Research Article

EFFECT OF METALLIC POLLUTANTS (COBALT, NICKEL, LEAD) ON SEED GERMINATION OF MULTIPURPOSE TREE SPECIES (*Acacia nilotica)*

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ABSTRACT
Studies revealed that, control treatment showed constantly higher seed germination while the concentrations of Cobalt, Nickel and Lead chloride reported negative impact on seed germination of*Acacianilotica*. In case of Cobalt chloride, overall mean seed germination was 19.10 per cent at 5 DAS and 62.75 per cent at 19 DAS. The highest germination was recorded in control (88.15%) followed by 100 ppm (85.56%), 200 ppm (73.33%) and 500 ppm (65.56%) at 19 DAS while in concentrations of Nickel chloride, germination of seeds started from 5 DAS in all the cases except 2000 ppm where it was observed from 14 DAS with 16.67 per cent germination. Control treatment showed the higher germination percentage as compared to other treatments during 5 to 19 DAS. Germination in concentrations of Lead chloride was recorded on 5 DAS in all the treatments except 2000 ppm concentration where germination was recorded at 14 DAS. The mean germination of 15.62 per cent was recorded at 5 DAS and 56.40% at 19 DAS. Maximum seed germination was obtained in control (88.15%).

INTRODUCTION

Since the down of the industrial revolution, mankind has been introducing numerous hazardous compounds in to the biosphere (Henry, 2000). These hazardous pollutants consist of a variety of organic compounds and heavy metals, which pose serious threat not only to human health but also to other flora and fauna of the earth. Heavy metal poses severe threat to the environment the long term basis and non reversible. The metals commonly found in the environment beyond the critical level as a result of human activities includes Cu, Zn, Ni, Pb, Cd, Co, Hg, Cr and As. There is an urgent need to reduce excess metals present in soil, sediments and water bodies so as to prevent environmental contamination (Lasat, 2000; Cheng, 2003). Recently, scientist and engineers have started to generate cost effective technologies that includes the use of micro-organisms and live plantin the cleaning process of polluted areas (Ebbs and Kochian, 1998; Wasay *et al*., 1998). Several studies have been conducted in order to evaluate the effect of different heavy metal concentration on live plants (Reeves and Baker, 2000; Raskin and Ensely, 2000). Most of these studies have been conducted using seedlings or adult plants (Chaterjee and Chaterjee, 2000; Pitchel *et al*., 2000).

Acacia nilotica belongs to family Luguminoceae and evergreen tree with a short, thick, cylindrical trunk, thin spreading crown and feathery foliage. It is commonly grown along roadsides, canal banks, drainage embracement and railway tracks. Farmers grow this tree naturally on the agricultural land, wasteland and on field boundaries. Therefore, present study was aimed to determine effect of metallic pollutants on seed germination of multipurpose tree species for the development of eco-friendly environment.

MATERIALS AND METHODS

Experiment was conducted in the experimental field of Department of Forestry, IGKKV, Raipur in completely randomized block design with seven concentrations replicated thrice. Fast growing and nitrogen fixing multipurpose tree species *Acacia nilotica* was selected for the study. Uniform sized and shape of seed of tree species was selected and treated with hot water (85^0C) for breaking the hard seed coat dormancy. When water started boiling the container removed from heating source and temperature immediately come down at 75 to 80^0C. Seed was kept in this water and left for overnight (Agrawal, 2003) after which uniform swelled seeds were selected and sown three seed in each container. After emergence and establishment of seedlings thinning was done to maintain one seedling in each container.

Seven concentrations consisting of 0, 100, 200 500, 700, 1000 and 2000 ppm of metallic pollutants Cobalt chloride, Nickel chloride and Lead chloride were used on the basis of per bag of soil on dry weight basis. The application of different treatments of each pollutant was given and mixed separately in the soil of each bag, so that it could be homogeneous. Thus multiplying of 100 ml stock solution of each concentration of each pollutant was prepared in the lab for 60 bags and one treatment without any pollutant served as control. The observations on seed germination was recorded for different treatments and analyzed statistically.

RESULTS AND DISCUSSION

Effect of metallic pollutants on seed germination of *Acacia nilotica*

Effect of Cobalt chloride: Significant variation was observed in seed germination due to concentrations of Cobalt chloride (Table 1). Seed germinated early i.e., 5 DAS and almost completed up to 19 DAS in all the treatments. Overall mean seed germination was 19.10 per cent at 5 DAS and 62.75 per cent at 19 DAS. The highest germination was recorded in control (88.15%) followed by 100 ppm (85.56%), 200 ppm (73.33%) and 500 ppm (65.56%) at 19 DAS. The germination percentage decreased gradually with increase in concentrations however, it was lowest in 2000 ppm (33.33%). Interaction between days to germination and cobalt chloride concentrations showed significant differences in seed germination. Smiderle *et al.* (2005) studied the time requirement for seed germination process with more or less similar results. Chaturvedi and Das (2004) reported early germination in *Acacia nilotica* as compared to *A. auriculiformis*. Early germination after sowing in *A. nilotica* was also reported by Singh (1998). Thukral and ParaminderKaur (1987) studied the germination and seedling growth in *Cyamopsis tetragonoloba* where presence of Cobalt delayed as well as suppressed the germination process as observed in the present studies.

Table 1. Effect of different concentrations of Cobalt chloride on seed germination of *Acacia nilotica*.

Treatments	Germination per cent of *Acacia nilotica*						
	5 DAS	8 DAS	11 DAS	14 DAS	17 DAS	19 DAS	Average
T_1 (0 ppm)	34.81 (36.15)	40.00 (39.23)	48.15 (43.91)	59.63 (50.53)	71.11 (57.48)	88.15 (69.82)	56.97 (48.97)
T_2 (100 ppm)	25.56 (30.33)	26.67 (31.05)	41.11 (39.87)	61.11 (51.41)	66.67 (54.70)	85.56 (67.62)	51.11 (45.63)
T_3 (200 ppm)	21.11 (27.35)	24.44 (29.60)	35.56 (36.57)	55.56 (48.16)	57.78 (49.43)	72.22 (58.18)	44.44 (41.78)
T_4 (500 ppm)	17.78 (24.88)	21.11 (37.35)	28.89 (32.46)	47.78 (43.68)	54.44 (47.52)	61.11 (51.41)	38.51 (38.35)
T_5 (700ppm)	15.56 (23.19)	21.11 (27.35)	24.44 (29.60)	36.67 (37.23)	43.33 (41.15)	54.44 (47.52)	33.59 (34.76)
T_6 (1000 ppm)	13.33 (21.39)	20.00 (26.56)	23.33 (28.86)	30.00 (33.21)	33.33 (35.24)	54.44 (47.52)	19.19 (26.49)
T_7 (2000 ppm)	00.00 (00.02)	00.00 (00.02)	00.00 (00.02)	16.67 (24.04)	23.33 (28.86)	33.33 (35.24)	12.22 (20.44)
Average	18.30 (25.33)	21.90 (27.90)	28.78 (32.39)	43.91 (41.50)	49.99 (44.94)	64.17 (53.19)	-
Treatments				**DAS**		**TXD**	
SE(m)±	0.59			0.55		1.45	
SE (d)±	0.84			0.77		2.05	
CD at 5%	1.67			1.54		4.09	

Values in parenthesis are angular transformed values.

Effect of Nickel chloride: Different concentrations of Nickel chloride, days to germination and their interactions was found statistically significant for *A. nilotica* (Table 2). Germination of seeds started from 5 DAS in all the cases except 2000 ppm where it was observed from 14 DAS with 16.67 per cent germination. Control treatment showed the higher germination percentage as compared to other treatments during 5 to 19 DAS. Results revealed that, the germination was found maximum in control (88.15%) followed by 100 ppm (88.56%), 200 ppm (72.22%) and it dropped up to 33.33 per cent in 2000 ppm concentration. Nickel is one of the major metallic pollutants in the ecosystem and even relatively low concentrations of it suppress the growth of plants (Ernst *et al*., 1992). Singh (1983 and 1985) studied the role of Nickel on *Vigna radiata* and identified that higher concentration of Nickel suppressed the mobilization of N and P resulting the enzymatic systems crucial for germination and initial stage of seedling growth. Agrawal *et al*. (1961), Jajetia and Arey (1998) also worked out the role of different Nickel salts on germination of moong, where higher concentrations become more inhibitory but the sulphate of Nickel was more inhibitory than chloride or nitrates.

Table 2. Effect of different concentrations of Nickel chloride on seed germination of *Acacia nilotica*.

Treatments	Germination per cent of *Acacia nilotica*						
	5 DAS	8 DAS	11 DAS	14 DAS	17 DAS	19 DAS	Average
T_1 (0 ppm)	34.81 (36.15)	40.00 (39.23)	48.15 (43.91)	59.63 (50.53)	71.11 (57.48)	88.15 (69.82)	56.97 (48.97)
T_2 (100 ppm)	25.56 (30.33)	26.67 (31.05)	41.11 (39.87)	61.11 (51.41)	66.67 (54.70)	85.56 (67.62)	51.11 (45.63)
T_3 (200 ppm)	21.11 (27.35)	24.44 (29.60)	35.56 (36.57)	55.56 (48.16)	57.78 (49.43)	72.22 (58.18)	44.45 (41.78)
T_4 (500 ppm)	17.78 (24.88)	21.10 (27.35)	28.89 (32.46)	47.78 (43.68)	54.44 (47.52)	61.11 (51.41)	38.51 (38.35)
T_5 (700ppm)	15.56 (23.19)	21.11 (27.35)	24.44 (29.60)	36.67 (37.23)	43.33 (41.15)	54.44 (47.52)	32.59 (34.76)
T_6 (1000 ppm)	13.33 (21.39)	20.00 (26.56)	23.33 (28.86)	30.00 (33.21)	33.33 (35.24)	54.44 (47.52)	29.07 (32.58)
T_7 (2000 ppm)	00.00 (00.02)	00.00 (00.02)	00.00 (00.02)	16.67 (24.04)	23.33 (28.86)	33.33 (35.24)	12.22 (20.44)
Average	18.30 (25.33)	21.90 (27.90)	28.78 (32.39)	43.91 (41.50)	49.99 (44.94)	64.17 (53.19)	-
Treatments				**DAS**		**TXD**	
SE(m)±	0.59			0.55		1.45	
SE (d)±	0.84			0.77		2.05	
CD at 5%	1.67			1.55		4.09	

Values in parenthesis are angular transformed values.

Effect of Lead Chloride: Seed germination was found statistically significant in different concentrations of lead chloride, days to germination and their interactions (Table 3). Germination was recorded on 5 DAS in all the treatments except 2000 ppm concentration where germination was recorded at 14 DAS. The mean germination of 15.62 per cent was recorded at 5 DAS and 56.40% at 19 DAS. Maximum seed germination was obtained in control (88.15%) followed by 100 ppm (77.78%) and 200 ppm (64.44%) respectively up to 19 DAS. It gradually decreased with increase in the concentrations and minimum germination was found in 2000 ppm (24.44%). Lead is one of the major environmental pollutants causing adverse effect on plants (Foy *et al.*, 1978). Khan *et al*. (1999) reported similar results in *Vigna ambacensis* where progressive and significant decrease in percentage of seed germination with increase in concentration of cadmium, mercury and lead chloride was observed. The presence of lead increase phenolic compounds that may be responsible for inhibition of germination and also decreased the protein contents in germinating seed as well as growing seedlings of maize (Kalimuthu and Sivasubramanian, 1990).

Table 3. Effect of different concentrations of Lead chloride on seed germination of *Acacia nilotica*.

Treatments	Germination per cent of *Acacia nilotica*						
	5 DAS	8 DAS	11 DAS	14 DAS	17 DAS	19 DAS	Average
T_1 (0 ppm)	34.81 (36.15)	40.00 (39.23)	48.15 (43.91)	59.63 (50.53)	71.11 (57.48)	88.15 (69.82)	56.97 (48.97)
T_2 (100 ppm)	23.33 (28.86)	40.00 (39.23)	54.44 (47.52)	57.70 (49.43)	67.78 (55.37)	77.78 (61.82)	53.50 (47.01)
T_3 (200 ppm)	21.11 (27.35)	30.00 (33.21)	46.67 (43.05)	56.67 (48.79)	62.22 (52.06)	64.44 (53.37)	46.85 (43.17)
T_4 (500 ppm)	13.33 (21.39)	22.22 (28.11)	42.22 (40.51)	47.78 (43.68)	51.11 (45.63)	55.55 (48.16)	38.10 (38.12)
T_5 (700ppm)	10.00 (18.44)	20.00 (26.56)	33.33 (35.24)	40.00 (39.23)	45.56 (42.42)	51.11 (45.63)	33.33 (35.24)
T_6 (1000 ppm)	08.89 (17.26)	16.66 (24.04)	23.33 (28.86)	25.56 (30.33)	27.77 (31.76)	33.33 (35.24)	22.59 (28.32)
T_7 (2000 ppm)	00.00 (00.02)	00.00 (00.02)	10.00 (18.44)	15.55 (23.19)	21.11 (27.35)	24.44 (29.60)	31.85 (20.09)

Average	15.92 (23.50)	24.12 (20.40)	36.87 (37.35)	43.27 (41.09)	49.52 (44.71)	56.40 (48.68)	-
Treatments				**DAS**		**TXD**	
SE(m)±	0.54			0.50		1.33	
SE (d)±	0.77			0.71		1.88	
CD at 5%	1.67			1.42		3.75	

Values in parenthesis are angular transformed values.

REFERENCES

Agrawal, S.C., A. Kumar and C.P. Sharma. 1961. Effect of excess supply of heavy metals on barley during germination with special reference to catalane and peroxidase. *Nature*, **191**: 726-727.

Agrawal, R.L. 2003. Seed Technology. *Oxford and IBH Publishing Co. Pvt. Ltd*. pp. 550-551.

Chaturvedi, O.P. and D.K. Das. 2004. Effect of seed drying, storage and pre-treatments on the germination and growth of *Acacia auriculiformis* and *Acacia nilotica* seedlings. *Indian J. Forestry*, **27(1):** 75-81.

Chaterjee, J. and C. Chaterjee. 2000. Phytotoxicity of cobalt, chromium and copper in cauliflower. *Environment and Pollution*, **109**: 69-74.

Cheng, S. 2003. Heavy metals in plants and phytoremediation. *Environmental Sciences and Pollution Research*, **10**: 335-340.

Ebbs, S.D. and L.V. Kochian. 1997. Toxicity of zinc and copper to brassica species implications for phytoremediation. *J. Environ. Qual*., **26**: 776-778.

Ernst, W.H.O., A.C. Verkleij and H. Chat. 1992. Metal tolerance in plants. *Acta Bot. Neerl*., **41**: 229.

Foy, C.D., R.L. Chaney and M.C. White. 1978. The physiology of metal toxicity in plants. *Ann. Rev. Plant Physiol*., **29**: 511-566.

Henry, J.R. 2000. Overview of the phytoremediation of lead and mercury. *National Network of Environmental management Studies* (NNEMS). pp. 2-4.

Jajetiya, B.L. and N.C. Arey. 1998. Effect of different nickel salts on germination in moong. *Environment and Development*. Scientific Publishers, Jodhpur. pp. 189-192.

Kalimuthu, K. and K. Sivasubramanian. 1990. Physiological effect of heavy metals on *Zea mays* seedlings. *Indian J. Plant Physiol.,* **33(3):** 242-244.

Khan, K.S., M.I. Lone and C.Y. Huang. 1999. Influence of cadmium, lead and zinc on the growth and metal content in ryegrass. *Pakistan J. Biol. Sci.*, **2**: 83-87.

Lasat, M.M. 2000. Phyto-extraction of toxic metals: A review of biological mechanisms. *J. International Quality*, **31**: 109-120.

Pichel, J., K. Kuroiwa and H.T. Sawyer. 2000. Distribution of Pb, Cd and Ba in soils and plants of two contaminated soils. *Environment Pollution*, **110**: 171-178.

Raskin, I. and B.D. Ensley. 2000. Phytoremediation of toxic metals using plants to clean up the environment. *John Wiley and Sons*, New York. pp. 303.

Reeves, R.D. and A.J.M. Baker. 2000. Metal accumulating plants. *John Wiley and Sons*. Torranto, Canada. pp. 303.

Smiderle, O.J., Jr. M. Maurao and R. Sousa. 2005. Pre-germination treatments in *Acacia* seeds. *Revista Brasileira de Sementes*, **27(1):** 78-85.

Singh, S.N. 1983. Effect of nickel on germination, seedling growth in *Luffa aegyptica* L. cultivars. *Geobias*, **10**: 86-88.

Singh, S.N. 1985. Effect of nickel on germination, seedling growth, total nitrogen and phosphate in *Vigna radiata* cultivars. *Indian J. Ecology*., **12(1):** 162-165.

Singh, R.R. 1998. Germination and growth and nodulation studies in three important nitrogen fixing tree species. *Indian J. Forestry*., **21(2):** 128-130.

Thukral, A.K. and Parminder Kaur. 1987. Effect of some trace elements of polluted water on the germination of *Cyamopsistetra gonoloba* Taub. *Indian J. Ecology*., **14(2**): 185-188.

Wasay, S.A., S.F. Barrington and S.F. Tokunaga. 1998. Using *Aspergillus niger* to remediate soils contaminated by heavy metals. *Bioremediation J*., **2(3)**: 183-190.

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