Impact of lithovit and planting depth on growth, productivity and quality of potato crop

A., N., A. Salama * and I., A., A. Haggag

Horticulture Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt

* Corresponding author E-mail: atef.nouh@azhar.edu.eg (A. Salama)

ABSTRACT

This study examined the effects of varying levels of nano lithovit 0, 0.25, 0.50, 1.00, 1.50, and 2.00 gram per liter on the growth, production, and companionship of potato cv. Hermes during two experimental successive seasons. The study was conducted in an open field with potato crop. The registered data demonstrated that 15 cm produced greater numbers in all analyzed growth, yield, and chemical parameters, however 25 cm produced better values for tuber cracks and plant diameter throughout the course of two growing seasons. Conversely, for control and nano lithovit levels (except for 1.5), the maximum vegetative growth, yield, and chemical properties were observed at 2.00 gram per liter for nano material only in the second season did the comparison at control and nano lithovit levels apart from 1.5 gram per liter produce the maximum plant diameter. With the exception of 1.5 gram per liter of nano lithovit with a deep 25 cm, which only produced the largest plant diameter during the second season, the application of nano lithovit at a depth of 15 cm yielded the best interaction during all potato characteristics. Throughout the two testing seasons, the control group without any lithovit had the lowest levels for every attribute. Therefore, it is advised that tubers be grown under 15 cm and that foliar application of 2 gram of nano lithovit per liter result in higher potato growth, yield, and quality along with a decrease in physiological defects of tuber production.

Keywords: Potato; nano lithovit; green tuber; planting depth; tuber yield.

INTRODUCTION

Potato crops pertain for solanaceae family, one of better important food in many countries. Potato crops rich in contents from starch, sugar, crude fiber, proteins, amino acids, vitamin C and minerals such as P, Ca, Mg, K, S, and Cl (Singh *et al.*, 2020). It's a spread through vegetative propagation while grown as an annual species (Graham *et al.*, 2001). Due to improved tuber yield can be choose suitable variety and more rational cultivation techniques (Chehaibi *et al.*, 2013). Shallow culture is favored in wet and heavy soils because in tubers planting soils deep lead to consumption of stored nutrient before sprouts emergence on the soil surface (Eldalgamony *et al.*, 2022). Conversely, texture of soils is a risk of dehydration due to moisture stress therefor deep cultivation very essential. Also, deep planting has advantage in comparison with shallow where the temperature is higher. In addition, deep planting may be also limited damage of tubers by certain pests. Finally, the cultivation depth, crop yield is also influenced with light period (Pruski *et al.*, 2001), light intensity and N nutrition (Etemad and Sarajuoghi 2012), variety, soil temperature degree (Chehaibi *et al.* 2013), potassium, planting density, plant height, stem and tubers number formed with size (Singh *et al.*, 2020). Cultivation depth was achieved through regulated machinery taking out rows regulate spacing, distribution tubers and uniform coverage of soil (Haider *et al.*, 2012).

Because of their gradual release and effective uptake by plants, nano fertilizers are employed as a substitute for conventional fertilizers. It might be encouraging low-cost environmental conservation and the efficient use of nutrients (Naderi and Shahraki, 2013). According to earlier research, plants may benefit from nanoparticles in terms of growth and development (Khaledian *et al.*, 2014). $CaCO_3$ makes up 80% of nano lithovit, magnesium 4.6%, and Fe 0.5%. This compound's beneficial effects include its ability to release $CaCO_3$ to CaO and CO_2 in leaves, where CO_2 speeds up photosynthesis and enhances carbon uptake and assimilation, which in turn boosts plant growth and other factors (Bilal, 2010 and Carmen *et al.*, 2014). According to Maswada and Abd EL-Rahman (2014), this side of the plant produced higher growth and photosynthesis, yield, and its constituent parts when lithovit was sprayed on wheat crops. Increased CO_2 levels in leaves and improved photosynthetic efficiency are the results of the lithovit mode of action (Abdelrehem, 2014 and Abdelghafar *et al.*, 2016). The objective of this experiment was to reduced mineral fertilizer and physiological defects of tuber (Green and Cracks) with improvement of growth, production and quantity of potato under two planting depth by using nano lithovit.

MATERIAL AND METHODS

Two field experiments were conducted during the two successive seasons of 2020/2021 and 2021/2022 at a private farm located in Zawetrazin village, EL-Menofiya Governorate, Egypt under surface irrigation to evaluate the effect of two planting depth at (15 and 25 cm) and foliar application with different concentrations at 0.25, 0.50, 1.00, 1.50 and 2.00 g/l of lithovit on the growth, productivity and quality of potato cv. Hermes. Soil preparation involved adding organic manure at a dose of 35 m^3fed and calcium superphosphate (15.5% P_2O_5) at a rate of 150 kg P_2O_5/fed. The soil texture of the experiment site was clay loam. Potato tubers were hand-cut into pieces weighing approximately 65-70 g and kept in shaded area at 5 days before cultivation to develop the sprouts. The sprouting potato planted into open field at the fourth week of December in the two successive seasons of 2020/2021 and 2021/2022. Every treatment included 4 replicates and each replicate consisted of 3 rows, each row was 7 m long and 80 cm width. The distance between rows was 80 cm apart and between plants was 25 cm. Automatic cultivation was used for planting tubers depths at 15 and 25 cm from top of seed tuber to top of ridge. Foliar applications with different concentrations at 0, 0.25, 0.50, 1.00, 1.50 and 2.00 g/l have begun after 50 days, the followed by second and third applications after 20 days intervals. The pests' control was performed whenever it was necessary, fertilization as recommended in the commercial production of potato according to Ministry of Agriculture, Egypt. Planting depth was measured by ruler centimeters from the top of the tuber's pieces to the top of the hill. Respecting number of days after sowing to harvest was 120 days in both seasons.

Data were recorded

Characteristics of vegetative growth

Plant height, diameter, number of stems, number of leaves, leaf area/plant and firmness. Data were characterized after 90 days from cultivation.

Characteristics of Yield*:*

Tubers number, tubers yield/ plant, total yield (ton/fed), tubers length, diameter, size, tuber green weight and cracks**.** These data were taken at harvesting date after 125 days from cultivation.

Data procedures:

Plant height (cm) was estimated by a ruler from the hill soil surface to the plant apical meristem.

The plant and tubers diameter of potato were estimated by vernier caliper.

Number of stems and leaves per plant were counted.

Leaf area (cm) was measured according to Koller, 1972 using the fresh weight method. The sixth leaf was chosen as constant leaf. 5 leaves were taken from each treatment and weighed in addition to 5disks from the previous leaves were taken and also weighed. The leaf area was calculated according to the following formula:

Leaf area (cm) = Fresh weight of leaves/ Fresh weight of disks × Area of the disk

Firmness (kg/ cm) was measured by applying the pressure tester FGV-0.5A to FGv-100shim instruments.

Number of tubers per plant was counted.

Total yield was weighed in ton/fed (feddan= 0.42 h) by a digital balance.

Tuber's length the tuber length of potato was estimated by was estimated by a ruler.

Tuber's diameter (cm) The Tubers diameter of potato was estimated by vernier caliper.

The size of tubers was measured in cm^3 by immersing the tubers in a container filled with water and the displaced water was measured by a graduated jar.

Green tuber weight protruding from the top of the hill were weighed in (ton/fed) by a digital balance.

Cracks was weighed in (ton/fed) by a digital balance.

Total soluble solids (%) The T.S.S. % was determined by hand Refractometer according to AOAC, (2000).

Ascorbic acid (mg/100g. f. w.) Ascorbic acid was determined by the method of titration with 2,6- dichlorophenol indophenol dye according to AOAC, (2000).

Nitrogen (g/100g. d. w.) The method for determining the nitrogen content was employed according to Pella (1990).

Total Potassium was determined by flame photometer (Kalra, 1998).

Phosphorous using ammonium molybdate (Cooper, 1977).

Total phenol was determined using Folin-Ciocalteau reagent according to the method of Kähkönen *et al.,* (1999).

Starch was determined by the method described by Somogy (1952).

Statistical analysis:

The experiment was statistically analyzed in a randomized complete block design two-way ANOVA with four replicates. The obtained data was subjected to the analysis of two-way ANOVA and L.S.D. method at 5 % level of significance according to Snedecor and Cochran (1982).

RESULTS AND DISCUSSION

Vegetative growth parameter

The data around the physical parameters of potato vegetative growth according to planting depth, different levels of nano lithovit and their interaction were showed in Tables (1, 2, 3, 4, 5 and 6).

The impact of cultivation depth on vegetative growth parameter of potato such as plant height, diameter, stem number, leaves number and leaf area per plant were shown in Tables 1, 2, 3, 4, 5 and 6 during two cultivation seasons. Therefor the highest significant values in previous parameters were obtained from planting depth at 15 cm, while 25 cm gave lowest number of this characters except plant diameter in the two growing season of 2020/2021 and 2021/2022. On the other side, the highest significantly of vegetative growth were obtained in 2.00 gram per liter of lithovit comparison with control and levels of lithovit except 1.5 gram per liter produced largest plant diameter during second season only. Concerning to, effect of interaction between cultivation depths and different levels lithovit on vegetative growth showed a significant difference during two growing seasons. The application of lithovit 2.00 gram per liter with depth at 15 cm gave better interaction during vegetative growth characters except 1.5 gram per liter lithovit with 25 cm produced largest plant diameter in the second season only. These findings might be explained by the fact that, in contrast to close depth, potato sprouts under deep cultivation must travel a great distance through the soil before emerging (Sultana et al., 2001). According to a related study, a progressive rise in depth was linked to longer times for emergence, delayed tuber sprout emergence, and lower crop yields (Bohl and Love 2005). Additionally, compared to deeper cultivation, the pace of emergence, tuber yield, and other potato characteristics are accelerated in depthless cultivation (Mangani et al., 2016). As a result, the distance at which the shoots had to initiate must have affected the emergence of the sprouts before they reached the soil's surface (Lewis and Rowberry 2011 and Love et al., 2012). In order to maximize dry matter content and eventual tuber output, plants need to emerge quickly in order to absorb solar radiation early on (Kumar et al., 2015). Additionally, the maximum values of plant height, stem length, and number of leaves per plant were found at 15 cm; however, while using 25 cm, these values decreased because of the proper environmental conditions, such as moisture, temperature, and soil air quality (Iritani, 2005).

Concerning to, the impact of lithovit on vegetative growth, the tabulated data in Tables (1, 2, 3, 4, 5 and 6) showed that increased lithovit concentrations gradually increased plant height, diameter, stem number, leaves number and leaf area per plant in both seasons. However, all concentrations of lithovit gave significant increase in growth parameters of potato plants comparison to untreated plants (control). In addition, highest lithovit level gave highest number in this connection with significant differences between other ones under the two planting depth in this study. Furthermore, nano-particles (lithovit) improved growth and parameters of potato crops (Abdelkader *et al.*, 2018). Therefore, the using of lithovit at 2 gram per liter resulted in increasing of most characters of plant (Ghatas and Mohamed 2018). On other work, higher value of guar plant height and stem number was found with lithovit compared untreated plants (Nassar *et al.* 2018). However, lithovit acts an excellent fertilizer and supply plants with highest concentration of CO_2 during atmosphere and increase of photosynthesis lead to an increasing natural growth and yield (Ghatas and Mohamed, 2018). Furthermore, the supplementing in macronutrients lead to increase growth and active enzymes should which play also role in increasing yield components of potato plant (Aladakatti *et al.*, 2012). However, using lithovit fertilizer with CO_2 stimulates improvement growth parameters might be due to, its role a reservoir supplying plant with CO_2 (Kumar, 2011). Thus, it is can improve growth and production wherefrom elevate CO_2 (Maswada and Abd El-Rahman 2014). Sprayed lithovit staying a film on surface leaf and penetrate frequently when it gets wet with dew at night (Rawat and Melkania, 2015).

Yield parameters:

The obtained results from two depth, lithovit concentrations and their interaction on yield characteristics like tubers number, total yield, length, diameter, size, tuber green weight and cracks were shown in Tables 7, 8, 9, 10, 11, 12, and13 during the two seasons of 2020/2021and 2021/2022.

Effect of cultivation depth on tubers yield of potato and its components as tubers number, length, diameter, size, total yield, tuber green weight and cracks were exhibited in Tables 7, 8, 9, 10, 11, 12 and 13 during the two growing seasons. The obtained data showed the highest significant values in the previous characteristics were resulted from at 15 cm while, the 25 cm produced the lowest number in yield and its components except the tuber cracks weight during the two experimental seasons. Impact of lithovit concentrations on tubers yield and its components showed a significant difference during two cultivation seasons respectively. Higher tubers yield characteristics were found with 2.00 gram per liter of nano material comparison for lithovit levels except the control under 25 cm produced the higher tuber cracks during two cultivation seasons. Regarding to, the interaction between lithovit concentrations under 15 and 25 cm cultivation depth on tuber yield and its characteristics exhibited a significant in the two growing seasons. Highest interaction was found from 2.00 gram per liter lithovit with 15 cm but control under 25 cm register higher tuber cracks in both seasons. The number of stems and total stolons that were tuberized determined the prior results pertaining to potato tubers. Furthermore, both genetic and environmental factors are important throughout the process of tuberization and stolon formation (Gebreselassie et al., 2016). The average size and weight of potato tubers at 15 cm as opposed to 25 cm may have increased as a result of these changes between near and deep planting, which could be caused by a rise in stem number, emerged, or planting density (Memari *et al.,* 2011). Previous research indicated that 15 cm produced the highest tuber production and other features because plants have a critical demand for nutrients and moisture in the soil at an early stage while preserving the ideal environmental conditions, which is reflected in the tuber output. These findings concur with those of Jalilvand et al. (2006), who observed that increasing planting depth led to a decrease in tuber yield and its constituent parts. According to Pavek and Thornton (2009), the quantity of potato plants' stems was intended to be reduced. However, by storing carbohydrates in the tuber, 15 cm boosted the potato crop's capacity to produce photosynthesis, increased the fresh weight of the tubers, and eventually increased the total tuber production at planting depth (Arab *et al.,* 2011 and Eldalgamony *et al.,* 2022).

Concerning to, effect of lithovit levels on yield and its compound indicated that, increasing concentrations of nano lithovit gradually increased yield parameters in Tables (6, 7, 8, 9, 10, 11, 12 and 13). Moreover, all concentration gave significant differences compared to the control. Furthermore, the highest levels of nano material at 2 grime per liter produced the better value in this concern compared to the other ones of this study. According to Dragicevic et al. (2016), the cause of these outcomes was sprayed lithovit particles on leaves, which were immediately absorbed by the stomata and transformed into carbon dioxide. Furthermore, lithovit's beneficial effects on yield characteristics might be attributable to its magnesium content, which was a key element in the chlorophyll molecule (Abd El-baset, 2018). With the exception of NO3 and NO2 levels, applying nanomaterials (lithovit) to head lettuce resulted in higher values for all characteristics studied when compared to untreated plants (Abdel Nabi et al. 2017). In other research, the lithovit mode of action optimizing impacts are to raise CO2 rat during plant leaf structure and hence improve photosynthetic efficiency. Furthermore, the lithovit complex's micronutrient supply offers a source of essential plant-available elements needed to support photosynthetic activity. The enhanced output and quality that have been noted are a result of the extra carbohydrates that are created and stored in the fruits and canopies, where plant physiological processes can freely utilize the extra carbohydrates for the growth of roots, stems, and leaves. Due to the additional carbohydrates that are distributed within the plant and supply energy for root growth, the flowering cycle, and defense against disease and insect assault, this natural plant partitioning response may lead to improved plant health. If the observed productivity and dry matter increases are being driven by increased carbohydrates produced as a result of lithovit application raising the CO2 environment at the leaf, then the additional benefits to general plant health accruing from increased carbohydrate resources retained within the plant, providing for a healthier plant, will also be felt. It is possible to draw the conclusion that lithovit enhances the beneficial effects by delivering CO_2 in nano form (Abd El-baset, 2018).

Chemical parameters:

The effect of planting depth, different levels of nano lithovit and their interaction on the chemical characteristics of potato was shown in Tables (15, 16, 17, 18, 19, 20 and 21) during the two seasons of 2020/2021and 2021/2022. The indicated data showed that the planting depth at 15 cm produced highest significantly values in all studied chemical characteristics of potato plants, while results indicated that there was no significant difference in the nitrogen, phosphorus and potassium contents during the two experimental seasons. Lowest values for all chemical characteristics resulted from planting depth at 25 cm in the two cultivation seasons.

The effect of different levels of nano lithovit on the chemical characteristics of potato tubers showed that the highest chemical characteristics of tubers were resulted from 2.00 g/l of nano lithovit in comparison with the other levels of lithovit and control in the two cultivation seasons. While the results cleared that there was no significant difference in the nitrogen, phosphorus and potassium contents during the two seasons. The minimum values for chemical characteristics were obtained from the control without any lithovit during the two experimental seasons. Regarding to, the interaction between planting depth and different levels of nano lithovit on the chemical characteristics of potato exhibited that, the planting depth at 15 cm with 2.00 g/l of nano lithovit gave the highest interaction in all studied of chemical characteristics, while the results cleared that there was no significant difference in the nitrogen, phosphorus and potassium contents during the two seasons. The minimum values for all chemical characteristics were obtained from planting depth at 25 cm with the control in the two experimental seasons. The application of potato plants with varying levels of lithovit may be the cause of these results, as all chemical features of the potato plants were significantly higher than those of the control. The increase in these contents that came from lithovit at various concentrations, particularly 2 g/l, could be because the lithovit particles increase natural photosynthesis, which in turn promotes crop growth and productivity (Shallan, et al., 2016). Additionally, nanomaterials serve as long-term CO_2 reservoirs for plants, which can boost plant growth and productivity through increased photosynthesis. This is because elevated CO_2 levels can inhibit the activity of ribulose-1,5-bisphosphate oxygenase, reduce photorespiration, and increase carbon assimilates, all of which are necessary for plant growth and development (Rebbeck and Scherzer 2002). According to Maswada and Abd El-Rahman (2014), enhanced carbon absorption, biomass, and leaf area of plants are the main ways that elevated CO_2 concentrations promote plant growth. According to Byan (2014), foliar spraying with lithovit improved the chemical contents of snap bean plants, including potassium, phosphate, and nitrogen, as compared to control. Ultimately, the fertilizer particles that were previously applied finely to the leaf surface are absorbed and converted to CO_2. Because the natural amount of CO_2 in the air is the external factor limiting photosynthesis, lithovit fertilizer can therefore greatly increase photosynthesis. (Carmen *et al.,* 2014). These outcomes concur with Agrawal and Deepak (2003); Wang *et al.,* (2013); Maswada and Abd El-Rahman (2014) and (Abdelghafar *et al.,* 2016).

CONCLUSION

The impact of two planting depth and four concentrations of nano lithovit on the growth, yield and chemical parameters of potato. The application of nano lithovit at 2.00 gram per liter under cultivation depth of 15 cm gave the better interaction in all characteristics of potato except 1.5 gram per liter of nano lithovit with 25 cm produced largest plant diameter in the second season only, while the minimum values of all characteristics were obtained from the control without any lithovit.

ACKNOWLEDGEMENT

Authors are grateful to Al-Azhar University, Faculty of Agriculture, Horticulture department, Government of Egypt for supporting this research project to carry out this work. An expression of gratitude to Prof. Dr. Shamel Ahmed Shanan at Horticulture Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt. Prof. Dr. Alaaeldin Abdallah Helaly at Horticulture Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt. for their assistance and support, as well as gave advice and suggestions.

REFERENCES:

AOAC, Association of Official Agricultural Chemists (2000). Official Methods of Analysis A.O.A.C. (17th Edition.) published by.A.O.A.C. Gaithersburg, M.D.

Abdelghafar, M.S., Al-Abd, M.T., Helaly, A.A., Rashwan, A.M. 2014: Foliar Application of lithovit and Rose Water as Factor for Increasing Onion Seed Production. Nature and Sciences. 14 (3): 53-61.

Abd El-baset, M.M. 2018: Effect of nano material lithovit on growth, flowering and chemical composition of *Echinacea purpurea* (l.). J. Plant Production, Mansoura Univ. 9 (6): 531 – 536.

Abdel Nabi, H.ME., Dawa, K.K., El-Gamily, E.E., Imryed, Y.F.E. 2017: Effect of magnetized water, foliar application with nano material and nitrogen levels on productivity and quality of head lettuce. Int. J. Adv. Res. Biol. Sci., 4(5): 171-181.

Abdelkader, M.A.I., Gendy, AS.H., Bardisi, I.A., Elakkad, H.A. 2018: The impact of NPK fertilization level and lithovit concentration on productivity and active ingredients of *Coriandrum sativum* plants. Middle East J. App. Sci., 8 (3): 827-836.

Abdelrehem, M.A. 2014: Studies on yield and quality of broccoli (*Brassica oleraceae L.)* under Assiut conditions. M.Sc. Thesis, Fac. Agric., Assiut Univ., Egypt.

Agrawal, M., Deepak, S.S. 2003: Physiological and biochemical responses of two cultivars of wheat to elevated levels of CO_2 and SO_2, singly and in combination. Environ. Pollut., 121:189–197.

Arab, H.R., Afshari, H., Sam, D.M., Laei, G., Toudar, S.R. 2011: The effect of planting date, depth and density on yield and yield components of potato in Shahrood (Iran).

Aladakatti, Y.R., Palled, Y.B., Chetti, M.B., Halikatti, S.I., Alagundagi, S.C., Patil, P.L., Patil, V.C., Janawade, A.D. 2012: Effect of nitrogen, phosphorus and potassium levels on growth and yield of stevia (*Stevia rebaudiana,* B.). Karnataka J. Agric. Sci., 25: 25-29.

Bilal, B.A. 2010: Lithovit: An innovative fertilizer. The 3rd e- Conference on Agricultural Biosciences (IeCAB 2010), 1st- 15th June 2010. http://www.slideserve.com/madison/lithovitan-innovative-fertilizer.

Bohl, W.H., Love, S.L. 2005: Effect of planting depth and hilling practices on total, US No. 1, and field greening tuber yields. Amer. J. Pot. Res., 82 (6): 441-450.

Byan, Usrya A.I. 2014: Influence of using some safety materials on water requirement and water use efficiency of snap bean plant. J. Agric. Sci., AinShams Univ., Cairo, 22 (2): 381-394.

Carmen, B., Radu, S., Ştefania, G., Sorin, V. 2014: Physiological indicators study involved in productivity increasing in tomato. Pro-environment, 7: 218 – 224.

Chehaibi, S., Hamdi, W., Abrougui, K. 2013: Effects of planting depth on agronomic performance of two potato varieties grown in the Sahel region of Tunisia. J. Devel. Agric. Econ., 5 (7): 272-276.

Cooper, T.G. 1977: The tools of biochemistry. A Wiley-Interscience Pub. John Wiley and Sons, New York.

Dragicevic, V., Nikolic, B., Waisi, H., Stojiljkovic, M., Simic, M. 2016: Increase of soybean nutritional quality with nonstandard foliar fertilizers. J. Cen. Euro. Agric., 17 (2): 356-368.

Eldalgamony, M.R., Awad, A.H., Al-Abd, M.T., Helaly, A.A. 2022: Effect of planting depth on vegetative growth, yield and quality of potatoes. Al-Azhar J. Agric. Res., 47 (2): 297-303

Etemad, B., Sarajuoghi, M. 2012: Study of the effect of different levels and application timing of nitrogen fertilizer on yield and number of potato tuber of agria in ghorveh, iran. Ann. Biol. Res., 3 (3):1385.

Gebreselassie, H., Mohamed, W., Shimelis, B. 2016: Evaluation of potato (*Solanum tuberosum l.*) varieties for yield and yield components in eastern Ethiopia. J. Biol. Agricu. Healt., 6 (5):146-154.

Ghatas, Y.A.A., Mohamed, Y.F.Y. 2018: Influence of mineral, micro-nutrients and lithovit on growth, oil productivity and volatile oil constituents of *Cymbopogon citruts* L. plants. Middle East J. App. Sci., 7 (1): 162-174.

Graham, T, Van de Fliert, E., Campilan, D. 2001: What happened to participatory research at the International Potato Center. Agric. Hum. Values 18:429-446.

Haider, M., Wasim, A., Chaudhary, M., Pervez, M.A., Asad, H.U., Raza, S.A., Ashraf, I. 2012: Impact of foliar application of seaweed extract on growth, yield and quality of potato (*Solanum tuberosum L.*). Soil Environ. 31 (2):157.

Iritani, W.M. 2005: Relationships between stem numbers, tuber set and yield of Russet Burbank potatoes. Amer. J. Pot. Res., 60: 423-431.

Jalilvand, M., Madanni, H., Naderi, M. 2006: Effect of different soil forming frequency on yield of four varieties of potato in Central Province MSc thesis Agriculture Islamic azaduni, Iran.

Kähkönen, M.P., Hopia, A.L., Vuorela, H.J., Rauha, J.P., Pihlaja, K., Kujala, T.S., Heinonen, M. 1999: Antioxidant activity of plant extracts containing phenolic compounds. J. Agric. Food Chem., 47: 3954-3962.

Kalra, Y.P. 1998: Handbook of reference method for plant analysis. CRC Press, Washington, DC.

Khaledian, M.S., Mohammadi, K., Javaheri, M., 2014: Grain yield and yield components of soybean affected by integrated fertilization methods. Int. J. Agric. Forest., 4:1-3.

Koller, H.R. 1972: Leaf area and leaf weight relationship in the Soybean Canopy. Crop and Sciences. 12: 180-183.

Kumar, P. 2011: Nanotechnology in agriculture. Financing Agriculture, 34: 8-10.

Kumar, P., Singh, S., Kumar, R., Rawal, S., Singh, B.P. 2015: Effect of tuber planting depth on yield, quality and profitability of potato (*Solanum tuberosum*) processing varieties. Ind. J. Agric., 60 (1): 139-144.

Lewis, W.C., Rowberry, R.G. 2011: Some effects of planting depth and time and height of hilling on Kennebec and Sebago potatoes. Amer. J. Pot. Res., 50 (9): 01–10.

Love, S.L., Eberlein, C.V., CStark, J., Bohl, W.H. 2012: Cultivar and seed-piece spacing effects on potato competitiveness with weeds. Amer. J. Pot. Res., 72 (4):197–213.

Mangani, R., Mazarura, U., Tuariraand, A.M., Shayanowako, A. 2016: Effect of planting method on growth, yield and quality of three irish potato (*Solanum tuberosum*) varieties grown in Zimbabwe. Ann. Res. Rev. Bio., 9 (5): 1-7.

Maswada, H.F., Abd El-Rahman, L.A. 2014: Inducing salinity tolerance in wheat plants by hydrogen peroxide and lithovit "A nano-CaCO3 fertilizer. J. Agric. Res. Kafr El-Sheikh Univ., 40 (4): 696-719.

Memari, T., Elnaz, F., Yarnia, F., Noshin, A.V. 2011: Effect of different irrigation level on yield potato. Ann. Biol., 2 (6):269.

Naderi, M.R., Shahraki, A.D. 2013: Nanofertilizers and their roles in sustainable agriculture. Int. J. Agric. Crop Sci., 19:2229-2232.

Nassar, S.M.A., Alaa, A.A., Abdelkader, M.A. 2018: Effect of salinity and lithovit on growth, yield components and chemical constituents of cluster bean (*Cyamopsis tetragonoloba*, Taub.). Zagazig J. Agric. Res., 45 (6 A): 1913- 1924

Pavek, M.J., Thorntonr, R.E. 2009: Planting depth influences potato plant morphology and economic value. Amer. J. Pot. Res., 86 (1):56-67.

Pella, E. 1990: Elemental organic analysis: part 1, Historical developments. Amer. Labor., 2: 116-125.

Pruski, K.P, Duplessis, T., Lewis, T., Astatkie, J., Nowak, P.C. 2001: Jasmonate effect on in vitro tuberization of Potato (*Solanum tuberosum L.*) cultivars under light and dark conditions. J. Potato Res, 44:315-325.

Rawat N., Melkania, U. 2015: Effect of increased level of Co2 on growth and yield of wheat crop. Lnter. J. Curr. Res., 7: 22261- 22265.

Rebbeck, J., Scherzer, A.J. 2002: Growth responses of yellow-poplar *(Liriodendron tulipifera L.)* exposed to 5 years of O_3 alone or combined with elevated CO_2. Plant Cell Environ, 25:1527–1537.

Shallan, M.A., Hazem, M.M., Alia, A.M., Ibrahim, A.A. 2016: The Influence of Lithovit fertilizer on the chemical constituents and yield characteristics of cotton plant under drought stress. Inter. J. Chem. Tech. Res., 9 (8): 01-11.

Singh1, N., Amandeep, S., Kanwaljit, S. 2020: Effect of depth of tuber planting on growth and yield parameters of potato crop. Inter. J. Curr. Micro. App. Sci., 9 (5):2504-2507.

Snedecor, G.W., Cochran, W.G. 1982: Statistical methods 7th ed. iowa state univ. Press, Ames., Iowa U.S.A. 325- 330.

Sultana, N., Bari, M.S., Rabbani, M.G. 2001: Effect of seedling tuber size and depth of planting on the growth and yield of potato. Pakis. J. Bio. Sci., 4 (10), 1205-1208.

Somogy, N. 1952: Notes on sugar determination. J. Biol.Chem., 145:19-23.

Wang, L., Feng, Z., Schjoerring, J.K. 2013: Effects of elevated atmospheric CO_2 on physiology and yield of wheat (*Triticum aestivum L.*): A meta-analytic test of current hypotheses. Agric. Ecosyst. Environ, 178: 57– 63.

Table 1: Effect of planting depth and different levels of nano lithovit on potato plant height during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	42.33 g	40.43 h	41.40 h	41.75 h	40.87 h	41.31 f
0.25 g/L	47.13 e	45.40 f	46.26 e	46.75 f	45.41 g	46.08 e
0.50 g/L	51.13 cd	47.16 e	49.15 d	50.77 e	47.16 f	48.97 d
1.00 g/L	52.33 c	50.41 d	51.37c	52.46 d	50.25 e	51.35 c
1.50 g/L	55.75 b	52.43 c	54.09 b	56.53 b	52.53 d	54.53 b
2.00 g/L	58.76 a	54.88 b	56.82 a	58.75 a	55.08 c	56.91 a
Mean	51.24 a	48.45 b		51.17 a	48.55 b	
L.S.D at 5%	Planting depth (A) Levels (B) Interaction (AxB)		0.57 1.00 1.42	Planting depth (A) Levels (B) Interaction (AxB)		0.48 0.83 1.17

Table 2: Effect of planting depth and different levels of nano lithovit on potato plant diameter (cm) during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	1.10 f	1.10 f	1.10 f	1.13 g	1.13g	1.13 e
0.25 g/L	1.36 e	1.53 d	1.45 e	1.33 f	1.50 e	1.41 d
0.50 g/L	1.70 c	1.93 b	1.81 d	1.66 d	1.96 c	1.81 c
1.00 g/L	1.96 b	2.06 d	2.01 c	1.96 c	2.10 bc	2.03 b
1.50 g/L	2.03 b	2.25 a	2.14 b	2.06 c	2.28 a	2.17 a
2.00 g/L	2.23 a	2.35 a	2.29 a	2.23 ab	2. 21 ab	2.22 a
Mean	1.73 b	1.87 a		1.73 b	1.88 a	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.05 0.10 0.14	Planting depth (A) Levels (B) Interaction (AxB)		0.05 0.09 0.14

Table 3: Effect of planting depth and different levels of nano lithovit on potato stems number plant during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	1.91e	2.00 e	1.95 c	1.98 cd	1.98 cd	1.98
0.25 g/L	2.02 de	2.03 de	2.02 c	1.95d	2.00 cd	1.97
0.50 g/L	2.33 cde	2.08 de	2.20 c	2.33 bcd	2.40 bcd	2.367
1.00 g/L	2.70 abc	2.5 bcd	2.60 b	2.70 ab	2.51 bc	2.60
1.50 g/L	2.93 ab	2.80 abc	2.86 ab	2.83 ab	2.83 ab	2.83
2.00 g/L	3.03 a	2.86 ab	2.95 a	3.13 a	2.88 ab	3.00
Mean	2.49 a	2.38 b		2.48 a	2.43 b	
L.S.D at 5%	Planting depth (A) Levels (B) Interaction (AxB)		0.18 0.31 0.44	Planting depth (A) Levels (B) Interaction (AxB)		0.20 0.35 0.49

Table 4: Effect of planting depth and different levels of nano lithovit on potato leaves number plant during the two seasons of 2020 /2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	14.00 d	12.23 g	13.11e	13.36 cd	12.03f	12.7d
0.25 g/L	14.4 c	12.33 g	13.36d	13.41 c	12.25f	12.83 d
0.50 g/L	14.80b	12.66 f	13.73c	13.90 b	12.35 f	13.13c
1.00 g/L	14.89 ab	12.90 e	13.93bc	13.97 ab	12.85 e	13.41 b
1.50 g/L	15.06 ab	13.1 e	14.08ab	14.06 ab	13.03de	13.55 ab
2.00 g/L	15.2 a	13.22 e	14.21 a	14.27 a	13.13cde	13.70 a
Mean	14.72 a	12.75 b		13.83 a	12.61 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.12 0.21 0.30	Planting depth (A) Levels (B) Interaction (AxB)		0.13 0.22 0.31

Table 5: Effect of planting depth and different levels of nano lithovit on potato leaf area during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	189.40 g	181.51 h	185.45 e	198.51 g	180.10 h	189.30 e
0.25 g/L	216.65 e	206.18 f	211.41 d	217.81 e	209.15 f	213.48 d
0.50 g/L	232.72 d	222.55 e	227.64 c	233.91 d	220.04 e	226.97 c
1.00 g/L	258.25 b	246.56 c	252.40 b	261.43 b	248.19 c	641.81 b
1.50 g/L	259.93 b	244.22 c	252.08 b	258.97 b	245.02 c	251.99 b
2.00 g/L	272.51 a	255.9 b	264.20 a	271.81 a	258.16 b	264.98 a
Mean	238.24 a	226.15 b		369.41 a	226.77 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		2.54 4.41 6.24	Planting depth (A) Levels (B) Interaction (AxB)		2.97 5.15 7.29

Table 6: Effect of planting depth and different levels of nano lithovit on tuber firmness during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	13.23 efg	11.83 g	12.53d	13.33 cd	11.7 d	12.51 d
0.25 g/L	13.91 de	12.33 fg	13.12 cd	14.16 bc	11.93 d	13.05 cd
0.50 g/L	14.20cde	13.41 ef	13.80 bc	14.35 bc	13.45 cd	13.90 bc
1.00 g/L	15.50 abc	13.00efg	14.25 b	15.80 ab	13.06 cd	14.73 b
1.50 g/L	15.16 abc	14.00 de	14.58 b	15.46 ab	14.00 bc	14.733 b
2.00 g/L	16.83 a	16.13 ab	16.48 a	16.76 a	16.36 a	16.56 a
Mean	14.80 a	13.45 b		14.98a	14.91b	
L.S.D at 5%	Planting depth (A) Levels (B) Interaction (AxB)		0.55 0.96 1.36	Planting depth (A) Levels (B) Interaction (AxB)		0.71 1.23 1.75

Table 7: Effect of planting depth and different levels of nano lithovit on potato tuber number/ plant during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	4.63 f	4.73 f	4.68 c	4.28 e	4.83 de	4.55 c
0.25 g/L	5.16 ef	4.81 f	4.99 c	5.03 cde	5.25 cd	5.14 c
0.50 g/L	6.96 ab	5.40def	6.18 b	6.61b	5.70 c	6.15 b
1.00 g/L	6.63 bc	5.86 cde	6.24 b	6.74 b	5.45 cd	6.10 b
1.50 g/L	6.83 b	5.69 de	6.26 b	6.88 b	5.75 c	6.32 b
2.00 g/L	7.70a	6.03 cd	6.86 a	7.76 a	6.52 b	7.14 a
Mean	6.32 a	5.42 b		6.22 a	5.58 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.30 0.53 0.76	Planting depth (A) Levels (B) Interaction (AxB)		0.31 0.53 0.75

Table 8: Effect of planting depth and different levels of nano lithovit on total yield ton/fed during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	12.37 g	10.95 i	11.66 e	12.17 e	11.09 f	11.6 f
0.25 g/L	13.01 f	11.57 h	12.29 d	12.86 e	12.47 e	12.66 e
0.50 g/L	14.15 d	13.43 ef	13.79 c	14.38 cd	12.73 e	13.55 d
1.00 g/L	15.08 c	13.84 de	14.46 b	15.07 c	14.15 d	14.61 c
1.50 g/L	15.53 b	13.96 d	14.74 b	16.30 b	14.35cd	15.32 b
2.00 g/L	17.123 a	14.90 c	16.01 a	17.44 a	14.90cd	16.17 a
Mean	14.546 a	13.11 b		14.70 a	13.28 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.14 0.30 0.43	Planting depth (A) Levels (B) Interaction (AxB)		0.32 0.56 0.80

Table 9: Effect of planting depth and different levels of nano lithovit on potato tuber length (cm) during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	5.16 de	4.86 e	5.01 d	5.20d	4.78 e	4.99 d
0.25 g/L	5.63c	5.50 cd	5.56 c	5.80 bc	5.36 d	5.58 c
0.50 g/L	5.75 c	5.21 de	5.48 c	5.79 bc	5.20 d	5.49 bc
1.00 g/L	5.83 c	5.13 de	5.48c	5.91b	5.29 d	5.60 bc
1.50 g/L	6.30 b	5.50 cd	5.90 b	6.16 b	5.49 cd	5.82 b
2.00 g/L	6.93 a	6.21 b	6.57a	7.00 a	6.03 b	6.51 a
Mean	5.93 a	5.40 b		5.97 a	5.36 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.15 0.26 0.36	Planting depth (A) Levels (B) Interaction (AxB)		0.14 0.24 0.35

Table 10: Effect of planting depth and different levels of nano lithovit on potato tuber diameter (cm) during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	4.06 f	4.16 ef	4.11 c	4.13 f	4.16 f	4.15 d
0.25 g/L	4.33 ef	4.20 ef	4.26 c	4.35 de	4.28 ef	4.31 c
0.50 g/L	4.83 bc	4.43 de	4.63 b	5.01 b	4.57 c	4.79 b
1.00 g/L	5.06 b	4.43 de	4.75 b	5.11 b	4.48 cd	4.80 b
1.50 g/L	5.00 bc	4.33 ef	4.66 b	5.06 b	4.63 c	4.85 b
2.00 g/L	6.60 a	4.73 cd	5.66 a	6.61 a	5.08 b	5.85 a
Mean	4.98 a	4.41 b		5.05 a	4.53 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.12 0.21 0.30	Planting depth (A) Levels (B) Interaction (AxB)		0.06 0.10 0.15

Table 11: Effect of planting depth and different levels of nano lithovit on potato tuber size during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	238.11 g	171.83 j	204.97 f	237.39 e	175.06 g	206.22 f
0.25 g/L	281.21 e	193.20 i	237.20 e	283.33 d	192.66 g	237.99 e
0.50 g/L	303.51d	203.71hi	253.61 d	310.00 c	211.94 f	260.97 d
1.00 g/L	325.18 c	218.24 h	271.71 c	360.45 b	228.24 ef	294.34 c
1.50 g/L	340.34 b	255.83 f	298.09 b	355.63 b	265.45 d	310.54 b
2.00 g/L	398.16 a	316.23cd	357.19 a	406.69 a	328.06 c	367.37 a
Mean	314.42 a	226.50 b		325.58 a	233.57 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		5.97 10.35 14.63	Planting depth (A) Levels (B) Interaction (AxB)		7.61 13.19 18.65

Table 12: Effect of planting depth and different levels of nano lithovit on potato green tuber weight during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	1.02 a	0.00 f	0.51a	0.96a	0.00	0.48a
0.25 g/L	1.00 b	0.00 f	0.50b	0.92b	0.00	0.46b
0.50 g/L	0.99bc	0.00 f	0.49bc	0.87c	0.00	0.43c
1.00 g/L	0.98 cd	0.00 f	0.49bcd	0.86cd	0.00	0.43c
1.50 g/L	0.97 de	0.00 f	0.48cd	0.85de	0.00	0.42c
2.00 g/L	0.96 e	0.00 f	0.48d	0.61e	0.00	0.30
Mean	0.99 a	0.00b		0.85a	0.00b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.05 N. S 0.07	Planting depth (A) Levels (B) Interaction (AxB)		0.09 0.15 0.22

Table 13: Effect of planting depth and different levels of nano lithovit on potato cracks tuber weight during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	0.51 e	0.85 a	0.68 a	0.50 e	0.86 a	0.68 a
0.25 g/L	0.48 f	0.82 b	0.65 b	0.45 f	0.87 a	0.66 b
0.50 g/L	0.48 f	0.82 b	0.65 b	0.48 fg	0.81 b	0.64 c
1.00 g/L	0.48 f	0.71 c	0.59 c	0.48 fg	0.70 c	0.59 d
1.50 g/L	0.48 f	0.70 c	0.59 c	0.48 g	0.70 c	0.59 d
2.00 g/L	0.47 f	0.67 d	0.57d	0.47 h	0.66 d	0.56 e
Mean	0.48 b	0.76 a		0.48 b	0.77 a	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.02 0.01 0.017	Planting depth (A) Levels (B) Interaction (AxB)		0.02 0.01 0.01

Table 14: Effect of planting depth and different levels of nano lithovit on potato T.S.S. during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	4.56 bcd	4.26 d	4.41 c	4.46 cd	4.25 d	4.35 c
0.25 g/L	4.56 bcd	4.43 cd	4.50 c	4.26 d	4.48 cd	4.37 c
0.50 g/L	4.76 bc	4.52 cd	4.64 bc	4.86 bc	4.51 cd	4.69 b
1.00 g/L	4.71 cb	4.63 bcd	4.67 bc	4.71 c	4.62 cd	4.67 b
1.50 g/L	4.96 ab	5.20 a	5.08 a	4.88 bc	5.23 ab	5.05 a
2.00 g/L	5.23 a	4.50 cd	4.86 ab	5.29 a	4.50 cd	4.89 ab
Mean	4.80 a	4.59 b		4.74 a	4.60 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.15 0.27 0.38	Planting depth (A) Levels (B) Interaction (AxB)		0.15 0.27 0.38

Table 15: Effect of planting depth and different levels of nano lithovit on potato ascorbic acid during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	26.83 de	21.58 g	24.20 e	27.83 d	21.91 f	24.87 e
0.25 g/L	29.00 c	22.08 g	25.54d	29.16 c	22.41 f	25.79 d
0.50 g/L	29.58 bc	25.00 f	27.29 c	29.66 c	25.91 e	27.79 c
1.00 g/L	30.33 b	25.16 f	27.75 c	30.58 b	25.91 e	28.25 c
1.50 g/L	31.16 a	26.50 e	28.83 b	31.33 a	26.66 e	29.00 d
2.00 g/L	31.66 a	27.50 d	29.58 a	31.91a	27.83 d	29.87 e
Mean	29.76 a	24.63 b		30.08 a	25.11 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.33 0.58 0.83	Planting depth (A) Levels (B) Interaction (AxB)		0.30 0.53 0.74

Table 16: Effect of planting depth and different levels of nano lithovit on potato nitrogen during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	1.42 f	1.41 f	1.42 f	1.47 b	1.46 b	1.46 b
0.25 g/L	1.54 de	1.52 e	1.53 e	1.55 b	1.54 b	1.54 b
0.50 g/L	1.58 d	1.56 de	1.57 d	1.59 b	1.57 b	1.58 ab
1.00 g/L	1.65 c	1.63 c	1.64 c	1.66 b	1.59 b	1.62 ab
1.50 g/L	1.84 b	1.82 b	1.83 b	1.89 a	1.82 a	1.85 a
2.00 g/L	1.96 a	1.94 a	1.95 a	1.98 a	1.97 a	1.98 a
Mean	1.66 a	1.65 a		1.69 a	1.66 a	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.017 0.030 0.043	Planting depth (A) Levels (B) Interaction (AxB)		0.16 0.27 0.39

Table 17: Effect of planting depth and different levels of nano lithovit on potato potassium during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	1.29 i	1.27 i	1.28 f	1.37 gh	1.35 h	1.36 f
0.25 g/L	1.42 g	1.36 h	1.39 e	1.44 f	1.41 fg	1.42 e
0.50 g/L	1.50 f	1.48 f	1.49 d	1.54 e	1.52 e	1.53 d
1.00 g/L	1.58 e	1.50 f	1.54 c	1.61 d	1.54 e	1.57 c
1.50 g/L	1.70 c	1.64 d	1.67 b	1.70 c	1.67 c	1.68 b
2.00 g/L	1.89 a	1.78 b	1.84 a	1.94 a	1.84 b	1.89 a
Mean	1.56 a	1.50 b		1.60 a	1.55 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.01 0.03 0.04	Planting depth (A) Levels (B) Interaction (AxB)		0.017 0.29 0.042

Table 18: Effect of planting depth and different levels of nano lithovit on potato phosphorus during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	0.41 f	0.40 f	0.41d	0.31 g	0.30 g	0.30 e
0.25 g/L	0.44 e	0.41 f	0.42 d	0.35 fg	0.34 f	0.34 d
0.50 g/L	0.47 d	0.44 e	0.46 c	0.40 cd	0.38 de	0.39 c
1.00 g/L	0.51 c	0.49 cd	0.50 b	0.43 c	0.41 cd	0.42bc
1.50 g/L	0.51 c	0.50 c	0.51b	0.42 c	0.40 cd	0.41 b
2.00 g/L	0.61 a	0.58 b	0.59 a	0.51 a	0.47 b	0.49 a
Mean	0.49 a	0.47 b		0.40 a	0.38 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.010 0.017 0.024	Planting depth (A) Levels (B) Interaction (AxB)		0.128 0.022 0.031

Table 19: Effect of planting depth and different levels of nano lithovit on potato phenol (mg/g f.w.) during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	10.15 d	10.07 d	10.11 c	10.49 c	10.27 c	10.38 c
0.25 g/L	12.69 bc	13.95 b	13.31 b	13.27 b	14.12 ab	13.69 b
0.50 g/L	13.20 bc	12.91bc	13.05 b	13.34 b	13.03	13.19 b
1.00 g/L	13.04 bc	13.22 bc	13.13 b	13.42 b	13.04	13.23 b
1.50 g/L	13.61bc	13.45 bc	13.53 b	13.84 b	13.57 b	13.71 b
2.00 g/L	15.29 a	13.97 b	14.64 a	14.95 a	14.1 ab	14.52 a
Mean	13.00 a	12.93 b		13.22 a	13.02 a	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		0.38 0.66 0.93	Planting depth (A) Levels (B) Interaction (AxB)		0.41 0.71 1.00

Table 20: Effect of planting depth and different levels of nano lithovit on potato starch (mg/g f.w.) during the two seasons of 2020/2021and 2021/2022

Seasons	Frist			Second		
Depth Levels	15 cm	25 cm	Mean	15 cm	25 cm	Mean
Control	80.39 f	79.08f	79.73 d	82.63 d	81.66d	82.14 b
0.25 g/L	117.13cd	113.40e	115.26 c	116.42 c	117.07 bc	116.74a
0.50 g/L	120.06 ab	115.22de	117.64 b	119.34 abc	114.96 c	117.15a
1.00 g/L	122.56 a	117.10cd	119.83 a	122.94 a	115.74 c	119.34a
1.50 g/L	122.73 a	117.66bcd	120.20 a	121.98 ab	117.29 bc	119.64a
2.00 g/L	122.68 a	118.24 bc	120.46 a	122.94 a	117.42 bc	120.18a
Mean	114.26 a	110.11 b		114.37 a	110.69 b	
L.S.D at 5 %	Planting depth (A) Levels (B) Interaction (AxB)		1.02 1.76 2.50	Planting depth (A) Levels (B) Interaction (AxB)		1.83 3.17 4.49

تأثير الرش باالنانو ليثوفيت وعمق الزراعة على نمو وانتاجية وجودة محصول البطاطس

عاطف نوح احمدسلامه*, اسماعيل احمد على حجاج

قسم البساتين, كلية الزراعة, جامعة الازهر, القاهرة, مصر.

* البريد الإليكتروني للباحث الرئيسي: atef.nouh@azhar.edu.eg

الملخص العربي

أجريت هذه الدراسة فى الحقل المكشوف على نباتات البطاطس لدراسة تأثير عمقى الزرعة 15و 25 سم مع تطبيق الرش بالتركيزات المختلفة 0 و 0.25 و 0.50 و 1.00 و 1.50 و 2.00 جم/ لتر من النانو لليثوفيت على نمو وانتاجية وجودة البطاطس صنف هرمس خلال موسمى التجربة المتتالين. النتائج المتحصل عليها اظهرت ان عمق الزراعة 15 سم اعطى اعلى القيم لكل صفات النمو الخضرى والمحصول والصفات الكميائية الا ان عمق الزراعة 25 سم اعطى اعلى قطر للنبات وتشقق للدرنات خلال موسمى الزراعة 2021/2020 و2022/2021. من ناحية اخرى سجلت اعلى القيم لصفات النمو الخضرى والمحصول والصفات الكميائية مع تطبيق الرش بـ2 جرام / اللتر بالمقارنة مع الكنترول والمستويات الاخرى من الليثوفيت الا 1.5 جرام /اللتر من الليثوفيت اظهر اعلى قيمة لقطر النبات خلال موسم الزراعة الثانى فقط . اظهر التفاعل بين

تطبيق الرش بـ2 جرام /اللتر مع الزراعة على عمق الزراعة 15 سم افضل القيم لصفات النمو الخضرى والمحصول والصفات الكميائية الا ان التفاعل بين 1.5 جرام/اللتر من الليثوفيت مع الزراعة على 25 سم اظهر اعلى قيمة لقطر النبات خلال موسم الزراعة الثانى فقط. بوجه عام اعطى الكنترول اقل القيم لجميع الصفات المدروسة. لذلك اوصت الدراسة ان الزراعة على عمق 15 سم مع تطبيق الرش بـ 2جرام / اللتر من الليثوفيت سجلا افضل القيم للصفات المدروسة مع تقليها لتشقق الدرنات والاخضر

الكلمات الاسترشادية: بطاطس, نانو لليثوفيت, اخضرار الدرنات, عمق الزراعة, محصول الدرنات.