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# EFFECT OF COMPOST AND SOME BIOFERTILIZERS ON GROWTH, YIELD AND QUALITY OF POTATO CROP (*Solanum tuberosum* L.)

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## ABSTRACT

Two field experiments were conducted during the fall (Nili) season of 1998/1999 and 1999/2000 at Abou Awad Village, Aga, Dakahlia Governorate, on potato cv. Diamont to investigate the effect of compost i.e. compost 1 (Rice straw and Wheat straw), compost 2 (City garbage manure) and some biofertilizers (Biogein, Phosphorein, phosphate dissolving bacteria (PDB) and silicate decomposing bacteria (SDB) as a substitute for chemical fertilizers on potato plants.

The obtained data show that the plants stand percentage at 45 days after planting was the highest with treatment 8 (compost 2 (City garbage manure) + ½ treatment 2 (Rock phosphate + Feldspar + Biogein + Phosphorein + *Bacillus circulans*). Vegetative growth, in terms of plant height, number of main stems/plant, foliage fresh weight/plant (g) and foliage dry weight (%) at 75 (DAP) were increased by using the mineral fertilizer (control). NPK (%) in leaves at 75 (DAP) and tubers at harvesting were also increased by treatment of compost 2 (City garbage manure) + ½ treatment 3 (Rock phosphate + Feldspar+ Biogein + *Bacillus megatrium* + *Bacillus circulans*) during the both seasons. On the other hand, total tubers yield (ton/fed.), number of tubers/plant, average weight of tubers/plant (g) and dry weight of tubers (%) were significantly increased with this treatment in both seasons. While treatment of compost 1 increased starch (%) in tubers, also the highest reduction in nitrate concentration (ppm) in tubers was recorded for treatment 3 (Rock phosphate + Feldspar+ Biogein + *Bacillus megatrium* + *Bacillus circulans*) in the both seasons.

Generally, the results indicate that using treatment of compost 2 (City garbage manure) + ½ treatment 3 (Rock phosphate + Feldspar+ Biogein + *Bacillus megatrium* + *Bacillus circulans*) as a substitute of chemical fertilizers of potato plants improved tuber yield, quality and saved considerable amount of mineral fertilizers of NPK requirements. Likewise, inoculation by mixture of biofertilizers may be helpful in reducing the pollution of environment and may be recommended in potato bio-production.

## INTRODUCTION

Potato (*Solanum tuberosum* L.) is considered one of the most important vegetable crops grown in Egypt for local consumption and export.

Organic manures which include compost and city garbage manure are applied to improve the nutritional status of the plant and maintain the fertility through its effect on physical and chemical properties of the soil (Abou-Baker and El-Magraby, 1994 and Attalah *et al.*, 1997). Giusquiani *et al.* (1988) also indicated that addition of compost to soil increased contents of available phosphorus and exchangeable potassium. Also, Berghe (1996) found that potato yields increased with increasing compost dose. Ashour and Sarhan (1998) showed that application of 25% city garbage manure with 75% of the recommend dose of N, P and K gave highest tuber yield. In the same respect,

Tawfik (2001) mentioned that the highest net profit was obtained from potatoes fertilized with 25 % city garbage manure + Microbein + 50 % NPK.

Rock phosphate as a nature source of phosphorous has better effect on growth and yield. Rock phosphate is considered more available when added with organic manures. Where, El-Banna and Abd El-Salam (2000) indicated that application of rock phosphate with farmyard manure at the rate of 15 ton/fed in addition to 180 kg N + 75 kg $P_2O_5$ /fed , increased total yield of tubers/fed.

On the other hand, many investigators showed that, potato plants inoculation with biofertilizers, known as phosphate dissolving bacteria (PDB) and silicate decomposing bacteria (SDB) play a fundamental role in converting P and K fixed form to be soluble ready available for plant nutrition, and application of biofertilizers are important economically to reduce pollution of environment. In this respect, El-Gamal (1996), Ashour and Sarhan (1998) and Tawfik (2001) reported that application of biofertilizers was improved plant height, dry weight and total tuber yield. Abdel-Ati *et al.* (1996), Hammad and Abdel-Ati (1998) and El-Banna and Tolba (2000) mentioned that using the biofertilizers increased plant height, number of branches / plant, number and weight of tubers / plant, dry matter content of tubers and total tubers yield/fed., as well as decreased the nitrate concentration in potato tubers.

Balabel (1997) and Afify and Bayoumy (2001) mentioned that the silicate bacteria have the ability to release $K_2O$ from feldspar and biotite. Balabel (1997) reported that inoculating orthoclase with *Bacillus circulans* (SDB) gave better effects on all vegetative and yield attributes. They also, indicated that these effects were reflected on N, P and K content of tubers. El-Banna (2001) indicated that using *Bacillus circulans* (SDB) gave rise to increase the vegetative growth characters.

Abdel-Ati *et al.* (1996) indicated that inoculation of potato tuber seeds with P-solubilizing bacteria (PSB) such as, *Bacillus megatrium* resulted in increasing P and K content and vegetative growth of potato (i.e., plant height, number of branches and dry matter as well as number of tubers / plant and total yield /fed.

Hauka *et al.* (1990 & 1996) and Hauka (2000) reported that soil microorganisms can play an important role in improving plant growth by solubilizing phosphorus from rock phosphate.

Therefore, the present investigation was designed as an attempt to investigate the effect of compost and some biofertilizers as effective alternatives for chemical fertilizers to produce potato tubers of high quality. Keeping out of environment from pollution is one of the promised goals.

## MATERIALS AND METHODS

Two successive field experiments were carried out during fall (Nili) seasons of 1998/1999 and 1999/2000 at Abou Awad Village, Aga, Dakahlia Governorate.

Some physical and chemical properties of the experimental soil are recorded in Table (1).

**Table (1): Some physical and chemical properties of the experimental soil.**

| Physical characteristics | | | | Chemical characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sand | Silt | Clay | Texture | PH | Available nutrients (ppm) | | | | | |
| | | | | | N | P | K | Zn | Mn | Fe |
| 30.3 | 34.6 | 35.5 | Clayey loam | 7.9 | 60.3 | 24.4 | 239 | 3.00 | 8.60 | 16.80 |

Phosphorein and Biogein biofertilizers were obtained from the General Organization for Agriculture Equalization Fund (GOAEF). An efficient inocula of *Bacillus megatrium* as phosphate dissolving bacteria (PDB) and *Bacillus circulans* as silicate decomposing bacteria (SDB) were obtained from Integrated Control Res. Dept., Plant Pathology Res. Inst., Agric. Res. Center, Giza.

Potato tuber seed were mixed with some biofertilizers (Phosphorein and Biogein) at the rate of 10.67 kg/ton seed tuber. Whereas, PDB and SDB inocula were added at rate of 200 ml/plot contains ($1 \times 10^8$ cells/ml culture). Rock phosphate or/and Feldspar was added to the soil immediately before the first irrigation.

Compost (1) and compost (2) at rate of 14, 24 ton/fed., respectively was spreaded and thoroughly mixed with the surface soil layer (0-20 cm) before planting. Compost (1) prepared from straw of both rice and wheat and compost (2) prepared from city garbage which was obtained from Mansoura Manufacture for Organic manure. The chemical analysis of compost (1) and compost (2) are shown in Table (2).

**Table (2): Chemical analysis of compost (1) and compost (2).**

| Manure Source | Macro-elements (%) | | | Micro-elements (ppm) | | | | pH | C/N ratio | OM (%) | Humic |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | P | K | Fe | Mn | Zn | Cu | | | | |
| Compost (1) | 1.32 | 0.47 | 0.82 | 151 | 312 | 65 | 37 | 7.7 | 15.6:1 | 32.6 | 4.8 |
| Compost (2) | 0.78 | 0.91 | 0.35 | 3800 | 510 | 190 | 236 | 7.9 | 17.2:1 | 35.9 | -- |

The chemical analysis of Rock phosphate and Feldspar ($KALSi_3O_8$) are shown in Table (3) as follows:

**Table (3): Chemical analysis of rock phosphate and feldspar*.**

| Source | Nutrients (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $P_2O_5$ | $K_2O$ | $SiO_2$ | $Al_2O_3$ | $FeO_3$ | MgO | CaO | $SO_4$ |
| Rock phosphate | 28.0 | 0.19 | 2.11 | 0.72 | 3.61 | 0.68 | 41.0 | 5.32 |
| Feldspar | 0.35 | 16.4 | 60.8 | 16.9 | 0.25 | 0.14 | 0.37 | -- |

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The soil was digested as described in Jackson (1967) using a modified Kjeldahl procedure, but, the plant samples were digested using sulfuric and perchloric mixture, Jackson (1967).

Contents of Fe, Mn, Zn and Cu were determined as described in Page *et al.* (1982) using an atomic absorption spectrophotometer.

Total nitrogen was determined with micro-Kjeldahl method according to Chapman and Pratt (1961). Phosphorus was colorimetrically determined following Jackson (1967). Potassium was determined using a flame photometer as described by Jackson (1967).

The experimental design was randomized complete blocks (RCB) with three replicates. Each plot consisted of 4 ridges, 5.0 m length and 75 cm width, each individual plot area was 15 $m^2$. Each plot contained 80 seed of tubers. Sprouted seed tubers of Diamont. were planted on 20$^{th}$ October and 15$^{th}$ October, in 1998 and 1999 respectively.

The experimental treatments of compost, inorganic fertilizers and biofertilizers in single or combined applications were conducted as follows:

1. Control (recommended full dose of mineral fertilizer (NPK) at the rate of 180 kg N/fed., 75 kg $P_2O_5$ /fed. and 96 $K_2O$ kg /fed.).
2. Rock phosphate (RP) + Feldspar (F) + Biogein (B) + Phosphorein + *Bacillus circulans* as silicate decomposing bacteria (SDB).
3. Rock phosphate (RP) + Feldspar (F) + Biogein + *Bacillus megatrium* as phosphate dissolving bacteria (PDB) + *Bacillus circulans* as silicate decomposing bacteria (SDB).
4. Compost 1 (Rice straw and wheat straw).
5. Compost 1 + ½ treatment 2 (Rock phosphate + Feldspar + Biogein + Phosphorein + *Bacillus circulans*).
6. Compost 1 + ½ treatment 3 (Rock phosphate + Feldspar + Biogein + *Bacillus megatrium* + *Bacillus circulans*).
7. Compost 2 (City garbage manure).
8. Compost 2 + ½ treatment 2 (Rock phosphate + Feldspar + Biogein + Phosphorein + *Bacillus circulans*).
9. Compost 2 + ½ treatment 3 (Rock phosphate + Feldspar + Biogein + *Bacillus megatrium* + *Bacillus circulans*).

Nitrogen was added at three equal portion at 3, 5 and 7 weeks after planting for (control) treatment, the 1$^{st}$ portion was added in form of ammonium sulphate (20.5% N), whereas, the second and third portions were added in the form of ammonium nitrate (33.5% N). Single super phosphate ($P_2O_5$ 15.5%) was added once during the soil preparation with rate of 75 kg $P_2O_5$/fed. Potassium sulphate (48% $K_2O$) was added twice with rate 96 kg $K_2O$/fed. Rock phosphate (28.0 % $P_2O_5$) and Feldspar (16.4 % $K_2O$) as natural sources of P and K were powdered and mixed with the soil before the first irrigation at the rate of 268 kg/fed. and 585 kg/fed., respectively.

**Studied characters:**

**1. Vegetative growth characters:**

Random samples of 5 potato plants were taken at 75 days after planting (DAP) from each plot and the following data were recorded: plant stand percentage at 45 (DAP), plant height (cm), number of main stems/plant, foliage fresh weight (g), and foliage dry weight (%).

**2. Yield parameters:**

Data at harvest, total weight of tuber yield (ton/fed), number of tubers/plant and average of tubers weight (g).

**3. Tuber quality properties:**

Tubers were dried separately in forced-air oven at 70°C to constant weight (for 72 hr) and then dry weight was determined. Percentage of starch content in tuber was determined according to A.O.A.C (1990).

**4. Chemical composition**

The mineral content, N, P and K were estimated by taken a sample of the 4$^{th}$ leaf from the plant apex at 75 days after planting and tubers at harvesting time. Nitrate concentration ppm (dry weight basic) estimated was measured as described by Singh (1988).

**Statistical analysis**

The all obtained data were statistically analyzed according to the procedure outlined by Snedecor and Cochran (1980). The means were compared using Duncan's multiple range test as published by Duncan (1955).

## RESULTS AND DISCUSSION

**1. Vegetative growth characters:**

Data in Table (4) indicated that plant stand percentage at 45 days after planting (DAP) was significantly affected by different treatments in the two seasons. The treatments received compost 2 (City garbage manure) + ½ treatment 2 (Rock phosphate + Feldspar + Biogein + Phosphorein + *Bacillus circulans*) was the best for plant stand. Data of the same table showed a significant increase in plant height (cm), number of main stems per plant, foliage fresh weight (g) and the percentage of foliage dry weight at 75 days after planting (DAP) in both seasons by treatment receiving mineral fertilization (control) compared with other treatments, except of the second season with number of stems per plant. The increase might be due to rapid releasing of essential nutrients from the mineral fertilizations to plant. These results are in agreement with those obtained by El-Banna (2001), and Ashour and Sarhan (1998).

On the other hand, the same table demonstrated clearly that using compost combined with biofertilizer had a positive effect on growth characters. This might be related to the improvement of physical conditions of the soil, provided energy for microorganisms activity and increase the availability and uptake of NPK, which was positively reflected on growth (Wani *et al.*, 1988; Awad, 1998 and Romero *et al.*, 2000).

Moreover, microorganism as using as biofertilizers produce plant promoting substances, mainly IAA, gibberellins and cytokinin-like substances, which could stimulate plant growth, absorption of nutrient and the metabolism process (Subba Rao, 1993, Chabat *et al.*, 1996 and El-Banna, 2001).

**Table (4): Plant stand percentage at 45 DAP, plant height, number of the main stems/plant, foliage fresh weight and foliage dry weight of potato as affected by fertilization with compost and some biofertilizers at 75 DAP in 1998/99 and 1999/2000 seasons.**

| Characters / Treatments | Plant stand (%) | | Plant height (cm) | | No. of main stems/plant | | Foliage fresh weight (g) | | Foliage dry weight (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1998 | 1999 | 1998 | 1999 | 1998 | 1999 | 1998 | 1999 | 1998 | 1999 |
| 1-Control (Mineral fertilizer (NPK) | 88.7 c | 91.3 c | 45.0 a | 42.7 a | 3.3 a | 3.0 a | 384.3 a | 346.6 a | 13.2 a | 12.9 a |
| 2-RP + F+ Biogein + Phosphorein + SDB | 90.9 ab | 91.6 c | 31.3 g | 30.0 e | 2.0 a | 1.7 a | 320.3 e | 287.3 bc | 10.5 d | 10.2 d |
| 3-RP + F + Biogein + PDB + SDB | 90.4 a-c | 92.1 bc | 33.7 f | 31.0 de | 2.0 a | 1.7 a | 313.3 e | 275.6 c | 11.6 c | 10.8 cd |
| 4-Compost 1 (Rice straw and wheat straw). | 89.3 bc | 93.6 ab | 35.0 e | 33.3 cd | 2.3 a | 2.0 a | 341.0 d | 298.3 bc | 12.2 bc | 11.5 bc |
| 5-Compost 1 + ½ treatment 2 | 91.0 ab | 92.9 a-c | 36.3 de | 36.0 bc | 2.7 a | 2.3 a | 360.0 c | 308.6 a-c | 12.0 bc | 11.8 bc |
| 6-Compost 1 + ½ treatment 3 | 89.6 bc | 93.0 a-c | 36.7 de | 37.0 b | 2.7 a | 2.7 a | 265.0 bc | 282.0 bc | 12.5 ab | 12.3 ab |
| 7-Compost 2 (City garbage manure) | 90.2 bc | 92.1 bc | 37.7 cd | 36.3 bc | 2.3 a | 2.3 a | 349.3 cd | 325.0 ab | 11.9 bc | 12.0 ab |
| 8-Compost 2 + ½ treatment 2 | 92.3 a | 94.4 a | 39.3 c | 38.3 b | 2.7 a | 2.3 a | 354.0 cd | 300.3 bc | 12.5 ab | 12.6 ab |
| 9-Compost 2 + ½ treatment 3 | 90.1 bc | 92.4 a-c | 42.0 b | 41.7 a | 3.0 a | 2.7 a | 376.0 ab | 325.3 ab | 13.0 a | 13.0 a |

**RP = Rock phosphate.**

**F = Feldspar.**

**SDB = Silicate decomposing bacteria.**
**PDB = Phosphorus dissolving bacteria.**
**DAP =Days after planting.**

**2. Yield and its components:**

Data in Table (5) indicated that total tuber yield (ton/fed), number of tubers/plant, average of tubers weight (g) and tuber dry weight (%) were increased significantly in both seasons, in case of treatment received compost 2 (City garbage manure) + ½ treatment 3 (Rock phosphate + Feldspar + Biogein + *Bacillus megatrium* + *Bacillus circulans*) compared with other treatments.

In case of total tuber yield, the percentage increase over the mineral fertilizer (NPK) amounted to be 16.16 and 16.07 in the first and second seasons, respectively. These results illustrated that the biofertilizer in addition to compost 2 (City garbage manure) could play an important role in improving plant growth and the nutrient status of the plant and maintain the fertility of the soil. This is due to releasing N, P and K from biofertilizer, rock phosphate and feldspar, respectively. Similar results were obtained by Mishustin *et al.* (1981), El-Dahtory *et al.* (1989); Abdel-Ati *et al.* (1996) and Tawfik, 2001).

Data in Table (5) also indicated that using treatment 8 (compost 2 (City garbage manure) + ½ treatment 2 (Rock phosphate + Feldspar + Biogein + Phosphorein + *Bacillus circulans*) was more effective on potato yield than with using uninoculation treatments alone.

**3. Mineral composition:**

Data in Table (6) showed that mineral fertilization significantly increased N, P and K percentage in leaves and tuber compared with other treatments in the two seasons. This result may be due to the nutrients in mineral fertilizers are directly available and quickly release to the plant roots in comparison with other treatments. Data in the same table indicated that application of treatment 9 (compost 2 (City garbage manure) + ½ treatment 3 (Rock phosphate + Feldspar + Biogein + *Bacillus megatrium* + *Bacillus circulans*) led to increase N, P and K in leaves and tuber. These results may suggest the role of $N_2$-fixing bacteria (*Azotobacter*) in Biogein, which 9providing the plants with their requirements from nitrogen. The same results are agreement with El-Dahtory *et al.* (1989); Hauka *et al.* (1990); Hauka (2000) and El-Banna (2001). In addition, application of compost 2 (City garbage manure) increased nutrients uptake and improved the efficiency of macro-elements and ability to meet some micro-elements requirements of potato crop.

**4. Tuber quality:**

**4.1. Starch content (%):**

The data in Table (7) indicated that percentage tuber starch content was significantly affected by nutrient sources. The treatment 4 (Compost 1 (Rice straw and wheat straw) significantly increased tuber starch content over the mineral fertilizers in the two seasons. Similar results were obtained by Abdulla (1999) and Tawfik (2001), who stated that applying the biofertilizer combined with organic manure significantly increased total starch content in tubers.

**Table (5): Total tuber yield, number of tuber/plant, tuber weight/plant and dry matter of tuber of potato as affected by fertilization with compost and some biofertilizers at 75 DAP in 1998/99 and 1999/2000 seasons.**

| Characters / Treatments | Total tuber yield (Ton/fed) | | No. of tuber / plant | | Tuber weight / plant (g) | | Dry matter of tubers (%) | |
|---|---|---|---|---|---|---|---|---|
| | 1998 | 1999 | 1998 | 1999 | 1998 | 1999 | 1998 | 1999 |
| 1-Control (Mineral fertilizer (NPK) | 11.28 b | 11.20 bc | 4.30 bc | 4.10 bc | 107.0 b | 104.7 b | 22.35 b | 21.93 ab |
| 2-RP + F+ Biogein + Phosphorein + SDB | 6.62 f | 6.52 e | 3.10 e | 2.90 e | 82.0 e | 80.0 f | 20.40 c | 19.17 c |
| 3-RP + F + Biogein + PDB + SDB | 6.89 f | 6.79 e | 3.20 e | 3.10 e | 85.3 e | 83.0 f | 21.94 b | 21.33 b |
| 4-Compost 1 (Rice straw and wheat straw). | 8.33 e | 8.25 d | 3.90 d | 3.70 d | 90.7 d | 88.7 e | 22.25 b | 21.57 ab |
| 5-Compost 1 + ½ treatment 2 | 9.36 d | 9.26 d | 4.40 bc | 3.70 d | 93.0 d | 91.3 de | 22.03 b | 21.75 ab |
| 6-Compost 1 + ½ treatment 3 | 10.44 c | 10.36 c | 4.40 bc | 4.10 bc | 97.7 c | 95.0 d | 21.98 b | 21.75 ab |
| 7-Compost 2 (City garbage manure) | 9.00 de | 8.93 d | 4.10 cd | 3.80 cd | 100.0 c | 99.7 c | 21.94 b | 21.32 b |
| 8-Compost 2 + ½ treatment 2 | 11.60 b | 11.58 b | 4.60 b | 4.40 b | 110.6 b | 108.3 b | 22.59 b | 22.09 ab |
| 9-Compost 2 + ½ treatment 3 | 13.11 a | 13.00 a | 5.30 a | 5.10 a | 118.0 a | 116.7 a | 23.46 a | 22.53 a |

**RP = Rock phosphate.**
**F = Feldspar.**
**SDB = Silicate decomposing bacteria.**
**PDB = Phosphorus dissolving bacteria.**
**DAP =Days after planting.**

**Table (6): Percentage of N, P and K in leaves of potato plant at 75 DAP and in tuber at harvesting as affected by fertilization with compost and some biofertilizer in 1998/99 and 1999/2000 seasons.**

| Characters / Treatments | N (%) | | | | P (%) | | | | K (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Leaves | | Tuber | | Leaves | | Tuber | | Leaves | | Tuber | |
| | 1998 | 1999 | 1998 | 1999 | 1998 | 1999 | 1998 | 1999 | 1998 | 1999 | 1998 | 1999 |
| 1-Control (Mineral fertilizer (NPK) | 3.11 a | 3.02 a | 1.95 a | 1.87 a | 0.39 a | 0.36 a | 0.52 a | 0.51 a | 3.25 a | 3.08 a | 1.92 a | 1.89 a |
| 2-RP + F+ Biogein + Phosphorein + SDB | 1.96 f | 1.85 g | 1.19 e | 1.15 e | 0.25 e | 0.22 e | 0.33 e | 0.32 f | 1.92 f | 1.90 f | 1.50 c | 1.11 e |
| 3-RP + F + Biogein + PDB + SDB | 2.00 f | 1.95 fg | 1.22 e | 1.18 e | 0.27 e | 0.24 e | 0.35 e | 0.33 f | 1.90 f | 1.89 f | 1.20 f | 1.15 e |
| 4-Compost 1 (Rice straw and wheat straw). | 2.22 e | 2.04 ef | 1.39 d | 1.33 d | 0.30 cd | 0.28 d | 0.39 d | 0.36 e | 2.03 ef | 2.00 ef | 1.34 e | 1.28 d |
| 5-Compost 1 + ½ treatment 2 | 2.39 d | 2.21 de | 1.47 d | 1.43 d | 0.32 bc | 0.30 cd | 0.41 d | 0.39 d | 2.18 e | 2.11 de | 1.46 cd | 1.42 c |
| 6-Compost 1 + ½ treatment 3 | 2.55 c | 2.44 c | 1.62 c | 1.56 c | 0.33 bc | 0.31 bc | 0.42 d | 0.40 d | 2.35 d | 2.21 d | 1.5 4 c | 1.50 c |
| 7-Compost 2 (City garbage manure) | 2.34 de | 2.24 d | 1.44 d | 1.42 d | 0.28 de | 0.27 d | 0.42 d | 0.40 d | 2.11 e | 2.02 ef | 1.38 de | 1.32 d |
| 8-Compost 2 + ½ treatment 2 | 2.86 b | 2.78 b | 1.74 b | 1.69 b | 0.34 b | 0.33 b | 0.45 c | 0.43 c | 2.53 c | 2.38 c | 1.72 b | 1.72 b |
| 9-Compost 2 + ½ treatment 3 | 2.99 ab | 2.93 ab | 1.79 b | 1.74 b | 0.32 bc | 0.31 bc | 0.48 b | 0.46 b | 2.91 b | 2.86 b | 1.86 a | 1.79 b |

RP = Rock phosphate.
F = Feldspar.
SDB = Silicate decomposing bacteria.
PDB = Phosphorus dissolving bacteria.
DAP =Days after planting.

**4.2. Nitrate concentration (ppm) in tubers:**

Table (7) showed that nitrate concentration in the flesh tuber was lower in the potatoes receiving treatment 3 (Rock phosphate + Feldspar + Biogein + *Bacillus megatrium* + *Bacillus circulans)*. Similar results were mentioned by Abdel-Ati (1998), Abdel-Naem *et al.* (1999) and El-Banna and Abd El-Salam (2000).

**Table (7): Percentage of stach content and nitrate concentration (ppm) in tuber as affected by fertilization with compost and some biofertilizer in 1998/99 and 1999/2000 seasons.**

| Characters / Treatments | Tuber starch content (%) | | Nitrate concentration (ppm) | |
|---|---|---|---|---|
| | 1998 | 1999 | 1998 | 1999 |
| 1-Control (Mineral fertilizer (NPK) | 13.91 d | 13.73 e | 73.70 a | 77.00 a |
| 2-RP + F+ Biogein + Phosphorein + SDB | 15.95 a | 15.88 ab | 34.30 f | 32.70 e |
| 3-RP + F + Biogein + PDB + SDB | 16.03 a | 15.98 a | 31.00 ef | 30.00 e |
| 4-Compost 1 (Rice straw and wheat straw). | 16.06 a | 16.01 a | 49.00 c | 47.70 c |
| 5-Compost 1 + ½ treatment 2 | 15.93 a | 15.73 b | 42.70 e | 43.30 cd |
| 6-Compost 1 + ½ treatment 3 | 15.88 a | 15.43 c | 43.30 e | 41.00 d |
| 7-Compost 2 (City garbage manure) | 14.76 c | 14.65 e | 54.30 b | 56.00 b |
| 8-Compost 2 + ½ treatment 2 | 15.21 b | 15.16 d | 47.00 cd | 45.30 cd |
| 9-Compost 2 + ½ treatment 3 | 15.02 bc | 14.97 d | 45.70 de | 44.30 cd |

**RP = Rock phosphate.**
**F = Feldspar.**
**SDB = Silicate decomposing bacteria.**
**PDB = Phosphorus dissolving bacteria.**
**DAP =Days after planting.**

On the other hand, the highest level of nitrate was detected in potato tubers produced from plants treated with mineral fertilizer (control). The steady release of nitrogen from organic fertilizers could make nitrogen taken up mainly in the form of ammonium, which probably lowered nitrate content in potato tubers (Kalbe *et al.*, 1995).

**Conclusion:**

This investigation could suggest that application of compost 2 (City garbage manure) + ½ treatment 3 (Rock phosphate + Feldspar + Biogein + *Bacillus megatrium* + *Bacillus circulans)* indispensable for optimum potato production, maximum yield and quality of tubers. Moreover, the application of compost combination with some biofertilizers would decrease both pollution of environment and the production costs.

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## تأثير الكمبوست وبعض الأسمدة الحيوية على نمو ومحصـــول وجـــودة محصـــول البطاطس

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أجريت تجربتان حقليتان خلال موسمين نيـليين ١٩٩٨/١٩٩٩، ١٩٩٩/٢٠٠٠ بقريـــة أبو عوض– أجا– بمحافظة الدقهلية على محصول البطاطس صنف ديامونت بهدف دراســة تـأثير مصدرين مختلفين من الكمبوست هما كمبوست ١ (من قش الأرز والقمح)، كمبوست ٢ (سماد قمامة المدن) مع بعض الأسمدة الحيوية (بيوجين، الفوسفورين والبكتريـا المذيبـة للفوسـفور والبكتريـا المحررة للبوتاسيوم) كبديل للأسمدة الكيماوية على نبات البطاطس. وأوضحت البيانات المتحصـل عليها أن المعاملة رقم ٨ (كمبوست ٢ + ٢/١ المعاملة ٢ (صخر الفوسفات + الفلسبار + البيوجيـن + الفوسفورين + البكتريا المحررة للبوتاسيوم) أدت إلى زيادة نسبة ظهور النبات فى الحقل عنـد ٤٥ يوم بعد الزراعة، وقد أوضحت النتائج أن قياسات النمو الخضرى لنبات البطاطس (إرتفاع النبات – عدد السيقان الرئيسية/نبات – الوزن الطازج للمجموع الخضرى – النسبة المئوية للـوزن الجـاف للمجموع الخضرى للنبات) عند ٧٥ يوم من الزراعة قد زادت بإستخدام الأسمدة المعدنية (الكنترول) بالإضافة إلى محتوى النتروجين والفوسفور والبوتاسيوم فى الأوراق عند ٧٥ يـوم مـن الزراعـة والدرنات عند الحصاد خلال موسمى الزراعة.

ومن ناحية أخرى أوضحت النتائج أن أعلى معدلات للمحصول الكلى لدرنات البطـاطس (طن/فدان) وعدد الدرنات/نبات ومتوسط وزن الدرنة/نبات والنسبة المئوية لمحتوى الدرنة من المادة الجافة قد زادت معنويا مع المعاملة رقم ٩ (كمبوست ٢ (سماد قمامة المـدن) + ٢/١ المعاملـة ٣ (صخر الفوسفات + الفلسبار + البيوجين + البكتريا المذيبة للفوسفات+ البكتريا المحررة للبوتاسـيوم) فى كلا الموسمين، بينما المعاملة رقم ٤ (كمبوست ١ (من قش الأرز والقمح) ادت الى زيادة النسبة المئوية لمحتوى النشا فى الدرنات، بينما المعاملة رقم ٣ (صخر الفوسفات + الفلسبار + البيوجين + البكتريا المذيبة للفوسفات+ البكتريا المحررة للبوتاسيوم) ادت الى انخفاض تركيز النترات بالدرنـات فى كلا موسمى الزراعة.

وبصفة عامة أشارت النتائج المتحصل عليها أن إستخدام المعاملة رقـم ٩ (كمبوسـت ٢ (سماد قمامة المدن) + ٢/١ المعاملة ٣ (صخر الفوسفات + الفلسبار + البيوجين + البكتريا المذيبـة للفوسفات+ البكتريا المحررة للبوتاسيوم) كبديل للأسمدة الكيماوية على نبات البطاطس تعمـل علـى تحسين المحصول وجودته ويوفر كميات لا بأس بها من الأسمدة النتروجينية والفوسفورية والبوتاسية وكذلك فإن إستخدام اللقاحات الخليطة من الأسمدة الحيوية ربما يساعد على خفض تلـوث البيئـة. ويمكن التوصية باستخدامها فى إنتاج البطاطس حيويا.