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Buha Divya Babubhai
Research Scholar
Dept. of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

MS Solanki
Professor, Dept. of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Barkha Rani
Research Scholar
Dept. of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Correspondence
Buha Divya Babubhai
Research Scholar
Dept. of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujrat, India

Effect of chemical and nano potassic fertilizers on potassium availability at different incubation periods

Buha Divya Babubhai, MS Solanki and Barkha Rani

Abstract
An incubation experiment was conducted during summer 2017 at Department of Agril. Chemistry & Soil Science, College of Agriculture, JAU, Junagadh. This study has been undertaken to investigate effect of different levels (0, 200, 400 and 600 ppm) of nano and chemical potassic fertilizers at various incubation periods (15^{th}, 30^{th}, 45^{th}, 60^{th}, 75^{th}, 90^{th}, 105^{th}, 120^{th}, 135^{th} and 150^{th}) on potassium availability and water soluble potassium. The time of incubation had the pronounced effect of potassium availability. The potassium availability from both nano and chemical potassic fertilizers increased with increasing days of incubation periods, but increment was found up to 30^{th} days in chemical potassic fertilizer. While, in case of nano fertilizer treated soil, the increment was found up to 60^{th} days of incubation periods, then it was declined in both the cases. The availability of potassium seems to have direct relationship with quantity of applied potassium. The results of incubation study clearly indicated that the availability of potassium was higher with nano fertilizer treated soil as compare to chemical fertilizer applied to soil at all the incubation periods.

Keywords: Nano polymer, nano fertilizer, incubation periods

Introduction
The nano-fertilizers have higher surface area it is mainly due to very less size of particles. Due to higher surface area and very less size, its reactivity is increased with other compound by many fold. They have high solubility in different solvent such as water. Utilization of nano-fertilizers may increase solubility and dispersion of insoluble nutrients in soil, reduce nutrient immobilization (soil fixation) and increase their bio-availability (Naderi and Shahraki, 2013) [8]. Nano- fertilizers had an important role where the ancient chemical fertilizers are replaced with nano fertilizers with their efficiency and environment friendly nature.Nano-fertilizers are very effective for precise nutrient management in precision agriculture with matching the crop growth stage for nutrient and may provide nutrient throughout the crop growth period.

Potassium (K) is an essential nutrient for plant growth. After nitrogen (N) and phosphorus, K is the third most likely nutrient to limit crop productivity. Using nano potash fertilizer as the source of potassium in rice, which resulted in increased number of grains per panicle and also the amount compared to muriate of potash was less. They revealed that coating wheat and corn by nano and slow release fertilizers of the same to crops has increased grain yield as well as effective recovery of N fertilizer (Subbarao *et al*., 2013) [9].

Materials and methods
In order to carry out the incubation study, a bulk of surface soil sample to a depth of 0-15 cm was taken from Central Experimental Station, Sagadividi farm, Junagadh. The soil was collected randomly from different points and composited. The composite sample was air-dried in the laboratory, powdered with wooden mortar and pestle and passed through a 2 mm sieve and mixed thoroughly. Soil was *Vertic Haplustepts*, medium black calcareous clayey in nature and slightly alkaline in reaction. Three kg of soil was taken in each six different plastic bowel and the soil was treated with chemical fertilizer (200, 400 and 600 ppm) and nano fertilizer (200, 400 and 600 ppm) with potassium (MOP and Nano K fertilizer) respectively as per treatments in triplicate and then fill the each plastic cup having size of 200 ml (72 mm dia.) with 100 g soil at room temperature (27-30 ^{o}C) in the laboratory.

The soil moisture content was maintained at field capacity of the soil and loss in water content in soil was made up throughout the incubation period by addition the water as determined by the loss in weight of bowel soils. Periodical soil sampling at 15 days interval (15th, 30th, 45th, 60th, 75th, 90th, 105th, 120th, 135th and 150th) was done with the help of a plastic tube.

Fig 1: The soil was collected randomly from different points and composited.

Result and discussion

Effect of different treatments of nano and chemical pottasic fertilizers on availability of potassium at different incubation periods.

The data pertaining in the table 1 represent the effect of different treatments of chemical and nano potassic fertilizer on availability of potassium at different incubation periods. A close look to the effect of incubation time in respect of potassium availability through the nano fertilizer, the value of available potassium significantly increases with increasing the incubation time up to 60th days of incubation period with the application 200 ppm potassium applied through nano potassic fertilizer then it was declined at all the incubation period (75th to 150th incubation days). The similar trend was also observed with the application of 400 ppm and 600 ppm potassium applied through nano fertilizer. While, in case of potassium applied through chemical fertilizer, the availability of potassium was significantly increased up to 30 days of incubation periods. Then, it was significantly deceased at all the incubation period (45th to 150th days). The mean data of available potassium release from nano fertilizer shows that the release of potassium was prominent in case of nano fertilizer throughout the entire experiment. The control soil contained less available K than the rest of the treatments. The maximum availability (42.86ppm) was observed at 30 days of incubation period while beyond this period it was decreased up to 150th days. The lowest availability (21.10ppm) was observed at 150th days of incubation period. These finding are in agreement with those earlier findings of Bley *et al*. (2017) [2] and Rajonee *et al*. (2017) [6]. Thirunavukkarasu (2015) observed that nano fertilizers are known to emit nutrients slowly and steadily for more than 35 days which may help in enhancing the nutrient use efficiency without any associated negative effects. Since the nano-fertilizers are formulated to deliver slowly over a long period of time, the loss of nutrients is substantially reduced.

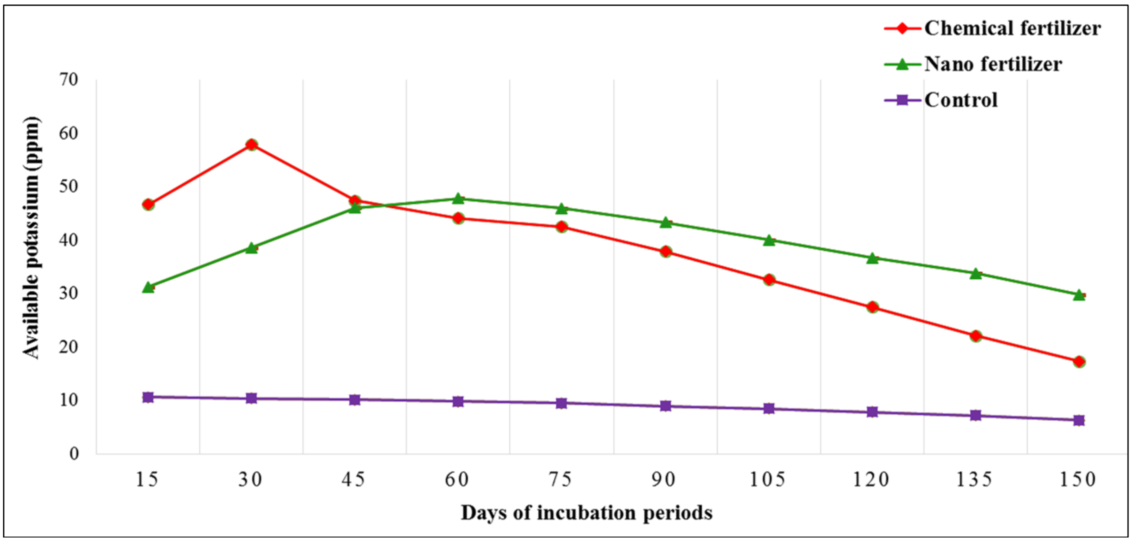

Fig 2: Effect of nano and chemical potassic fertilizers on availability of K at different incubation periods

The close look of figure (fig-1.1) indicated that the mean value of potassium availability was increased with increasing incubation period under both nano (up to 60th days) and chemical potassic fertilizers (up to 30th days). Then, the potassium availability trend was declined but similar up to 45th days of incubation period in both the cases, after mean value of available potassium remain higher in nano fertilizer treated soil as compare to applied chemical fertilizer soil throughout the incubation period (45th to 150 days).The results clearly indicated that the addition of potassium through nano pottasic fertilizers reduced potassium fixation in soils with the resultant increase in the available K in soil throughout incubation period.

Effect of different treatments of nano and chemical potassic fertilizers on water soluble potassium at different incubation periods.

The data regarding to water soluble form of potassium as affected by different treatments of nano and chemical potassic fertilizer in different incubation period are presented in table-1.2.A close look at this table showed that the release of water soluble potassium through the nano fertilizer, significantly increases with increasing the incubation time up to 60th days of incubation period with the application of 200, 400 and 600 ppm potassium applied through nano potassic fertilizer then it was declined up to end of incubation period (75th to 150th incubation days). While in case of application of potassium through chemical fertilizer, the release of water soluble potassium was significantly increased up to 30th days of incubation periods. It showed that the significant effect of time of incubation on overall mean value of water soluble potassium up to 30th days period and after that there was significantly decreased with different levels of nano and chemical potassic fertilizers. The maximum availability (13.20ppm K) was observed at 30 days incubation period while beyond this period it was decreased up to 150th days. The lowest availability (5.88ppm K) was observed at 150thdays period. Similar observations were made by Li *et al*. (2013) [5] mentioned that the water soluble K content in the soils were mentioned at high levels in the potassium incorporated zeolite than in control treatment. These finding are in agreement with those earlier findings of Horra *et al*. (2013) [4], He *et al*. (2016) [3]. He *et al*. (2016) [3] observed that the water-extractable K and exchangeable K had significant effects on the concentration distributions for fertiliser micro-sites. Assimakopoulos *et al*. (1994) [1] reported that during incubation of moist soil samples the water-soluble and exchangeable potassium increased with the rate of K-application and varied with moisture content and time of incubation.

Table 1: Effect of different treatments of nano and chemical potassic fertilizers on availability of potassium (ppm) at different incubation periods

Treatments	Incubation periods (days)										Mean	Incubation
	15th	30th	45th	60th	75th	90th	105th	120th	135th	150th		
T_1- Control	10.67	10.40	10.17	9.86	9.55	8.96	8.47	7.84	7.19	6.29	8.94	8.21
T_2- 200 ppm CK	39.54	47.37	39.11	36.08	34.63	30.56	25.38	21.76	16.35	12.53	30.331	27.15
T_3- 400 ppm CK	46.03	59.88	48.07	44.26	42.66	38.13	33.26	27.05	22.51	16.71	37.856	34.68
T_4- 600 ppm CK	54.49	66.45	55.15	52.11	50.27	45.02	39.29	33.80	27.69	22.76	44.703	41.29
Mean	46.69	57.90	47.44	44.15	42.52	37.90	32.64	27.54	22.18	17.33		
T_5- 200 ppm NK	24.77	31.70	37.88	39.11	37.21	34.88	31.27	28.70	25.70	21.97	31.319	28.17
T_6- 400 ppm NK	31.55	38.55	46.43	48.29	46.49	43.78	40.49	37.07	34.70	30.16	39.751	36.65
T_7- 600 ppm NK	37.48	45.64	53.82	56.13	54.17	51.36	48.35	44.41	41.14	37.27	46.977	43.65
Mean	31.27	38.63	46.04	47.84	45.96	43.34	40.04	36.73	33.85	29.80		
Overall Mean	34.93	42.86	41.52	40.83	39.28	36.10	32.36	28.66	25.04	21.10		
S.Em±	0.31	0.60	0.55	0.58	0.44	0.39	0.42	0.37	0.42	0.34		0.19
C.D. at 5%	0.94	1.81	1.67	1.75	1.34	1.19	1.27	1.12	1.27	1.04		0.58
C.V.%	1.53	2.41	2.30	2.45	1.95	1.88	2.25	2.24	2.90	2.81		1.05

Table 2: Effect of different treatments of nano and chemical potassic fertilizers on water soluble potassium (ppm) at different incubation periods

Treatments	Incubation periods (days)										Mean	Incubation
	15th	30th	45th	60th	75th	90th	105th	120th	135th	150th		
T_1- Control	3.40	3.12	2.91	2.83	2.78	2.53	2.36	1.74	1.40	1.07	2.41	2.41
T_2- 200 ppm CK	5.20	10.87	7.29	5.13	5.97	4.27	3.33	2.53	1.80	1.16	4.76	4.75
T_3- 400 ppm CK	7.87	21.73	16.31	13.24	12.16	11.27	10.51	8.93	7.37	5.91	11.53	11.53
T_4- 600 ppm CK	11.70	27.80	21.04	19.10	17.54	16.27	13.03	11.83	9.71	7.67	15.57	15.60
Mean	8.26	20.13	14.88	12.49	11.89	10.60	8.96	7.76	6.29	4.91		
T_5- 200 ppm NK	2.10	4.28	6.37	7.78	6.87	6.57	6.01	5.25	4.55	4.07	5.39	5.38
T_6- 400 ppm NK	5.14	10.78	15.42	17.23	16.52	15.37	14.30	12.35	10.51	8.78	12.64	12.64
T_7- 600 ppm NK	9.40	13.85	20.51	23.24	20.13	19.69	17.92	16.86	14.37	12.47	16.84	16.79
Mean	5.55	9.64	14.10	16.08	14.51	13.88	12.74	11.49	9.81	8.44		
Overall Mean	6.40	13.20	12.84	12.65	11.71	10.85	9.64	8.50	7.10	5.88		
S.Em±	0.10	0.21	0.14	0.15	0.17	0.11	0.14	0.10	0.10	0.09		0.04
C.D. at 5%	0.30	0.63	0.43	0.46	0.52	0.35	0.43	0.30	0.32	0.29		0.12
C.V.%	2.70	2.74	1.91	2.07	2.55	1.82	2.58	2.04	2.54	2.77		0.70

Conclusion

The time of incubation had the pronounced effect on potassium availability. The potassium availability was increased with increasing days of incubation periods up to 30th days in chemical potassic fertilizer added soil. While, in case of nano potassic fertilizer treated soil, the potassium availability increased up to 60th days of incubation period, then it was declined up to throughout the incubation period (150th day) in both the cases.

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