**Effect of organo- nitrogen fertilization on N-uptake and growth yield of potatoes using 15N**

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**Abstract**

Fertilization is an important and limiting factor for growth and tuber production of potatoes crop because plants non adsorption amounts of nutrients from the soil. Data obtained the compost tea foliar or compost tea fertigation alone or mixed with mineral-N. Resulted in grand mean the highest tuber yield of potatoes foliar compost tea methods, the value of tuber yield value (42.34 tan ha -1) which relatively increased by about 15.68%, 11.31% over the untreated addition compost to soil and compost tea fertigation.Also data show that grand mean the highest shoot dry weight of potatoes foliar compost tea methods, the value of tuber yield value (4.79 tan ha -1) which relatively increased by about 41.54%,24.43% over the untreated addition compost to soil and compost tea fertigation.Also data show under methods, fertigaion compost tea, with treatment 50% compost tea+ 50% mineral –N seems to be the best ones in Nitrogen uptake by tuber potato plant (131.24 kg ha-1). the compost tea fertigation, %Ndff, Ndfcompost in tuber was much higher for compost tea fertigation (57.74 kg ha-1) ,(56.62 kg ha -1 )than for compost tea foliar methods (50.21 kg ha-1),(51.84 kg ha-1) and compost addition to soil (33.02 kg ha-1) , (27.82 kg ha-1) respectively . The percentage nitrogen use efficiency (%NUE) by tuber ranged from %9.17 to %16.27 due to (MA1)+R2 and 100 % MF , respectively.

**Key words:** compost tea**,** 15N technique, Potato

**1. Introduction**

Fertilization is one of the most expensive agricultural productions and that provides higher economic return practices **(SILVEIRA et al., 2015).** Foliar spraying complements the soil fertilization and is used when a given plant needs to recover quickly, in most cases of nutrient deficiencies. The fertigation method is another technique that allows the application of fertilizers. This technique enables the application of nutrients mixed with the irrigation water, ensuring uniform distribution of nutrients on the area, labor saving and high efficiency of nutrients utilization, allowing also the fertilizer to be applied in the region with higher concentration of roots, besides better fractionation of doses **(BISCARO et al., 2012).** The use of fertilizers in liquid form via foliar spraying or fertigation is increasing in agriculture. Despite this increase, this practice is still considered new in agriculture, making it necessary the evaluation of the products available in the market for the correct indication of the best doses and application methods.( **Álvaro.et.al 2018).**Potato (*Solanum tuberosum* L.) is cultivated in Egypt in a wide area and ranks the first vegetable crop for export and local market. Potato is one of the most important export vegetable crops in Egypt and the second most important vegetable crop after tomato in economic value. Egypt is one of the top 20 producers of potato worldwide and the top largest producer in Africa **(Potatopro, 2014).** A total production of 4.8 million tons year -1, including 637,434 ton for exportation with a market value of 250 million USD. About 19% of total area devoted for vegetable production is cultivated with potato **(MALR 2016**).Nowadays, potato cultivation is facing several challenges to maintain and improve production, from the point of view of both quality and quantity. The aim of the present study was to investigate the effect of organo- nitrogen fertilization on N-uptake and growth yield of potatoes grown on sand soil with application of 15N tracer technique.

**2. Materials and Methods**

A field experiment was carried out at the Soils and Water Research Department, Nuclear Research Center, Inshas, Egypt, on potato as an indicator plant using the materials described below. physical and chemical properties of used sandy soil were 88.5% sand , Silt 2.7%, and 8.8% clay , pH(1: 2.5) 7.97, EC(dSm-)0.27,O.C%0.017, O.M%0.03, T.N%0.007, C/N Ratio2.43, Ca CO3 %1.0. Tubers of potato cultivar (*Solanum tuberosum* L) (Burn)**,** supplied by theAgriculture Research Centre (ARC), Giza, Egypt were used in the experiments carried out through the study. Tuber Burn plant was sown on 27Th of January in seasons 2018 and spaced at 20cm, deep 15 cm apart. The chemical properties of compost the used investigated were PH (1:5) 6.70, EC ds/m12.70, C/N ratio12.62, O.M%56.89, N %2.83, P%0.84, and K % 0.692 .Compost tea was obtained by extraction from compost treatment on 1day up 90 days. The chemical properties of compost tea the used investigated were PH (1:5) 6.40, EC ds/m18.80, C/N ratio10.15, O.M%57.02, N %3.13; P%0.51, K %1.617 .A field experiment was carried out where the experimental design was complete randomized block with three replicates. The drip irrigation occupied the main plots.The experiment included (13 treatments of potato Burn) each 9 treatments of 3 replicate (1 treatment360 kg ha-1 Mineral fertilizer (ammonium nitrate as control), 1 treatments 360 kg ha-1 organic manure **(**compost or compost tea) and 1 treatments 180 kg ha-1 organic manure **(**compost or compost tea) + 180 kg ha-1 Mineral fertilizer (ammonium nitrate) and three methods i compost applied to soil, ii compost tea fertigation, iii compost tea foliar. A basic supplemental of N, P and K fertilizers were applied to each plots (4 x 10 m2) at the rate of 360 kg ha-1as organic manure**(**compost or compost tea) orMineral fertilizer (ammonium nitrate), 180 kg ha-1 as phosphoric acid and 230.4 kg ha-1 as potassium sulfate, respectively. 15N-Labeled ammonium nitrate (3% 15N atom excess) was applied as a source of mineral nitrogen (ammonium nitrate) was applied as solution three time after 18,30,50 days from planting. The dry weights of whole plants and plant parts, total nitrogen, Nitrogen derived from fertilizer (%Ndff), Nitrogen derived from soil (% Ndfs), Nitrogen derived from organic compost (% Ndf comp) and Fertilizer use efficiency (% FUE) were calculated according to Training course series No 14,IAEA (2001). After 115 days, plants were harvested and shoots were dried at 70ºC, weighed and digested.

Chemical and physical analyses of tested soil samples were determined according to Black (1965) and Page (1982).

Statistical analysis:Analysis of variance was determined an obtained data.

**3. Results and Discussion**

Production yield tuber of potato plant as affected by compost and compost tea additions was presented in graphically illustrated by Fig (1). In this regard, yield tuber of potato was positively affected by compost or compost tea and mineral fertilizer treatments. Results showed that addition compost to soil alone none significantly increased tuber yield of potatoes compared other application to method, compost tea foliar or compost tea fertigation alone or mixed with mineral-N. Resulted in grand mean the highest tuber yield of potatoes foliar compost tea methods, the value of tuber yield value (42.34 tan ha -1) which relatively increased by about 15.68%, 11.31% over the untreated addition compost to soil and compost tea fertigation . On the other hand, 100% MF resulted in slight by lower tuber yield values as compared with the corresponding ones .Also data show that the combination of compost or compost tea and mineral fertilizer (half +half ) where the tuber yield was enhanced with compost or compost tea and the highest grand mean(45.86 tan ha -1) .when compared with organic treatment alone(31.25 tan ha -1) or mineral nitrogen alone(37.30 tan ha -1).

In our study the crop organs remained relatively constant by the internal Nitrogen concentration (significant differences) regardless of whether there was optimal or deficient Nitrogen available, the variation in plant uptake proved to depend on the utilization efficiency of the plant to develop biomass with an increasing supply of Nitrogen and methods application.Therefore, the increase in tuber production due to foliar compost tea methods and higher N- mineral or organo applications in Optimal and deficient Nitrogen situations was due to greater crop biomass development, generating more synthesis and translocation of photosynthates from the foliage to the tubers **(Kumar et al., 2007)**. On the other hand , optimal and anther methods Nitrogen availability conditions have proven to cause a decrease in potato crop yields (Morales et al., 2013) and may also have detrimental effects on tuber quality and the environment **(Goffart et al., 2011; Khan et al., 2014).**

**Fig .1** **Effect of organic manure and N- mineral on tuber of potato tan ha-1.**

**Methods of addition (MA) :** Compost addition to soil (MA1), compost tea fertigation (MA2), compost tea foliar (MA3)

**Rate of addition nitrogen (R):** 100% compost (R1), 50% compost or compost tea + 50% mineral -N(R2), **100** %mineral -N ( 100% MF)

Data in Fig (2) show that shoot dry weight of potatoes plant as affected by addition compost or compost tea and mineral -N. shoot dry weight of potatoes significantly increased by addition 50%compost or compost tea plus 50% mineral –N . The rate of increase shoot dry weight of potatoes plant due to compost or compost tea mixed with mineral –N was 4.09,4.03 and 3.39 tan ha -1 at the treatment 50% organic manure as compost or compost tea + 50% mineral – N ,100% mineral – N , and 100% compost or compost tea respectively . Addition compost to soil under all treatment compost or compost tea with mixed with mineral -N none significantly increased compared other method, compost tea foliar or compost tea fertigation under rate of compost or compost tea alone or combination with mineral –N. data also show that grand mean the highest shoot dry weight of potatoes foliar compost tea methods, the value of tuber yield value (4.79 tan ha -1) which relatively increased by about 41.54% ,24.43% over the untreated addition compost to soil and compost tea fertigation. **Fontes et al., ( 2010).**found that the high rate of Nitrogen application handicapped the emergence and further development of plant.

**Fig .2** **Effect of organic manure and N- mineral on shoot dry matter of potato tan ha-1.**

Nitrogen uptake by tuber potato plant was greatly improved by the compost or compost tea and mineral –N in Fig ( 3) data in grand main of rate nitrogen addition organic or mineral-N effected on nitrogen uptake by tuber potato addition rate 50% compost or compost tea + 50%mineral –N increased nitrogen uptake by tuber potatoes under all methods as comparing to other rate. Under methods fertigaion compost tea, with treatment 50% compost tea+ 50% mineral –N seems to be the best ones in Nitrogen uptake by tuber potato plant (131.24 kg ha-1). The lowest value of N uptake by tuber was recorded with 100% compost. foliar compost tea methods had increased N uptake by tuber over those recorded with compost tea fertigation,compost addition to soil accumulated 124.14 ,109.37,100.55 kg ha-1 respectively. A crop is total dry matter production and kg of N absorbed can be used to calculate the internal nitrogen requirement for that crop **(Sun et al., 2012).**

Tuber number per plant has been shown to increase, decrease or to be unaffected by N fertilization **(Bélanger et al. 2002).**Tuber yield is responsive to fertilizer N addition in almost all cases **(Zebarthet al. 2009 ) .** Fertilizer N application increases yield primarily though an increase in tuber mass **(De la Morena et al. 1994 )** .

N uptake by shoots potato plant in Fig ( 4) Data show that enhanced N uptake by shoot it was clear that with treatment compost tea foliar as compared to other method. Under rate of nitrogen amendment to soil, the treatment compost tea plus mineral –N induced high and the best N uptake by shoots compared other to be totally fertilized with organic or mineral –N. Also, nitrogen mineralized from sources organic of soil could be more relevant than the type of fertilizer applied in the nitrogen availability in soil during season growing of the plant, being a determining factor to consider in fertilizer strategies . Agroecosystems to avoid N losses **(Martínez-Lagos et al., 2015).**

**Fig.3Effect of organic manure and N-mineral on N uptake kgha-1 of tuber potato.**

**Fig.4Effect of organic manure and N-mineral on N uptake kgha-1 of shoot dry weight potato.**

Nitrogen derived from fertilizer (%Ndff) nitrogen derived from compost (%Ndfcompost ) in tuber potatoes higher than these recorded with shoots, also mean of rate of 50% mineral -N combination with 50% compost or compost tea greater than those for treatment compost addation to soil table (1) data show the compost tea fertigation, %Ndff, Ndfcompost in tuber was much higher for compost tea fertigation (57.74 kg ha-1) ,(56.62 kg ha -1 )than for compost tea foliar methods (50.21 kg ha-1),(51.84 kg ha-1) and compost addition to soil (33.02 kg ha-1) , (27.82 kg ha-1) respectively .The percentage nitrogen use efficiency (%NUE) in tuber of potato was higher compared than those recorded with shoots under all treatment and methods. (%NUE) by tuber ranged from %9.17 to %16.27 due to (MA1)+R2 and 100 % MF , respectively. Improving nitrogen use efficiency is especially important for potato plants because of their relatively low ability to take up available soil mineral nitrogen **(Goffart *et al.*, 2008)**. Furthermore, it is important to investigate the potato nitrogen uptake efficiency and risks of N fertilizer application before and at planting, considering the efficacy of these timing strategies in minimizing N losses **(Rens *et al.*, 2015)**. Therefore, we propose that it is necessary to validate the parameters for the reasoned fertilization of potato crops (*Solanumtuberosum L*.) under the dryland conditions of the Valdivia agro-ecosystem. **Kumar et al. (2007)** Found that the increase in total tuber yield due to higher N applications in deficient and optimal N situations was due to greater crop biomass development, generating more synthesis and translocation of photosynthates from the foliage to the tubers .

Three N availability situations were established (deficient,optimal and supra-ptimal), where the behavior of the evaluated parameters allowed us to estimate when the N use efficiency of potato crops decreased due to excess fertilization, causing excessive increases in the residual N in an soil **(Dante Pinochet et .al 2018). Kołodziejczyk(2014)** determined that each increase in the rate of nitrogen fertilization caused a decrease in the N use efficiency.

**Table (3)** **Effect of organic manure and N- mineral on N dff ,Ndfcompost kg ha-1 and % NUE of potato varieties.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Methods of addition compost or compost tea (MA) | | | | | | | | | Source of applied nitrogen (R) |
| shoot | | | | | Tuber | | | |
| Ndff kg ha-1 | | | | | | | | |
| Mean | (MA3) | | (MA2) | (MA1) | Mean | (MA3) | (MA2) | (MA1) |
| 37.20 | 32.88 | | 45.12 | 33.6 | 46.99 | 50.21 | 57.74 | 33.02 | (R2) |
| 47.98 | | | | | 58.57 | | | | 100%M F |
| Ndfcompost or compost tea kg ha-1 | | | | | | | | |  |
| 41.34 | 48.96 | | 31.92 | 43.15 | 45.43 | 51.84 | 56.62 | 27.82 | (R2) |
| %NUE | | | | | | | | |  |
|  | | 9.13 | 12.53 | 9.33 |  | 13.95 | 16.04 | 9.17 | (R2) |
| 13.33 | | | | | 16.27 | | | | 100%M F |

Conclusion

Data show that ,grand mean the highest tuber yield of potatoes foliar compost tea methods .

the compost tea fertigation, %Ndff, Ndfcompost in tuber was much higher for compost tea fertigation compared to compost tea foliar methods The percentage nitrogen use efficiency (%NUE) by tuber ranged from %9.17 to %16.27 due to (MA1)+R2 and 100 % MF , respectively.

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الملخص العربي

تاثير التسميد العضوى النتروجينى على امتصاص النتروجين ونمو المحصول البطاطس مستخدما ن15

**احمد عبد المنعم مرسى و مازن مصطفى اسماعيل**

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يعتبر التسميد عاملاً مهمًا ومحدِّدًا لنمو وإنتاج درنات محصول البطاطس لأن النباتات لاتمتص كل المغذيات من التربة. البيانات التي تم الحصول عليها من رش شاى الكمبوست او استخدامه مع ماء الرى منفردا أو مختلطة مع النتروجين المعدنى.ارتفع محصول درنات البطاطس مع طريقة الرش لشاى الكمبوست وكانت قيمة محصول الدرنات 42.34% طن/هكتار بزياده حوالى 15.68% ,11.31% مقارنه بطريقة الكمبوست المضاف للتربه وطريقة اضافة شاى الكمبوست مع ماء الرى . ايضا اظهرت ان المتوسط الرئيسى زياده الماده الجافه لدرنات البطاطس مع طريقة رش شاى الكمبوست وكانت قيمتها 7.79 طن/ هكتار بزياده حوالى 41.54 , 34.43 عن طريق اضافة الكمبوست للتربه و طريقه اضافة شاى الكمبوست مع الرى

اظهرت البيانات تحت اضافة شاى الكمبوست مع ماء الرى وكذلك المعدل 50% شاى الكمبوست + 50% نتروجين معدنى كانت احسن معامله فى النتروجين الممتص بواسطة درنات البطاطس 131.24 كيلوجرام /هكتار. ادى اضافةشاى الكمبوست مع الرى الى ارتفاع النتروجين المشتق مع السماد وكذلك النتروجين المشتق مع شاى الكمبوست مع درنات البطاطس وسجلت 57.74 كيلو جرام / هكتار, 56.62كيلو جرام / هكتار مقارنه بطريقه الاضافه بالرش وكانت50.21 كيلو جرام / هكتار, 51.84كيلو جرام / هكتار وطريقة اضافة الكمبوست للتربه وكانت 33.02كيلو جرام / هكتار, 27.82كيلو جرام / هكتار على التوالى.

كانت نسبة كفاءة النتروجين المسجله بواسطة درنات البطاطس بين 9.17% حتى 16.27% مع المعامله اضافة الكبوست للتربة مع المعدل 50% كمبوست + 50% نتروجين معدنى و المعامله 100% نتروجين معدنى على التوالى .