تأثير استجابة الشعير للتسميد العضوي ونانو- الحيوي

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الملخص العربى :

أجريت تجربتان حقليتان في مزرعة خاصة في كوم حمادة محافظة البحيرة-مصر خلال موسمي الزراعة 2019، 2020 لدراسة تأثير استجابة الشعير للتسميد العضوي والنانو- الحيوي . وقد استخدم في هذه التجربة تصميم القطاعات كاملة العشوائية مع ثلاثة مكرارات. تتكون المعاملات من (كنترول، 2لتر نانو/فدان ، 4لتر نانو/فدان ، 5 طن سماد عضوي/فدان،10 طن سماد عضوي/فدان،15 طن سماد عضوي/فدان ،2لتر نانو/فدان + 5 طن سماد عضوي/فدان ،4لتر نانو/فدان + 15 طن سماد عضوي/فدان). أظهرت النتائج أن المعاملة 4لتر نانو/فدان + 15 طن سماد عضوي/فدان أعطت أفضل القيم لكل الصفات المدروسة (طول السنبلة، وزن السنبلة، وزن 1000 حبة، محصول الحبوب، محصول القش، المحصول البيولوجي، دليل الحصاد)، ــ أيضا ــ سجلت أفضل القيم للصفات الكيميائية (النسب المئوية لكل من النيتروجين، الفوسًفور، البوتاسيوم) مقارنة ببقية المعاملات الأخرى بينما سجلت معاملة الكنترول أقل القيم لكل الصفات المدروسة، خلال كلا الموسمين تحت هذه الدراسة.

Response barley (*Hurdeom vulgar* L.) to organic and nanobiofertilizer

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ABSTRACT

Two filed experiments were carried out in a private Farm at Kom Hamda - Beheira, Governorate, Egypt during the two successive growing seasons of 2019 and 2020 to study the response barley (*Hurdeom vulgar* L.) to organic and nano-biofertilizer. The used experimental design was randomized complete block design (RCBD) with three replicates. The treatments were (control, 2L/ fed Nano-Bio, 4L/ fed Nano-Bio, 5kg/fed. OM, 10 kg/fed. OM, 15kg/fed. OM, 2L/fed Nano-bio + 5kg/fed. OM and 4L/fed Nano-bio + 15kg/fed. OM). The obtained results showed that the treatments of 4L/fed Nano-bio + 15kg/fed. OM recorded the highest values of spike length, spike weight, 1000- grain weight, grain yield, straw yield, biological yield and harvest index, also, recorded the maximum values of chemical composition percentages of nitrogen, phosphorus, potassium and protein percentages, as compared with the other treatments, while control treatment recorded the lowest mean values of all studied characters, during both seasons under this study.

Keywords: barley, organic manure, nano-biofertilizer, yield components, chemical composition.

INTRODUCTION

Barley (*Hordeum vulgare* L.), belonging to Poaceae family, is one of the most important staple food crops in the world. It is the world's fourth most important cereal after wheat, rice and maize **(Mohammad *et al.*, 2011[16], Chavarekar *et al.*, 2013[5], Tarun *et al*. 2013)[24].** It ranks fifth among cropping rain production in the world after maize, wheat, rice and soybean **(Miralles *et al.*, 20011[15], Zeid, 2011[25], Soleymani and Shahrajabian, 2011[22].** Barley ranks fourth among cereals in the world and is grown annually on 48 million hectares in a wide range of environments **ICRISAT/ICARDA (2011)[10]**.

The application of manures to soil provides potential benefits including improving the fertility, structure, water holding capacity of soil,

increasing soil organic matter and reducing the amount of synthetic fertilizer needed for crop production **(Phan *et al.*, 2002[20] and Blay *et al.*, 2002)[3].** Manures are the main sources of nitrogen (N) supply in organic crop production. Nitrogen availability from applied manure includes the
inorganic N (NO3-N and NH4-N) in manure plus the amount of organic N mineralized following application. Nitrogen mineralization differs for
different manure types since the inorganic/organic fraction and quality of organic N varies **(Eghball *et al.*, 2002[7] and Jae-Hoon *et al.*, 2006)[11].**

Further, nanotechnology provides excellent solutions for an increasing number of environmental challenges. For example, the development of nanosensors has extensive prospects for the observation of environmental stress and enhancing the combating potentials of plants against diseases (**Afsharinejad *et al.*, 2016[1] and Kwak *et al.*, 2017)[13].**

Nanoparticles (NPs) are organic, inorganic or hybrid materials with at least one of their dimensions ranging from 1 to 100 nm (at the nanoscale). NPs that exist in the natural world can be produced from the processes of photochemical reactions, volcanic eruptions, forest fires, simple erosion, plants and animals or even by the microorganisms (**Dahoumane *et al.*, 2017)[5].**The production of plant- and microorganism- derived NPs, has emerged as an efficient biological source of green NPs that draw an extra attention of scientist in recent times due to their eco-friendly nature and simplicity of production process compared to the other routes **(Panpatte *et al.*, 2016[18] and Park *et al.*, 2016)[19].**

Nanotechnology recommends significant prospects for tailoring nanofertilizer production. They are typically coated with desired chemical composition having controlled release and targeted delivery of effective nanoscale ingredients, ability to improve plant productivity and to minimize environmental pollutants. The present review focuses primarily on the usefulness of nanofertilizers, as well as its environmental and safety concerns **(Faria *et al.*, 2020)**[9].

The aimed of this study to response barley (*Hurdeom vulgar* L.) to organic and nano-biofertilizer.

MATERIALS AND METHODS

Two field Experiments were conducted at in a private Farm at Kom Hamda - Beheira, Governorate, Egypt during the two successive growing seasons of 2019 and 2020 to study the response barley (*Hurdeom vulgar* L.) to organic and nano-biofertilizer. The experimental design was randomized complete block design (RCBD) with three replicates.

Samples of soil were collected at depth 0-30 from the experimental orchard for all treatments, some physical and chemical properties of the experimental soil in 2019 as shown in **Table (1).**

Table (1): Some Physical and chemical properties of the experimental soil in 2017 and 2018 seasons

Parameter	Value	Unit
Mechanical Analysis		
Sand	68.30	%
Silt	12.02	%

Clay	19.68	%
Textural class	**Sandy loam**	
pH (1:1)	7.46	-
Ca co_3	3.0	%
EC(1:1, water extract)	0.61	dS/m
O.M	0.21	
Soluble cations		
Ca^{2+}	2.0	meq/l
Mg^{2+}	1.0	meq/l
Na^{+}	2.7	meq/l
K^{+}	0.4	meq/l
Soluble anions		
$HCO3^{-}$	3.8	meq/l
Cl^{-}	1.8	meq/l
SO_4^{2-}	1.5	meq/l
Available nutrients		
Nitrogen (N)	210	mg/l
Phosphorus (P)	67.25	mg/kg
Potassium (K)	750	mg/kg

Studied characteristics

Yield and its components

At harvest time and its components were calculated from an area of one square meter from each plot. The following criteria were recorded:

1. Spike length (cm): estimated as an average of ten random spikes from each plot.
2. Spike weight
3. 1000- Grains weight (g): expressed as an average of three samples from each plot.

4. Grain yield (ton/ha): plants of each plot were threshed and grain yield was weighted in kilograms and converted to ton/fed.
5. Straw yield (ton/ha): estimated as weight of straw which harvested from each plot in kilograms and converted to ton/fed.
6. Biological yield (ton/ha): calculated as grain yield /ha+ straw yield/ha.
7. Harvest index (HI %): was estimated according to the following equation:

$$\text{Harvest index (HI)} = \frac{grain\ yield}{bio\log ical\ \ yield}$$

Chemical analysis

The NPK percentages were determined in the dry grains. Their dry weights were determined following drying in a drying chamber to a constant weight at 75ºC for 72 hour according to **Tandon (1995)[(23)].** After dryness, the plant samples were milled and stored for analysis as reported. However, 0.5g of the grains powder was wet-digested with H_2SO_4 – H_2O_2 mixture according **(Lowther 1980)[(14)]** and the following determinations were carried out in the digested solution to determine the following:

Nitrogen content in grains (N%): Total nitrogen was determined in digested plant material calorimetrically by Nessler`s method **(Chapman and Pratt, 1978)[(4)]**. Nessler solution (35 IK/100 ml d.w. + 20g $HgCl_2$ / 500 ml d.w.) +120 g NaOH / 250 ml d.w. Reading was achieved using wave length of 420 nm and N was determined as percentage as follows:

% N = NH4 % x 0.776485

Grain protein (%)

Grain protein was determined by estimating the total nitrogen in the grains and multiplied by 6.25 to obtain the percentage according of grain protein percentage to **A.O.A.C. (1990).**

Crude protein content (%) = N (%) x 6.25

Phosphorus content in grains (P %): was determined by the Vanadomolyate yellow method as given by **Jackson (1973)**[12] and the intensity of color developed was read in spectrophotometer at 405nm.

Potassium content in grains (K %): was determined according to the method described by method **Jackson (1973)[12]** using Beckman Flame photometer.

RESULTS AND DISCUSSIONS

A) Yield and yield components

It is clear from **Table (2 and 3)** yield and yield components significantly increased by increasing rate of organic fertilizer and nano-bio. However, the highest spike length (11.45 and 12.82 cm), spike weight (4.85 and 5.43 g), 1000- grain weight (54.15 and 60.65 g), grain yield (4.08 and 4.57 t/fed.), straw yield (4.65 and 5.21 t/fed), biological yield (8.73 and 9.78 t/fed) and harvest index (46.74 and 46.73 %) was observed with mixed 4l/fed. Nano-bio+15kg/fed. OM, as compared with control treatments which gave the lowest mean values of spike length (6.11 and 6.84 cm), spike weight (2.61 and 2.92 g), 1000- grain weight (38.75 and 43.40 g), grain yield (1.73 and 1.94 t/fed.), straw yield (2.02 and 2.26 t/fed), biological yield (3.75 and 4.20 t/fed) and harvest index (46.13 and 46.19 %), during both seasons.

Similar results were obtained by **Ramah *et al.* (2014)[21].** In this concern, **Badr *et al.* (2009)[2]** found that the differences among the four rates organic fertilizer (zero, 10, 20, 30 m^3/faddan were significant.

Obtained results might be due to the stimulation effect of organic manures on improving the physical properties of the soil, increasing soil fertility and increasing the availability of many nutrients element to plant uptake, which in turn on improving the growth of barley plants and consequently positively affected yield and yield components. **Ofosu-Anim and Leitch [35][17]** stated that, organic manure application had the potential of increasing spring barley yield by 1.5 to 4-fold. **Cerny *et al.* [19]** proved that, application of sewage sludge and manure increased the yield of barley yield by 22%. **El-Ghamry *et al*. (2009)[8]** proved that, adding FYM at rates of 20 ton ha^{-1} and some micronutrients as foliar application increased yield and yield components.

Table (2). Spike length (cm), spike weight (g), 1000- grain weight as affected by organic manure and nano-bio on barley during 2019/2020 seasons.

Treatments	Spike length (cm)		Spike weight (g)		1000- grain weight (g)	
	2019	2020	2019	2020	2019	2020
Control	6.11	6.84	2.61	2.92	38.75	43.40
2l/ fed Nano-Bio	7.35	8.23	2.96	3.32	42.35	47.43
4l/ fed Nano-Bio	8.55	9.58	3.57	4.00	50.75	56.84
5kg/fed. OM	7.62	8.53	2.84	3.18	44.88	50.27
10kg/fed. OM	8.86	9.92	3.39	3.80	49.25	55.16
15kg/fed. OM	9.75	10.92	4.15	4.65	51.90	58.13
2l/fed Nano-bio + 5kg/fed. OM	10.9	12.21	4.41	4.94	53.70	60.14
4l/fed Nano-bio+15kg/fed. OM	11.45	12.82	4.85	5.43	54.15	60.65
LSD(0.05)	**0.58**	**0.65**	**0.43**	**0.48**	**6.16**	**6.90**

Table (3). Grain yield (kg/fed), straw yield (kg/fed), biological yield (kg/fed), harvest index as affected by organic manure and nano-bio on barley during 2019/2020 seasons.

Treatments	Grain yield (t/ fed.)		Straw yield (kg/fed)		Biological yield (kg/fed)		Harvest Index (HI %)	
	2019	**2020**	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**
Control	1.73	1.94	2.02	2.26	3.75	4.20	46.13	46.19
2l/ fed Nano	2.11	2.36	2.90	3.25	5.01	5.61	42.12	42.07
4l/ fed Nano	2.74	3.07	3.13	3.51	5.87	6.58	46.68	46.66
5kg/fed. OM	1.99	2.23	3.25	3.64	5.24	5.87	37.98	37.99
10kg/fed. OM	2.75	3.08	3.50	3.92	6.25	7.00	44.00	44.00
15kg/fed. OM	3.11	3.48	3.90	4.37	7.01	7.85	44.37	44.33
2l/fed Nano + 5kg/fed. OM	3.51	3.93	4.15	4.65	7.66	8.58	45.82	45.80
4l/fed Nano+15kg/fed. OM	4.08	4.57	4.65	5.21	8.73	9.78	46.74	46.73
LSD(0.05)	**0.65**	**0.73**	**0.79**	**0.88**	**1.44**	**1.61**	**0.45**	**0.45**

A) Chemical composition

It is clear from **Table (4)** that application of organic fertilizer plus nano-bio recorded the highest mean values of NPK percentages of grain barley. However, the treatments of 4l/fed. Nano-bio+15kg/fed. OM gave the highest percentages of nitrogen (2.78 and 3.11%), phosphorus (0.72 and 0.81%) and potassium (2.55 and 2.86 %), as compared with control treatment which gave the lowest mean values of nitrogen (1.11 and 1.24%), phosphorus (0.13 and 0.15%) and potassium (1.19 and 1.33 %), during both seasons.

Table (4). NPK in grains as affected by organic manure and nano-bio on barley during 2019/2020 seasons.

Treatments	N (%)		P (%)		K (%)	
	2019	2020	2019	2020	2019	**2020**
Control	1.11	1.24	0.13	0.15	1.19	1.33
2l/ fed Nano	1.76	1.97	0.42	0.47	1.88	2.11
4l/ fed Nano	2.01	2.25	0.55	0.62	2.45	2.74
5kg/fed. OM	2.10	2.35	0.23	0.26	1.68	1.88
10kg/fed. OM	2.23	2.50	0.45	0.50	1.95	2.18
15kg/fed. OM	2.45	2.74	0.57	0.64	2.35	2.63
2l/fed Nano + 5kg/fed. OM	2.58	2.89	0.65	0.73	2.42	2.71
4l/fed Nano+15kg/fed. OM	2.78	3.11	0.72	0.81	2.55	2.86
LSD(0.05)	0.40	0.45	0.30	0.34	0.63	**0.71**

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