*The Andhra Agric. J* 63(3): 580-584, 2016

# Judging the Ground Water Quality Used in Maize Crop Grown Soils of Chittoor District, Andhra Pradesh

**R V Sagar Kumar Reddy, P Venkataram Muni Reddy and S Soma Sekhar Babu**
Department of Soil Science and Agricultural Chemistry
S.V. Agricultural College (ANGRAU), Tirupati - 517 502, Andhra Pradesh.

**ABSTRACT**

A survey was undertaken to judge the quality of irrigation water used in maize crop grown soils in Chittoor district of Andhra Pradesh. The irrigation water samples collected from sandy clay loam (scl) texture were found to be $C_3S_1$ (37.50 per cent) and $C_4S_1$ (62.50 per cent) category while the water samples collected from clay loam texture (cl) were fallen under category of $C_2S_1$ (3.33 per cent) and $C_3S_1$ (96.67 per cent). With respect to irrigation water samples collected from sandy loam (sl) texture were fit to classify as $C_3S_1$ (85.71 per cent) and $C_4S_1$ (14.29 per cent). Further, the water samples collected from clay (c) texture were categorized as $C_3S_1$ (33.33 per cent) and in $C_4S_1$ (66.67 per cent). With reference to Minhas and Gupta classification, water samples collected from different textural classes were found to be safe with respect to EC, SAR and RSC values.

**Key words :** Classification, Irrigation water samples, Maize grown soils, Quality parameters.

Maize (*Zea mays* L.) is one of the important cereal crops next only to wheat and rice in the world. In India, it ranks fourth after rice, wheat and sorghum. In the world, it is grown over an area of 131 million ha with an annual production of 506 million tonnes with a productivity of 3890 kg $ha^{-1}$. In India, it is cultivated over an area of 6.10 million ha with an annual production of 10 million tonnes and productivity of 1639 kg $ha^{-1}$. The area is mostly concentrated in Rajasthan, Uttar Pradesh, Madhya Pradesh, Karnataka, Andhra Pradesh, Bihar, Gujarat and also grown in a small areas in almost all the states.

In Andhra Pradesh, though maize is predominantly grown in kharif, irrigated maize is gaining popularity in view of higher productivity. The extent of yield reduction owing to moisture stress depends on the critical growth stages at which it occurs. Limited irrigation at critical moisture stages increases production levels and stability as well as profit. Ideal scheduling of available water should be based on meeting full crop water requirement at most sensitive stages and at less sensitive stages to deficit water. Maize crop will do well on any soil with adequate drainage to allow for the maintenance of sufficient oxygen for good root growth and activity and enough water holding capacity to provide adequate moisture throughout the growing season.

## MATERIAL AND METHODS

The survey area in Chittoor district of Andhra Pradesh is located at the East longitudes of 76° 58' to 79° 34' and North latitudes of 14° 54' to 16° 18' and lies on the eastern side of peninsular India.

About 90 water samples were collected from the cultivator's fields at flowering stage (60 DAS). The source of irrigation is through from the bore wells having a depth ranging from 90 to 160 feet. From each of the three orders *viz.,* Alfisols, Inceptisols and Vertisols, 30 holdings were selected from which the water samples were collected at flowering stage (60 DAS). All the 90 water samples were analysed for pH, EC and sodium as per the standard procedures (Jackson, 1973). The carbonates and bicarbonates content in water samples were estimated by titrating the samples with standard (0.1 *N*) sulfuric acid using phenopthalein and methyl orange as indicators (Piper, 1966). The Ca and Mg were determined by Versenate method (Diehl *et al.,* 1950) whereas residual sodium carbonate (RSC) and sodium

adsorption ratio (SAR) were calculated by using the formulae given by Richards, 1954.

The irrigation water was classified based on the electrical conductivity, sodium adsorption ratio and residual sodium carbonate as given by United States Department of Agriculture (USDA, 1973) hand book No. 60 (general classification) and also by Minhas and Gupta (1992) classification for irrigation water (based on clay per cent in the soil).

## RESULTS AND DISCUSSION

### Quality parameters in irrigation water samples (pH, EC, SAR and RSC)

The pH and EC alone are not good criteria for judging the suitability of water for irrigation. Determination of individual anions and cations is inevitable for the evaluation of quality of water samples (Krishnamurthy, 1965).

The pH of water samples ranged from slightly alkaline (7.02) to moderately alkaline (8.39). The mean pH of water samples collected from Alfisols, Inceptisols and Vertisols was 7.31, 7.53 and 8.21, respectively. The EC of the water samples under different orders indicated that they were of non-saline in nature. EC of Alfisols varied from 1.59 to 2.36 with a mean of 2.01 whereas, it ranged from 0.73 to 1.10 with a mean value of 0.89 in Inceptisols and from 1.07 to 2.54 with a mean value 2.00 in Vertisols. In Alfisols, the Sodium absorption ratio content ranged from 2.19 to 7.60 with a mean of 4.06. In Inceptisols, it varied from 0.75 to 6.50 with a mean of 3.07 and in Vertisols the corresponding values are 4.00 to 9.37 with an average of 6.45. The water samples collected from Vertisols record highest SAR than Alfisols and Inceptisols. The highest value of sodium adsorption ratio may be due to higher value of soluble sodium percentage compared to combined values of calcium and magnesium cations (Gupta *et al.,* 1998). In Alfisols, the RSC content ranged between 0.25 and 1.10 with a mean of 0.78. In Inceptisols, it varied from 0.30 to 1.15 with a mean of 0.75 and in Vertisols the corresponding values were 0.50 to 2.40 with an average of 1.18 (Table 1). All the water samples record RSC less than 6 $m.eL^{-1}$ of RSC, which was consider being safe as per Bajwa *et al.* (1992). All the water samples were in safe limits with respect to pH, EC, SAR and RSC as per the limits mentioned by Richards, 1954.

### Classification and distribution of water samples (USDA System)

Ground water samples collected from bore wells of maize fields of study area were analysed for various quality attributes in order to assess the quality. By critical scanning of the data, the classification of the irrigation water (USDA system) are presented in table 2 and depicted diagrammatically in figure 1. According to USDA classification, 37.50 per cent of water samples in scl were found to be categorized as $C_3S_1$ (high salinity with low sodium hazard), while the rest 62.50 per cent were grouped under $C_4S_1$ category (very high salinity with low sodium). Regarding the water samples collected from Clay loam texture, 3.33 per cent of samples have fallen under category of $C_2S_1$ (medium salinity with low sodium hazard) while the rest of 96.67 per cent in $C_3S_1$ (high salinity with low sodium hazard). With respect to sl texture, 85.71 per cent of water samples were fit to classify as $C_3S_1$ (high salinity with low sodium hazard), whereas 14.29 per cent in $C_4S_1$ category (very high salinity with low sodium). In case of c texture, 33.33 per cent of water samples were categorized as $C_3S_1$ (high salinity with low sodium) and 66.67 per cent in $C_4S_1$ (very high salinity with low sodium).

### Percent distribution of water samples collected from different textural classes based on quality attributes [Minhas and Gupta]

Minhas and Gupta made an attempt on the classification of water based on clay content of soil and different water quality attributes *viz.,* Electrical Conductivity, Residual Sodium Carbonate and Sodium Adsorption Ratio and suggested the limits for suitability of the water for the purpose being used. The data is summarized in table 3. The water samples collected from the sandy clay loam soils, revealed that 100 per cent (16 samples) samples were said to be safe based on E.C, SAR and RSC. In case of clay loam soils, 100 percent (30 samples) samples have fallen in safe category with respect to quality attributes E.C, RSC and SAR. Further, in sandy loam soils (Moderately coarse (10-20% clay), all the water samples were considering safe based on E.C, SAR and RSC. With reference to water samples collected from clayey soils [fine (>30% clay)], the E.C, RSC and SAR are found to be safe.

Table 1. Quality parameters in irrigation water – pH, EC, SAR and RSC.

| Sl. No. | Soil orders | Number of samples | Quality Parameters in Irrigation Water | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | pH | | EC (dS $m^{-1}$) | | SAR | | RSC (m.eq $l^{-1}$) | |
| | | | Range | Mean | Range | Mean | Range | Mean | Range | Mean |
| 1 | Alfisols | 30 | 7.02-7.66 | 7.31 | 1.59-2.36 | 2.01 | 2.19-7.60 | 4.06 | 0.25-1.10 | 0.78 |
| 2 | Inceptisols | 30 | 7.07-7.93 | 7.53 | 0.73-1.10 | 0.89 | 0.75-6.50 | 3.07 | 0.30-1.15 | 3.07 |
| 3 | Vertisols | 30 | 7.99-8.39 | 8.21 | 1.07-2.54 | 2.00 | 4.00-9.37 | 6.45 | 0.50-2.40 | 1.18 |

Table 2. Classification and distribution of water samples collected from different textural classes (USDA system)

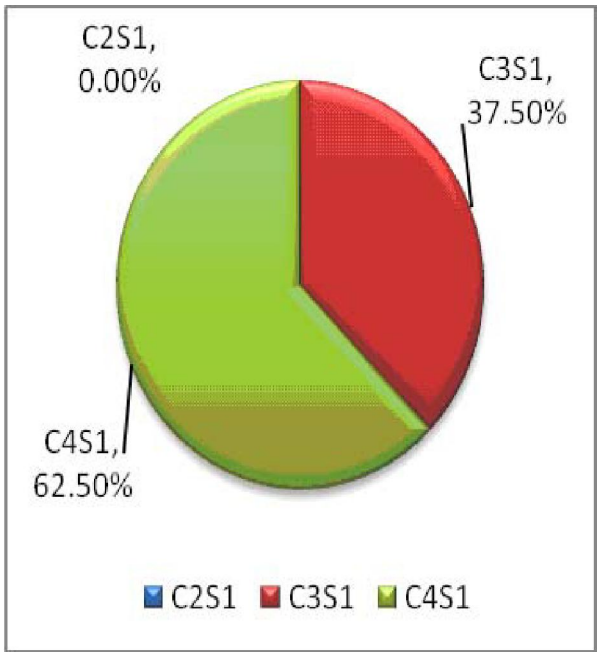
| Textural classes | Class and distribution of water as per USDA system | | | | | |
|---|---|---|---|---|---|---|
| | *$C_2S_1$ | | *$C_3S_1$ | | *$C_4S_1$ | |
| | No. of sample | Percent distribution | No. of sample | Percent distribution | No. of sample | Percent distribution |
| Scl | - | - | 6 | 37.50 | 10 | 62.50 |
| Cl | 1 | 3.33 | 29 | 96.67 | - | - |
| Sl | - | - | 12 | 85.71 | 2 | 14.29 |
| C | - | - | 10 | 33.33 | 20 | 66.67 |

*$C_2S_1$ = Medium salinity with low sodium
*$C_3S_1$ = High salinity with low sodium
*$C_4S_1$ = Very high salinity with low sodium

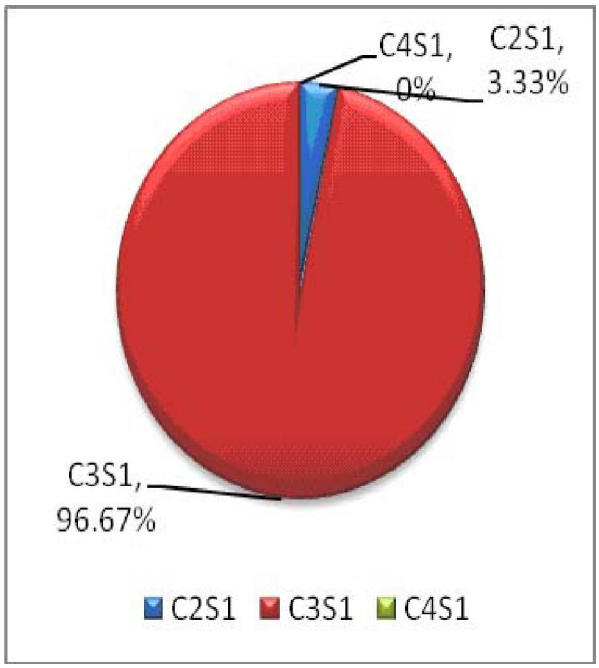
Table 3. Per cent distribution of water samples collected from different textural classes based on quality attributes (Minhas and Gupta)

| Textural classes classification | EC (ds $m^{-1}$) | | RSC (m.eq $l^{-1}$) | | SAR | |
|---|---|---|---|---|---|---|
| | Safe limits | Percent distribution | Safe limits | Percent distribution | Safe limits | Percent distribution |
| Scl[Moderately fine (20-30% clay)] | < 4.5 | 100 | 3.5 to 5.0 | 100 | < 10.0 | 100 |
| Cl[Moderately fine (20-30% clay)] | < 4.5 | 100 | 3.5 to 5.0 | 100 | < 10.0 | 100 |
| Sl[Moderately coarse (10-20% clay)] | < 8.0 | 100 | 5.0 to 7.5 | 100 | < 15.0 | 100 |
| C[Fine (>30 % clay)] | < 3.0 | 100 | 2.5 to 3.5 | 100 | < 10.0 | 100 |

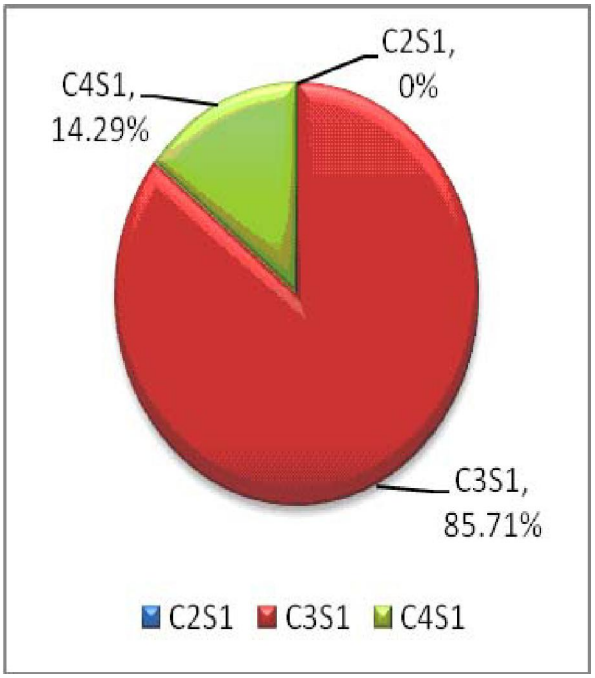
Fig 1. Classification and distribution of water samples collected from different textural classes (USDA System)



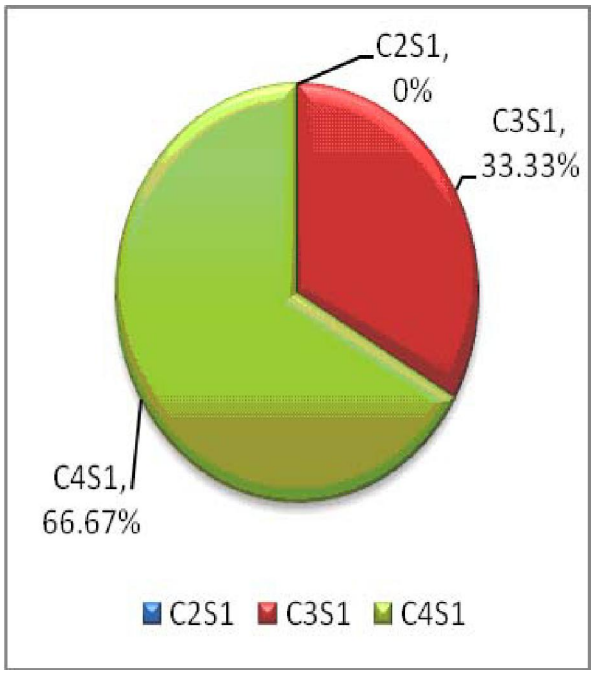

Sandy clay loam (Scl)




Clay loam (Cl)




Sandy loam (Sl)




Clayey (C)

**Conclusion**

According to USDA classification, 37.50 per cent of water samples in scl were found to be categorized as $C_3S_1$ (high salinity with low sodium hazard), while the rest 62.50 per cent were grouped under $C_4S_1$ category (very high salinity with low sodium). Regarding the water samples collected from Clay loam texture, 3.33 per cent of samples have fallen under category of $C_2S_1$ (medium salinity with low sodium hazard) while the rest of 96.67 per cent in $C_3S_1$ (high salinity with low sodium hazard). With respect to sl texture, 85.71 per cent of water samples were fit to classify as $C_3S_1$ (high salinity with low sodium hazard), whereas 14.29 per cent in $C_4S_1$ category (very high salinity with low sodium). In case of c texture, 33.33 per cent of water samples were categorized as $C_3S_1$ (high salinity with low sodium) and 66.67 per cent in $C_4S_1$ (very high salinity with low sodium). With reference to Minhas and Gupta water samples collected from different textural classes *viz.,* sandy clay loam, clay loam, sandy loam and clayey soils indicated that all the water samples were found to be safe with respect to EC, SAR and RSC values.

## LITERATURE CITED

**Bajwa M S, Choudhary O P and Josan A S 1992** Effect of continuous irrigation with sodic and saline-sodic water on soil properties and crop yields under cotton-wheat rotation in North Western India. *Agricultural Water Management*, 22: 345-356.

**Diehl H, Goetz C A and Hach C C 1950** The versenate titration for total hardness. *Ametuer Water Works Association Journal*, 42: 40-48.

**Gupta J P, Sumbria N M and Khanna Y P 1998** Quality of different sources of irrigation water of Jammu region. *Madras Agricultural Journal,* 85 (2): 110-112.

**Jackson M L 1973** *Soil Chemical Analysis*. Oxford IBH Publishing House, Bombay. pp: 38.

**Krishnamurthy R 1965** A study on the utility of electrical conductivity as an index of irrigation water. *Madras Agricultural Journal,* 52: 499-505.

**Minhas P S and Gupta K 1992** Quality of irrigation water assessment and management. *Journal of Indian Society of Soil Science,* 36: 584-587.

**Piper C S 1966** *Soil and Plant Analysis*. Hans Publications, Bombay. pp.59.

**Richards L A 1954** *Diagnosis and Improvement of saline alkali soils*. U.S.D.A Hand Book 60. Oxford and IBH Publishing Co., New Delhi.

**USDA 1973** *Diagnosis and Improvement of saline and alkali soils*. U.S.D.A Hand Book 60. Oxford and IBH Publishing Co., New Delhi.

(Received on 20.08.2012 and revised on 19.10.2013)