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EVALUATION OF FOLIAR APPLICATION WITH NANO FERTILIZER (SUPER MICRO PLUS) IN DIFFERENT TIMES ON AVAILABILITY AND UPTAKE OF SOME MICRONUTRIENTS AND SOME QUALITY PROPERTIES OF RICE (*ORIZA SATIVA* L.)

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Abstract

A field experiment was conducted in Al – Najaf Al Ashraf Governorate during summer season 2017 to study the effect of foliar application with Nano fertilizer with three levels (0, 1 and 2) gm L^{-1} (super micro plus that contains (5% N, 3% P, 3% K, 4.5% Fe, 8% Zn, 6% Ca, 6% Mg, 0.7% Mn, 0.65 % Cu, 0.65% B and 0.1% Mo) and three stages of application at tillering stage, booting stage and flowering stage in Fe, Zn, Cu and Mn availability, uptake in straw, protein and white grains present of rice (*Oriza sativa L.*) Amber 33 variety. A experiment was conducted in accordance with to RCBD with three replicates. The following results were obtained Superior the level 2g L^{-1} Nano fertilizer in availability of Iron, cooper & manganese in soil (4.1 & 1.70 & 3.22) mg kg^{-1} soil respectively. uptake of Iron, zinc, cooper & manganese in straw (0.504 & 0.107 & 0.080 & 0.289) kg h^{-1} and protein, white grains percent (8.20 & 67.97) % respectively. Superior stage of adding Nano fertilizer in flowering stage on manganese availability in soil (2.90) mg kg^{-1} soil, and cooper uptake and manganese in straw (0.055 & 0.252) kg h^{-1} respectively. Superior the interaction between levels of nano fertilizer application and stage of foliar application in level 2gm L^{-1} in flowering stage in availability of manganese (3.44) mg kg^{-1} soil. Iron uptake, cooper uptake and manganese (0.529 & 0.082 &0.298) kg h^{-1} respectively, and protein present (8.41).

Key words : Nano fertilizer, available and uptake, rice quality properties.

Introduction

The total area are Cultivated by rice in the world is 162.3 million hectares and a yield 738.1 million tons with an average rate of 4.5 tons. FAO UN (2014). Which is the second most important major crops in the world after the wheat crop because it contains proteins, carbohydrates, vitamins and many nutrients that have a significant impact on health and reduce the risk of diseases, especially cancer Aguilar-Garcia *et al.,* (2007). Rice is a major source of most trace elements of human, including zinc, accounting for 49% of zinc for children and 69% for women. Arsenauault *et al.*, (2010). The use of modern scientific technologies is the best way for vertical expansion of agricultural production. The use of Nano fertilizers improves plant nutrition, increases production and reduces production costs, environmental damage and fertilizer waste. The rate of plant and plant growth has increased with the use of Nanomaterials compared to conventional fertilizers. Shashidara (2015). The large rice crop requirements of different fertilizers lead to increased environmental pollution and increased production costs. However, when using Nano fertilizers, the amount used can be significantly reduced, reducing environmental pollution and production costs. Lemraski, *et al.*, (2017). Affectivity and efficiency of Nano fertilizers results small diameters that average from 1 to 100 nanometers. Liu and Lal (2015). The aim of this research is to assess the effect of Super micro plus in certain qualitative characteristics of rice, and the effect of nano-fertilizer on the absorption and concentration of some Micro nutrients in soil.

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Materials and Methods

A field experiment was carried out in the summer season 2017 in clay loam soil (table 1). The experiment carried out by using RCBD design with three replication, super micro plus Nano fertilizer (made in Iran) containing the following elements: (N 5%, P 3%, K 3%, Fe4.5%, Zn 8%, Ca 6%, Mg 6%, Mn 0.7%, Cu 0.65%, B 0.65% and Mo 0.1%) in three Concentrations (0, 1 and 2 g L^{-1}) and three additional dates (at the tillering stage, in the booting stage and in the flowering stage). Nitrogen fertilizer was added two months later, 50 kg. N. h^{-1} of urea fertilizer 46% nitrogen while phosphorus 80 kg P h^{-1} .Jadoo (1999) and potassium 62.5 kg K h^{-1} were added before planting Jassim (2005). The experiment was planted with wet sowing at 20/6. Crop service operations and removal of weeds were carried out as needed. The harvest was done 18/11. Statistical analysis of the data was performed and the least significant difference was used for L.S.D under the probability level of >= 0.05.

Table 1: Some properties of physical and chemical soil before planting.

Properties	Unit	Estimation Method
EC_e	5.6 ds m^{-1}	Page *et al.*, (1982)
pH	7.9	Page *et al.*, (1982)
Carbonate	276 gm kg^{-1} soil	Page *et al.*, (1982)
Gypsum	3.4 gm kg^{-1} soil	Page *et al.*, (1982)
Organic matter	8 gm kg^{-1} soil	Page *et al.*, (1982)
Phosphor available	8.9 gm kg^{-1} soil	Page *et al.*, (1982)
Potassium available	160 gm kg^{-1} soil	Jackson (1958)
Zinc available	0.82 mg kg^{-1} soil	Lindsay and Norvell (78)
Iron available	4.4 mg kg^{-1} soil	Lindsay and Norvell (78)
Cooper available	2.6 mg kg^{-1} soil	Lindsay and Norvell (78)
Manganese available	4.8 mg kg^{-1} soil	Lindsay and Norvell (78)
Sand	360 gm kg^{-1}	
Silt	260 gm kg^{-1}	
Clay	380 gm kg^{-1}	
Soil texture	Clay loam	Black (1965)

Soil and Plant Samples

Soil samples were randomly selected from different sites of experimental plates before adding fertilizer parameters for chemical and physical analysis of soil as shown in table 1. Harvest a square meter of each treatment at maturity after measuring its height for the purpose of making some measurements. The grains were dried at 65^0 for 48 hours to count grain yield. Randomized soil samples were taken from each post-harvest treatment to study iron, zinc, copper and manganese availability in soil. The protein content in the grains according to the method of Anonymous (1980), white grains is estimated for 100 g of each treatment and repeated three times.

Results and Discussion

Effect of levels and timing of foliar with Nano fertilizer in iron availability in soil after harvest

The result shows table 2 that there are no significant differences in the stages of foliar with nano-fertilizer. In the same table, there are significant differences in the levels of foliar with nano-fertilizer, showing a significant superiority of the level 2 g L^{-1} This may be due to the fact that the plant obtained a large part of the quantity necessary to fulfill its vital requirements, which provided a large part of the iron ready in the soil as well as increased availability of iron under the conditions of water bestowal, which is grown rice crop by the transformation of triangular valence equivalence Which is ready to be absorbed by the plant. Ali *et al.,* (2014). The binary interaction between the foliar stages and their levels was not significant despite the superiority of foliar at the level of flowering level 2 g. L^{-1} but it did not reach the moral level.

Effect of levels and timing of foliar with Nano fertilizer in the availability of zinc in soil

Table 3 showed no significant effect on the levels of foliar Nano fertilizers, addition stages or overlap.

Effect of levels and timing of foliar with Nano fertilizer in soil copper availability in post-harvest

Table 4 shows a significant increase in the levels of Nano fertilizer foliar, with a foliar treatment of 2g L^{-1} at a concentration of 1.70 mg Cu kg^{-1} soil. This may be because the plant has taken an appropriate amount of Nano fertilizer which has fulfilled a large amount of plant nutrition requirements further to fall some of foliar fertilizer at the ground, which led to this amount of concentration. The stages of adding Nano fertilizer and Interference between the levels of foliar and its timing was not significant.

Effect of levels and timing of foliar with nano-

Table 2: Effect of levels and timing of foliar with Nano fertilizer on iron availability in soil at post-harvest mg Fe kg^{-1} soil.

foliar stage / foliar level	Tillering stage	Booting stage	Flowering stage	Average
0	3.6	3.5	3.7	3.6
1 gm L^{-1}	3.9	3.8	3.9	3.82
2 gm L^{-1}	4.1	3.9	4.3	4.1
Average	3.86	3.73	3.96	....
LSD S= 0.40	LSD T = n.s		LSD T*S= n.s	P>= 0.05

S=foliar level T = foliar Time n.s = non-significant

Table 3: Effect of levels and timing of foliar with Nano fertilizer in zinc availability in post-harvest mg Zn kg^{-1} soil.

foilar stage / foilar level	Tillering stage	Booting stage	Flowering stage	Average
0	0.44	0.47	0.58	0.49
1 gm L^{-1}	0.65	0.59	0.62	0.62
2 gm L^{-1}	0.74	0.64	0.70	0.69
Average	0.64	0.65	0.63	....
LSD S= n.s	LSD T = n.s		LSD T*S= n.s	P>= 0.05

S=foliar level T = foliar Time n.s = non-significant

Table 4: Effect of levels and timing of foliar with Nano fertilizer in copper availability in post-harvest mg Cu kg^{-1} soil.

foilar stage / foilar level	Tillering stage	Booting stage	Flowering stage	Average
0	1.17	1.32	1.28	1.25
1 gm L^{-1}	1.55	1.63	1.58	1.58
2 gm L^{-1}	1.64	1.72	1.76	1.70
Average	1.45	1.55	1.54	....
LSD S= 0.42	LSD T = n.s		LSD T*S= n.s	P>= 0.05

S=foliar level T = foliar Time n.s = non-significant

fertilizer in availability of manganese in soil at post-harvest

Table 5 shows a significant increase in the levels of Nanoparticle foliar with a level exceeding 2 g L^{-1} at the other levels at a concentration of 3.22 mg Mn kg^{-1} soil. This may be due to the rapid feeding of Nano fertilizer, resulting in reduced absorption of soil as well as falling from Manure to the ground and increased manganese availability under rice cultivation conditions due to reduction processes that convert the non-ready triangulated manganese into a ready-to-absorbent duo by the plant. Ali *et al.*, (2014). The stages of adding manure have had a significant effect on the increase the concentration of manganese in the soil at the stage of flowering at 2.90 mg Mn kg^{-1} soil, perhaps because of the addition of manure in later stages of the plant life led to its survival in the soil to Post-harvest as well as manganese reduction and transformation into the ready formula under these conditions and the effective role of nanoparticles in the completion of a large part of the requirements of the crop and reduce its absorption from the soil, interference was also significant by the superiority of the treatment of the foliar at the stage of flowering at the level of 2 g L^{-1} concentration of 3.44 mg Mn kg^{-1} soil.

Effect of levels and timing of foliar with Nano fertilizer on iron up take in straw

Table 6 shows a significant increase in the levels of Nano fertilizer in the amount of iron absorbed in straw. The treatment exceeded 2 g L^{-1} with an iron of 0.504 kg Fe h^{-1}. This is the results of the role of Nano fertilizers in increasing absorption due to small size and easy entry To the plant through the openings of holes and the layer of cuticle in large quantity and high speed, which led to an increase in concentration in the dry matter and this is consistent with that found in Liu and Lal (2015). The stages of addition of fertilizer had a significant effect in this capacity. Interference was significant with the superiority of the treatment of interference 2 g L^{-1} in the flowering stage of 0.529 kg Fe h^{-1}.

Table 5: Effect of levels and timing of foliar with Nano fertilizer in manganese availability in post-harvest mg Mn kg^{-1} soil.

foilar stage / foilar level	Tillering stage	Booting stage	Flowering stage	Average
0	1.87	2.17	2.43	2.15
1 gm L^{-1}	2.78	2.92	2.85	2.85
2 gm L^{-1}	2.94	3.29	3.44	3.22
Average	2.53	2.79	2.90	....
LSD S= 0.33	LSD T = 0.33		LSD T*S= 0.67	P>= 0.05

S=foliar level T = foliar Time n.s = non-significant

Effect of levels and timing of foliar with Nano fertilizer in zinc up take in strawkg h^{-1}

Table 6 shows the superiority of the foliar treatment of 2 g L^{-1} on the rest of the transactions 0.107 kg Zn h^{-1}. This may be due to the role played by Nano fertilizers to increasing the absorption, which led to increased concentration of zinc in the dry matter. Fertilizer has no significant effect in stage timing. Treatment of interference 2 g L^{-1} when foliar in the booting stage in the amount of 0.111 kg Zn h^{-1}.

Table 6: Effect of levels and timing of foliar with Nano fertilizer on iron up take in straw.

foilar stage / foilar level	Tillering stage	Booting stage	Flowering stage	Average
0	0.375	0.371	0.368	0.475
1 gm L^{-1}	0.433	0.437	0.448	0.439
2 gm L^{-1}	0.484	0.499	0.529	0.504
Average	0.430	0.435	0.448	....
LSD S= 0.06	LSD T = n.s		LSD T*S= 0.13	P>= 0.05

S=foliar level T = foliar Time n.s = non-significant

Effect of levels and timing of foliar with Nano fertilizer in copper up take in straw kg h^{-1}

Table 8 shows a significant increase in the foliar levels in straw up take copper kg h^{-1}. The foliar treatment was 2gL^{-1} with a copper amount of 0.080 kg h^{-1}. This indicates the increase in the amount absorbed by increasing the concentration, as well as the role of the Nano fertilizer

Table 7: Effect of levels and timing of foliar with Nano fertilizer in zinc up take in straw.

foilar stage / foilar level	Tillering stage	Booting stage	Flowering stage	Average
0	0.068	0.066	0.067	0.067
1 gm L^{-1}	0.102	0.100	0.104	0.102
2 gm L^{-1}	0.109	0.111	0.102	0.107
Average	0.093	0.092	0.091	....
LSD S= 0.38	LSD T = n.s		LSD T*S= 0.13	P>= 0.05

S=foliar level T = foliar Time n.s = non-significant

and its properties which allowed the increase in the amount absorbed. The stages of addition of fertilizer had a significant effect in this effect, as the treatment of foliar in the flowering stage exceeded the amount of 0.055 kg Cu h^{-1}, a critical stage of the life of the plant, which led to an increase in the amount absorbed, especially the presence of fertilizer with its nanoparticles that are more suitable and absorption. Was significantly superior to the interference treatment at foliar with a concentration of 2 g L^{-1} in the flowering stage (0.082 kg cu h^{-1}) and this may be due to the time of the plant to receive it as much as possible element, especially when available at a critical stage of the plant life with a lack of readiness in the soil and give it from a highly fertilizer efficient.

Effect of levels and timing of foliar with nano-fertilizer in straw up take manganese kg h^{-1}

Table 9 shows that there are significant differences in the levels of fertilizer additive foliar. The foliar treatment at the concentration of 2 g L^{-1} was exceeded by 0.289 kg Mn h^{-1}. This shows the importance of increasing the amount of fertilization, especially when the level of element in soil is low. The foliar phase had a significant effect, especially when foliar at the flowering stage. The amount of manganese absorbed was 0.252 kgMn h^{-1}, which is a critical stage in the age of the plant, which requires more nutrients to complete all its metabolic processes. Was significantly superior to the interference ratio of 2 g L^{-1} when foliar at the stage of the flowering giving a up take of 0.298 kg Cu h^{-1}.

Table 8: Effect of levels and timing of foliar with Nano fertilizer in Copper up take in straw.

foilar stage / foilar level	Tillering stage	Booting stage	Flowering stage	Average
0	0.021	0.020	0.020	0.020
1 gm L^{-1}	0.061	0.062	0.064	0.062
2 gm L^{-1}	0.078	0.080	0.082	0.080
Average	0.053	0.054	0.055	....
LSD S= 0.06	LSD T = 0.06		LSD T*S= 0.12	P>= 0.05

S=foliar level T = foliar Time n.s = non-significant

Effect of levels and timing of foliar with nano-fertilizer in protein percentage

The results showed that in the table 10, there was a significant increase in the levels of foliar with Nano fertilizer. The treatment exceeded 2 g L^{-1}. The highest protein percentage in the grains was 8.20%. This may be due to the efficiency of foliar with the Nano compatibility which has a high penetration rate of the cell wall and its rapid representation by the plant As well as the components of elements such as zinc, nitrogen and iron, which contributed significantly to increase the proportion of protein in the grains, especially as the proportion of these elements in the soil and without the critical limit of the plant as the manure of nanoparticles lead to growth significantly and this is consistent with Shashidara, (2015). There is not significant differences for timing foliar application.

Table 9: Effect of levels and timing of foliar with Nano fertilizer in manganese absorbed in straw Kg Mn h^{-1}.

foilar stage / foilar level	Tillering stage	Booting stage	Flowering stage	Average
0	0.205	0.204	0.204	0.204
1 gm L^{-1}	0.252	0.248	0.254	0.251
2 gm L^{-1}	0.280	0.291	0.298	0.289
Average	0.246	0.248	0.252	....
LSD S= 0.044	LSD T = 0.044		LSD T*S= 0.088	P>= 0.05

S=foliar level T = foliar Time n.s = non-significant

The interaction between levels and time application

Table 10: Effect of levels and timing of foliar with Nano fertilizer in protein in grains%.

foilar stage / foilar level	Tillering stage	Booting stage	Flowering stage	Average
0	6.36	5.95	5.87	6.06
1 gm L^{-1}	7.28	7.74	7.53	7.52
2 gm L^{-1}	7.96	8.22	8.41	8.20
Average	7.20	7.30	7.27	....
LSD S= 1.22	LSD T = n.s		LSD T*S= 2.44	P>= 0.05

S=foliar level T = foliar Time n.s = non-significant

Table 11: Effect of levels and timing of foliar with Nano fertilizer in the percentage of white grains %.

foilar stage / foilar level	Tillering stage	Booting stage	Flowering stage	Average
0	61.7	62.2	62.9	62.3
1 gm L^{-1}	65.5	64.4	65.3	65.07
2 gm L^{-1}	67.4	68.6	67.9	67.97
Average	64.86	65.07	65.37	....
LSD S= 2.22	LSD T = n.s		LSD T*S= 4.44	P>= 0.05

S=foliar level T = foliar Time n.s = non-significant affected significantly on protein percentage when foliar 2 g L^{-1} at flowering stage (8.41%). This may be due to the passage of the plant at as a critical stage of its life As well as the role of high activity of Nanomaterials.

Effect of levels and timing of foliar with Nano fertilizer in the percentage of white grains

The table 11 shows the superiority of the levels of foliar with Nano fertilizer on percentage of white grains after foliar, with the highest rate of 67.97% in the foliar treatment 2 g L^{-1}. This may be due to the appropriate nutrition of different nutrients in Nano fertilizer as well as the efficiency of nanoparticles in nutrient absorption and rapid representation By the plant. The foliar stage did not have a significant effect in white grains. Interference was significant in The foliar treatment exceeded 2 g L^{-1} in the booting stage by 68.6%, which did not differ significantly in the two stages of flowering and flowering which reached 64.86% and 67.9%, respectively, showing the role of foliar with nanoparticles Achieving balanced nutrition has significantly contributed to the absorption and metabolism of nutrients in a manner that ensures full grain fulfilment and high levels of white rice grains.

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