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Effect of Different Levels of Chemical and Nano Nitrogenous Fertilizers on Yield and Yield attributes of Sorghum Crop (*Sorghum bicolor* L.) cv. Gundri.

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A B S T R A C T

A pot culture experiment was conducted during summer 2017 at Department of Agril. Chemistry & Soil Science, College of Agriculture, JAU, Junagadh to study effect of chemical and nano nitrogenous fertilizer on growth, yield and yield attributes by sorghum (*Sorghum bicolor* L.) crop. The investigation was carried out in CRD design three replication with seven different treatments. The treatments included T_1 = Absolute control (No fertilizer), T_2 = Nano polymer, T_3 = RDN dose of sorghum crop through chemical fertilizer, T_4 = $NN_{2.5}$-2.5 times reduction of RDN through nano fertilizer, T_5 = NN_5-5 times reduction of RDN through nano fertilizer, T_6= NN_{10}-10 times reduction of RDN through nano fertilizer, T_7 = RDN through nano fertilizer. The results revealed that the application of 2.5 time reduction of RDN through nano fertilizer significantly increased growth parameters, yields and quality characters of sorghum crop. This also brought significant increase in content and uptake of nutrients.

Introduction

Sorghum (*Sorghum bicolor* L.) is a warm-season (C_4 photosynthetic pathway), short-day annual grass. It grows best under relatively high temperatures and under sunny conditions. Sorghum as a crop originated as far back as 3,000 years ago (Mir *et al.*, 2015). Sorghum (*Sorghum bicolor* L.) is a drought tolerant and nutritious cereal crop usually cultivated for food, feed and fodder by subsistence farmers in India. Nitrogen (N) occupies a conspicuous place in plant metabolic system. Nitrogen being a major food for plants is an essential constituent of protein and chlorophyll present in many major portions of the plant body. Nitrogen plays a most important role in various physiological processes (Leghari *et al.*, 2016). Fertilizers have an axial role in enhancing the food production in developing countries especially after the introduction of high yielding and fertilizer responsive crop varieties. The applied N through fertilizers undergo transformation processes such as biological nitrogen fixation, humus mineralization, immobilization, nitrification and at acidic and alkaline pH, respectively, denitrification and volatilization (Patra *et al.*, 2006). These transformation processes make N management very complex and quite difficult to improve the N use efficiency. In order to improve the N use efficiency by crops, several strategies have been suggested in the past few decades. Among these, nanotechnology has the potential to revolutionize the agricultural system. Nano fertilizer technology is designed to deliver nutrients in a regulated pattern in correspondence with the crop demand thereby nutrient use efficiency can be improved without associated ill-effects (Naderi and Shahraki, 2013). Nano fertilizers are the important tools in agriculture to improve crop growth, yield and quality parameters, reduce wastage of fertilizers and cost of cultivation. Nanotechnology can reduce the rate of fertilizer nutrients loss through leaching and increase their availability to plants which ultimately leads to reduced water and soil pollution. Present days nano fertilizers are emerging as an alternative to conventional fertilizers. (Veronica *et al.*, 2014). In order to solve higher fertilizer requirement during crop growth, environmental issues and also taking economic aspects, the use of nitrogen nano fertilizer is essential. In this research, effect of nitrogenous nano fertilizer on growth, yield and nutrient uptake by sorghum (*Sorghum bicolor* L.) crop*"* was studied.

Materials and Methods

To determine the effect of nitrogen nano fertilizer under incubation trial and its effect on growth, yield and nutrient uptake by sorghum (*Sorghum bicolor* L.) crop, a pot study was conducted in summer season of 2017 with 7 treatments replicated in thrice under net house condition at Department of Biotechnology, JAU, Junagadh. The experimental soil was *Vertic Haplustepts*, medium black calcareous clayey in nature and slightly alkaline in reaction. Earthen pots having an upper diameter of 30 cm and lower diameter of 15 cm with 25 cm height were used in investigation. The pots were filled with 15 kg of soil. The required quantity of nitrogen was calculated as per treatment of different sources of nitrogen product on the basis of 15 kg bulk of soil and applied as basal dose. The pot culture experiment was conducted with seven levels of nitrogen and two different source of nitrogen (Urea and Nano N Fertilizer) in completely randomized block design. The required quantity of potassium and phosphorus was applied as basal dose through KCl and SSP were also mixed with the soil. The treated soil was filled in polythene lined earthenware pots.

Results and Discussion

Growth and Yield attributes

Plant height

The data conclusively demonstrated that all the growth parameters were significantly affected by the application of different levels of chemical and nano nitrogenous fertilizers. The plant height was significantly increased from 129.17 to 177.67 cm under different doses of nano and chemical fertilizer. The maximum plant height (177.67 cm) was recorded with the treatment T_4= (2.5 times reduction of RDN through nano fertilizer) which was statistically at par with T_7 (RDN through nano fertilizer). The lowest plant height (129.17 cm) was recorded under absolute control treatment followed by nano polymer (132.17 cm). Khospeyak *et al.*, (2016) reported that the plant height, number of lateral branches, number of umbels per plants, number of grains per plant, 1000-grain weight were significantly higher with nano fertilizer treatment over conventional fertilizer.

No. of leaves

The different levels of chemical and nano nitrogenous fertilizers also produced significant effect on number of leaves of sorghum crop. The maximum number of leaves (17.73) were observed with the application of 2.5 times reduction of RDN through nano fertilizer (T_4), which was statistically at par with T_7 (RDN through nano fertilizer). The lowest no. of leaves (10.83) was recorded in control treatment followed by nano polymer (12.07).

Length of spike

Among all the treatments, significantly more length of the spike was recorded with the application of T_4 (2.5 times reduction of RDN through nano fertilizer). Then it was significantly decreased with the five and ten time's reduction of RDN (T_5 and T_6) through nano fertilizer. The treatment T_7 (24.90cm) remained statistically at par with T_4 treatment. Janmohammadi *et al.,* (2017) reported that highest plant height, wide canopy, large number of branches and maximum number of leaves were observed.

Test weight

The data regarding the effect of chemical and nano nitrogenous fertilizers on test weight of sorghum grains are given in Table 1.1. The test weight was significantly increased from 17.10 to 28.33 g under different levels of chemical and nano nitrogenous fertilizer. The highest test weight (28.33 g) was observed with the application of T_4 (2.5 times reduction of RDN through nano fertilizer) followed by T_7 (RDN through nano fertilizer) and found statically at par with each other. While, the lowest test weight was recorded under control (17.10 g) and nano polymer (19.70 g) treatments in soil.In general the application of 2.5 times reduction of RDN through nano fertilizer produced significantly higher plant height, no. of leaves, length of spike and test weight of 1000 grains of sorghum crop than conventional treatment of RDN through chemical fertilizer treatment. These may be due to nano nitrogenous fertilizer act as slow release fertilizer hence as a result to reduce nitrogen losses, improve nutrient use efficiency, minimize pollution and also provide balance crop nutrition as per requirement during the crop growth period. Such types of the beneficial effect of nano fertilizer were observed by Hasaneen *et al.,* (2016), Kaviani *et al.,* (2016) and Rostami *et al.,* (2017).

Yield and yield attributes

The result of different levels of chemical and nano nitrogenous fertilizer on seed and straw yield of sorghum crop are given in table 1.2.The data indicated that seed yield significantly affected by the application of different levels of chemical and nano nitrogenous fertilizer. The seed yield was significantly increased from 31.53 to 51.23g pot^{-1} under different doses of nano and chemical fertilizer.

The application of 2.5 times reduction of RDN through nano fertilizer (T_4) treatment produced significantly the highest seed yield (51.23g pot^{-1}) but it was statistically at par with T_7 (RDN through nano fertilizer) treatment. The lowest seed yield was recorded under the control treatment (31.53g pot^{-1}) followed by nano polymer (35.50). It is striking to note that nano fertilizer increased the seed yield to the tune of 61.54 percent under T_4 over control treatment.

S. No.	Treatments	Nitrogen (g per 15 kg soil)	Source
1	T_1	0	No fertilizer
2	T_2	0 g urea in 2.90 liter nano polymer	Nano polymer
3	T_3	3.48	Urea
4	T_4	1.38 g urea in 1.15 liter nano polymer	Nano N fertilizer
5	T_5	0.68 g urea in 0.56 liter nano polymer	Nano N fertilizer
6	T_6	0.34 g urea in 0.28 liter nano polymer	Nano N fertilizer
7	T_7	3.48 g urea in 2.90 liter nano polymer	Nano N fertilizer

Note: SSP (2.51gm) and MOP (0.66gm) was applied as basal dose

Fig.1 Effect of different levels of chemical and nano nitrogenous fertilizers on grain and straw yield of sorghum crop

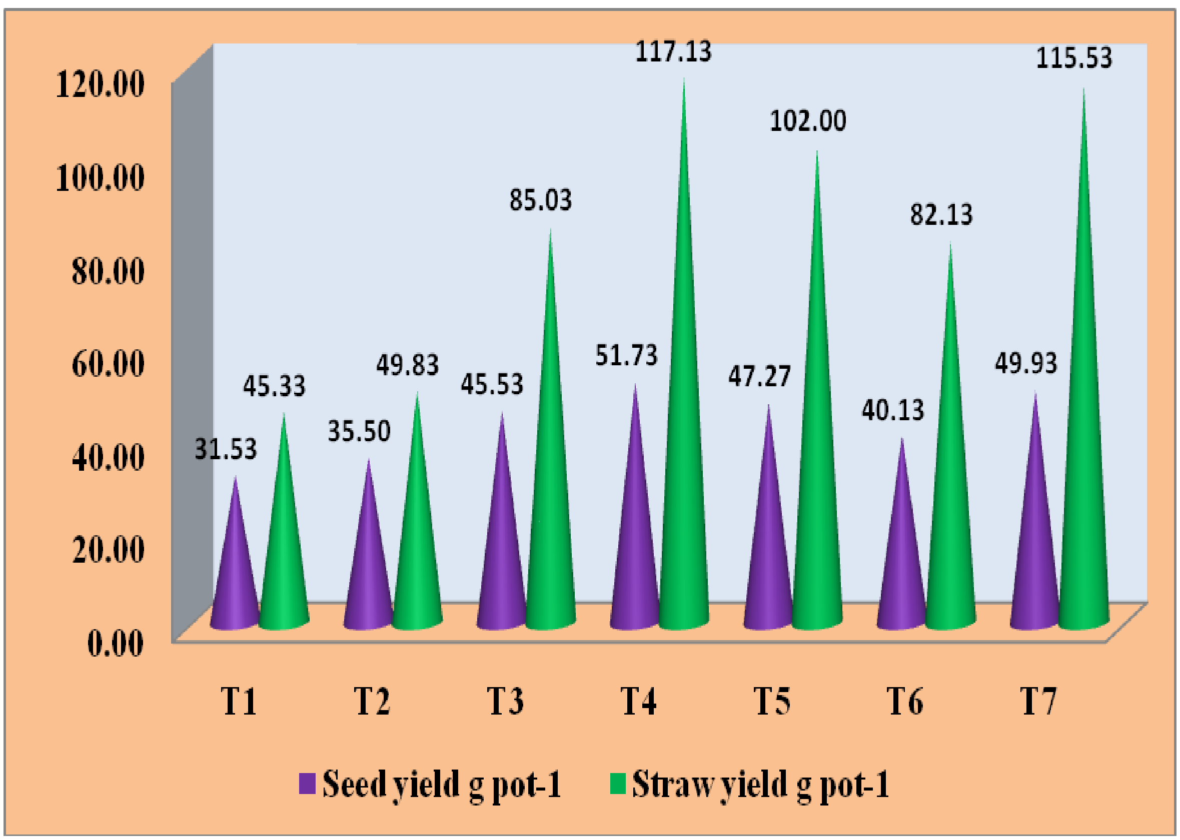

Table.1.1 Effect of different levels of chemical and nano nitrogenous fertilizers on growth and yield attributing characters of sorghum

Treatments	Plant height at harvest (cm)	No. of leaves plant^{-1} at harvest	Length of spike at harvest (cm)	Test weight 1000 grain (g)
T_1 - Absolute Control	129.17	10.83	14.63	17.10
T_2 - Nano polymer	132.17	12.07	16.20	19.70
T_3 –RDN through chemical fertilizer	156.83	14.97	22.13	24.47
T_4 - $NN_{2.5}$ -2.5 time reduction of RDN through nano fertilizer	177.67	17.73	25.53	28.33
T_5 - NN_5 -5 time reduction of RDN through nano fertilizer	146.43	13.97	20.30	22.60
T_6 - NN_{10} -10 time reduction of RDN through nano fertilizer	141.07	12.92	18.17	20.77
T_7 - RDN through nano fertilizer	169.40	16.50	24.90	27.17
S.Em.±	4.68	0.62	0.81	0.71
C.D. at 5%	14.20	1.89	2.45	2.15
C.V.%	5.39	7.63	6.89	5.36

Table.1.2 Effect of different levels of chemical and nano nitrogenous fertilizers on seed and straw yield of sorghum crop

Treatments	Seed yield (g pot^{-1})	Straw yield (g pot^{-1})
T_1 = Control	31.53	45.33
T_2 = Nano polymer	35.50	49.83
T_3= RDN dose through chemical fertilizer	47.27	102.0
T_4 = $NN_{2.5}$-2.5 times reduction of RDN through nano fertilizer	51.23	117.13
T_5 = NN_5-5 times reduction of RDN through nano fertilizer	45.50	98.93
T_6= NN_{10}-10 times reduction of RDN through nano fertilizer.	40.13	92.40
T_7=RDN through nano fertilizer	49.93	115.53
S.Em±	1.42	2.76
C.D. at 5%	4.29	8.39
C.V.%	5.69	5.40

Ekinci *et al.,* (2014) reported that the nano fertilizer treatments significantly improved the yield of cucumber crop compared to control. Mukhopadhyay *et al.,* (2015) revealed that NCPC was applied in combination with 100 % N through farm yard manure (FYM) successfully increased the grain yield of lentil. The different levels of chemical and nano nitrogenous fertilizer also produced significant effect on straw yield of sorghum crop. The straw yield was significantly increased from 45.33 to 117.13g pot^{-1} under different doses of nano and chemical fertilizer. The application of T_4 (2.5 times reduction of RDN through nano fertilizer) treatment produced significantly the highest straw yield (117.13g pot^{-1}). Rajonee *et al.,* (2016) also observed that the fresh weight production of kalmi was higher with nano fertilizer treated soil compared to conventional fertilizer.

The graphical presentation also showed the significant effect of nano and chemical nitrogenous fertilizer on grain and straw yields. The Fig.1 showed that the highest grain and straw yields were observed with T_4 treatment (2.5 times reduction of RDN through nano fertilizer), whereas the lowest yield was observed in control treatments. The T_4 treatment was statistically at par with the T_7 (RDN through nano fertilizer). The application at 2.5 times reduction of RDN through nano nitrogenous fertilizer recorded significantly the highest grain and straw yields, which was statistically at par with 100% RDN through chemical fertilizer.

Based on the results summarized above, it can be concluded that the application of 2.5 time reduction of RDN through nano fertilizer significantly increased growth parameters, yields and quality characters of sorghum crop. This study clearly indicated that the application of nano fertilizer can save about 40% dose of recommended nitrogenous fertilizer dose in sorghum crop. Thus, use of nitrogenous nano fertilizer increased nitrogen availability to considerable extent. This might be due to it control the release of nitrogen steadily for longer time as per the requirement of the crop.

References

Ekinci, M.; Dursun, A.; Yıldırım, E and Parlakova. F. 2014. Effects of nanotechnology liquid fertilizers on the plant growth and yield of cucumber (*Cucumis sativus* L.). *Acta Sci. Pol., Hortorum Cultus.* 13(3): 135-141.

Hasaneen, M. N.; Abdel-aziz, H. M and Omer, A. M. 2016. Effect of foliar application of engineered nanomaterials carbon nanotubes and chitosan nanoparticles NPK fertilizer on the growth of french bean plant. *J. of Biochem. and Biotech. Res.* 4(4): 68-76.

Janmohammadi, M.; Sabaghnia, N.; Seifi, A and Pasandi, A. 2017. The impacts of nano-structured nutrients on chickpea performance under supplemental irrigation. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis.* 65(3): 859–870.

Kaviani, B.; Ghaziani, M.V.F and Negahdar. N. 2016. Effect of application methods and different concentrations of biologic nano fertilizer, especial for ornamental plants on some morphological, physiological and proliferation traits and enhancing the quality of buxus hyrcana pojark. *Int. J. of Advan. in sci. Engine. and Tech.* 2(4): 92-105.

Khospeyak, S.; Haghi, R. S.; Ahmadiyan. A. 2016. The effect of application of nano organic fertilizer and nitrogen fertilizer on yield, yield components and essential oil content of fennel. *Ira. J. of field crop res.* 14(4): 775-787.

Leghari, S.J.; Mustafabhabhan, N. G. M and

Hussain, K. 2016. Role of nitrogen for plant growth and development. *Adv. in Envt. Bio.* 10(9): 209-218.

Mir,S.; Sirousehr, A. and Shiramohammadi, E. 2015. Effect of nano and biological fertilizers on carbohydrate and chlorophyll content of forage sorghum. *Int. J. of Biosci.* 6(4): 157-164.

Naderi, M. R. and Shahraki, A. D. 2013. Nano fertilizers and their roles in sustainable agriculture. *Int. J. of Agric. and Crop Sci.* 5(19): 2229-2232.

Patra, A. K., A. Clays, V. Degrange, S.J. Grayston, N. Guillaumaud, P. Loiseau, F.Louault, S. Mahmood, S. Nazaret, L. Phillippot, F. Poly, J.L. Prosser and X. LeRoux. 2006. Effects of management regime and plant species on the enzyme activity and genetic structure of N fixing, denitrifying and nitrifying bacterial communities in grassland soils. *Environ. Microbiol.*, 8: 1005-1016.

Rajonee, A. A.; Nigar, F.; Ahmed S and Imamul H. 2016. Synthesis of nitrogen nano fertilizer and its efficacy. *Canadian J. of Pure and Applied Sci*. 10(2): 3913-3919.

Rostami, M.; Movahedi, Z.; Davari, M.Z.; Siahpoosh, S. 2017. Effect of foliar application of biofertilizer and nano-fertilizers on morpho-physiological characteristics of peppermint (*Mentha piperita* l.) Department of Agronomy, Malayer University, Iran.

Veronica, N.; Thatikunta, R.; Reddy, N. S. 2014. Crop nutrition management with nano-fertilizers. *Int. J. of Envt Sci. and Tech.* 1(1): 4-6.

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