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Effect of Nano Fertilizers on Growth and Quality of Wheat (*Triticum aestivum* L.)

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ABSTRACT: To study the "Effect of nano fertilizers on growth and quality of wheat (*Triticum aestivum* L.), a field experiment was carried out at Instructional Farm, College of Agriculture, Jodhpur during two consecutive *rabi* seasons of 2021-22 & 2022-23. The field experiment was laid out in randomized block design (RBD) with fourteen treatments replicated thrice. Results showed that the application of 100% RDF + ST with nano DAP and two foliar spray of nano urea at 35 & 55 DAS was recorded highest amount of dry matter accumulation (g/m^2) and CGR (g/m^2/day) at different crop growth stages which was found statistically at par with treatments of100% RDF + 2 FS of nano urea at 35 and 55 DAS, 100% RDF + FS of nano DAP at 35 DAS, 75% RDF + ST with nano DAP and 2 foliar spray of nano urea at 35 & 55 DAS. Application of 100% RDF + ST with nano DAP and two foliar spray of nano urea at 35 & 55 DAS was also recorded highest amount of grain yield which was found statistically at par with treatments of100% RDF + 2 FS of nano urea at 35 and 55 DAS, 100% RDF + FS of nano DAP at 35 DAS, 75% RDF + ST with nano DAP and 2 foliar spray of nano urea at 35 & 55 DAS respectively on pooled basis.

Keywords: Foliar spray, CGR, Dry matter accumulation, Seed treatment and Wheat.

INTRODUCTION

Wheat has a global significance as it is staple food for millions of people and supplies 20% of the food calories for World's population. In India, it is the second staple food crop next to rice contributing about 32% of the total food grain production. Wheat and rice are considered as the backbone of Nation's food security system. It is the cheapest source and supplier of the calories and protein for healthy diet (Heyne, 1987). Wheat straw is also a major source of fodder for the animal population of the country. Wheat grains contain gluten, a protein that allows leavened dough expansion by creating tiny gas cells, thereby enabling bakers to create soft bread products. China, India, U.S.A., Russia, France, Canada, Germany, Turkey, Australia and Ukrain are leading wheat producing countries. In India, wheat stands second position in area and production, but first in productivity amongst all the cereals with acreage, production and productivity of 31.23 million hectares, 112.92 million tonnes and 3615 kg/ha, respectively (IIWBR, Karnal, 2023-24). In Rajasthan, wheat crop covers an area of 27.85 lakh hectares with an annual production of 10.41 million tonnes and an average productivity of 3739 kg/ha which is slightly higher than national average. Rajasthan state is on fifth position in wheat production after Uttar Pradesh, Punjab, Haryana and Madhya Pradesh (Government of Rajasthan, 2023-24).

Wheat has significantly contributed towards the success of green revolution and has greatly helped to transform our country from a situation of hand to mouth to being self-sufficient. The increase in wheat productivity mainly depends on the fertilizers as it is a heavy feeder crop. Macro nutrients like N, P and K in sufficient quantity throughout the growing season are essential for optimum plant growth (Haque *et al*., 2001). Nitrogen has important phenomenon in various physiological process of plant as it gives a dark green color to leaves and promotes the cell division in growing part the plant mainly stem, leaves and other vegetative parts. It also stimulates plant root growth. Phosphorus is next important nutrient which act as energy currency within the plants and participate in a wide range of plant processes from promoting cell division to development of vigorous root system and plays a vital role in uniform grain filling, grain quality (protein and oil production) and higher yield (Choudhary *et al*., 2018). Phosphorus helps in root, flower and fruit development. It is very much important for quality seed production. It is constituent of ADP and ATP, plays key role in energy transformation and storage. It also helps in the assimilation of photosynthates into other metabolites and hence act as an activity zone for CO_2 assimilation.

Nano fertilizers, ranging in size from 1 to 100 nanometres, release nutrients gradually over an extended period. This controlled release effectively reduces nutrient loss from the soil and minimizes the risk of soil and groundwater pollution (Meena *et al.,* 2017). The progress of agriculture sector is only achievable by rising resource use efficiency with the minimum damage to production led through effective use of modern technologies (Naderi and Shahraki 2013). To conquer all these drawbacks, nano fertilizers can go extensive way in ensuring sustainable health of soil and production of crops (Lal, 2008). Adoption of nano fertilizers for revolutionary transformation through nanotechnology, which helps to sustain soil health at the same time ensuring high productivity (Shang *et al.*, 2019). Nano fertilizers can be produced by different carrier materials *e.g*., zeolite, hydroxyapatite NPs, mesoporous silica NPs, nitrogen, carbon, zinc, copper, silica and polymeric NPs (Chaitra *et al*., 2021) which release nutrients in protective manner. Benzon *et al.* (2015) reported that nano fertilizers when combined with conventional ones, enhanced plant height by providing nutrients and aiding nutrient transport and absorption. Nano fertilizers are recognized for their precise nutrient release and targeted delivery at the nanoscale, enhancing plant productivity and mitigating environmental pollution (Fatima *et al.,* 2020). Nano fertilizers are required in small quantity which reduces toxic effect caused by the extreme use of conventional fertilizers and have higher use efficiency than conventional fertilizers which reduces losses of nutrients. Foliar application is a method of nourishing plants by spraying liquid fertilizers directly onto their leaves, promoting enhanced absorption in the above-ground parts of the plant (Nasiri *et al.,* 2010; Marzouk *et al.,* 2019). The application of foliar nano ureaitrogen and Zinc fertilizers has been shown to enhance the growth parameters of wheat when compared to other fertilizer sources (Ghorbanpour *et al.,* 2017). Nano fertilizers are efficiently absorbed by plant because of its ultra high absorption feature and high surface to volume ratio (Elemike *et al*., 2019). Nano fertilizers performed better than commercial urea in different crops (Velmurugan *et al.,* 2021). In this context, nano fertilizers are better substitute to conventional fertilizers as they are eco-friendly, cost effective, maintain soil fertility and plant health.

Many researchers have witnessed that it is a boon for high crop production, so the present research work entitled "Effect of nano fertilizers on growth and quality of wheat (*Triticum aestivum* L.)**"** have been framed.

MATERIALS AND METHODS

Experimental site. The experiment was carried out at Instructional Farm, College of Agriculture, Jodhpur during *rabi* seasons of 2021-22 & 2022-23. Geographically, Jodhpur is situated between 26°15′ N to 26°45′ North latitude and 73°00′ E to latitude 73°29' East longitude at an altitude of 231 meter above mean sea level. The soil was loamy sand in texture, slightly alkaline in reaction (pH 7.8), low in organic carbon (0.14%) and available nitrogen (175 kg/ha).

Experimental treatments. The field experiment was tested in randomized block design (RBD) with fourteen treatments replicated thrice. The treatments comprised of T_1-100% RDF + two foliar spray of nano urea at 35 & 55 DAS, T_2-100% RDF + foliar spray of nano DAP at 35 DAS, T_3-100% RDF + ST with nano DAP at 5 ml/kg seed and two foliar spray of nano urea at 35 & 55 DAS, T_4-75% RDF + two foliar spray of nano urea at 35 & 55 DAS, T_5-75% RDF + foliar spray of nano DAP at 35 DAS, T_6-100% RDF + ST with nano DAP at 5 ml/kg seed and two foliar spray of nano urea at 35 & 55 DAS, T_7-50% RDF + two foliar spray of nano urea at 35 & 55 DAS, T_8-50% RDF + foliar spray of nano DAP at 35 DAS, T_9-50% RDF + ST with nano DAP at 5 ml/kg seed and two foliar spray of nano urea at 35 & 55 DAS, T_{10}-Foliar spray of nano DAP at 35 DAS+ two foliar spray of nano urea at 35 & 55 DAS, T_{11}-ST with nano DAP at 5 ml/kg seed + foliar spray of nano DAP at 35 DAS+ two foliar spray of nano urea at 35 & 55 DAS, T_{12}-ST with nano DAP at 5 ml/kg seed+ two foliar spray of nano urea at 35 & 55 DAS, T_{13}-100% RDF through conventional fertilizers and T_{14}-Control.

In accordance with the treatments, recommended doses of nitrogen, phosphorus and potassium fertilizers were given as basal application at the time of sowing through urea, di-ammonium phosphate (DAP) and murate of potash (MOP). Specifically, half of the prescribed nitrogen quantity was applied as a basal application while the remaining amount of nitrogen top dressed within the standing crop through urea at the time of the first irrigation. As per treatments, ST was done with nano DAP at 5 ml/kg of seed with required quantity of water to form thin film on seed surface and then dried in shade. Thereafter, sowing was done in each marked plots. The FS of nano urea and nano DAP were done as per treatment combination. The foliar sprays of nano urea at 4 ml/L and nano DAP at 2 ml/L water was applied as per scheduled treatments. The first spray of nano urea was applied at 35 DAS, and the second spray at 55 DAS. FS of nano DAP was applied at 35 DAS.

RESULT AND DISCUSSION

Effect on growth attributes. Among the several applied treatments in the experiment, application of 100% RDF + ST with nano DAP and 2 foliar sprays of nano urea at 35 & 55 DAS recorded highest amount of dry matter accumulation and CGR at different crop growth stages which was statistically at par with 100% RDF + 2 FS of nano urea at 35 and 55 DAS, 100% RDF + FS of nano DAP at 35 DAS, 75% RDF + ST with nano DAP and 2 foliar spray of nano urea at 35 & 55 DAS, on pooled basis**.** The notable increase in dry matter accumulation can be attributed to the positive effects of nano fertilizers on plant height, number of tillers and leaf area index. The accelerated photosynthetic rate and more amount of food production in leaves might be another reason for significant increase in dry matter and CGR in the treatments of nano applied at optimum fertility levels. A higher leaf area might have facilitated better

utilization of solar radiation and available nutrients, which has increased dry matter accumulation. This increase in dry matter accumulation may be attributed cumulative growth, resulting in more biomass and nutrient uptake. The enhanced crop growth rate can be linked to the higher dry matter accumulation observed at various intervals in this trial. Singh *et al.* (2022) while working on wheat reported that the improved growth parameters observed with the application of nano fertilizers in combination with RDF, can be attributed to the gradual and sustained release of nutrient with the use of nano. The prolonged and enhanced availability of P from nano sources at critical physiological phases of crop growth might have played a pivotal role in augmenting various metabolic processes within the plants. Nano urea nitrogen and phosphorus nutrition at optimum RDF levels might have increased root length and root area resulting better uptake of other nutrients and this efficient absorption and utilization of other minerals might have supported growth of crop plant. Researchers have reported that phosphorus promotes enlargement of the root system of plants, especially the lateral and fibrous roots (Chopra *et al.,* 2017). These results corroborate the findings of Aziz *et al*. (2016); Midde *et al.* (2022); Singh *et al.* (2022).

Effect on grain yield. Data revealed that 100% RDF + ST with nano DAP and 2 FS of nano urea at 35 & 55 DAS produced maximum grain yield of 4399 kg/ha which was statistically at par with treatments applied with 100% RDF + 2 FS of nano urea at 35 and 55 DAS (4203 kg/ha), 100% RDF + FS of nano DAP at 35 DAS (4154 kg/ha) and 75% RDF + ST with nano DAP and 2 FS of nano urea at 35 & 55 DAS (3965 kg/ha) but remained significantly superior over treatments applied with 50% RDF in combination with nano fertilizers. Application of ST with nano DAP + 2 FS of nano urea at 35 and 55 DAS recorded grain yield of 2294 kg/ha and when this treatment was super imposed with 50, 75 and 100% RDF, the grain yield was further improved by 54.4, 72.8 and 91.7%, respectively. The treatment of 50% RDF+ ST with nano DAP and 2 FS of nano urea at 35 & 55 DAS significantly improved the grain yield by 881 and 1940 52 kg/ha over FS of nano DAP at 35 DAS + 2 FS of nano urea at 35 and 55 DAS and control, respectively on pooled basis. Jones *et al*., (2020) postulated that the combined utilization of seed dressing and foliar applications represented a promising and effective alternative strategy for phosphorus fertilization in the context of spring wheat cultivation. Notably, the application of P in the form of seed dressing has been observed pronounced impact on lateral root production. Valluru *et al*. (2010) also reported the significance of seed dressing as a valuable tool for enhancing phosphorus fertilizer use efficiency. These findings are in close confirmity with the results reported by Al-Juthery *et al.* (2018); Kumar *et al.,* (2020); Meena *et al.* (2021); Attri *et al.* (2022).

Effect on quality parameters

Effect on crude protein content (%). Application of 100% RDF + ST with nano DAP and 2 foliar spray of nano urea at 35 & 55 DAS increased protein content in wheat seed higher over ST with nano DAP + 2 foliar spray of nano urea at 35 and 55 DAS and control by 13.7 and 17.3%, respectively. Application of seed treatment with nano DAP + 2 FS of nano urea at 35 and 55 DAS produced protein content of 9.19%, when this treatment was super imposed with 50, 75 and 100% RDF, protein content was significantly improved by 9.7, 12.1 and 13.7%, respectively on pooled basis. The logical explanation for this phenomenon is that nano fertilizers are known to enhance the surface area of crop plants, thus facilitating increased nutrient uptake. This, in turn, contributes to the elevation of critical plant quality parameters, including protein and sugar content by quickening the rate of response or synthesis processes within the plant. Additionally, the controlled and steady release properties of nano-fertilizers played a pivotal role in maintaining equilibrium between the higher nitrogen content and uptake by the plant. This equilibrium, in turn, resulted in an improvement in protein content within the plants. These findings are aligned with prior research conducted by Al-juthery *et al.* (2018); Burhan & AL-Hassan (2019); Morsy *et al.* (2021); Ram *et al*. (2023); Dev *et al.* (2023). These studies collectively support that nano-fertilizers have a consistent positive effect on protein content in plants, underscoring their potential to enhance crop quality parameters.

Table 1: Effect of nano fertilizers and RDF levels on plant population of wheat crop (two year pooled).

Treatments		Plant population/m^2	
		30 DAS	At harvest
T_1	100% RDF + 2 FS nano urea 35 & 55 DAS	96.68	93.70
T_2	100% RDF + FS nano DAP 35 DAS	96.18	92.67
T_3	100% RDF + ST nano DAP & 2 FS nano urea 35 & 55 DAS	97.20	94.34
T_4	75% RDF + 2 FS nano urea 35 & 55 DAS	95.07	91.38
T_5	75% RDF + FS of nano DAP at 35 DAS	94.10	91.42
T_6	75% RDF + ST nano DAP & 2 FS nano urea35 & 55 DAS	95.96	92.35
T_7	50% RDF + 2 FS nano urea 35 & 55 DAS	93.32	90.02
T_8	50% RDF + FS nano DAP 35 DAS	92.20	88.70
T_9	50% RDF + ST nano DAP & 2 FS nano urea35 & 55 DAS	93.75	91.00
T_{10}	FS nano DAP 35 DAS + 2 FS nano urea 35 & 55 DAS	91.52	88.09
T_{11}	ST nano DAP + FS nano DAP 35 DAS & 2 FS nano urea	92.25	89.17
T_{12}	ST nano DAP + 2 FS nano urea 35 & 55 DAS	90.90	88.04
T_{13}	100% RDF conventional fertilizers	95.34	92.05
T_{14}	Control	89.95	87.15
SEm±		2.90	3.14
CD (*P=0.05*)		NS	NS

Table 2: Effect of nano fertilizers and RDF levels on dry matter accumulation, CGR and grain yield of wheat crop (two year pooled).

Treatments		Dry matter accumulation (g/m^2)			CGR (g/m^2/day)		Grain yield (kg/ha)	Crude protein content (%)
		40 DAS	80 DAS	At harvest	40-80 DAS	80 DAS- at harvest		
T_1	100% RDF + 2 FS nano urea 35 & 55 DAS	167.83	808.50	980.50	16.13	3.70	4203	10.41
T_2	100% RDF + FS nano DAP 35 DAS	166.33	797.67	964.17	15.97	3.58	4154	10.36
T_3	100% RDF + ST nano DAP & 2 FS nano urea 35 & 55 DAS	168.83	825.00	1004.67	16.40	3.86	4399	10.45
T_4	75% RDF + 2 FS nano urea 35 & 55 DAS	160.52	737.17	893.50	14.39	3.36	3896	10.17
T_5	75% RDF + FS of nano DAP at 35 DAS	160.02	720.33	872.17	14.00	3.26	3736	10.12
T_6	75% RDF + ST nano DAP & 2 FS nano urea 35 & 55 DAS	163.50	775.67	938.50	15.30	3.50	3965	10.30
T_7	50% RDF + 2 FS nano urea 35 & 55 DAS	158.53	688.83	823.33	13.26	2.89	3485	9.92
T_8	50% RDF + FS nano DAP 35 DAS	158.00	670.50	803.00	13.06	2.85	3325	9.89
T_9	50% RDF + ST nano DAP & 2 FS nano urea 35 & 55 DAS	159.67	711.33	852.83	13.79	3.04	3543	10.08
T_{10}	FS nano DAP 35 DAS + 2 FS nano urea 35 & 55 DAS	139.83	550.00	662.17	10.25	2.41	2662	9.29
T_{11}	ST nano DAP + FS nano DAP 35 DAS & 2 FS nano urea	140.33	583.17	706.17	11.06	2.65	2872	9.49
T_{12}	ST nano DAP + 2 FS nano urea 35 & 55 DAS	140.42	501.17	605.33	9.03	2.24	2294	9.19
T_{13}	100% RDF conventional fertilizers	161.23	738.00	899.00	14.41	3.46	3937	10.19
T_{14}	Control	121.67	402.50	462.00	7.02	1.28	1603	8.91
SEm±		5.86	31.71	31.01	0.77	0.19	154.7	0.08
CD (*P=0.05*)		17.03	92.18	90.13	2.23	0.55	449.7	0.24

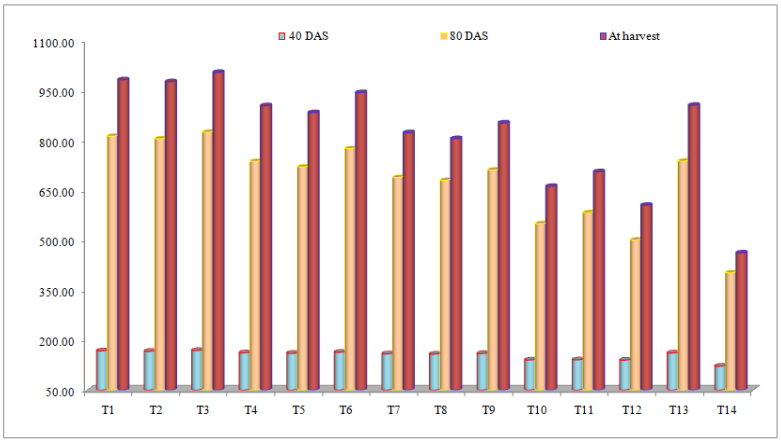

Fig. 1. Effect of nano fertilizers and RDF levels on dry matter accumulation of wheat crop.

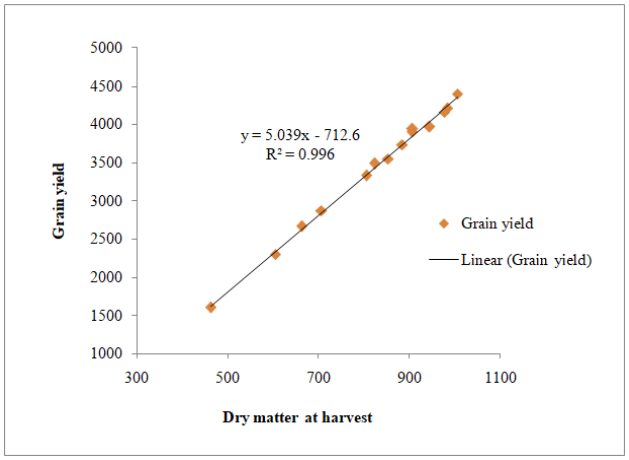

Fig. 2. Linear regression between dry matter at harvest and grain yield.

Fig. 3. Foliar spray of nano urea fertilizer during experimentation at 35 DAS.

Fig. 4. General view of experimental trial.

CONCLUSIONS

On the basis of two years experimentation, it can be concluded that wheat crop can be fertilized with 100% RDF (90 kg N/ha, 40 kg P_2O_5 and 20 kg K_2O/ha) along with seed treatment with nano DAP @ 5 ml/kg of seed and two foliar spray of nano urea @ 4 ml/L of water at 35 & 55 DAS for higher production from crop. This treatment combination recorded highest amount of dry matter, crop growth rate, grain yield and crude protein content.

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Conflict of Interest. None.

REFERENCES

Al–Juthery, H. W., Habeeb, K. H., Altaee, F. J. K., Al–Taey, D. K. and Al–Tawaha, A. R. M. (2018). Effect of foliar application of different sources of nano fertilizers on growth and yield of wheat. *Bioscience Research*, *4*, 3976–3985.

Attri, M., Sharma, N. and Sharma, B. C. (2022). Effect of foliar application of nano urea on productivity and profitability of fine rice under irrigated subtropics of Jammu region. *Indian Journal of Ecology*, *49*(5), 1935-1938.

Aziz, H. M. M., Hasaneen, M. N. A. and Omer, A. M. (2016). Nano chitosan-NPK fertilizer enhances the growth and productivity of wheat plants grown in sandy soil. *Spanish Journal of Agricultural Research*, *14*(1), 1-11.

Benzon, H., Rubenecia, M., Ultra, V. and Lee, S. (2015). Nano fertilizer affects the growth, development and chemical properties of rice. *International Journal of Agronomy and Agricultural Research*, *7*(1), 105-117.

Burhan, M. G. and Hassan, S. A. (2019). Impact of nano urea P K fertilizers to correlation between productivity, quality and flag leaf of some bread wheat varieties. *Iraqi Journal of Agricultural Sciences*, *1029*(50), 1-7.

Chaitra, P., Kalia, A., Ahuja, R., Sidhu, S. P. K. and Sikka, R. (2021). Importance of nano fertilizers in sustainable agriculture. *Environmental Sciences and Ecology: Current Research*, *1*(5), 1029.

Chopra, K., Payum, T., Srivastava S. and Kumar, V. (2017). Effects of integrated nutrient management on agronomical attributes of tomato (*Lycopersicon esculentum* L.) under field conditions. *Archives of Agriculture and Environmental Science*, *2*(2), 86-91.

Choudhary, D. K., Karmakar, S. and Kumar, B. (2018). Intercession of legume based inter-cropping and nano Phosphorus as managerial input for upland of Jharkhand. *Chemical Science Review and Letters*, *7*(28), 941-946.

Dev, P., Singh, U., Singh, L. N., Shivay, Y. S., Kumar, M. and Raiger, P. R. (2023). Zinc biofortification of mungbean (*Vigna radiata* L.) as influenced by varieties and zinc fertilization. *Journal of Environmental and Agricultural Sciences,* 25(1&2), 1-17.

Elemike, E. E., Uzoh, I. M., Onwudiwe, D. C. and Babalola, O. O. (2019). The role of nano-technology in the fortification of plant nutrients and improvement of crop production. *Applied Science*, *9*(499), 1-32.

Fatima, F., Hashim, A. and Anees, S. (2021). Efficacy of nano particles as nano fertilizer production: A review. *Environ. Sci. Pollut. Res., 28*, 1292–1303.

Ghorbanpour, M., Manika, K. and Varma, A. (2017). Nano science and Plant-Soil Systems. *Springer International Publishing*, *37*, 112-116.

Govt. of Rajasthan, 2023-24. Second Advance Estimates of Area, Production and yield of crops in respect of Rajasthan State for the year 2023-24.

Haque, M. M., Hamid, A. and Bhuiyan, N. I. (2001). Nutrient uptake and productivity as affected by nitrogen and potassium application levels N maize/sweet potato intercropping system. *Korean Journal of Crop Science, 46*, 1-5.

Heyne, E. G. (1987). *Wheat and wheat improvement.* 2nd ed. Madison, Wisconsin, U.S.A.

IIWBR (2023-24). Indian Institute of Wheat and Barley Research, Karnal. (Website: https://iiwbr.icar.gov.in)

Jones, D. L., Talboys, P. J., Healey, J. R., Withers, P. J., Roose, T., Edwards, A. C. and Pavinato, P. S. (2020). Combining seed dressing and foliar applications of phosphorus fertilizer can give similar crop growth and yield benefits to soil applications together with greater recovery rates. *Frontiers*, 1-39.

Jyothi, T. V. and Hebsur, N. S. (2017). Effect of nano fertilizers on growth and yield of selected cereals - A review. *Agric. Rev.*, *38*, 112-120.

Kumar, Y., Tiwari, K. N., Nayak, R. K., Rai, A., Singh, S. P., Singh, A. N., Kumar, Y., Tomar, H., Singh, T. and Raliya, R. (2020). Nano fertilizers for increasing nutrient use efficiency, yield and economic returns in important winter season crops of Uttar Pradesh. *Indian journal of Fertilizers, 16*(8), 772-786.

Lal, R. (2008). Promise and limitations of soils to minimize climate change. *Journal of Soil Water Conservation*, *63*, 113A-118A.

Marzouk, N. M., Abd-Alrahman, H. A., Tanahy, E. L. and Mohmouud, S. H. (2019). Impact of foliar spraying of nano micronutrient fertilizers on the growth, yield, physical quality, and nutritional value of two snap bean cultivars in sandy soils. *Bull. Natl. Res. Cent., 43*, 84.

Meena, R. H, Jat, G. and Jain, D. (2021). Impact of foliar application of different nano fertilizers on soil microbial properties and yield of wheat. *Journal of Environmental Biology*, *42*, 302-308.

Meena, S., Gautam, C., Patidar, P., Meena, M., Prakasha, G. and Vishwajith, G. (2017). Nano fertilizers is a new way to increase nutrients use efficiency in crop production. *Int. J. Agric. Sci., 9*, 3831–3833.

Midde, S. K., Perumal, M. S., Murugan, G., Sudhagar, R., Mattepally, V. S. and Bada, M. R. (2022). Evaluation of nano urea on growth and yield attributes of rice (*Oryza Sativa* L.). *Chemical Science Review and Letters*, *11*(42), 211-214.

Morsy, A. S. M., Awadalla, A. and Sherif, M. M. (2018). Effect of irrigation, foliar spray with nano fertilizer (lithovit) and N levels on productivity and quality of durum wheat under Toshka conditions. *Assiut Journal Agriculture Science*, *49*(3), 1-26.

Naderi, M. and Shahraki, A. (2013). Nano fertilizers and their roles in sustainable agriculture. *International Journal Agricultural Crop Science*, *5*, 2229-2232.

Nasiri, Y., Zehtab-Salmasi, S., Nasrullahzadeh, S., Najafi N. and Ghassemi-Golezani, K. (2010). Effects of foliar application of micronutrients (Fe and Zn) on flower yield and essential oil of chamomile (*Matricaria chamomilla* L.). *J. Med. Plant. Res., 4*, 1733-1737.

Ram M., Kumhar B. L., Kumar M., Meena R. C. and Meena D. S. (2023). Comparative assessment of urea and nano urea on growth and yield of pearl millet. *Ecology, Environment & Conservation*, *29*, S203-S206.

Shang, Y., Hasan, M. K., Ahammed, G. J., Li, M., Yin, H. and Zhou, J. (2019). Applications of nanotechnology in plant growth and crop protection: A review. *Molecules*, *24*(14), 2558.

Singh, B. V., Singh, S., Verma, S., Yadav, S. K., Mishra, J., Mohapatra, S. and Gupta, S. P. (2022). Effect of nano urea nutrient on growth attributes, yield, Zn content and uptake in wheat (*Triticum aestivum* L.). *International Journal of Environment and Climate Change*, *12*(11), 2028-2036.

Valluru, R., Vadez, V., Hash, C. T. and Karanam, P. (2010). A minute P application contributes to a better establishment of pearl millet (*Pennisetum glaucum* (L.) R. Br.) seedling in P deficient soils. *Soil Use and Management*, *26*, 36- 43.

Velmurugan, A., Subramanil, T., Bommayasamy, N., Ramakrishna, M. K. and Swarnam, T. P. (2021). Effect of foliar application of nano urea (liquid) on Rice (*Oryza sativa* L.). *Journal of the Andaman Science Association, 26*(2), 76–81.

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