*J. Plant Production, Mansoura Univ., Vol. 7 (8): 861 - 867, 2016*

# Response of Potato Plants to Organic, Bio and Mineral Fertilization

**AbdEl-Nabi, H. M. E. ; El-Gamily and Nahla A. R. Keshta**
**Faculty of Agriculture – Mansoura University**



## ABSTRACT

Two field experiments were conducted in a loam soil at the private Farm of El-GamaliaDakahlia Governorate, Egypt during the summer seasons of 2014 and 2015 to study the effect of the various combinations among organic manures, bio and mineral fertilization on the production of safe and economic potato tubers spunta cultivar. Twenty-four treatments were arranged in split – split plot design with 3 replicates, which were the simple possible combination between two sources of organic manure [Farmyard manure (FYM) and compost] as main plots, treatments of mineral fertilization (50, 75, and 100% NPK from recommended doses) as sub plots and three sources of bio fertilization (EM, yeast extract and mixture of multi strains) as sub-sub plot. Thus, the total numbers of every experiment were 72 experimental units. The obtained results indicated that;the mean values of, fresh, dry weights of tubers /plant , number of tuber and total yield of potato ton $fed^{-1}$ as well as cholorophyll content after 70 days in leaves, Nitrite ($No_2$-N), Nitrate ($No_3$-N), reducing sugars percentages, non-reducing sugars percentages and total sugar percentageswere significantly affected due to adding FYM (20 ton $fed^{-1}$) and compost (15 ton $fed^{-1}$) during both seasons of the experimentation. The highest mean values of traits were recorded with adding compost. As for, the mean values of parameters under study were significantly increased with increasing NPK from 50 up to 75% of the recommended dose during both seasons, then decreased with adding 100%. In the same way the highest significant values of the aforementioned parameters were recorded with spraying plants by mixture of bio- fertilization(*Azotobacterchroccoccum* (AZ), *Bacillus megatherium* (PSB) and *Bacillus circulans* (KSB)) (2 ml/L.) followed by spraying EM (2 ml/plant).The highest mean values were recorded with 15 ton $fed^{-1}$. compost and inoculation with mixture and 75% NPK RD.

**Keywords:** organic fertilization, mineral fertilization, bio-fertilization, potato plants.

## INTRODUCTION

Potato (*Solanum tuberosum* L.) is the fourth important crop in the world. It is cheap source of energy, it contains high levels of carbohydrates and a considerable amounts of vitamins B, C and minerals. It is relatively considered rich in some free amino acids, fiber and very small amounts of fat(Muthoni and Nyamango, 2009). In Egypt, potato plays an important economic role as a food and a cash crop by potato exportation to other countries.

The organic manure (such as compost and FYM) are another source of nitrogen and other nutrient, which can decrease the demand of chemical fertilizer, and it has been used for many centuries to increase soil fertility (Durzi, 2012) Moreover, many researchers have mentioned the beneficial effects of organic fertilizer including the increase of hydraulic conductivity, raising the water holding capacity, changes the soil pH where increases or decreases in the pH, it reduces the frequency of plant diseases (Tagoe*et al.*, 2008). So recycling of different organic wastes as composted manure as well as using FYM in conjunction with some growth regulators; humic acid, cytokinin and yeast in the presence and absence of a mixture of biofertilizers would be a good source of organic manure to increase the yield quantity and quality of plants besides ensuring hygienic disposal of the organic wastes. (Mansour, 2012).

As the universe is going now on the way of clean agriculture and minimizing pollution effects. Bio-fertilization technology has taken a part to minimize production costs and at the same time, avoid the environmental hazards. Microorganisms can secrete growth promoting substances, i.e., indole acetic acid, gibberellins, cytokinins like substances and auxins (Baddour, 2010).

One kind of bio-stimulants is yeast which considered a natural source of cytokinins which stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid and chlorophyll (Fathy*et al.*, 2002). Bread yeast contains IAA and GA3,so dry bread yeast has been used for improving growth and productivity in some vegetable crops (Sarhan, 2008).

The use of only chemical fertilizers alone may not keep pace with time in maintaining the soil health and sustaining the productivity. It is also detrimental to human health and the environment (Arisha and Bardisi, 1999)

The conventional use of chemical fertilizer can increase the tubers yield but inordinate use of nitrogen has a negative effects on tubers quality, environment pollution, public health and economical losses (Najm*et al.*, 2011), reduces starch, dry matter and sugar contents in tubers and potatoes go bad more rapidly during the storage (Balemi, 2012).

Recent research illustrates an alternative method for enhancing the value of organic amendments. Reports indicate that effective microorganisms (EM) have the ability to enhance the decomposition of organic materials and to improve soil physical, chemical composition (Xu *et al.*, 2001).

Therefore, the present investigation aims to study the response of potato plants to the farmyard manure and compost as organic fertilizer, bio fertilization and mineral as well as their combination to determine the most appropriate integration for nitrogen as organic or inorganic fertilizer at different levels for improving vegetative growth, obtaining the optimum potato yield with good tubers quality.

## MATERIALS AND METHODS

Two field experiments were conducted in a loam soil at a private Farm at El-GamaliaDakahlia Governorate, Egypt during the summer seasons of 2014 and 2015 to study the effect of the various combinations among organic manures, bio-fertilizers and chemical fertilization on the production of safe and economic potato tubers (spunta cultivar).

Twenty-four treatments were arranged in split – split plot design with 3 replicates, which were the simple possible combinations two sources of organic manure [Farmyard manure (FYM) and compost] as main plots, the treatments of mineral fertilization (50, 75, and 100% NPK from recommended doses) as sub plots and three sources of bio fertilization (EM, yeast extract and mixture of multi strains) as sub-sub plot.

Each treatment was replicated three times; thus, the total numbers of every experiment were 72 experimental units. The plot area was 10.5 $m^2$, which contained three rows, 5m long and 0.7 m wide.

The soil of the experimental field was loam in texture and moderately fertile soil. Soil sample was collected from the surface layer (0-30 cm) of the experimental field and analyzed for some physical and chemical properties as shown in table 1

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

| **Seasons** | | **2014** | **2015** |
|---|---|---|---|
| Mechanical analysis (%) | Coarse sand | 2.8 | 2.9 |
| | Fine sand | 26.5 | 27.1 |
| | Silt | 38.3 | 37.2 |
| | Clay | 32.4 | 32.8 |
| | Texture class | SCL | SCL |
| E C dS $m^{-1}$(1:5) | | 2.98 | 3.01 |
| pH(1:2.5) | | 8.17 | 8.09 |
| S P % | | 51.5 | 53 |
| O M % | | 1.17 | 1.21 |
| $CaCO_{3\%}$ | | 3.77 | 3.67 |
| Available (mg/kg) | N | 47.3 | 48.8 |
| | P | 5.12 | 5.08 |
| | K | 223 | 234 |
| | Fe | 5.97 | 5.87 |
| | Pb | 2.63 | 2.71 |
| | Zn | 0.88 | 0.82 |

Ripe farmyard manure was taken from a private station of animal production, while compost was taken from Company for organic manures.Chemical analysis of the organic manures used are presented in Table 2

Organic manures were added to the soil before cultivation in a single application at a rate of 20 $m^3fed^{-1}$and 15 $m^3fed^{-1}$of FYM, and compost, respectively. Each experimental plot was mixed with FYM, and compost then irrigated up to saturation percentages.

**Table 2: chemical analysis of the organic manures used**

| **Organic manure properties** | **FYM** | | **Compost** | |
|---|---|---|---|---|
| | **2014** | **2015** | **2014** | **2015** |
| pH 1:5 | 6.59 | 6.47 | 6.04 | 7.02 |
| EC (1:10)($dSm^{-1}$) | 4.03 | 3.89 | 3.67 | 3.86 |
| Organic matter (%) | 33.75 | 34.65 | 36.20 | 37.01 |
| Organic carbon (%) | 19.62 | 20.04 | 21.05 | 21.12 |
| Total nitrogen (%) | 1.09 | 1.22 | 1.57 | 1.76 |
| C/N ratio | 18.00 | 16.72 | 13.41 | 12.00 |
| Total Phosphorus (%) | 0.47 | 0.52 | 0.51 | 0.54 |
| Total Potassium (%) | 0.59 | 0.61 | 0.66 | 0.71 |
| SP% | 145 | 151 | 167 | 171 |
| Iron ppm | 57.63 | 56.98 | 73.41 | 73.93 |
| Zinc ppm | 17.59 | 17.46 | 18.25 | 18.43 |
| Lead | 6.47 | 6.39 | 3.91 | 4.03 |

- Yeast solution was used at rates 20 $L.fed^{-1}$ for yeast it was added besides the plants.
- Effective microorganisms(EM) solution was used at the rate of 48$L.fed^{-1}$.
- Cell suspension of *Azotobacterchroccoccum* (AZ), *Bacillus megatherium* (PSB) and *Bacillus circulans* (KSB) were kindly provided from the unit of biofertilizers, Fac. Agric. Ain shams Univ. Egypt. The mixture was applied at rate of 48$L.fed^{-1}$.

Bio fertilization were added twice, once after 6 weeks from cultivation and the other two weeks later.

mineral fertilization treatments were treated 50, 75 and 100% from recommended doses of N, P and K by the Min. of Agric. and Soil Reclamation (MASR) for potatoes in the forms of ammonium nitrate (33.5 % N), super phosphate (15.5 % $P_2O_5$) and potassium sulfate (48 % $K_2O$). Full dose of P was added to the soil before sowing while; N and K were divided in to two equal doses one was added before the first irrigation and the second before the seconed irrigation.

Tubers of potato (*Solanum tubersum* L.); cv. spunta were used in this study. The whole seed tubers were planted on 25th January 2014 and 2015, respectively, at 25 cm apart between each other, depth (10-15) cm and on one side of ridges Throughout the experiment, soil moisture was kept at field capacity by watering every 5-7 days. All other agriculturepracticals were carried out as recommended by (MASR) for potato crop.

After 70 days from cultivation; five plant samples were randomly taken from each plot for determinationChlorophyll content was estimated on 5th

leaves from the plant apix accordingThen, dry matter was calculated (g plant$^{-1}$) and the dried parts were thoroughly ground and stored for chemical analysis.

Quality parameters of fresh tubers after 110 days i.e. R-sugar, NR-sugar, total sugar, $NO_3$ and $NO_2$ content (mg kg$^{-1}$) were determined on average weight for tubers per plant.

to Sadasivam and Manickam, (1996).

N, P and K concentrations in both organic manures sample was analyised according to the methodsdescribed by Jones *et al.* (1991), Peters *et al.*, (2003) and Singh (1988), respectively.

Total soluble sugar, was determined according to the method described by Sadasivam and Manickam, (1996). Reducing sugar was estimated by Nelson-Somogy method as described by Naguib (1964).

All data were statistically analyzed according to the technique of analysis variance (ANOVA) and the least significant according difference (LSD) was used to compare the deferencesamong the means of treatments values to the methods described by Gomez and Gomez, (1984). All statistical analyses were performed using analysis of variance technique by means of CoSTATE Computer Software.

# RESULTS AND DISCUSSION

**1. Yield and its components:**

Table 3 reveal yield and its components, i.e. fresh, dry weight (kg fed$^{-1}$), number of tuber and total yield of potato ton fed$^{-1}$ as affected by the interaction among organic manures, bio-fertilizers and mineral fertilization during both seasons.

With respect to the effect of interaction among organic manure, mineral fertilization and bio-fertilization on yield and its components of potato plants, it is evident from such data presented in Table 3 that the interaction amongthe studied three factors had a significant effect on yield and its components of potato plants.

It was clearly noticed that the best records in the mentioned characters were obtained by plants fertilized with 15 ton fed$^{-1}$ of compost + bio mixture and 75% NPK from recommended dose and the lowest one were recorded with using 20 ton fed-1 FYM+50% NPK RD. This effect was true during both seasons of the experiment. The positive effect of the interaction upon yield and its components could be considered as a reversion of the effects upon the vigorous growth of potato plants. Obtained results are in agreement with those reported byEid and El-Sayed (2012), Singh (2013)and Verma*et al.* (2013).

**Table 3: Fresh, dry weight, No. of potato tubers and total yield during 2014 and 2015 as affected by interaction among organic manures, bio-fertilizers and mineral fertilization.**

| Treat. | | Char. | Fw tuber g/plant 1st | Fw tuber g/plant 2nd | DW tuber g/plant 1st | DW tuber g/plant 2nd | No. of tuber/plant 1st | No. of tuber/plant 2nd | Total yield ton/fed 1st | Total yield ton/fed 2nd |
|---|---|---|---|---|---|---|---|---|---|---|
| FYM | 100% | EM | 613.00 | 764.67 | 15.55 | 15.87 | 2.38 | 2.47 | 12.87 | 13.23 |
| | | Yeast | 520.33 | 654.67 | 15.15 | 15.47 | 2.23 | 2.27 | 12.09 | 12.17 |
| | | Mix | 708.33 | 838.33 | 15.83 | 16.14 | 2.54 | 2.63 | 13.73 | 14.14 |
| | | 0 | 427.67 | 545.33 | 14.84 | 15.05 | 2.07 | 2.11 | 11.19 | 11.30 |
| | 75% | EM | 642.33 | 804.33 | 15.66 | 15.99 | 2.45 | 2.53 | 13.27 | 13.58 |
| | | Yeast | 553.00 | 686.67 | 15.28 | 15.60 | 2.26 | 2.32 | 12.23 | 12.43 |
| | | Mix | 752.67 | 874.33 | 15.99 | 16.29 | 2.58 | 2.67 | 13.97 | 14.35 |
| | | 0 | 655.33 | 578.00 | 14.92 | 15.19 | 2.13 | 2.16 | 11.52 | 11.57 |
| | 50% | EM | 577.00 | 729.67 | 15.40 | 15.73 | 2.36 | 2.41 | 12.77 | 12.94 |
| | | Yeast | 493.00 | 616.67 | 15.07 | 15.32 | 2.17 | 2.22 | 11.74 | 11.90 |
| | | Mix | 676.00 | 839.00 | 15.73 | 16.13 | 2.48 | 2.57 | 13.40 | 13.80 |
| | | 0 | 394.67 | 511.33 | 14.69 | 14.94 | 2.07 | 2.05 | 11.19 | 10.99 |
| Compost | 100% | EM | 729.67 | 883.33 | 16.80 | 15.07 | 2.61 | 2.59 | 14.11 | 13.89 |
| | | Yeast | 625.33 | 761.67 | 16.45 | 14.63 | 2.46 | 2.41 | 13.33 | 12.94 |
| | | Mix | 843.00 | 1032.00 | 17.17 | 15.48 | 2.64 | 2.76 | 14.29 | 14.80 |
| | | 0 | 514.00 | 640.67 | 16.07 | 14.18 | 2.27 | 2.25 | 12.30 | 12.07 |
| | 75% | EM | 770.33 | 928.00 | 16.95 | 15.22 | 2.66 | 2.66 | 14.40 | 14.26 |
| | | Yeast | 653.00 | 864.67 | 16.61 | 14.77 | 2.48 | 2.47 | 13.40 | 13.25 |
| | | Mix | 873.00 | 1047.00 | 17.34 | 15.61 | 2.72 | 2.82 | 14.71 | 15.13 |
| | | 0 | 548.33 | 680.67 | 16.13 | 14.34 | 2.33 | 2.32 | 12.63 | 12.45 |
| | 50% | EM | 690.00 | 842.00 | 16.76 | 14.95 | 2.53 | 2.54 | 13.70 | 13.61 |
| | | Yeast | 583.33 | 717.00 | 16.29 | 14.47 | 2.41 | 2.34 | 13.05 | 12.55 |
| | | Mix | 811.67 | 967.00 | 17.09 | 15.34 | 2.66 | 2.69 | 14.39 | 14.44 |
| | | 0 | 474.67 | 599.00 | 15.96 | 14.04 | 2.19 | 2.18 | 11.83 | 11.68 |
| LSD at 5% | | | 18.76 | 48.68 | 0.11 | 0.12 | 0.05 | 0.04 | 0.29 | 0.22 |

**Chlorophyll content in potato leaves:**

Table 4 indicated the effect of some organic manures, bio-fertilizers and chemical fertilization as well as their interaction during the two seasons of 2014 and 2015 on chlorophyll a, b and total chlorophyll mg g$^{-1}$ FW.

The interaction effect among organic manures, NPK-fertilization and bio-fertilization on chlorophyll a, b and total in the leaves in Table 10, show that the average values of the parameters under study were significantly increased under applications of bio-fertilization with application of NPK-fertilizer and adding compost.

The highest mean values were recorded with mixture of cell + 75 % NPK + 15 ton fed$^{-1}$ of compost, while the lowest values recorded with 50% RD + 20 ton fed$^{-1}$ of FYM. These results are in agreement with those obtained by Abdel-Salam and Shams (2012), Congera *et al.* (2014)and Baddour (2014)

**Table 4: Chlorophyll content of potato plant foliage after 70 days from cultivation during 2014 and 2015 as affected by interaction among organic manures, bio-fertilizers and mineral fertilization.**

| Treat. | | Char. | Chlorophyll a mg.g$^{-1}$ FW 1st | Chlorophyll a mg.g$^{-1}$ FW 2nd | Chlorophyll b mg.g$^{-1}$ FW 1st | Chlorophyll b mg.g$^{-1}$ FW 2nd | Total chlorophyll mg.g$^{-1}$ FW 1st | Total chlorophyll mg.g$^{-1}$ FW 2nd |
|---|---|---|---|---|---|---|---|---|
| FYM | 100% | EM | 0.723 | 0.766 | 0.432 | 0.550 | 1.156 | 1.316 |
| | | Yeast | 0.693 | 0.740 | 0.417 | 0.529 | 1.110 | 1.269 |
| | | Mix | 0.758 | 0.792 | 0.462 | 0.570 | 1.220 | 1.362 |
| | | 0 | 0.671 | 0.712 | 0.386 | 0.508 | 1.058 | 1.220 |
| | 75% | EM | 0.727 | 0.773 | 0.447 | 0.557 | 1.174 | 1.330 |
| | | Yeast | 0.701 | 0.748 | 0.413 | 0.536 | 1.114 | 1.285 |
| | | Mix | 0.767 | 0.801 | 0.474 | 0.580 | 1.241 | 1.381 |
| | | 0 | 0.682 | 0.720 | 0.396 | 0.514 | 1.079 | 1.234 |
| | 50% | EM | 0.715 | 0.754 | 0.425 | 0.541 | 1.140 | 1.295 |
| | | Yeast | 0.691 | 0.730 | 0.401 | 0.522 | 1.092 | 1.252 |
| | | Mix | 0.741 | 0.783 | 0.459 | 0.564 | 1.200 | 1.348 |
| | | 0 | 0.657 | 0.704 | 0.380 | 0.501 | 1.037 | 1.205 |
| Compost | 100% | EM | 0.856 | 0.834 | 0.556 | 0.593 | 1.413 | 1.427 |
| | | Yeast | 0.826 | 0.808 | 0.550 | 0.570 | 1.376 | 1.377 |
| | | Mix | 0.891 | 0.861 | 0.565 | 0.612 | 1.457 | 1.473 |
| | | 0 | 0.804 | 0.771 | 0.529 | 0.549 | 1.333 | 1.321 |
| | 75% | EM | 0.857 | 0.841 | 0.565 | 0.599 | 1.423 | 1.440 |
| | | Yeast | 0.841 | 0.815 | 0.546 | 0.576 | 1.387 | 1.391 |
| | | Mix | 0.894 | 0.873 | 0.582 | 0.613 | 1.476 | 1.486 |
| | | 0 | 0.812 | 0.791 | 0.532 | 0.557 | 1.344 | 1.348 |
| | 50% | EM | 0.848 | 0.823 | 0.562 | 0.587 | 1.410 | 1.410 |
| | | Yeast | 0.819 | 0.798 | 0.543 | 0.563 | 1.362 | 1.361 |
| | | Mix | 0.880 | 0.850 | 0.569 | 0.606 | 1.448 | 1.456 |
| | | 0 | 0.793 | 0.769 | 0.515 | 0.544 | 1.309 | 1.312 |
| | LSD at 5% | | 0.012 | 0.006 | 0.012 | 0.007 | 0.018 | 0.009 |

**3. Tubers quality:**

Tuber quality parameters which include Nitrite ($No_2$-N), Nitrate ($No_3$-N), R.sugars, N-R sugars and total sugarpercentages as affected by some organic manures, bio-fertilizers and chemical fertilization as well as their interaction of tuber after 120 days from planting during the two seasons of 2014 and 2015 at Tables 5 to 6.

**Nitrite and nitrate in potato tubers:**

With respect to the effect of interaction among organic manure, NPK-fertilization and bio-fertilization application treatments on $NO_3$-N and $NO_2$-Nin tubers of potato after 110 days. It is event from such data presented in Table 5 that the highest records of $NO_3$-N and $NO_2$-Nvalues were obtained by plants fertilized with FYM at 20 ton fed$^{-1}$, NPK-fertilization at 50% RD without bio fertilization. comparing with other treatments. While, the lowest values were recorded with using 15 ton fed$^{-1}$ + 50% Rd+ mixture of bio-fertilizers . This trend was true during both seasons of 2014 and 2015.

**Table 5: $NO_3$-N and $NO_2$-N in potato plant tuber after 110 days from planting during 2014 and 2015 as affected by interaction among organic manures, bio-fertilizers and mineral fertilization.**

| Treat. | | Char. | $NO_3$-N (mg kg$^{-1}$) 1st | $NO_3$-N (mg kg$^{-1}$) 2nd | $NO_2$-N (mg kg$^{-1}$) 1st | $NO_2$-N (mg kg$^{-1}$) 2nd |
|---|---|---|---|---|---|---|
| FYM | 100% | EM | 46.66 | 53.34 | 0.91 | 1.16 |
| | | Yeast | 46.82 | 53.51 | 0.93 | 1.21 |
| | | Mix | 46.61 | 53.16 | 0.87 | 1.14 |
| | | 0 | 47.14 | 54.04 | 1.02 | 1.37 |
| | 75% | EM | 46.50 | 52.78 | 0.80 | 0.99 |
| | | Yeast | 46.53 | 52.99 | 0.83 | 1.06 |
| | | Mix | 46.36 | 52.61 | 0.76 | 0.94 |
| | | 0 | 46.81 | 53.92 | 0.98 | 1.27 |
| | 50% | EM | 46.14 | 52.22 | 0.65 | 0.84 |
| | | Yeast | 46.25 | 52.43 | 0.73 | 0.90 |
| | | Mix | 45.89 | 51.95 | 0.62 | 0.77 |
| | | 0 | 46.88 | 53.65 | 0.95 | 1.22 |
| Compost | 100% | EM | 44.29 | 50.95 | 0.72 | 0.96 |
| | | Yeast | 44.51 | 51.12 | 0.74 | 1.01 |
| | | Mix | 44.14 | 50.75 | 0.62 | 0.88 |
| | | 0 | 44.97 | 51.66 | 0.90 | 1.13 |
| | 75% | EM | 43.91 | 50.44 | 0.55 | 0.81 |
| | | Yeast | 44.02 | 50.58 | 0.62 | 0.84 |
| | | Mix | 43.80 | 50.23 | 0.54 | 0.74 |
| | | 0 | 44.83 | 51.47 | 0.83 | 1.08 |
| | 50% | EM | 43.54 | 49.85 | 0.43 | 0.65 |
| | | Yeast | 43.65 | 50.04 | 0.53 | 0.72 |
| | | Mix | 43.39 | 49.74 | 0.47 | 0.60 |
| | | 0 | 44.65 | 51.30 | 0.77 | 1.03 |
| | LSD at 5% | | 0.13 | 0.17 | 0.06 | 0.05 |

**Reducing sugars, Non - reducing sugars, total sugarpercentages after 70 and 110 days:**

Data of R.sugars, N-R sugars, total sugarpercentages after 110 days as affected by organic manures, bio-fertilizers and chemical fertilization are present in Table 6 during both seasons.

- **Effect of interaction;**

As for the effect of the interaction among organic manure, NPK-fertilization and bio-fertilization application in Table 6,it can be noticed that adding 15 ton fed$^{-1}$ of compost manure and 75% NPK from RD combined with mixture ofbio-fertilizersgave the highest

values ofR.sugars, N.R sugar and total sugars percentages. The highest values were recorded as 1.86-2.12, 3.46-3.65 and 5.32-5.77 %during both seasons for R.sugars, N.R sugar and total sugars percentages. The present results were in agreement with the findings ofAdemoyegum *et al.* (2011) who concluded that organic manure significantly increased the tuber quality.Yogita (2012)and Asghari (2015).

**Table 6:R.sugar, N.R sugar and total sugar of potato tuber after 110 days from planting during 2014 and 2015 as affected by interaction among organic manures, bio-fertilizers and mineral fertilization.**

| Treat. | | Char. | R.sugar % | | N.R sugar% | | Total sugar% | |
|---|---|---|---|---|---|---|---|---|
| | | | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| FYM | 100% | EM | 1.55 | 1.68 | 2.66 | 3.28 | 4.21 | 4.95 |
| | | Yeast | 1.45 | 1.54 | 2.54 | 3.05 | 3.99 | 4.59 |
| | | Mix | 1.72 | 1.87 | 2.97 | 3.45 | 4.68 | 5.32 |
| | | 0 | 1.35 | 1.39 | 2.38 | 2.86 | 3.73 | 4.25 |
| | 75% | EM | 1.57 | 1.73 | 2.75 | 3.28 | 4.33 | 5.02 |
| | | Yeast | 1.44 | 1.57 | 2.59 | 3.11 | 4.02 | 4.68 |
| | | Mix | 1.75 | 1.89 | 3.13 | 3.50 | 4.88 | 5.39 |
| | | 0 | 1.41 | 1.41 | 3.48 | 2.95 | 4.89 | 4.37 |
| | 50% | EM | 1.48 | 1.63 | 2.65 | 3.18 | 4.13 | 4.81 |
| | | Yeast | 1.41 | 1.48 | 2.48 | 2.97 | 3.89 | 4.45 |
| | | Mix | 1.65 | 1.78 | 2.86 | 3.38 | 4.51 | 5.17 |
| | | 0 | 1.28 | 1.31 | 2.40 | 2.80 | 3.68 | 4.11 |
| Compost | 100% | EM | 1.75 | 1.86 | 3.30 | 3.39 | 5.05 | 5.25 |
| | | Yeast | 1.58 | 1.63 | 3.14 | 3.21 | 4.72 | 4.83 |
| | | Mix | 1.86 | 2.05 | 3.39 | 3.59 | 5.25 | 5.64 |
| | | 0 | 1.52 | 1.48 | 2.86 | 3.02 | 4.38 | 4.49 |
| | 75% | EM | 1.75 | 1.92 | 3.29 | 3.46 | 5.03 | 5.39 |
| | | Yeast | 1.71 | 1.70 | 3.14 | 3.26 | 4.86 | 4.96 |
| | | Mix | 1.86 | 2.12 | 3.46 | 3.65 | 5.32 | 5.77 |
| | | 0 | 1.57 | 1.54 | 2.93 | 3.10 | 4.50 | 4.63 |
| | 50% | EM | 1.67 | 1.74 | 3.21 | 3.32 | 4.87 | 5.06 |
| | | Yeast | 1.60 | 1.56 | 3.04 | 3.12 | 4.64 | 4.68 |
| | | Mix | 1.78 | 1.99 | 3.39 | 3.52 | 5.17 | 5.51 |
| | | 0 | 1.46 | 1.44 | 2.82 | 2.97 | 4.28 | 4.40 |
| | $LSD_{at\ 5\%}$ | | 0.07 | 0.07 | 0.06 | 0.07 | 0.10 | 0.10 |

**The objective of this investigation can be discussed as follows:**

The results mentioned previously has been proved that;such increment in yield parameters might be as a result of adequate supply of macro nutrients (NPK) by compost rice straw to plants moreover the improve of soil condition which in turn increased plant contents of these elements i.e. (NPK). Also the increase in fresh weight of plants obtained by the application of compost would increase photosynthetic surfaces and the current of photosynthetic products would enhance the physiological activities leading to production of more assimilates used to cause a significant increment in yield production. These results are in conformity with the finding ofMoursy, (2013) and Baddour, (2014). Moreover, incorporation of organic materials in soils can further increase NPK availability by increasing $CO_2$ forming $H_2CO_3$ in the soil solution. In the same line, it was found that inorganic N, P and K fractions were increased due to application of organic amendments such as farmyard manures. These results confirm those obtained byBarmaki*et al.,* (2008)andBaddour, (2014). As for the effect on nitrate and nitrite the result indicated with Barmaki*et al.,* (2008) found that nitrate contents in tubers of plants received with organic manure alone or organic manure combined with inorganic N fertilizers were less than tubers of plants received chemical fertilizers only. Similar was reported byFarnoosh, (2014) and Baddour, (2014).

The enhancing effect of applying NPK to a particular level on tuber yield characters could be explained on the basis that, NPK fertilization encourage the vegetative growth to go forward and probably accelerated the photosynthetic rate, so number of tubers and tuber weight ,were increased. These results appear to be in close agreements with the findings ofShaheen*et al*., (2014) and Nooruldeen and Al-Juthery, (2015). Also, These results may be owed to the availability of N, P and K elements for plant and improving root growth, hence increasing the absorbing area of root. Similar result was reported byShaheen*et al*., (2013) andBaddour (2010). As for the effect on $NO_3$ and $NO_2$ dataillustrated thatthe highest nitrate content due to chemical fertilization may be attributed to that mineral fertilizer salts are soluble and nitrogen is immediately available for plant uptake soon after fertilizer application, otherwise, organic N fertilizers release nutrients slowly.

These increments in yield of potato plant might be attributed to the nonsymbiotic bacteria present in biofertilizers which have beneficial effects on morphology and / or physiology of the root system enhancing N2–fixation and mineral uptake, so increased thechlorophyll concenteration (Table 4) to go forward which, in turn, promoted the synthesis of more photosynthates required for tuber formation and development. The obtained results confirmed the previous findings ofMirshekari and Alipour (2013) and Baddour (2014). As for, $NO_3$ and $NO_2$ the same line withBaddour (2014)indicated that Co inoculation of potato tubers and onion bulbs with the mixture of microorganisms sharply decrease the main values of nitrate less than those obtained for the uninoculated tubers. Opposite findings were recorded by Salehi *et al.* (2014).

## CONCLUSION

Under the same conditions of this investigation it could be recommended that treating potato plants with the mixture combined with compost at rate of 15 $m^3$ $fed^{-1}$ and the addition NPK at 75% from RD are considered as the most suitable treatment for realizing the highest economic and safe yield of potato tubers.

## REFERENCES


Abdel-Salam, M. A. and A. S. Shams (2012). Feldspar-K fertilization of potato (*Solanum tuberosum* L.) augmented by biofertilizer. American-Eurasian J. of Agric. & Environ. Sci; 12(6):694-699.

Admoyegum,O.T ;T.A.Fariyike and R. B. Aminu-Taiwo (2011).Effect of poultry dropping on the biologically active compounds in *capsicum annum* (var. Nsukka yellow). Agric. Biol. J. North. Amer ., 2 (4): 665-672.

Arisha, H. M. and A. Bardisi (1999).Effect of mineral and organic fertilizers on growth, yield and tuber quality of potato under sandy soil conditions. Zagazig J. Agric. Res., 26(2): 391-405.

Asghari, M. T . (2015). Farmyard manure application of potato (*Solanum tuberosum*var.Agria) with three levels of nitrogen fertilizer. Intl. J. Farm and Alli Sci., 4 (6):536-540.

Baddour, A. G. (2014).Ecological study on potato and onion crops grown under organic farming comparing with mineral fertilization. PhD.Thesis, Fac. Agric. Mans. Univ. Egypt.

Baddour, A. G., (2010). Effect of bio-fertilization on growth and productivity of tomato plant. M. Sc. Thesis Fac. Agri. Mans. Univ. Egypt.

Balemi, T. (2012). Effect of integrated use of cattle manure and inorganic fertilizers on tuber yield of potato in Ethiopia. J. Soil Sci. Plant Nutr., 12(2): 253 261.

Barmaki, M., F. R. Khoei, S. Z. Salmasi, M. Moghaddam and G. N. Ganbalani (2008). Effect of organic farming on yield and quality of potato tubers in Ardabil. J. Food Agric. Environ. 6: 106-109.

Congera, A.; M. Anjanappa, K. M.Indiresh, and B. S. Kumara, (2014). Effect of integrated nutrient management on tuber dry matter accumulation and uptake of nutrients by potato (*Solanum tuberosum* L.). Crop Res., (Hisar); 46(1/3):174-177.

Durzi, M. T. (2012). Effects of organic manure and bio-fertilizer application on flowering and some yield traits of coriander (*Coriandrumsativum*). Intl. J. Agri. Crop Sci., 4(3): 103 – 107.

Eid, R. R. and S. F. El-Sayed (2012). Effect of organic and bio-fertilization on potato productivity. Special Issue New Medit N. 4/2012.pp 66-68.

Farnoosh, J. (2014). Effect of manure application on reduced nitrogefertilizer Consumption at Potato Cv. Agria. Int. J. Adv. Biol. Biom. Res., 2 (8), 2437-2440.

Fathy, E. S. L.; S. Farid and S. A. El- Desouky (2002). Induce cold tolerance of outdoor tomatoes during early summer season by using triphosphate (ATP), yeast, other natural and chemical treatments to improve their fruiting and yield. Agric. Sci. Mansoura Univ., 25(1): 377-401.

Gomez, K. A., and A. A. Gomez, (1984). "Statistical Procedures for Agricultural Research". John Wiley and Sons, Inc., New York.pp:680.

Jones, J.; B. J. B. Wolf, and H. A. Mills (1991). Plant analysis Handbook: A Practical Sampling, Preparation, Analysis, and Interpretative Guide. Micro-Macro Publishing, Athens, Ga.

Mansour, M. A., (2012). Standardization of micronutrients enrichment technique in organic manures and its impact on soil and crop. M.Sc.thesis Tamil nadu Agric. Univ. India..

Mirshekari, B. and M. H. Alipour (2013). Potato (*Solanum tuberosum*) seed bio-priming influences tuber yield in new released cultivars. International Journal of Biosciences (IJB); 2013. 3(6):26-31.

Moursy, A. A., (2013). Organic fertilization for improving potato production with application of 15 N- isotope dilution technique. J. Amer. Sci; 9 (10):221-226.

Muthoni, J. and D. O. Nyamango (2009). A review of constraints to ware Irish potatoes production in Kenya. J. Horticult. Forestry, 1 (7): 98 102.

Naguib, M. I. (1964). "Modified Nelsons solution". Effect of serin on the carbohydrates and nitrogen metabolism during germination cotton seeds.

Najm, A. A.; M. R. Haj SeyedHadi, R. Shamorady, M. Gharaviri and I. Panahi (2011). Comparison of dry matter and harvest index in potato plants grown under conventional, integrated and organic production systems. Paper Presented at the 18th Triennial Conference of the Oulu Finland. (C.F comp. search)

Nooruldeen, S. A. and H. W. A. Al-Juthery (2015). The combined effect of different fertilizer sources and irrigation method on potato and water productivities under iraqi conditions. Intl. J. Recent Scientific Res., 6 (8): 5569-5572.

Peters, I. S.; B. Combs, I. Hoskins, I. Iarman, M. Kover Watson, and N. Wolf, (2003). Recommended Methods of Manure Analysis. Univ. of Wisconsin, Cooperative extension Publ., Madison.

Sadasivam, S. and A. Manickam (1996). Biochemical Methods, 2nd Ed. New Age international (P) Limitid Publishers, New Delhi P. 42-43.

Salehi, B.; J. Daneshian, M. R. Ardakani, M. H. Arzanesh, and A. H. S. Rad, (2014). Various source of supply of nitrogen (chemical, animal and biological) on growth, yield and quality potatoes (*Solanum tuberosum* L.). Inter. J. Biosci., (IJB); 4(5):232-242.

Sarhan, T. Z. (2008). Effect of biological fertilizer, animed residues and urea on growth and yield of potato plant C.V. Desiree. Ph.D. Thesis – College of Agric. and Forestry - University of Mosul.

Shaheen, A. M.; F. A. Rizk and N. G. Abd El-Rahman (2014). Growth, tubers yield and its nutritional value of potatoes as affected by cattle, chicken and /or chemical nitrogen fertilizer. Middle East J. Agric. Res., 3 (2): 292 301.

Shaheen, A. M.; F. A. Rizk, E. H. Abd El Samad and S. M. El-Ashry (2013). Effect of nitrogen fertilizer and soil conditioner on the productivity of potato plants grown under sandy soil conditions. J. Appl. Sci. Res., 9 (3): 1774 1781.

Singh, J. P., (1988). A rapid method for determination of nitrate in soil and plant extracts. Plant and soil. 110: 137-139.

Singh, U. N., (2013). Effect of bio-fertilizers on yield and economic traits of potato at two fertility levels. HortFlora Rese. Spectrum; 2(3):262-264.

Tagoe, S. O.; T. Horiuchi, and T. Maisui (2008). Effects of carbonized and dried chicken manures on the growth yield and N content of soybean. Plant and Soil, 306 (1) : 211 – 220.

Verma, R. B.; A. Kumar andS. P. Pathak (2013).Studies on nutrient management options in potato. Potato J., 40 (1): 72-75.

Xu, H. L.; R. Wang, A. A. U. Mridha and H. Umemura (2001).Phytopththora resistance of tomato plants grown with EM Bokashi. In Proc.6th International Conference on Kyusei Nature Farming, Ed. Senanayake, Y.D.A., Sangakkara, UR APNAN, Thailand: 259 – 264.(C.F comp. search)

Yogita, R. B. (2012). Effect of chemical and bio-fertilizers on quality of onion. HortFlora Res. Spectrum; 1(4):367-370.

## استجابة نباتات البطاطس للتسميد العضوى والحيوى والمعدنى

**حسام محمد السعيد عبدالنبى , السيد ابراهيم الجميلى و نهلة أحمد رفعت قشطه**
**كلية الزراعة ـ جامعة المنصورة**

اجريت تجربتان حقليتان في التربه الطمييه في مزرعه خاصه بالجماليه خلال الموسمين الشتويين ٢٠١٤ و ٢٠١٥ لدراسه تاثير التفاعلات الممكنه بين التسميد العضوى ، التسميد الحيوى و التسميد المعدنى على انتاجيه محصول البطاطس صنف سبونتا. تم تصميم التجربه في قطاعات منشقه مرتين بين ٢٤ معامله في ٣ مكررات والتى اشتملت التفاعلات الممكنه بين التسميد العضوى (سماد بلدى، كمبوست) كقطع رئيسيه، ثلاث معاملات من التسميد المعدنى (٥٠، ٧٥، ١٠٠% من الموصى به للبطاطس) كقطع منشقه و ثلاث مصادر تسميد حيوى (ميكروبات فعاله، مستخلص خميره و خليط من سلالات ميكروبيه) كقطع تحت منشقه. وبالتالى المجموع الكلى للمعاملات هو ٧٢ وحده تجريبيه. اظهرت النتائج ان متوسطات القيم لكل من الوزن الجاف و الطازج للدرنات، عدد الدرنات ، المحصول الكلى ومحتوى الكلوروفيل فى الاوراق بعد 70 يوم من الزراعه ، النترات والنيتريت، السكريات المختوله والغير مختزله والسكريات الكليه فى الدرنات جميعها تاثرت بالزياده المعنويه نتيجه لاضافه ٢٠ طن للفدان سماد بلدى و ١٥ طن للفدان كمبوست بينما سجلت اعلى القيم عند استخدام ١٥ طن للفدان كمبوست. بالنسبه لاستخدام التسميد المعدنى سجلت اعلى القيم للمتوسطات تحت الدراسه باضافه التسميد المعدنى عند ٧٥% ولكن تناقصت معنويا عند اضافه ١٠٠%. اما بالنسبه للتسميد الحيوى فسجلت اعلى القيم عند استخدام خليط من السلالات الميكروبيه بمعدل ٢مل للتر يليها اضافه الميكروبات الفعاله بمعدل ٢ مل لكل نبات. بالاضافه الى التفاعل المشترك بين المعاملات تحت الدراسه أعطت اعلى القيم للمتوسطات تحت الدراسه عند اضافه ١٥ طن للفدان كمبوست فى وجود خليط من السلالات الميكروبيه تحت ٧٥% من الموصى به تسميد معدنى.