EFFECT OF CHLOR-ALKALI SOLID WASTE EFFLUENT ON ROOT MORPHOLOGY OF A LITTLE MILLET CROP

BOTANY

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 length of adventitious root increased with the increase in sampling period in all treatment and control beds. However, a gradual decreasing trend in length was observed from control to treatment-1, treatment-2, treatment-3 and then to treatment-4 in all the sampling period. The number of adventitious root on the other hand reduced gradually from control to treatment-4 during early stages of growth i.e. on 30DAS and 45DAS, Thereafter, the number showed a trend of control < Treatment - 1 < Treatment - 2 < Treatment - 3 > Treatment - 4 at 60 DAS, 75 DAS and 87 DAS. Maximum numbers of adventitious roots were recorded during 75 DAS in all control and treatment beds.

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.

Literature Review

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 the investigations are confined to fodder and grain yield. However, no work has been done on the effect of chlor-alkali solid waste effluent on root morphology of little millet crop.

Aim of the Study

The aim of this investigation is to find out the effect of chlor-alkali factory solid waste effluent on root morphology of a little millet crop with a view to waste management in Agriculture.

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 (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 the 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 from 30 days after sowing (DAS) till the harvest of the crop. Five plants were selected randomly from each control and treatments. The adventitious roots were counted and measured. The average values were taken and incorporated in this investigation.

Results

The length of adventitious roots in each treatment and control at 30,45,60,75 and 87 days after sowing (DAS) are presented in Fig - 1. It is observed that the root number gradually decreased from control to treatment - 4 following a trend control > treatment -1 > treatment -2 > treatment - 3 > treatment - 4 in all the sampling period. However, an increasing trend of length was marked with the increase in sampling period in both control and treatment beds. A maximum of 18.9 ± 0.987, 18.8 ± 0.914, 18.5 ± 1.625, 18.3 ± 1.512 and 17.7 ± 2.025 cm were observed in control, treatment - l, treatment - 2, treatment - 3 and treatment - 4 respectively during harvest.
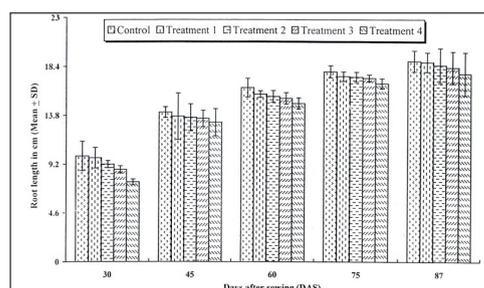

Fig - 1 : Length of roots in cm (Mean ± SD) at different days after sowing.

Original Research Paper

Figure 2 shows the number of roots for each control and various treatment plants at different sampling periods. It is observed that the number gradually got reduced from control to treatment - 1 to treatment - 2 to treatment - 3 and then to treatment - 4 on 30 DAS and 40 DAS. However, the number of roots increased from the control to treatment - 1 then to treatment - 2 and peaked in treatment - 3. There was reduction in number of roots in the treatment - 4 (compared to treatment - 3) on 65, 75 and 87 DAS. Maximum number of roots was observed during 75 DAS in all treatments and control.
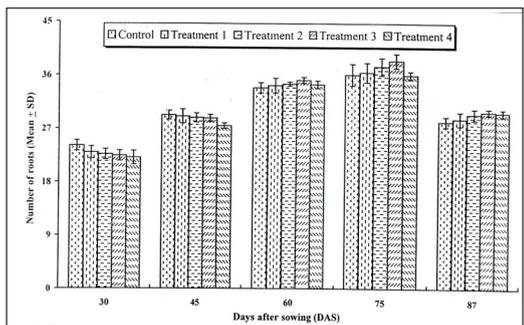

Fig - 2 : Number of roots (Mean ± SD) at different days after sowing.

Discussion

The root length followed the trend, control > treatment - 1 > treatment - 2 > treatment - 3 > treatment - 4 at different days after sowing which was probably due to availability of mineral and nutrient in soil profile. The waste soil might have undergoes some chemical reaction in the soil that provided nutrient at upper soil profile. Number of roots on the other hand during 30 DAS and 45 DAS followed a decreasing trend from control to treatment - 4 which might be due to increase in waste soil concentration in soil. Afterwards (i.e. 60 DAS, 75 DAS and 87 DAS), gradual increase in number of root from control to treatment - 1 to treatment - 2 to treatment - 3 and reduction in root number in treatment - 4 indicated that the concentration of waste soil from treatment -1 to treatment -3 went in favour of the formation of new roots. In treatment - 4, waste soil showed adverse effects that seized the formation of new roots at 60DAS, 75 DAS, and 87 DAS, However, the ANOVA test relating to root morphology (i.e. root length and number of roots) did not show any definite trend (Table-1). The length and number of roots were perhaps not affected by soil amendment as evident from the results of ANOVA test.

Table-1. Variance ratio test on the root morphology of a little millet crop (*P. sumatrense*) variety, SS. 81-1 in control and four treatments at different days after sowing (n=25).

Days after sowing (DAS)	Root length (cm)	Root (no)
30 DAS	F=8.015*** LSD = 1.042	F=3.305 LSD=1.294
45 DAS	F=0.397 NS	F=4.037* LSD=1.059
60 DAS	F=4.103* LSD=0.804	F=2.082 NS
75 DAS	F=3.609* LSD=0.621	F=5.158** LSD=1.353
87 DAS	F=0.435 NS	F=1.889 NS

*< 0.05p, **< 0.01p ***< 0.001, NS=Not Significant, LSD= Least Significant Difference (p=0.05)*

Conclusion

In this investigation gradual decrease in length of roots from control to treatment – 1, treatment – 2, treatment - 3 and then to treatment - 4 might be due to the adverse effect of chlor-alkali solid waste effluent applied in the field. The gradual decline in root number from control to treatment-3 at early stage of growth is attributed to the adverse effect of waste soil. However 60 DAS and onwards a gradual increase in number of roots from control to treatment -3 and reduction in number of roots in treatment - 4 indicated that the concentration of waste soil from treatment -1 to treatment - 3 might have gone in favour of the formation of new roots. However, particularly in treatment-4, the concentration applied in the field soil might have been higher than the crop tolerance limit, as a result of which the number of adventitious roots declined in treatment-4 compared to treatment - 3 plants. 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 by modern improved technology also played major role in the detoxification of the solid waste concentration applied in the field soil.

Acknowledgements

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. and 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. ICAR (1992-93): All India coordinated small millet improvement project. Annual Report, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore.
4. ICAR (1993-94): All India coordinated small millet improvement project. Annual Report, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore.
5. ICAR (1994-95): All India coordinated small millet improvement project. Annual Report, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore.
6. ICAR (1995-96): All India coordinated small millet improvement project. Annual Report, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore.
7. ICAR (1996-97): All India coordinated small millet improvement project. Annual Report, Indian Council of Agricultural Research and Cooperating Agencies, Bangalore.
8. Mishra, B.B., Nanda, D.R. and Misra, B.N. (1985): Reclamation with blue-green algae; Mercury uptake by algae cultured in solid waste of a chIor-alkali factory and its effect on growth and pigmentation. J. Environ. Biol., 6(4), 223-231.
9. Mishra, B.B., Nanda, D.R. and 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.
10. Nanda, D.R., Mishra, B.B. and 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.
11. Nanda, D.R., Mishra, B.B. and 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.
12. Nunda, D.R., Mishra, B.B. and 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.
13. 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.
14. Shaw, B.P., Sahu, A, and 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.