EFFECT OF SODIUM FLUORIDE ON CLUSTER BEAN (*CYAMOPSIS TETRAGONOLOBA*) SEED GERMINATION AND SEEDLING GROWTH

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SUMMARY: The influence of 0 to 30 µM sodium fluoride (NaF) on the germination, seedling growth, and total biomass of the cluster bean (*Cyamopsis tetragonoloba*) was studied under strictly controlled conditions. At the end of 15 days of treatment, significant reductions in percent seed germination, root and shoot length, and total biomass were observed at increasing F concentration. At 30 µM NaF 100% mortality of the seeds occurred.

Keywords: Cluster bean (*Cyamopsis tetragonoloba*); Fluoride and germination; Seedling growth.

INTRODUCTION

Fluoride (F) is one of the potent anions to which humans are exposed through ingestion or inhalation. Earlier it was believed that food was not a rich source of F for humans, but it is now well documented that certain types of food can have high F content.[1-4] Many plants are sensitive to F pollution. Certain physiological processes are known to be markedly affected by F: e.g., decreased plant growth,[5-10] chlorosis, leaf-tip burn and necrosis,[11] and decrease in chlorophyll.[12-14]

The importance of seed germination in plant growth is widely recognized, and its study has been used as a model for investigating F toxicity by various authors.[15-17] This paper reports results of a laboratory investigation to study the effect of F on the germination of the cluster bean, *Cyamopsis tetragonoloba*, var. RGC-197, the aim being to determine the extent to which this test species can tolerate excess amounts of F.

MATERIALS AND METHODS

Cluster bean (*Cyamopsis tetragonoloba*, var. RGC-197) seeds were obtained locally and soaked in distilled water for 24 hr. The seedlings were then transferred to Petri dishes containing filter paper, moistened from below with sterilized cotton pads and treated with 5, 10, 15, 20, 25, or 30 µM NaF prepared from a stock solution. Double distilled water was used for treating the control seedlings. After 15 days the experiments were terminated, the seedlings were studied for percent seed germination, and the shoot and root length and their dry weight were determined.

RESULTS AND DISCUSSION

The resultant seedlings were examined for the effect of F on root and shoot length, root and shoot dry weight, and percentage germination. The published literature suggests that some crop plants are tolerant but others are sensitive to high fluoride contents.[18]

Root and shoot length: As seen in Table 1, the average root and shoot length decreased monotonically with increasing F concentration. At 5 µM NaF the average root length was nearly 23.7% less than that of the control, and the shoot

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length was just over 51.4% less. At 25 µM NaF the root length was only one-third that of the control, and the shoot length only 27% of the control.

Table 1. Root and shoot lengths, and percent inhibition of cluster bean seedlings (mean ± SE)

Concentration of NaF (µM)	Root		Shoot	
	Length (cm)	Inhibition (%)	Length (cm)	Inhibition (%)
Control	3.8±0.76		3.7±0.76	
5	2.9±1.89	23.7	1.8±0.72	51.4
10	2.8±0.34	26.3	1.6±0.34	56.8
15	2.4±0.18	36.8	1.5±0.30	59.5
20	2.0±0.18	47.4	1.3±0.18	64.9
25	1.3±0.13	65.8	1.0±0.15	73.0

Root and shoot dry weight: As seen in Table 2, the average dry weight (80ºC for 72 hr) also decreased monotonically with increasing F concentration. At 5 µM NaF the average root dry weight was 48% less than that of the control, and the dry shoot weight was 44% less. At 25 µM NaF the dry root weight was only about 10% of the control, and the dry shoot weight was about 11% of the control.

Table 2. Root and dry weights, and percent inhibition of cluster bean seedlings (mean ± SE)

Concentration of NaF (µM)	Root		Shoot	
	Weight (mg)	Inhibition (%)	Weight (mg)	Inhibition (%)
Control	12.7±0.03		35.7±0.03	
5	6.1±0.02	52.0	15.7±0.01	56.0
10	4.5±0.01	64.6	12.8±0.01	64.2
15	2.3±0.01	81.9	7.8±0.01	78.2
20	1.8±0.01	85.8	5.7±0.01	84.0
25	1.2±0.01	90.6	3.9±0.01	89.1

Percent germination: As seen in Table 3, seed germination also showed a direct decrease with increasing NaF concentrations. At 5 µM NaF, 80% of the seeds germinated. At 25 µM NaF the percent germination was reduced to 20%. At 30 µM NaF no seed germination was observed.

Table 3. Germination (%) of cluster bean seeds (mean ± SE)

Concentration of NaF (µM)	Germination (%)
Control	100±0.01
5	80.00±1.00
10	80.00±0.89
15	66.60±0.58
20	40.00±0.01
25	20.00±0.01
30	0

The results of this study indicate that cluster bean seedlings exposed to increasing levels of NaF suffered reduction in root and shoot length and thus their dry weight. This observation is similar to those of other workers for other plant seedlings.[19-27] Overall, our results are in good agreement with observations made by other workers.

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