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Effect of Chlor-Alkali Solid Waste Effluent on NPK Content in Grain of A Little Millet Crop

KEYWORDS: Chlor-alkali factory, solid waste effluent, nitrogen, phosphorus, potassium, little millet

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ABSTRACT *The little millet (Panicum sumatrense Rath ex. Roem and Schult) crop variety SS. 81-1, exposed to chlor-alkali solid waste effluent @ 100 g m-2 (treatment - 1),200 g m -2 (treatment - 2), 300 g m-2 (treatment - 3) and 400 g m-2 (treatment - 4) was studied in vivo at the Agriculture Research Station, Ankuspur in the District of Ganjam, Odisha at an interval of 15 days starting from 30 days after sowing (DAS) till harvest of the crop following the ICAR technology proposed by Seetharam (1994) with little modification depending upon the soil condition and climate of the locality. The nitrogen, phosphorus and potassium content in grain were determined following the methods proposed by Misra (1968), Yoshida et. al. (1976) and Chapman (1976) respectively. The percentage of nitrogen showed almost identical value in control, treatments - 1,2 and 3. The percentage was found to be less in treatment - 4. Similar trend of results was also observed in case of phosphorus and potassium contents. The percentage of NPK in control and all treatments showed high significant F value ($p \leq 0.001$) for nitrogen and potassium whereas a very little variation was seen in case of phosphorus content. However, the analysis of variance test for control, treatments - 1, 2 and 3 with regard to percentage of NPK did not show significant variation. This indicates that the concentration of solid waste applied in treatment - 4 was, perhaps, higher than the tolerance limit of the crop. Besides, the precipitation, atmospheric temperature, relative humidity, solar insolation, soil characteristics, soil microbes, etc. do play vital role in variation of NPK content of grain of the crop plant.*

Introduction

The degradation of environment due to industrial waste threatens the survival of living beings. Literature available revealed mostly the adverse effects of chlor-alkali solid waste on algae (Mishra **et at**. 1985, 1986), on fish (Shaw **et al.** 1985) and on rice (Nanda **et al.** 1993, 1994, 1996, Behera **et al.** 1995). So far as the little millet crop is concerned, some work has been done by Indian Council of Agricultural Research (ICAR, 1992-93, 1993-94, 1994-95, 1995-96 and 1996-97) under All India Coordinated Small Millet Improvement Project associated with various cooperative agencies for the development of crop productivity. Most of these investigations are confined to fodder and grain yield. However, no work has been done on the effect of chlor-alkali solid waste effluent on the nitrogen, phosphorus and potassium content in grain of little millet crop. Therefore, in this investigation an attempt has been made to study the nitrogen, phosphorus and potassium content in grain of a little millet crop grown on various concentration of chlor-alkali solid waste effluent.

Study site and Environment

The experiment was conducted at the Agriculture Research Station (a Research farm of Orissa University of Agriculture and Technology, Bhubanswar, Odisha), Ankuspur (l9°46'N; 94°21'E) situated at a distance of about 25 km from the Bay of Bengal Coast, Odisha.

The climate of the experimental site was monsoonal with three distinct seasons i.e. rainy (July to October), winter (November to February) and summer (March to June). Out of 863.65mm of rain recorded during the experimental year, a maximum of 28.8 per cent was observed in June. The mean minimum and mean maximum atmospheric temperature recorded during the year were found to be normal. The mean minimum temperature ranged from 15.4°C (December) to 26.13°C (May) whereas mean maximum showed a range of 27.6°C (December) to 37.81 °C (May).

The soil was found to be sandy (75%) and acidic (pH = 6.58) in nature. The phosphorus and potassium contents of the soil were high (i.e., 9.0 and 46.6 ppm respectively) whereas the amount of organic carbon (%) was very low (0.35%). The solid waste of chlor-alkali factory (M/s. Jayashree Chemicals) applied in the field soil was found to be alkaline (pH=8.06). Textural analysis showed almost nil of sand, silt and clay. The waste soil exhibited a medium range of phosphorus and potassium contents. The organic carbon (%) of the waste was of very low order (Barik, 2016)

Materials and Methods

Twenty-five beds were prepared following the usual agricultural practice. Solid waste collected from the chlor-alkali factory was applied at the concentration of 100 g m^{-2}, 200 g m^{-2}, 300 g m^{-2} and 400 g $m^{-2}$and marked as treatment -1, 2, 3 and 4 respectively. The soil was mixed thoroughly in each bed and leveled. Five beds for each concentration and the control were maintained. ICAR technology proposed by Seetharam (1994) was employed for cropping with little modification depending upon the soil condition and climate of the locality. The sampling was made at an interval of 15 days starting with a 30 days period after sowing till the harvest of the crop.

Nitrogen was estimated following the usual micro-kjeldahl method (Misra, 1968), whereas phosphorus content was determined following the method proposed by Yoshida **et al.** (1976). The potassium content was estimated Flame Photometrically (Chapman, 1976).

Results and Discussion

The percentage of nitrogen showed almost identical value in control, treatments - 1, 2 and 3. The percentage was found to be less in treatment - 4. Similar trend of results was also observed in case of phosphorus and potassium contents in the control, treatments - 1, 2, 3 and 4 (Table - 1). The identical values of NPK in control, treatments - 1, 2 and 3 and low values in treatment - 4 might be due to some physicochemical interaction of solid waste with the soil. When compared to the findings of NPK contents in

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rice with these findings (Table - 2), the percentage of NPK showed more or less identical values to those observed by Patnaik (1982). ANOVA test relating to percentage of NPK (Table - 3) in control and all treatments showed high significant F value ($p \leq 0.001$) for nitrogen and potassium, whereas a very little variation was seen in case of phosphorus (%). However, the variance analysis for control, treatments - 1, 2 and 3 relating to percentage of NPK did not show significant variation. This indicates that the concentration of solid waste applied in treatment - 4 (400 g m^{-2}) was perhaps higher than the tolerance limit of the crop. Besides, the precipitation, atmospheric temperature, relative humidity, solar insolation, soil characteristics, soil microbes, etc. do play vital role in variation of NPK content in grain of the crop plant.

Table – 1. Percentage on nitrogen, phosphorus and potassium content of litle millet *(P. sumatrense*) grain in control and various treatments of Chlor-alkali solid waste (values are in mean ± SD, n = 5 each)

Percentage	Control	Treatment - 1	Treatment - 2	**Treatment - 3**	**Treatment - 4**
Nitrogen	0.941 ± 0.002	0.943 ± 0.003	0.943 ± 0.004	0.945 ± 0.002	0.891 ± 0.005
Phosphorus	0.054 ± 0.003	0.055 ± 0.002	0.055 ± 0.003	0.055 ± 0.003	0.051 ± 0.002
Potassium	0.628 ± 0.003	0.628 ± 0.003	0.629 ± 0.004	0.631 ± 0.004	0.612 ± 0.004

Table – 2. Percentage of nitrogen, phosphorus and potassium content of some grain samples

Sources	Crop	Variety	**Nitrogen (%)**	**phosphorus (%)**	**potassium (%)**
Patnaik (1982)	Rice	Parijat (Kharif)	1.39	0.061	0.600
Mashuri (Kharif)		Parijat (Rabi)	1.09	0.053	0.600
			1.09	0.036	0.600
This study	Little millet	SS. 81-1			
Treatment - 1		Control	0.94	0.054	0.628
			0.94	0.055	0.628
			0.94	0.055	0.629
Treatment - 2			0.94	0.055	0.631
Treatment - 3			0.89	0.051	0.612
Treatment - 4					

Table – 3 : Variance analysis test as applied to NPK content in grain of a little millet (*P. sumatrense*) in control and various treatments exposed to chlor-alkali solid waste.

	Control with treatment – 1,2, 3 and 4 (n = 25)	Control with treatment – 1,2 and 3 (n = 20)
Nitrogen (%)	F = 247.472*** LSD = 0.004	F = 1.430. NS
Phosphorus (%)	F = 2.577 (NS)	F = 0.167 NS
Potassium (%)	F = 17.783*** LSD = 0.005	F = 0.575 NS

* $\leq$ 0.05p, ** $\leq$ 0.01, *** $\leq$ 0.001, NS = Not Significant, LSD = Least Significant Difference (p = 0.05)

Conclusion

The percentage of nitrogen, phosphorus and potassium content of grain revealed identical values in control, treatment – 1, treatment – 2 and in treatment – 3 but less in treatment – 4. This might be due to the influence of chlor-alkali solid waste effluent applied in the field soil (400g m^{-2}) which went higher than the tolerance limit of the crop. Besides, the soil characteristics, precipitation, atmospheric temperature, relative humidity, solar insolation, soil microbes, etc. do play vital role in variation of NPK content in grain of the crop plant.

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