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Relative performance of aromatic grasses under saline irrigation

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ABSTRACT

The relative performance of aromatic grasses like citronella (*Citronella java*), lemon grass (*Cymbopogon citrates* Stapf), palmarosa [*Cymbopogon martini* (Roxb.) Wats.] and vetiver [*Vetiveria zizanioides* (L.) Nash] was evaluated for their suitability to saline irrigation in a field experiment conducted on a calcareous sandy-loam soil during 1995–97 at Bir Reserved Forest, Hisar. After the establishment of grasses, these were irrigated with either of the canal and saline (ECw 8.5 dS/m) water or with these waters alternatively. On an average, the maximum biomass (90.9 tonnes/ha dry weight basis) was produced by vetiver, followed by palmarosa (29.1 tonne/ha) and lemon grass (16.1 tonnes/ha), whereas citronella could not survive. Reduction in yield with saline irrigation ranged from 24 to 29%, whereas it ranged from 3 to 21% with alternation in irrigation with canal and saline waters, vetiver being least affected.

Key words: Calcareous soils, Saline water, Lemon grass, Palmarosa, Vetiver, Citronella, Arid soils

Agricultural productivity in many arid and semi-arid regions of India, especially the north–western states suffers due to water deficits associated with scanty and uneven distribution of rainfall and long dry spells following the rainy season. Many parts of these lands usually lack supplemental irrigation water supplies except for the groundwater that is often very deep, saline and even the aquifers are low yielding. In the past, efforts towards utilization of poor quality water have been mainly aimed at enhancing the production of annual crops and high value fruit trees (Minhas and Gupta, 1992). Since only low salinity waters can be utilized for these crops, viable alternatives must be find out for production of non-traditional crops like aromatic grasses which can tolerate high salinity levels. Information regarding tolerance of aromatic and medicinal species to salinity from pot and short-term microplot studies (Pal *et al.*, 1989; Singh *et al.*, 1987 is available, but such information on soil salinities tolerated by these species under actual field situation is limited. Keeping this in view, performance of some aromatic species native to arid and semi-arid regions was evaluated for saline irrigation.

MATERIALS AND METHODS

A field experiment was conducted during 1995–97 on a highly calcareous soil (typic haplustalf) at Bir Reserved Forest, Hisar (29°10' N and 75°44' E, 220 m above mean sea-level). The climate at the site was semi-arid monsoon type with an annual rainfall of about 350 mm, 70–80% of which ocurrs during July–September. The soil was sandy loam in texture. In addition to scanty and erratic rainfall, the soil was highly calcareousness (1.8–15.0%) was another impediment in crop productivity. The experiment was laid out in randomized blcok design with a plot size of 5.0 m × 3.0 m with 4 aromatic grass species, viz. lemon grass, palmarosa, 3 cultivars ('NC 66403', 'NC 66404', 'Pusa Hybrid 8') of vetiver and citronella. Three treatments of the irrigation water quality imposed included irrigation with a good quality canal water, irrigation with saline water (ECw 8.5 dS/m) and altenate application of canal and saline water. Planting of root slips of lemon grass, palmarosa and vetiver was done during July–August 1995, whereas citronella was transplanted in March 1996. A basal dose of 20 kg N and 16 kg P was applied at transplanting and thereafter 20 kg N/ha was applied with the onset of monsoon rains. Irrigations with the specific quality water were applied as and when required. Number of irrigations during the period of experiment (1995–97) was 26, in addition to 139.7 cm rainfall.

RESULTS AND DISCUSSION

Establishment of all the cultivars of vetiver was highest (93–98% survival) and remained unaffected by saline irrigation, followed by lemon grass and palmarosa with survival of 56 and 42%, respectively, whereas citronella showed very poor survival of 4 % (Table 1). The main reason of poor survival in the latter was its susceptibility to the termite attack which is mostly prevalent in soils of

Table 1. Growth and yield of various cultivars of vetiver as affected by saline irrigation

Water quality	Cultivar			
	'NC 66403'	'NC 66404'	'Pusa Hybrid 8'	Mean
		Survival (%)		
Canal water	96	98	96	97
Saline water	92	93	98	94
Alternate CW:SW	92	97	99	96
Mean	93	96	98	96
CD (P=0.05)				
Water qualities (WQ)		NS		
Varieties (Var)		NS		
WQ × Var		NS		
		Shoot biomass (dry weight, tonnes)		
Canal water	94.7	104.4	100.5	99.9
Saline water	72.6	78.7	77.3	76.2
Alternate CW:SW	93.8	99.1	96.7	96.5
Mean	87.0	94.1	91.5	90.9
CD (P=0.05)				
Water qualities (WQ)		17.3		
Varieties (Var)		NS		
WQ × Var		NS		
		Root biomass (tonnes/ha)		
Canal water	1.28	0.86	2.08	1.41
Saline water	1.12	1.33	1.71	1.36
Alternate CW:SW	1.22	1.34	2.45	2.08
Mean	1.21	1.11	2.08	
CD (P=0.05)				
Water qualities (WQ)		NS		
Varieties (Var)		0.35		
WQ × Var		0.61		

Table 2. Growth and yield of palmarosa dn lemon as affected by saline irrigation

Water quality	ECe* (dS/m)	Survival (%)	Shoot biomass (tonnes/ha)	
			Fresh	Dry matter
Palmarosa				
Canal water	3.8	52	92.8	34.0
Saline water	6.8	36	66.3	24.3
Alternate CW:SW	5.4	38	79.6	29.1
CD (P=0.05)		NS	12.5	4.8
Lemon grass				
Canal water	3.8	82	69.4	19.2
Saline water	6.4	38	50.7	14.0
Alternate CW:SW	5.4	47	54.5	15.1
CD (P=0.05)		19	7.7	2.1

*At harvest

arid climates.

Considerable mortality with saline irrigation was observed in lemon grass, but the effects remined non-significant in palmarosa (Table 2). Similar to survival, dry-matter production was also maximum in vetiver (90.0 tonnes/ha), being about 3- and 6-fold higher than palmarosa (29.1 tonnes/ha) and lemon grass (16.1 tonnes/ha). Yields were reduced by about one-fourth (22–29%) with saline irrigations in all these grasses. However, alternate irrigations with saline and canal waters could sustain yields only in vetiver but reduction was 14 and 21%in palmarosa and lemon grass respectively. Singh *et al.* (1987) reported the safe limits of salinity in irrigation water to be 12 dS/m for vetiver. However, it may be pointed out that the performance of palmarosa and lemon grasses was not that good with saline irrigation. Starting with a non-saline soil and growing these grasses under sub-humid conditions (annual rainfall of about 100 cm), they did not observe any adverse effect on the herb yield when irrigated with saline water up to EC 10 dS/m and these grasses could even be successfully grown with water of ECiw 16 dS/m. In fact, such variations in performance are expected as salinity build up with saline irrigation waters is generally associated with aridity and effects are prone to be severe in actual field conditions than those prevailed under the pot and micro-plot conditions. Cintronella could not survive either with saline irrigation or its alternation with canal water. Pal *et al.* (1989) also reported poor performance of citronella at ECiw of 45 dS/m. Production of root biomass, an economic component of vetiver grass, was at par amongst the various cultivars tested (Table 1). This was rather improved (12%) when irrigated alternately with saline and canal water, while it remained unaffected under saline irrigation. This also indicated towards better tolerance of vetiver to saline conditions in comparison with the other aromatic grasses included in this study. It was concluded that cultivation of vetiver can prove to be viable alternative under saine irrigation conditions.

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