EFFECT OF VERMICOMPOST, MINERAL AND BIOFERTILIZATION ON SOIL FERTILITY AND PRODUCTIVITY OF PEARL MILLET PLANTS GROWN IN SANDY SOIL

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This study was carried out during the two successive seasons of 2020 and 2021 on pearl millet (*Pennisetum glaucum*), grown in sandy soil under drip irrigation system at Baloza Research Station, North Sinai Governorate, Egypt (31°32 03 N and 32° 362 03 E). The present study aims at the evaluation of the effect of using vermicompost, NPK (100 and 75% levels), biofertilization (mixture from *Azotobacter chroococcum*, *Pseudomonas fluorescence* and *Streptomyces microflavus*), dual (verimcompost + NPK) and mixed treatment (vermicompost + NPK + bio). The obtained results indicated that the mixed treatment (vermicompost + NPK + bio) increased growth parameters, yield parameters, NPK content and improved soil fertility. Furthermore, addition of biofertilizers showed a positive effect on total microbial counts, *Azotobacter* densities, *Pseudomonas* and Actinomycetes counts in the rhizosphere region of pearl millet plant. On the other hand, microbial activity expressed by dehydrogenase enzyme increased as compared to the control.

Key words: vermicompost, biofertilization, pearl millet, NPK, sandy soil

INTRODUCTION

Pearl millet (*Pennisetum glaucum* L.) is a perennial grass, originally from Africa that shows drought resistance, with excellent water efficiency for forage production. It grows well in sandy and low fertility soils as well (Tabosa et al., 1999).

In Egypt, pearl millet has been grown as a forage crop in summer season. Several dairy farmers reflect on it better to other fodder crops for milk production and farmers producing beef because the mean hydrocyanic acid potential (HCN-P) values for pearl millet are very low as compared with sorghum and sorghum-sudan grass hybrids (Geweifel, 1997).

Co-inoculation of the advantageous, synergistically acting microorganisms offers promising opportunities for reducing the effects of salt stress on plants and enhancing the productivity of plant species. Co-inoculation enhanced the plant ability to absorb nitrogen, phosphate, and mineral nutrients as compared to single inoculation (Yadegari et al., 2008 and Dos Santos et al., 2020).

Many helpful microorganisms are applied in agriculture to improve crop development and yield quality. So, it is conceivable to create efficient various microbial inoculants, but it is essential to use local communities of helpful bacteria because doing so takes use of the partners' inherent biological and genetic environmental adaptations (Gentili and Jumpponen, 2006).

Actinomycetes, in particular *Streptomyces* spp., play a significant role in the natural production of antibiotics or antifungals that can defend plants from a variety of phytopathogen agents (Champness, 1999). *Streptomyces* promotes the growth of crops and vegetables by creating bioactive chemicals that are associated to plant growth enhancement (Keiser et al., 2000 and Thangapandian et al., 2007).

Azotobacter species are widely distributed in various settings, and many plants' soil and rhizosphere contain them (Kizilkaya, 2009). *Azotobacter* spp. has been highlighted for its ability to create several growth hormones (indole acetic acid and other auxins, gibberellins and cytokinins), vitamins, and siderophores, but they are most famous for their non-symbiotic ability to fix nitrogen (Mrkovac and Milic, 2001 and Song et al., 2008 and). *Azotobacter* has the ability to change nitrogen into ammonia, which is then absorbed by plants (Prajapati et al., 2008). It can also make antifungal substances to combat numerous plant infections (Chen, 2006).

MATERIALS AND METHODS

The present investigation was carried out during two successive seasons; 2020 and 2021 in newly reclaimed arid land in the Agricultural Experimental region of the Desert Research Center at Baloza Research Station, North Sinai Governorate (31°32 03 N and 32° 362 03 E), to investigate the effect of integration between organic fertilizer (vermicompost), mineral and biofertilization on soil fertility and productivity of pearl millet plants grown in sandy soil using highly efficient strains of *Azotobacter chroococcum, Pseudomonas fluorescence* and *Streptomyces microflavus*. The experiment was planned in a randomized complete block design with three replicates.

The experiment included eight treatments as follows:

T1: Control (untreated with organic fertilizer or biofertilizers).

T2: 100% mineral NPK of recommended dose.

T3: Organic fertilizer (4.8-ton vermicompost/ha)

T4: Vermicompost + biofertilization (mixture of beneficial microbe strains as *A. chroococcum, P. fluorescence* and *S. microflavus* (bio).
T5: Vermicompost+75% mineral NPK of recommended dose.
T6: Vermicompost+100% mineral NPK of recommended dose.
T7: Vermicompost+75% mineral NPK of recommended dose + bio.
T8: Vermicompost+100% mineral NPK of recommended dose+ bio

Grains of pearl millet cv. Shandaweel–1 were kindly supplied by the Fodder Crops Research Institute, Agricultural Research Center, Giza, Egypt, were sown on May 12th and 16th in 2020 and 2021, respectively. Grains of pearl millet were seeded in hills, 20 cm apart at a rate of 30 kg/ha.

The full dose of nitrogen fertilizer (100%) was added at about 170 kg N/ha in the form of ammonium sulfate (20% N) at three equal doses where the 1st, 2nd and 3rd doses were after thinning, before the second and the third irrigation, respectively. Phosphorus fertilizer was added in the form of calcium superphosphate (15.5% P_2O_5) at a rate of 72 kg P_2O_5/ha during soil preparation. Also, during soil preparation vermicompost was added at a rate of 4.8 ton/ha, where its properties are presented in Table (1). Potassium fertilizer was applied in the form of potassium sulfate (48% K_2O) at a rate of 180 kg K_2O/ha after 50 days of sowing. At harvesting stage, ten guarded plants were taken randomly from each plot to measure biological parameters (plant height, biological yields, dry weights of grain and stover) and N, P and K of grains were determined in acid digested solution, which was prepared according to Cottenie et al. (1982). Physical and chemical properties of the experimental soil were determined according to Page et al. (1982) as shown in Table (2). Plants were irrigated under drip irrigation system with water obtained from El-Salam Canal and its chemical analysis is shown in Table (3).

1. Determination of Available NPK in Soil

Available nitrogen in soil samples was extracted by 2M potassium chloride solution and determined according to Dhank and Johnson (1990). Available potassium and phosphorous were measured according to the method described by Soltanpour (1991).

2. Isolation, Purification and Selection of *Azotobacter, Pseuomonas* and Actinomycetes Isolates

Different soil samples were collected from different sites of North Sinai Governorate, Egypt used for isolation of *Azotobacter*, *Pseudomonas* and Actinomycetes eight species were obtained from each genus of microorganism. Cultures of *Azotobacter*, *Pseudomonas* and Actinomycetes isolates were purified by successive streaking on Ashybys, King's medium B, Waksman and Lechevalier (Murray et al., 2003), respectively. Microscopical examination was carried out to check the purity of cultures. The purified seven isolates *Azotobacter*, *Pseudomonas* and Actinomycetes isolates were tested for their phosphate dissolving efficiency quantitative and

qualitative according to De Freitas et al. (1997). For purification and maintenance of *Azotobacter*, *Pseudomonas* and Actinomycetes the isolates were purified by streak plate method on Ashbys, King's B and Waksman and Lechevalier medium (1962), respectively. Individual colonies were streaked on respective slants and stored in a refrigerator at 4°C for further studies.

Table (1). Nutrient contents of vermicompost.

macronutrients (%)			micronutrients (mg/l)			
N	**P**	**K**	**Fe**	**Zn**	**Mn**	**Cu**
1.35	0.42	2.17	1.72	120.9	58.65	44.25

Table (2). Some physical and chemical properties of the experimental soil.

Depth (cm)	**0-30**	**30-60**
Partical size distribution (%)		
Sand	89.12	90.73
Silt	6.34	5.56
Clay	4.54	3.71
Texture class	sandy	sandy
pH of soil extraction (1: 2.5)	8.25	8.11
EC(dS/m) of soil extraction (1: 2.5)	1.47	1.25
Soluble ions in of soil extraction (1: 2.5) (meq/L)		
Na	5.13	2.84
K	0.54	3.91
Ca	3.65	4.89
Mg	4.40	0.48
Cl	3.30	3.12
HCO_3	3.85	3.54
SO_4	6.57	5.47
Available nutrients (mg/kg)		
N	35.00	27.00
P	2.66	1.74
K	44.00	32.00

Table (3). Some chemical analysis of the used irrigation water.

pH	**E.C (dsm^{-1})**	**Soluble Cations (meq./l)**				**Soluble Anions (meq.l)**			
		Ca^{++}	**Mg^{++}**	**Na^{+}**	**K^{+}**	**CO_3^{--}**	**HCO_3^{-}**	**SO_4^{--}**	**Cl^{-}**
7.79	1.76	3.38	2.41	11.12	0.71	Nil	1.28	5.21	11.13

3. Identification of Bacterial Isolates

Table (4) shows the identification of *Azotobacter*, *Pseudomonas* and Actinomycetes isolate. The most active *Azotobacter*, *Pseudomonas* and

Actinomycetes isolates with phosphate dissolving activity were identified by using biochemical tests (Hol et al., 1994) and their efficiency for growth regulators production (Rizzolo et al., 1993), nitrogen fixation (Page et al., 1982), antibiotics production (Jarlier et al., 1996) were determined.

Table (4). Phosphate solubilization, by *Azotobacter*, *Pseudomonas* and Actinomycetes isolates.

Isolate no.	Phosphate solubilization (inhibition zone in cm)		
	Azotobacter	***Pseudomonas***	**Actinomycetes**
1	1.2	1.8	1.1
2	1.3	2.7	1.9
3	1.9	2.1	2.1
4	**2.4**	2.5	1.8
5	1.6	1.7	1.5
6	2.2	**2.8**	2.1
7	1.3	2.6	**2.6**

4. Compatibility Test of the Inoculants

Azotobacter, *Pseudomonas* and Actinomycetes were tested for compatibility of growth by cross streak assay in nutrient agar medium. Nutrient agar medium was prepared and sterilized. The medium was poured into sterile petri plates and allowed for solidification. To test the compatibility of *Azotobacter*, *Pseudomonas* and Actinomycetes, they were streaked as a strip at one end of the plate and incubated for 24 h to form a thick growth. The test cultures (pathogenic bacteria and fungi) were streaked perpendicular to the other one growth. The plates were incubated for 48 h and observed for the growth of *Azotobacter*, *Pseudomonas* and Actinomycetes.

5. Preparation of Microbial Inoculum

The inoculum of each strain was prepared by growing in 500 ml flasks containing selective media. Flasks were incubated at 30°C for 48 h under shaking, the suspension containing 10^8 cfu/ml was used for inoculation. Heavy cell suspension of *Azotobacter chrocchocum* was obtained by growing it on Ashby´s media for 7 days at 28±2°C and *S. microflavus* isolates was obtained by growing it on starch nitrate broth for 7 days at 28±2°C, and *Pseudomonas flourecense* on Kings B media.

6. Microbiological Analyses

Rhizosphere soil samples were collected to determine the microbiological parameters, the root hairs were collected for detection of mycorrhizal root colonization.

7. Determination of the Total Microbial Counts

Total microbial count was determined using the decimal plate count technique by Seeley and Vandemark (1981).

8. Determination of *Azotobacter* Densities

Azotobacter densities was determined by using the most probable number (MPN) method after incubating the tubes at 28±2˚C for 10 days on modified Ashby's medium (Becking, 2006). Estimating the number of *Azotobacter* by MPN technique was calculated using Cochran's table (Cochran, 1950).

9. Determination of Actinomycetes Counts

Total Actinomycetes count was determined on starch nitrate medium (Waksman and Lechevalier, 1962).

10. Determination of *Pseudomonas* Counts

Total *Pseudomonas* count was determined using MPN of *Pseudomonas* after incubating the tubes at 30±2˚C for 48 h on King's B medium (King et al., 1954). Estimates of number of *Pseudomonas* by MPN technique were calculated using Cochran's table.

11. Statistical Analysis

Analysis of variance (ANOVA) was calculated according to the method of Duncan's, multiple range tests at 0.05 level, using MSTAT computer statistical software according to Russel (1991).

RESULTS AND DISCUSSION

1. Isolation and Selection of *Pseudomonas* Isolates

A total of 7 *Azotobacter*, *Pseudomonas* and Actinomycetes isolates were isolated (Table 4), purified, and tested for their ability to dissolve phosphate qualitatively (De Freitas et al., 1997).

2. Identification of Pseudomonas isolate

The most active isolate no. 4 in *Azotobacter*, no. 6 in *Pseudomonas* and no. 7 in Actinomycetes were completely identified according to Hol et al. (1994). The morphological and physiological characters reported that, selected *Azotobacter* isolate was found to be *A. chroococcum*, *Pseudomonas* isolate was found to belong to *Pseudomonas fluorescens.* Selected Actinomycetes isolate was found to be *S. microflavus.*

3. Biochemical Activities of *Azotobacter chroococcum, Pseudomonas fluorescens*and, *Streptomyces microflavus*

Beneficial bacteria known to create a variety of secondary metabolites including *S. microflavus, P. fluorescens,* and *A. chroococcum*. The metabolic processes used by *A. chrococcum, P. fluorescens,* and *S. microflavus* strains in the trial to produce plant hormones, antibiotics, and nitrogen fixation are shown in Table (5).

According to Table (5), the microorganisms demonstrated *in vitro* biochemical and hormonal activities that might have a positive impact in the field (Abd El-Gawad, 2008).

Table (5). Biochemical activities of the selected microbial isolates.

	P. fluorescens	***A. chrococcum***	***S. microflavus***
Nitrogenase (µl $C_2H_4H^{-1}I^{-1}$)	-	310 (ppm)	-
Hormonal activity (µg/ml)			0.291
IAA	10.25	2.90	4.260
GA_3	3.11	3.41	14.280
Cytokinin	24.05	11.90	
Antibiotic reduction (mm)			
E. coli	29	31	**44**
Salmonella typhi	20	27	**32**
F. oxysporum	34	15	**38**
R. solani	27	13	**30**

4. Compatibility Test of the Inoculants

Azotobacter, *Pseudomonas* and Actinomycetes were found to be compatible with each other and were able to grow simultaneously without inhibition in growth.

5. Microbiological Measurements

To calculate the total microbial counts in soil (x10 cfu/g dry soil). On selective media, the MPN is used to calculate the densities of *Azotobacter*, *Pseudomonas* and Actinomycetes numbers.

6. Total Microbial Counts

Before cultivation, there were 118×10^6 cfu/g of dry soil in the overall microbial count (Table 6). The fact that total microbial counts varied with different treatments and biofertilization treatments might be explained by the simulative influence of additional biofertilizers on the microbial population in the rhizosphere of pearl millet, which results in an increase in total microbial counts. Many soil improvement indicators use the enhancing effect of microbial activity as a good parameter. For instance, *A. chroococcum* stimulates the formation of organic acids, growth-promoting compounds, biological nitrogen fixation, and other enzymatic activities, all of which promote plant development and increase the surface area available for absorbing nutrients (Abd El-Gawad et al., 2014). The vermicompost and mixed biofertilization treatments had the greatest overall microbial counts, with 100% NPK being 230106 cfu/g dry soil.

Table (6). Effect of vermicompost, mineral and biofertilization on microbial determinations in rhizosphere of pearl millet plant.

Treatments	Total microbial counts ($\times10^6$cfu/g dry soil)	Total *Azotobacter* densities ($\times10^4$cells/g dry soil)	Total *Pseudomonas* counts ($\times10^4$cfu/g dry soil)	Total Actinomycetes counts ($\times10^3$cfu/g dry soil)
Control	139^{G}	111^{G}	103^{F}	19^{E}
100% NPK	141^{G}	115^{F}	104^{F}	20^{E}
Vermicompost	154^{F}	129^{E}	113^{E}	25^{D}
V + biofertilizers (bio)	207^{C}	181^{C}	187^{A}	33^{AB}
V + 75% NPK	188^{E}	180^{C}	142^{D}	28^{C}
V + 100% NPK	195^{D}	172^{D}	153^{C}	30^{BC}
V + 75% NPK + bio	237^{A}	209^{B}	185^{A}	36^{A}
V + 100% NPK + Bio	230^{B}	212^{A}	173^{B}	35^{A}
L.S.D at 0.05	1.0138	1.014	1.9579	1.5811

7. *Azotobacter* Densities

The represented data in table (6) show an increase in *Azotobacter* densities in comparison to the control after various treatments. Vermicompost inoculation with mixed biofertilizers, including *S. microflavus, P. fluorescence,* and *A. chroococcum*, had a stimulating effect on microbial concentrations in the rhizosphere. The largest increase above control, 91%, was found in the biofertilization + vermicompost + 100% NPK interaction. The application of *A. chroococcum* has the effect of promoting soil fertility, microbial community, and plant growth in addition to nitrogen fixation (El-Shazly, 2021). Other factors contributing to this effect including the production of amino acids, organic acids, vitamins, and antimicrobial substances.

8. *Pseudomonas* Densities

Initial *Pseudomonas* concentration was 89×10^4cfu/g dry soil. The data in Table (5) demonstrate a significant rise in *Pseudomonas* density. The greatest density was 173×10^4cfu/g dry soil under the interaction treatment of *Pseudomonas, Azotobacter,* and Actinomycetes with vermicompost application and 100% NPK. These findings concur with those made by Maamoun and El-Shazly (2014).

9. Actinomycetes Counts

Data in Table (6) show that there were significant differences in Actinomycetes counts among all treatments in the rhizosphere of pearl millet. The greatest Actinomycetes counts (35×10^4cfu/g dry soil) were found with 100% NPK, vermicompost, and biofertilization treatment, respectively. These findings concur with those made by Abdulla et al. (2017).

10. Vegetative Growth and Yield Parameters of Pearl Millett Plant

Results in Table (7) demonstrate that the use of vermicompost significantly increased the growth and yield components of pearl millet. Moreover, biofertilizer treatments for minerals produced higher production values. In terms of improving the growth and yield characteristics for pearl millet (plant height (cm), biological, grain, and stover weight of plant kg/fed), the V + 100% NPK + bio exceeded the other treatments. The V + 100% NPK + bio treatment at a rate of 100% produced plants with 134.67, 9632.0, 2504.3, and 7127.7, for plant height (cm), biological yield (kg/ha), grain yield (kg/ha), and stover yield (kg/ha), respectively. whereas the lowest was owned by control. When vermicompost and NPK-biofertilizers were applied together, growth and yield parameters increased more noticeably than when vermicompost or NPK-fertilizers were applied alone. This is because vermicompost application enhances the soil's physical and hydraulic properties as well as the availability of NPK, which increases plant growth. These results are in close conformity with Hend (2017), Habiba et al. (2018) and Savita et al. (2019).

Table (7). Effect of vermicompost, mineral and biofertilization on growth and yield parameters of pearl millet plant.

Treatments	Plant height (cm)	Biological Yield (kg/ha)	Grain Yield (kg/ha)	Stover Yield (kg/ha)
Control	85.00^{D}	3616^{C}	940.2^{C}	2675.8^{C}
100% NPK	100.67^{CD}	5600^{C}	1456.0^{C}	4144.0^{C}
Vermicompost	107.00^{C}	5360^{C}	1393.6^{C}	3966.4^{C}
V + biofertilizers (bio)	130.00^{AB}	6160^{BC}	1601.6^{BC}	4558.4^{BC}
V + 75% NPK	116.67^{BC}	5824^{BC}	1514.2^{BC}	4309.8^{BC}
V + 100% NPK	125.00^{AB}	6160^{BC}	1601.6^{BC}	4558.4^{BC}
V + 75% NPK + bio	131.67^{AB}	8960^{AB}	2329.6^{AB}	6630.4^{AB}
V + 100% NPK + bio	134.67^{A}	9632^{A}	2504.3^{A}	7127.7^{A}
LSD at 0.05	17.701	3245.7	843.89	2401.8

11. Nutrient Concentration and Uptake of Pearl Grains

The data in Table (8) show the estimated NPK concentration (%) in the grain of pearl millet. In comparison to the other treatments, treatment V + 100% NPK + bio caused much more NPK in the grain of pearl millet. Because NPK is more readily available, grains treated with organic and biofertilizers had higher NPK contents. Compared to all other treatments, the treatment V + 100% NPK + bio considerably increased the absorption of NPK. Among the treatments, the uptake ($kgha^{-1}$) of nutrients in pearl grains was ranged from 7.994 to 37.906A for N, 1.3671C to 6.0321A for P and 4.441CC to 23.449A for K. Vermicompost treatment, inorganic fertilizer application, and foliar biofertilizer application significantly increased grain

NPK uptake when compared to T1 (control).The enhanced NPK content and better grain production of pearl millet may be responsible for this rise in absorption. The usage of vermicompost and biofertilizer greatly raised the nitrogen, phosphorus, and potassium content in grain, which may be primarily attributable to their availability in soil in a notable quantity and in the usable form because of this microbial inoculant. It also encourages the release of chemicals that stimulate development. These results also corroborate with Abdullahi et al. (2014), Togas et al. (2017) and Savita et al. (2019).

Table (8). Effect of vermicompost, mineral and biofertilization on grains nutrient concentration and uptake of pearl millet plant.

Treatments	Concentration (%)			Uptake (kg/ha)		
	N	P	K	N	P	K
Control	0.8500^{B}	0.1467^{A}	1.7233^{D}	7.994^{C}	1.3671^{C}	4.441^{C}
100% NPK	0.9267^{B}	0.1600^{A}	1.8033^{CD}	14.094^{C}	2.3205^{BC}	8.770^{BC}
Vermicompost	0.9500^{B}	0.1600^{A}	1.8567^{C}	13.317^{C}	2.3344^{BC}	9.165^{BC}
V + biofertilizers (bio)	1.2000^{AB}	0.1633^{A}	1.9167^{C}	20.229^{BC}	3.4074^{B}	12.455^{B}
V + 75% NPK	1.0033^{AB}	0.1567^{A}	1.8800^{C}	14.672^{BC}	2.7120^{BC}	9.989^{BC}
V + 100% NPK	1.0400^{AB}	0.1600^{A}	1.9000^{C}	16.820^{BC}	3.0277^{B}	11.560^{B}
V + 75% NPK + bio	1.2500^{AB}	0.1667^{A}	2.0600^{B}	29.149^{AB}	5.4722^{A}	21.467^{A}
V + 100% NPK + bio	1.5633^{A}	0.1800^{A}	2.3133^{A}	37.906^{A}	6.0321^{A}	23.449^{A}
LSD at 0.05	0.5826	0.0473	0.0185	14.857	1.6415	7.0260

12. Soil Properties

12.1. Soil pH

In accordance with data from a soil water extract 1:1, shown in Fig. (1), all treatments caused the soil pH to decrease in comparison to the control. The pH of the control was 8.2, while the pH of the treatment, V + 100% NPK + bio, was 7.42. All treatments had pH values that were significantly lower than the control, which demonstrated that organic matter biodegradation directly impacted the initial pH of the soil. Such results might be a result of the pH being lowered because of both the generation of acidic chemicals and the biodegradation of organic waste. the results reported by Kannika et al. (2019).

12.2. Nutrient availability in soil

As shown in Table (9), the availability of N, P, and K in the soil was greatly improved by the addition of vermicompost and biofertilizers. When compared to the other examined treatments and the control, the treatment V + 100% NPK + bio significantly showed higher NPK availability in soil (74.483, 5.546, and 69.340 mg/kg, respectively). This research demonstrated how adding vermicompost and biofertilizers can increase the soil's NPK availability while reducing nutrients loss through leaching. As reported by

Kannika et al. (2019), who demonstrated that applying vermicompost improved the chemical characteristics of soil compared to control levels of N, P, K, and carbon, which were 0.14, 0.11, 0.06, and 4.19%, respectively. The previous results seemed to be supported by those obtained by other studies (Manivannan et al., 2009 and Rekha et al., 2018).

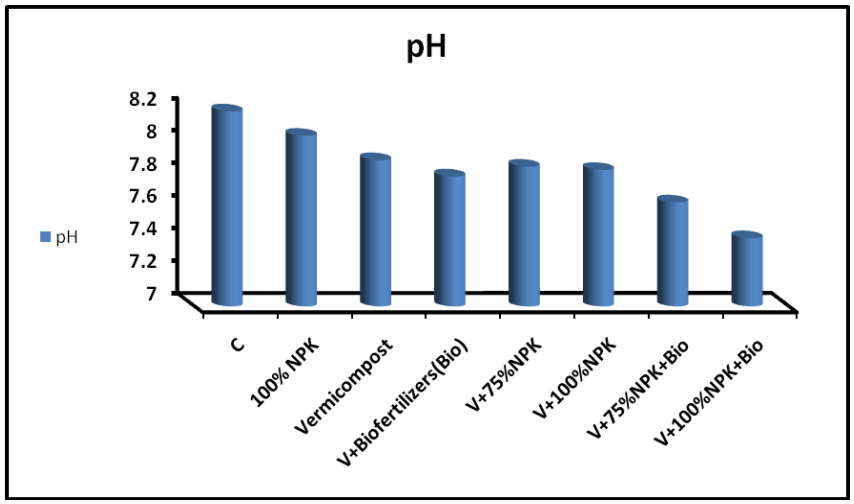

Fig. (1). Effect of vermicompost, mineral and biofertilization on soil pH at 0-30 cm.

Table (9). Effect of Vermicompost, mineral and biofertilization onnutrient availability (NPK) in soil.

Treatments	N (mg/kg)	P(mg/kg)	K (mg/kg)
Control	26.373^{B}	3.506^{B}	34.213^{D}
100% NPK	29.813^{B}	4.793^{AB}	54.040^{C}
Vermicompost	31.437^{B}	4.833^{AB}	55.690^{C}
V + biofertilizers (bio)	49.083^{AB}	5.020^{A}	57.453^{C}
V + 75% NPK	35.070^{AB}	4.830^{AB}	56.327^{C}
V + 100% NPK	37.700^{AB}	4.993^{A}	56.927^{C}
V + 75% NPK + bio	52.590^{AB}	5.160^{A}	61.883^{B}
V + 100% NPK + bio	74.483^{A}	5.546^{A}	69.340^{A}
LSD at 0.05	40.759	1.4426	3.6978

CONCLUSION

Main research aim of this article was examining the integrated effect of vermicompost, mineral and biofertilization. It can be concluded that vermicompost stimulated microbial activity in pearl millet rhizosphere and it is recommended using vermicompost with biofertilizers application to enhance soil fertility and productivity.

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تأثير الفيرمي كمبوست والتسميد المعدني والحيوي على خصوبة التربة وانتاجية نبات الدخن النامي في أرض رملية

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أجريت هذه الدراسة خلال موسمين متتاليين لعام ٢٠٢٠ و٢٠٢١ على نبات الدخن النامي في تربة رملية تحت نظام الري بالتنقيط في محطة بحوث بالوظة بمحافظة شمال سيناء بمصر. كان الهدف من هذه الدراسة هو تقييم تأثير استخدام الفيرمي كمبوست vermicompost ومستويين من السماد المعدني NPK (٧٥ و١٠٠٪)، والتسميد الحيوي (خليط من الأزوتوباكتر كروكوككم *Azotobacter chroococcum* والسيدوموناس فلوريسنس *Pseudomonas fluorescence* والأستربتومايسس مايكروفلافس *Streptomyces microflavus*، ومعاملة ثنائية (verimcompost + NPK)، ومعاملة مخلوط ثلاثي عضوي ومعدني وحيوي (حيوي + vermicompost + NPK). أشارت النتائج المتحصل عليها إلى أن المعاملة بالمخلوط الثلاثي (vermicompost + NPK + BIO) أدت إلى زيادة في قياسات النمو وقياسات المحصول ومحتوى NPK بالحبوب، وأدت أيضًا إلى تحسن في خصوبة التربة. علاوة على ذلك، أظهرت المعاملات بالتسميد الحيوي إلى تأثير إيجابي على العدد الكلي للميكروبات، كثافة الآزوتوباكتر، وأعداد السيدوموناس والأكتينوميسيتات في منطقة ريزوسفير نبات الدخن. وعلى الجانب الآخر أدت معاملات التسميد الحيوي إلى زيادة النشاط الميكروبي الذي تم تقديره بقياس إنزيم ديهيدروجينيز مقارنةً بالكنترول.