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Effect of different levels of chemical and nano potassic fertilizer on yield and yield attribute of maize crop (*Zea mays* L.) cv. Amber

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Abstract
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 potassic fertilizer on growth, yield and yield attributes of maize (*Zea mays* 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 = RDK dose of maize crop through chemical fertilizer, T_4 = $NK_{2.5}$-2.5 times reduction of RDK through nano fertilizer, T_5 = NK_5-5 times reduction of RDK through nano fertilizer, T_6= NK_{10}-10 times reduction of RDK through nano fertilizer, T_7 = RDK through nano fertilizer. The maximum growth parameter and yield characters were observed with nano fertilizer treated soil than chemical fertilizer added to soil. The results revealed that the application of 2.5 time reduction of RDK through nano fertilizer significantly increased growth parameters, yields and quality characters of maize crop. This also brought significant increase in content and uptake of nutrients.

Keywords: Nano polymer, nano potassic fertilizers, chitosan polymer recommeded dose of potassium (RDK)

Introduction
Maize (*Zea mays* L.) is the world's leading crop and is widely cultivated as cereal grain that was domesticated in Central America. In India, maize is the third important food crop after rice and wheat. Globally, maize is known as queen of cereals because of its highest genetic yield potential. The area under maize in the Saurashtra region is almost negligible. It is mainly cultivated in *kharif* season, and due to photo-insensitive crop, it is also grown as *rabi* and summer crop. It being an exhaustive crop depletes a major portion of plant nutrients from soil unless the soils are supplied with nutrients removed by the crop, it will be great threat to maintain soil health and to sustain crop production (Anonymous, 1997) [2]. Potassium is one of the principle plant nutrients underpinning crop yield production and quality determination. Potash is the nutrient required in the greatest amount by maize. Application of potassium had significant effects on leaf water potential, turgor potential, photosynthetic rate, transpiration rate, grain weight, weight per cob, biological yield and grain yield. K fertilization improves yield which generally comes out because of increase in the kernel weight (Sharma *et al*., 2005) [10].

Nano-fertilizers provide more surface area for different metabolic reactions in the plant which increase rate of photosynthesis and produce more dry matter and yield of the crop (Singh *et al.*, 2017) [11]. Besides these, it also increase nutrient mobilization by the plants, 17-54 % improvement in the crop yield, more release of different beneficial enzyme better soil health and native nutrient mobilization (Rameshaiah *et al.*, 2015) [9]. Nano fertilizers are advantageous over conventional fertilizers as they increase soil fertility, yield and quality parameters of the crop, they are less harmful to environment and humans with minimize cost and maximize profit.

Materials and Methods
A pot experiment was conducted during *summer*-2017, to study the "Evaluation of potassic nano fertilizer under incubation trial and it's effect on growth, yield and nutrient uptake by maize (*Zea mays* L.) crop" with 7 treatments replicated in thrice under net house condition at the Department of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University 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 potassium was calculated as per treatment of different sources of potassium 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 potassium and two different source of potassium (MOP and Nano K fertilizer) in completely randomized block design. The required quantity of nitrogen and phosphorus is applied as basal dose through Urea and SSP were also mixed with the soil. The treated soil was filled in polythene lined earthenware pots.

The required quantity of potassium was calculated as per treatment of different sources of potassium product on the basis of 15 kg bulk of soil and applied as basal dose

Sr. No.	Treatments	Potassium (g per 15 kg soil)	Source
1	T_1	0 g MOP	No fertilizer
2	T_2	0 g MOP in 1.11 liter of nano polymer	Nano polymer
3	T_3	1.33 g	MOP
4	T_4	1.06 g MOP in 0.88 liter of nano polymer	Nano potassic fertilizer
5	T_5	0.52 g MOP in 0.43 liter of nano polymer	Nano potassic fertilizer
6	T_6	0.26 MOP in 0.22 liter of nano polymer	Nano potassic fertilizer
7	T_7	1.33 MOP in 1.11 liter of nano polymer	Nano potassic fertilizer

Note: Nitrogen and phosphorus apply as a basal dose by neem coated urea (1.74 g) and SSP (2.51g) respectively.

Result and Discussion

Growth and Yield attributes

Plant height

The result of different treatments of chemical and nano potassic fertilizers on plant height, number of leaves plant^{-1}, length of cob plant^{-1} and test weight of 1000 seed of maize crop at harvest are given in table 1. The plant height was significantly increased from 129.63 to 173.55 cm under different treatment of chemical and nano potassium fertilizer. The significantly highest plant height (173.55 cm) observed with application of T_4-$NK_{2.5}$ (2.5 times reduction of RDK through nano fertilizer) treatment followed by T_7, T_3, T_5, T_6 and T_2 treatments, respectively. But T_4 treatment was statistically at par with treatment of T_7 (RDK through nano fertilizer). While the lowest plant height was recorded under control (129.63 cm) which was statistically at par with T_2. Hassani *et al*. (2015) [7] observed that the highest plant height, the number of branches, leaves of branch and nodes with the application of nano K fertilizer.

Number of leaves

The significantly highest number of leaves plant^{-1}(15.67) was observed with treatment of T_4 ($NK_{2.5}$-2.5 time reduction of RDK through nano fertilizer). But it was statistically at par with treatment of T_7 (RDK through nano fertilizer). The treatment of T_1 and T_2 were statistically at par with each other and the lowest number of leaves plant^{-1}(10.33) was observed under treatment of T_1.

Length of cob

The data conclusively demonstrated that all the growth parameters were significantly affected by the application of different levels of chemical and nano potassic fertilizers. The maximum length of cob plant^{-1} of the maize crop were observed with the treatment of 2.5 time reduction of RDK through nano fertilizer (T_4). The treatment T_7(21.43cm) remained statistically at par with T_4 treatment. Ajirloo *et al.* (2014) [1] reported that the application of K nano fertilizer can directly cause the positive effects on plant growth by stimulating shoot and root growth but its effect is more prominent on the roots.

Test weight

The result of different treatments of chemical and nano potassic fertilizer on test weight of maize crop are given in table 1. The test weight was significantly increased from 17.25 to 23.17 g under different levels of chemical and nano potassic fertilizer. The highest test weight (23.17 g) was observed with the application of T_4 (2.5 times reduction of RDK through nano fertilizer. While, the lowest test weight was recorded under control (17.25 g) and nano polymer (17.55 g) treatments in soil. These may be due to nano potassic fertilizer which act as a slow release fertilizer hence as a result to reduce fertilizer losses, improve nutrient use efficiency as well as provide balanced crop nutrition. Moreover nano fertilizer are known to emit nutrients slowly and steadily for long time during the crop growth period which may help in enhancing without any associated negative effect. This results are also in direct line with those earlier workers of Gomaa *et al*. (2017) [6], Gerdini (2016) [5] and Maqsood *et al*. (2013) [8].

Yield and yield attributes

The result of different treatments of chemical and nano potassic fertilizer on grain and fodder yield of maize crop are given in table 2 and fig. 1. The data conclusively demonstrate that grain yield significantly affected by the application of different levels of chemical and nano fertilizer. The grain yield was significantly increased from 27.74 to 44.00 g pot^{-1} under different treatments of nano and chemical fertilizer. The application of 2.5 times reduction of RDK through nano fertilizer produced significantly highest grain yield (44.00 g pot^{-1}) but it was statistically at par with treatment of T_7 (RDK through nano fertilizer). The treatment of T_5 and T_6 was remain statistically at par with each other. While, the lowest grain yield was recorded under control (27.74 g pot^{-1}) treatment, but it was statistically at par with T_2 treatment (28.80 g pot^{-1}). Ajirloo *et al.* (2014) [1] reported that the application of 300 kg ha^{-1} K nano fertilizer provide the highest number of fruit per plant, fruit weight, fruit diameter and fruit yield of tomato crop. Similarly, this observations support the work reported by Farnia and Ghorbani (2014) [4] who showed that the increase in yield and yield components of red bean. The different treatments of chemical and nano potassium fertilizer produced significant effect on fodder yield of maize crops. The significantly highest fodder yield (68.55 g pot^{-1}) was also observed under treatment of T_4($NK_{2.5}$-2.5 time reduction of RDK through nano fertilizer). But it was statistically at par with treatment of T_7 (RDK through nano fertilizer). While, the treatment of T_1(43.63 g pot^{-1}) produced lowest fodder yield followed by T_2(45.29g pot^{-1}) treatment and was remain statistically at par with each

other.The fodder yield also was similarly influenced by the 2.5 time reduction of RDK through nano fertilizer application. It is clearly seen that the use of nano potassic fertilizer provides not only nutrients to plants but also increases the nutrient availability to the plants and the efficiency of the fertilizer applied. While, El-Ghanam and EL-Ghozoli (2003) [3] observed that the application of humic acid and K nano fertilizer significantly increased the dry matter production of faba bean plants.

Table 1: Effect of different treatments of chemical and nano potassic fertilizers on growth and yield attributing characters of maize crop

Treatments	Yield attributing characters			
	Plant height plant^{-1} at harvest(cm)	No. of leaves plant^{-1} at harvest	Length of cobs plant $^{-1}$at harvest(cm)	Test weight 1000 seed (g)
T_1 - Absolute Control	129.63	10.33	13.53	17.25
T_2 - Nano polymer	132.81	11.67	14.02	17.55
T_3 -RDK through chemical fertilizer	155.32	14.33	19.10	20.85
T_4 - $NK_{2.5}$ -2.5 time reduction of RDK through nano fertilizer	173.55	15.67	21.97	23.17
T_5 - NK_5 -5 time reduction of RDK through nano fertilizer	148.97	13.33	18.70	20.14
T_6 - NK_{10} -10 time reduction of RDK through nano fertilizer	143.00	12.67	16.30	19.88
T_7 - RDK through nano fertilizer	168.87	15.33	21.43	23.15
S.Em.±	4.39	0.40	0.56	0.69
C.D. (P=0.05)	13.32	1.21	1.68	2.08
C.V.%	5.06	5.18	5.39	5.87

Table 2: Effect of different treatments of chemical and nanopotassic fertilizers on grain and fodder yield of maize crop

Treatments	Grain yield (g pot^{-1})	Fodder yield (g pot^{-1})
T_1 - Absolute Control	27.74	43.63
T_2 - Nano polymer	28.80	45.29
T_3 -RDK through chemical fertilizer	39.97	62.24
T_4 - $NK_{2.5}$ -2.5 time reduction of RDK through nano fertilizer	44.00	68.55
T_5 - NK_5 -5 time reduction of RDK through nano fertilizer	35.47	59.83
T_6 - NK_{10} -10 time reduction of RDK through nano fertilizer	33.78	55.14
T_7 - RDK through nano fertilizer	42.84	66.61
S.Em.±	1.10	1.71
C.D. (P=0.05)	3.34	5.17
C.V.%	5.29	5.15

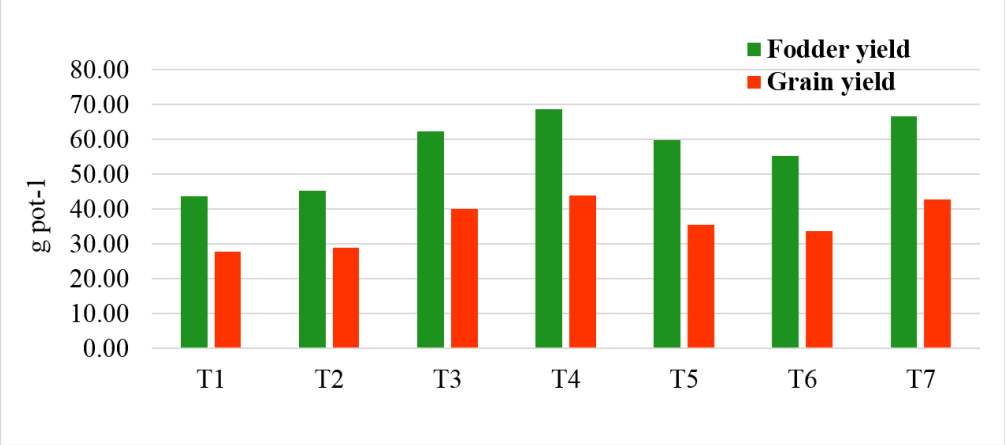

Fig 1: Effect of different treatments of chemical and nanopotassic fertilizers on grain yield and fodder yield of maize crop

The figure 1 clear indicated that the grain and fodder yield of maize significantly increased with different levels of chemical and nano potassium fertilizer. The significantly highest grain and fodder yield were observed with treatment of T_4 (2.5 times reduction of RDK through nano fertilizer) which was statistically at par with T_7(RDK through nano fertilizer). The lowest grain yield and fodder yield was observed with treatment T_1 (control) followed by T_2 treatment (nano polymer) and remain statically at par with each other. It is quite evident that usage of nano potassic fertilizer reduce the 2.5 times reduction of recommended chemical potassic fertilizer such type of the positive effect of nano fertilizer have been reported by Ajirloo *et al.* (2014) [1], Ghahremani *et al.* (2014) and Tian *et al.* (2017) [12].

Conclusion

Based on the results summarized above, it can be concluded that the application of 2.5 time reduction of RDK through nano fertilizer significantly increased growth parameters, yields and quality characters of maize crop. This study clearly indicate that the application of nano fertilizer can saved about 40% of recommended potassic fertilizer dose in maize crop. This may be due to it control the release of potassium and supply of K for longer time as per the requirement of crop.

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