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Effect of Chlor-Alkali Solid Waste Effluent on Caloric Content in Fodder of A Little Millet Crop

BOTANY

KEYWORDS : Chlor-alkali factory, solid waste effluent, little millet, caloric content, fodder,

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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 gm-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 method and formula as proposed by Leith (1975) were employed for the determination of caloric value of the material. Caloric content of fodder in control and various treatments were determined. Very little or no increase in caloric value was observed from control to treatment - 1, 2 and then to treatment-3. Treatment - 4 showed less caloric content to that of treatment - 3. The caloric value of fodder in control and all treatments showed high order of variation ($p \leq 0.001$). However, the ANOVA test for caloric values in the control, treatments - 1, 2 and 3 did not show significant variation

INTRODUCTION

The degradation of environment due to industrial waste threatens the survival of living beings. Literature available revealed mostly the adverse effect 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. However, no work has been done on the effect of chlor-alkali solid waste effluent on the caloric content of little millet crop. Therefore, in this investigation an attempt has been made to study the caloric content in fodder 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 harvested plant samples i.e. fodder and grain were dried and powdered in a Willy Mill separately. These fine powdered materials (about 1g) were pressed to form pellets. Five replicates were taken from control and from each of the treatments exposed to various concentration of solid waste effluent. The caloric value of the material was determined by igniting these pellets in a "Toshniwal" make Bomb Calorimeter following the method and formula given by Leith (1975).

$$V = \frac{W\ (\Delta t - \Delta c)}{G}$$

Where,

V = Calorific value of the biological material
W = Water value of the instrument
t = Corrected temperature difference reading at the Beckmann thermometer before and after burning
c = Correction value for the ignition wire
G = Sample dry weight.

RESULT AND DISCUSSION

Caloric content of fodder in control, treatments - 1, 2, 3 and 4 are presented in Table –1. Very little or no increase in caloric value was observed from control to treatments – 1, treatment - 2 and then to treatment – 3. Treatment .- 4 showed less caloric content to that of treatment - 3, even the value was found to be less than that observed in the control. The trend of caloric content i.e. control < treatment - 1 < treatment - 2 < treatment - 3 was most probably due to the influence of solid waste. The decrease in caloric content in treatment - 4, was perhaps, due to the adverse effect of solid waste. The concentration of solid waste applied in treatment - 4 might have been higher than the tolerance limit of the crop.

Compared to rice (Parijat and Mashuri varieties), the caloric content of present study showed greater variation (Table

-2). The caloric value of fodder revealed less caloric content to that of Parijat, and Mashuri varieties of rice. ANOVA test (Table -3) relating to fodder in the control and 4 treatments showed high amount of differences (0.00lp). However, the ANOVA test for control, treatments - 1, 2 and 3 caloric values of fodder did not show significant variation. The results, thus, revealed that the solid waste applied in treatment - 4 might be higher than the crop tolerance limit. Besides, the soil characteristics, precipitation, atmospheric temperature, relative humidity, etc. do play vital role in variation of caloric content in fodder.

Table – 1 : Caloric values (Cal g^{-1} dry wt.) in fodder of a little millet crop (*P. sumatrense*) in control and various treatments exposed to chlor-alkali solid waste at harvest (values are in mean ± SD, n = 5 each)

Variable	Fodder
Control	2737.882 ± 3.007
Treatment - 1	2739.159 ± 2.965
Treatment - 2	2739.980 ± 3.098
Treatment - 3	2740.482 ± 3.219
Treatment - 4	2678.087 ± 5.418

Table – 2 : Caloric value in fodder of some crop ecosystem at harvest.

Sources	Crop	Variety	Fodder
Patnaik (1982)	Rice	Parijat(kharif) a	3297.70
		b	2823.21
		Parijat (Rabi) a	3459.15
		b	4199.07
		Mashuri a	3060.46
		b	3157.11
This study	Little millet	SS. 81-1 c	2737.88
		d	2739.16
		e	2739.98
		f	2740.48
		g	2678.09

a = without fertilizer, b = with fertilizer, c = control, d = treatment – 1, e = treatment – 2, f = treatment – 3 and g = treatment – 4 (treatment – 1,2,3, and 4 are exposed to chlor-alkali solid waste).

Table – 3 : Variance analysis of caloric value in fodder of a little millet crop (*P. sumatrense*) showing the variance ratio (F), the least significant differences (LSD) and the significant level (p) in control and various treatments exposed to chlor-alkali solid waste effluent.

Compartment	Contrl with treatment – 1,2,3 and 4 (n = 25)	Contrl with treatment – 1,2 and 3 (n = 20)
Fodder	F = 286.783 *** LSD = 4.856	F = 0.651 (NS)

*** ≤ 0.001, NS = Not Significant

CONCLUSION

In this investigation the caloric value of fodder of little millet crop showed very little fluctuation following the trend, control < treatment-1 < treatment-2 < treatment-3 > treatment-4. The rain fall at the early stage of growth could perhaps have diluted the waste soil concentration, as a result of which an increasing trend in caloric value was obtained from control to treatment-1, treatment-2 and then to treatment-3. Treatment-4 showed less caloric content compared to treatment-3. This might be due to the influence of waste soil concentration in soil. It revealed that the chlor-alkali solid waste effluent applied in treatment-4 might be higher then the tolerance limit of the crop. However, this concentration of chlor-alkali solid waste 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 setup of the crop. Besides, the soil quality and the soil amendment practices with modern improved technology also play major role in the detoxification of the waste soil concentration applied in the field.

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