012 | 2012/2013 | 2011/2012 | 2012/2013 |
| Biofertilization | **Control** | 0.861 | 0.923 | 2.03 | 2.10 |
| | **Phosphorin (P)** | 1.49 | 1.54 | 3.72 | 3.37 |
| | **Cerialin (C)** | 1.72 | 1.56 | 3.92 | 3.50 |
| | **Mix. (P+C)** | 2.21 | 2.18 | 4.65 | 4.66 |
| | **Sig** | * | * | ** | * |
| | **L.S.D 0.05** | **0.17** | **0.20** | **0.58** | **0.44** |
| Kg N/ha | **80** | 1.15 | 1.29 | 2.59 | 2.66 |
| | **100** | 1.76 | 1.63 | 4.00 | 3.70 |
| | **120** | 1.80 | 1.73 | 4.15 | 3.89 |
| | **Sig** | ** | * | * | * |
| | **L.S.D 0.05** | **0.22** | **0.17** | **0.45** | **0.33** |
| | **Interaction** | N.S. | N.S. | * | * |

N.S. and *, ** : Not significant and significant differences at 0.05 and 0.01 levels of probability.

Generally, it could be recommended that treated seeds of triticale with biofertilizers mixed from phosphorene and cerialin as well as fertilized with nitrogen fertilizer at the rate of 120 kg N/ha improved grain and biological yield of triticale under El-Baida condition, Libya.

Table (9): Effect of interaction between biofertilization and nitrogen levels on biological yield (ton/ha) of triticale in 2011/2012 and 2012/2013 seasons

| Treatment | | 2011/2012 | | | 2012/2013 | | |
|---|---|---|---|---|---|---|---|
| | | Kg N/ha | | | Kg N/ha | | |
| | | 80 | 100 | 120 | 80 | 100 | 120 |
| Biofertilization | Control | 1.89 | 1.69 | 2.51 | 1.90 | 2.04 | 2.36 |
| | Phosphorin (P) | 2.86 | 5.11 | 3.79 | 2.99 | 3.14 | 3.99 |
| | Cerialin (C) | 2.28 | 4.71 | 4.16 | 2.46 | 4.33 | 3.71 |
| | Mix. (P+H) | 3.31 | 5.10 | 5.54 | 3.29 | 5.28 | 5.41 |
| L.S.D 0.05 | | 0.88 | | | 0.56 | | |

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**الملخص العربى**

## تأثير التسميد الحيوى ومستويات التسميد النتروجيني المعدنى على المحصول ومكوناته فى الترتيكال

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**قسم المحاصيل – كلية الزراعة – جامعة عمر المختار – ليبيا**

اجري هذا البحث بمزرعة كلية الزراعة جامعة عمر المختار ، البيضاء ، ليبيا موسمي 2012/2011 و 2013/2012. يهدف هذا البحث الى دراسة تأثير اربعة معاملات من التسميد الحيوي (مقارنه ، المعامله بالفوسفورين ، المعامله بالسريالين ومعاملة مخلوط الفوسفورين مع السريالين) وثلاثة مستويات من التسميد النتروجينى (80 ، 100 و 120 كجم/هـ) والتفاعل بينهما على المحصول ومكوناته فى التريتيكال. استخدم تصميم القطع المنشقه مرة واحده فى ثلاث مكررات لتنفيذ التجربه حيث وزعت معاملات التسميد الحيوى فى القطع الرئيسيه ومستويات التسميد النتروجينى فى القطع المنشقه. ويمكن تلخيص اهم النتائج المتحصل عليها فيما يلى:

اظهرت النتائج انه قد اثر التسميد الحيوى معنويا على ارتفاع نبات الترتيكال (فى كلا الموسمين) ومحتوى ورقة العلم من الكلوروفيل (موسم 2012/2011) ، عدد الحبوب/سنبلة ، وزن 1000 حبة ، وزن حبوب السنبله (فى كلا الموسمين) وقد زادت هذه الصفات نتيجة معاملات التسميد الحيوى مقارنة بالكنترول واعطى التسميد الحيوى بمخلوط الفوسفورين مع السريالين اعلى القيم مقارنة بباقى المعاملات. كما اعطت معاملة المخلوط ايضا اعلى القيم معنويا لكل من صفات طول السنبلة ، محصول الحبوب النهائى والمحصول البيولوجى لكلا الموسمين ووزن السنبلة فى الموسم الاول. كان لاختلاف مستوى التسميد النتروجينى تأثيرا عالى المعنويه ومعنويا على صفة ارتفاع النبات فى الموسم الاول والثانى على الترتيب كما كان هذا التأثير عالى المعنويه على محتوى الاوراق من كلوروفيل a , b فى الموسم الاول فقط. كما اظهرت النتائج ايضا تأثيرا عالى المعنويه لاختلاف مستوى التسميد النتروجينى على صفات طول ووزن السنبلة فى الموسمين وتأثرا معنويا على صفات طول وعدد سنيبلات السنبله فى الموسم الاول ، وكذلك عدد ووزن حبوب السنبله والنسبه المئوية للبروتن بالحبوب فى الموسم الثانى ووزن الالف حبه ومحصول الحبوب الكلى والمحصول البيولوجى فى كلا الموسمين. اعطى التسميد بمعدل 120 كجم نتروجين للهكتار اعلى القيم لهذه الصفات وبدون فروق معنويه عن التسميد بمعدل 100كج ن/هـ لبعص الصفات.

أثر التفاعل بين التسميد الحيوي ومستويات التسميد النتروجينى تأثيرا معنويا على صفات وزن السنبله ، عدد ووزن حبوب السنبله موسم 2013/2012 والمحصول البيولوجى لكلا الموسمين. اعطى التسميد الحيوى بمخلوط السريالين والفوسفورين عند التسميد بمعدل 100 او 120 كجم نتروجين للهكتار اعلى القيم لهذه الصفات وبدون فروق معنويه بين المعدلين من التسميد المعدنى.

توصى الدراسة بتسميد نبات الترتيكال بمخلوط من السماد الحيوى فوسفورين مع سريالين واضافة السماد النتروجينى بمعدل 120 كجم ن/هـ والذى ادى الى زيادة محصول الحبوب والمحصول البيولوجى لنبات الترتيكال تحت ظروف البيضاء ، ليبيا.