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ANALYSIS OF IRRIGATION WATER QUALITY AT KADAWA IRRIGATION PROJECT FOR IMPROVED PRODUCTIVITY

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Abstract
In the face of water scarcity and the several negative consequences, such as water wastage, flooding, water logging, soil losses and production losses, conserving the finite amount of fresh water is a must. The quality of irrigation water must therefore be ascertained. The chemical quality of three sources of irrigation water from canal and drainage water, namely drainage water, fresh irrigation water from canal, and drainage/irrigation water mixture, were analyzed from Kadawa irrigation Project for year 2013 and 2014 cropping seasons, with the view to evaluating the potential risks associated with their use in irrigation and hence their suitability or otherwise for irrigation purposes. The analysis revealed that the use of drainage water alone for irrigation may result in problems associated with salinity, while a blend of drainage/irrigation water in the ratio of 1:1 is a viable means of water conservation and a good means of crop production.
Key words: Water, scarcity, conservation, quality, Drainage, Irrigation water

Introduction

Water, the fundamental resources on which agriculture depends (Safwat, 1999), is a limiting factor in Nigeria, especially the Northern parts (Tyagi, 1999) which is characterized by high temperature, low amount and unevenly distributed rainfall, short duration of rainy season, and evidently high evaporation rate (Ogunwole, et al., 1998). Low per capita productivity, high level of poverty, high rate of rural-urban migration, etc. that prevail in the region (Odigboh, 2002).

The desired sustainable long-term improved food productivity is however achievable with irrigation. Evidently, there is practical reason to call for all possible means of conserving the existing limited water resources and stop, or at least reduce, the negative impacts of water wastage in irrigation fields. Soil erosion, surface and ground water pollution, water logging, soil salinity and, possibly, soil sterilization, are some of the examples.

Despite the health and safety concerns, planning the use of low quality water such as municipal, industrial and agriculture effluents for irrigation purposes is practically a useful option (FAO, 2002; Tyagi, 1999). Agriculture drainage water mixed with irrigation water from canals is nowadays one of the best methods of waster reuse. This will be partially helpful in reducing the volume of water withdrawn from fresh water sources for irrigation purposes; reduce flooding that might arise from such water sources; and neutralize the effect of the extreme chemical composition and temperature of such water; as well as add Nitrogen, Phosphorus, Potassium and other minerals to the soil, thereby reducing fertilizer requirement (Jifu, et al., 1999; Tyagi, 1999).

To minimize the potential health and environmental hazards, the quality of all water used for irrigation must be similar to that for irrigation projects in the Northern part of Nigeria, with considerable degree of salinity and/or high water table (Malgwi et al, 2003; Tanko, et al, 2002).

This study therefore aimed at (1) Assessing the quality of water supplied for irrigation in Kadawa Irrigation Project, Kano and (2) Examining the possibility or otherwise of using drainage water and fresh water from canal for irrigation purpose.

Materials and methods

The field aspect of the research work was conducted at the Irrigation Research Station, Kadawa in the Kano River Irrigation Project during the 2013 and 2014 irrigation seasons. The location lies between latitude 11^0 45' 5'N and longitude 8^0 45' 5'E in the Sudano-Sahelian region of Nigeria region of Nigeria. The area has a mean annual rainfall of 884mm.

The three treatments used were irrigation water from canal; Drainage water; and a blend of Irrigation/Drainage water. A bucket was used to collect each source of water, from various locations across the irrigation station, every two weeks from February to March of each of the two seasons. Each sample was then analyzed chemically and statistically.

Electrical conductivity (EC) and pH were recorded using meter bridge at 25^0C, and pH meter (290 MK 2 model), respectively. Sodium Absorption Ratio (SAR) was computed using the formula given below . Flame photometry was used to determine the Sodium (Na) and Potassium (K) contents, while Calcium (Ca) and Magnesium (Mg) were obtained by 'EDTA titration' method. Boron (B) was determine calorimetrically using a calorimeter, while Turbidity meter was used to determine the Turbidity levels (T).

$$SAR = \frac{Na^{+}}{\sqrt{Ca^{2+} + Mg^{2+}=/2}}$$

Results and discussion

The results of the chemical characterizes of the three sources of water are presented in Table 1. With the exception of Na, pH and SAR, the numerical values of all the parameters analyzed were higher in irrigation water supplied during the 2014 cropping season (IW-14) than those from the irrigation water used in 2013 (IW-13).

Using the guidelines for irrigation water quality (FAO, 1998) as standard, IW14's acidity was found to be in excess of the range referred to as 'No problems' (Table 2). This has translated from its comparatively higher EC, and such water generally has greater potential of salinizing the soil, thereby reducing crop growth and productivity (James, 1980).

Both IW-13 and IW-14 were ranked C_1S_1, indicating low salinity and low sodality, but the sodium ion concentration in IW-13 was more than 70% of the total cations, a condition which could have the possibility of accumulating exchangeable sodium (Tyagi, 1999). Such water should therefore be used with extra caution and/or only crops less sensitive to sodium should be irrigated with it. The turbidity levels (T) of the three sources of water were within acceptable range.

Table 1: Chemical Constituents of three sources of irrigation water

	DRAINAGE WATER (DW)		IRRIGATION WATER (IW)		DRAINAGE/IRRIGATION WATER (DIW)	
	2013	2014	2013	2014	2013	2014
Calcium (mg/i)	2.55	9.03	120	3.05	1.4880	6.875
Magnesium	1.18	1.98	0.54	0.73	0.8391	6.250
(mg/I)	56.83	44.39	27.16	3.09	43.1700	17.480
Sodium (mg/1)	0.54	0.60	0.46	0.52	0.4300	0.470
Boron (mg/1)	2.36	2.43	1.86	2.23	2.1100	2.230
Nitrate(mg/1)	6.75	6.71	6.64	6.21	6.7000	6.340
pH	2.30	2.30	0.46	0.52	04300	0.470
EC(microhos/cm	18.78	20.60	3.63	2.93	4.1200	8.670
)	46.87	49.24	22.39	28.05	30.3100	38.900
SAR(mg/1)						
Turbidity						

Table 2: Guidelines for Irrigation Water Quality (FAO, 1976)

WATER CONSTITUENT	INTENSITY LIMITS		
	No problem	Moderate	Severe
Salinity (Ms/cm)	<0.75	0.75-3.00	>3.0
Sodium Absorption Ratio	<16.00	16.00-24.00	>24.0
Chloride (mg/1)	<4.00	4.00-10.00	>100.0
NO_3, HN_4^+ (mg/1)	<5.00	5.00-30.00	>30.0
HCO_3, (mg/1)	<1.50	1.50-8.5	>8.5
pH	6.5-8.4	5.1-6.4	>8.4
Boron (mg/1)	<0.75	0.75-2.0	>2.0

The Drainage water of both 2013 (DW-13) and 2014 (DW-14) were ranked C_2S_3, signifying medium salinity and high sodality. This condition indicates the possibility of salt accumulation and development of harmful levels of exchangeable sodium in most soils. Such water is therefore absolutely not suitable for irrigation except on highly tolerable crops.

The interaction of considerable levels of salinity and that of SAR will disrupt the soil structure, impede on the soil hydraulic conductivity and restrict soil water uptake by plants, with the net result of poor yield and economic loss to the farmers (Graham et al, 2003).

The mixture of Drainage/irrigation water (DIW) generally reduced the concentration of all the chemical constituents in the drainage water (DW). DIW-13 resulted in reduction of 23.40% Na, 31%EC and 78%SAR compared to DW-13. Similarly, DIW-14 resulted in reduction of 61% Na, 29%EC and 58% SAR. Both DIW-13 and DIW-14 were therefore ranked C_1S_1, meaning low salinity and sodality, and hence suitable for irrigating most crops.

Boron (B) and Nitrate (NO_3) levels in both sources of water were further moved away from the problem zone. The pH of DIW-14 stood at 6.425 (Table 1) and was too acidic than DIW-13. Irrigation water pH values in excess of the normal range should advisably be treated to ensure safety with respect to health and crop injury, as well as avert environmental implications (Nahal, 1980, James, 1988).

Conclusion

The irrigation water supplied in 2014 was found to contain higher concentration of chemical constituents, whereas the 2013 irrigation water had higher Sodium and SAR value. Drainage water of both 2013 and 2014 cropping season were without prior appropriate treatment.

Both Drainage/Irrigation water mixtures of 2013 and 2014 exhibited low concentrations of chemical constituents, with little or no possibility of salinity and/or sodicity accumulation. Drainage/Irrigation water mixture can therefore be used for irrigation with reduced or no fear of salinity and sodicity problems.

The use of mixed Drainage/Irrigation water can also reduce the volume of fresh water abstraction, thereby conserving the limited fresh water resources. It is therefore recommended that irrigation water quality should always be evaluated before use, and during the cropping season, on a routine basis.

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