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Evaluation of Fertilizer Dosing (M,P,Em) on Groth of Wheat (Triticum Aestivum)

تأثير المخصب الحيوي والفسفور وفطر المايكورايزا على نمو محصول القمح

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الأيـــــة

قال تعالي":

"يُخْرِجُ الْحَيَّ مِنَ الْمَيِّتِ وَيُخْرِجُ الْمَيِّتَ مِنَ الْحَيِّ وَيُحْيِي الأَرْضَ بَعْدَ مَوْتِهَا وَكَذَلِكَ تُخْرَجُونَ "

صدق الله العظيم

سورة الروم "19"

DEDICATION

To our dear family

Dear Father, lovely mother, Dear brother and sisters

To our friends and colleagues

With love and respect

Mohamed Emad

And Ogba Abdall

ACKNOWLEDGEMENTS

My great thanks are first to ALLAH, who supported us with strength and patience to finish this research successfully.

OUR great indebted to Dr. Samia Osman Yagoub ,and ,for his unlimited support. Also our thanks and appreciation to Ustz .Mazen Ahamed Abd Alroof .

ABSTRACT

This experiment was conducted on the farm of the College of Agricultural Studies Sudan University of Science and Technology Shambat in the winter season 2018/2019 to study the effect of fertilizers ((Mycorrhizea phosphorous, the effect of microorganisms) on the growth and productivity of wheat under the conditions of Shambat climatic.

The experiment was planted on 11/17/2018 by designing complete random sectors in four replications. The results of the study indicated that there are significant differences in plant height and the number of tillers per the plant, while there were no significant differences for the number of leaves and the number of plants per linear meter. The study showed that there were significant differences in the weight of the heads per plant, the weight of the head seeds per plant and the weight of a hundred seeds, while there were no significant differences in both the weight of the spike in the plant, the weight of the seeds in the spike and the number of seeds in the spike.

الخلاصه

أجريت هذه التجربه في مزرعه كليه الدراسات الزراعيه- جامعه السودان للعلوم والتكنولوجيا شمبات في الموسم الشتوي 2019/2018 لدراسه أثر الاسمدة (مايكورايزا، فسفور، تأثير السماد العضوي) علي نمو وإنتاجيه القمح تحت ظروف شمبات المناخيه .

زرعت التجربه في 2018/11/17 بتصميم القطاعات العشوائيه الكامله في أربعه مكررات وتم اخذت قراءة لطول النبات-وعدد الاوراق –وعدد الخلف –ووزن السنبله ووزن البذور .

دلت نتائج الدراسه إن هناك فروقات معنويه في طول النبات وعدد الخلف في النبات بينما لم توجد أي فروقات معنويه في كل من عدد الاوراق وعدد النباتات في المتر الطولي .أيضا دلت نتائج الدراسه أن هناك فروقات معنويه في وزن سنابل الخلف في النبات ووزن بذور الخلف في النبات ووزن المئه حبه .بينما لم توجد أي فروقات معنويه في كل من وزن السنبله في النبات ووزن البذور في السنبله وعدد البذور في السنبله . سجلت معاملة الفسفور و السماد العضوي و سماد المايكورايزا أقل المتوسطات في جميع القياسات .

LIST OF CONTENTS

LIST OF TABAL

List of carfe

CHAPTER ONE

Introduction

Wheat (*Triticum aestivum* L.) is one of the world's major cereal crops and stable food of many regions grown under both irrigated and rain fed conditions. Unlike rice and maize, which prefer tropical environment, wheat is extensively grown in temperate regions occupying 17% of all crop acreage worldwide. It is the staple food for 40% of the world's population (Goyal and Prasad, 2010; Peng l*et al*., 2011). Currently it is also becoming most important cereals grown on a large scale (Fassil *et al*., 2000), because of its significance as cash crop, high level of 42 J. Plant Breed. Crop Sci. production per unit area, its major role in supplying the dietary requirements of the society.

Wheat is the second only to rice which provides 21% of the total food calories and 20% of the protein for more than 4.5 billion people in 94 developing countries (Braun *et al*., 2010). Food consumption of wheat is projected at 488 million tones, 1.3% higher than in the 2014 season, keeping the average per capital level steady at 67.6 kg (FAO, 2015). Global wheat grain production must increase 2% annually to meet the requirement of consistently increasing world population (around 9 billion) till 2050 (Rose grant and Agcaoili, 2010). It is well known that the conciliation of performance improvement of wheat crops depends on maintaining the stock of nutrients in the soil, which is essential for plant growth. As reported by Tilman *et al*. (2002), the global use of nitrogen (N) and phosphorus fertilizers increased by 7- and 3.5-fold, respectively, in the past six decades;

both fertilizers are expected to increase further three fold by 2050. Moreover, the abundant use of fertilizers also increases the risk of pollution. In addition, due to high cost of mineral fertilizers and escalating trends in their prices, there is an increasing trend of using organic fertilizers such as sewage sludge and compost in agriculture, especially in arid and semi-arid regions of the country (ref)…. Therefore, their application to agricultural soils may be sustainable and economical. In this regard, several studies have shown that sewage sludge, by their richness in organic matter, improves the mineral and water statuses of soil and therefore increases crop production (Lobo *et al*. 2013).

The application of sewage sludge (SS) to agricultural land can improve soil fertility and physical properties and enhance crop production (Marinari *et al*. 2000).symbiosis between plant roots and AM fungi is one of methods used to enhance nutrient and water uptake in plants under stress conditions (Abdul-Wasea and Elhidni 2011). It has been shown that symbiosis in AM-inoculated plants not only affects growth but also contributes to improved tolerance to biotic and abiotic stresses (Augé 2001). AM – inoculated plants absorb greater amounts of nutritional elements such as phosphorus (P), nitrogen (N), zinc (Zn) and copper (Cu) and consequently perform better than their non-inoculated counterparts (Smith and Read 2008). Al-Karaki *et al*. (2004) reported higher shoot P and Fe concentrations under field conditions in the mycorrhiza treated wheat cultivars than untreated ones. In addition, the results revealed improved growth, grain yield and nutrient uptake in the AM inoculated wheat cultivars under drought stress. External hyphal development and soil aggregation of the mycorrhiza treated plants were enhanced by drought acclimation (Davies *et al*. 1992). The AM fungus was more effective under higher levels of drought stress and it enhanced wheat and corn tolerance to the stress condition (Mira sari and Smith 2007 and 2008). Evaluating a beard wheat cultivar under different sources of nitrogen fertilizer, Bahrain *et al*. (2010) indicated that grain yield and yield components were affected significantly by inoculation with the AM fungus. In addition, they reported higher number of spikes per square meter in the AM treated cultivars compared to those no inoculated plants.

All Sudanese soil is poor of nitrogen fertilizers which made farmers use more amount of fertilizers which increase the cost of productivity in sudan. Thus the objective of this research is to study(i) the effect of different fertilizers types(Phosphorus, Effective micro organism and mycorrhiza) on vegetative growth of wheat

(ii) the effect of different fertilizers types(Phosphorus, Effective micro organism and mycorrhiza) on yield.

CHAPTER TWO

Literature Review

2.1 Origin :

In view of correct taxonomic categorization the evolution of the genus Triticum should be carefully studied .it is also useful for genetic research, as well as for practical breeding work .but while taking the questing of origin new correlation concerning human evolution and the prehistory of Europe have been disclosed , the genera Triticum and Hordeum ,wheat and barley ,played a decisive role in human civilization and cultural development ,this fact too, was recognized through investigations into evolution genetics.

2.1.1Botany:

The plant is made up of a root and shoots system. Two types of roots are found, the seminal roots nodal roots. (Kirby 1993). Tillers, which have the same basic structure as the main shoot, arise from the axils of the basal leaves. At an thesis only some of the tillers that have developed survive to produce an ear. On the other hand, may be difficult to find in the mature plant (Kirby 1993). Each leaf comprises the sheath, wrapping around the subtending leaf, and a lamina (blade) at the junction of the sheath and lamina , there is a membranous structure , the ligules , and a pair of small, hairy projections the auricles .the base of the leaves on the culms thickened to from a hard knot or pulpiness . (Kirb1993). The elongated distal internodes increase in length from the basal to the most distal, the peduncle (Kirby 1993) Different systems for identifying leaves and internodes have been developed, their form depending on the use to which they are put, as with the total number of leaves, the Number of nodes on the shoot are often not known with certainty. (Kirby 1993). Wheat plant has two types of roots, the seminal (seed) roots and roots that initiate after germination the nodal (crown or adventitious) roots. About six root primordial are present in the embryo at germination the primary root burs thought the followed by the emergency of four or five lateral seminal roots (Kirby 1993). The seed, grain or kernel of wheat (more pedantically, the caryopsis) is a dry in a dehiscent fruit, the dorsal side. With respect to the spike let axis is smoothly rounded while the ventral side has the deep decrease (1993). The Young seminal root has a root cop behind which the root is bare until the root hair zone. (1993).

2.1.2 Climate:-

The climate of the wheat producing areas is classified as arid and semi-arid, with maximum daily air temperatures range from 32.9C in January to 41.C' in May while minimum daily air temperatures range from 14.3C' in January to 24.5C' in June. The rainy growing Season extends from May to October, with a peaking July. Average annual total rain fall amount to 306.4 mm. Cultivated in the Sudan is during the cool season which is short (100-110 day). And experiences short hot spells. Sowing is normally in November while harvesting is in March and April. The soils of the major wheat production areas are cracking heavy clay vertisols, with 58-66% clay, with very low water permeability. PH is about 8.5 with low on organic matter (0.05%).The soil is deficient in nitrogen content (300-400 ppm) and low in available phosphorus (2-4 ppm) (Dawelbeit(1992).

2.1.5 Yields:-

Wheat yield variability was especially high in Gezira. It is more or less comparable to other crops in new Halfa but still slightly higher than those of groundnut and sorghum, since wheat receives considerable attention and enjoys continual un form supple of many in puts as compared with sorghum and groundnut, its variability levels should be lower. Part of the wheat yield variability is explained by yield improvement over time which could be discerned in to areas, namely, Gezira and northern Sudan, wheat yields in the north are noticeably higher but still quite variable despite the effects of many management factors on wheat yields within and across seasons time-related variability is largely explained by the variation in the level of winter temperatures and availability of major in puts such as irrigation water and fertilizes. Analysis of time-series data for Gezira (Faki and Ismail 1994). The persistent wheat yield variability in irrigation schemes should have implications on the strategy of producing the crop at profitable levels. While in addition to temperatures irrigation also contributes to time variability, many other natural and management factors should be responsible for a major portion of yield variability among farmers and sites. Analysis of wheat yields in the Gezira from 1988/89 to 1992/1993 (Faki and Ismail 1994) reveals high space variability as reflected by high coefficients of variation in individual seasons.

2.2.4 Fertilization:-

A geeb et al., (1986). Conducted are searcher-managed trial at Wad Medani, Turabi and New Halfa to study the Effects of land preparation, irrigation yield. It was found that the addition of 43 kg P2 O5/ha caused an increase of 325 kg /ha in grain yield in Gazira.

Ibrahim (1987 , 1989) at Hudeiba, Mohamed (1989) at Shendi, and Ibrahim Mohamed (1988) investigated there response of three wheat cultivars, condor Wade Elneil Debeira to different rates of N application(0,43,86 and 129 kg N/ha), application increased wheat grain and straw yields considerably on the karu and high terrace soils. It was later found that positive and significant response to N application was associated with P application on the high terrace soil(Ibrahim 1989).

2.2.5 Weed control:-

In large scale production schemes (Gazira and New Half) the wheat follows cotton in the rotation in which chemical weed control is practical this practice will ensure less weeds in the wheat land. Also, most of the weeds in the wheat land are controlled during land preparation, and its effect in smothering weeds and for economic consideration no herbicide is officially recommended for wheat. (Ali 1987).

2.2.6 Pests:-

The only economically important insect pest in all wheat production areas is aphids and to some extent stem borers. Screening has been made for many insecticides. Also their dose and time of application have been investigated and some of the scientist are recommended for the control of aphids. (Ali 1987) Chemical control normally gives quick and positive results. According, it received most attention as cultivation of wheat was expanding in central Sudan.

Insecticides of organic phosphorus, chlorinated hydrocarbons and carbonate groups, both individually or as mixtures, were tested against aphids for 2-3 years in Gazira Research Farm (GRF) in nature, aphids are response to attack by many natural enemies and are easy to suppress due to their non-flying habit, their sluggish movement and their sedentary way of feeding (Sharaf Eldin *et al*., 1982).

2.1 Phosphorus

Application of phosphorus fertilizer produces taller plants (Cheema *et al*., 2001). Fertilizers are also important to enhance the crop yield but in some case it decreases the yield due to shortage of irrigation (Li et al., 2001; Rusan *et al*., 2005; Usman, 2013). Integrated effect of phosphorus and irrigation causes increase in grains weight might be due to production of maximum number of grains. Higher phosphorus application rates enhanced the grain size which increases the grain weight (Hussein *et al*., 1996; Turk and Tawaha, 2002). The phosphorus that remained in the soil is important for long term phosphorus management practices. Phosphorus fertilizer recovery is low because of its conversion into unavailable forms of phosphorus that cannot be taken up by plants (Osborne and Rengel, 2002; Wang *et al*., 2005). Phosphorus deficiency is a common problem in crop production all over the world. It is estimated that over 40% of world's cultivated land is short of P for crop production (C, Allan DL. 2003;157: 423–447) Phosphorus availability can be problem in both i.e. alkaline calcareous soils and acidic soils. High pH and higher concentration of $CaCO_3$ are responsible for P unavailability in alkaline calcareous soils (Rahmatullah , Gill MA,. 1994;8: 227–234). while in acidic soils, higher concentration of Al and Fe declines P availability to plants .Moreover, continuously increasing prices, injudicious use of N fertilizers and increased environmental issues of phosphoric fertilizers (Gaffer S, Stevenson RJ; 2017).

2.2 Microorganisms

Microorganisms play an important role in agricultural systems. Specifically, carbuncular mycorrhizya fungi (AMF) are potential components of sustainable management systems (Adesemoye & Kloepper, 2009). These fungi are bio trophic because they depend on their host to complete their life cycle. They establish symbiotic associations with the majority of terrestrial plants in a diversity of ecosystems (Graham, 2008; Smith & Read, 2008; Neumann & George, 2010), improve plant tolerance to both biotic stresses (e.g., pathogens) and biotic stresses (e.g., drought, soil salinity, and pollution) (Bunuel's *et al*., 2014; Ruiz-Lozano *et al*., 2012; Cicatelli *et al*., 2014; Songachan *et al*., 2011), and play a role in remediation (Monika *et al*., 2012).

Over the past few decades, companies throughout the world have manufactured and commercialized AMF inoculants using either single AMF species or mixtures of AMF species that may include plant-growth-promoting rhizobacteria or other symbiotic and/or biocontrol fungi (Gianinazzi & Vosátka, 2004).

The industrial manufacturing of AMF as crop inoculants is relatively new, and, despite practical demonstrations of the efficiency of AMF, and crop producers have been slow to adopt them((Yücel *et al*., 2009). Inoculation with effective microorganisms could lead to enhanced crop productivity and higher incomes for farmers. The effectiveness of the AM symbiosis is highly dependent on the host plant genotype (Yücel *et al*., 2009).

These hexaploid Canadian wheat genotypes differed in AM root. The selection of crop cultivars that have strong associations with AMF may be important in providing adequate soil fertility to the crop (Singh *et al*., 2012).

CHAPTER THREE

Materials and methods

Site of experiment:

A field experiment was conducted at the experimental farm of the College of Agricultural Studies, Sudan University of Science and Technology (Shambat), Khartoum State, Shambat is located between (Latitude 15.14North and longitude 32 .32East) and altitudes of 380 meters above sea level, during the winter season 2018/2019. The climate is characterized by semi \desert tropic with allow percentage of humidity and average rainfall of 158 mm per annum and temperature of 20.3^{0}C and clay Celtic soil (khairy 2010) .soil PH 7.5-8.7 as described by (Hamden 2010).

Source of materials:

Seeds of wheat were obtained from Shmbat Research Station. Imam variety was used in this study, Fertilizers were Mycorrhiza (10g/hole),super phosphate (10g/hole)and EM(Effective micro organism)10 ml/ hole from Shmbat Research Station.

Field design and treatment :

The treatments were arranged in a randomized complete block design (RCBD) in four replicates. Application of Mycorrhiza (10g/hole) ,phosphorus (10g/hole) and EM (Effective micro organism)10 ml/ hole with planting.

Cultural practice:

Land preparation:

The experimental site was disc ploughed and then followed by harrowing and levelling, riding up north –south. The spacing between ridges was 70 cm . the sowing date was in November 2018 . The space of seed was 20 cm with fertilizer on same whole weeding was done twice after three weeks from sowing and one month from the first hand weeding.

Irrigation:

The first irrigation was done immediately after sowing and then every 10 days.

Data collection:

Plant height (cm):

Three plant of wheat were randomly selected from each plot and the plant height was measured from soil surface to the tip of leaf using a measuring tape and then the mean height was obtained.

Number of leaves / plant:

Three plant of wheat were randomly selected from each plot and the average number of leaves per plant was counted.

Number of tillers / plant:

From three plant of wheat were randomly selected from each plot, the average number of tillers per plant was counted.

The yield (t/ ha):

Plant from an area of one meter square were taken , weighed and the yield was calculated as follows .

Area in m^2 (10000 m^2) x forage weight per m^2 (g) ÷ weight unit 1000×1000

Statistical analysis:

The data were statistically analyzed according to Randomize Copelet block Arrangement (RCBD) using MSTAT-. Software Means were separated by least significant difference (L.S.D) (Gomez and Gomez 1984).

Chapter four

Results

4.1 Plant height:

At 30 DAS highly significant difference were observed between the treatments in plant height (Table 4.1). MI Treatment increased plant height by 21.8% compared to control (Table 4.1). P Treatment increased plant height by 20.9% . EM treatment increased plant height by 19.7%. combination of P +Mi treatment increased plant height by 15.4% compared to control. EM +Mi treatment increased plant height by 9% compare to control. EM+P treatment increased plant height by 8.8%. Mi +p+ EM treatment reduced plant high by 11.5% compared to control.

At 45 DAS non- significant differential were observed between the treatments in plant height (Table 4.1). Treatment Mi increased plant height by 9.6% compared to control (Table 4.1). P Treatment increased plant height by7.7% . EM treatment increased plant height by4.9% . P +Mi treatment increased plant

height by3.6% . compared to control. EM +Mi treatment increased plant height by3%.% compare to control. EM+P treatment increased plant height by 0.5%. Mi +p + EM treatment reduced plant height by1.3%. compared to control.

At 60 DAS non- significant differential were observed between the treatments in plant height (Table 4.1). Treatment Mi increased plant height by8.6%. compared to control (Table 4.1). P Treatment increased plant height by7.1%. EM treatment increased plant height by 5.5%. P +Mi treatment increased plant height by3%. compared to control. EM +Mi treatment increased plant height by 3%. compare to control. EM+P treatment increased plant height by2%. Mi +p +EM treatment reduce plant height by0.1%. compared to control.

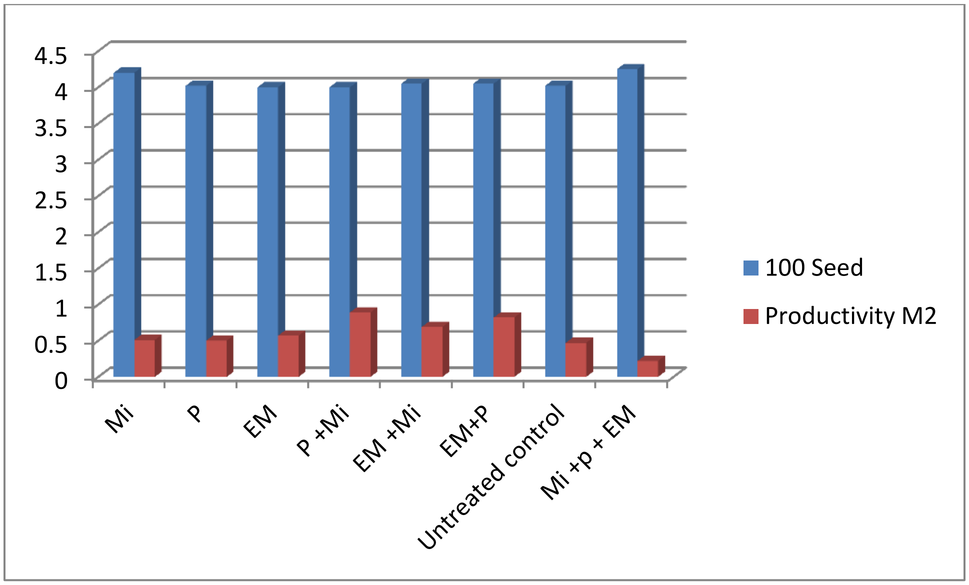
Table: 4.1 wheat plant height\cm

Wheat height (cm)			
Days After Sowing (DAS)			
Treatments	**30**	**45**	**60**
Mi	53.600 A	74.833 A	74.117 A
P	53.242 A	73.583 AB	73.133 A
EM	52.725 A	71.917 AB	72.042 A
P +Mi	50.833 AB	71.000 AB	71.075 A
EM +Mi	48.000 AB	70.333 AB	71.033 A
EM+P	47.908 AB	68.667 AB	70.750 A
Untreated control	44.025 BC	68.250 B	68.967 A
Mi +p + EM	38.925 C	67.300 B	68.858 A
LSD	2.080	2.080	2.080
CV%	9.96	6.13	6.20
F- Value	0.0035**	0.2272 N.s	0.6772 N.s

Mi = **Mycorrhizea**, EM= Effective microorganism= phosphorus

Means within a column followed by the same letter(s) are not significantly different according to LSD-Test. *P≤0.05, **=P≤0.01.

Carve: 4.1 wheat plant height\cm



4.2 Number of leaves:

At 30 DAS non- significant difference were observed between the treatments in number of leaves (Table 4.2). Treatment Mi increased number of leaves by16.1%. compared to control (Table 4.2). P Treatment increased number of leaves by8%. EM treatment increased number of leaves by8%. P +Mi treatment increased number of leaves by4.8%. compared to control. EM +Mi treatment increased number of leaves by 0 compare to control. EM+P treatment increased number of leaves by 0 Mi +p +EM treatment reduce number of leaves by3.2%. compared to control.

At 45 DAS were non- significant difference were observed between the treatments in number of leaves (Table 4.2). Treatment Mi increased number of leaves by 23.8%(Table 4.2). compared to control (Table 4.2). P Treatment increased number of leaves by 19% . EM treatment increased number of leaves by 19% P +Mi treatment increased number of leaves by 11.9% .compared to control. EM +Mi treatment increased number of leaves by 11.9%.compare to control. EM+P treatment increased number of leaves by 7.1%. Mi +p +EM treatment reduce number of leaves by 0% .compared to control.

At 60 DAS were non- significant differential were observed between the treatments in number of leaves (Table 4.2). Treatment Mi increased number of leaves by 14.2%. compared to control (Table 4.2). P Treatment increased number of leaves by 14.2% . EM treatment increased number of leaves by 5.7% P+ Mi treatment increased number of leaves by 5.7% compared to control. EM +Mi treatment increased number of leaves by 5.7% . compare to control. EM+P treatment increased number of leaves by

5.7% . Mi +p +EM treatment reduce number of leaves by 0%. compared to control.

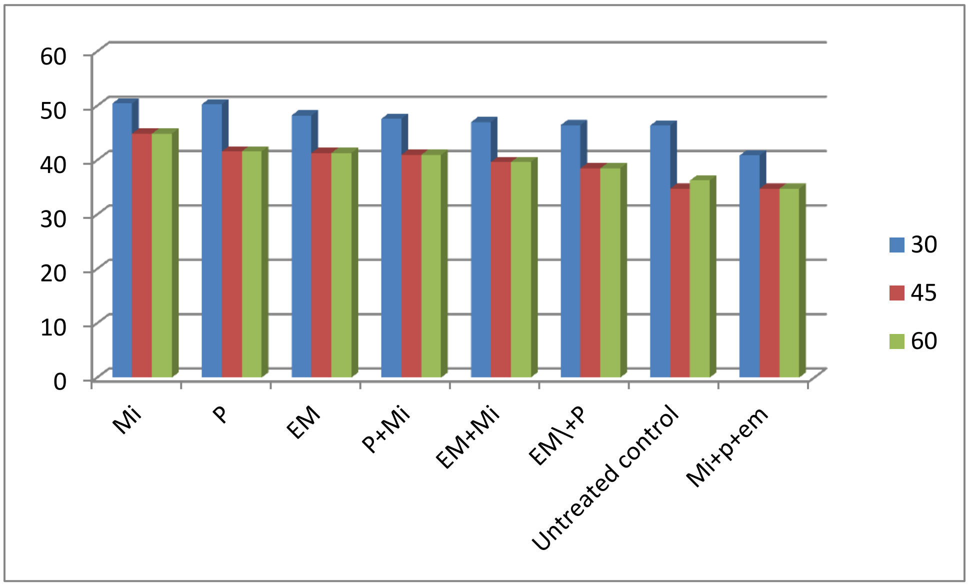
Table: 4.2 Wheat number of leaves\plant

Number of leaves\plant			
Days After Sowing (DAS)			
Treatments	**30**	**45**	**60**
Mi	7.2500 A	5.2500 A	4.0000 A
P	6.7500 AB	5.0000 A	4.0000 A
EM	6.7500 AB	5.0000 A	3.7500 A
P+ Mi	6.5000 AB	4.7500 A	3.7500 A
EM +Mi	6.2500 AB	4.7500 A	3.7500 A
EM\+P	6.2500 AB	4.5000 A	3.7500 A
Untreated control	6.2500 AB	4.2500 A	3.5000 A
Mi +P+ EM	6.0000 B	4.2500 A	3.5000 A
LSD	2.080	2.080	2.080
CV%	10.48	16.77	14.55
F- Value	0.2630 N.s	0.5006 N.s	0.8382 N.s

Mi = **Mycorrhizea** EM= Effective microorganism= phosphorus

Means within a column followed by the same letter(s) are not significantly different according to LSD-Test. *P≤0.05, **=P≤0.01

Carve: 4.2 Wheat number of leaves\plant



4.3 Number of tillers

At 30 DAS Tillers non - significant differential were observed between the treatments in Number of tillers (Table 4.3). Treatment Mi increased Number of tillers by 43.5% compared to control (Table 4.3). P Treatment increase Number of tillers by 35.2% . EM treatment increased Number of tillers by 17.6%. P +Mi treatment increased Number of tillers by 14.1% compared to control. EM +Mi treatment increased Number of tillers by 0% compare to control. EM+P treatment increased Number of tillers by 0%. Mi +p+ Em treatment reduce Number of tillers by 10.5% compared to control.

At 45 DAS were non- significant differential were observed between the treatments in Number of tillers (Table 4.3). Treatment Mi increased Number of tillers by71.4% (Table 4.3). compared to control (Table 4.3). P Treatment increase Number of tillers by 68.8% EM treatment increased Number of tillers by62.3% P +Mi treatment increased Number of tillers by . 36.3% compared to control. EM +Mi treatment increased Number of tillers by10.3%. compare to control. EM+P treatment increased Number of tillers by.6.4 % MI +P +EM treatment reduce Number of tillers by6.4%. compared to control.

At 60 DAS were non- significant differential were observed between the treatments in Number of tillers (Table 4.3). Treatment Mi increased Number of tillers by56.9%. compared to control (Table 4.3). P Treatment increased Number of tillers by53.8%. EM treatment increased Number of tillers by 46.1%. P+ Mi treatment increase Number of tillers by18.4%. compared to control. EM +Mi treatment increased Number of tillers by 10.7%. compare to control. EM+P treatment increased Number of tillers by7.6%. Mi +p +EM treatment reduce Number of lives by23%. compared to control.

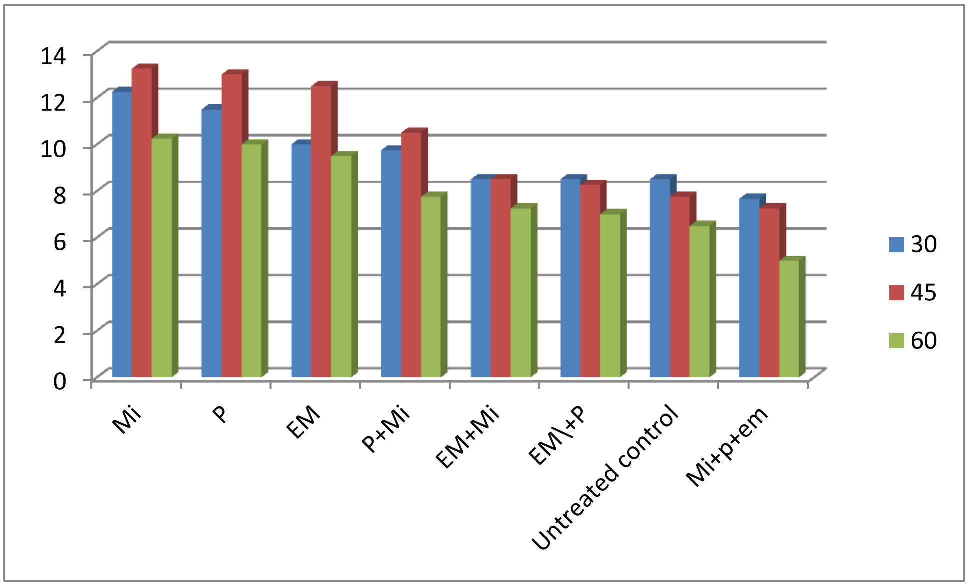
Table:4.3 Effects of Fertilizers (Mycorrhizya , Phosphorus and ,Effective Micro-organism) on Number of tillers\plant (cm)

Number of tillers\plant (cm)			
Days After Sowing (DAS)			
Treatments	30	45	60
Mi	12.250 A	13.250 A	10.250 A
P	11.500 A	13.000 AB	10.000 AB
EM	10.000 A	12.500 ABC	9.500 ABC
P+ Mi	9.750 A	10.500 ABC	7.750 ABCD
EM +Mi	8.500 A	8.500 ABC	7.250 ABCD
EM\+P	8.500 A	8.250 ABC	7.000 BCD
Untreated control	8.500 A	7.750 BC	6.500 CD
Mi+ P+ EM	7.667 A	7.250 C	5.000 D
LSD	2.080	2.080	2.080
CV%	35.00	36.65	27.52
F- Value	0.5086 N.s	0.1361 N.s	0.0271 N.s

Mi = Mycorrhiaz , EM= Effective microorganism= phosphorus

Means within a column followed by the same letter(s) are not significantly different according to LSD-Test. *P≤0.05, **=P≤0.01 .

Carve :4.3 Number of tillers\plant (cm)



4.4 Chlorophyll content

At 30 DAS Chlorophyll contain NON-significant differential were observed between the treatments in Chlorophyll contain (Table 4.4). Treatment Mi increased Chlorophyll contain by 8.8% compared to control (Table 4.4). P Treatment increased Chlorophyll contain by 8.4% . EM treatment increased Chlorophyll contain by 4.1%. P+ Mi treatment increased Chlorophyll contain by 2.8% compared to control. EM +Mi treatment increased Chlorophyll contain by 1.5% compare to control. EM+P treated increased Chlorophyll contain by 0.2%. Mi +p + EM treatment reduce Chlorophyll contain by 11.8% compared to control.

At 45 DAS were non- significant differential were observed between the treatments in Chlorophyll contain (Table 4.4). Treatment Mi increased Chlorophyll contain by 29.1% (Table 4.4). compared to control (Table 4.4). P Treated increased Chlorophyll contain by19.8% . EM treatment increased Chlorophyll contain by19%. P +Mi treatment increased plant high by17.8%. compared to control. EM +Mi treatment increased Chlorophyll contain by14.1%. compare to control. EM+P treatment increased Chlorophyll contain by 10.9%. Mi +p+ EM treatment reduce Chlorophyll contain by 0% compared to control.

At 60 DAS were non- significant differential were observed between the treatments in Chlorophyll contain (Table 4.4). Treatment Mi increased Chlorophyll contain by. 23.7% compared to control (Table 4.4). P Treatment increase Chlorophyll contain by 14.9% EM treatment increased Chlorophyll contain by14% P+ Mi treatment increased Chlorophyll contain by12.9% compared to control. EM +Mi treatment increased Chlorophyll contain by 9.3% compare to control. EM+P treatment increased Chlorophyll contain by 6.3% MI +P+EM treatment reduce Chlorophyll contain by 4.1% compared to control.

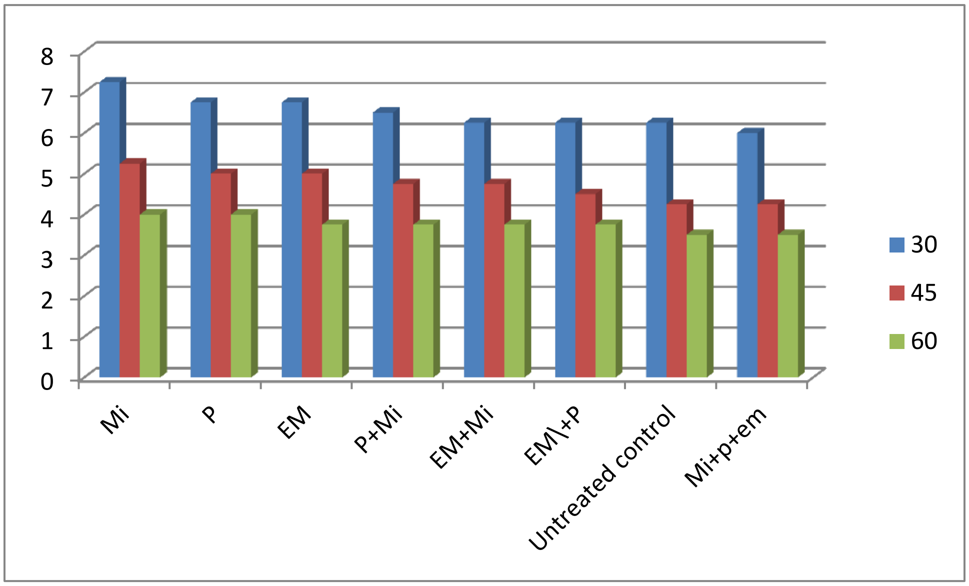
Table:4.4 Effects of Fertilizers(Mycorrhizea, Phosphorus and ,Effective Micro-organism) Chlorophyll content\plant

Chlorophyll content\plant			
Days After Sowing (DAS)			
Treatments	30	45	60
Mi	50.400 A	44.875 A	44.875 A
P	50.275 A	41.600 AB	41.600 AB
EM	48.225 A	41.325 AB	41.325 AB
P+ Mi	47.600 A	40.975 AB	40.975 AB
EM +Mi	47.000 A	39.650 AB	39.650 AB
EM\+P	46.425 A	38.500 AB	38.500 AB
Untreated control	46.350 A	34.750 B	36.250 AB
Mi +p +EM	40.850 A	34.750 B	34.750 B
LSD	2.080	2.080	2.080
CV%	20.85	14.97	14.98
F- Value	0.9096 N.s	0.2158 N.s	0.3614 N.s

Mi = **Mycorrhizea**, EM= Effective microorganism= phosphorus

Means within a column followed by the same letter(s) are not significantly different according to LSD-Test. *P≤0.05, **=P≤0.01 .

Carve : 4.4Chlorophyll content\plant



Wheat yield:

Weight of 100 seed :

The analysis showed there was no significant deference between the treatments in compression with control .mycorrhiza treatment it highest weight (4.20 gm) Table (4.6).the lowest 100 seed weight recorded by effective microorganism and phosphorus +effective micro organism (4 gm) table (4.6).

Wheat productivity M^2 :

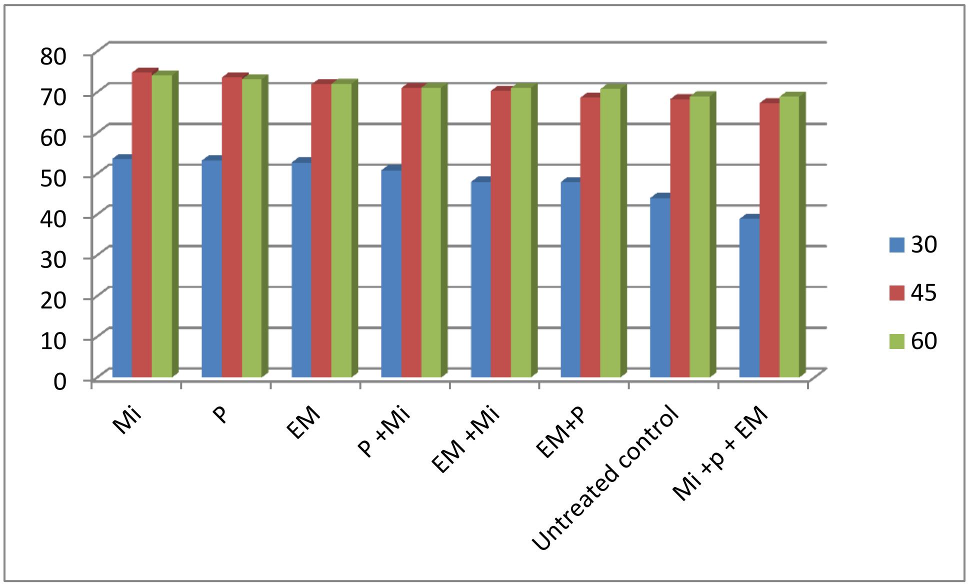
The analysis showed there was no significant deference between the treatments in compression with control. The height productivity recorded by combination phosphorus and mycorrhiza (0.89 tan/ha) Table (4.6). The lowest productivity recorded by combination phosphorus , effective microorganism and Mycorrhiza (0.22 tan/ha) Table (4.6)

Table 4.6: Effects of Fertilizers (Mycorrhizea, Phosphorus and ,Effective Micro-organism) on Wheat yield and productivity

Wheat yield		
Treatments	**100 Seed**	**Productivity M2**
Mi	4.20 A	0.51 B
P	4.02 A	0.50 B
EM	4.00 A	0.57 B
P +Mi	4.00 A	0.89 A
EM +Mi	4.05 A	0.69 A
EM+P	4.05 A	0.82 A
Untreated control	4.02 A	0.47 B
Mi +p + EM	4.25 A	0.22 C
LSD	2.08Ns	0.29 Ns
CV%	10.19	34.27
F- Value	0.21	4.53

Mi = **Mycorrhizea**, EM= Effective microorganism= phosphorus
Means within a column followed by the same letter(s) are not significantly different according to LSD-Test. $*P\leq0.05$, $**=P\leq0.01$

Carve:4.5 Wheat yield



Chapter five

Discession

A field experiment was conducted at the experimental farm of the College of Agricultural Studies, Sudan University of Science and Technology (Shambat), Khartoum State, Shambat is located between (Latitude 15.14North and longitude 32 .40East) and altitudes of 380 meters above sea level, during the winter season 2018/2019.Statistic analysis showed The combination between phosphorus , effective micro-organism and micorhiza decreased the plant height that because the increase vegetaTIVE growth and that is on account of plant height . Phosphorus Treatment increased plant height. According to Bollandet al.(Bolland MDA, Bowden 1991), early plant growth is particularly dependent on phosphorus because it needs rapid cell division. (Wolf andKippe 1997). Phosphorus Treatment increase Number of tillers by 35.2% .Table (4.3). This phenomenon was confirmed by Aulakh et al. (2003). The lowest productivity recorded by combination phosphorus, effective microorganism and Mycorrhiza (0.22 tan/ha) Table (4.6) The combination of fertilizer gave the lowest 100 seed weight .this might be due to more assimilates (sink-source relation) to the seed which increased the number of seeds hence less weight .This against the result of Mammon et al. (2005) and Mehdi *et al*. (2007). Mycorrhiza, phosphorus and effective micro organism treatment reduce Chlorophyll contain by 4.1% compared to control in 30,45 and 60 DAS as result my be might of the absence of nitrogen component which is essential in formation of chlorophyll .

Chapter SIX

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