# Effects of nano fertilizers on performance of some traits of potato

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*Abstract*—**Potato production needs precise management of soil fertility and water supplies. This study was carried out to determine the effects of different fertilizers on potato cultivar. The experiment was designed as a randomized complete block design with three replications and three treatments consisted on NanoCa; nano-chelated calcium (2 kg ha$^{-1}$), NanoZn+B; nano-chelated zinc and boron (1 kg ha$^{-1}$) and Nano- Com: nano-chelated complete fertilizer (1 kg ha$^{-1}$). Plant height (PH), number of stems main (NS), stem diameter (MSD), number of the days to row closure (DRC), number of days to maturity (NDM), harvest index (HI), mean tuber weight (MTW), Mean tuber diameter (MTD), tuber weight per plant (TWP), tuber yield (TY), dry matter content (DM) nitrate content (NC), and starch content of initial fresh (ST) were measured. Analysis of variance showed that the effects of nano-fertilizers on all measured traits were statistically significant. The tallest plants were recorded when using NanoCa and NanoZn+B, while the lowest plants were observed in Nano- Com. The response of TY was similar to TWP and the highest tuber yield was produced via application of NanoCa and NanoZn+B nano-fertilizers. NanoZn+B and Nano-Com nano-fertilizers caused high performances in DM, but simultaneously produced high NC as a harmful component. Considering all traits, it seems that application of NanoCa nano-fertilizer is more useful for achieving high amounts of most important traits of potato flowed by NanoZn+B nano-fertilizer. However, the performance and influence of Nano-Com nano-fertilizer. The results of the present experiment revealed that balanced crop nutrition through effective nano-fertilizers can improve potato crop yield.**

***Keywords- nano-chelated boron; nano-chelated calcium;, nano-chelated zinc***

## 1. introduction

Potato is one of the most important food crops of mankind and leading vegetable crops. Iran is the twelfth largest producer of potatoes in the world and the third largest in Asia after China and India. Iran's annual potato production is nearly six million tons, which is achieved by about two hundred hectares. Because potatoes managed with maximum productivity have a high demand for soil nutrients and the use of fertilizers affects not only the quantitative part of the tuber yield, but also the qualitative aspects of the product. An important part of the nutrients accumulates in the tops and leaves the harvested tubers of the field. Therefore, careful nutrient management is very important in potato fields. Although, there are some nutrient deficiencies in the soils of semi-arid regions, mineral deficiency is a widespread problem, mainly due to the consumption of staple crops, which naturally have low tissue mineral content. Therefore, in addition to nutrient management, the selection of high-quality cultivars is important. Therefore, nutrient management is one of the most important approaches to achieve high potato productivity in this region. In addition, balanced nutrition is essential for optimal crop growth in semi-arid regions and may be the most important strategy for improving potato yield [1]. The paucity of locally available food sources emphasizes the need for more efficient fertilization.

Nanotechnology is a recently emerging new field of technology in agricultural fields and can be very useful in designing a new generation of fertilizers with higher nutrient utilization efficiency. Nano-fertilizer technology is very innovative and has the potential to revolutionize agricultural systems. Nano-fertilizers are nanostructured fertilizers that release nutrients into the soil in a gradual and controlled manner. Nanostructured fertilizers have new physical chemical properties, so they can more effectively satisfy plant root needs compared to traditional fertilizers, and this can be done through dissolution and ion exchange reactions. The use of nano-fertilizers can improve the solubility and distribution of insoluble nutrients in soil, reduce nutrient immobilization, and increase bioavailability [2]. Nano-sized active ingredients in nanostructured fertilizer can help improve nutrient use efficiency and this may be due to their small size and larger surface area, which facilitates plant uptake of most of the nutrients. Adequate calcium content is also an important part of potato mineral nutrition. Calcium participates in the construction and functioning of cell walls and membranes of all plants. Micronutrient availability generally decreases as soil pH increases. Boron is one of the trace elements required for cell wall synthesis and affects calcium absorption. Therefore, it appears that boron can affect the storage quality characteristics of tubers. In addition, zinc is a necessary component in various enzyme systems for energy production, protein synthesis, energy production, maintenance of structural integrity of bio-membranes, and growth regulation. In northwestern Iran, micronutrient deficiencies are nutritional disorders in potato farming systems. Despite some research on potato nutrient management, there is little information on the effects of biological and non-fertilizers on potato yield and quality. The aim of this study was to determine the potential of seasonal supplementary nano-fertilizers to optimize potato production.

## 2. Materials and Methods

The trial was performed in an experimental farm located in Sarab which is located in the central part of province on based on the Köppen-Geiger classification, its climate is BSk. The total annual rainfall was 240 mm, and approximately 43% of the total precipitation falls during the growing season. The seed tubers of Agria cultivar as medium-late were allowed to grow for at least a week before planting. After primary and secondary cultivation, seeds were hand sown to a depth and during the growing season, a free-flow surface irrigation system was used to distribute water, and plants were grown under direct irrigation. The experiment was designed as a randomized complete block design with three replications and three treatments consisted on NanoCa; nano-chelated calcium (2 kg $ha^{-1}$), NanoZn+B; nano-chelated zinc and boron (1 kg $ha^{-1}$) and Nano- Com: nano-chelated complete fertilizer (1 kg $ha^{-1}$). Nano-chelated fertilizers were obtained from Sepehr Parmis Company, Iran, containing calcium oxide, zinc oxide, and boron trioxide nanoparticles. Plant height (PH), number of stems main (NS), stem diameter (MSD), number of the days to row closure (DRC), number of days to maturity (NDM), harvest index (HI), mean tuber weight (MTW), Mean tuber diameter (MTD), tuber weight per plant (TWP), tuber yield (TY), dry matter content (DM) nitrate content (NC), and starch content of initial fresh (ST) were measured.

## 3. Results and Discussion

Analysis of variance showed that the effects of nano-fertilizers on all measured traits were statistically significant (at 99% confidence level, results are not shown). The tallest plants were recorded when using NanoCa and NanoZn+B, while the lowest plants were observed in Nano- Com (Table 1). Such similar results were found for number of stems (NS) and tuber weight per plant (TWP). Comparison of means indicated that the thickest stem was observed in plants grown with NanoZn+B and Nano-Com nano-fertilizers, while the thinnest stem was observed in plants are grown NanoCa. NanoCa and Nano-Com nano-fertilizers had high amounts of number of the days to row closure (DRC), while the largest means were recorded for number of days to maturity (NDM), in Nano-Com and both NanoCa and NanoZn+B caused lower NDM. The response of harvest index (HI) to applied nano-fertilizers was similar to NDM (Table 1). However, evaluation of the mean tuber weight (MTW) showed that plants grown with complete nano fertilizer and nano chelated Zn+B had the highest values, while in plants which are grown NanoCa and NanoZn+B fertilization were produced higher tuber weight.

Table 1. Mean comparison of nano-fertilizers via LSD test.

| Traits | NanoCa | | NanoZn+B | | Nano- Com | |
|---|---|---|---|---|---|---|
| PH | 65.43 | A | 65.00 | AB | 64.13 | B |
| NS | 4.48 | A | 4.56 | AB | 4.08 | B |
| MSD | 5.33 | B | 5.48 | A | 5.59 | A |
| DRC | 38.00 | A | 37.33 | B | 38.50 | A |
| NDM | 117.33 | B | 117.33 | B | 118.00 | A |
| HI | 62.01 | B | 62.75 | B | 63.32 | A |
| MTW | 57.29 | A | 55.83 | A | 52.85 | B |
| MTD | 4.61 | A | 4.47 | B | 4.69 | A |
| TWP | 621.67 | A | 613.33 | AB | 604.67 | B |
| TY | 25.48 | A | 25.58 | A | 24.92 | B |
| DM | 18.61 | B | 20.44 | AB | 20.31 | A |
| NC | 66.67 | B | 70.67 | A | 69.00 | A |
| ST | 15.61 | A | 15.50 | B | 15.58 | A |

Traits are: Plant height (PH), number of stems main (NS), stem diameter (MSD), number of the days to row closure (DRC), number of days to maturity (NDM), harvest index (HI), mean tuber weight (MTW), Mean tuber diameter (MTD), tuber weight per plant (TWP), tuber yield (TY), dry matter content (DM) nitrate content (NC), and starch content of initial fresh (ST).

High mean tuber diameter (MTD) was obtained with using NanoCa and Nano-Com nano-fertilizers while high magnitude of tuber weight per plant (TWP) was observed by application of NanoCa and NanoZn+B nano-fertilizers (Table 1). The response of tuber yield (TY) was similar to TWP and the highest tuber yield was produced via application of NanoCa and NanoZn+B nano-fertilizers. NanoZn+B and Nano-Com nano-fertilizers caused high performances in dry matter content (DM), but simultaneously produced high nitrate content (NC) as a harmful component. NanoCa and Nano-Com nano-fertilizers result in high amounts of starch content of initial fresh (ST) in Agria cultivar. Considering all traits, it seems that application of NanoCa nano-fertilizer (2 kg $ha^{-1}$ nano-chelated calcium) is more useful for achieving high amounts of most important traits of potato flowed by NanoZn+B (1 kg $ha^{-1}$ nano-chelated zinc and boron) nano-fertilizer. However, the performance and influence of Nano-Com nano-fertilizer (1 kg $ha^{-1}$ nano-chelated complete fertilizer).

This investigation showed that application of NanoCa and NanoZn+B nano-fertilizers considerably induced the vegetative growth of potato which suggests that the field soil have both micronutrients' deficiencies. In terms of effectiveness, calcium was located in fourth place. The soil test recommendation for Ca for potato production is around 300 ppm. Although calcium deficiency can be observed in sandy soils, the necessity of calcium application becomes more evident with increasing soil salinity in semi-arid region. It seems that nano-fertilizers by gradual and controlled release of micronutrients such as Ca, Zn and born, largely eliminate this deficiency. Nutrient source in nano-fertilizers is as chelated structure and this is one of the reasons for their superiority compared to conventional inorganic salts. Formulation of the fertilizer also influences the application method and rate for micronutrients. Application rates can generally be lower when the chelate form is applied compared with the inorganic salt. The nutrient should also be available for a longer time interval after application when it is in the chelate form [3]. On the other hand, the utilization of nano fertilizers as fertigation has increased its advantages. It has been revealed that pre-plant application of

conventional fertilizers of Ca, Zn and born increase the possibility of oxidation to unavailable forms before plant uptake, particularly on the high pH, calcareous soils.

## References


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