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Response Wheat to Spray Some of Synthetic Nano Fertilizers

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Abstract. The National Program of Wheat Development in Iraq (NPWD) performed a field experiment at the Al-Shafeieyah Wheat Research Station to determine the impact of sprayed nano-specific, nano-complete micronutrients, and nano-manganese on the agronomic traits and yield of wheat (cv. Baghdad 3). The experiment involved spray application of eight treatments with nano-specific (NSF), nano-complete micro (NCM), and nano-manganese fertilizers (NMnF), as well as di (NSF+NCM), (NSF +NMF), (NCM + NMnF), and tri (NSF+NCM+NMF). Different agronomic traits, as well as yield (quality and quantity) characteristics, were measured. As a result of the statistical study, the following conclusions were drawn: LSD0.05 was sprayed with NMnF, NCM, and NSF, followed by spraying with a combination of di (NMnF+NCM), (NMnF+NSF), (NCM+NNSF), and tri (NMnF+NCM+NSF), treatments in all agronomic traits and yield of wheat, with an increment of 94.92cm, 14.00cm, 66.00 SPAD, (2.20, 0.60, and 1.87) percent, (141.90, 44.82, 37.22, and 94.55) µg g-1 for plant height, spike length, total chlorophyll, and N,P,K, Fe, Cu, Zn, and Mn concentrations in grain, respectively, in comparison to the control treatment. The same treatment was considerably better in biological yield, grain yield, protein yield, and harvest index, with 14.792 Meg ha-1, 7.100 Meg ha-1, 890.34 kg ha-1, and 40.00 percent, respectively, as compared to control, bilateral combinations, and mono spray. The greatest agronomic efficacy was obtained when foliar spraying tri combination treatments and dual nano-mixed fertilizers of (NCM + NSF) (1850.00 and 2111.11) kg kg-1, respectively.

Keywords. Wheat, Sprayed, Nano-Manganese, Nano-Micro nutrients, Agronomic efficiency.

1. Introduction

Foliar treatment ensures that nutrients are available to crops, resulting in a higher yield [1]. Nitrogen is one of the most important plant nutrients for increasing yield of different field crops. Appropriate nitrogen application is crucial for a large wheat crop. Foliar nitrogen application is more effective than foliar spray and hence has a bigger influence on wheat production and yield components [2,3]. Following nitrogen, phosphorus (P) has been recognized as the key nutrient that is most inadequate in a wide variety of agricultural production systems (N). Nutrient inputs into production systems have grown as a consequence of the increasing need for high-yielding crops to feed the world's growing population. Phosphorus is created through the weathering of soil minerals and other stable geologic components of the soil, and it is found in both inorganic and biological forms [4,5]. Potassium is a “workhorse” nutrient for plants. This could explain why it isn't found in any specific plant compound. As a result, potassium is essentially free to move about and wheel and deal within the plant. It should come as no surprise that a lack of potassium can lead to a reduction in crop yield, quality, and profitability. Potassium foliar spray in combination with nitrogen and other micronutrients such as zinc had a substantial effect on wheat grain production [3,6,7]. Foliar feeding of macro and micronutrients to the leaves is more effective in terms of maximizing yield and minimizing losses [5]. Plant crops grown in micronutrient-deficient soils have low Zn and Fe content, as well as reduced bioavailability [8-11]. As a result, due to the high occurrence of micronutrient insufficiency in human populations, improving and raising Fe and Zn concentration in food crops is a major global concern [12,13].

Grain yield, agromorphological features, and grain micronutrient concentration of food crops can be influenced by environmental factors (such as the use of macro- and microfertilizers) and agronomic biofortification strategies [11,14].

Nano-fertilizers are more effective than the majority of polymeric-type traditional fertilizers due to their high surface area to volume ratio. Additionally, these properties may aid in the release and absorption of nutrients by plants. As a result, this approach provides the framework for long-term and unique nutrient delivery systems that make advantage of plant component nanoporous surfaces. It is feasible to boost the effectiveness of applied fertilizer, restore soil fertility and plant health, and prevent environmental pollution and agroecological degradation via the use of encapsulated nanoparticles, nanoclays, and zeolites [15,16]. Spraying wheat with a variety of nano-fertilizers has also resulted in great wheat grain production and quality [17].

Manganese (Mn) is a necessary component for photosynthesis, respiration, and nitrogen (N) metabolism in plants. Mn is also necessary for root and shoot disease tolerance [18,19,20,21]. Mn therapy has been shown to provide agronomic advantages in numerous crops, correlating with these cellular-level functions. For example, maize, beans, soybeans, wheat, and sugarcane all grew and/or produced much more after being fertilized with Mn in the ionic form at optimum concentrations [22-24]. However, depending on the chemical characteristics of the soil, such as low pH and high redox potential, which both increase the bioavailability of Mn and change its oxidation state to the more lethal Mn2+ form, Mn can be toxic to plants at high exposure levels [18,22,25].

Expanding our knowledge of bioregulators may help enhance agricultural production efficiency and crop quality. [26,27,28,29]. When compared to conventional fertilizers, nano-fertilizers improve growth parameters (plant height, leaf area, and leaf number per plant), dry matter production, chlorophyll production, and photosynthesis rate, resulting in increased photosynthesis and photosynthesis translocation to various parts of the plant. [30,31,32].

As a result, our goal was to see how much foliar feeding of nano-Specific, nano-chelated complete micro and nano-manganese fertilizers, as well as di of combination and tri of them, affected wheat growth and yield in comparison to control.

2. Materials and Methods

A field experiment was performed at the National Program for Wheat Development's Al-Shafeieyah Wheat Research Station (NPWD), Al-Qadisiyah Governorate, Iraq, on Silt clay Loam soil (Table 1).

The study used the foliar spray Nano Chelated Manganese Fertilizer (NMnF) 25 percent Mn, a nano-specific liquid fertilizer for wheat containing 3% N, 1% P2O5, 1% K2O, 0.6 percent Mg, 0.4 percent Ca, 3% Fe, 1% Zn, 2% Cu, and 0.6 percent Mn from Sepehrparmis Nano-technology, Iran (www.sepehrparmis.com), Nano chelated full micro fertilizer from KHAZRA Nanochelating technology Iran contains 8% iron, 1.5 percent zinc, 1.5 percent manganese, 0.5 percent boron, 0.5 percent molybdenum, and 0.5 percent copper in chelated form and is absorbable at pH 3-11 (NCM). Spray in single, dual, tri, and control arrangements with three replicates in a simple one-way experience using RCBD.

Foliar treatment was initiated at the start of the flag leaf stage and was carried out according to the spraying dates and concentrations specified in Table 2. 400 liters ha-1 of mixture were applied to the leaves early in the morning, with a 14-day interval between treatments.

Table 1. Several physical and chemical characteristics of soil.

property	value	Estimated Methods
Particle size distribution (gm kg^{-1}soil)		
Clay	121	
Silt	590	
Sand	310	
Texture	Silt clay Loam	Kilmer and Alexander,1949
CEC Cmolc kg^{-1}Soil	24.4	
OM gm kg^{-1}Soil	12.3	
Total carbonates gm kg^{-1}Soil	241	
pH	7.5	Salim and Ali,2017
EC (ds m^{-1})	2.4	
Available macronutrients (mg kg^{-1}soil)		
N	21	
P	14	
K	220	
Bulk density Mg m^{-3}	1.35	Landon,1984

Table 2. Treatments of nano-fertilizer application.

Tr. N^O	Treatments of foliar Spraying	Stages and rates of foliar apllication treatments combinations (gm or ml per L^{-1} water)	
		lining stage	50% flowering stage
T_1	Control (spray water only)	0	0
T_2	Nano-Manganese fertilizer (NMnF)	2	2.5
T_3	Nano-Complete Micro fertilizer (NCM)	2	2.5
T_4	Nano-Specific fertilizer of wheat (NSF)	2	2.5
T_5	(NMnF + NCM)	1+1	1.25+1.25
T_6	(NMnF + NSF)	1+1	1.25+1.25
T_7	(NCM + NSF)	1+1	1.25+1.25
T_8	(NMnF+ NCM + NNSF)	1+1+1	1.25+1.25+1.25

As a starter and supplier of N and P, all treatments received 240 kg ha-1 of di ammonium phosphate (DAP 18:46:0). To aid in management, nitrogen was applied at a rate of 150 kg N ha-1 by urea (46% N) and potassium at a rate of 100 kg K ha-1 via potassium sulfate (41.5K). All relevant soil management procedures (e.g., land preparation, "tillage," and irrigation) and plant management activities (e.g., pesticide application) were completed. The experiment units were 9m2 (3x3m) in size, with a 1.5 m separation between units and duplicates to increase trial accuracy. Each experimental unit was composed of 15 lines measuring 3 meters in length, 20 centimeters apart, and 5 centimeters in depth, and seeds were sawn at a rate of 120 kg ha-1 on November 15, 2020 using the cv. Baghdad 3.
Numerous variables affecting development and production were evaluated at the grain maturity stage. Wet digestion was used to determine the nitrogen, phosphorus, and potassium contents of grain [33]. Fe, Mn, Zn, and Cu concentrations in di-acid solutions were determined using an atomic absorption spectrophotometer (AAS) and then quantified [34]. The total chlorophyll content was determined as follows: SPAD, weighing the whole plant (grains + straw) on three lines 50 cm apart from each experimental unit calculated the biological yield ton ha-1 of all plants. Following isolation and straw removal, the weight of 1000 grain was also determined at a 12 percent relative humidity [35]. The protein content of grain was determined using (N percent 5.7) and AE = (Y-Y0)/F [36]. ANOVA was performed using the Genstate software with a straightforward one-way experiment and a less significant difference (LSD) of (0.05).

3. Results

The use of nano-, micro-, and manganese fertilizers considerably improved the grain wheat's agronomic properties and nutritional content. After foliar spraying with a tri mixture of combination T8, plant height, spike length, and flowering duration were significantly increased. Chlorophyll, N, P, K, Fe, Cu, Zn, and Mn contents in grain were significantly increased in all di, mono, and control treatments (94.92cm, 14.00cm, 66.00 SPAD, 2.20, 0.60, 1.87 percent, 141.90, 44.82, 37.22, and 94.55 g g-1).

Table 3. The influence of spraying nano-spe, micro, and manganese fertilizers on plant height, spike length, total chlorophyll, and N, P, K, Mn, Zn, Cu, and Fe concentrations in wheat grain.

Tr. No	Plant height (cm)	Length of spike (cm)	Chlorophyll SPAD	Concentration of some of macro and micro nutrients in grain						
				%			μg g^{-1}			
				N	P	K	Fe	Cu	Zn	Mn
T_1	70.49	8.99	40.00	1.55	0.30	1.40	77.66	25.32	18.02	60.44
T_2	74.00	9.44	46.66	1.64	0.32	1.42	80.00	25.62	20.54	80.40
T_3	77.00	10.55	48.00	1.77	0.36	1.33	95.49	34.00	30.55	70.30
T_4	82.55	11.77	53.66	1.89	0.40	1.65	110.30	33.77	30.00	65.84
T_5	84.66	12.11	60.00	2.00	0.41	1.63	120.44	37.11	31.99	84.88
T_6	87.44	12.76	62.22	2.01	0.43	1.70	120.88	34.44	26.70	90.00
T_7	90.22	13.55	63.00	2.05	0.46	1.75	125.00	41.00	33.89	87.33
T_8	94.92	14.00	66.00	2.20	0.60	1.87	141.90	44.82	37.22	94.55
$L.S._{D0.05}$	7.34	3.60	8.56	0.29	0.12	0.07	6.43	5.40	12.21	10.64

Additional spraying of the leaves with a Nano-specific fertilizer generated a robust response to these features. However, as compared to nano-manganese and control, spraying with a higher concentration of six critical nano-nutrients T3 resulted in the greatest growth of plant parameters, while di-spraying combinations treatments resulted in the best growth criteria (Table 3). Wheat plants treated with T8 produced a higher biological yield of 14.792 Meg ha-1 and a grain yield of 7.100 Meg ha-1.

Table 4. The influence of nano-spe, micro, and manganese fertilizers on the biological yield, grain yield, 1000 grain weight, harvest index, protein yield, and agronomic efficiency (Kg Kg^{-1}) of wheat was investigated.

Tr. N_O	biological yield Meg ha^{-1}	grain yield Meg ha^{-1}	weight of 1000 grain g	harvest index %	Protein %	Yield of Protein (Kg ha^{-1})	Agronomic Efficiency (Kg Kg^{-1})
T_1	9.429	3.300	38.66	35.00	8.84	291.56	0.00
T_2	10.210	3.800	39.42	37.22	9.35	355.22	277.78
T_3	10.412	4.200	40.16	40.34	10.09	423.74	500.00
T_4	11.905	5.000	42.33	42.00	10.77	538.65	944.44
T_5	12.826	5.600	43.55	43.66	11.40	638.40	1277.78
T_6	13.451	6.100	44.00	45.35	11.46	698.88	1555.56
T_7	14.276	6.630	45.88	46.44	11.69	774.72	1850.00
T_8	14.792	7.100	47.00	48.00	12.54	890.34	2111.11
$L.S.D_{0.05}$	1.76	0.75	3.1	4.30	1.65	107.65	120.23

Combinations of binary numbers T7 exceeded conventional spraying in terms of biological output (14,276 Meg ha-1), grain yield (6,630 Meg ha-1), grain weight (45.88 g), protein yield (774.72 Kg ha-1), and agronomic efficiency (1850.00 Kg Kg-1). The highest harvest index, protein yield, and agronomic efficiency were achieved by spraying treatment T8 at a rate of 48.00 percent, 890.34 kg ha-1, and 2111.11 kg kg-1, respectively (table 4).

4. Discussion

Foliar feeding is one of the approaches that can help increase cereal output by providing balanced nutrients, especially micronutrients. From the perspectives of crop production, nutrient uptake, and flour quality, this technology is examined in the prospects for biofortification of wheat flour in the farmer's field.

Fertilization with macronutrients is now essential for the growth of agricultural output and plays an important role in food safety. The significance of synthetic fertilizers lies in their ability to provide essential nutrients for plant growth. [37,38]. When a nano-fertilizers composite containing macro and micronutrients was sprayed to grain crops, the absorption and agronomic efficiency appeared to improve. [39,40]. The current findings revealed that treatments of wheat with nano-specific, micro fertilizers, and nano-manganese, at increasing concentrations over the course of the experiment, resulted in a wide range of significant increases in nutrient content of wheat grains, as well as a significant increase in protein content in wheat grains. (Tables 3). To back up the previous findings, yielding grains are one of the most susceptible organs to the effects of nano-cheleated fertilizers. According to several studies, spraying nano-fertilizer on wheat grains improved chlorophyll content, plant height, spike length, and nutrient content [26]. Those reported by [27,41,42], who stated that employing various forms of nano-fertilizers boosted crop growth.

Micro fertilizers sprayed on the foliage had a substantial impact on yield and components. They are only required in trace amounts, but their availability enhances nutrient availability and, in turn, impacts cell physiological processes, which are reflected in growth and production [43]. These findings are consistent with those of [41,42,44], who found that employing different types of nano-fertilizers boosted wheat growth criteria and yield. Foliar feeding is a method of supplying micronutrients to plants. During the fast development period, it might shorten the time between spraying and plant uptake. It can also get around the issue of an elment's restricted uptake from the soil [45]. Nutrient uptake may be more active with this strategy than with soil fertilization, where nutrients are absorbed on soil particles and hence are only partially available to the root system [46].

Photosynthesis, chlorophyll synthesis, root and respiration cell growth, and the effectiveness of enzymes involved in primary and secondary metabolism are all examples of macronutrient functions in plants. [47,48]. Mn foliar spray inhibits chemical fixation by limiting the amount of time that it interacts with soil particles. As advised by, foliar Mn treatment of soybeans continues to be an essential and economically viable option for reducing yield loss and nutrient imponderability in calcareous soils [49]. Wheat crown root initiation, tillering, and engagement phases are critical for MnSO4 fertilizer application in sandy soils [50,51]. By spraying 500 g Mn ha-1 on safflower growing in dark clay soil in South-East Australia, the number of seeds plant-1 and seed yield are improved [52]. While foliar feeding is an effective strategy, excessive micronutrient application may result in leaf burning and unintentional toxicity [5,53] . Frequently, two or three sprays of Mn foliar feeding are required for maximum response. Although foliar Mn spraying may give sufficient Mn to compensate for Mn deficiency, it is prohibitively expensive and cumbersome for farmers working on marginal soils. Additionally, foliar Mn feeding is only effective for a limited time period due to Mn's low mobility within the plant and its inability to remobilize from older leaves to Mn-deficient young leaves [54,55]. Nano-fertilizers are more active than the majority of traditional polymeric fertilizers due to their high surface area to mass ratio. Additionally, these characteristics may enable a more progressive release and increased nutrient absorption efficiency by plants. As a result, by allowing plant components to have nanoporous surfaces, this technique sets the framework for long-term and unique nutrient delivery systems. [16,56,57].

Conclusion

Finally, foliar nutrition using a nano chelated Spesific, nano micro complete nano-manganese combination was found to be the most effective for growth, yield, nutrient concentration in grains, and agronomic efficiency.

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