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THE ROLE OF INCREASING SOIL ENDOMYCORRHIZA ON THE GROWTH AND PRODUCTIVITY OF WHEAT

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ABSTRACT

In Egypt, wheat as a cereal crop might display the top among all strategic crops through its annual production and it is always behind the need and gap the between production and consumption remain great. The main target of the present investigation has been to study the effect of soil endomycorrhiza as biofertilizer and its impact on wheat as a major cereal crop in Egypt. Soil endomycorrhizal populations have been increased by growing four trap-crops namely onion, wheat, faba-bean and corn for a period of four months where spore count reached a maximum of 566/100 gm soil and root-colonization scored 97% in onion. For experimentation, the recommended cultivar Sakha-93 of *Triticum aestivum* L. was obtained and field experiments were conducted within the University Agriculture Farm at Al-Arish where the soil is typically sandy loam with little silt and clay. Two experiments were carried out simultaneously as follows: natural soil as control and mycorrhized soil (i.e soil with increased endomycorrhiza). From each treatment, three plant samples were collected during the vegetative and reproductive phases and finally at the grain stage for comparing growth, productivity and yield-quality. The results indicated that fresh and dry weight of plant parts increased greatly by soil endomycorrhiza compared to control soil. Also, soil mycorrhization increased greatly NPK and total carbohydrates. Growth and yield of wheat were greatly significantly increased by soil mycorrhization compared to control soil.

Key Words: Wheat, Soil Endomycorrhiza, Biofertilizer, Growth, Productivity & Yield-Quality, NPK and Total Carbohydrates.

INTRODUCTION

1. Importance of wheat as a crop:

Wheat **(**particularly ***Triticum aestivum*** **L.)** is the first important and strategic cereal crop for the majority of world's populations. It is the most important staple food of about two billion people (36% of the world population). Worldwide, wheat provides nearly 55% of the carbohydrates and 20% of the food calories consumed globally. It exceeds in acreage and productivity every other grain crop including rice, maize, etc. and is cultivated over a wide range of climatic conditions **(Breiman & Graur, 1995).** It is planted annually in about 7.2 million $ha^{-1}$with an average annual yield of 1596 $kg/ha^{-1}$and a total annual productivity of 11.6 million tons **(Rangaraj *et al.*, 2007).**

Wheat is grown mostly for human food and only about 10 percent is retained for seed and industry (for the production of starch, pasta, malt, dextrose, gluten). According to **Curtis *et al.* (2002)** wheat grains contain all essential nutrients; carbohydrates (60-80%, mainly as starch), proteins (8-15%), comprising adequate amounts of all essential amino acids (except lysine, tryptophan and methionine), fats (1.5-2%), minerals (1.5-2%), vitamins (such as B complex & E) and 2.2% crude fibers.

Wheat normally needs between 110 and 130 days between sowing and harvest, depending upon climate, seed type, and soil conditions.

According to the US Department of Agriculture, optimal crop management requires the farmer's detailed understanding of each stage of development of the growing plants particularly issues related to fertilizers, pesticides, and growth regulators **(USDA 2006; van Heel & West 2006; FAO 2013).**

2. Mycorrhiza as a biofertilizer:

A mycorrhizal fungus is a symbiotic association in and on the roots of a host plant of which the arbuscular mycorrhizal group (AM) is the most common. It is an obligate group **(Javaid 2007; Javaid *et al.* 2007; Javaid & Riaz 2008)** found in more than 80% of land plant families **(Smith & Read, 2008).**

In this association, the fungus is supplied with soluble carbon sources by the host plants, whereas the fungus provides the host plant with a better ability to take up water and nutrients from the soil **(Entry *et al.* 2002; Javaid 2009).**

The endomycorrhiza significantly enhance the nutrient uptake and storage capacity of host plants and therefore they are considered as modifiers of soil fertility **(Barea, 1991)**.

This has been confirmed by many researchers dealing with different crops such as: **a-** wheat **(Hetrick *et al.*, 1984; Baltruschat & Dehne, 1988 & 1989), b-** barley **(Jensen & Jakobsen, 1980), c-** maize **(Guttay & Dandurand 1989; Braunberger *et al.* 1991; Kothari *et al.*, 1991; Asmah 1995; Abdul-Khaliq *et al.* 1997; Posta & Fuleky 1997), d-** *sorghum* **(Raju *et al.*, 1990), e-***trifolium&medicago* **(Jain *et al.*, 1998), f-**onion **(Ojala *et al.* 1983; Sylvia & Neal 1990), g-**garlic **(Koch *et al.*, 1997), h-**tomato **(Sasai,1991), i-**grape **(Krishna *et al.*, 2005),** strawberry **(Vestberg 1992; Khanizadeh *et al.* 1995)** as well as many other crops such as pepper, pea, coffee, carrot, mint, and lentil.

MATERIALS AND METHODS

It became well known that the majority of terrestrial plants accommodate endomycorrhiza however, the potentiality among plants toward developing AM fungi in high density and great diversity differ markedly from one plant to another. Host plants whose roots increase markedly the number of endomycorrhizal spores in their rhizosphere are usually referred as **"trap-crops"**, and to increase soil fertility in cropping lands, it became important that trap-crops would be always used as a part of a crop-rotation system.

1. Increase of density and diversity of endomycorrhizal fungi in soil:

To increase mycorrhization in the form of spore count (i.e inoculum potential) in the soil and root colonization to be used for open field experiments, mixed spores were collected from the rhizosphere of the four trap-crops **(onion, corn, wheat and faba-bean)**. Spores were then surface sterilized

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as described by **Ravolanirina *et al.* (1987),** and cultivated in an autoclaved soil for a period of 4 months to increase spore density.

Heavily colonized adventitious roots were also chopped into small fragments and mixed thoroughly with the associated rhizospheric soil (containing hyphae and spores) to form root balls.

Spores and heavily colonized roots, in the form of root balls, were then transferred to the experimental field and incorporated into the soil at a depth of 2-3 cm below wheat seedlings according to **Menge & Timmer (1983)**.

2. Extraction and identification of AMF spores from rhizosphere soils:

Extraction of arbuscular mycorrhizal spores was carried out following the wet-sieving and decanting method **(Gerdemann and Nicolson, 1963).** A soil-water mixture (25:1000; w/v) was decanted through stacked sieves of mesh sizes ranging between 315 µm to 35µm.

To remove colloidal materials and debris retained on the last set of sieves spores were either thoroughly washed under a stream of water or re-suspended and decanted again through the same set of sieves. Spore suspension and retaining debris were filtered through Whatman No 1, marked with small squares (1:1cm) for easy counting.

The slides were prepared using PVL (polyvinyl alcohol + lactophenol) and PVLG (polyvinyl alcohol + lactic acid + glycerol) for the identification of AM species. Estimation and identification were carried out according to **Schenck & Perez (1987).** After count, spore density was expressed in terms of the number of spores per 100 g of soil.

Spores were separated into groups according to their size and the general morphological similarities recorded under a stereomicroscope.

3. Assessment of mycorrhization:

The root samples were rinsed thoroughly with running tap water several times to remove the debris and adhering soil particles. Roots were cut into 1 cm. segments for cleaning and staining. Root segments were cleared in KOH (10%, w/v; 90^{o}C, 2 h). Darken roots were bathed in alkaline H_2O_2 for 20 min according to **(Kormanik & MacGraw 1982)** to remove over stained areas. Roots were then washed with tap water and stained with 0.05 % trypan blue.

The assessment of root colonization by arbuscular mycorrhizal fungi was done by the slide method; root segments were selected randomly from stained samples and examined for the presence or absence of functional structures (hyphae, vesicles and arbuscules).

A minimum of 100 root segments were used for enumeration, and the colonization rate was calculated using the following formula:

$$\text{ColnizationRate (\%)} = \frac{\text{Total number of root segments colonize}}{\text{Total number of root segments studi}}$$

4. Field design and experimentation:

For field experiments, the recommended winter variety of wheat (Triticum aestivum L.), Sakha-93 was obtained from the Agricultural Research Center, Ministry of Agriculture, Giza.

After being washed several times with tap water, wheat grains were surface sterilized by immersing in 1.5% sodium hypochlorite for three minutes followed by

soaking in 70% ethanol for two minutes **(Royse & Ries, 1978)** then rinsed with sterile water. For field cultivation, wheat grain amounts at the rate of 70 Kg/Feddan were used.

Field experimentation has been conducted during early winter (November of the season 2012 and repeated in the next season November of 2013) in a plot within The Agriculture Farm, Faculty of Agricultural & Environmental Sciences at Al-Arish.

The experimental plot was subdivided further into subplots everyone was 2X2 m and plants were grown in rows of 10 cm apart and assigned to accommodate a certain treatment. Two treatments were used natural soils control **(C)**, and soil with increased endomycorrhizal population **(M).**

This experiment was conducted under the natural conditions prevailing at the University Farm where: temperature, minimum 14^{o}C, maximum, 17^{o}C, day length, 14 h day, 10 h night, relative humidity 60%, light intensity 310 µEm^{-2}S^{-1}.

As the results indicated that the soil of the Agriculture Farm is typically sandy-loam with little amounts of silt and clay, slightly saline and relatively poor in organic matter.

Also, values of all micro- and macro-elements were in the normal limits.

Form each treatment, three groups of plant samples were collected randomly at different time intervals during the experiment of each season. The first two groups of samples at two different stages during the vegetative growth.

The first sample at the tillering stage i.e after 55 days from sowing and the second at the flowering stage i.e after 75 days from sowing. Growth traits considered were:

fresh & dry weight, plant height (cm), spore counts and root colonization.

After drying at 70 ^{o}C for 7 days, dry fresh samples were ground into fine powder and tested for: NPK concentration and total carbohydrates.

The third groups of sample (was represented by grains after maturity of kernels and yellowing of internodes i.e. after 150 days from sowing) was taken after harvesting to determine the following parameters: **a-**grain yield (Kg/fad), **b-**weight of 100 seeds, **c-**NPK concentration and **d-**carbohydrates.

5. Chemical and biochemical analysis of vegetative parts and yield:

a- NPK concentration:

Chemical analysis of host tissues for total nitrogen (N), phosphorus (P) and potassium (K) were determined in dry matter using leaves at the flowering stage i.e. after 75 days after sowing:

Total Nitrogen was determined by Keldahl distillation method **(Keeney, 1982)**. Phosphorus content was determined by the Colorimetric method **(Olsen *et al.* 1954).**

While, Potassium was determined by Flame photometer method **(Merwin & Peech 1950).**

The soil sample was extracted with neutral normal ammonium acetate solution, the filtrate was aspirated into the atomizer of a calibrated flame photometer, and the electric current produced was measured by the galvanometer of the flame photometer as mentioned earlier in the vegetative analysis for total nitrogen, phosphorus and potassium by being determined in dry

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matter using seeds at the grain maturity stage (i.e after 150 days).

b- Total carbohydrates:

Total carbohydrates content was determined at the vegetative and grain maturity stages spectrophotometrically by Thermo Electron Corporationat 480 nm according to **Dubois *et al.* (1956)**.

Statistical analysis of the data obtained during this study was carried using statistical analysis of variance (ANOVA) according to **Snedecor & Cochran (1980)** and least significant difference (LSD) was calculated to determine the statistically significant treatment at 5% level of significance for the error degree of freedom **(Little & Hills, 1978).**

RESULTS

1.Increase of soil mycorrhization:

The inoculum potential of endomycorrhiza (AM) in soil (spores &colonization rates)have been increased by subjecting four plants as candidate trap-crops, these were onion, wheat, faba bean and corn for comparing their ability to increase the inoculum potential of AM..

The two elements related to the inoculum potential of endomycorrhiza namely: spore density (as count/100 gm) and colonization rate were used to compare between the rates of soil mycorrhization in the four candidate trap crops Table (2).

The results of Table (2) indicated also that spore count in all trap crops increase by aging. Counts status showing a prominent decrease in the first two weeks followed by a steady increase a throughout up to the twelve-week (end experiment). In view of spore density, onion came first by showing a count of 566/100 gm followed by wheat (438/100 gm), faba bean (373/100 gm) and corn (330/100 gm).

As for colonization rate, also onion came first by showing 97.3% followed by wheat (87%), corn (78.3%) and faba bean (78%). As for species diversity, detailed examination of isolated spores showed the presence four-endomycorrhizal genera (represented by 7 spp.) these were:

Glomus (*G. mosseae, G. clarum*, *G. monosporum, G. verruculosum*),*Gigaspora margarita*, *Acaulospora levis* and *Scutellospora sp*

2. Effect of soil mycorrhization on fresh and dry weight of wheat plants:

Comparison was made at two different growth phases, at tillering (after 55 days) and flowering (after 75 days) and the results are given in Table (3).

The data clearly indicate that changes in the fresh and dry weight of shoots, roots and total plants in soil mycorrhization treatment compared with control.

By comparison, weights of all elements (shoots, roots and total plants) showed greater values at the flowering stage than at tillering stage.

The results of Table (3), showed that by comparison with control treatment, soil mycorrhization significantly increased fresh and dry weight of all elements. For example, the data of fresh shoots at the flowering stage, in mycorrhized soil showed an average weight of 13.9 gm while in control scored at 7.1 gm.

The same trend showed in fresh and dry weights of total plant 20.03 gm and 7.55 gm respectively.

3. Effect of soil mycorrhization on plant height and number of organs:

The effect of soil mycorrhization on plant dimensions and number of organs was

Table (2): Increasing of soil endomycorrhiza by trap-crops

a- Spore density

Plant Species	Spore count/ 100 g dry soil					
	Start	Week 2	Week 4	Week 6	Week 8	Week 12
Onion	125.33±1.45	71.00±5.03	147.67±0.33	255.00±11.27	319.00±3.51	566.67±3.18
Wheat	125.33±1.45	45.00±2.31	75.00±1.15	243.67±12.47	316.33±1.86	438.00±20.03
Faba bean	125.33±1.45	43.67±2.19	75.33±2.91	203.67±8.67	298.67±4.70	373.67±7.31
Corn	125.33±1.45	57.67±1.76	83.67±1.20	129.33±1.76	205.33±6.89	330.33±7.75
LSD (5%)	4.74	10.12	5.49	30.97	15.06	37.36

b- Colonization rate (%)

Plant Species	After 6 weeks	After 8 weeks	After 12 weeks
Onion	92.33±0.33	94.33±0.33	97.33±0.33
Wheat	82.00±0.58	84.00±0.58	87.00±0.58
Faba bean	73.33±0.88	75.33±0.88	78.33±0.88
Corn	73.00±0.58	75.00±0.58	78.00±0.58
LSD (5%)	2.03	2.03	2.03

Values in the table are means ± standard error of means, LSD; least significant difference at P=0.0.

Table (3): Effect of soil mycorrhization on the fresh and dry weight of wheat plants at tillering and flowering stages.

Growth Stage	Treatments	Fresh weight (gm)			Dry weight (gm)		
		Shoot	Root	Total plant	Shoot	Root	Total plant
Tillering (after 55 days)	**C**	0.98±0.13	0.06±0.02	1.05±0.13	0.19±0.04	0.02±0.02	0.21±0.04
	M	1.60±0.23	0.37±0.02	1.98±0.24	0.26±0.04	0.09±0.06	0.35±0.10
	LSD (5 %)	0.51	0.06	0.50	0.20	0.07	0.21
Flowering (after 75 days)	**C**	7.14±0.13	1.94±0.07	9.08±0.14	2.31±0.58	1.35±0.31	3.66±0.87
	M	13.85±0.26	6.18±0.02	20.03±0.25	4.68±0.06	2.87±0.09	7.55±0.09
	LSD (5 %)	1.33	0.32	1.41	1.13	0.42	1.38

Abbreviations: C; Control natural soil, **M;** Mycorrhized soil, Values in the table are means ± standard, **LSD;** least significant difference at P=0.05.

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studied, and the results are given in Table (4).

The results clearly refer to the presence of clear positive effect of soil mycorrhization and by comparison, figures were much greater in mycorrhized soil than control natural soil.

This trend was evident in all elements considered: shoots, roots, spikes and total plant height.

For instance, at soil mycorrhization showed an average height of 62.3 cm and 114.3 cm at tillering and flowering stages respectively, while in control treatment scored at 38.2 cm and 78.3 cm at the same stages.

The same trend, in soil mycorrhization was increased significantly the number of tillers and leaves compared to control.

4. Effect of soil mycorrhization on the mineral content of NPK:

The data of Table (5) show that the absorption rate of the three major elements N, P, K at flowering or at grain maturity stages followed one pattern by being high in mycorrhized than control soils.

Phosphorus content is the most affected mineral by soil mycorrhization while the other two elements (N & K) were slightly affected.

Comparison of phosphorus absorption at mycorrhized and control soils during the flowering stage showed that highly significant absorption of plants in mycorrhized soil (8.01 mg/gm) than control soil (2.14 mg/gm).

The results of Table (5) showed also that there was steady increase in nitrogen content by aging i.e by showing greater values at the grain maturity stage than flowering stage.

On the contrary, potassium absorption showed lower rates at grain maturity compared to that at the flowering stage.

5. Effect of soil mycorrhization on total carbohydrates:

The effect of soil mycorrhization on total carbohydrates (as mg/gm) in plant tissues and grains at flowering and grain maturity stages was studied in wheat plants cultivated in mycorrhized (M) and control natural soil, and the data are given in Table (6).

The results of Table (6), showed that compared to control natural soil, mycorrhized soil showed significant increase of total carbohydrates at 15.95 mg/gm and 363.25 mg/gm in both flowering and grain maturity stages respectively.

6. Effect of soil mycorrhization on growth and productivity

Data related to the effect of soil mycorrhization on the growth and productivity of wheat plant was given in **Table (7)**.

The data of all parameters considered (No. of flowers/ spike, No. of seeds/spike, weight of 100 seeds and yield) showed significant improved in soil mycorrhization at all studied characters compared to control natural soil.

As for quality (expressed as No. of seeds/ spike and weight of 100 seeds), soil mycorrhization was able to increase the number of seeds/spike from 40 and 5.75 gm (in control treatment) to 56.33 and 6.37 gm respectively.

The same trend of improvement was also revealed by total yield (Ton/Feddan) which showed regular increase in mycorrhized (M) than control soils.

Table (4): Effect of soil mycorrhization on plant height, No. of tillers and leaves at the tillering and flowering stage

Growth Stage	Treatments	Plant Length (cm)				Number	
		Shoot	Root	Spike	Total Plant	Tillers	Leaves
Tillering (after 55 days)	C	28.67±1.01	9.50±0.76	0	38.17±1.09	0.00±0.00	5.00±0.00
	M	44.67±1.20	17.67±0.67	0	62.33±1.87	1.33±0.33	5.00±0.00
	LSD (5 %)	**4.65**	**2.29**	**-**	**6.35**	**0.71**	**0.35**
Flowering (after 75 days)	C	58.33±1.20	9.33±0.33	10.67±1.59	78.33±3.13	1.00±0.00	5.00±0.00
	M	81.83±2.68	14.33±0.67	18.17±0.17	114.33±3.52	2.00±0.00	11.33±0.33
	LSD (5 %)	**7.09**	**1.47**	**2.48**	**7.84**	**0.35**	**1.77**

Abbreviations: C; Control natural soil, **M;** Mycorrhized soil, Values in the table are means ± standard, **LSD;** least significant difference at P=0.05.

Table (5): Effect of soil mycorrhization on the minerals (NPK) at flowering and grain maturity stages.

Growth Stage	Treatments	Nitrogen (mg/gm)	Phosphorus (mg/gm)	Potassium (mg/gm)
Flowering (after 75 days)	C	0.14±0.03	2.14±0.40	1.81±0.28
	M	0.28±0.03	8.01±0.38	3.17±0.28
	LSD (5 %)	**0.09**	**1.17**	**0.91**
Grain maturity (after 150 days)	C	2.06±0.25	0.22±0.07	1.17±0.06
	M	2.62±0.25	6.50±0.19	3.00±0.00
	LSD (5 %)	0.74	0.41	0.31

Abbreviations: C; Control natural soil, **M;** Mycorrhized soil, Values in the table are means ± standard, **LSD;** least significant difference at P=0.05

Table (6): Effect of soil mycorrhization on total carbohydrates at Flowering and grain maturity stages.

Growth Stage	Treatments	Total Carbohydrates mg/gm

Flowering (after 75 days)	**C**	5.46±0.49
	M	15.95±0.49
	LSD (5 %)	1.51
Grain maturity (after 150 days)	**C**	154.63±2.26
	M	363.25±5.95
	LSD (5 %)	10.56

Abbreviations: C; Control natural soil, **M;** Mycorrhized soil, Values in the table are means ± standard, **LSD;** least significant difference at P=0.

The data showed that (1.82 Ton/Feddan) was reported at soil mycorrhization while in control only 1.16 Ton/Feddan.

DISCUSSION

1. Endomycorrhiza as a biofertilizer:

The role of endomycorrhiza as a biofertilizer has been established since long time and became a major element in sustainable agriculture. Its great effect on the enhancement of nutrient uptake and storage capacity of host plants toward minerals especially phosphorus has been verified in many strategic crops like cereals.

Based on the degree of necessity of host plants to this type of beneficial symbiosis to meet their basic P requirements, investigators were able to discriminate between two groups of plants, **a- highly dependent group** such as leek and corn, and **b- less dependent group**such as wheat and barley **(Plenchette 1983; Smith & Read 1997; Ryan & Angus 2003).**

2. Effect of soil mycorrhization on wheat growth and productivity:

a- Fresh & dry weight:

The data revealed that soil endomycorrhiza significantly increased fresh and dry weight compared with control. The increase in biomass (fresh & dry weight) upon soil endomycorrhiza was also noticed by several investigators in different countries like **Azam & Lodhi, (2001), Chatha *et al.* (2002); Sharif *et al.* (2009)** in Pakistan; **Bozkurt & Yarılgaç (2003)** in Turkey; **Lakhdar *et al.* (2010)** in Tunisia; in Egypt **Sorial (2001)** and **Rabie (2005)** using soil mycorrhization alone were also able to show the significant effect of mycorrhization on wheat growth in terms of biomass.

b- Plant height & number of organs:

Like fresh and dry weight as growth parameters, the plant height and number of organs (tillers & leaves) were increased significantly by soil mycorrhization. A very similar observation was also noticed by **Sorial (2001)** in Egypt; **Chatha *et al.* (2002)** and **Jamil *et al.* (2004)** in Pakistan; **Singh *et al.* (2004)** in India.

c- NPK content:

The data obtained in the present study, revealed that the absorption rate of the three minerals by wheat plant was always greater in mycorrhized than non- mycorrhized soils especially at the grain maturity stage. A very similar observation on the enhancement of nutrient uptake on wheat inoculated with mycorrhiza and/or grown in sludge-amended soils, was also noticed in Egypt, on the same crop, by **Sorial (2001); Mazen *et al.* (2010) and Galal (2012)**. In other countries it was also noticed by **Lerch**

***et al.* (1990)** in USA; **Ryan & Angus, (2003)** in Australia, **Ailincăi *et al.*(2008 & 2012)** in Greece; **Nunes *et al.* (2008)** in Portugal, **Khan (2011)** in Pakistan.

d- Total yield and yield quality:

The effect of soil mycorrhization was studied, the data clearly showed a prominent positive effect of soil mycorrhization on both total yield and yield quality. Soil mycorrhization significantly increased the total yield from 1.16 Ton/Feddan in control natural soil to 1.82 Ton/Feddan. As for yield quality represented by total carbohydrates.

The same trend reported in yield quality has also been noticed in yield quality where the effect on all parameters tested was much better in mycorrhized soil.

Table (7): Effect of soil mycorrhization on total carbohydrates at Flowering and grain maturity stages.

Treatments	Growth & Productivity				
	No. of flowers/spike	No. of seeds/spike	Wt. of 100 seeds (gm)	Total Plant Yield (gm)	Total Yield (T/Fed.)
C	86.00±2.00	40.00±2.89	5.75±0.08	2.30±0.19	1.16±0.12
M	116.00±5.29	56.33±2.96	6.37±0.16	3.63±0.06	1.82±0.03
LSD (5 %)	13.25	8.97	0.35	0.74	0.36

Abbreviations: C; Control natural soil, **M;** Mycorrhized soil, Values in the table are means ± standard, **LSD;** least significant difference at P=0.05.

Our observation on the improvement of total yield and yield quality as a result of sludge amendment were also noticed by many investigators worldwide like **Chatha *et al.* (2002); Jamil *et al.* (2004); Akrivos *et al.* (2006); Khan *et al.* (2007); Tamrabet *et al.* (2009); Aslam *et al.* (2011); Özyazıcı (2013)** who noticed a significant effect with increasing rate of sludge on yield and yield quality.

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دور الفطريات الجذرية الداخلية في زيادة النمو والإنتاجية علي محصول القمح

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يعتبر نبات القمح من أهم محاصيل الحبوب الاستراتيجية في مصر والعديد من بلدان العالم إلا أن الإنتاج السنوي في مصر دائماً لا يكفي الاستهلاك المحلي ودائما ما تكون هناك فجوة كبيرة بين الإنتاج والاستهلاك مما يستلزم الاستيراد بكميات كبيرة من الخارج.

ولقد تغيرت أساليب التسميد كثيرًا في القرن الماضي. وبعد التطبيق للعديد منها تبين أن بعضها قليل الفاعلية أو غير مجدي من الناحية الاقتصادية أو ذو آثار ضارة علي الإنسان والبيئة. وجري البحث العلمي في اتجاهات مختلفة بهدف الوصول إلي طرائق آمنه وفعالة وقليلة التكلفة وكان من ثمار ذلك استخدام المخصبات الحيوية والذي يطبق حالياً بأساليب مختلفة، ومن هنا جاءت فكرة هذه الدراسة وهي زيادة إنتاجية نبات القمح من خلال تقييم فعالية استخدام الفطريات الجذرية الداخلية (كمخصب حيوي)، وأثرها على القمح كمحصول رئيسي في مصر من حيث الإنتاجية والجودة.

اشتملت الخطة أيضاً زيادة كثافة الفطريات الجذرية الداخلية (الميكوريزا) في التربة حيث تم ذلك من خلال زراعة أربعة محاصيل هي : البصل والقمح والفول والذرة لمدة أربعة أشهر حيث تبين أن نبات البصل هو أكثر النباتات المستخدمة زيادة للجراثيم في التربة حيث بلغ عدد الجراثيم ٥٦٦ جرثومة لكل ١٠٠جرام تربة ووصلت نسبة انتشار الفطر داخل جذور نبات البصل إلي ٩٧٪.

ولتقييم تأثير الميكوريزا علي النمو والإنتاجية في القمح تم استخدام سلالة القمح سخا ٩٣وهو من الأصناف جيدة الإنتاج والملائمة لمناخ منطقة الدراسة طبقا لتوصيات وزارة الزراعة. تم تجهيز منطقة تجارب في مزرعة الجامعة بالعريش وتم تقسيم المعاملات إلي الآتي:

أولاً: تربة طبيعية.

ثانياً: تربة طبيعية تم زيادة محتواها من الميكوريزا.

تم زراعة محصول القمح وتم جمع العينات الممثلة للمعاملات السابقة علي ثلاثة مراحل وهي: مرحلة التفريع (tillering) ؛ مرحلة الازهار (flowering) وأخيراً مرحلة نضج الحبوب (grain maturity)لمقارنة النمو والإنتاجية وجودة المحصول.

وقد أظهرت النتائج ما يلي:

١- زيادة النمو الخضري في النباتات المعاملة بالميكوريزا زيادة معنوية ؛ وقد انعكس ذلك علي طول النبات في الجذر والساق وأيضاً عدد الخلفات (tillers) والأوراق وكذلك الوزن الطازج والجاف للنبات وكان التأثير أكثر وضوحا في مرحلة الإزهار.

٢- الميكوريزا أدت إلي زيادة كبيرة في إجمالي الكربوهيدرات، والدهون والبروتين وأيضاً زيادة المحتوى المعدني للنيتروجين والفسفور والبوتاسيوم في الأجزاء النباتية والحبوب.

٣- ساهمت الميكوريزا في تحسين إنتاجية محصول القمح وجودته؛ حيث بلغت الإنتاجية ١,٨٢ طن / فدان.

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