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An incubation study on the effect of zeolite application on soil chemical properties, nitrogen and phosphorus release

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Abstract
A laboratory incubation study experiment was conducted at ambient temperature in the shadenet house of the Department of Soil Science and Agricultural Chemistry, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri to study the effect of levels of zeolite on soil chemical properties and nutrient release at 25, 50 and 75 days incubation stages. There were three replications comprising of twelve treatments. Treatments were T_1: Absolute control, T_2: GRDF,
T_3: GRDF + Zeolite @ 20 kg/ha, T_4: GRDF + Zeolite @ 40 kg/ha, T_5: GRDF + Zeolite @ 60 kg/ha, T_6: GRDF + Zeolite @ 80 kg/ha, T_7: GRDF + Zeolite @ 100 kg/ha, T_8: Zeolite @ 20 kg/ha, T_9: Zeolite @ 40 kg/ha, T_{10}: Zeolite @ 60 kg/ha,T_{11}: Zeolite @ 80 kg/ha,T_{12}: Zeolite @ 100 kg/ha. The effect of zeolite levels on soil pH showed non-significant result. A slight increase in electrical conductivity was observed. The available nitrogen and available phosphorus was observed to increase significantly with increasing Zeolite treatment and also with increase in the days of incubation.

Keywords: Incubation, zeolite, GRDF, soil properties, nutrient release

Introduction

Ming and Dixon (1987) [3] observed that the worldwide number of identified natural zeolite – about forty demonstrates both their great variety and the present-day interest on their potential applications in the industry and the agriculture. Ming and Mumpton (1989) [4] observed that zeolite minerals are crystalline hydrated aluminosilicates of alkali or alkaline-earth metals, structured in three-dimensional rigid crystalline network, formed by the tetrahedral AlO_4 and SiO_4, which come together to compose a system of canals, cavities and pores.Zeolite have three main properties, which are of great interest for agricultural purposes: high cation exchange capacity, high water holding capacity in the free channels, and high adsorption capacity. Perez-Caballero *et al*. (2008) [5] observed that zeolites have the ability to lose and gain water reversibly, without the change of crystal structure. They could be used as fertilizers, stabilizers and chelaters. Zeolites enable both inorganic and organic fertilizers to slowly release their nutrients.

Materials and Methods

A laboratory incubation study experiment was conducted at ambient temperature in the shednet house of the Department of Soil Science and Agril. Chemistry, MPKV, Rahuri to study the effect of levels of zeolite on soil chemical properties and nutrient release at 25, 50 and 75 days incubation stages. The soil from the field experiment site was collected at a depth of 0-15 cm and was pounded and sieved with 2 mm sieve. This soil was used for the incubation study. Soils was medium deep black belonging to Inceptisol order and chemical properties of experimental soil showed moderately in alkaline reaction (pH 8.10), normal in electrical conductivity (0.33 dSm^{-1}), Soil fertility was low in available nitrogen (175.6 kg ha^{-1}), medium in available phosphorous (18.09 kg ha^{-1}). The experiment was conducted in randomized block design. The plastic bowls of 2 kg capacity were filled with 2 mm sieved 2 kg soil. The zeolite and recommended dose of fertilizers and FYM were calculated for 2 kg soil and were applied in the bowl and were thoroughly mixed. There were no doses for treatment T_1 Absolute control only recommended dose of fertilizer + FYM was added to treatment T_2, without zeolite.

Zeolite @ of 20, 40, 60, 80 and 100 kg ha-1 + GRDF and FYM were added to treatment T3, T4, T5, T6 and T7 respectively. Only zeolite @ 20, 40, 60, 80 and 100 kg ha-1 were added to treatment T8, T9, T10, T11 and T12 respectively.

The soil from each bowl was saturated with distilled water. Field capacity in the bowl was maintained by using soil moisture meter.

At the end of each incubation stage, the soils from the bowls was removed and dried in shed and clean cloth and soil was processed for analysis for various parameters. The effect of zeolite on various soil chemical parameters at 25, 50, 75 days of incubation was studied and presented in the results and discussion chapter.

Result and Discussion

Effect of Zeolite Application on pH and EC of Soil at 25, 50, 75 Days of Incubation

The results of the incubation study indicate that the pH and electrical conductivity of soil were not influenced due to the zeolite application. The effect of zeolite levels on soil pH showed non significant result.

Effect of Zeolite application on EC of soil at 25, 50, 75 days of incubation: A slight increase in electrical conductivity (0.44 dSm^{-1}) was observed at 75 days in treatment T_6 (GRDF+ Zeolite @ 80 kg ha^{-1}) incubation stage which might be due to the increase in the total soluble salts due to release of nutrient Cations in the soil solution.

Table 1: Effect of zeolite application on pH & EC of soil at 25, 50, 75 days of incubation

Tr. No.	Treatment	pH (1:2.5)			EC (dSm^{-1})		
		25 days	50 days	75 days	25 days	50 days	75 days
T_1	Absolute control	8.10	8.10	8.09	0.39	0.39	0.39
T_2	GRDF (20:40:00 kg ha^{-1} $N:P_2O_5:K_2O$ + FYM @ 5 t ha^{-1})	8.10	8.10	8.10	0.39	0.40	0.40
T_3	GRDF + Zeolite @ 20 kg ha^{-1}	8.09	8.09	8.10	0.38	0.39	0.40
T_4	GRDF + Zeolite @ 40 kg ha^{-1}	8.09	8.10	8.10	0.39	0.40	0.41
T_5	GRDF+ Zeolite @ 60 kg ha^{-1}	8.10	8.09	8.11	0.38	0.40	0.42
T_6	GRDF+ Zeolite @ 80 kg ha^{-1}	8.10	8.10	8.10	0.38	0.42	0.44
T_7	GRDF+ Zeolite @ 100 kg ha^{-1}	8.10	8.09	8.09	0.38	0.40	0.43
T_8	Zeolite @ 20 kg ha^{-1}	8.10	8.08	8.10	0.38	0.38	0.39
T_9	Zeolite @ 40 kg ha^{-1}	8.09	8.10	8.08	0.38	0.38	0.40
T_{10}	Zeolite @ 60 kg ha^{-1}	8.11	8.10	8.10	0.39	0.39	0.41
T_{11}	Zeolite @ 80 kg ha^{-1}	8.11	8.10	8.09	0.39	0.40	0.42
T_{12}	Zeolite @ 100 kg ha^{-1}	8.09	8.11	8.08	0.38	0.38	0.41
	S.Em+	0.008	0.005	0.005	0.008	0.007	0.003
	CD at 5%	NS	NS	NS	NS	NS	0.009

Table 2: Effect of zeolite application on available N & available P in soil at 25, 50, 75 days of incubation

Tr. No.	Treatment	Available N (mg kg^{-1})			Available P (mg kg^{-1})		
		25 days	50 days	75 days	25 days	50 days	75 days
T_1	Absolute control	75.62	82.13	85.87	7.50	7.88	8.07
T_2	GRDF (20:40:00 kg ha^{-1} $N:P_2O_5:K_2O$ + FYM @5t ha^{-1})	78.76	91.47	95.20	7.88	8.08	8.28
T_3	GRDF + Zeolite @ 20 kg ha^{-1}	85.87	97.06	102.66	7.95	8.14	8.34
T_4	GRDF + Zeolite @ 40 kg ha^{-1}	89.31	104.53	113.86	7.98	8.44	8.63
T_5	GRDF+ Zeolite @ 60 kg ha^{-1}	93.33	110.13	117.59	8.16	8.58	8.88
T_6	GRDF+ Zeolite @ 80 kg ha^{-1}	104.30	117.68	126.93	8.37	9.02	9.56
T_7	GRDF+ Zeolite @ 100 kg ha^{-1}	89.59	113.87	121.65	8.21	8.71	9.24
T_8	Zeolite @ 20 kg ha^{-1}	78.08	82.20	89.59	7.71	7.96	8.09
T_9	Zeolite @ 40 kg ha^{-1}	80.26	86.63	98.93	7.80	8.09	8.23
T_{10}	Zeolite @ 60 kg ha^{-1}	84.00	100.79	110.13	7.87	8.18	8.50
T_{11}	Zeolite @ 80 kg ha^{-1}	91.46	107.59	115.73	8.13	8.53	8.93
T_{12}	Zeolite @ 100 kg ha^{-1}	85.66	106.0	112.45	8.02	8.17	8.63
	S.Em+	2.66	1.32	1.62	0.07	1.17	1.43
	CD at 5%	7.80	3.89	4.77	0.23	3.44	4.21

Effect of zeolite application on available N in Soil at 25, 50, 75 Days of Incubation

The available nitrogen was observed to increase significantly with increasing zeolite treatment and also with increase in the days of incubation. The highest available N was observed in treatment T_6 (GRDF+ Zeolite @ 80 kg ha^{-1}) (104.30, 117.68 and 126.93 mg kg^{-1} soil) in 25, 50 and 75 days incubation stages respectively. It was observed that the available N content increased with increasing levels of zeolite along with RDF and zeolite alone, and it also increased with increase in the period of incubation. This increase in the available nitrogen status of soil with increase in the incubation period may be attributed to the initial fixation of NH_4 ions during hydrolysis and a subsequent release and nitrification, leading to the increase in the available N with increase in the incubation period. The increase in available N status with increase in the levels of zeolite may be attributed to the increased sites of NH_4 adsorption by zeolite. Majid *et al.* (2012) [2] showed that incorporation of natural zeolite into a sandy soil decreased nitrate leaching and increase availability of nitrogen.

Effect of zeolite application on available P in Soil at 25, 50, 75 Days of Incubation

The available phosphorus was observed to increase significantly with increasing zeolite treatment and also with increase in the days of incubation. The highest available P was observed in treatment T_6 (GRDF+ Zeoilte @ 80 kg ha^{-1}) which was also found an optimum dose for increasing the soil available phosphorus nutrients in the field. Handreck (1997) [1] studied that the zeolite/RP exchange-induced dissolution system offers the considerable advantage of phosphorus release in response to plant demand.

Conclusion

A slight increase in electrical conductivity was observed. The available nitrogen and available phosphorus was observed to increase significantly with increasing zeolite treatment and also with increase in the days of incubation. It was observed that application of zeolite @ 80 kg ha^{-1} along with GRDF was observed to be the best treatment to improve the soil chemical properties and nitrogen and phosphorus release of green gram.

References

1. Handreck KA. Phosphorus requirements of Australian native plants. Australian Journal of Soil Research. 1997;35:241-289.
2. Aghaalikhani M, Gholamhoseini M, Dolatabadian A, Khodaei-Joghan A, Asilan KS. Zeolite influences on nitrate leaching, nitrogen-use efficiency, yield and yield components of canola in sandy soil. Archives of Agronomy and Soil Science. 2012;58(10):1149-1169.
3. Ming DW, Dixon JB. Quantitative determination of clinoptilolite in soils by a cation-exchange capacity method. Clays and Clay Mineralogy. 1987;35:463-468.
4. Ming DW, Mumpton FA. Zeolites in soils. In 'Minerals in soil environments' 2nd edn. Journal of American Society of Soil Science. 1989;35:873-911.
5. Perez-Caballero R, Gil J, Benitez C, Gonzalez JL. Effect of adding zeolite to soils in order to improve the N-K nutrition of olive trees, preliminary results. American Journal of Agriculture Biological Science. 2008;2(1):321-324.