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Short Note

Assessment of Irrigation Water Quality in Prakasam District of Andhra Pradesh

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Some important physico-chemical parameters of irrigation water of guava orchards in Prakasam district were evaluated for the criteria of the irrigation water quality. Thirty water samples were collected from three different mandals of the Prakasam district. The present study revealed that pH was neutral to moderately alkaline, Electrical Conductivity (EC) was high, Sodium Adsorption Ratio (SAR) was low to medium and Residual Sodium Carbonate (RSC) was good to marginal. So, initiative must be taken to reduce salt accumulation in the soil through drainage and adopting the highly salt tolerant crops like cotton, mustard and tamarind for the better utilization of the land.

Key words: Irrigation water, Quality, Electrical conductivity, Sodium adsorption, Prakasam District

Water is the most important input required for plant growth in agriculture or horticulture crop production. Irrigated agriculture is dependent on adequate water supply of usable quality is the most important input required for plant growth in agriculture crop production. Water quality concerns have been neglected because good quality water supplies often have been plentiful and readily available for agriculture (Shamsad and Islam, 2005, Islam *et al*.1999).The situation is now changing in many areas. Intensive use of nearly all good quality supply means that new irrigation projects, and old projects seeking new or supplemental supplies, must rely on lower quality and less desirable sources (Cuena, 1989). Irrigation water quality is related to its effects on soils and crops and its management. High quality crops can be produced only by using high quality irrigation water keeping other inputs optimal. The chemical constituents of irrigation water can affect plant growth directly through toxicity or deficiency or indirectly by altering plant availability of nutrients (Rowe *et al*.1995).

To evaluate the quality of irrigation water, we need to identify the characteristics that are important for plant growth, and their acceptable levels of concentrations. A knowledgeable interpretation of the results can help to correct water quality problems and /or choose fertilizers and irrigation techniques to avoid crop damage. A detailed investigation regarding the irrigation water quality and its suitability for guava orchard was lacking. Keeping these in mind, the present research reports the bench mark survey of irrigation water quality of Prakasam district.

Materials and Methods

A field research was conducted to evaluate the suitability of ground water for the irrigated guava orchards of Prakasam districts. A total of 30 ground water samples representing extensively used tube wells and open well were collected from guava orchards of three mandals (Maddipadu,Gudluru and Ulavapadu mandal). The high density PVC bottles were used for sampling. They were thoroughly cleaned by rinsing with 8N HNO_3 and deionised water followed by repeated washing with water samples as suggested (De, 1989). Before sampling from a well, water was pumped out sufficiently so that the sample represents the ground water from which water is fed. The bottles were kept air tight and labeled properly for identification. Aeration during the sampling was avoided by stoppering the bottle quickly and carefully transported to laboratory and were preserved for in a refrigerator for analysis. The water samples were analyzed for their chemical constituents by adopting standard procedures (Richards, 1954).

Results and Discussion

The data presented in the Table 1 shows that the overall pH of irrigation water under the study areas ranged from neutral to moderately alkaline (7.31 to 8.44) with the mean value of 7.65, 7.75 and 7. 90 in Maddipadu, Gudluru and Ulavapadu mandals, respectively. The variation in pH of the irrigation water in the above said mandals might be due to hydrolysis of sodium and distance from the sea coast. The Maddipadu mandal is distanced from coastal than Ulavapadu and Gudluru mandals. The EC of the irrigation water in Gudluru and Ulavapadu mandals ranged from 0.76 to 2.21 and 0.93 to 2.20 dSm^{-1} with the mean values of 1.15 and 1.35 dSm^{-1}, respectively whereas, the EC of the water in Maddipadu mandal varied between 0.84 to 1.27

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Table 1. Chemical composition and quality of irrigation water

Water quality	Maddipadu Mandal Range	Maddipadu Mandal Mean	Gudluru Mandal Range	Gudluru Mandal Mean	Ulavapadu Mandal Range	Ulavapadu Mandal Mean	Overall Range	Overall Mean
pH	7.40-8.16	7.65	7.31-8.44	7.75	7.50-8.35	7.90	7.31-8.44	7.75
EC (dSm^{-1})	0.84-1.27	1.03	0.76-2.21	1.15	0.93-2.20	1.35	0.76-2.21	1.14
K ($me.L^{-1}$)	0.05-0.92	0.27	0.02-0.81	0.25	0.05-0.52	0.20	0.02-0.92	0.24
Na ($me.L^{-1}$)	5.25-8.60	6.73	5.64-10.61	8.18	8.20-13.92	10.09	5.25-13.92	8.15
Ca ($me.L^{-1}$)	1.00-4.05	2.87	0.60-3.00	1.29	1.00-1.30	1.16	0.60-4.05	1.89
Mg ($me.L^{-1}$)	0.52-2.90	1.45	2.20-7.40	3.61	1.20-3.20	2.22	0.52-7.40	2.44
SO_4 ($me.L^{-1}$)	0.06-0.58	0.32	3.52-7.08	4.96	3.12-6.82	4.39	0.06-7.08	3.1
Cl ($me.L^{-1}$)	2.65-5.84	4.85	4.20-6.26	5.56	2.84-6.52	5.77	2.65-6.52	5.39
CO_3 ($me.L^{-1}$)	0.00-1.00	0.21	0.00-1.00	0.14	0.00-1.08	0.16	0.00-1.08	0.16
HCO_3 ($me.L^{-1}$)	2.90-6.40	3.56	1.2-4.52	2.55	2.16-7.40	4.13	1.20-7.40	3.62
SAR	4.26-6.12	5.06	3.35-8.50	5.67	4.75-9.40	7.20	3.35-9.40	5.85
RSC ($me.L^{-1}$)	0.24-2.48	1.08	-7.08 -0.77	-2.17	-2.97-0.90	-0.04	-7.08-2.48	-0.37

dSm^{-1} with a mean value of 1.03 dSm^{-1}. The EC of the irrigation water was found to be good to marginally saline as per the standards established by Gupta *et al.* (1994). The irrigation water used for the guava orchard were falling under high salinity (C_3) category set by the United States Salinity Laboratory (Richards, 1954).The water cannot be used on soils with inadequate drainage since saline conditions likely to develop. The guava tree managed thrive well inspite of the high EC due to loamy sand to sandy clay texture of the orchards leads to the leaching of excess salts and hardiness of the plant to tolerate the salt content.

Among the cations, Na^+ was the dominant in the irrigation water and ranged from 5.25 to 8.60, 5.64 to 10.61 and 8.20 to 13.92 $me.L^{-1}$ with the mean values of 6.73, 8.18 and 10.09 $me.L^{-1}$ in Maddipadu, Gudluru and Ulavapadu mandals, respectively. The irrigation water that has high sodium (Na^+) content can bring about a displacement of the Ca^{2+} and Mg^{2+} from the clay minerals of the soil, followed by the replacement of cations by the sodium. The sodium-saturated soil peptizes and loses their permeability, so that their fertility and suitability for cultivation decrease (Matthess, 1982). The Mg^{2+} was the second dominant cation in Gudluru and Ulavapadu mandal ranging from 2.20 to 7.40 $me.L^{-1}$and 1.20 to 3.20 $me.L^{-1}$ with the mean values of 3.61 $me.L^{-1}$and 2.22 cmol L^{-1}, respectively, whereas in Maddipadu mandal Mg^{2+} was the third dominant cation ranging from 0.52 to 2.90 $me.L^{-1}$with a mean value of 1.45 $me.L^{-1}$. The Ca^{2+} was the second dominant cation in Maddipadu mandal ranging from 1.00 to 4.05 $me.L^{-1}$ with a mean value of 2.85 $me.L^{-1}$ whereas in Gudluru mandal and Ulavapadu mandal, Ca was the third dominant cation ranging from 0.80 to 3.00 $me.L^{-1}$and 0.60 to 4.05 $me.L^{-1}$with the mean values of 1.29 $me.L^{-1}$and 1.37 $me.L^{-1}$, respectively. The K^+ cation in Maddipadu mandal ranging from 0.05-0.92 $me.L^{-1}$ with a mean value of 0. 27 $me.L^{-1}$ whereas in Gudluru mandal and Ulavapadu mandal, K^+ ranging from 0.02-0.81 $me.L^{-1}$ and 0.05-0.52 $me.L^{-1}$ with the mean values of 0.25 $me.L^{-1}$and 0.20 $me.L^{-1}$, respectively . From the above study of water on cations, it was learned that waters of Gudluru and Ulavapadu mandals had the cation sequence in the order of $Na^+ > Mg^{2+} > Ca^+ > K^+$, whereas in Maddipadu mandal, it was in the order of $Na^+ > Ca^+ > Mg^{2+} > K^+$.

Among the anion, the Cl^- was dominant in the irrigation water under the study areas ranging from 2.65 to 6.52 $me.L^{-1}$ with a mean value of 5.39 $me.L^{-1}$.It is evident that the values of Cl^- of the study area were excellent (0-5 $me.L^{-1}$) to good (5-10 $me.L^{-1}$). The second dominant anion of irrigation water in Gudluru and Ulavapadu mandals was SO_4^{2-} ranging from 3.52 to 7.08 and 3.12 to 6.82 $me.L^{-1}$ with the mean values of 4.96 and 4.39 $me.L^{-1}$, respectively whereas in Maddipadu mandal SO_4^{2-} was third dominant anion after HCO_3^- ranging from 0.06 to 0.58 me. L^{-1} with a mean value of 0.32 $me.L^{-1}$. In Maddipadu mandal, the HCO_3^- content was the second dominant anion and ranged from 2.90 to 6.40 $me.L^{-1}$, with a mean value of 3.56 $me.L^{-1}$ whereas in Gudluru and Ulavapadu mandal $HCO_3^-$was the third dominant anion and ranged from 1.20 to 4.52 and 2.16 to 7.40 $me.L^{-1}$ with the mean values of 2.55 and 4.13 $me.L^{-1}$, respectively. From the foregoing discussion on the anions of the water, the anion sequence was in the order of $Cl^- > SO_4^{2-} > HCO_3^- > CO_3^{2-}$ in Gudluru and Ulavapadu mandals, and $Cl > HCO_3^- > SO_4^2 > CO_3^2$ in Maddipadu mandals.

The dominance of Mg^{2+} and SO_4^{2-} in irrigation water of Gudluru and Ulavapadu mandals as compare to Maddipadu mandal might be due to the influence of sea water as these mandals are very nearer to the sea. Ca^{2+} and HCO_3^- ions were dominant in Maddipadu mandal as compared with Gudluru and Ulavapadu mandals might be due to the distance from the sea coast.

The overall SAR of the irrigation waters under the study ranged from 3.35 to 9.40 with a mean value of 5.85 which showed that all the waters under the investigation were good for cultivation of guava crop as per the standards developed by Gupta *et al*. (1994).According to the water quality diagram (Richards, 1954), the diagram classifies 16 classes with reference to SAR as an index of sodium hazard and EC as an index of salinity hazard. By plotting the obtained results in the diagram, it was found that 21 samples (70%) of the 30 samples were categorized into C_3-S_1 class and 9 samples (30%) fell under C_3-S_2 class. 75% of the irrigation water samples shown medum (S_2) in sodium hazard in Ulavapadu mandal where as 9 % and 18% in Maddipadu and Gudluru manadal, respectively. The Residual Sodium Carbonate (RSC) ranging from -7.08 to 2.48 with a mean value of 0.37. Only 2 samples of 30 samples were shown marginal in RSC and rests were fell under class 'Good'.

Conclusion

Different physico-chemcal properties of irrigation water of Prakasam District were compared with the national and international water quality standards set for irrigation. Electrical conductivity (EC) of the irrigation water samples fall in the class 'high', SAR in 'Low to Medium', RSC in 'Good to Marginal' and Cl^- content within 'Excellent to Good'. The results showed that waters of Ulavapadu and Gudluru mandal were affected by sea water intrusion as evidenced by the cation sequence following the order: $Na^+ > Mg^{2+} > Ca^+ > K^+$ and the anion sequence
: $Cl^- > SO_4^{2-} > HCO_3^- > CO_3^{2-}$. The quality of the irrigation water in these mandals were deteriorated. On the basis of the standard set for EC and SAR, Irrigation water samples had high salinity and medium sodicity problem. The irrigation water is suitable for guava cultivation on sustainable basis with proper drainage facility to remove the excess salts or change the guava crop to grow a highly salt tolerant fruit crops like tamarind or highly salt tolerant agricultural crops like cotton and mustard for better remuneration. Further study is needed to identify the highly salt tolerant guava variety to introduce in the study area.

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