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SEED GERMINATION OF PEA (Pisum Sativum, L) UNDER DIFFERENT BORON CONCENTRATION LEVELS

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1 ABSTRACT

This experiment attempted to establish the effect of irrigation with water containing different concentration of boron on the germination of pea (*Pisum sativum* L.), selected as a typical example of dicotyledon plants. 25 seeds were planted in aluminum trays bedded with a layer of cotton of a depth 1 cm, as a germination medium. The media was wetted to saturation with waters of varying boron concentration starting from zero B level (control treatment) up to the highest concentration of 20 (mg.dm^{-3}) B. Germination of peas was not affected by boron concentrations up to 8 (mg.dm^{-3}), and only slightly reduced as 20 (mg.dm^{-3}). Once germinated, the seedling were smaller, took longer to develop and already showed toxicity symptoms when boron was applied in large doses. Hence, large amounts of boron seem to have little influence on germination, but distinct negative effects on the development of plants at the seedling stage.

Keywords: irrigation, germination, boron, pea.

2 INTRODUCTION

Boron is one of the seven essential micronutrients required for the normal growth of most plants. Boron has a marked effect on plants, both from the standpoint of plant nutrition - in cases where boron is deficient in soil - and toxicity - if it present in excessive amounts. To complicate matters, there is a relatively small range of values between levels of soil boron that cause deficiency and those that produce toxicity symptoms in plants.

Excess, and consequent toxicity of boron is more of a problem than deficiency in soils of semi-arid and arid areas. Boron toxicity occurs in these areas either due to high levels of boron in the soil or else due to the addition of boron in irrigation water.

Significant contribution have been made by Scofield (1935), Eaton (1950), Richards (1954) and Wilcox & Durum (1967), on water quality with respect to the element boron. In spite of the reasonable agreement between those authors with respect to criteria and limits, they have proposed different methods for classifying irrigation waters. It has been suggested that these workers tended to place too much emphasis on attempting to answer the question of how good the water is rather than what can be done with this water. Another point which is of vital importance because of its influence crop production is seed germination and how it is influenced if waters of relatively bad quality are to be practiced in irrigation proposes. Excess boron in the soil solution is an important problem where irrigation water must be continually applied. In fact, the boron concentration in water often determines its suitability for irrigation and the type of crop that can be grown (Biggar & Fireman, 1960).

Wilcox (1960) proposed a classification of crops according to their sensitivity to boron. The classification constitutes limits of boron in irrigation water for sensitive, semi-tolerant and tolerant crop species based on toxicity symptoms observed in plants grown in sand culture. The limits of boron concentrations proposed are 0,3-1, 1-2 and 2-4°(mg.dm^{-3}) for sensitive, semi-tolerant and tolerant crop species respectively. Recently guidelines concerning the maximum permissible level of various trace elements in irrigation water have been developed by U.S. Committee on water quality (Branson et al. 1975) with respect to boron the maximum recommended concentration in irrigation water used continuously on all soils was the value of 0,75 (mg.dm^{-3}) while for use up to 20 years on fine textured soil at pH 6,0 to 8,5 and the recommended maximum concentration of boron in any irrigation water lay between 2,0 to 10,0 (mg.dm^{-3}). According to the FAO publication (1976), a guideline for evaluating the suitability for irrigation with respect to boron was proposed. This consists of the following three limits:

a) Irrigation water with boron concentration of less than 0,75 (mg.dm^{-3}). Such water could be used safely without creating problems.
b) Irrigation waters with boron concentration lying between 0,75 and 2°(mg.dm^{-3}). Such water could results in increasing problems.
c) Lastly, water having a boron concentration of more than 2 (mg.dm^{-3}). Such types of water could cause severe problems.

In this context, the permissible boron concentration in irrigation water which could be used without leading to a harmful reduction in the germination rate for crops varieties and species is still a matter of question. Therefore, the present work was conducted to evaluate the germination of pea plants as a function of irrigation with water at different boron concentration levels.

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3 MATERIAL AND METHODS

Aluminum dishes bedded with cotton of 1,0 cm thickness as a germination medium were used in this experiment. The cotton media were completely wetted with boron solutions at concentrations of 2, 4, 8, 10, 15 and 20 ($mg.dm^{-3}$). One treatment was wetted only with water as a control treatment. Each treatment consisted of 4 replicates.

After complete wetting, 25 seeds of pea variety Rondo, were uniformly distributed in each aluminum dish, which were tightly covered and then kept in the dark for a period of 10 days to germinate. After sowing, the number of seedlings were recorded and the percentage of germination was estimated for each treatment, as an average of the four replicates involved.

4 RESULTS AND DISCUSSION

The irrigation water treatments and the percentage of seed germination are tabulated in Table (1).

The data show clearly that the germination of peas is not at all influenced by the boron concentration in irrigation water when it is found in he range lying between 2 and 8° ($mg.dm^{-3}$). There were no significant differences noted in the percentage of seed germination between the control treatment (n° 1) receiving only tap water, and the boron treatment numbers 2, 3 and 4 where the seeds were treated with waters of boron concentration 2, 4 and 8 ($mg.dm^{-3}$) respectively. The germination percentage was of a value of 87% for the control treatment, and with boron treatments nearly the same value was obtained for different boron concentration levels, indicating that irrigation levels, indicating that irrigation with water containing up to 8 ($mg.dm^{-3}$) cold be used without any deleterious effects.

The raise in the boron concentration level in irrigation water up to 15 ($mg.dm^{-3}$) slightly influenced the germination of the pea seeds reducing it by nearly 6% with respect to the control treatment of zero boron level. With the highest boron concentration treatment, 20 ($mg.dm^{-3}$), the reduction in the percentage of germination did not exceed 8% as compared with the control one.

It is well know fact, that the success or failure of the germination of seeds is closely related to the salt concentration levels of the germination medium, and that the higher the salinity of the growing medium the greater will be the raise in osmotic pressure. At the point where the osmotic pressure of the growing media is superior to that of the cell saps, the water will move backwards from the swelling seeds towards the growing medium rendering the germination rate in a ratio proportional to the salinity level present in the growing medium.

As shown by the Table , the gradual increase in the boron concentration level in the irrigation water was not accompanied by any increase in the EC values, which were nearly constant with all the boron concentration levels. This evidently confirms the conclusion that, pea seeds support irrigation water of relatively high boron concentration levels and successfully germinate without any deleterious effects, yet with the seedlings the situation was completely different.

It was observed that the period between the germination and seedlings stages varied according to the differences in the boron concentration level. The higher the boron concentration level, the longer will be the period needed, particularly at the relatively high boron concentration levels: those exceeding 10 ($mg.dm^{-3}$). Also, it was observed that increasing the boron concentration level in the growing medium led to a decrease in the height of the developing seedlings. Moreover, the boron toxicity symptoms started to appear on the leaves in this early stage of growth with all irrigation treatments of boron concentration values higher than 2 ($mg.dm^{-3}$). The symptoms were markedly noticed with the relatively high boron doses.

Table 1. Percentages of seed germination under different water treatments.

Treatment nº	**Composition of irrigation water**	**EC mmhos/cm 25º**	**nº of germination seeds**	**% of germination**
1	0 (mg.dm^{-3})	0,8	21 22 22 22	87
2	2 (mg.dm^{-3})	0,9	23 21 22 22	88
3	4 (mg.dm^{-3})	0,9	20 22 22 21	85
4	8 (mg.dm^{-3})	0,9	22 21 22 19	84
5	10 (mg.dm^{-3})	0,9	22 19 21 20	82
6	15 (mg.dm^{-3})	0,9	22 21 18 21	82
7	20 (mg.dm^{-3})	0,9	18 20 21 21	80

5 CONCLUSIONS

Germination of peas was not affected by boron concentrations up to 8 (mg.dm^{-3}), and only slightly reduced at 20 (mg.dm^{-3}). Once germinated, the seedlings were smaller, took longer to develop and already showed toxicity symptoms when boron was applied in large doses. Hence, large amounts of boron seem to have little influence on germination, but distinct negative effects on the development of plants at the seedling stage.

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7 REFERENCES

AYERS, R.S., WESTCOT, D. W. *Water quality for agriculture Bull.* F.A.O., n.29, 1976. 97p.

BIGGAR, J.W., FIREMAN, Boron adsorption and release by soils. *Soil Sci. Soc. Am.,* n.84, p.115-20, 1960.

BRANSON, R. L., PRATT, P.F., RHOADES, J.D. et al.. Water quality in irrigated waters heds. *J. Environ. Qual.,* n.3, p.33-40, 1975.

EATON, F. M. Deficiency, toxicity and accumulation of boron in plants. *J. Agric. Res.*, n.69, p. 237-77, 1950.

RICHARDS, L.A. Diagnosis and improvement of saline and alkaline soils. *Agric. Handboo,* U.S.D.A., n.60, 1954.

SCOFIELD, C.S. The salinity of irrigation water. *Smithsoni. Ins. Ann. Rep., S.n., p.275-87, 1935.*

WILCOX, L.V. Boron injury to plants. *Agr. Inform. Bull.,* n.211, 1960.

WILCOX, L.V., DURUM, W.H. Quality of irrigation water. *J.Am. Soc. Agron.,* v. 2 p. 104-22, 1967.