

INFLUENCE OF CHLORIDES IN IRRIGATION WATER AND FERTILIZER LEVELS ON TOBACCO SEEDLINGS UNDER RAINFED LIGHT SOILS OF PRAKASAM AND NELLORE DISTRICTS

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Field experiment was conducted with water containing 28, 50, 100, 200, 300, 400, 500 and 600 ppm chlorides in main plots and two fertilizer levels viz., recommended dose of fertilizer (RDF) and 150% RDF in sub-plots in split plot design with three replications, for three seasons (2006-07 to 2008-09) with cv. Hema to find out maximum concentration of chlorides in irrigation water without affecting the seedlings. The germination count declined significantly beyond 200 ppm chlorides. Damping off and blight tended to decline slightly to increased chloride content. Yellowing, upward cupping, thickening and brittleness of leaves and slow death of seedlings are some of the symptoms observed in high chloride treatments. Fresh and dry weights decreased significantly with increased chlorides in water especially beyond 300 ppm. Weight of seedlings was significantly high under increased fertilizer dose. Yield of transplantable seedlings decreased with increased chlorides beyond 50 ppm. Higher number of transplantable seedlings was recorded with increased fertilizer dose especially with water containing higher chlorides. The experiment conducted in pot culture with main plots showed the effects more clearly. These seedlings when raised in field could not influence either yield or quality of leaf. As observed in separate feeler trials, use of FYM @ 25t/ha + high fertilizer dose and use of high chloride water mixed with rain water are some of the measures to counter the ill-effects of high chlorides in water.

INTRODUCTION

In Prakasam and Nellore districts of Andhra Pradesh FCV tobacco is grown in an area of 61,000 ha in red sandy loams and 46,000 ha in silt loams, known in tobacco circles as southern light soils (SLS) and southern black soils (SBS),

respectively. Rainfall is highly erratic in distribution. The decennial mean rainfall (2000-2009) recorded at CTRI Research Station, Kandukur is 260 mm during South West monsoon and 525 mm during NE monsoon while it is 35 mm in winter and 70 mm in summer. The water used by farmers for tobacco nurseries under SLS conditions contains high concentration of salts, mainly chlorides, which impair the germination, growth and quality of seedlings.

Underground water in SLS is saline due to parent material and proximity to sea (Murthy *et al.*, 2002). Farmers are using water containing chlorides up to 400 ppm and succeeded in growing nurseries in some seasons with variable results depending on weather and other prevailing conditions. The influence of the quality of water on growth, occurrence of nursery diseases and production of seedlings is not studied so far in this region. Hence, the present experiment was planned to study the effect of different levels of chlorides in irrigation waters on seedling growth so that the permissible limit of salinity in applied water to nursery is identified and possible precautionary measures can be worked out.

MATERIALS AND METHODS

A nursery experiment was conducted at Central Tobacco Research Institute Research Station, Kandukur in one sq.m. beds using water containing 28, 50, 100, 200, 300, 400, 500 and 600 ppm chlorides in main plots and two fertilizer levels viz., recommended dose of fertilizer (RDF) and 150% RDF in sub-plots. The RDF for nursery comprises basal application of NPK @ 20-50-50 kg/ha in the form of ammonium sulphate, super phosphate and sulphate of potash and top

dressing of 70 kg N/ha in the form of ammonium sulphate. The nursery experiment was conducted in split-plot design with three replications

Rain water (28 ppm chloride) collected in farm ponds and bore water (600 ppm chloride) were mixed to obtain different levels of chlorides in irrigation water. The experiment was conducted for three seasons (2006-07 to 2008-09) with cv. Hema. Observations on germination count, occurrence of diseases, fresh and dry weight of seedlings and number of transplantable seedlings were recorded and subjected to analysis of variance.

RESULTS AND DISCUSSION

Influence of quality of irrigation water and fertilizer levels on crop growth

The germination count declined significantly with increased chloride content in irrigation water beyond 200 ppm and the minimum count (35.0/0.01m²) was observed at 600 ppm chloride content (Table 1). Yellowing, thickening, brittleness and upward cupping of leaves and slow death of seedlings were some of the symptoms observed in high chloride treatments. Anuradha *et al.* (2005) reported that high concentration of chlorides resulted in thick and brittle leaves with cupped margins (8.75% Cl⁻) and poor growth. The growth of seedlings as indicated by fresh and dry weight decreased significantly with increase in chlorides in irrigation water beyond 300 ppm. The weight of seedlings observed was significantly more in 1.5 RDF level. Increased fertilizer dose counteracted the effect of chloride beyond 300 ppm. However, the interaction effects were non-significant. The yield of transplantable seedlings decreased with increase in chlorides in water. The reduction was 56% from 28 to 600 ppm chlorides. Higher number of transplantable seedlings was recorded under increased fertility level, especially with water containing high chloride. The interaction effects were non-significant.

The diseases occurring in nursery viz., damping-off and blight declined with increased chlorides. At 600 ppm chlorides, the diseased seedlings decreased. However, the differences were significant only in case of damping-off. Incidence of damping-off and blight was relatively more at

1.5 RDF dose compared to RDF and the differences were significant only in case of blight.

Krishnamurthy *et al.* (1981) reported that 1.4 m.eq or 50 ppm chloride/l is the upper permissible limit for suitability to irrigate tobacco crop. Krishnamurthy *et al.* (2004) indicated that irrigation water having EC < 500 micro mhos/cm and Cl⁻ < 50 ppm are fit for irrigation of tobacco nurseries and field crops.

Influence of quality of irrigation water on soil health

Chlorides in irrigation water affected the soil pH; use of high Cl⁻ water increased the soil pH from 7.5 to 8.0. Similarly, electrical conductivity increased by almost 2 times (0.17 to 0.36 dS/m). There was an accumulation of chlorides in the soil, irrigated with chloride water (Table 2). It was observed that 125-130 ppm chlorides accumulated in the soil when soil was irrigated with 600 ppm chloride water, whereas it was 50 ppm with 28 ppm Cl⁻ water. In transplantable seedlings, the chloride accumulation was 10% higher at 600 ppm chloride water. No significant difference was observed with depth in all soil parameters studied. Similarly, no significant interaction effect was observed between salinity and fertilizer levels.

Influence on yield and quality of leaf

Seedlings produced under different water quality treatments were raised in the field following standard package of practices. The differences between various treatments were non-significant either in yield or grade outturn (Table 3). The mean values of nicotine, reducing sugars and chloride were 2.31, 13.60 and 0.32 % (Table 4). The values are within acceptable limits (Gopalachari, 1984).

Mitigation strategies

Results on feeler trials with use of FYM @ 25t/ha + high fertilizer dose and use of high chloride water mixed with rain water are some of the measures to counter the ill-effects of high chlorides in water. Chloride injury commonly encountered in SLS could be mitigated by applying well decomposed FYM/neem kernel powder along

Table 1: Effect of chlorides in irrigation water on germination, growth, incidence of diseases and number of transplantable seedlings**(Pooled Data 2006-07 to 2008-09)**

Treatments	Germination count (0.01 m ²)	Fresh wt. (g/20 seedlings)	Dry wt. (g/20 seedlings)	Damping off seed- lings/ m ²	Blight affected seedlings/ m ²	Transplantable seedlings/ m ²
Chloride levels		Main plots				
28 ppm	43.6	83.3	10.41	64.0	44.9	704
50 ppm	45.5	84.4	10.11	60.9	47.4	711
100 ppm	42.8	82.7	9.55	61.6	44.5	670
200 ppm	42.5	80.0	8.77	58.8	43.7	562
300 ppm	40.9	75.4	8.66	59.2	41.5	509
400 ppm	38.2	73.8	8.48	56.2	41.0	424
500 ppm	36.8	71.0	7.94	50.0	37.9	365
600 ppm	35.0	68.0	7.65	44.4	34.6	312
Fertilizer levels		Sub plots				
1.5 % RDF	41.2	79.4	9.24	58.7	42.9	546
RDF	40.0	75.2	8.66	55.1	39.8	518
Seasons						
2006-.07	41.8	87.8	11.06	60.5	50.9	595
2007-08	38.4	72.1	8.00	57.0	48.5	533
2008-09	41.7	72.2	7.79	53.2	24.6	469
G.Mean	40.6	77.3	8.95	56.9	41.3	532
SEm ±						
Seasons	0.91	0.88	0.13	1.40	1.12	5.94
Main plots	0.91	2.32	0.24	2.36	2.45	9.71
Sub plots	1.57	4.02	0.41	4.09	4.24	16.81
Interaction	1.49	2.85	0.31	3.05	2.78	13.45
CD (P=0.05)						
Seasons	NS	3.05	0.44	4.85	3.86	20.57
Main plots	2.51	6.44	0.66	6.55	NS	26.91
Sub-plots	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS
CV (%)						
Seasons	15.45	7.89	9.79	17.07	18.70	7.74
Main plots	9.45	12.75	11.36	17.61	25.15	7.74
Sub-plots	11.02	11.07	10.32	16.06	20.19	7.58

Table 2: Effect of quality of irrigation water (chlorides) on soil properties and chlorides content in seedlings (Pooled Data 2006-09)

Treatments	Soil pH(1:2)		E.C (dS/m)		Chlorides (ppm)		Chlorides in seedlings(%)
	D1	D2	D1	D2	D1	D2	
Chloride levels							
Main plots							
28 ppm	7.41	7.35	0.173	0.168	50	51	2.89
50 ppm	7.57	7.47	0.185	0.186	50	60	2.87
100 ppm	7.60	7.55	0.210	0.219	60	72	2.98
200 ppm	7.75	7.60	0.238	0.235	66	73	2.93
300 ppm	7.79	7.75	0.271	0.269	72	78	3.02
400 ppm	8.00	7.87	0.331	0.344	90	96	3.00
500 ppm	7.85	7.85	0.335	0.339	124	111	3.04
600 ppm	7.91	7.90	0.362	0.359	128	130	3.19
Fertilizer levels							
Sub plots							
1.5 time RDF	7.74	7.66	0.268	0.264	74	75	3.11
RDF	7.75	7.77	0.270	0.267	85	92	2.91
Seasons							
2006-07	7.60	7.60	0.290	0.289	103	113	2.40
2007-08	7.73	7.60	0.265	0.264	79	82	3.00
2008-09	7.85	7.72	0.248	0.236	56	54	3.62
G.Mean	7.72	7.63	0.268	0.263	80	84	3.01
SEm ±							
Seasons	0.06	0.04	0.05	0.04	5.30	4.40	
Main plots	0.07	0.04	0.03	0.03	8.55	4.33	
Sub-plots	0.03	0.03	0.01	0.02	4.07	4.91	
CD (P=0.05)							
Seasons	NS	NS	NS	NS	NS	25.2	
Main plots	0.253	0.262	0.087	0.083	31.4	26.3	
Sub-plots	NS	NS	NS	NS	NS	NS	
CV (%)							
Seasons	3.29	3.72	20.3	19.7	27.4	27.1	
Treatments	3.79	3.80	27.4	26.3	31.2	30.4	

Table 3: Influence of seedlings raised with water varying in chloride content on yields of FCV tobacco (kg/ha)

Treatment	Green leaf	Cured leaf	Bright leaf	Bright leaf (%)	Grade index
Chloride levels					
28 ppm	9530	1315	782	59.46	1092
50 ppm	9533	1319	786	59.59	1096
100 ppm	9428	1321	789	59.72	1099
200 ppm	9662	1328	776	58.43	1087
300 ppm	9204	1308	782	59.78	1092
400 ppm	9270	1305	767	58.77	1085
500 ppm	9400	1308	766	58.56	1083
600 ppm	9430	1328	773	58.20	1086
Mean	9432	1314	765	58.22	1090
SEm±	704	128	125	-	73.2
CD (P=0.05)	NS	NS	NS	NS	NS

Table 4 : Influence of seedlings raised with water varying in chloride content on quality of FCV tobacco

Treatment	Nicotine (%)	Reducing sugars (%)	Nicotine: R.sugars (%)	Chlorides
Chloride levels				
28 ppm	2.01	13.75	6.84	0.36
50 ppm	2.56	11.27	4.37	0.37
100 ppm	1.84	12.92	7.02	0.23
200 ppm	1.80	14.37	7.98	0.25
300 ppm	1.92	14.22	7.40	0.35
400 ppm	1.96	14.93	7.67	0.39
500 ppm	3.26	10.23	3.13	0.20
600 ppm	1.94	17.13	8.82	0.44
G. Mean	2.31	13.60	5.89	0.32

with other recommended practices for raising nursery successfully in SLS (Murthy *et al.*, 1996).

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REFERENCES

Anuradha, M., K. Nageswara Rao, K. Siva Raju, K. Deo Singh, V. Krishnamurthy and D. Prabakara Babu. 2005. Studies on toxicity of iron, manganese, boron, molybdenum and chloride in flue-cured tobacco. National Conference on Tobacco-2005, ANGRAU, Hyderabad, Oct, 3-7, 2005. Abstracts. p.120.

Gopalachari, N.C. 1984. *Tobacco*. ICAR, New Delhi. pp.327.

Krishnamurthy, V., B.V. Ramakrishnayya and D.P. Reddy. 1981. Soil characteristics and irrigation water quality of Northern light soils of Andhra Pradesh. **Tob.Res.** 7:38-45.

Krishnamurthy, V., H. Ravishankar and K.D. Singh. 2004. Decision support system for irrigation water quality evaluation and its suitability for FCV tobacco crop. **Tob.Res.** 30:144-8.

Murthy, K.S.N., J.A.V. Pasaad Rao, R. Srinivasulu and K.D. Singh. 1996. Influence of organic amendments in raising successful tobacco nurseries using saline waters in SLS area. **Tob.Res.** 22:49-51.

Murthy, K.S.N., R. Srinivasulu and K.D. Singh. 2002. Irrigation water quality in tobacco growing zones of southern coastal Andhra Pradesh. **Tob.Res.** 28:72-5.