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Conjunctive Use of Alkali/Canal Water on the Yield of Potato (*Solanum Tuberosum*) in Semi-Arid Condition.

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Management of Salt affected soils and use of saline water in agriculture.
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Abstract

A field experiment was conducted to study the effect of quality of irrigation water on yield of potato crop during rabi 2005-06 to 2006-07 under semi-arid sub tropical climate condition. The results of experiment reflected that the tuber yield of potato was found highest in experimental plots irrigated with all canal water (270.3 q/ha^{-1}) and lowest in experimental plots irrigated with all alkali water (38.7 q/ha^{-1}) along with significant reduction. The different irrigation modes of canal and alkali water also differ significantly with all canal water treatments. Amongst the different canal, alkali waters modes highest yield was recorded in treatment of 2 year canal: 1 year alkali with 69 % relative yield in plots irrigated with all canal water. The modes 1 year canal : 2 year alkali, 1year alkali : 2 year canal and mixing (1 canal + 2 alkali) produced significantly lower yield over 2 year canal : 1 year alkali modes. However, the former mixing was superior to all the alternate modes except 2 year canal: 1 year alkali. The relative yield of different canal/alkali irrigation modes were 62 % in 1 year canal : 2 year alkali , 57 % 2 year alkali : 1 year canal , 69 % in 2 year canal : : 1 year alkali , 71 % in 1 year alkali : 2 year canal , 60 % in alkali (R) : canal(S), 61 % in mixing (1canal+2alkali) and 78% in mixing (2canal + 1alkali) when compared with cyclic modes respectively.

Introduction

Degradation of soils with the use of alkali ground waters constitutes a major threat to irrigated agriculture in semi arid parts especially south Asia [3, 6]. High incidence (30 -50%) of these waters is found in semi arid parts (annual rainfall 500 – 700 mm), which are intensively cultivated areas in the Indo-Gangetic plains. Irrigation with alkali water results in a rise in soil's alkalinity and sodicity thus adversely affecting the soil's physical behavior in terms of crusting, hard setting and low intake rates. This not only decreases the crop yield but also limits the choice of crops that can be grown on these soils [2]. Specialized soil crop irrigation management practices, which help to maintain the sodicity in the root zone with permissible limits, and therefore advocated for sustained irrigation with alkali waters. In addition to appropriate selection of crop and improvement in water management, application of amendments is required to maintain soil structure/permeability and thus sustain irrigation with alkali waters.

Material and Methods

The experiment was conducted at the experimental farm of R. B. S College of Agriculture, Bichpuri, Agra. The climate of this site is semi arid with average rainfall 600 mm about 80 % of which is received during July – September. The soil at this site is well drained (water level below 13 m) sandy loam soil with an electrical conductivity of saturation paste extract (ECe) of 2.7 dS/m, pH of the saturation paste of 7.9, exchangeable sodium percentage (ESP) of 5.3, organic matter of 2.9 g/kg soil and clay content of 14%. Treatment consisted of a combination of irrigation with an alkali water (AW, ECiw

3.6dS/m, RSC 15.8 me/l, SAR 12.4) and good quality canal water (CW, Eciw 1.1dS/m, RSC Nil, SAR 1.8) applied either alone, as blender or in cyclic (i.e. alternate) application both irrigation wise.
Specifically, these treatments were:

(a) Irrigation either with CW or AW alone.
(1) Irrigation with good quality canal water alone (CW for reference).
(2) Irrigation with alkali water alone (AW).
(b) Applying the two waters cyclically either irrigation wise.
(1) Alternate irrigation with CW and AW, with canal water (CW) to start with (1yCW:2yAW)
(2) Alternate irrigation with CW and AW, with AW to start with (2yAW : 1yCW)
(3) Alternate irrigation with CW and AW, with CW to start with (2yCW : 1y AW)
(4) Alternate irrigation with CW and AW, with AW to start with (1yAW : 2y CW)
(5) Crop wise alternation of CW and AW, with application of AW to potato
(c) Irrigation with blends of CW and AW.
(1) Blending in the ratio of 2:1 (2CW:1AW)
(2) Blending in the ratio of 1:2(1CW:2AW)

Treatments were imposed in a randomized block design with three replications. The plot size was $4m \times 4m$ and to control fluxes of salt and water each plot was lined with polyethylene sheet down to a depth of 0.9 m. Alkali water was synthesized by dissolving the required quantities of Sodium Bicarbonate in canal water. Local agronomic practices in terms of inter/intra row spacing, seed rates, fertilizers, irrigation schedules and other cultural practices were followed for each crop. Potato variety Kufari 3797 was planted during the end of October and harvested during the end of February or first week of March.

Results and Discussion

The yield of potato crop improved under the various combinations of CW and AW usage compared with AW alone. The crops tended to perform better with cyclic water use compared to blending (Table 1), when averaged over the 2 years, the RY of potato were 61.7, 56.8, 69.2, 71.5 and 60.3% under the cyclic 1yearCW:2year AW, 2yearAW:1yearCW, 2yearCW:1yearAW, 1yearAW:2yearCW and AWp: CWs treatments, respectively while the RY was 77.9 and 60.8% for waters blended in the ratio 2CW:1AW and 1CW:2AW, respectively.

The cyclic use when canal water was used initially marginally improved yields when compared with blending. However, the yield declined slightly when 2yearAW irrigations were applied initially. This is consistent with earlier studies (4 and 5)) which show that for similar salt input, cyclic applications have an advantage over blending the water supplies especially when the better quality water is used initially at crop establishment. The blending the low and high salinity waters can result in the loss of consumable water and more crop production can be achieved from the same total water supply if the two components are used sequentially. Thus, the results of the present study further corroborate that the same also holds for the combined use of alkali and good quality waters when the good quality water is applied initially.

For potato, soil sodicity build up under different treatments, in addition to affecting crop yield is also reflected in terms of the quality of produce (Table 2). In general, the lower grade potato (c grade), increased with decline in yield under different treatments. Storage quality also deteriorated with AW irrigation (e.g. the potatoes shriveled with two –third –weight loss on storage for 90 days under AW treatment where as the weight loss was just about two-fifth under CW. The water use efficiency (WUE) also declined with reduced yields and sodicity development under various treatments (Table 2). For potatoes WUE declined from 801.0 kg/ha-cm with CW to 129.7 kg/ha-cm with AW. The values ranged between 706.5 and 654.5 kg/ha-cm with various CW and AW combinations except for 2year AW: 1year CW treatment about the WUE 314.6 kg/ha-cm.

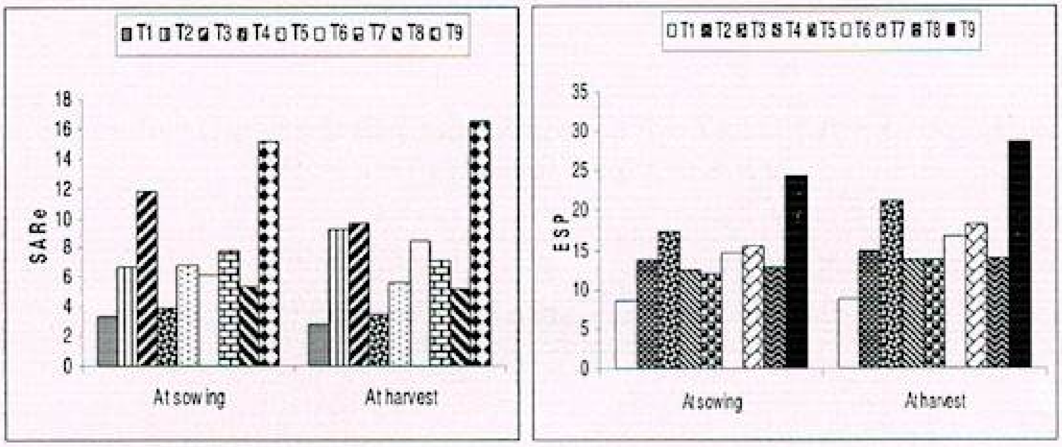
It can be concluded that the combined use of alkali and good quality canal waters can maintain the soil sodium saturation at relatively low levels depending upon the proportion of the two waters. Amongst the various treatment options, the cyclic use should be preferred especially when canal waters are utilized for initial irrigation since it would have both operational and performance advantages over the blending of the water supplies. The use of AW should be avoided during the initial stage of crop growth. The buildup salinity and sodicity in soils was also related to the proportion of AWused in various modes of irrigation while little difference was observed between respective blending and cyclic use. The SARe in less in sowing of potato 3.4 in CW and 15.2 in AW treatment but salinity increased at harvest time 3.8 and 16.5 in CW and AW.The monitoring the ESPvalues at sowing and at harvest of potato crop in the two years average data the ESP increased due to use of more AW water in the crop this value was 8.5 and 24.5 in CW and AW treatments in at sowing and at harvest .The use of more alkali water in irrigation at harvest time increase the ESP 8.8 and 28.6 in CWand AW treatments (fig1 A&B) (1) as earlier reported the same results [1].

Table 1: Effect of various modes of irrigation with alkali and canal waters on yield of potato Tuber

Modes of water use	Tuber yield (q ha^{-1})			
	2005-06	2006-07	Mean	RY(%)
Canal water,CW	281.8	258.8	270.3	100
Alkali water.AW	42.8	33.6	38.2	14
Cyclic use				
1yearCW:2yearAW	173.0	165.1	169.6	62
2yearAW:2yearCW	113.9	184.3	149.1	57
2yearCW:1yearAW	240.9	208.6	224.8	69
1yearAW:2yearCW	1198.0	178.7	188.4	71
AWs:CWp	162.3	158.8	160.1	60
Blending				
2CW:1AW	203.9	217.3	210.6	78
1CW:2AW	153.0	172.1	163.6	51
CD at 5%	20.6	16.5	-	-

Table 2: Effect of various treatments on water use and water use efficiency in potato and quality parameters (Av.2years)

Modes of water use	Tuber yield grade wise(qha-1) 'A' 'B' 'C'			% weight loss	Water use (cm)	Water use efficiency kg/ha-cm
Canal water,CW	107.6	90.4	72.3	25.3	35.2	801.0
Alkali water.AW	10.9	15.9	22.4	47.8	33.0	129.7
Cyclic use						
1yearCW: 2year AW	60.1	54.1	54.4	27.7	34.5	518.8
2yearAW: 2year CW	46.7	53.6	48.8	31.8	34.3	314.6
2yearCW: 1yearAW	90.7	80.8	53.3	32.2	34.1	706.5
1yearAW: 2yearCW	61.2	50.1	77.1	30.8	34.1	492.7
AWs:CWp	70.1	51.5	38.8	31.5	34.3	394.2
Blending						
2CW:1AW	87.1	64.1	59.4	29.3	34.2	654.7
1CW:2AW	50.4	45.5	67.7	31.1	34.2	447.4
CD at 5%	4.5	3.6	3.9	0.7	-	-



(A) (B)

Fig-1 (A)SARe (mmol/l) and (B) ESP in different treatments.

References

1. Chauhan, S.K.,Chauhan,C.P.S. and Mihas,P.S. (2007). Effect of cyclic use and blending of Alkaliand good quality waters on soil properties, yield and quality of potato, sunflower and Seabania. Irrig Sci.**26**:81-89.
2. Minhas, P.S. (1996). Saline water management for irrigation in India. Agric Water management. **30**:1-24
3. Minhas, P.S.,Bajwa, M.S.(2001). Use and management of poor quality waters for the rice-Wheat based production system Crop Prod **4**:273:305.
4. Minhas,.P.S., and Gupta, R.K. (1993a). Conjunctive use of saline and non-saline waters in response of wheat to initially variable salinity profiles and modes of Stalinization. Agriculture Water Manage **23**:125-137.
5. Minhas,P.S., and Gupta, R.K. (1993b). Conjunctive use of saline and non-saline waters III. Validation and applications of a transient state model for wheat Agriculture Water Manage **23**:149-160.
6. Qadir,M. and Oster,J.D. (2004). Crop and irrigation management strategies for saline sodic soils and waters aimed at environmentally sustainable agriculture Sci Total Environ **23**:1-19.