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Judicious Use of Canal Water in Semi Irrigated Canal Areas

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Abstract

The use of groundwater for agriculture in hot semi-arid/arid areas where rainfall is scarce leads to increase ground water salinity and limits the selection of crops for cultivation. Presence of different types of solutes determines the quality of irrigation water. Electrical conductivity (EC) or TDS (Total dissolved solids) determines water salinity, ph (potential of hydrogen) determines alkalinity of water, sodium hazards measures by SAR (Sodium adsorption ratio) and RSC (Residual sodium carbonates). Generally, four basic criteria that are EC, Ph, SAR and RSC determine quality of irrigation water. But if farmer knows TDS and ph then they can roughly estimate EC and RSC of water. So, this article will help the farmers to get rough estimate of quality of irrigation water, moreover this article also suggests blending methods to get net "quality water." Finally, there is also suggestion to farmers for regular detailed checking of water and soil annually.

Key words: Electrical conductivity, Total dissolved solids, sodium adsorption ration, potential of hydrogen (ph), Residual sodium carbonates.

Introduction

Water being a wonder liquid has ability to dissolve the most of solutes present on this earth. Irrigation water must have sufficient (neither more nor less) amount of such solutes, which decides its quality. Excess chemicals or solutes affect the soil structure as well as crop performance. Hydroponic system needs proper check of EC (Electrical conductivity) or Ph. Detailed report of water testing includes EC, Ph, SAR (Sodium adsorption ratio) and RSC (Residual sodium carbonate). Quality irrigation must have EC< 2ds/m, Ph=7-7.5, SAR<10 and RSC<2.5 meq/l (POP, CCSHAU, 2011), but according to Follete (2002) and Bauder *et al.*, 2011, EC must be less than 750 miscrosemen per centimeter, ESP<15 (FAO-UNESCO 1973), SAR<10 (Sahid and Mahmoudi, 2014).

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Farmers check quality of water by various local methods, one famous method is tasting the water. General two tastes are there if quality of water is poor, one is salty which indicates more TDS (Total dissolved solids) or EC and if water tastes bitter then it indicates more ph and RSC. This article focusses on scientific use of quality water from farmer perspective, for areas where canal water is limiting and ground water is brackish.

Measuring quality of water cost effectively

We can measure EC of water by knowing its TDS, and TDS meter (Plate-1) is cheaper as compare to EC meters. We can roughly says that,

$$TDS\ (mg/l) = 640 \times EC_W\ (ds/m) \quad \ldots\ldots (1)$$

The above relationship in most cases is applied for TDS ranging 0-3000 mg/l and not applicable for wastewater (Kahlown and Khan, 2002).

TDS can easily measure by dipping TDS meter in water, hence very easy to check. If TDS =320 mg/l, then EC will be 0.5 ds/m. Similarly if TDS = 640mg/l then EC = 1ds/m.

For ph measurement we use ph meter (Plate1), but first we have to calibrate this meter. The calibration methods depend on model of meter. But it is important to note that for mixing of chemicals (of ph meter) always use distilled water, which easily available in medical stores. After calibration of ph meter it gives reading by simple dipping meter electrode in water. Room temperature (25°C) is best to take reading of TDS and Ph meter.

Quality comparison

EC is very important indicator of salts like sodium or potassium chloride in water. If water have EC less then 1 ds/m (TDS =640 mg/l) then such water is said to be of very good quality and can be used any type of soil in most of crops. Canal water generally have EC<0.3ds/m and rain water EC<0.15 ds/m. Below list of some crops sensitive to different EC (Table -1). EC value 1.5 – 2 ds/m cause very moderate problem if soil is clay in nature if such water

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Plate-1 Ph and TDS/temperature meters

Table-1 Crop Tolerance and Yield Potential of Selected Crops as Influenced by Irrigation Water Salinity (EC_w) or Soil Salinity (EC_e)

Yield Potential

FIELD CROPS	100%		90%		75%		50%		0% "maximum"	
	EC_e	EC_w	EC_e	EC_w	EC_e	EC_w	EC_e	EC_w	EC_e	EC_w
Barley *(Hordeum vulgare)*	8.0	5.3	10	6.7	13	8.7	18	12	28	19
Cotton *(Gossypium hirsutum)*	7.7	5.1	9.6	6.4	13	8.4	17	12	27	18
Sugarbeet *(Beta vulgaris)*	7.0	4.7	8.7	5.8	11	7.5	15	10	24	16
Sorghum *(Sorghum bicolor)*	6.8	4.5	7.4	5.0	8.4	5.6	9.9	6.7	13	8.7
Wheat *(Triticum aestivum)*	6.0	4.0	7.4	4.9	9.5	6.3	13	8.7	20	13
Wheat durum *(Triticum*	5.7	3.8	7.6	5.0	10	6.9	15	10	24	16

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durum)										
Soybean *(Glycine max)*	5.0	3.3	5.5	3.7	6.3	4.2	7.5	5.0	10	6.7
Cowpea *(Vigna unguiculata)*	4.9	3.3	5.7	3.8	7.0	4.7	9.1	6.0	13	8.8
Groundnut (Peanut) *(Arachis hypogaea)*	3.2	2.1	3.5	2.4	4.1	2.7	4.9	3.3	6.6	4.4
Rice (paddy) *(Oryza sativa)*	3.0	2.0	3.8	2.6	5.1	3.4	7.2	4.8	11	7.6

(https://www.fao.org/)

used regularly. But water having EC>2 is not recommended for irrigation. Although water of EC upto 3ds/m can be used in very sand soils. Moreover, it also depends on average rainfall of particular area, area receiving rainfall about 400 mm per year and soil is sand, then such farmers can use water up to EC =3 ds/m (POP, CCSHAU,2011).

For ph calculation (which indicates alkalinity of water) we have simple rule, ph 6.8-7.5 is good for most of crops. Generally, for field crops ph 7-7.5 is better. But if ph exceeds 8 then water is said to be alkaline and then we have use to use gypsum for correction of RSC and ph of water.

Correcting net EC and ph value for irrigation

When two waters of different are mix with different EC, to get net EC we can use following formula,

$$EC_{net} = \frac{\{(EC\ of canal)\ x\ (V\ of\ canal\ water)\}+\{(EC\ of\ tubewell)\ x\ (V\ of\ tubewell)\}}{(\text{V of canal+V of tubewell})}$$

Where EC (of canal) = Electric conductivity of canal = $(TDS_{OF\ CANAL\ (mg/l)})/640$

V of canal water = Volume of canal water used

EC (of tubewell) = Electric conductivity of tubewell water = $(TDS_{OF\ TUBEWELL(mg/l)})/640$

V of tubewell = Volume of tubewell water used

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How to use above formula? Farmer can use above formula as

For example, if you want to maintain net EC = 2ds/m, 1st check TDS of canal water, let it be 200 mg/l, then EC of canal = 200/640 = 0.31 ds/m. Now check TDS of tube well water, let it be 2500 mg/l, EC of tube well = 2500/640 = 3.90 ds/m.

Now, consider that your canal water gives 3-inch water yield (water stored in pound) and now how much water of tube well we mix with it.

By using above formula, we can find V of tube well water = 2.7 inch water (yield in terms of farmer).

Ph and RSC correction, RSC checked by detailed water report, ph can be checked by ph meter. Ph of water can be adjusted by following methods as shown in Plate-2,

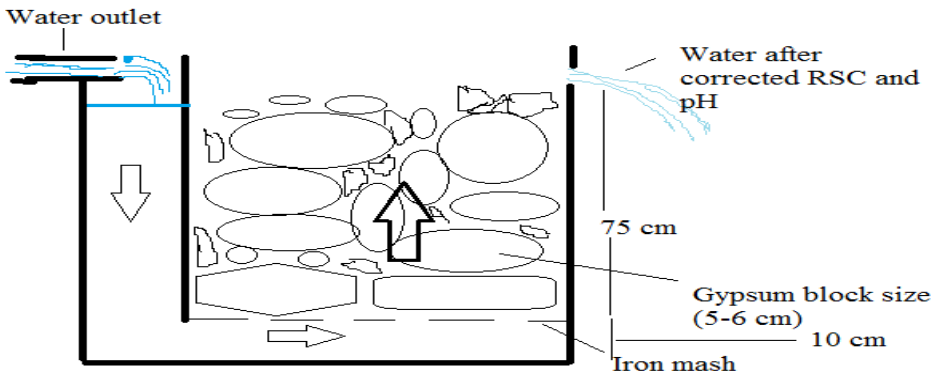

Plate-2 Correcting RSP and ph of irrigation water

In above Plate -2, we are using gypsum blocks (5-6 cm) the height of tank is general kept fixed but length and breadth can be adjusted according to ph and number of block required. Approximately if ph is between 8-9, then RSC will varies between 3-12 me/l (Kumar and Sharma, 2010). By using table-2 farmers can design its tank to het desired RSC and ph of irrigation water (Table -2). Although correct value of RSC can only be checked in laboratory.

Tube well discharge in liter/sec	RSC = 3-4 (ph 8-8.3) Length x	RSC =6 (ph 8.3-8.5) Length x	RSC =8 (ph above 8.5) Length x	RSC =10 (ph aprox. 8.8-9) Length x

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	breadth of tank required to construct in meter square	breadth of tank required to construct in meter square	breadth of tank required to construct in meter square	breadth of tank required to construct in meter square
1	0.21	0.43	0.66	0.92
2	0.42	0.86	1.32	1.84
3	0.63	1.29	1.98	2.76
4	0.84	1.72	2.64	3.68
5	1.05	2.15	3.30	4.60
6	1.26	2.58	3.90	5.52
7	1.47	3.01	4.62	6.44

(POP, CCSHAU,2011)

Conclusion and suggestions

Not only EC and Ph determine quality of irrigation water, RSC and SAR are other important parameters. So, it is suggested to farmers not only rely on EC and Ph report. Annual detailed report of irrigation water and soil testing report is recommended to farmers. Water having EC<1ds/m, TDS<640 mg/l, ph range =6.8-7.5, RSC<2.5 me/l and SAR<8, is said to be of excellent quality. The low cost method of measuring EC and ph suggested here is recommended for day to day basis water testing. Moreover methods like ridge and furrow, sprinkler irrigation, drip irrigation methods… etc for different crops and for different soil give more efficiency.

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