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Effect of sodium flouride and magnesium chloride and its interaction on seedling growth of Medicago Sativa, Anand, Gujarat

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ABSTRACT

Study of physiology of seedlings and plants under fluoride toxicity is of recent origin, adding one more factor in the environmental stress. The toxicity of fluoride affects the yield of agricultural crops. Fluoride contamination in water, soil and plants has been a continuing problem in the world. The present study was made to assess the effect of fluoride on especially in germination of seeds. In this investigation, the effects of NaF, $MgCl_2$ and NaF+$MgCl_2$ on seedling growth of Alfalfa plants (Medicago sativa. L.) and physiological parameters viz., root length, shoot length, seedling growth, dry weight and moisture were studied. After observation fluoride effect on Medicago sativa root length and shoot length increased in all media. Seedling growth besides the root and shoot elongation is the fresh weight is increased and dry weight gradually decreased in all media. The initial uptake of water by NaF seedling is less, later on as the germination proceeds, it was higher or less equal to other seedling by adjusting internal osmotic balance. It is known that Na increases to cause succulence.

Key words: Physiology, Toxicity, Germination, Alfalfa plants

INTRODUCTION

Pollution and its consequent adverse effects have become a global problem. Presence of any pollutant in the environment influences not only abiotic but also biotic components of the ecosystem by certain change in the functioning of their normal life system. The various types of pollutants have been identified and their effects on living systems have been studied in detail by many researchers all over the world. Pollutants are discussed as being additional or abnormal components of the environment in which plants have been managed to survive. The inability of plants to accommodate to the conditions of the changed environment due to pollution damage to environment. Pollution is linked with our habitual conduct whether personal and collective or industrial. Pollution cause retardation in growth, reproduction and life span of the individuals. The gaseous fluoride components hydrogen fluoride (HF) and silicon tetrafluoride (SiF_4) and known to be highly toxic to plants (Thomas, 1961). The entry of the fluoride in the environment may be due to the natural phenomenon or by man's activities which pollute air, soil and water. Fluoride affects a wide range of physiological processes including plant growth, chlorosis, leaf tip burn and leaf necrosis. The specific metabolic and nutrient content of fluoride affected crop have been studied in a variety of economically important plants especially they are used as green fodder. The Alfalfa (Medicago sativa L.) is one such member of the Papilionaceae and belonging to the tribe, trifolieae on which an in depth study is yet needed. The alfalfa appears to the only foragecrop which was cultivated before recard history (Bolten, 1962). It was thus considered of intrest to investigats effect of NaF on seedlings of Alfalfa plants (Medicago sativa L.), a protein rich forage plant. Sabal and Khan et al. (2006) was studied effect of sodium fluoride on cluster bean (Cyamopsis tetragonoloba) seed germination and seedling growth. Effect of fluoride on early root and shoot growth of typical crop plants of India (Pants and Bhiravamurthy et al., 2008). Phytotoxicity of fluoride in the germination of paddy and its effects on the physiology and biochemistry of germinating seedling (Gupta, Banerjee and Mondal et al., 2009).

MATERIALS AND METHODS

Seeds of Alfalfa (Medicago sativa. var. Anand-2) cultivars were sterilized with 0.1% $HgCl_2$ up to 5-10 min and after sterilization the seeds were washed with 2 to 5 times with distilled water. They were spread in sterilized petridish (10 seeds/ petridish) lived with filter papers soaked as: (1) distilled water (as control), (2) Sodium Flouride [NaF-(0.025%)], (3) Magnesium Chloride [$MgCl_2$ –(0.1%)], (4) Sodium Flouride + Magnesium Chloride NaF+$MgCl_2$ (0.025%– 0.1%) of seedling growth were carried out up to 96 hours at an interval of 24 hours. After noting the percent germination, extension growth of the root and shoot of 20 seedling was measured and the mean was calculated. The length of root and shoot and seedling was expressed as cm/seedling. From there data standard deviation was also calculated. Fresh weight and dry weight of 20 seedlings were recorded in two lots. i.e. 10 seedling each were taken and mean was expressed as mg/seedling. Percent moisture was calculated from the data of fresh and dry weight at every 24 hours interval up to 96 hours.

RESULTS AND DISCUSSION

Seeds of Alfalfa variety (Medicago sativa var. Anand-2) were kept in different media- D.W., NaF, $MgCl_2$, NaF + $MgCl_2$. The seed were germinated after 24 hrs, root and shoot appeared after 48 hrs in case of all the treatments. However, germination was delayed in NaF by keeping other external conditions control the germination like temperature, light, oxygen and the external water supply. Fig- 1 represents the percentge of germination. Extension growth of the seedling increased with the progress in germination period in all the conditions studied time, seeds germination in all media were delayed NaF, $MgCl_2$, combination media of NaF and $MgCl_2$ compared to D.W. Fig-1a represents shoot length (cm/seedling). The shoot length increased manyfold from 48 hrs and continued to increase up to 96 hrs in all the seedlings. Shoot length increased throughout the germination periods, in all the media. It was inhibited in NaF up to 96 hrs, but at 120 hrs there is negligible difference observed compared to D.W. Extension growth of shoot is lower compared to D.W. at 48 hrs and growth of shoot length is not much more effected in $MgCl_2$ and mixed solution (NaF + $MgCl_2$) from 72 hrs to120 hrs. Fig-1b graphically represents data on root length (cm/seedling). In all cases, Root length rises up to 96 hrs and increased throughout the germination periods in seedling, in all media. Root elongation is slow in all the such media compared with D.W. throughout the germination periods. Considering the seedling length (cm/seedling) as shown in fig- 1c, the same trend was observed in root and shoot length. Thus NaF reduces the elongation of root, shoot and seedling. The negative effect of fluoride in plant is discussed by Threshow (1970).

One of the parameters of the seedling growth besides the root and shoot elongation is the fresh and dry weights of seedlings. Data on the fresh weight (mg/seedling) of lucerne seedling as presented in fig-2a. The fresh weight of seed remained steady in D.W., but in NaF increase at 48 hrs and after that it became steady and same trend is observed in $MgCl_2$. In mixed solution there is a gradual increased in fresh weight during the germination period. It can be seen from fig-2b that the dry weight (mg/seedling) of seedling advanced with germination period. In all media dry weight gradually decreased up to 48 hrs and then remained more or less at the same level at 72 hrs, however, at 96 hrs in D.W. it was declined. In case of present study dry weight of seedlings in NaF and $MgCl_2$ was greater compared to D.W. because of slow growth of seedlings. These data are in contrast to the previously reported results by Threshow (1970), Murray (1984) and Sakurai (1986) who observed lower dry weights in NaF seedlings. Fig-2c graphically represents the data on moisture contents. There are observed a significant change in moisture percentage in all media during the germination periods, except in untreated seedling. Availability of moisture or water uptake is one of the first conditions of germination specially at its initiation. Any failure of seedling i.e. root, shoot emergence may thus be correlated with water availability such a low water content, the percentage moisture of seedling is low as stated earlier. The cells have to be turgid before they could extend or expand and only then the emergence takes place. Since the moisture content itself is very low, root and shoot emergence is highly inhibited.

EFFECT OF SODIUM FLUORIDE AND ITS INTERACTION WITH MAGNESIUM CHLORIDE ON SEEDLING GROWTH AND METABOLISMS OF ALFALFA

FIG. 1 % OF GERMINATION

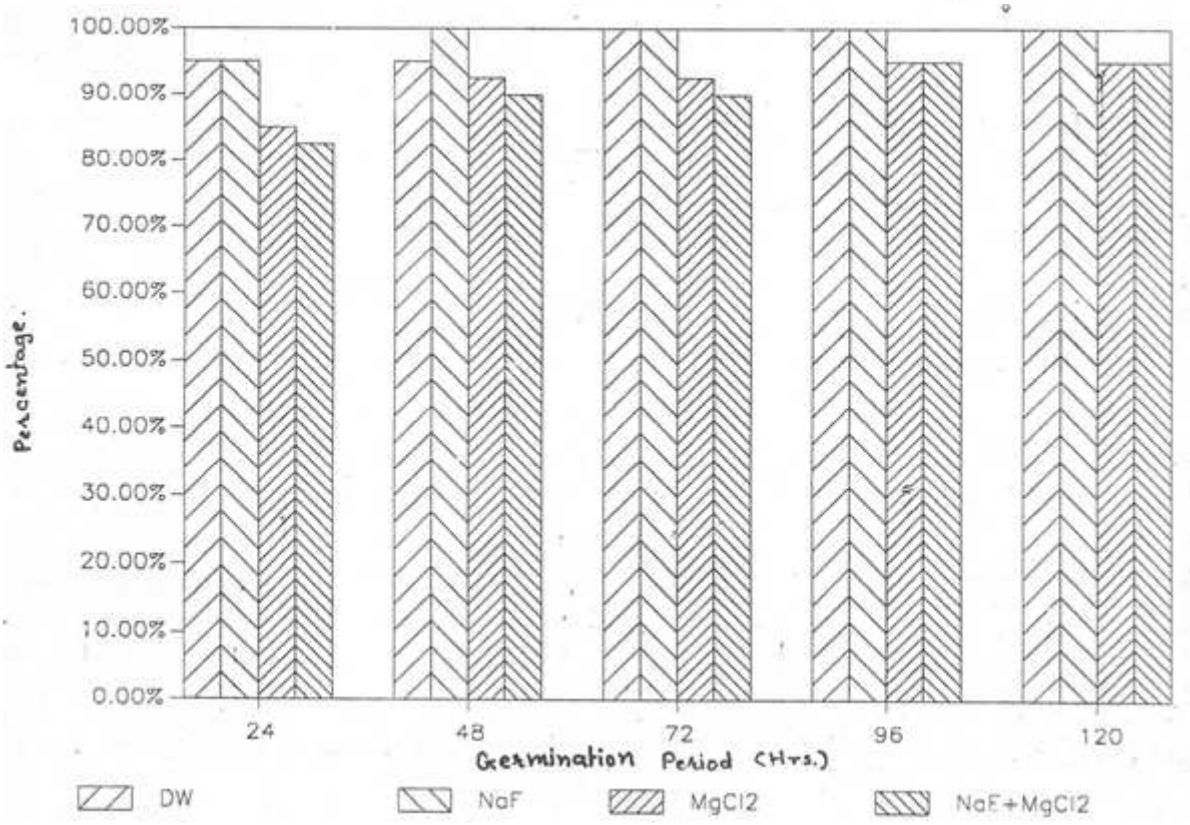


FIG. 1a SHOOT LENGTH

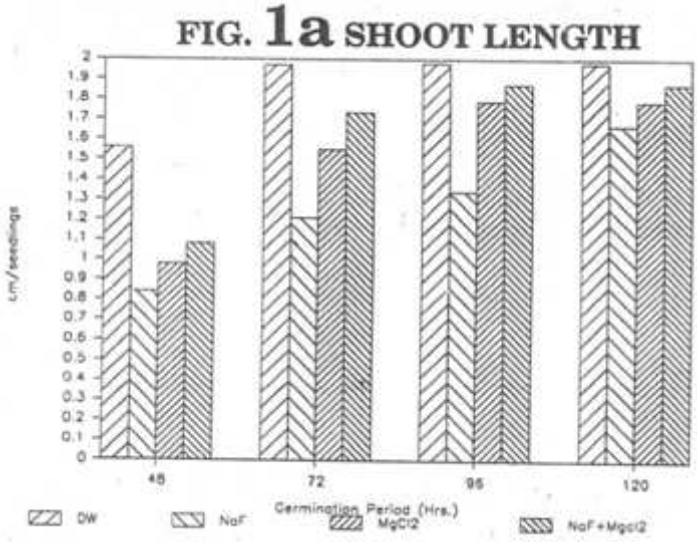


FIG. 1b ROOT LENGTH

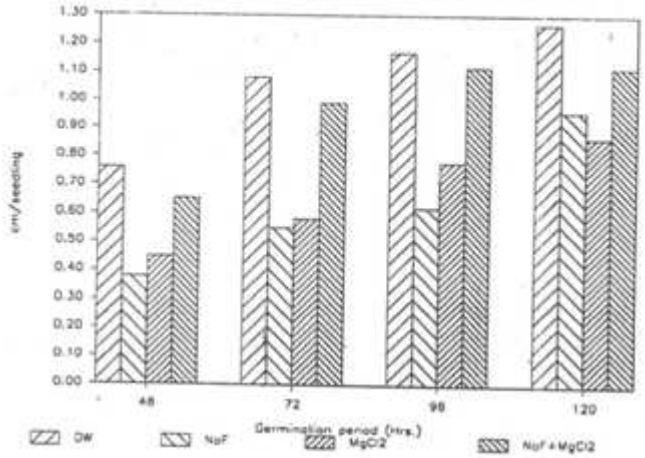
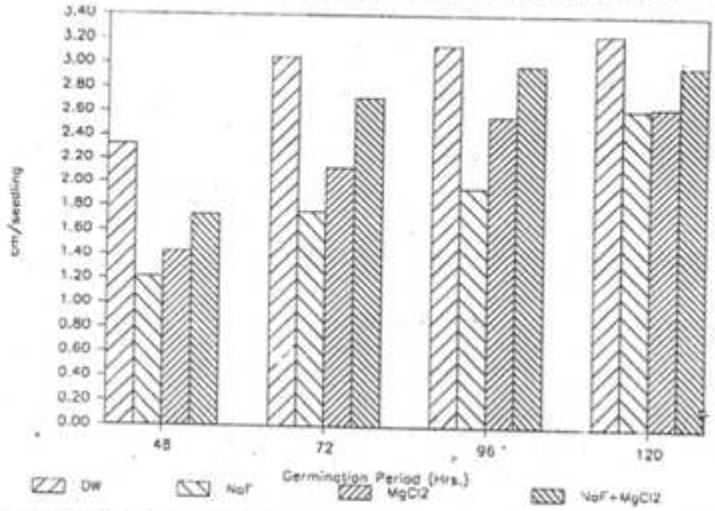
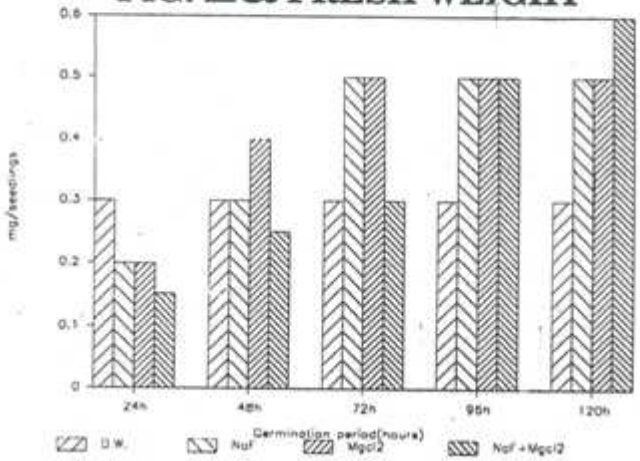


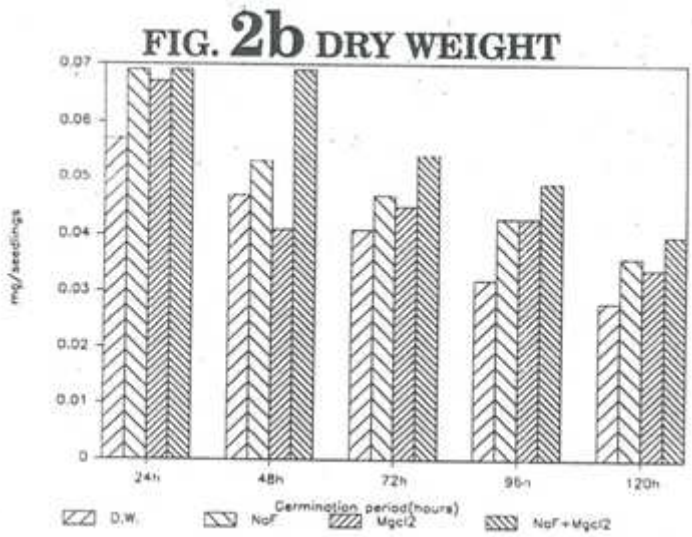
FIG. 1c SEEDLING LENGTH

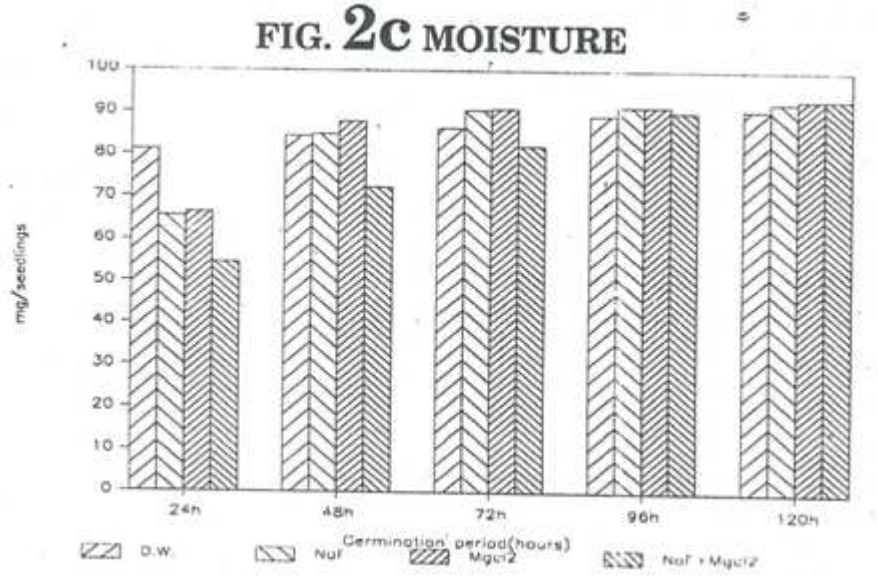


EFFECT OF SODIUM FLUORIDE AND ITS INTERACTION WITH MAGNESIUM CHLORIDE ON SEEDLING GROWTH AND METABOLISMS OF ALFALFA

FIG. 2a FRESH WEIGHT







CONCLUSION

In the alfalfa seed germination fluoride stress adds a new dimension in the stress physiology. Fluoride through a natural earthy material, its concentration affect due to plants growth and therefore fluoride may also be considered as an additional stress.

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