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Impact of nanofertilizers on growth and yield parameters of rice crop; A Review

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Abstract
In the present review paper, we assessed the utilization of nanotechnology-based items and its application in rice crop. Several researchers acknowledgment that traditional cultivating practices does not have the option to build any further productivity nor stop environmental problems due to this technology has cleared the pathway to utilization of nanotechnology in farming. Nanofertilizer alters the accessibility of nutrients by controlling the amount and quality which results in improvement of the nutritive quality of plants. Published written works with respect to the potential of nanofertilizer in upgrading these properties are uncommon. Therefore, this review is intended to clarify the conceivable impact of the utilization of nanofertilizer in rice cultivar. The review likewise assessed the impact of nanofertilizer on the development and improvement of rice. With the rise in populace and lack of healthy nutrients and diminishing farming terrains for crop cultivation, a new invention technology like nanotechnology is an absolute necessity.

Keywords: Development, growth, productivity, nanofertilizer, nanotechnology, nutrients

Introduction
For over half of the population, rice (*Oryza sativa* L.) is considered as one the most important staple food crop in the planet (Masum *et al*., 2013) [12]. It is a crop that contains a wide range of nutrients such as starches, proteins, dietary fibre, nutrients, and minerals. Rice is considered as the second-best manufactured crops produced around the world. For cultivation of rice, the world is recorded to commit 162.3 mha in 2012 and the total produces was about 738.1 MT. The normal yield of the world in the farm for rice cultivation was found to be 4.5 t/ha in 2012 (FAOUN, 2014) [3]. In improving the yield and quality of food, fertilizers play a vital part especially for those cultivars which are high-yielding and fertilizer responsive. Rice needs huge amounts of inorganic data sources for better growth and yield. Rice yield is influenced by soil conditions as well as the availability of nutrients such as Nitrogen, Phosphorous, potassium, Sulfur, and Zinc (Masum *et al*., 2013) [12]. Rice crops necessitate a lot of mineral and supplements as well as nitrogen for their growth and development and production of grain (Ma, 2004) [10].

The primary target of nanofertilizers in field of agronomy is to increase the plant yield efficiency and diminish losses of nutrients (Ingale *et al*.,2013) [6]. Apparently, plant breeding methodologies can't be gotten rid of the picture and its ability to impact plant composition, growth and development of crops (Yafang *et al*., 2011) [21]. It would be exceptionally useful if we use nanofertilizer in rice crops to limit the potential negative impacts realized by the broad utilization of synthetic fertilizers without bargaining production and nourishing advantages (Benzon *et al*., 2015) [2]. In spite of the fact that micronutrients are required in little amounts, they assume imperative jobs in growth and developed of plants. The incredible significance of micronutrients is a direct result of their stimulatory and reactant impacts on metabolic procedures and their constructive outcomes on yield and quality (Hansch and Mendel, 2009; Marschner, 2012) [5, 9]. It was discovered that these nanofertilizers were effective for germination of wheat seed as well increase the development of seedlings and they can give a controlled, responsive and on time conveyance of nutrients to crops. Likewise a few investigations show that exogenous use of some nanofertilizers can fundamentally improve plant development (Mandeh *et al*., 2012; Song *et al.*, 2013) [11, 19].

Methodology
The current review is initially a survey paper. All the information that are utilized in this paper is optional information gathered from different review and research papers to share the

information concerning the application of nanofertilizers and to share the different expectances of applications of nanofertilizers in rice crop for future smart farming.

Nanofertilizers

Nanotechnology is the new innovation during late years and is working in all fields of agriculture. Nanofertilizers stand apart as one of the most helpful tool, because of their high productivity, functionalities, advantageous and simple applications. .Nanotechnology is the promising field with its extensive applications in biotechnology, pharmaceutical science, nano-medication and other research territories (Janmohammadi *et al*., 2016) [7]. Nanofertilizer improve growth parameters of plants such as height of plants, leaf area, number of leaves per plant ,increase in dry matter and chlorophyll, photosynthesis rate which outcome more translocation of photosynthets and production to various parts of the plant contrast to chemical fertilizers.

Nanonotechnology (nanofertilizer) have an extraordinary potential improve food quality, worldwide crop productivity, plant assurance, identification of crops and animal health, monitoring of plant growth, pesticide, herbicides, and fungicides (Goswami *et al*., 2019) [4]. As long as nanotechnology industry is developing in a very rapid manner, there is an essential desperation to perform further findings about guidelines for utilization of nanofertilizers, utilization rates, synergistic, antagonistic or neutral interactions and its outcomes on the cellular and molecular level (Janmohammadi *et al*., 2016) [7]. Over the most recent couple of years, a few specialists attempted to look at the capability of nanotechnology to improve nutrient use proficiency. These endeavors prompted structure and improvement of nanofertilizer. Nanotechnology based nutrients could be more dissolvable or more receptive than their mass counterparts (Nair *et al*., 2010; Naderi and Danesh-Shahraki, 2013; Rameshaiah and Jpallavi, 2015) [15, 14, 16]. Utilization of nanofertilizer may improve solvency and scattering of insoluble nutrients in soil, diminish fixation of fertilizer and immobilization and increment the bio-accessibility (Naderi and Danesh-Shahraki, 2013) [14]. Nano planned nutrients can be handily consumed by plants and they may show delayed compelling span of nutrient flexibly in soil or on plant (Rameshaiah and Jpallavi, 2015; Zhang *et al*., 2006) [16, 22]. Impact of nanofertilizers as far as seed germination, development advancement and improvement of metabolic rate has been assessed by several researchers. Moreover, they also show negative impacts for example, suppression of plant growth, inhibition of chlorophyll synthesis, photosynthetic efficiency and so on. Impacts of nanofertilizers can be either positive or negative. It mainly relies on the type of crop species and sort of nanoparticles utilized and its fixation (Goswami *et al*., 2019) [4]. Nanotechnology has enormous potential and benefits in the field of agriculture and biotechnology. The chance of negative effect of nanofertilizers on crops alongside positive implications, it is important to deliberately inspect the concentration of nanoparticles and its communication with crops. The amount of nanoparticles additionally assumes a significant part in the interface, buildup and growth inside the crops. Such information is significant before the utilization of nanoparticles in future research work in plant sciences. In this manner, the assessment on nanofertilizers particularly identified with association with crops and their effects on physiological and biochemical parameters should be studied (Rathnayaka *et al*., 2018) [17] Nanofertilizer is considered as appropriate options in comparison to traditional fertilizer for continuous and controlled transport of nutrients in the soil. Elective nanofertilizers, for example, nano chelate with concoction of manures decrease contaminations which is conservative (Mousavi-Fazl and Faeznia, 2008) [13]. Overseeing rice yield's nitrogen nourishment is troublesome while the culture of swamp rice crop prompts nitrogen misfortunes through volatilization of ammonia, nitrification, nitrification, runoff and leaching which diminishes the accessibility of nitrogen for rice plants (Johnson, 2006) [8].

Nanofertilizer in Rice

This review mostly emphasizes the harmful effects of nanoparticles on. Several studies have suggested that nanoparticles work together at a safe dose can encourage the growth and development of crops Benzon *et al*., (2015) [2] conducted the experiment on rice crops, the experiment was performed in a nursery setting at the Agricultural Experiment Station and Research Facility in South Korea. The trial was set up with 5

replications following completely Randomized Design. 15 kg of soil was filled up in pots utilizing 31 × 27 cm size pots. Nutrients were assigned in split in the appropriate pots rice seedlings that had recently grown (10-15) days were transplanted into pots and allowed to grow until development. The nanofertilizers (Nitrogen greater than 1.2 percent; Phosphorous greater than 0.001 percent; potassium greater than 0.0001 percent) were utilized as the treatment. Their review showed the use of standard fertilisers and its mixture with nanofertilizers resulted in an increase in the total number of spikelet’s, panicles, and reproductive tillers (fig. 2). The parameters increased even further when the Full Recommended Rate of conventional fertilisers (FRR-CF) was combined with the Full Recommended Rate of nanofertilizer (FRR-NF). The rate increment over the Full Recommended Rate of conventional fertilizer (FRR-CF) was 9.10 percent and 15.42 percent individually. It appears that nanofertilizers were only used as a replacement during rice's reproductive period. The use of nanofertilizers, on the other hand, clearly improved the previously described parameters. Nanofertilizer may have synergistic impact on the ordinary fertilizer for better absorption of nutrients by crops and for ideal growth and development of crops. The height of the plant was improved by the utilization of full suggested dose of nanofertilizers at 15 and 30 days after transplanting. In addition, FRR-NF treatment altogether extended plant height as the plant develops contrasted with the control. These propose that nanofertilizers can either give nutrients to the plant or help in absorption and transportation of accessible nutrients bringing about growth of the rice crop. Related examination discovered comparative discoveries in soybean. They tested the impact of another form of hydroxyapatite phosphorus nanoparticles (NPs) with a size of 16 nm on soybean in latent developing medium in a nursery. The outcome revealed that the rate of growth was extended by 33% utilizing phosphorus NPs. However, it was clear that application of nanofertilizers improved almost all the parameters in rice (Benzon *et al*., 2015) [2].

A research was done by Upadhyaya *et al.*, (2015) at Regional Agricultural Research Station, Assam in rice seeds (variety KMJ -6-1-2) with different treatments of zinc nanofertilizers (Zn NP) i.e. 0, 25, 50, 75, 100 and 150 mg L^{-1}. Morphological changes i.e., length of root and shoot was found to increase in reaction of zinc nanofertilizers treatment when exposed to 0, 25, 50, 75, 100 and 150 mg L^{-1} of zinc nanofertilizers. With the increasing dose of zinc nanofertilizers treatments, the length of the root and shoot gradually improved. Figure 3 shows how it works. Zinc nanofertilizers was found to continuous increase in dry matter, total fresh and dry mass of root and shoot of rice crop. Highest rate being shown with increasing level of zinc nanofertilizers, which might be recognized to improved responses of antioxidant in rice crop treated with zinc nanofertilizers. During the month of April in 2017, an investigation was conducted at the Rice Research Station in Sammanthurai, Sri Lanka, into the use of nitrogen, phosphorus, and potassium fertilisers, as well as nitrogen nanofertilizers, to measure the growth and yield traits of rice (Bg- 250). The study was carried out using a Randomized Complete Block Design (RCBD) with five treatments and four replications. In plastic pots, it was led. The seeds were wrapped in net cotton fabric and transferred to a seedling plate three days after germination. Seedlings that were standardized and solid at 12 days old were transplanted into plastic pots. A total of ten seedlings were cultivated in each plastic pot. T1 – Control (no manure), T2 – 100% advised compost (no manure), T3 – 100% suggested compost (no manure), T4 – 100% suggested compost (no manure), T5 – 100% suggested compost (no manure), T6 – 100% (nano nitrogen). The results showed that using 100 percent Nano-Nitrogen fertilizer gave the rice cultivar the best growth in terms of plant height (57.9cm), number of tillers per plant (6), plant dry matter (9.9g), and yield (2.8tonnes ha-1). Control plant has given the least performance as compared to all the treatments. Thus, it could be concluded that Nano-Nitrogen fertilizer can be use as an alternative of urea in the growth of rice cultivar with decreased nitrogen pressure on the ground (Rathnayaka *et al*., 2018) [17]. Similarly, some other researchers also revealed that nanofertilizers remarkably impact the straw and grain yield of rice (Gao *et al*., 2013; Janmohammadi *et al*., 2016) [7]. And several other researcher also proved that the importance of nanofertilizers. For example, that found increased of higher grain yield in rice by means of applying nanofertilizers. This is in concurrence with the results of detailing that nanofertilizers application expanded yield of crop by 20percent – 40percent.

Fig 1: Effect of Silver nanoparticles on rice (Source: Thuesombat *et al*., 2014) [20].

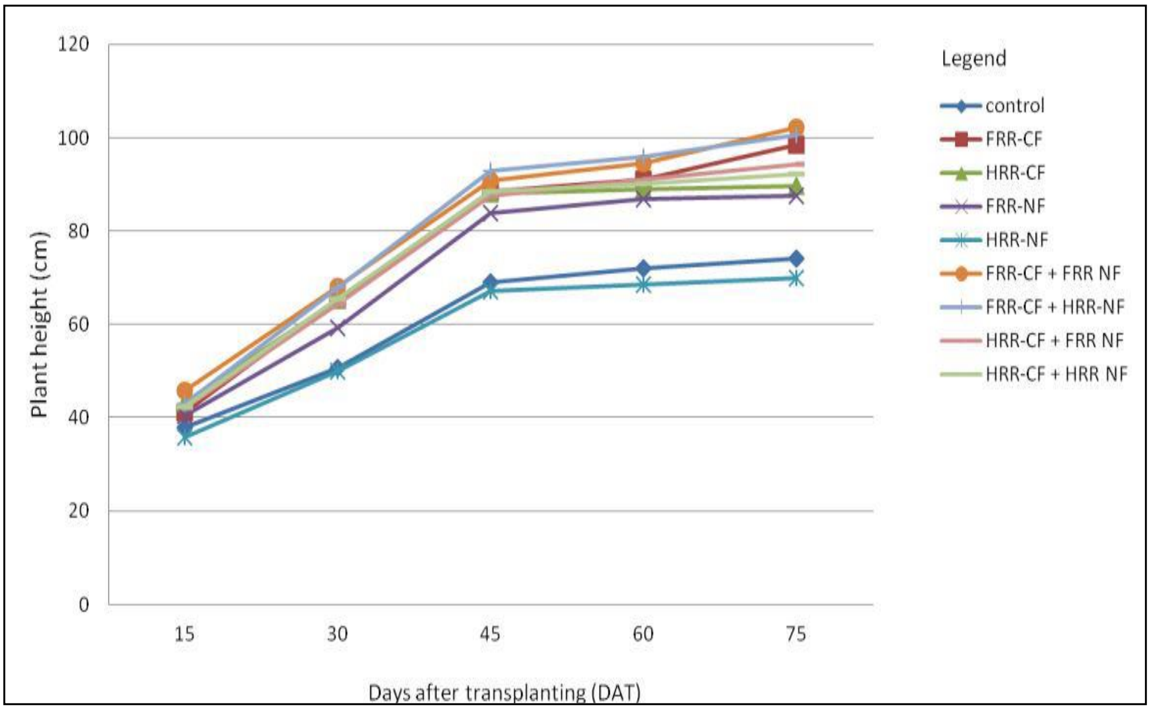

Fig 2: Rice plant height as a feature of synthetic and nanofertilizer application in a greenhouse (Source: Benzon *et al.*, 2015) [2].

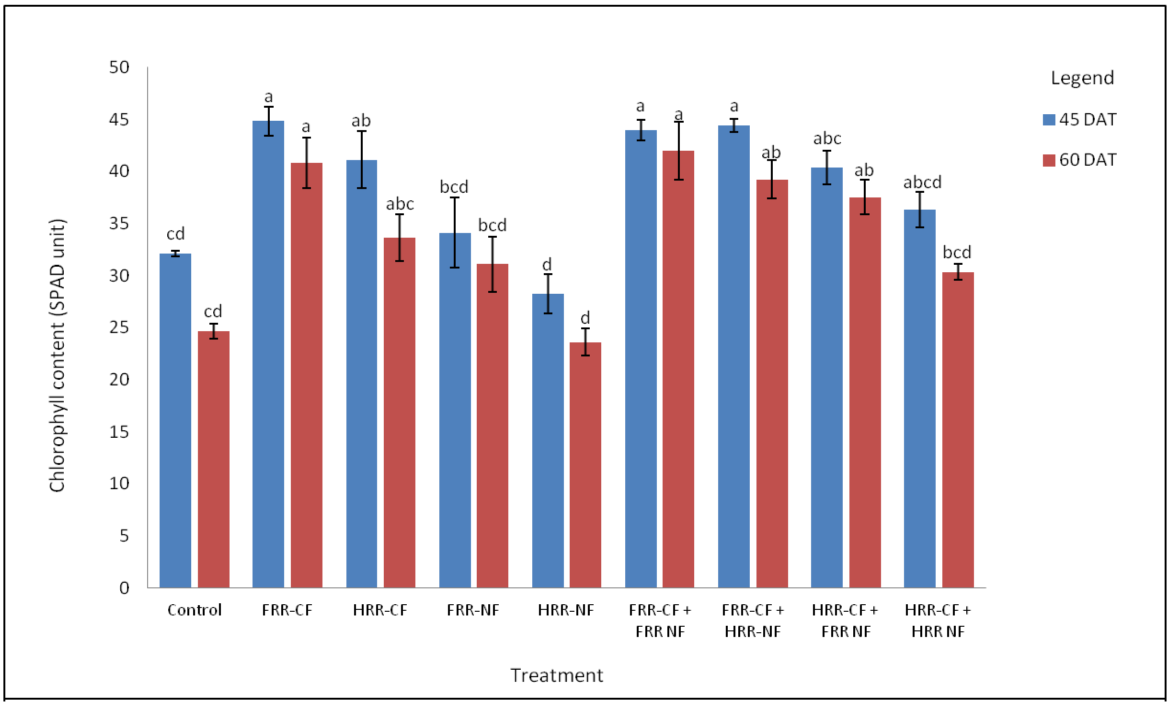

Fig 3: Under greenhouse conditions, the effect of chemical and nanofertilizer application on rice chlorophyll content (Source: Benzon *et al.*, 2015) [2].

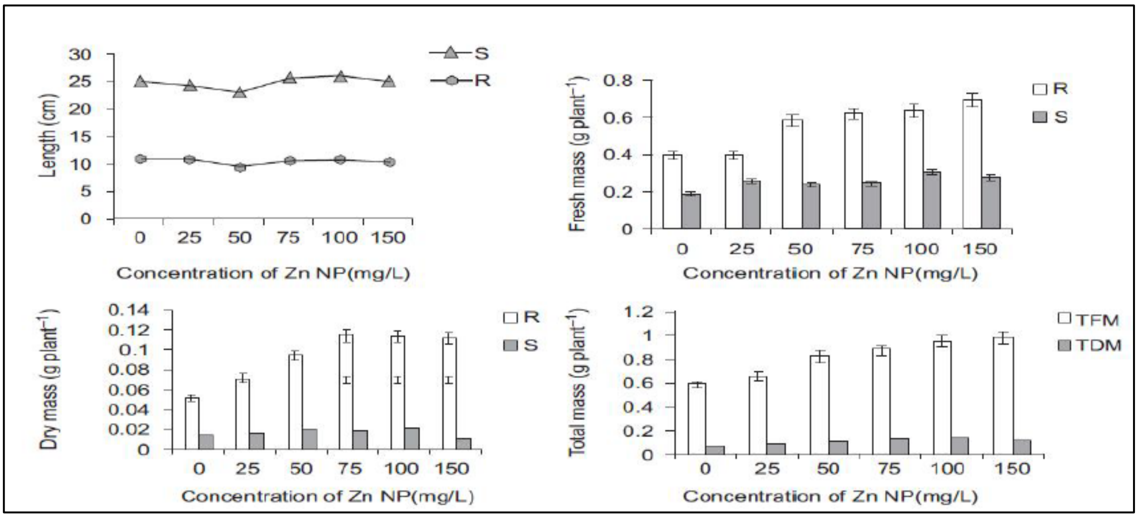

Fig 4: Changes in rice plant weight, fresh and dry mass of root and shoot, and total fresh and dry mass after treatment with various concentrations of Zn NP (Source: Upadhyaya *et al.*, 2015).

Conclusion

Utilization of nanotechnology in the field of agriculture is still in its growing stage .An outrageous nutrient insufficiency in agricultural soil has realized exceptional decreases in viability of yield and huge economic crisis. Although improvement in crop productivity could accomplish by utilization of compound fertilizers but their utilization in abundance is certainly not a superior choice for expanded time (Sadique *et al.*, 2017) [18]. Rice growth, development, and antioxidant activity were all boosted by nanofertilizer application, which has the potential to improve crop production and plant nutrition. Other studies involving the application of nanotechnology in agriculture will benefit from the findings of this study.

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