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COMPARATIVE PERFORMANCE OF UPLAND AND DESI COTTON CULTIVARS AT GERMINATION STAGE OF GROWTH UNDER DIFFERENT SALINITY LEVELS

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Abstract: Sixteen commonly grown cultivars in Pakistan belonging to upland (*G. hirsutum* L.) and desi (*G. arboreum* L.) cotton were studied to work out comparative salt tolerance at germination stage. Four different salinity levels viz. 0.25%, 0.5%, 0.75% and 1.0% were raised by mixing NaCl, $MgSO_4$ $7H_2O$ $CaCl_2$ $2H_2O$: $NaHCO_3$ (9:8:2:1). Delinted cottonseeds were incubated at $30^oC \pm 2^oC$ and germination was recorded upto 96 hours of incubation in darkness. Increasing salinity levels delayed seed germination rather to inhibit this biological process. This delay was significant upto 48 hours. However, onward delay was insignificant in most of the cotton cultivars. Sixty precent or more germination in 1% salinity level after 48 hours of incubation period was selected as the criteria to compare the salt tolerance at germination. Upland cotton cultivars B557, Rehmani, K68, Niab 78, Sarmast, Qalandari and desi cotton cultivar Rohi, Ravi and SK 10/19 appeared as most salt tolerant under 1% salinity level at germination.

Keywords: Cotton cultivars, delinted cottonseed, germination stage, growth, salinity level, salt tolerance.

INTRODUCTION

Salt tolerance is known to differ with ontogeny of the plant [Ayers 1953, Bernstein and Hayward 1958, Mass and Nieman 1978]. It would thus appear that salt tolerance in different species might differ at various stages of growth starting with the germination of seeds, establishment of seedlings, vegetative growth, flowering and fruiting.

Germination of seeds and development of seedling in general are adversely affected in saline soils and thus become the limiting factor in crop production. Metabolic activities in seed during the germination depend on the hydration level attained by the viable seeds. Since a series of metabolic activities start during this transition phase, any set of conditions affecting the hydration level may cause water stress, decrease osmotic potential and retard or even inhibit seed germination. It is reported that thinly populated cotton fields under saline environment is the result of poor seed germination [Strogonov 1962]. Similar trends have also been reported in barley, sugar beet, bean and other crops [Lunin and Gallatin 1965, Hamid and Talibuddin 1976].

MATERIALS AND METHODS

Cottonseeds of the following sixteen different cotton cultivars were used for the germination studies:

G. arboreum (desi): S119, Ravi, Rohi, TDI, Sk10/19

G. hirsutum (Upland): Niab78, MNH93. CIM70. B557, MS84, MS39, Rehmani, K68, Qalandari, Sarmast, MNH129.

Twenty delinted seeds of above cultivars were placed on Whatman filter paper No. 1 in 100 x 15mm sterilized petri plates. They were irrigated with water or the following four salt concentrations according to the treatment:

1- Control (Water)
2- 0.25% salt solution equivalent to Ec = 3.12dSm^{-1}
3- 0.50% salt solution equivalent to Ec = 5.80 dSm^{-1}
4- 0.75% salt solution equivalent to Ec = 8.49dSm^{-1}
5- 1.00% salt solution equivalent to Ec = 10.75dSm^{-1}

The above salt concentrations were made by mixing NaCl: $MgSO_4$ $7H_2O$: $CaCl_2$ $2H_2O$: Na HCO_3 (9:8:2:1) [Abdullah *et al.* 1978].

The experimental set up was incubated at 30^{o}C ± 2^{o}C and germination was recorded after 24, 48, 72 and 96 hours of incubation. Three replicates were made for each treatment and petri-plates containing seeds were randomized.

RESULTS AND DISCUSSION

Observations on seed germination after different periods of incubation under different salinity levels are presented in Figs. 1-2. Data presented in the above figures show a delaying effect of salinity on the process of germination, which were directly proportional to the increase in salinity in the growth medium in all the cotton cultivars. There were significant varietal differences and adverse effect of salinity on seed germination in both upland and desi cotton cultivars. However, these germination differences were minimized as the germination progressed to later hours of incubation. Most of the seeds of upland and desi cotton germinated within 24 hours of incubation period under control. Among upland cotton cultivars Rehmani, K68, Sarmast, CIM70, Niab78, MNH 93, Qalandari (Fig. 1) and among the desi cotton cultivars SK10/19. Ravi, TDI and Rohi (Fig. 2) showed better germination percentage than remaining cultivars under control conditions. Similar varietal differences in germination have also been found in cereals [Ayers 1952, Ayers *et al.* 1952, Wahab 1961]; alfa-alfa [Redmann1974]; flax, cotton and castor beans [Younis *et al.* 1987].

Delay in germination due to salt concentrations in upland cotton cultivars started from 0.5% and in desi cotton cultivars from 0.75% salinity levels. Increase in salt concentration has been reported to delay germination in barley [Ungar 1974] and sugar beat and bean [Hamid and Talibuddin 1976]. Salinity may affect germination by increasing the osmotic pressure of the soil solution to a point which will retard or prevent uptake of water in seeds [Ayers 1952, Bernstein1961] or by causing toxicity to the embryo and seedling [Mehta and Desai 1958]. During this early period of growth, there is hardly any possibility of appreciable photosynthetic activity and

the main source of energy is derived through enzymatic hydrolysis of stored food. Enzymes extracted from normally grown seedlings indicate an adverse effect of higher salt concentrations in vitro on their activities; hence the salt damage is apparently due to inhibition of the enzyme activity rather than its synthesis [Sarin and Narayana 1968].

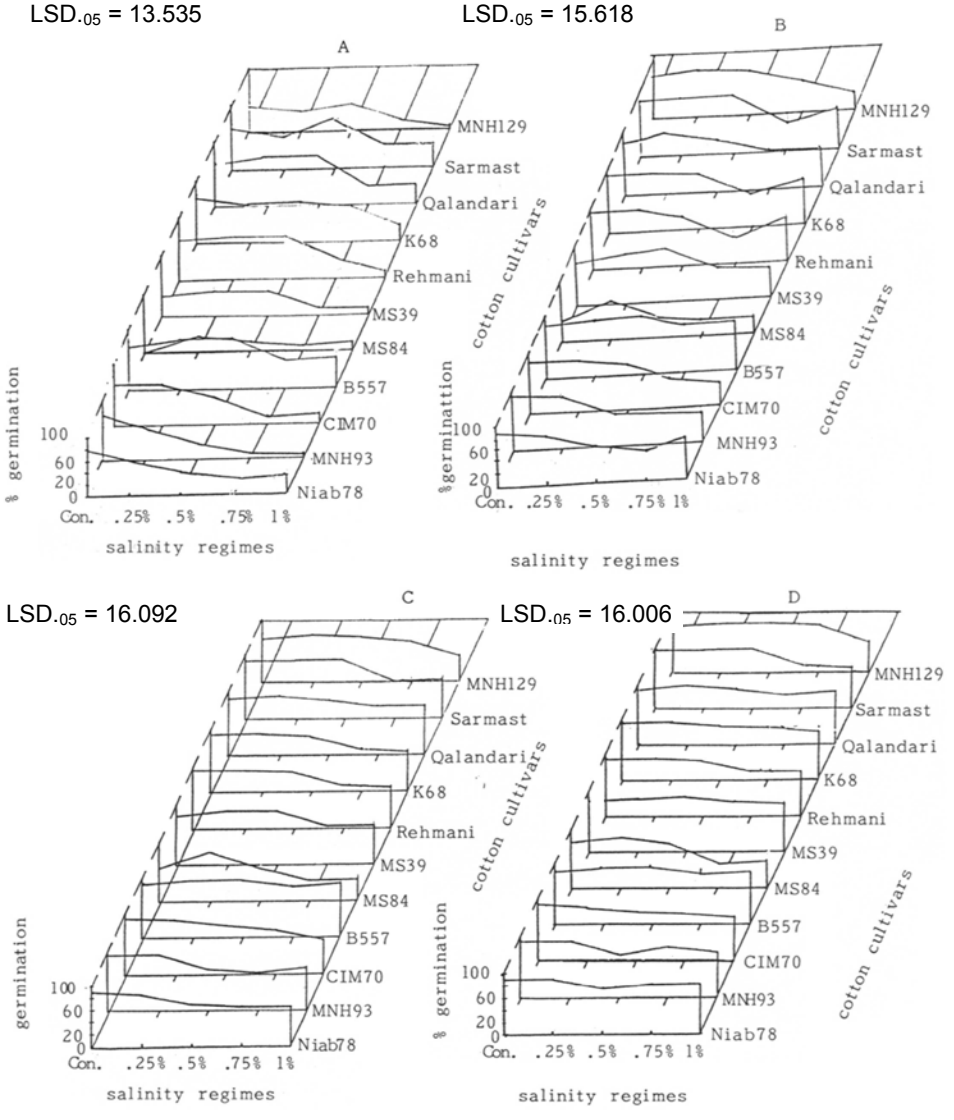


Fig.1 Seed germination of G. hirsutum cultivars after different hours of incubation as affected by different salinity regimes.

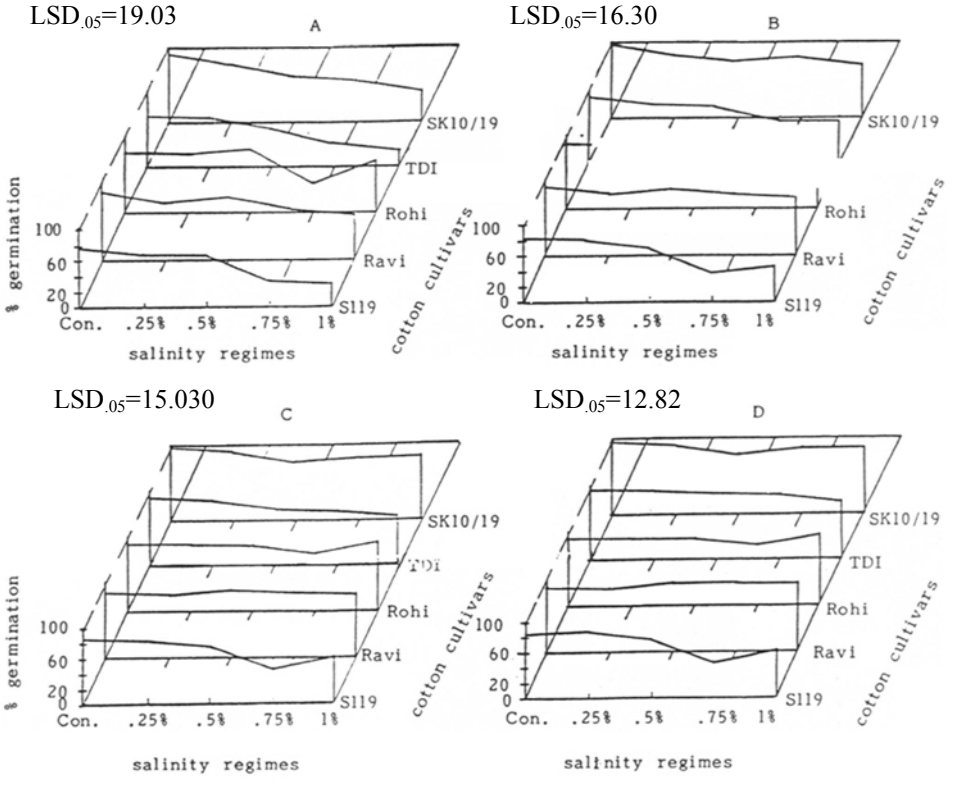


Fig. 2 Seed germination of G. arboreum cultivars after different hours of incubation as affected by different salinity regimes.

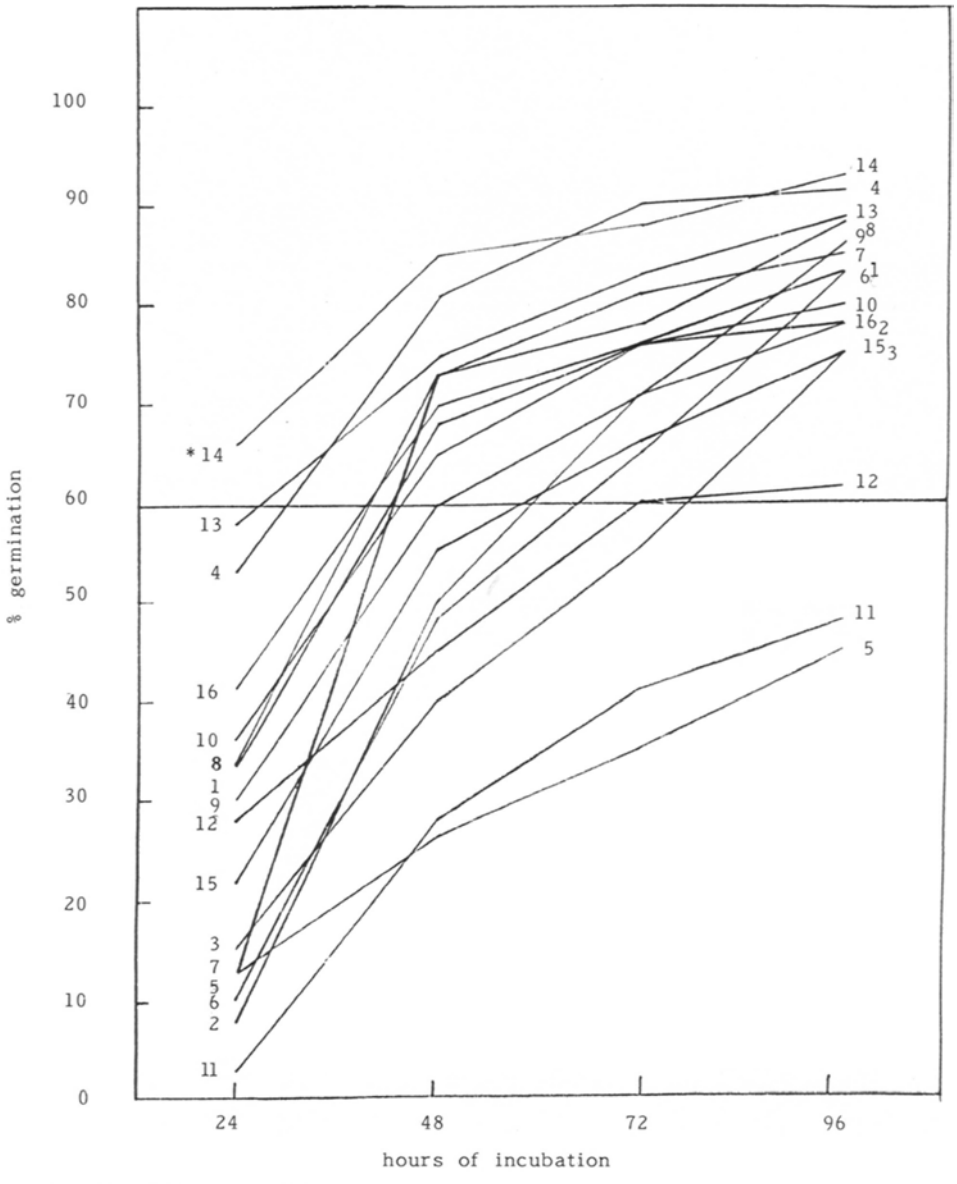
CONCLUSION

As the difference in germination of individual cultivars at higher salinity regimes between 48 to 96 hours of incubation period were mostly insignificant, it is considered important that screening for salt tolerance may be undertaken at 48 hours of incubation period and expressing 60% or more germination. Keeping in view the above criteria, upland cotton cultivars B557, Rehmani. K68, Niab 78, Sarmast, Qalandari, and desi cotton cultivars Rohi, Ravi and SK10/19 appeared as most salt tolerant under 1% salinity level at germination stage (Fig. 3).

References

Abdullah, Z., Ahmad, R. and Ahmad, J. (**1978**) "Salinity induced changes in the reproductive physiology of wheat plants", *Plants and Cell Physio.*, 19, 99-106.

Ayers, A.D. (**1952**) "Seed germination as affected by soil moisture and salinity", *Agron. J.*, 44, 82-84.



* cotton cultivars

1.	Niab78	5.	MS84	9.	Qalandari	13.	Ravi
2.	MNH93	6.	MS39	10.	Sarmast	14.	Rohi
3.	CIM70	7.	Rehmani	11.	MNH129	15.	TD1
4.	B557	8.	K68	12.	S119	16.	SK10/19

Fig. 3: Germination percentage of upland and desi cotton cultivars in 1% salinity regime after 48 hours of incubation.

Ayers, A.D. (**1953**) “Germination and emergence of several varieties of barley in salinized soil cultures”, *Agron. J*., 45, 68-71.

Ayers, A.D., Brown, J.W. and Wadleigh, C.H. (**1952**) “Salt tolerance of barley and wheat in soil plots receiving several salinization regimes”, *Agron. J.*, 44, 307-310.

Bernstein, L. (**1961**) “Osmotic adjustment of plants to saline media. I. Steady State”, *Amer. J. Bot.*, 48, 909-918.

Bernstein, L. and Hayward, H.E. (**1958**) “Physiology of salt tolerance”, *Amer. Rev. Plant Physiol.*, 9, 25-46.

Hamid, A. and Talibuddin (**1976**) “Effect of sodium on the growth and ion uptake by barley, sugar beet and broad beans”, *J. Agric. Sci. Cambridge*, 86, 49-56.

Lunin, J. and Gallatin, M.H. (**1965**) “Zonal salinization of root system in relation to plant growth”, *Soil Sci. Soc. Am. Proc.*, 29, 608-612.

Mass, E.V. and Nieman, R.H. (**1978**) “Physiology of plant tolerance to salinity”, In: G.A. Jung (Ed.), *Crop Tolerance to Sub-optimal Land Conditions*, ASA Special Publication Number 32, ASA, CSSA, SSSA, Madison, Wisconsin, p. 227.

Mehta, B.V. and Desai, R.S. (**1958**) “Effect of soil salinity on germination of some seeds”, *J. Soil and Water Conserv. in India*, 7, 101-115.

Redmann, R.E. (**1974**) “Osmotic and specific ion effect on the germination of alfa-alfa”, *Can. J. Bot.*, 52, 803-808.

Sarin, M.N. and Narayana, A. (**1968**) “Effect of soil salinity and growth regulators on germination and seedling metabolism of wheat”, *Physiol. Plant*, 21, 1201-1209.

Strogonov, B.P. (**1962**) “Physiological bases of salt tolerance of plants as affected by various types of salinity”, IPST, England, Jerusalem.

Ungar, I.A. (**1974**) “The effect of salinity and temperature on seed germination and growth of *Hordeum jubatum*”, *Can. J. Bot.*, 52, 1357-1362.

Wahab, A. (**1961**) “Salt tolerance of various varieties of crops at the germination stage”, *Arid Zone Res.*, 14, 185-193.

Younis, M.E., Hasaneen, M.N.A. and Nemet-Alla, M.M. (**1987**) “Plant growth metabolism and adaptation in relation to stress conditions. IV. Effect of salinity on certain factors associated with the germination of three different seeds high in fats”, *Can. J. Bot.*, 60, 337-334.