Original Research Paper BOTANY

Effect of Chlor-Alkali Solid Waste Effluent on Protein Content in Grain of a Little Millet Crop

K. L. Barik Assistant Professor,Department of Botany, North Orissa University, Baripada-757003,Mayurbhanj (Odisha)

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 protein content in grain was estimated following the method proposed by Lowry et al. (1951). Protein content in grain exhibited identical values in control, treatments - 1, 2 and 3. Treatment - 4 showed low values compared to control, treatments - 1, 2 and 3. The protein content in the control, treatments - 1, 2, 3 and 4 showed very high significant F value ($p \leq 0.001$) whereas very little or no variation in protein content was observed in the control and treatments - 1, 2 and 3. The precipitation, atmospheric temperature, relative humidity, solar insolation, soil characteristics and the soil amendment practices with modern improved technology do play vital role in variation of protein content in grain of the crop plant.

KEYWORDS Chlor-alkali factory, solid waste effluent, little millet, protein

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 al**. 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 (lCAR, 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 protein content of little millet crop. Therefore, in this investigation an attempt has been made to study the protein content in grain of a little millet crop exposed to 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 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. The protein content of the sample was determined following the method proposed by Lowry **et al.** (1951) with BSA as the standard.

Results and Discussion
Protein content (g per 100g of grain sample) exhibited identical values in control, treatments – 1, 2 and 3. Treatment - 4 showed low value compared to control, treatments - 1, 2 and 3 (Table - 1). The identical value of protein in control, treatment - 1, 2 and 3 and less in treatment - 4 is probably due to effect of solid waste applied in the field soil. Compared to rice and wheat (Table - 2), the millet showed a trend of rice < millet < wheat in protein content as reported by Gopalon **et al**. (1989).

Table – 1. Protein content (g per 100 g of seed samples) of little millet (P. sumatrense) grain in the control and various treatments exposed to Chlor-alkali solid waste (values are in mean ± SD, n = 5 each)

Variable	Protein
Control	7.654 ± 0.044
Treatment - 1	7.657 ± 0.042
Treatment - 2	7.661 ± 0.027
Treatment - 3	7.664 ± 0.022
Treatment - 4	7.418 ± 0.059

Table – 2. Protein content of some Indian foodstuffs (g per 100g of seed samples).

Sources	Crop	Protein
Gopalon **et al**. (1989)	Rice (Milled)	6.8
	Wheat	11.8
	Finger millet	7.3
	Proso Millet	12.5
	Foxtail Millet	12.3
	Kodo millet	8.3
	Barnyard millet	6.2
	Little millet	7.7
This study	Little millet	
	Control	7.65
	Treatment - 1	7.66
	Treatment - 2	7.66
	Treatment - 3	7.66
	Treatment - 4	7.42

ANOVA test (Table - 3) pertaining to protein content in the control, treatments - 1, 2, 3 and 4 showed very high significant F value ($p \leq 0.001$) whereas very little or no variation in protein content was observed in the control and treatments - 1, 2 and 3. This explains that the solid waste applied up to treatment - 3 has very little or no impact on millet crop ***(P. sumatrense*)**. In treatment - 4, the concentration of solid waste in the soil might have been higher than the tolerance limit of the crop. Besides, the precipitation, atmospheric temperature, relative humidity, soil characteristics, and soil amendment practices with modern improved technology do play vital role in variation of protein content in grain of the crop plant.

Table – 3. ANOVA test pertaining to amount of protein content in the grain of P. sumatreance 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)
Protein	F = 37.37.262*** LSD = 0.053	F = 0.103 (NS)

*** ≤ 0.001, NS = Not Significant,
LSD = Least Significant Difference (p = 0.05)

Conclusion

The protein content in grain of little millet crop exosposed to chlor-alkali solid waste effluent revealed identical value in control, Treatment – 1,2 and 3 but less in treatment – 4. This indicates that the application of chlor-alkali solid waste effluent up to the concentration of 300g m^{-2} (treatment-3) is not detrimental to the crop plant on protein content in grain. However, this concentration of chlor-alkali solid waste effluent applied in the field would vary from place to place and also from crop to crop because of climatic variation of the place and also the genetic set up of the crop. Besides, the soil quality, and soil amendment practices with modern improved technology also play major role in the detoxification of the solid waste concentration applied in the soil.

Acknowledgements

The author gratefully acknowledges the financial assistance extended by University Grants Commission (U.G.C.), New Delhi. Thanks are due, to Prof. B.N. Misra (Retd.), Prof. M.K. Misra (Retd.), and Prof. A.K. Panigrahi (Retd), Department of Botany, Berhampur University, Berhampur, Odisha for their co-operation throughout the progress of this investigation. The author is also indebted to Dr. R.C. Misra (Sr. Breeder and Officer in- charge), Dr. H.K. Mohapatra (Entomologist), Dr. S. Panda (Pathologist), Dr. B.K. Jena (Agronomist) and Mr. S.N. Biswal (Field Asst.) of Agriculture Research Station, Ankuspur for providing necessary help throughout the cropping.

References

1. Barik, K.L. (2016) : Effect of chlor-alkali solid waste effluent on the fodder and grain yield of a little millet crop. The Global J. Environ. Sci. and Research, 3 (1), 85-88.
2. Behera, M., Padhy, B. & Patra, B. (l995): Effect of industrial effluent on seed germination and seedling growth of rice (Oryza sativa L). Neo Botanica, 3 (1&2),7-12.
3. Gopalon, C, Ramasastri, B.V. & Balasubramanian-eds. (1989) : Nutritive value of Indian food, National Institute of Natrition, ICMR, Hyderabad.
4. ICAR. (1992-93) : All India coordinated small millet improvement project. Annual Report, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore.
5. ICAR (1993-94) : All India coordinated small millet improvement project. Annual Report, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore.
6. ICAR. (1994-95) : All India coordinated small millet improvement project. Annual Report, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore.
7. ICAR. (1995-96) : All India coordinated small millet improvement project. Annual Report, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore.
8. ICAR. (1996-97) : All India coordinated small millet improvement project. Annual Report, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore.
9. Lowry, O.H., Rosebrough, N.J., Farr, A.L. & Randall, R.J. (1951) : Protein measurement with Folin phenol reagent J.. Biol. Chem. 193: 265 - 275.
10. Mishra, B.B., Nanda, D.R. & Misra, B.N. (1985) : Reclamation with blue-green algae; Mercury uptake by algae cultured in solid waste of a chlor-alkali factory and its effect on growth and pigmentation. J. Environ. Biol., 6 (4), 223-231.
11. Mishra, B.B., Nanda, D.R. & Misra, B.N. (1986) : Reclamation with blue-green algae; Changes in free amino acid content of algae exposed to solid waste of a Chlor - alkali factory. Microb. Lett., 33, 139-142.
12. Nanda, D.R., Mishra, B.B. & Misra, B.N. (1993) : Effect of solid waste from a Chlor-alkali factory on rice plants; Mercury accumulation and changes in biochemical variables. J. Environ. Studies, 45,23-28.
13. Nanda, D.R., Mishra, B.B. & Misra, B.N. (1994) : Changes in bio- chemical variables of a Crop plant exposed to saturated solid waste extract from a Chlor-alkaJi factory. Mendel, 11 (3 & 4), 151-152.
14. Nunda, D.R., Mishra, B.B. & Misra, B.N. (1996) : Effect of solid waste from a Chlor-alkali factory on accumulation of mercury and changes in biomass of rice roots. Oryza., 33, 51-54.
15. Seetharam, A. (1994) : Technology for increasing finger millet and other small millets production in India, Project Coordination Cell, All India Coordinated Small Millet Improvement Project, Indian Council of Agricultural Research, GKVK Campus, Bangalore.
16. Shaw, B.P., Sahu, A, & Panigrahi, A.K. (1985) : Residual mercury concentration in brain, liver and muscle of contaminated fish collected from an estuary near a caustic-chlorine industry. Curr. Sci., 54 (16), 810-812.