ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Some Agriculture Practices for Maximizing Wheat Production under New Reclaimed Sandy Soil.

Bakry, A.B, M.M Tawfik, Alice, T Thalooth and El-Karamany, M.F

Field Crops Research Department, Agricultural and Biological Division, National Research Centre, Dokki, Giza, Egypt, 33 El Bohouth St, P.O. 12622.

ABSTRACT

Maximizing wheat productivity especially under new reclaimed sandy soil conditions became a vital object to decrease the gap of wheat between production and consumption in Egypt. To achieve the aforementioned objectives, two field experiments were carried out at the Agricultural Production and Research Station, National Research Centre, Nubaria Province, Behaira Governorate, Egypt, during the two successive winter seasons of 2012/2013 and 2013/2014 to study the effect of some agriculture treatments (Mycorrhizza 1kg/fed., charcoal 4 tons/fed., foliar application with KNO_3 5g/L) in addition to control treatment on yield and its components for three wheat cultivars i.e. (Sakha-93, Gemiza-7 and Shandweel-1). Wheat cultivars significantly differed in all growth characters under study at 90 days from sowing as well as for yield and its components with superiority to Skha-93 cultivar. All agriculture treatments significantly enhanced all growth and yield characters with superiority to the treatment with charcoal (4 tons/fed.) over the other treatments. As for the interaction effect between wheat cultivars and the agriculture treatments, the results showed that the effective treatments for growth, yield and yield attributes characters were obtained from Sakha-93 cultivar treated with charcoal (4 tons/fed.). The results also showed that the highest values of N, P and CP % in wheat grains were obtained in Sakha-93 cultivar treated with Mycorhizza, while the highest values of K% were recorded in Sakha-93 cultivar treated with KNO_3.
Keywords: wheat cultivars**,** Mycorrhizza, charcoal, sandy soil conditions.

Corresponding author: *Bakry_ahmed2004@yahoo.com*

INTRODUCTION

Wheat (*Triticum aestivum*, L.) is an important cereal crop which belongs to the grass family of *Poaceae,* formerly *Gramineae* and makes up the genus (*Triticum spp*). It is one of the most important cereal crops in Egypt and all over the world. Wheat provides 37 % of the total calories for the people and 40 % of the protein in the Egyptian diet (Mujeeb *et al*., 2008). Recently, a great attention of several investigators has been directed to increase the productivity of wheat especially in the new reclaimed sandy soil, to minimize the gap between the Egyptian production and consumption by increasing wheat production through increasing unit land area productivity and increasing cultivated area **(**Ahmed *et al*., 2011). Increasing wheat yield per unit area can be achieved by breeding high yielding varieties and applying the optimum cultural practices and applying some agronomic practice to sustain soil fertility through their effect on the physical, chemical and biological properties of soil (Hassanein *et al*., 2013, Hattem, *et al*., 2015 and). Grain, straw and biological yields and its components were significantly differed owing to varietal differences (Abdel-Ati and Zaki, 2006).

Charcoal is the dark residue consisting of carbon, and the remaining ash, obtained by removing water and other volatile constituents from vegetation substances (Laird, 2008). Charcoal is usually produced by pyrolysis at temperatures from 300 to 600 °C (Rajkovich, 2012). There are some researches showing that biochar can be used to improve soil fertility and sequester carbon for reduction of carbon mitigation to mitigate climate change (Lehmann *et al.,* 2006, Lehmann *et al.,* 2009 and Sohi *et al.,* 2010). Charcoal has also been shown to change soil biological conditions in terms of the quality and quantity of soil microorganisms (Kim *et al.,* 2004). According to (Steiner *et al*., 2008), these changes may well have effects on nutrient cycles and soil structure which in turn can lead to differences in plants growth and productivity. The possible connections between biochar properties and the soil biota, and their implications for soil processes have not yet been systematically described (Lehmann *et al*., 2009 and Ibrahim, *et al*., 2015).

Potassium is the most abundant cation in higher plants. It is the target of many researches because it is essential for enzymes activation, protein synthesis and photosynthesis (Silva, 2004 and Chavis, *et al*., 2005). Furthermore, potassium is necessary for phloem solute transport and for the maintenance of cation/anion balance in the cytosol as well as in the vacuole. Potassium stimulates root growth and hence, efficient exploration of soil water (Saxena, 1985). Further, it decreases the loss of soil moisture by reducing the transpiration and increasing the retention of water in plants. (Umar and Moinuddin, 2002 Bakry, *et al*, 2012). They added that potassium plays an important role in the growth and development of plants. It activates enzymes, maintains cell turgor, enhances photosynthesis, reduces respiration, helps transport sugars and starches, aids in nitrogen uptake and is essential for protein synthesis. In addition to plant metabolism, potassium improves crop quality because it helps with grain filling and kernel weight, strengthens straw, increases disease resistance, and helps the plant better withstand stress (Ashley *et al*., 2011). Its role is well documented in photosynthesis, increasing enzyme activity, improving synthesis of protein, carbohydrates and fats, translocation of photosynthetic, enabling their ability to resist pests and diseases. Sources of potassium and its effect on growth and yield of crops were studied by (Abd El-Aal *et al.,* 1995 and Bakry, *et al*., 2015) who observed yield improvement in plants fertilized with both soil and foliar K. Another possible approach to crop productivity is the foliar application of magnesium which plays several physiological and biochemical roles i.e., chlorophyll formation, activation of enzymes, synthesis of proteins, carbohydrate metabolism and energy transfer.

The vesicular arbuscular mycorrhiza (VAM) is a mutually beneficial symbiosis of fungi which are found associated with the majority of agricultural plants. The fungi belong to the Glomeromycota with the genera *Endogone, Glomus, Entrophosphora, Gigaspora, Acaulospora, Scutellospora.* They are obligate symbionts which have not been cultured on nutrient media yet because of their obligately biotrophic life style which makes it essential for VAM fungi to infect and spread inside a living root. (Smith, 1983). Versicular arbuscular mycorrhiza has been shown to improve productivity in soils of low fertility (Jeffries, 1987). They are particularly important for increasing the uptake of slowly diffusing ions such as PO_4 (Jacobsen *et al*., 1992), immobile nutrients such as P, Zn and Cu (Liu *et al*., 2002). Mycorrhiza fungi can also improve absorption of N from $NH4^+$ mineral fertilizers, transporting it to the host plant (Johansen *et al*., 1993). Its transport and absorption can also increase biomass production in soils with low Potassium, Calcium and Magnesium (Liu *et al*., 2002). Khavazi *et al*., (2005) stated that, VAM induce additional root hair and lateral root formation and enhance plant's ability to take up additional nutrients and water from soil and increase photosynthesis, the rates of photosynthetic storage and consequently plant yield. Moreover, Narula *et al.,* (2002) reported a net saving of

25-30 kg nitrogen by using VAM inoculants on wheat. They added that, the productiveness of rhizosphere for VAM may be attributed to favorable influence exerted by root exudates that contain amino acids, carbohydrates, organic acids, growth promoting substances and also phytohormones. Furthermore, Biswas *et al*., (2000) and Maha, *et al*., (2015) suggest that certain strains of VAM can promote wheat growth and yield through mechanisms that improve single leaf net photosynthetic rate rather than biological N_2 fixation.

The objective of this work was to test growth, yield and yield components of three wheat cultivars (Gemiza-7, Sakha-93 and Shandweel-1) under some agronomic treatments (Charcoal, Mycorrhiza and KNO_3).

MATERIALS AND METHODS

Two field experiments were carried out at the Agricultural Production and Research Station, National Research Centre, Nubaria Province, Behaira Governorate, Egypt, during the two successive winter seasons of 2012/2013 and 2013/2014 to test growth and yield of three wheat cultivars (Gemiza-7, Sakha-93 and Shandweel-1) under four agriculture treatments (Charcoal - Mycorrhiza - KNO_3 and control treatment). The surface soil sample (0-30 depth) of the experimental area was subjected to laboratory analysis to determine some of its physical and chemical properties according to the method described by Chapman and Pratt (1979) in Table (1).

Table 1: Mechanical and chemical analyses of the experimental soil (2012/2013 and 2013/2014 seasons).

Mechanical analysis:	2012/2013	2013/2014
Sand %	92.3	90.1
Silt %	3.1	4.3
Clay %	4.6	5.6
Chemical analysis:	2012/2013	2013/2014
$CaCo_3$ %	1.3	1.5
Organic matter %	0.3	0.3
EC. mmhos/cm^2	0.3	0.3
pH	7.4	7.2
Soluble N%	8.0	8.2
Available P (ppm)	3.0	3.4
Available K (ppm)	19.8	20.2

The experimental design was split plots design with four replicates. Wheat cultivars was assigned to the main plots, while the agronomic treatments were randomly distributed in the sub plots (Control treatment, Mycorrhiza 1kg/fed., charcoal 4 tons/fed., foliar application with KNO_3 5g/L). Wheat grains were planted on 14^{th} and 16^{th} November in 2012 and 2013 in both seasons, respectively. Irrigation was carried out using sprinkler irrigation system where water was added every 5 days. The normal agriculture practices of growing wheat were practiced till harvest as recommended by wheat Research Dept .A.R.C., Giza.

Samples of one square mater were taken at random from the middle area of each plot from the three replicates to measure plant height cm, number of spikes/plant, number of tillers/plant, flag leaf area cm^2 and dry weight of whole plant at 90 days from sowing. At harvest time one square meter was taken at random from the middle area of each plot from the three replicates to determine plant height cm, number of spikes/m^2, dry weight of spikes g/m^2, spike length, number of grains/ spike, weight 1000 grains weight (g). In addition, grain, straw and biological yields ton/fed. NPK in grains were determined according to the method described by A.O.A.C (2005) and the grain protein content was calculated by multiplying total nitrogen concentration by 5.75. Statistical analysis was performed according to Snedecor and Cochran (1990). Treatments mean were compared by L.S.D. test. Combined analysis was made from the two growing seasons hence the results of two seasons followed similar trend.

RESULTS AND DISCUSSION

Growth characters

Effect of cultivars

Data in Table (2) shows that cultivars Sakha-93, Gemiza-7 and Shandweel-1 significantly differed in vegetative growth characters, i.e. number of tillers / plant, number of leaves / plant, number of spikes / plant, flag leaf area and also dry weight of whole plant, while plant height was insignificantly affected. It is clear from the data that Sakha-93 exceeded other cultivars in all characters under study at 90 days from sowing. It could be concluded that varietal differences between wheat cultivars may be due to the genetical differences between cultivars and differences genotypes concerning partition of dry matter, where wheat cultivars differed in carbon equivalent (Abd-El-Gawad et al., 1987). The superiority of Sakha-93 cultivar may be due to the increase in the efficiency to photosynthate of more water and minerals from soil. This reflected on increasing the production of more sizeable organs. The results of varietal differences in growth parameters in this study are in agreement with those obtained by Zaki *et al*.,(2004).

Table 2: Effect of wheat cultivars on growth characters

Wheat cultivar	Plant height cm	Number of spikes/plant	Number of leaves /plant	Number of tillers $/m^2$	Flag leaf area cm^2	Dry weight of plants g/plant
Gemiza-7	85.59	4.85	16.54	4.22	41.81	11.94
Sakha 93	90.29	5.05	15.05	3.94	44.37	12.49
Shandweel 1	79.88	4.54	19.02	3.38	39.89	11.19
LSD 5%	6.36	0.31	1.35	0.19	NS	0.55

Effect of some agronomic treatments:

Table 3: Effect of some agriculture treatments on growth characters

Agricultrure treatment	Plant height cm	Number of spikes/plant	Number of leaves /plant	Number of tillers $/m^2$	Flag leaf area cm^2	Dry weight of plants g/plant
Control	81.21	4.33	14.98	3.45	38.99	10.36
Mycorhizza	86.57	4.90	17.59	4.02	42.88	12.52
Charcoal	88.75	5.17	18.28	4.19	43.92	12.79
KNO_3	84.48	4.86	16.63	3.73	42.31	11.83
LSD 5%	NS	0.33	1.25	0.23	NS	0.65

Data in Table (3) shows the effect of different agriculture treatments on growth of wheat plant. It is clear that all agronomic treatments (Mycorrhiza 1kg/fed., charcoal 4 tons/fed., foliar application with KNO_3 5g/L), significantly affected growth characters as compared with control treatment. It is also clear from the table that addition of 4 ton/fed. charcoal recorded the highest values for all growth characters. Similar results were obtained by Vaccari *et al*., (2011). This increasing in growth could be because of ability of charcoal for improving soil condition from increasing water holding capacity (Jeffery, 2011). And thus improved nutrient retention through cation adsorption (Liang *et al*., 2006). However, charcoal has also been shown to change soil biologi in terms of the quality and quantity of soil microorganisms (Kim *et al*., 2007). As for the positive impact of VAM, Smith and Read (2002) reported that VAM grow in the cortical root tissues and also grow out from the roots into the surrounding soil, forming an external hyphae network which increases uptake of mineral nutrients and consequently promotes plant growth. Furthermore, Ghahfarokhy *et al.,* (2011) reported that comparison of the root in control and root colonized with VAM showed that colonization of root with VAM fungi and *Trichoderma* promote massive root growth which intern help in absorption of nutrients. Hence, this is consistent with the observations and results of the present study. On the other hand, Potassium has the major role in osmoregulation, photosynthesis, transpiration, stomatal opening and closing and synthesis of protein etc. (Cakmak, 2005, Milford and Johnston, 2007).

Effect of the Interaction

The effect of interaction between wheat cultivars and agriculture treatments on plant growth characters i.e. plant height, number of tillers / plant, number of leaves / plant, number of spikes / plant, flag leaf area and also dry weight of whole plant were significant. The results in Table (4) showed that, the highest values for plant height, number of tillers / plant, number of spikes / plant, flag leaf area and dry weight of whole plant were recorded in Sakha-93 treated with charcoal (4 ton/fed.), while Shandweel-1 recorded the highest number of leaves / plant. These results are confirmed with that obtained by Vaccari *et al*., (2011). This increasing in growth could be because of ability of charcoal for improving soil condition from increasing water holding capacity (Jeffery, 2011). However, charcoal has also been shown to change soil biologi in terms of the quality and quantity of soil microorganisms (Kim *et al*., 2007). Moreover, Hosam-El Din (2006) and Hetrick *et al*., (2015) reported that the interaction between wheat cultivars and VAM affected significantly in growth characters. Several factors such as host plant, AM fungal isolate, and soil environment can influence effectiveness of root- AM fungi symbioses. It is important to understand and manipulate these factors to optimize plant growth responses to AM fungi. It may also be necessary to select AM fungal isolates best adapted to the environment in which a plant species is to be grown. Isolates of AM fungi differ in ability to enhance plant growth.

Table 4: Effect of interaction between wheat cultivars and agriculture treatments on growth characters

Wheat cultivar	Agriculture treatment	Plant height cm	Number of spikes/plant	Number of leaves /plant	Number of tillers /m^2	Flag leaf area cm^2	Dry weight of plants g/plant
Gemiza-7	Control	81.40	4.33	14.23	3.91	39.21	10.50
	Mycorhizza	87.48	4.96	17.36	4.38	42.65	12.60
	Charcoal	89.02	5.25	18.20	4.44	44.36	12.87
	KNO_3	84.45	4.87	16.36	4.16	41.03	11.81
Sakha 93	Control	86.32	4.63	13.36	3.42	41.23	10.80
	Mycorhizza	90.35	5.12	15.69	4.19	45.98	13.14
	Charcoal	94.25	5.30	16.58	4.36	46.02	13.65
	KNO_3	90.25	5.14	14.58	3.77	44.25	12.37
Shandweel 1	Control	75.91	4.03	17.36	3.02	36.54	9.79
	Mycorhizza	81.88	4.62	19.72	3.47	40.02	11.82
	Charcoal	82.98	4.96	20.06	3.78	41.37	11.84
	KNO_3	78.75	4.56	18.94	3.25	41.65	11.30
LSD 5%		8.25	0.39	2.32	0.32	NS	0.95

Yield and its Components:

Effect of Cultivars:

Data in Table (5) and fig (1) indicated that there were significant differences between cultivars in all characters under this study i.e. plant height, number of spikes / m^2, dry weight of spikes/m^2, spike length, number of grains / spikes, 1000 grains weight as well as grain, straw and biological yield / fed. Sakha-93 cultivar surpassed other two cultivars in all the studied yield characters followed by Gemiza-7. It could be concluded that varietal differences between wheat cultivars may be due to the genetical differences between cultivars and differences genotypes concerning partition of dry matter, where wheat cultivars differed in carbon equivalent (Abd-El-Gawad et al., 1987). In this concern, this increase in number of grains per spike was due to increase in number of spikelets, similar response was observed in wheat where photosynthesis and root respiration increased grain yield (Liu *et al*., 2005).

Table 5: Effect of wheat cultivars on yield attributes characters

Wheat cultivar	Plant height cm	Number of spikes/m^2	Dry weight of spikes g/m^2	Spike length (cm)	Number of grains/spike	1000 grains weight (g)
Gemiza-7	93.36	479.53	506.30	12.12	63.14	50.50
Sakha-93	97.95	504.82	537.87	13.12	66.55	52.81
Shandweel-1	90.83	454.06	469.03	11.13	59.52	47.31
LSD 5%	NS	24.36	23.65	0.68	3.35	2.36

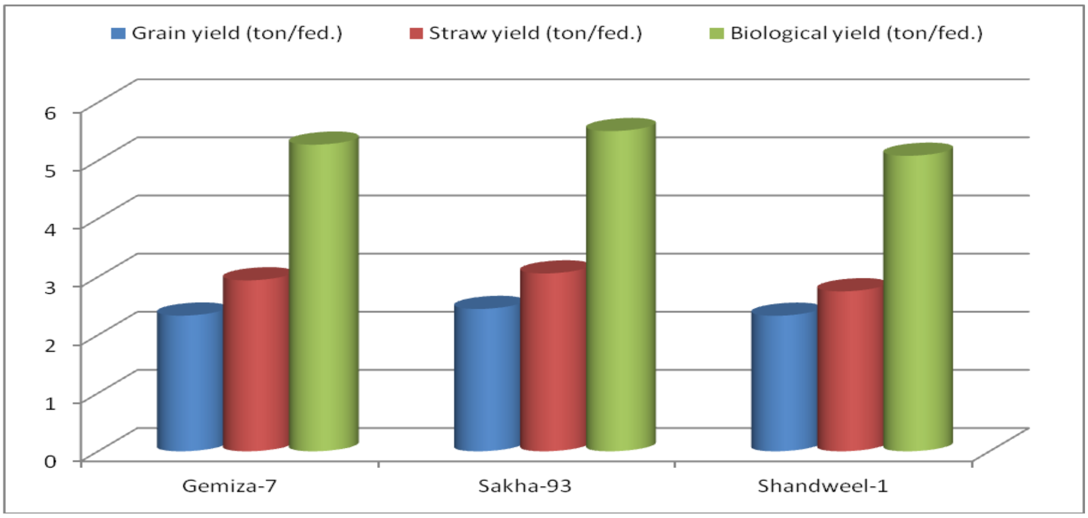

Figure 1: Effect of wheat cultivars on yield characters (LSD 5% Grain yield= NS & Straw yield = NS and Biological yield = NS)

Effect of agriculture treatments

Table 6: Effect of some agriculture treatments on yield attributes characters

Agriculture treatment	Plant height cm	Number of spikes/m^2	Dry weight of spikes g/m^2	Spike length (cm)	Number of grains/spike	1000 grains weight (g)
Control	89.55	432.68	435.37	10.89	59.06	43.81
Mycorhizza	97.53	490.06	520.74	12.69	64.32	52.94
Charcoal	95.85	509.22	550.46	13.15	65.87	54.07
KNO_3	93.26	485.91	511.03	11.76	63.03	50.01
LSD 5%	NS	26.35	28.65	0.61	4.02	3.02

Treating wheat with VAM, charcoal or KNO_3 resulted in a significant increase in the all the studied yield and yield attributes as compared with control treatment (Table 6 and fig 2). It is also clear from the table that addition of 4 ton/fed. charcoal recorded the highest values for all growth characters. Similar results were obtained by Vaccari *et al.*, (2011). This increasing in yield and yield attributes characters, could be due to the ability of charcoal for improving soil condition from increasing water holding capacity (Jeffery, 2012). And thus improved nutrient retention through cation adsorption (Liang *et al.*, 2006). However, charcoal has also been shown to change soil biology in terms of the quality and quantity of soil microorganisms (Kim et al., 2007). Moreover, this could be attributed to the enhanced P uptake by VAM. The improved grain yield with fungal-inoculants was due to the absorption of more nutrients by wheat plants (Behl *et al.,* 2003). Manske *et al.*(1998) have also provided access to more soil volume as extra metrical hyphae of VAM fungi enlarge the effective surface outside of the roots. Fungal inoculation increased sink size by increasing either panicle number or spikelet number per panicle. Yanni *et al.,* (1997) also reported higher grain yield following inoculation with VAM in a field experiment in Egypt. The importance of additive effects of fungal-inoculants was reported by earlier workers for component traits like plant height, spike length, grain weight, flag leaf area and grains per spike (Katiyar and Ahmad, 1996). On the other hand, Potassium has the major role in osmoregulation, photosynthesis, transpiration, stomatal opening and closing and synthesis of protein etc. (Cakmak, 2005, Milford and Johnston, 2007). It was indicated by many investigators that potassium played a key role in the osmotic adjustment (stomatal opening) of plants and yield may be improved due to foliar potassium application to plants (Foyer *et al.*, 2002).

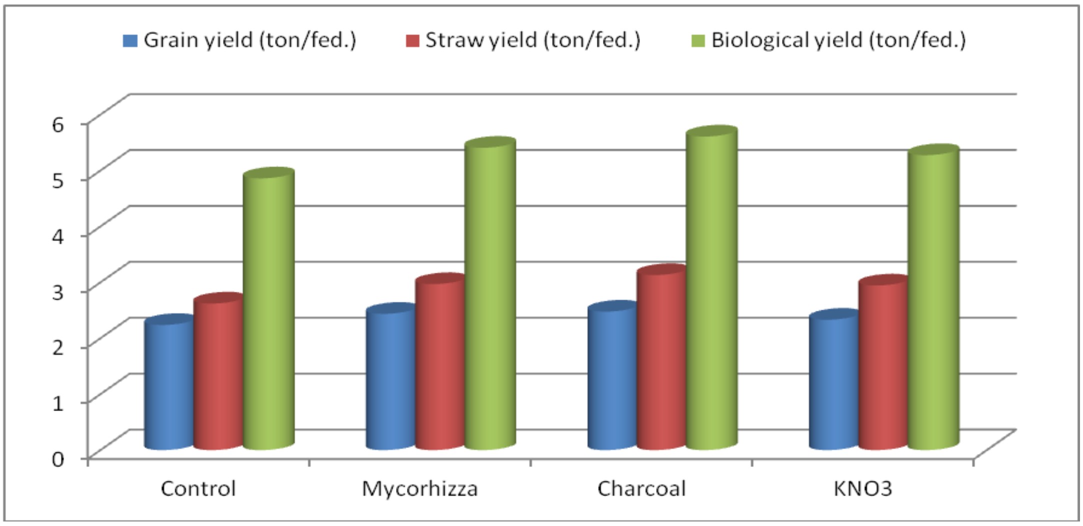

Figure 2: Effect of some agriculture treatments on yield characters (LSD 5% Grain yield= NS & Straw yield = 0.17 and Biological yield = 0.30)

Effect of interaction between wheat cultivars and some agriculture treatments:

The effect of interaction between wheat cultivars and the agriculture treatments on yield and yield attributes were significant (Table 7 and Fig 3). The results showed that the effective treatments for yield and yield attributes characters were obtained from Sakha-93 cultivar treated with charcoal (4 tons/fed.). These results are in harmony with those obtained by Sohi *et al.*, (2010). There are some research who shows that, charcoal can be used as a possible means to improve soil fertility as well as other ecosystem services and sequester carbon for reduction of carbon mitigation (C) to mitigate climate change (Laird, 2008). In this concern, Eykelbosh *et al.,* (2015) found that Biochar increased soil porosity and cation exchange capacity, suggesting that it may help to prevent nutrient leaching losses. In conclusion, the use of charcoal became ineludible to minimize the environmental pollution and to improve the yield quality of wheat plant. Moreover, Mohammadi *et al*., (2013) confirmed the role of potassium in increasing yield of wheat plant.

Table 7: Effect of interaction between wheat cultivars and some agriculture treatments on yield attributes characters

Wheat cultivars	Agriculture treatment	Plant height cm	Number of spikes/m^2	Dry weight of spikes g/m^2	Spike length (cm)	Number of grains/spike	1000 grains weight (g)
Gemiza-7	Control	88.65	432.70	430.25	11.18	58.82	44.38
	Mycorhizza	95.36	496.12	532.81	12.52	63.97	53.27
	Charcoal	96.54	502.00	548.35	12.89	66.54	54.43
	KNO_3	92.91	487.29	513.79	11.88	63.25	49.93
Sakha-93	Control	93.65	462.58	477.54	11.41	61.84	45.66
	Mycorhizza	98.57	512.37	552.06	13.98	68.97	55.57
	Charcoal	100.36	529.96	581.70	14.52	69.03	57.72
	KNO_3	99.21	514.37	540.20	12.57	66.38	52.31
Shandweel- 1	Control	86.36	402.77	398.32	10.08	56.54	41.39
	Mycorhizza	98.65	461.71	477.36	11.58	60.03	49.99
	Charcoal	90.65	495.70	521.32	12.03	62.05	50.06
	KNO_3	87.65	456.08	479.11	10.85	59.45	47.78
LSD 5%		8.25	41.2	37.25	1.23	6.02	5.27

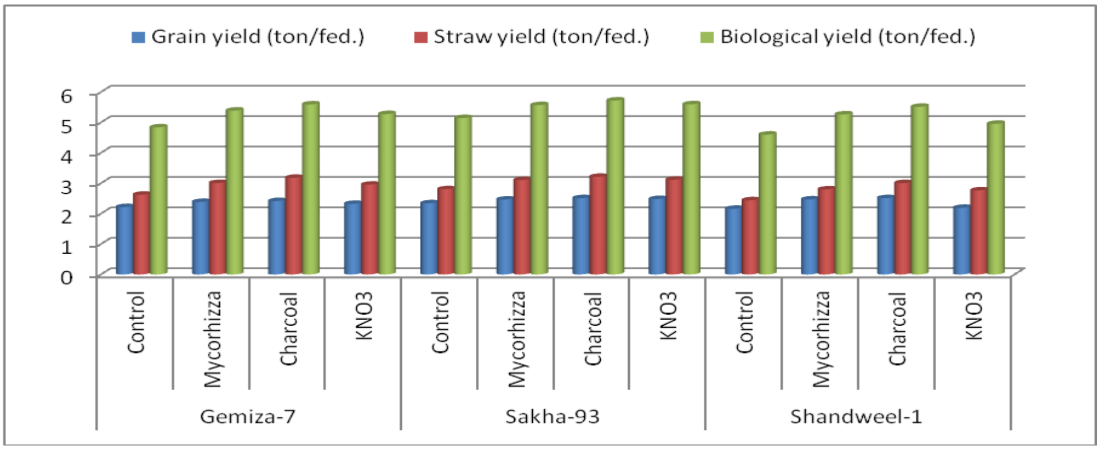

Figure 3: Effect of interaction between wheat cultivars and some agriculture treatments on yield (LSD 5% Grain yield= NS & Straw yield = 0.35 and Biological yield =0.63)

N, P, K and crude protein %:

Effect of Cultivars

Data in Table (8) showed that the differences between cultivars were insignificant with regard the percentage of N, P, K and crude protein% in wheat grains. However, Sakha-93 cultivar surpassed other two cultivars in all the studied chemical constituemts followed by Gemiza-7. It could be concluded that varietal differences between wheat cultivars may be due to the genetical differences between cultivars and differences genotypes concerning partition of dry matter, where wheat cultivars differed in carbon equivalent (Abd-El-Gawad *et al.,* 1987).

Table 8: Effect of wheat cultivars on N, P, K and crude protein %

Wheat cultivar	N %	P %	K %	CP %
Gemiza-7	1.91	0.24	0.48	11.00
Sakha-93	1.93	0.24	0.50	11.08
Shandweel-1	1.87	0.22	0.47	10.75
LSD 5%	NS	NS	NS	NS

Effect of agriculture treatments:

Obtained results recorded in Table (9) revealed that percentage of nitrogen, phosphorus, potassium and crud protein in grains significantly affected with agriculture treatments. However, treatments plants with Mycorhizza recorded the highest percentage for grain nitrogen, phosphorus and crude protein as compared with control plants. On the other hand, the highest values of potassium were obtained under the treatment with KNO_3. These results are in agreements with those reported by Dreyer *et al*., (2010) who stated that, the symbiosis between Mycorhizza and plants is based on the beneficial exchange of reduced carbon from the plant and mineral nutrients, especially phosphate and nitrogen as well as water from the fungus. Moreover, Treseder (2013), conducting a field-based trials on several plant species, confirmed the association between colonized root length and P content. Furthermore, Mohammadi *et al*., (2013) confirmed the role of potassium in increasing the percentage of K and CP content in wheat plants.

Table 9: Effect of some agriculture treatments on N, P, K and crude protein %

Agricultrure treatment	N %	P %	K %	CP %
Control	1.75	0.20	0.43	10.08
Mycorhizza	2.05	0.27	0.47	11.79
Charcoal	1.89	0.23	0.49	10.87
KNO_3	1.92	0.24	0.54	11.04
LSD 5%	0.10	0.01	0.03	0.75

Effect of interaction between wheat cultivars and some agriculture treatments:

The effect of interaction between wheat cultivars and the agriculture treatments on N, P, K and crude protein% in wheat grains were significant (Table 10). The results showed that the highest values of N, P and CP % were obtained in Sakha-93 cultivar treated with Mycorhizza, while the highest values of K% were recorded in Sakha-93 cultivar treated with KNO_3. These results are in harmony with those obtained by Treseder (2013) who confirmed the association between Mycorhizza and P content. Moreover, Mohammadi *et al*., (2013) confirmed the role of potassium in increasing the percentage of K and CP content in wheat plants.

Table 10: Effect of interaction between wheat cultivars and some agriculture treatments on N, P, K and crude protein %

Wheat cultivars	Agriculture treatment	N %	P %	K %	CP %
Gemiza-7	Control	1.75	0.21	0.43	10.06
	Mycorhizza	2.05	0.27	0.48	11.79
	Charcoal	1.92	0.22	0.48	11.04
	KNO_3	1.93	0.26	0.53	11.10
Sakha-93	Control	1.78	0.20	0.44	10.24
	Mycorhizza	2.09	0.28	0.48	12.02
	Charcoal	1.89	0.25	0.52	10.87
	KNO_3	1.95	0.24	0.57	11.21
Shandweel-1	Control	1.73	0.19	0.42	9.95
	Mycorhizza	2.01	0.25	0.46	11.56
	Charcoal	1.86	0.22	0.47	10.70
	KNO_3	1.88	0.21	0.52	10.81
LSD 5%		0.14	0.02	0.04	1.21

CONCLUSION

Our results showed that the addition charcoal 4 tons/fed., Mycorrhiza 1kg/fed., or foliar application with KNO_3 5g/L enhanced all studied growth and yield characters as well as the percentage of N,P,K and crude protein with superiority to charcoal and Mycorrhizza treatments. Use of charcoal in agricultural systems may reduce the need for using commercial fertilizers and have positive carbon sequestration effects, which in turn will help our environment and increase crop yields simultaneously. Moreover, both Mycorrhiza and KNO_3 has a vital role in wheat production especially in new reclaimed sandy soil.

REFERENCES

[1] A.O.A.C. (2005). Association of official agriculture chemist. Official method of analysis. 16th Ed., Washington, D.C.

[2] Abbott, L. K., Robson, A. D., The role of vesicular-arbuscular mycorrhizal fungi in agriculture and the selection of fungi for inoculation. Aust. J. Agric. Res., 1982, 33:389–408.

[3] Abd El-Aal, H. A., E. A. Makram and A. A. Darwish (1995). Effect of soil and foliar application potassium fertilizer timing on growth and yield of cotton (cultivar Giza 75). J. Agric. Sci., Mansoura Univ., 20: 1997-2004.

[4] Abdel-Ati, A. A. and K. I. Zaki (2006). Productivity of some wheat cultivars in calcareous soils under organic farming and rainfed conditions with special references to plant disease. J. Agric. Sci. Mansoura Univ., 31(4): 1875-1889.

[5] Abd-El-Gawad, A. A., K. A. El-Shouny, S. A. Saleh and M. A. Ahmed (2005). Partition and migration of dry matter in newly cultivated wheat varieties. Egypt. J. Agron., 1987, 12(1-2): 1-16.

[6] Ahmed, M. A., Amal, G. Ahmed, Magda, H. Mohamed and M. M. Tawfik (2011). Integrated effect of organic and biofertilizers on wheat productivity in new reclaimed sandy soil. Res. J. Agric. & Biol. Sci., 7(1): 105-114.

[7] Al-Karaki, G. N (1998). Benefit, cost and water-use efficiency of arbuscular mycorrhizal durum wheat grown under drought stress. Mycorrhiza, 8:41–45.

[8] Ashley, M. K., Grant, M and Grabov, A (2011). Biological and mineral nitrogen supply impacts on salinity response of faba bean (*Vicia faba* L.) in Abdulrahman M. Almadini. European Journal of Scientific Research, 49 (2): 187-199.

[9] Bakry, A. B., O.A. Nofal and M.S. Zeidan (2012). Agronomic Characteristics Of Three Flax Varieties As Affected By Some Sources Of Potassium Fertilization Under Newly Reclaimed Sandy Soil Conditions. Australian Journal of Basic and Applied Sciences, 6(4): 77-81.

[10] Bakry, A.B, Osama A. N, M.S Zeidan and M. Hozayn (2015). Potassium and Zinc in Relation to Improve Flax Varieties Yield and Yield Components as Grown under Sandy Soil Conditions. Agricultural Sciences, 6(1):152-158.

[11] Behl, R. K., Sharma, H., Kumar, V., and Narula, N (2003). Interaction amongst mycorrhiza, Azotobacter, International Biological Programme, Cambridge Univ. Press, Cambridge, UK.

[12] Biswas, J. C., Ladha, J. K and Dazzo, F. B (2000). Rhizobia inoculation improves nutrient uptake and growth of lowland rice. Soil Sci. Soc. Am. J., 64: 1644-1650.

[13] Cakmak, I. (2005). The role of potassium in alleviating detrimental effects of abiotic stresses in plants. J. Plant Nutr. Soil Sci., 168:521– 530.

[14] Chapman, H. O. and Pratt, P. E (1961). Methods of analysis for soil, plants and waters. Univ. Calif. Div. Agic. Sci., P. 309.

[15] Chavis, L. H., Viegas, R.A., Vasconuceles, A. C. and Viera, H (2005). Effect of potassium on Moringa plant grown in nutrients solution. Revistaia De Biologia E. Ciencais De Terra, 5 (2): 1-8.

[16] Davies, F.T., Potter, J. R. and Linderman, R.G (1992). Mycorrhiza and repeated drought exposure affect drought resistance and extra radical hyphae development on pepper plants independent of plant size and nutrient content. J Plant Physiol., 139:289–294.

[17] Dreyer, B., Morte, A., Ángel Lopez, J., Honrubia, M (2010). Comparative study of mycorrhizal susceptibility and anatomy of four palm species. Mycorrhiza, 20: 103-15.

[18] Eykelbosh, A. J., M. S. Johnson, and E. G., Couto (2015). Biochar decreases dissolved organic carbon but not nitrate leaching in relation to vinasse application in a Brazilian sugarcane soil. Journal of Environmental management, 14:9-16.

[19] Foyer, C. H., H. Vanacker, L. D. Gomez and J. Harbinson (2002). Regulation of photosynthesis and antioxidant metabolism in maize leaves at optimal and chilling temperatures: review. Plant Physiol. Biochem., 40: 659– 668.

[20] Ghahfarokhy, M. R., Goltapeh, E. M., Purjam, E., Pakdaman, B. S., Modarres Sanavy, S.A.M. and Varma, A (2011). Potential of mycorrhiza-like fungi and Trichoderma species in biocontrol of Take-all Disease of wheat under greenhouse condition. Journal of Agricultural Technology, 7(1): 185-195.

[21] Hassanein, M. S., Amal, G. Ahmed, Nabila, M. Zaki, H. I. El-Alia and M.M. Tawfik (2013). Response of Two Wheat Cultivars Grown in Newly Cultivated Lands to Iron and Slow Release N Fertilizers. Australian Journal of Basic and Applied Sciences, 7(1): 498-505.

[22] Hattem M. El-Shabrawi, Bakry, A.B, Mohamed A. Ahmed and Mohamed Abou-El-Lail (2015). Humic and Oxalic Acid Stimulates Grain Yield and Induces Accumulation of Plastidial Carbohydrate Metabolism Enzymes in Wheat Grown under Sandy Soil Conditions. Agricultural Sciences, 6(1):175-185.

[23] Hetrick, B. A. D., G. W. T. Wilson, T. C. Todd (2015). Mycorrhizal response in wheat cultivars: relationship to phosphorus. Canadian Journal of Botany, 74(1): 19-25.

[24] Hosam El-Din, A.T (2006). Productivity of some wheat varieties using bio and organic fertilization in the new valley. M.Sc. Thesis, Fac. Agric. Ain Shams Univ.

[25] Ibrahim, O.M., Bakry, A.B., El-Karamany, M.F and Elewa, T.A (2015). Evaluating the role of Bio-char application under two levels of water requirements on wheat production under sandy soil conditions. Global journal of advanced research, 2(2): 411-418.

[26] Jacobsen, I., Abbott, L. K., and Robson, A. External Hyphae of Vesicular Arbuscular Mycorrhiza Fungi Associated with Trofoluim subterraneum L. I. Spread of Hyphae and Phosphorus Inflow into Roots. New Phytol., 1992, 120:371-380.

[27] Jeffery,S.,verheijen,F.G.A.,vandervelde,M.and Bastos , A.C. A (2011). Quantitative review of the effects of biochar application to soil on productivity using meta-analysis, Agric. Ecosyst. Environ. 144(1), 175-187.

[28] Jeffries, P. Use of Mycorrhiza in Agriculture. Crit. Rev. Biotechnol. 1987, 5:319-357.

[29] Johanssen, A., Jakobsen, I., and Jessen, E. S (1993). External Hyphae of Vesicular-Arbuscular Mycorrhizal Fungi Associated with (*Trifolium Subterraneum* L.) 3. Hyphal Transport of 32 P and 15 N. New Phytol, 124:61-68.

[30] Katiyar, P. K. and Ahad, Z (1996). Detection and epistatic component of variation for yield contributing traits over two environments in bread wheat. Indian J. Genet., 56: 285-291.

[31] Khavazi, K., H., Asadi-Rahmani and Malakouti, M. J (2005). Necessity for the production of biofertilizers in Iran. Ministry of Jihad-e- Agriculture, Agricultural Research and Education Organization (AREO) and Soil and Water Research Institute (SWRI), Tehran, Iran, pp: 419.

[32] Kim, S., Kaplan, L. A., Brenner, R., Hatcher, P. G (2004). Hydrogen-deficient molecules in natural riverine water samples - Evidence for the existence of black carbon in DOM. Mar. Chemistry, 92: 225-234.

[33] Laird, D. A (2008). The Charcoal Vision: A Win–Win–Win Scenario for Simultaneously Producing Bioenergy, Permanently Sequestering Carbon, while Improving Soil and Water Quality". Journal of Agronomy, 100 (1):178- 186.

[34] Lehmann, J., Czimczik, C., Laird, D., Sohi, S (2009). Stability of biochar in soil. In: Lehmann, J., Joseph, S. (Eds.), Biochar for Environmental Management: Science and Technology. Earthscan, London, pp. 183 – 205.

[35] Lehmann, J., Gaunt J., Rondon M (2006). Bio-char sequestration in terrestrial ecosystems Mitigation and Adaptation Strategies for Global Change, pp. 403–427.

[36] Liang, B. Lehmann, J. Solomon, D. Kinyangi, J. Grossman, J. O'Neill, B. Skjemstad , J. O. Thies, J. LuizÃ£o, F. J. Petersen, J. and Neves, E. G (2006). Black Carbon Increases Cation Exchange Capacity in Soils. Soil Science Society of America Journal, 70: 1719-1730.

[37] Liu, A., Hamel, C., Elmi, A., Costa, C and Smith, D.L (2002). Concentrations of K, Ca and Mg in Maize Colonised by Arbuscular Mycorrhiza Fungi under Field Conditions. Can. J. Soil Sci., 82(3): 271-278.

[38] Liu, H. S. and F. M. Li (2005). Root respiration, photosynthesis and grain yield of two spring wheat in response to soil drying, Plant growth regul., 46: 233-240.

[39] Maha Mohamed-Shater Abd Allah, Hala Mohamed Safwat El-Bassiouny, Bakry Ahmed Bakry and Mervat Shamoon Sadak (2015). Effect of Arbuscular Mycorrhiza and Glutamic Acid on Growth, Yield, Some Chemical Composition and Nutritional Quality of Wheat Plant Grown in Newly Reclaimed Sandy Soil. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 6(3):1038-1054.

[40] Manske, G.G.B., Behl, R. K., Luttger, A. B and Vlek, P. L. G (1998). Enhancement of mycorrhizal (AMF) infection, nutrient efficiency and plant growth by Azotobacter chroococcum in wheat. Evidence for varietals effects. In: Narula N. (ed.): Azotobacter in sustainable agriculture. CBS Publ. Distrib., New Delhi, pp: 136-147.

[41] Milford, G. F. J. and A. E. Johnston (2007). Potassium and nitrogen interactions in crop production. Proceedings No. 615, International Fertilizer Society, York, UK.

[42] Mohammadi, M. M. A. Maleki, S. A. Siaddat, M. Beigzade (2013). The effect of zinc and potassium on the quality yield of wheat under drought stress conditions. Intl J Agri Crop Sci., 6 (16): 1164-1170.

[43] Mujeeb, R., A. S., Umed, Z. Mohammad and G. Shereen (2008).Effects of NaCl salinity on Wheat (*Triticum aestivum* L.) Cultivars. World J. Agri. Sci., 4 (3): 398-403.

[44] Narula, N., Behl, R. K., Dudi, H. R., Suneja, S and Lakshminaryana, K (2002). Response of wheat genotypes to Azotobacter inoculation under rainfed conditions. Journal of Microbiology, 17: 66-67.

[45] Rajkovich,S., Enders,A., Hanley,K., Hyland,C., Andrew, R., Zimmerman and J. Lehmann (2012). Biology and Fertility of Soils Volume, 48.

[46] Ruiz-Lozano JM, Azcon R, Gomez, M (1995). Effects of arbuscular mycorrhizal Glomus species on drought tolerance: physiological and nutritional plant responses. Appl. Environ. Microbial, 61:456–460.

[47] Saxena, N. P (1985). The role of potassium in drought tolerance, Potash review, 5 (16): 1-15.

[48] Silva, S. L (2004). Transpiration and ion partitioning in grafted seedling and rootstocks of different cashew genotypes exposed to salt stress. Fortaliza, pp. 65.

[49] Smith, S. E., and Read, D. J (2002). Mycorrhizal Symbiosis. Academic Press: London., pp 43.

[50] Smith, S.E (1983). Mycorrhiza of autotrophic higher plants. Biol. Rev., 55, 475-510.

[51] Snedecor, G.W. and W.G. Cochran (1990). Statistical Methods 8th Ed. Iowa State Univ. Press Ames, Iowa, U.S.A.

[52] Sohi, S. P., H. C. Yates and J. L. Gaunt (2010). Testing a practical indicator for changing soil organic matter .Soil Use and Management, 26 (2): 108–117.

[53] Steiner, C. Glaser, B. Teixeira, W. G. Lehmann, J. Blum, W. E. H. and Zech, W (2008). Nitrogen retention and plant uptake on a highly weathered central Amazonian Ferralsol amended with compost and charcoal. Journal of Plant Nutrition and Soil Science, 171: 893-899.

[54] Treseder, K.K (2013). The extent of mycorrhizal colonization of roots and its influence on plant growth and phosphorus content. Plant and Soil, 371, 1e13

[55] Umar, S. and K. and Moinuddin (2002). Genotypic differences in yield and quality of groundnut as affected by potassium nutrition under erratic rainfall conditions. J. Plant Nutr., 25: 1549-1562.

[56] Vaccari, F. P., Baronti, S., Lugato, L., Genesio, L., Fornasier, F., Miglietta, F and Castaldi, S. (2011). Biochar as a strategy to sequester carbon and increase yield in durum wheat, 34: 231–238.

[57] Yanni, Y.G., Rizk, R.Y., Corich,V., Squartini, A., Ninke, K., Philip, S., Hollingsworth, G., Orgambide, F., De Bruijn, J., Stoltzfus, D., Buckley, T.M., Schmidt, P.F., Mateos, J.K., and Dazzo, F. B (1997). Natural endophytic association between Rhizobium Leguminosarum bv. trifolii and rice roots and assessment of its potential to promote rice growth. Plant Soil Sci., 194: 99-114.

[58] Zaki, M. Nabila, M.A. Ahmed and M.S. Hassanein (2004). Growth and yield of some wheat cultivars irrigated with saline water in newly cultivated land as affected by nitrogen fertilization. Annals of Agric. Sci., Moshtoher, 42(2): 515-525.