

ECOLOGICAL ANALYSIS OF A LITTLE MILLET CROP ECOSYSTEM EXPOSED TO CHLOR-ALKALI SOLID WASTE EFFLUENT, III. ABOVE GROUND NET PRODUCTION

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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. ICAR technology was followed for cropping with little modification depending upon the soil condition and climate of the locality. Short term harvest method was employed for the determination of various compartmental biomass (dry weight) values. Live green, standing dead and grain were taken together for estimation of above ground biomass. The productivity of above ground compartment was determined by taking the increment value of concerned biomass from the successive sampling period and was expressed as g m^{-2} . Above ground net production in all the beds increased with the increase in successive sampling period. Maximum aboveground production was observed during 87 DAS in all control and treatment beds. Compared to control, treatment-1,2 and 3 showed increasing trend whereas treatment -4 exhibited lower value to that observed in treatment-3 bed in most of the sampling period (except 30 DAS). A declining trend of above ground net production from control to treatment -1, 2, 3 and 4 was observed at 30 days after sowing.

Keywords : Chlor-Alkali Factory, Solid Waste Effluent, Little Millet, Above Ground Net Production.

I. INTRODUCTION

Millet in general is the staple food of tribals and also of the labour class in the eastern part of the state of Odisha. The crop withstands heavy rain and drought condition to a considerable extent. *Panicum sumatrense*, formerly known as *Panicum miliari* is one of the typical minor millet crop grown widely on the hill tops, hill slopes and also in the hill bases. Recently cultivation of this crop has also been taken up in the plains. Compared to other small millet, *Panicum sumatrense* has some unusual features. It has the capacity to withstand drought and water logging to a considerable extent. It does not need crop protection measures.

Basically it is free from pest. It does not require either irrigation or fertilizer and pesticide. Simply the tribals broadcast the seed by hand with the onset of first rain and harvest after 85-90 days.

II. LITERATURE REVIEW

The degradation of environment due to industrial waste is a global concern. The adverse effects of chlor-alkali solid waste on algae were studied by Mishra et al., 1985 [1], 1986[2]; on fish by Shaw et al., 1985[3] and on rice by Nanda et al., 1993[4], 1994[5], 1996[6] and Behera et al., 1995[7]. Some work has been reported on the primary productivity of groundnut by Sahu et al. 1981[8] and Sundermoorty & Lakshamanachary, 1989[9]; maize by Khohar, 1981[10]; barely by Hojokinen, 1990[11]; onion by Saraf, 1994[12]; mungbean by Keshan, 1994[13]; rice and wheat by Chaturvedi, 1996[14]; on vegetable crop by Leelavani, 1996[15] and many more. So far as the little millet crop is concerned, some work has been done by Barik, 2016[16] and Indian Council of Agricultural Research, ICAR, 1992-93[17], 1993-94[18], 1994-95[19], 1995-96[20] and 1996-97[21]) under All India Coordinated Small Millet Improvement Project associated with various cooperative agencies for the development of crop productivity. In all agricultural studies, emphasis is given on production of economic return. However, in plant ecology studies production includes all the compartments (i.e. live green, standing dead and grain) including belowground parts. This type of study is seldom made by agriculture workers. Most of the investigation is confined to fodder and grain yield only. Further, no work has been reported on the effect of chlor-alkali solid waste effluent on the primary productivity of little millet crop. Therefore, in this study an attempt was made to assess the productivity of above ground net production of a little millet (*Penicum sumatrense*) crop (variety SS. 81-1) exposed to various concentration of chlor-alkali solid waste effluent with a view to management of industrial waste in Agriculture.

2.1 Study site and Environment

The experiment was conducted at the Agriculture Research Station (a Research farm of Orissa University of Agriculture and Technology, Bhubaneswar, Odisha), Ankuspur (19°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 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 the mean maximum showed a range of 27.6°C (December) to 37.81 °C (May).

The soil of the experimental site 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.

III. 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[22] was employed for cropping with little modification depending upon the soil condition and climate of the locality. Short term harvest method proposed by Odum, 1960[23] was employed for the determination of various compartmental biomass values (dry weight). The sampling were made at an interval of 15 days starting from 30 days after sowing (DAS) till harvest of the crop. Five quadrates of 50cm x 50cm size were harvested randomly in each bed, labeled and brought to the laboratory. The live green, standing dead and grain available in each sampling period were collected carefully and separated. Care was taken not to leave any plant material escape during processing. All these plant materials (compartment wise) were first dried at room temperature and then transferred to oven for drying at 80⁰C for 48 hours and weighed. The above ground net production was determined by summing up the increments of live green, standing dead and grain biomass values and was expressed in g m⁻².

IV. RESULT AND DISCUSSION

Figure -1, shows the above ground net production value in control and various treated beds at different days after sowing. The value in control and all treated beds increased with the increase in successive sampling period. A maximum of 538.269 ± 17.179, 568.582 ± 22.904, 593.574 ± 24.609, 626.527 ± 25.255 and 605.942 ± 19.932 above ground net production were observed in control, treatment-1, treatment-2, treatment-3 and treatment-4 respectively at 87 DAS. Compared to control, treatment-1, -2, and 3 showed increasing trend whereas treatment-4 exhibited a lower value to that observed in treatment-3 bed.

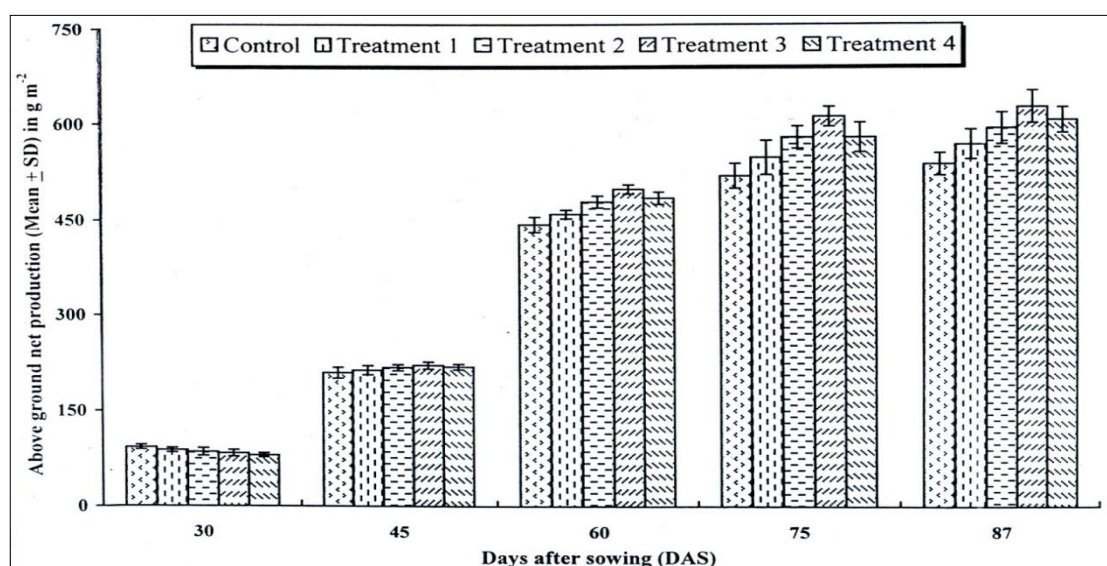


Fig. 1 Above ground net production (mean ± SD) in g m⁻² at different days after sowing

Increase in above ground net production from 30 DAS to 87 DAS in all the beds was mostly due to growth of the crop. However, the gradual increase in production value from control to treatment-1, treatment-2 and treatment -3 might be due to the influence of solid waste at 45 DAS, 60 DAS, 75 DAS and at 87 DAS. The concentration applied in case of treatment -4 was perhaps higher than the threshold value and thus affected the crop in the amended soil. This caused reduction in above ground net production to some extent. During early stage of growth i.e. 30 DAS, the production declined from control to treatment-1,2,3 and became less in treatment - 4 which might be due to the toxicity of waste soil concentration applied in field soil. The precipitation after 30 DAS might have reduced the toxicity of solid waste, as a result of which an increasing trend from control to treatment-1, treatment-2 and then to treatment-3 was observed during 45 DAS, 60 DAS, 75 DAS and 87 DAS.

Analysis of variance test (Table -1) pertaining to above ground net production showed a high significant F value ($P \leq 0.001$) at 60 DAS, 75 DAS and at 87 days after sowing, whereas no significant variation was observed at early stage of growth (i.e. 30 DAS and 45 DAS). This revealed that the concentration of chlor-alkali solid waste effluent applied in the field soil might not be detrimental to above ground net production of the crop.

Table-1 : Variance ratio test (F) on above ground net production of a little millet crop (*Panicum sumatrense*, Variety : SS. 81-1) exposed to solid waste effluent at different days after sowing (n=25), Least Significant Difference (LSD) at 0.05p.

Days after sowing	'F' Values	LSD
30	0.611 (NS)	-
45	2.375 (NS)	-
60	27.296 ***	12.581
75	16.291 ***	26.108
87	17.473 ***	24.526

*** ≤ 0.001 , NS = Not Significant,

V. CONCLUSION

The chlor-alkali solid waste effluent at the concentration of 100 g m^{-2} , 200 g m^{-2} and 300 g m^{-2} applied in field soil in treatment-1, treatment-2 and treatment-3 respectively might not have affected the above ground net production of little millet crop. Moreover, the concentration of waste soil (400 g m^{-2}) applied in treatment-4 might be detrimental for crop growth. As a result, less amount of above ground net production was observed in treatment-4 compared to treatment-3. 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 played major role in the detoxification of chlor-alkali solid waste effluent applied in the field soil.

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REFERENCES

1. B.B. Mishra, D.R. Nanda and B.N. Misra, 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), 1985, 223-231.
2. B.B. Mishra, D.R. Nanda and B.N. Misra, 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, 1986, 139-142.
3. B.P. Shaw, A. Sahu and A.K. Panigrahi, Residual mercury concentration in brain, liver and muscle of contaminated fish collected from an estuary near a caustic-chlorine industry, *Curr. Sci.*, 54 (16), 1985, 810-812.
4. D.R. Nanda, B.B. Mishra and B.N. Misra, Effect of solid waste from a Chlor-alkali factory on rice plants; Mercury accumulation and changes in biochemical variables, *J. Environ. Studies*, 45, 1993, 23-28.
5. D.R. Nanda, B.B. Mishra and B.N. Misra, Changes in bio- chemical variables of a crop plant exposed to saturated solid waste extract from a Chlor-alkali factory, *Mendel*, 11 (3 & 4), 1994, 151-152.
6. D.R. Nanda, B.B. Mishra and B.N. Misra, Effect of solid waste from a Chlor-alkali factory on accumulation of mercury and changes in biomass of rice roots, *Oryza.*, 33, 1996, 51-54.
7. M. Behera, B. Padhy and B. Patra, Effect of industrial effluent on seed germination and seedling growth of rice (*Oryza sativa* L). *Neo Botanica*, 3 (1&2), 1995, 7-12.
8. S.N. Sahu, R.S. Dwivedi and D.D. Misra, Net primary productivity of groundnut under agro-ecosystem. *Trop. Ecol.*, Silver Jubilee Symp., 1981, 217.
9. P. Sundermoorthy, and A.S. Lakshmanachary, Effect of alum treated effluent and activated sludge process treated effluent on growth parameter and yield of groundnut. Proc. 76th Indian Sci. Cong. Madurai, Section -IV, Abst., 1989, 246.
10. M.F.K., Khokhar, Biomass, productivity and growth analysis of maize. *Trop. Ecol.*, Silver Jubilee Symposium abs., 1981, 120.

11. R. Hojokinen, Effects of phosphorus precipitation chemicals on characteristics and agricultural value of municipal sewage sludge. 2. Effect of sewage sludge on yield, element contents and uptake by spring barley. *Acta agric. Scand.*, 40 (2), 1990, 131-140.
12. R.K. Saraf., Efficacy of herbicides for weed control in kharif Onion (*Allium cepa*. L) in Satpura Plateau of Madhya Pradesh. Ph. D Thesis, Dr. Hari Singh Gour Vishwavidyalaya, Sagar, Madhya Pradesh, 1994.
13. U. Keshan, Cadmium phytotoxicity and its influence on some morphological, biochemical and ultrastructural characteristics of Mungbean (*Vigna radiata* L. Wilczek) in relation to productivity . Ph. D. Thesis, University of Calcutta, Calcutta, 1994.
14. S.S. Chaturvedi, Eco-behavior of some crops under waste water irrigation. Ph.D. Thesis, Banaras Hindu University, Varanasi, India, 1996.
15. A. Leelavani, Studies on toxicity of some heavy metals with reference to flyash application in some vegetable crops. Ph. D. Thesis, Berhampur University, Berhampur, Orissa, 1996.
16. K.L. Barik, Effect of chlor-alkali solid waste effluent on the fodder and grain yield of a little millet crop. *Global J. Environ. Sci. and Research*, 3 (1), 2016, 85-88.
17. ICAR, All India coordinated small millet improvement project, *Annual Report*, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore, 1992-93.
18. ICAR, All India coordinated small millet improvement project, *Annual Report*, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore, 1993-94.
19. ICAR, All India coordinated small millet improvement project, *Annual Report*, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore, 1994-95.
20. ICAR, All India coordinated small millet improvement project, *Annual Report*, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore, 1995-96.
21. ICAR, All India coordinated small millet improvement project, *Annual Report*, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore, 1996-97.
22. A. Seetharam, *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, 1994.
23. E.P. Odum, Organic production and turnover in old field succession. *Ecology*, 41., 1960, 39-49.