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Conventional and Nano Fertilizers and Its Effect on Growth and Nutrient Status of Lupine Plants

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ABSTRACT
A pot experiment was conducted in the greenhouse of the National Research Centre, Egypt to evaluate the effect of Nano and conventional fertilizer of nitrogen, phosphorus and potassium (NPK) on lupine plant grown in clay loam soil. Three treatments in five replicates were designed as completely randomized plot. Nano (2ml/litre) and Conventional mineral (3gm/litre) fertilizer of nitrogen, phosphorus and potassium were foliar applied on plant, while the third treatment was fertilized in the soil by recommended doses of lupine plant. Obtained results indicated that the growth parameters of lupine increased by foliar application either Nano or conventional NPK fertilizer compared to soil application of conventional NPK fertilizer, where the highest plants were obtained by foliar application conventional NPK fertilizer, but Nano NPK fertilizer was achieved the highest fresh and dry plant weight of lupine. However the lowest values of fresh and dry plant weight were recorded by soil application of conventional NPK fertilizer, NPK determinations were included. It could be detected that Nano fertilizers potentially influenced in crop growth enhancement and development.

Key words: Lupine (*Lupinus termis* L), fertilizer application methods, type fertilizer, Nano fertilizer, mineral fertilizer, plant growth, NPK determinations.

Introduction

Under limited availability of land and water resources, development and agriculture parallel to the continuous raises in the increases in rate of population, it can faces and achieved exclusively through increasing productivity by using modern technologies'. Primarily, Fertilizers have an important role of enhancing food productivity (production and quality especially after the introduction of varieties characterized by high yielding capacity and fertilizer response. Application profile of nano-particles is rapidly expanding even in agriculture. Application of nanotechnology in agriculture is still in its budding stage. However, it has the potential to revolutionize agricultural systems particularly where the issues on fertilizer applications are concerned. (Benzon *et al.,* 2015). Ajirloo *et al.,* (2015) stated that nano fertilizers will combine nano devices in order to synchronize the release of fertilizer-N and K with their uptake by crops, so preventing undesirable nutrient losses to soil, water and air via direct internalization by crops, and avoiding the interaction of nutrients with soil, microorganisms, water, and air (DeRosa *et al.,* 2010).

Artificial fertilizers are inorganic fertilizers prepared in ideal concentrations of macro and micro nutrients. Nitrogen is an important nutrient element which is essential for plant growth (Marchener, 1995 and Hussein *et al.,* 2019). This element very important for building cells, protein, enzymes and anti-oxidative defense compounds. Phosphorus has an important role in several physiological processes in the plant, such as energy storage photosynthesis, energy transfer and respiration, cell enlargement and cell division (Vandana *et al.,* 2018). Phosphorus is an important structural component of many biochemical's such as nucleic acids (DNA, RNA) coenzymes, nucleotides, sugar phosphate and phospholipids. It stimulates root growth, fruit setting blooming and seed formation (Memon, 1996). Potassium is considered an essential nutrient in photosynthesis, nitrogen metabolism, sugar translocation, enzyme activation, water relation, stomatal opening and growth of meristematic tissues (Marchener, 1995 and Hussein *et al.,* 2008).

Essential plant nutrients are mainly applied to soil and plant foliage for achieving maximum economic yields. Soil application method is more common and most effective for nutrients, which required in higher amounts. However, under certain circumstances, foliar fertilization is more

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economic and effective. Foliar symptoms, soil and plant tissue tests, and crop growth responses are principal nutrient disorder diagnostic techniques. Soil applications of fertilizers are mainly done on the basis of soil tests, whereas foliar nutrient applications are mainly done on the basis of visual foliar symptoms or plant tissue tests (Rahman *et al.,* 2014). Hence, correct diagnosis of nutrient deficiency is fundamental for successful foliar fertilization. In addition, there are some more requirements for successful foliar fertilization. Foliar fertilization requires higher leaf area index for absorbing applied nutrient solution in sufficient amount, it may be necessary to have more than one application depending on severity of nutrient deficiency (Beck's Hybrids, 2018). Nutrient concentration and day temperature should be optimal to avoid leaf burning and fertilizer source should be soluble in water to be more effective. Foliar fertilization of crops can complement soil fertilization (Patil and Chrtan, 2016) If foliar fertilization is mixed with post emergence herbicides, insecticides, or fungicides, the probability of yield response could be increased and cost of application can be reduced (Fageria *et al.,* 2009).

Nanotechnology can revolutionize the agriculture system, biomedicine, environmental engineering, safety and security, water resources and energy convention (Baruah and Dutta, 2009). Also, its role in raising the amelioration of plants against biotic and abiotic stresses (Hussein *et al.,* 2019) and lowering coast of fertilizers application and diminishing the environment pollution (Fageria, 2009).

The objective of this work was to evaluate the effect of NPK fertilizers method of application and sources on growth of plants and NPK nutrients concentration and uptake in lupine plant tissues.

Materials and Methods

A pot experiment was conducted in the greenhouse of the National Research Centre to evaluate the effect of Nano and conventional fertilizer of nitrogen, phosphorus and potassium on lupine plant growth.

Three treatments in four replicates were designed as completely randomized plot as follows:

1- Nano NPK fertilizer treatment as foliar application on plant
2- Conventional NPK fertilizer treatment as foliar application on plant
3- Conventional NPK fertilizer treatment as soil application.

Soil samples were collected from Giza government. Every trail pot was received 10 kg of the soil. The soil chemical properties using the methods described by Jackson (1967) were illustrated in Table (1).

Table 1: Some elements in studied soil before lupine planting

N ppm	P ppm	K ppm	Fe ppm	Zn ppm	Mn ppm	Cu ppm
58.24	7.381	37.8	1.778	0.066	0.588	0.246

Table 2: the analysis of irrigation water

Ec dSm^{-1}	Ec ppm	pH	Solube Anions				Soluble Cations				SAR
			CO_3	HCO_3	Cl	SO_4	Ca	Mg	Na	K	
0.4	256	7.7	0	2	3.26	0.43	1.03	0.45	2.36	0.14	1.93

Lupine seeds (*Lupinus terms L.*) were sown in November, 15 Nano fertilizers of nitrogen, phosphorus and potassium (2ml/litre) was foliar applied on plant. Also, Conventional NPK fertilizer (3gm/ litre) where N: P: K ration was 20:20:20 was sprayed as foliar application on plant. Nano fertilizers, nitrogen, phosphorus and potassium used in the in the rate of 2ml/L; Taking into consideration that Nano and conventional were sprayed after 30 days from sowing. However, the third treatment was applied in the soil as recommended doses for lupine.

Plant height, fresh plant weight and dry plant weight of lupine were measured. Two plants from every replicate of treatments were collected, dried in electric oven, ground, digested and N, P and K concentration were determined using the methods of Cottenee *et al.,* (1980).

Results and Discussion

Methods and sources of NPK

Growth

Data in table (3) and Fig. (1) Showed that Plant height as NPK foliar fertilization addition slightly more than the nano source of these minerals and both more than soil application. Dry matter values as illustrated in Fig. 2 clearly indicated that foliar nano fertilizer the superior followed by foliar spray of these elements and traditional method of application through the soil comes later. Hussein *et al.,* (2019) on wheat; Hussein and Abo Bakr (2018) and Hussein *et al.,* (2017) on cotton and Sabbour and Hussein (2018) concluded that affective on plants. Application of NPK fertilizer through soil was reported by many authors (Hussein *et al.,* 2014; Hussein *et al.,* 2015).

Table 3: Growth and NPK concentrations affected by source and method of fertilizers application

Treatments	Plant height	Fresh weight	Dry weight	N%	P%	K%
Soil mineral	37.33	5.66	0.68	1.22	0.091	1.18
Foliar mineral	43.17	4.36	1.06	1.32	0.139	1.42
Nanofoliar	42.95	2.72	1.30	1.83	0.142	1.60
LSD at 5%	1.710	0.945	0.102	0.289	0.024	0.067

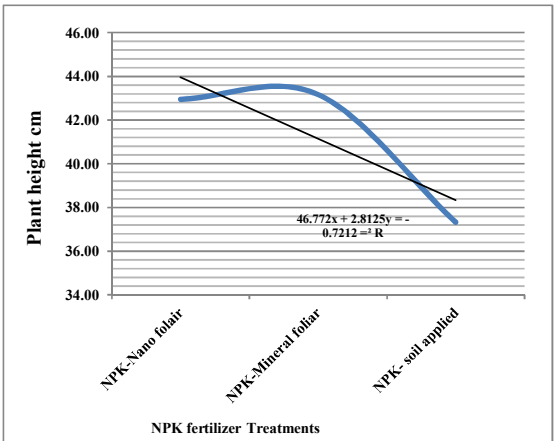

Fig. 1: Plant height of lupine as affected by methods and sources of NPK fertilizer

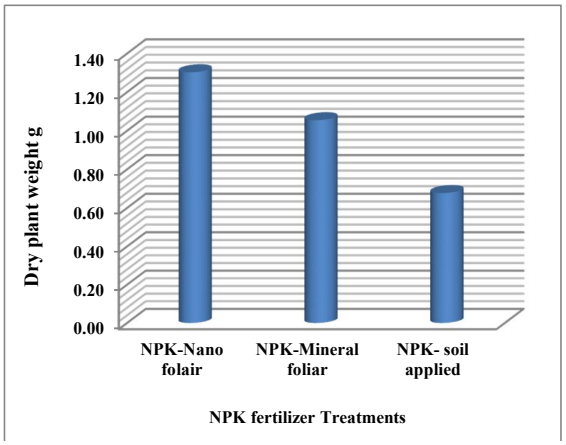

Fig. 2: Dry matter of lupine plants as affected by method and Source of NPK fertilizers

The foliar method of fertilizer application is usually preferred because very small amounts of fertilizers are applied per hectare. It also reduces the number of passes of the applicant, thereby reducing problem of soil compactness. Foliar application is also less likely to result in ground water pollution. Nutrients supply to plants become a limiting factor because of soil properties, foliar spray can serve a useful purpose in by passing the soil to ensure optimal supply of nutrients to plants (Hamayun *et al.,* 2011). In general, best results were recorded from the plants treated with NPK through both soil and foliage. Foliar application of fertilizer should be viewed as temporary or emergency solution only but still it showed excellent results in some crops. Foliar application is regard as a preferred solution when the quantity is small. Quick supply of nutrients is hindered or the soil conditions are not conducive for the absorption of minerals. In addition in the case of depression pollution, avoid nitrogen fixation and treating the deficiency of nutrients. Foliar of application of nutrients more than mentioned above induced some physiological effects such as photosynthesis, (Pokhrellorn *et al.,* 2017), enzymes activity (Niewiadomska *et al.,* 2020; protein building (Burbajanta *et al.,* 2019), osmotic adjustment (Heidari *et al.,* 2007) and oxidative defense (Naveed *et al.,* 2020)

Nano fertilizers are new products which contain readily available nutrients in the nanoscale range and are preferred largely due to their efficiency. Application of nano fertilizer improved growth parameters and increased plant height. Hussein *et al.,* (2017 and 2018) confirmed these findings. Benzoln *et al.,* (2015) found that the nano fertilizer treatment increased plant height over the control more than that plant height more enhanced when nano fertilizer added in combination with the traditional one, even in low rates. These suggest that nano fertilizer can either provide nutrients for the plant or absorption of available nutrients which intern resulting in better crop growth. Liu and Lal (2014) confirmed these findings. Ajirloo *et al.,* (2015) found that application of 400 kg per ha K nano fertilizer had the highest plant height and stem diameter. Also results showed that application of 300 kg per ha K nano fertilizer had the highest number of fruit per plant, fruit weight, fruit diameter and fruit yield. The K nano fertilizer increases the absorption of nitrogen, potassium, calcium, magnesium and phosphorus by plants. They concluded that K nano fertilizer can directly cause the positive effects on plant growth. Shoot and root growth is stimulated by K nano fertilizer, but its effect is more prominent on the roots. Nano fertilizers enhancing the growth of plants and this intern reflected in crop improvement, in this concern, Abd El-Aziz *et al.,* (2016) revealed that nano particles were taken up and transported through phloem tissues. Treatment of wheat plants grown on sandy soil with nano chitosan-NPK fertilizer induced significant increases in harvest index, crop index and mobilization index of the determined wheat yield variables, as compared with control yield variables of wheat plants treated with normal non-fertilized and normal fertilized NPK. The application of a nano-engineered composite consisting of N, P, K micronutrients, mannose and amino acids enhance the uptake and use of nutrients by crops (Jinghua, 2004). In addition, nanofertilizers will combine nano devices in order to synchronize the release of fertilizer-N and -P with their uptake by crops, so preventing undesirable nutrient losses to soil, water and air via direct internalization by crops, and avoiding the interaction of nutrients with soil, microorganisms, water and air (De Rosa *et al.,* 2010). Mahmoodzadeh *et al.,* (2013) reported that direct exposure of wheat plants to specific types of nanoparticles cause significant increase in all growth variables determined at optimum concentrations of nano solution. The application of carbon nanoparticles promoted tobacco plant growth at the resettling growth stage, vigorous growth stage and maturity stage compared with conventional fertilizer (Liang *et al.,* 2013). Furthermore, nanoparticles have high surface energy and activated properties.

Mineral status

Data presented in Table 4 showed that the foliar nano fertilization by NPK is the superior in N, P and K concentration in the lupine plants, and the soil application comes later. The highest increases were in P % (52.76 and 56.04%). Meanwhile the difference in increment between foliar of mineral NPK and that of nano gave its higher values in N % (8.20 and 50, 00%) compare to that of soil application. Generally the lowest values of this phenomenon were in P % followed by that bin K% (20.34 and 35.59%).

Table 4: Effect of treatments on nutrients uptake of lupine plant at growth stage

Treatment	Macro nutrients uptake mg/plants				
	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium
NPK- soil applied	8.72	0.62	8.01	45.81	4.60
NPK-Mineral foliar	14.23	1.29	13.86	62.82	5.48
NPK-Nano folair	23.18	1.77	19.86	64.65	6.32
LSD 0.05	5.943	0.367	2.117	9.134	0.831

Table 4: Cont.

Treatment	Micro nutrients uptake µg/plants			
	Iron	Zinc	Copper	Manganise
NPK- soil applied	69.19	18.28	8.59	18.96
NPK-Mineral foliar	515.97	32.12	13.22	77.88
NPK-Nano folair	873.98	46.01	17.35	255.99
LSD 0.05	205.074	2.997	0.732	79.842

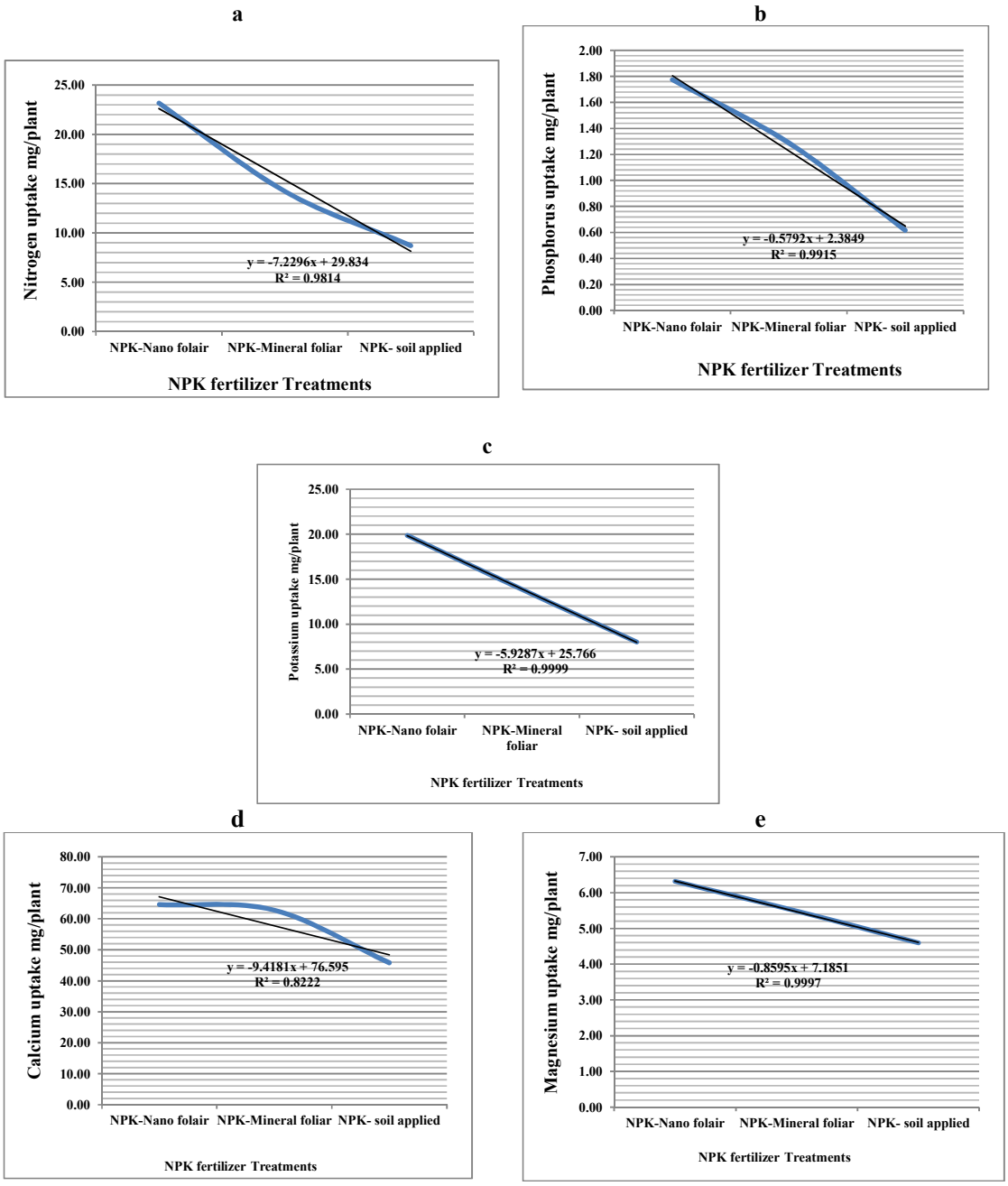

Fig. (3: a,b,c,d and e): Some macro nutrients uptake of lupine plants as affected by methods and sources of NPK fertilizer.

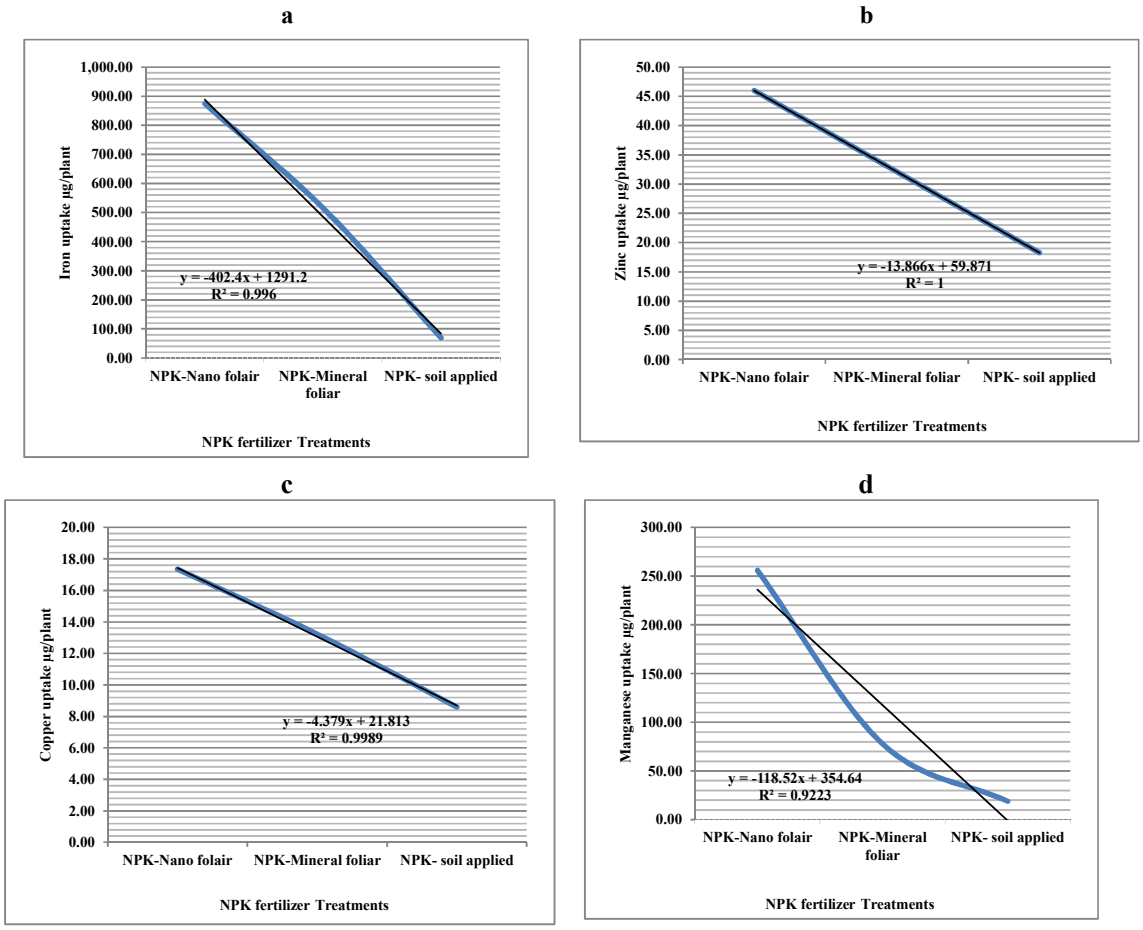

Fig. (4: a,b,c and d): Some micro nutrients uptake of lupine plants as affected by methods and sources of NPK fertilizer.

In this concern, Abd El-Aziz *et al.,* (2016) mentioned that the application of traditional NPK fertilizers and nano-NPK fertilizers with increasing concentrations to wheat plants grown on sandy soil throughout the entire period of experiment appeared, in general, to significantly decrease the leakage of ions from the differently treated plants below those of control levels; the response being more operative with the nano-NPK fertilizers. The good absorption of nano fertilizers can be explained on the basis that the sprayed nano composite-NPK nanoparticles may get absorbed through the stomata of wheat leaves and be translocated in the plant. In addition, Dhoke *et al.,* (2013) concluded that selective uptake, biotransformation, and translocation of various nanoparticles by a model plant have been schematically represented. They added that nanoparticles have high reactivity because of more specific surface area, more density of reactive areas, or increased reactivity of these areas on the particle surfaces. Xiao *et al.,* (2008) demonstrated that NO3 - -N leaching was decreased by coating with nano materials in a rotation of wheat-maize. Hussein *et al.,* (2019) results showed increase in nitrogen and phosphorus, content and uptake and on reverse decrease in Na content and uptake when adding N nano fertilizer.

Conclusion

In a pot experiment conducted in the greenhouse of the National Research Centre in Egypt to evaluate the effect of source and method of NPK fertilizers on growth and N,P and K concentration and content in lupine plants. It could be concluded from the obtained results that nano fertilizer as foliar on the plant more affected than mineral fertilization either through incorporating in the soil or foliar via the leaves of the plant so in dry matter of above ground parts or the content as well as concentration of these nutrients.

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