



Partial Replacement of Chemical N Fertilizer by Using Plant Compost and Chicken Manure in Potato Cv. “Lady Balfour” in New Reclaimed Land

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Abstract: This study was carried out at El- Kawther Experimental farm, Faculty of Agriculture, Sohag University during 2017/ 2018 and 2018/ 2019 Nily seasons in potato cv Lady Balfour have been fertilized potato plant cv. Lady Balfour planted in sandy soil the recommended rate i.e. 150 unit nitrogen as 100% from chemical , 75% chemical plus 25% organic, 50% chemical plus 50% organic and 25% chemical plus 75% organic as a trial for reducing the amount of chemical nitrogen fertilizer . The sources of chemical fertilizer nitrogen were (ammonium nitrate) and organic fertilizer nitrogen were (plant compost and chicken manure) results showed that decreasing the percentage of chemical N fertilizers from 100 to 50% and in the same time increasing the percentages of both organic (plant compost and chicken manure) from 0.0 to 50% of the suitable rate of N was accompanied with enhancing in growth characters, yield and plant pigments and the percentages of N, P and K as well as TSS %, nitrogen and protein in tubers of lady Balfour potato cv. for producing organic tubers lady Balfour potato cv. as well as improving yield quantitatively and qualitatively . It is preferable to fertilizer plants with i.e. 150 unit nitrogen per fed. as 50% chemical N (ammonium nitrate) and 50% organic (plant compost or chicken manure).

[Yaser A.M. Shehata **Partial Replacement of Chemical N Fertilizer by Using Plant Compost and Chicken Manure in Potato Cv. “Lady Balfour” in New Reclaimed Land** *Researcher* 2020;12(12):79-86]. ISSN 1553-9865 (print); ISSN 2163-8950 (online). <http://www.sciencepub.net/researcher>. 10. doi:[10.7537/marsrsj121220.10](https://doi.org/10.7537/marsrsj121220.10).

Keywords: Potato, Lady Balfour, Plant compost, Chicken manure

1. Introduction

Potato (*Solanum tuberosum*) has an economic important both in Egypt and worldwide , and it is a world staple crop. It ranks the fourth position in the world after wheat , rice and maize as non- cereal food crop. Potato is used in many ways like vegetable potato wafers / chips, powder, finger chips etc. It originated in the Andean mountains of south America and became important worldwide, especially in Europe and Egypt. (Hawkes, 1990)

Potato is one of members of the family of solanaceae, which includes plants such as tomato, eggplant, pepper, tobacco and petunia. It is usually categorized as a dicotyled onous annual, though tubers may persist in the field from one season to the next. The tubers are modified portions of the underground stem, termed a rhizome or stolon. The tips of the stolons produce the tubers, or the edible. Portions of the plant and initiation of growth occur when the plants are approximately 6-8 inches high, or about 5-7 weeks after planting (Seiczka and Thorton, 1993).

Each 100 g. potato fresh tubers contains about 72- 80 g moisture, 12- 17 g starch , 1-2 g. protein , 6 g. sugar , 0.4- 1.0 fibers and about 0.96 g ash.

Also, potato tubers are rich in potassium, phosphorus, Iron and vitamin C, but poor in calcium and vitamin B (Watt and Merrill, 1963).

Fertilizers as well as cultivar selection, time of harvest and cultural practices determine quality of potato production for adequate growth large amounts of nitrogen and potassium are needed (Dean, Bill, 1994).

Organic potato production is growing in Egypt now to take place in the European markets and their consumers who are willing to play high price for healthy safe products. It gained a considerable importance as an export crop to European markets and one of the national income resources (El-Ghamry, 2009).

Advantages of organic fertilizers.

-Better for the soil provides organic matter essential for microorganisms. It is one of the building blocks for fertile soil rich in humus.

-nutrient release , slow and consisted at a natural rate that plants are able to use no danger of over concentration of any element, since microbes must break down the material.

Trace mineral: typically present in broad range, providing more balance nutrition to the plant.

Won't burn: safe for all plants with no danger of burning due to salt concentration.

Long lasting: doesn't leach out since the organic matter binds to the soil particles where the roots have access to it.

Stronger plants and grass: greater resistance to disease and insect attacks.

Encourages soil life: microbes convert the organic matter to the form of nutrients the plants need. Earthworms feeding on organic materials aerate and loosen the soil

2. Materials and Methods

This study was carried out at El- Kawthar Experimental farm, Faculty of Agriculture Sohag University- Sohag, Egypt. During the two successive Nily seasons of 2017/ 2018 and 2018/ 2019 in the open field.

Ten soil sample were randomly taken from soil before transplanting air dried, crushed, sieved and used to determine, the following physical and chemical analysis of the experimental soil site in two studies (Table 1 and 2) (Hesse 1971 and Jackson, 1973).

Table (1) some physical and chemical characteristics of El-Kawthar Experimental farm (New reclaimed soil) (Wilde *et al.*, 1985).

| Constituents | Values |
|----------------------------|------------|
| Clay % | 7.90 |
| Silt % | 22.90 |
| Sand % | 69.20 |
| Texture grade | Sandy loam |
| pH | 8.00 |
| EC (1-5) dsm ⁻¹ | 4.07 |
| CaCO % | 11.71 |
| O.M. % | 1.8 |
| N% | 0.178 |
| P (ppm) | 11.0 |
| K (ppm) | 311.0 |

Description and some economical characters of Lady Balfour potato used in the present study.

Parentage: 8204 S x 15119 AC5

Characters: Lady Balfour is a very high yielding under Egyptian conditions is new reclaimed and old lands . Productivity is around 12-20 ton/ Acer.

Tuber characteristics:

- Smoothness of skin: medium.
- Shape of tuber: oval.
- Depth of eyes: medium red

-Color of skin: parti-colored

-Color of flesh: white

-Maturity: main

Botanical description:

-Height of plants: very tall

-Frequency of berries: absent

-Color of base of light sprout : pink

The recommended rate of nitrogen fertilize were added i.e. 150 unit nitrogen

Table (2): Some physicochemical analysis of the plant compost and chicken manure

| Parameters | Values | |
|---------------------------|---------------|-----------------|
| | Plant compost | Chickens manure |
| Cubic meter weight (kg.) | 600.0 | 580.0 |
| Moisture % | 29.0 | 20.0 |
| O.M. % | 30.9 | 58.27 |
| Organic carbon % | 28.55 | 27.93 |
| pH (1:2.5 extract) | 7.26 | 10.20 |
| EC (ds/m) (1:2.5 extract) | 10.28 | 5.90 |
| C/N ratio | 14.28 | - |
| Total N % | 2.0 | 2.5 |
| Total P% | 1.03 | 1.14 |
| Total K % | 1.22 | 1.26 |
| Total Ca% | 1.26 | - |
| Total Mg % | 1.33 | - |
| Total Fe (ppm) | 18.8 | 18.6 |
| Total Mn (ppm) | 38.00 | 17.5 |
| Total Zn (ppm) | 4.11 | 44.09 |

Treatments for this experiment:

T₁- chemical 100% fertilizer (~ 450 kg/ fed ammonium nitrate).

T₂- Chemical 75% (~ 336 kg/ fed. ammonium nitrate) + plant compost 25% (1.875 ton / fed. plant compost)

T₃ -Chemical 75% (~ 336 kg/ fed. ammonium nitrate + chicken manure 25% (1.500 ton/ fed. chicken manure).

T₄ -Chemical 50% (~ 225 kg/ fed. ammonium nitrate +plant compost 50% (3.75 ton/ fed. plant compost).

T₅ -chemical 50% (~ 225 kg/ fed. ammonium nitrate + chicken manure 50% (3.0 ton/ fed. chicken manure).

T₆- Chemical 25% (~ 112.5 kg/ fed. ammonium nitrate + plant compost 75% (5.625 ton/ fed. plant compost)

T₇ – Chemical 25% (~112.5 kg/ fed. ammonium nitrate + chicken manure 75% (4.5 ton/ fed. chicken manure).

Nitrogen chemical fertilizer (Ammonium nitrate) was divided into three equal doses and added at 35, 50 and 65 day after planting.

Nitrogen organic fertilizer (plant compost and chicken manure) were added once before planting.

The following characters were determined:

1-Plant morphological characters:

Samples of five plants after 70 days from sowing randomly collected from each experimental until and labeled to measure the following characters.

- plant height (cm)
- Number of main stems / plant
- Percentages of dry matter leaves.
- chlorophylls A and B (mg/ 1.0 g F.W.)

2- The Chemical components of leaves after 70 days from planting.

-Nitrogen: was determined using Kjeldhle apparatus according to (Jackson, 1973).

- Phosphorus: was determined by the molybdenum blue method using the spectrophotometer Device according to (Jackson 1973).

-Potassium: was measured using the flame – photometer. Device according to (Jackson, 1973).

3-Yield and its components:

Five plants each plot were harvested at last week of Jan. in both cultivars on seasons. A maturity stage after 105 days from planting and the following data was recorded:

- Number of tubers/ plant.
- Weight of tubers / plant (kg / plant)
- Tubers yield (ton / Feddan).
- Dry matter percentages of tubers.

4- Chemical components of tubers:

- Total soluble solids (TSS%)
- Nitrogen in tubers.
- Protein in tubers.

5-Statistical analysis:

The collected data were subjected to the statistical analysis of variance procedures and

treatment means were compared using the new L.S.D. at 5% as described by (Gomez and Gomez , 1984).

3. Results and Discussion

1-Effect of organic and inorganic fertilizers on the percentage of germination after 18 and 35 days from planting on lady Balfour potato cv are shown in Table (3)

Inorganic and organic fertilizers had significant effect in percentages of germination only after 35 days from planting in the both seasons.

Fertilization of potato plants with recommended nitrogen with 50% chemical (ammonium nitrate) and 50% chicken manure gave the highest germination percentages while the highest values were (94.30 and 95.00) respectively.

2-Effect of some organic and inorganic fertilizers on number of main stems/ plant, plant height and leaves dry matter % after 70 days from planting of Lady Balfour potato cv. 2017/ 2018 and 2018/ 2019 seasons are shown in Table (3).

Reducing inorganic (chemical) fertilizers from 100% to 50% resulted in significant reduction on the number of main stem / plant , plant height and leaves dry matter percentage .

The same trend was recorded with organic fertilizers at 75% . The best organic fertilizer in this respect was chicken manure at 50% with chemical fertilizer at 50% in both seasons. These results were true during both seasons.

The maximum values were recorded on Lady Balfour potato on number of main stems/ plant, plant height and leaves dry matter % in fertilized with chemical 50% (ammonium nitrate) and chicken manure at 50% of the recommended N during both seasons. The present results are in the same line with those obtained by Abdel-Ati (1998); Abou- Hussein *et al.*, (2002 b and c), Kuhwah and Banafer (2003), Kate *et al.*, (2005); Covarrubias- Ramirez *et al.*, (2005) ; El-Sayed (2010) and Abdel Magid (2012).

Table (3): Effect of some organic and inorganic fertilizers on percentage germination and some vegetative growth characters of Lady Balfour potato cultivars during the Nily seasons of 2017/ 2018 and 2018/ 2019

| Organic and chemical fertilizers treatments | Germination % after 18 days from planting | | Germination % after 35 days from planting | | No. of main stems/ plant after 70 days | | Plant height after 70 days | | Dry matter % of leaves after 70 days | |
|---|---|-----------|---|-----------|--|-----------|----------------------------|-----------|--------------------------------------|-----------|
| | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 |
| T ₁ - chemical 100% | 86.62 | 86.70 | 91.00 | 91.13 | 3.11 | 3.14 | 55.70 | 56.00 | 19.50 | 19.60 |
| T ₂ -chemical 75% + plant compost 25% | 89.20 | 89.82 | 94.20 | 94.28 | 2.96 | 2.98 | 58.20 | 59.10 | 19.88 | 19.93 |
| T ₃ -Chemical 75% + chicken manure 25% | 89.098 | 90.20 | 95.00 | 95.11 | 2.97 | 3.00 | 59.11 | 60.20 | 20.10 | 20.18 |
| T ₄ -Chemical 50% + plant compost 50% | 92.00 | 92.44 | 96.30 | 96.39 | 2.55 | 2.60 | 60.30 | 61.10 | 20.19 | 20.33 |
| T ₅ -Chemical 50% + chicken manure 50% | 92.50 | 93.10 | 96.88 | 96.97 | 2.63 | 2.66 | 61.80 | 62.30 | 21.25 | 21.36 |
| T ₆ -Chemical 25% + plant compost 75% | 94.30 | 95.00 | 98.20 | 98.31 | 2.00 | 2.10 | 51.90 | 52.50 | 18.60 | 18.89 |
| T ₇ -Chemical 25% + chicken manure 75% | 95.10 | 95.90 | 99.00 | 99.05 | 2.30 | 2.44 | 52.80 | 53.10 | 18.90 | 19.20 |
| New L.S.D. at 5% | 1.11 | 1.14 | 0.98 | 0.99 | 0.55 | 0.57 | 1.08 | 1.10 | 0.90 | 0.95 |

3-Effect of some organic and inorganic fertilizers on plant pigments (chlorophylls A and B) after 70 days from planting of Lady Balfour potato cv. 2017/ 2018 and 2018 / 2019 seasons.

Data concerning the effect of chemical and organic fertilizers on chlorophylls A and B in the leaves of potato plants during 2017/ 2018 and 2018/2019 are given in Table (4).

It is evident from the obtained data that very nitrogen management had significant influence on the two plant pigments namely chlorophylls A and chlorophyll B. fertilization the plants with chemical N at 50% of the suitable N significantly promoted such two plant pigments in relative to the application of 25% chemical and 75% organic fertilizer. The maximum values were recorded with using the suitable nitrogen completely via chemical 50% and chicken manure 50% . These results were true during both seasons.

In potato cv Lady Balfour supplying the plants with nitrogen through chemical N 50% and chicken manure 50% effectively maximized chlorophylls A and B during both seasons. These finding are in harmony with those obtained by *Shahi et al., (2003)*; *Semiha Guler (2009)* and *El- Sayed (2010)*.

4-Effect of some organic and inorganic fertilizers ion percentage of N, P and K in leaves potato after 70 days from planting of Lady Balfour potato cv. 207/ 2018 and 2018/2019 seasons.

Data concerning the effect of some chemical and organic fertilizers on percentages of N, P and K in potato leaves during 2017/ 2018 and 2018/ 2019 seasons are given in Table (4) . It is evident from the obtained data that decreasing inorganic nitrogen or two organic (plant compost and chicken manure). The organic nitrogen fertilizer namely chicken manure was superior than plant compost. Application of chicken manure at 50% and chemical (ammonium nitrate) at 50% gave the best results in most cases with few exceptions. Similar trend was noticed during both seasons. The maximum N, P and K percentages was recorded on potato cv. Lady Balfour that received nitrogen completely via chemical and chicken manure. These results are in accordance with those obtained by (*Borin and Mgrini (1989)*; *Chaurasia and Singh (1995)*; *Doikova et al., (1997)* *Arisha and Bardisi (1999)*; *Ouda, (2000)* ; *El-Banna et al., (2001)*; *Hussein and Radwan (2002)*; *El- Ghamry (2009)* and *Saiedi et al., (2009)*.

Table (4): Effect of some organic and inorganic fertilizers on the leaf chemical composition of Lady Balfour potato cultivars during the Nily seasons of 2017/ 2018 and 2018/ 2019

| Organic and chemical fertilizers treatments | Chlorophyll a (mg/ 1.0 g F.W.) | | Chlorophyll b (mg/ 1.0 g F.W.) | | N % in leaves after 70 days | | P % in leaves after 70 days | | K % in leaves after 70 days | |
|---|--------------------------------|------------|--------------------------------|------------|-----------------------------|------------|-----------------------------|------------|-----------------------------|------------|
| | 2017/ 2018 | 2018/ 2019 | 2017/ 2018 | 2018/ 2019 | 2017/ 2018 | 2018/ 2019 | 2017/ 2018 | 2018/ 2019 | 2017/ 2018 | 2018/ 2019 |
| T ₁ - chemical 100% | 28.35 | 29.00 | 11.33 | 11.42 | 1.92 | 1.94 | 0.29 | 0.31 | 1.18 | 1.21 |
| T ₂ -chemical 75% + plant compost 25% | 29.41 | 29.98 | 12.45 | 12.68 | 2.11 | 2.16 | 0.36 | 0.39 | 1.21 | 1.25 |
| T ₃ -Chemical 75% + chicken manure 25% | 29.99 | 30.33 | 13.05 | 13.46 | 2.18 | 2.22 | 0.39 | 0.44 | 1.39 | 1.44 |
| T ₄ -Chemical 50% + plant compost 50% | 30.32 | 31.00 | 13.98 | 14.11 | 2.32 | 2.35 | 0.56 | 0.62 | 1.44 | 1.351 |
| T ₅ -Chemical 50% + chicken manure 50% | 31.11 | 32.09 | 14.15 | 14.62 | 2.44 | 2.46 | 0.61 | 0.67 | 1.46 | 1.56 |
| T ₆ -Chemical 25% + plant compost 75% | 27.00 | 27.15 | 10.00 | 10.18 | 1.81 | 1.86 | 0.28 | 0.29 | 1.11 | 1.14 |
| T ₇ -Chemical 25% + chicken manure 75% | 27.45 | 27.66 | 10.50 | 10.73 | 1.87 | 1.91 | 0.26 | 0.33 | 1.13 | 1.16 |
| New L.S.D. at 5% | 0.99 | 1.00 | 0.89 | 0.91 | 0.45 | 0.47 | 0.18 | 0.19 | 0.06 | 0.08 |

5-Effect of some organic and inorganic fertilizers on yield (ton/ fed.) of Lady Balfour potato cv. 2017/ 2018 and 2018/2019 seasons Table (5).

Decreasing chemical nitrogen and two organic fertilizers (plant compost and chicken manure) from 100% to 25% of the recommended nitrogen rate was significantly responsible for reducing yield and yield components namely (number f tubers / plant , total tubers number and weight per plant).

The chicken manure of 50% and chemical fertilizers at 50% nitrogen gave the highest values with regard to tuber yield per feddan of Lady Balfour potato during both seasons.

The results are in coincidence with those obtained by El- Banna and Abd El- Salam (2000); Acharya and Kapur (2001) ; Kumar *et al.*, (2001);

Willekens *et al.*, (2008); Jarvan and Edesi (2009) and Passoni and Borin (2009).

6-Effect of some organic and inorganic fertilizers on the TSS % as well as nitrogen % and proteins % in the tubers of Lady Balfour potato cv. 2017/ 2018 and 2018/ 2019 seasons. in Table (6)

Using plant plus organic at 75% and chemical at 25% rate resulted in the highest total soluble solids % as well as nitrogen % and protein % followed by chemical 50% and organic 50%.

When potato plant received chicken manure at rate 75% and chemical 25% gave the highest value in this regard during both seasons. The same trend was noticed by Maiboroda *et al.*, (1988); Asmaa and Magda (2010) and Abdel Magid (2012).

Table (5): Effect of some organic and inorganic fertilizers on the yield per fed. as well as average of number and weight total tubers per plant of Lady Balfour potato cultivars during the Nily seasons of 2017/ 2018 and 2018/ 2019

| Organic and chemical fertilizers treatments | Total tuber yield? (Ton/ fed.) | | Average of number of total tubers/ plant | | Weight of total tubers (kg/ plant) | |
|---|--------------------------------|-----------|--|-----------|------------------------------------|-----------|
| | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 |
| T ₁ - chemical 100% | 11.350 | 11.480 | 11.50 | 11.62 | 0.70 | 0.72 |
| T ₂ -chemical 75% + plant compost 25% | 11.860 | 11.990 | 11.98 | 12.05 | 0.81 | 0.84 |
| T ₃ -Chemical 75% + chicken manure 25% | 12.000 | 12.300 | 12.10 | 12.15 | 0.84 | 0.85 |
| T ₄ -Chemical 50% + plant compost 50% | 13.170 | 13.330 | 12.60 | 12.66 | 0.88 | 0.91 |
| T ₅ -Chemical 50% + chicken manure 50% | 13.250 | 13.820 | 13.00 | 13.11 | 0.91 | 0.95 |
| T ₆ -Chemical 25% + plant compost 75% | 9.320 | 10.100 | 10.05 | 10.10 | 0.62 | 0.68 |
| T ₇ -Chemical 25% + chicken manure 75% | 9.980 | 10.450 | 10.35 | 10.40 | 0.66 | 0.69 |
| New L.S.D. at 5% | 1.150 | 1.311 | 0.91 | 0.93 | 0.08 | 0.09 |

Table (6): Effect of some organic and inorganic fertilizers on some chemical characteristics of the potato tubers of Lady Balfour potato cultivars during the Nily seasons of 2017/ 2018 and 2018/ 2019

| Organic and chemical fertilizers treatments | Dry matter % in potato tubers | | TSS % in potato tubers | | N % in potato tubers | | Protein % in potato tubers | |
|---|-------------------------------|-----------|------------------------|-----------|----------------------|-----------|----------------------------|-----------|
| | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 | 2017/2018 | 2018/2019 |
| T ₁ - chemical 100% | 22.40 | 22.60 | 4.80 | 4.86 | 1.66 | 1.68 | 10.30 | 10.33 |
| T ₂ -chemical 75% + plant compost 25% | 23.62 | 23.88 | 4.98 | 5.10 | 1.78 | 1.80 | 11.11 | 11.17 |
| T ₃ -Chemical 75% + chicken manure 25% | 24.11 | 25.25 | 5.10 | 5.15 | 1.81 | 1.86 | 11.68 | 11.71 |
| T ₄ -Chemical 50% + plant compost 50% | 25.00 | 25.60 | 5.19 | 5.2 | 1.96 | 1.97 | 12.91 | 12.99 |
| T ₅ -Chemical 50% + chicken manure 50% | 25.35 | 25.98 | 5.25 | 5.31 | 1.98 | 1.99 | 13.00 | 13.11 |
| T ₆ -Chemical 25% + plant compost 75% | 20.00 | 20.33 | 5.87 | 5.98 | 2.00 | 2.06 | 13.04 | 13.10 |
| T ₇ -Chemical 25% + chicken manure 75% | 20.50 | 20.98 | 6.00 | 6.11 | 2.06 | 2.11 | 13.11 | 13.13 |
| New L.S.D. at 5% | 0.96 | 0.98 | 1.00 | 1.03 | 0.06 | 0.07 | 0.08 | 0.09 |

References

- [1]. **Abdel- Ati, Y.Y. (1998):** Yield and quality of potato as affected y phosphorus, Assiut J. of Agric. Aci., Volume 29 (5): 129-147.
- [2]. **Abdel –Mageid, B.A. (2012):**Response to two cultivars of potato to some chemical and organic fertilizer treatments. M. Sc. In the thesis of Agric. Minia Univ. Egypt.
- [3]. **Abou- Husein, S.D. El- Okh, I.; El-Shorbagy, T. and El- Nahiry, U.S. (2002c):** Effect of chicken manure. Compost and biofertilizer on vegetative growth, tuber characteristics and yield of potato crop. Egypt. J. of Hortic. 29: 135-149.
- [4]. **Abou- Hussein, S.D.; El- Bahiry, U.A., El-Oksh, I. and Kalafallah, M.A. (2002b):** Effect of compost biofertilizer and chicken manure on nutrient content and tuber quality of potato crops Egypt. J. of Hortic. 29: 117-133.
- [5]. **Acharya, C.L. and Kapur, O.C. (2001):** Using organic wastes as compost and mulch for potato (*Solanum tuberosum* L.) in low water retaining hill soils of north- west India. Indian J. of Agric. Sci. 71 (5): 306-309.
- [6]. **Arisha, H.M. and Bardisi, A. (1999):** Effect of mineral and organic fertilizers on growth, yield and tuber quality of potato under sandy soil conditions . Zagazig J. Agric. Res. 26: 391-405.
- [7]. **Asmaa, R.; Mahmoud and Magda, M. Hafez (2010):** Increasing productivity of potato plants (*Solanum tuberosum*, L.) by using potassium fertilizer and humic acid application. International Journal of Academic research. Volume 2 No.2 March 2010.
- [8]. **Borin, M.a dn Magrini, L. (1989):** Nitrogen and organic fertilizer application to potatoes crop yield and nitrogen use efficiency Rivista di Agronomia, 23: 43-50.
- [9]. **Chaurasai, S.N.S. and Singh, K.P. (1995):** Tuber yield and uptake of N, P and K in the leaves stems and tubers as affected by nitrogen levels and haulms cutting potato cv. Kufri Bahar J. of the Indian. Potato. Assoc. Vol. 22 (1/2) 80-82.
- [10]. **Covarrubias- Ramires, J.M. ; Castillo-Aguilar, S.; Vera- Ninez, J.A.; Nunez-J.A.; Nunez- Escobar, R.; Samnchez- Garcia, P.; Aveladano- Salazar, R. and Pena-Cabriales, J.J. (2005):** Phosphorus uptake and use efficiency by potato cultivar Alpha using 32p Agrocienza Montecilo, 39: 127-136.
- [11]. **Dean , Bill , B (1994) :** Managing the potato production system. Food Products Press , New York.
- [12]. **Djokova, M.; Belichki, I. and Boteva, H. (1997):** Biological removal of N, P₂O₅ and K₂O with vegetable marrow yield under conditions of mineral fertilizer application. Acta- Horticulture. (462) :801- 808.
- [13]. **El- Bonna, E.N. Awad, E.M.; Ramadan , H.M. and Mohamed, M.R. (2001):** Effect of bioorganic fertilization in different seasons on growth, yield and tubers quality of potato (*Solanum Tuberosum* L.) J. Agric. Sci. Mansoura Univ., 26: 1687-1696.
- [14]. **El- Ghamry, A.M. (2009):** Effect of organic and mineral nitrogen fertilizers on potato crops. Mansoura Univ. Journal of Agric. Sci. V. 34 (4): part B.
- [15]. **El- Sayed- Hala, A. (2010):** Effect of organic and mineral fertilizers on productivity and quality of potato: 1-Vegetative growth Mansoura Univ. J. of plant production, V.1 (5): p. 745-756.
- [16]. **El-Banna, E.N. and Abd El- Salam, H.Z. (2000):** Effect of rock phosphate and super phosphate application with organic manures on growth yield and quality of Potato (*Solanum tuberosum* L.) Journal Agriculture Science Mansoura University, 25(7) 4531-4540.
- [17]. **Gomez, K.A. and Gomez, A.A. (1984):** Statistical procedures for agricultural research, 2nd edition John Wiley and Sons, New York, 680 pp.
- [18]. **Hawkes, J.G. (1990):** The potato evaluation biodiversity and genetics resources Belhaven Pr., London, 259 p.
- [19]. **Hesse, P.R. (1971):** A text book of soil chemical analysis , publisher, John Murray, London, Orate Britain.
- [20]. **Hussein, H.F. and Radwan , S.M.A. (2002):** Bioorganic fertilization of potato under plastic mulches in relation to quality of production and associated weeds, Arab Universities Journal of Agric. Sci. 10, 287-309.
- [21]. **Jachson, M.L. (1997):** Soil chemical analysis prentice Hall, New Dwlhi India.
- [22]. **Jarvan, M. and Edesi, L. (2009):** The Effect of cultivation methods on the yield and biological quality of potato Agronomy Res. 7 (Special Issue). 289-299.
- [23]. **Kate, D.M. ; Solanke, A.V.; Tiwari, T.K. and Nemada, S.M. (2005):** Growth and yield of potato cultivars as affected by integrated

- nutrient management system J. of Maharashtra Agric. Univ. 30: 236-237.
- [24]. **Kmar, P. Sharma, R.C., Upadhyay, N.C. and Rawak, S. (2001):** Effect of spacing farmyard manure and dehauling on production of seed-m sized tubers of potato (*Solanum tuberosum*, L.) Indian J. of Agric. Sci. 71: 10, 658-660.
- [25]. **Kushwah, S.S. and Banafar, R.N.S. (2003):** Comparative study of chemical and biofertilizers on growth and yield of potato (*Solanum tuberosum* L.) cv. Kufi Jyoti Adv. In plant Sci. 16: 209-213.
- [26]. **Maiboroda, N.M. Voloshin, E.I. and Terekova, V.F. (1988):** Effects of rates and proportions of mineral fertilizers on yield, quality and storage quality of different potato cultivars under conditions of the Krtanoyarsk forest steppe Zone. Agrkimiya (2): 29-32.
- [27]. **Ouda, A.M.M. (2000):** Biological studies on tomato yield and its components Ph. D. Thesis Fac. Agric. Mansoura Univ. Egypt.
- [28]. **Passoni, M. and Borin, M. (2009):** Effects of different composts on soil nitrogen balance and dynamics in biennial crop succession. Compost science and utilization, 17(2): 108-116.
- [29]. **Semiah- Guler (2009):** Effect of nitrogen on yield and chlorophyll of potato (*Solanum tuberosum* L.) cultivars, Bangladesh J. Botany 38 (2): 163-169.
- [30]. **Shahi, U.P.; Suman Kumar; Singh, N.P. and Tiwari, A.K. (2003):** Effect of different fertility levels on spectral characteristics growth and yield of potato cv. Kufri Bahal J. of the Indian potato Association 30, 325- 328.
- [31]. **Sieczka- Joseph, B. and Robert- Thornton, E. (eds) (1993):** Commercial potato production in North America Revision of American potato Journal Supplement Vol. 57 and USDA Handbook 267 by the extension section of the potato association of America. Onion, Maine.
- [32]. **Watt, B.K. and Merrill, A.L. (1963) :** Composition of Foods, U.S. Dept. Agric. Agric. Handbook No. 8-190p.
- [33]. **Wilde, S.A, Corey, R.B., Layer, J.G. and Voigt, G.K. (1985):** Soils and plant analysis for tree culture. Oxford and IBH, Publishing Co., New Delhi, India.
- [34]. **Willekens, K.; Vliegheer, A. de; Vandexastelle, B., and Carlier, L. (2008):** Effect of compost versus animal manure fertilization on crop development yield and nitrogen residue in the organic cultivation of potatoes. Cultivating the future based on science volume 1. Organic crop production proceedings of the second scientific conference of the international society of organic Agric. Res. ISOFAR, held at the 16th IFOAM organic world conference in cooperation with the Intr., Federation of organic Agric. Movements. LFOAM and the consorzio Modenabio in Modena, Italy 18-20 July 2008, 576-579.

12/22/2020