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# Assessment of salt accumulation through irrigation water in the soil of agriculture technical school, Manjri Farm, Pune

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**Abstract**
An investigation was undertaken to study Seasonal Variation of Salts through Irrigation Water in the Soil of Agriculture Technical School, Manjri Farm, Pune, in the year 2018-19. 94 surface soil samples (0-22.5 cm depth) were collected in pre-monsoon (April-2018) and post-monsoon (October-2018) seasons. The ionic concentrations viz., $Ca^{2+}$, $Mg^{2+}$, $Na^{+}$, $K^{+}$, $CO_3^{2-}$, $HCO_3^{-}$, $Cl^{-}$ and $SO_4^{2-}$, were 1.13, 0.78, 0.13, 0.06, 0, 0.30, 0.81 and 0.93 me $L^{-1}$, respectively in pre-monsoon season while post-monsoon results showed 1.00, 0.64, 0.12, 0.05, 0, 0.19, 0.57 and 0.81 me $L^{-1}$. The dominant accumulated salt in soil was $CaCl_2$ followed by $MgSO_4$, $CaHCO_3$, $MgCl_2$, $CaSO_4$, $Na_2SO_4$ and $K_2SO_4$. The ionic concentration and salt accumulation in soil were high in pre-monsoon than post-monsoon season. In post-monsoon season ion leached out with rainfall water beyond the root zone.

**Keywords:** technical, season, concentration, rainfall

## Introduction
Water is the most important input required for increasing agricultural production and maintaining the soil health. Chemistry of ground water is dictated by supply of various elements from both natural and anthropogenic sources (Bishnoi *et al*. 1984) [2]. Rainfall plays an active role for changing the water quality of underground aquifers (Kaushik *et al*. 2002) [3]. This poor quality is available mainly in canal region or in command of big irrigation projects (Bhakare and Nikam, 2012) [1]. The well water quality is also affected predominantly by canal, seepage, of rain water and excess use of irrigation water etc. (Sugirtharam *et al*. 2008) [7]. However, the assured supply of good quality irrigation water is one of the important factors for increasing agricultural production. The quality of water is an important consideration in an irrigated area. Mismanagement of land at all levels, particularly in agriculture, has led to the problem of rising water table, soil salinization and pollution of surface and ground water resources (Manjunatha *et al*. 2011) [4]. Several studies indicate that the brackish water can successfully be used for irrigation crop production (Singh and Panda, 2012) [6]. However, negative effects on crops may occur from using saline water due to accumulation of salts in soils (Wang, *et al*. 2015) [9]. Agriculture Technical School, Manjri Farm, Pune, comes under plain zone of Maharashtra and is located at $18^0$29' to $18^0$30' N latitude and $73^0$58' to $73^0$59' E longitude. The elevation from mean sea level is 562 m. The area under cultivation is 43.04 ha out of which 27.84 ha area under lift farm and 15.20 ha under central farm. The climate is usually hot and is classified as semiarid tropical the annual rainfall 545 mm. The mean maximum temperature ranged between 34 $^0$C to 42 $^0$C while annual mean minimum temperature varies from 8 $^0$C to 20 $^0$C. The mean humidity percentage ranged between 78-95 percent.

## Materials and Methods
Total 94 surface soil samples (0-22.5 cm depth) were collected in pre-monsoon (April-2018) and post-monsoon (October-2018) season. The soil samples were collected from fields and allowed to dry completely in a shade. Soluble ion ($CO_3^{2-}$, $HCO_3^{-}$, $Cl^{-}$, $SO_4^{2-}$, $Ca^{2+}$, $Mg^{2+}$, $Na^{+}$ and $K^{+}$) were extracted by 1:5 soil and water extract (USSLS, 1954). Cations and anions were analyzed by (Richards, 1968) [5] standard process.

## Results and Discussion
The ionic concentration and salt accumulation are given in table 1 and 2.

### Ionic concentrations
The ionic concentration in soil presented in Table 1. The data in Table 1 indicate that

the value of $Ca^{2+}$ was ranged from 0.80 to 1.50 me $L^{-1}$ with an average value 1.13 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.70 to 1.30 me $L^{-1}$ with an average value 1.00. The value of $Mg^{2+}$ was ranged from 0.40 to 1.10 me $L^{-1}$ with an average value 0.78 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.30 to 1.00 me $L^{-1}$ with an average value 0.64. The value of $Na^{+}$ was ranged from 0.08 to 0.22 me $L^{-1}$ with an average value 0.13 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.06 to 0.21 me $L^{-1}$ with an average value 0.12. The value $K^{+}$ was ranged from 0.02 to 0.11 me $L^{-1}$ with an average value 0.06 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.01 to 0.09 me $L^{-1}$ with an average value 0.05. The carbonate was absent in both seasons. The value of $HCO_3^{-}$ was ranged from 0.10 to 0.50 me $L^{-1}$ with an average value 0.30 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.10 to 0.40 me $L^{-1}$ with an average value 0.19. The value of $Cl^{-}$ was ranged from 0.20 to 1.20 me $L^{-1}$ with an average value 0.81 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.20 to 1.00 me $L^{-1}$ with an average value 0.57. The value of $SO_4^{2-}$ was ranged from 0.69 to 1.12 me $L^{-1}$ with an average value 0.93 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.59 to 1.05 me $L^{-1}$ with an average value 0.81. Among all the ionic concentrations predominant cation was $Ca^{2+}$ followed by $Mg^{2+}$, $Na^{+}$ and $K^{+}$ and predominant anion was $SO_4^{2-}$ followed by $Cl^{-}$, $HCO_3^{-}$ and $CO_3^{2-}$. In pre-monsoon season the ionic concentration was high in soil than post-monsoon season, depicted in Fig.1. Because in post-monsoon season the ions was leached down below root zone through rainfall water, (USSLS, 1954).

**Table 1:** Ionic Concentration in pre-monsoon and post-monsoon season soil sampling

| | Ionic concentration (me $L^{-1}$) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $Ca^{2+}$ | $Mg^{2+}$ | $Na^{+}$ | $K^{+}$ | $CO_3^{2-}$ | $HCO_3^{-}$ | $Cl^{-}$ | $SO_4^{2-}$ |
| **Pre-monsoon** | | | | | | | | |
| Range | 0.80-1.50 | 0.40-1.10 | 0.08-0.22 | 0.02-0.11 | 0 | 0.10-0.50 | 0.20-1.20 | 0.69-1.12 |
| Average | 1.13 | 0.78 | 0.13 | 0.06 | 0 | 0.30 | 0.81 | 0.93 |
| SD | 0.17 | 0.15 | 0.04 | 0.02 | 0 | 0.10 | 0.22 | 0.10 |
| **Post-monsoon** | | | | | | | | |
| Range | 0.70-1.30 | 0.30-1.00 | 0.06-0.21 | 0.01-1.00 | 0 | 0.10-0.40 | 0.20-1.00 | 0.59-1.05 |
| Average | 1.00 | 0.64 | 0.12 | 0.05 | 0 | 0.19 | 0.57 | 0.81 |
| SD | 0.17 | 0.17 | 0.04 | 0.02 | 0 | 0.10 | 0.21 | 0.11 |

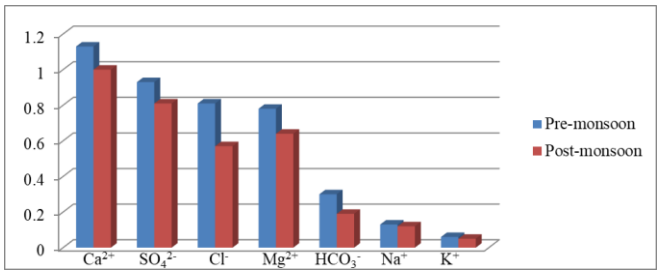


**Fig 1:** Season wise variation in ionic concentration (me $L^{-1}$) of soil

## Salt Accumulation

The salts accumulation in soil was calculated on the basis of ionic concentration in soil. Salt accumulation data presented in Table 2. The data in Table 2 indicate the accumulation of $CaHCO_3$ was ranged from 0.10 to 0.50 me $L^{-1}$ with an average value 0.30 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.10 to 0.40 me $L^{-1}$ with an average value 0.19. The accumulation of $CaCl_2$ was ranged from 0.20 to 1.00 me $L^{-1}$ with an average value 0.72 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.20 to 0.90 me $L^{-1}$ with an average value 0.54. The accumulation of $MgCl_2$ was ranged from 0.10 to 0.60 me $L^{-1}$ with an average value 0.24 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.10 to 0.30 me $L^{-1}$ with an average value 0.16. The accumulation of $Mg_2SO_4$ was ranged from 0.20 to 0.90 me $L^{-1}$ with an average value 0.68 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.20 to 0.80 me $L^{-1}$ with an average value 0.51. The accumulation of $Na_2SO_4$ was ranged from 0.04 to 0.21 me $L^{-1}$ with an average value 0.12 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.03 to 0.19 me $L^{-1}$ with an average value 0.10. The accumulation of $K_2SO_4$ was ranged from 0.01 to 0.09 me $L^{-1}$ with an average value 0.05 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.01 to 0.08 me $L^{-1}$ with an average value 0.04. The accumulation of $CaSO_4$ was ranged from 0.10 to 0.40 me $L^{-1}$ with an average value 0.16 me $L^{-1}$ in pre-monsoon and in post-monsoon it was ranged from 0.07 to 0.24 me $L^{-1}$ with an average value 0.15. In pre-monsoon season the salt accumulation in soil was high than post-monsoon season, depicted in Fig. 2. Because in post-monsoon season the ionic concentration was low than pre- monsoon season. (USSLS, 1954).

**Table 2:** Salt accumulation in pre-monsoon and post-monsoon season in the soil

| | Salt accumulation (me $L^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|
| | $CaHCO_3$ | $CaCl_2$ | $MgCl_2$ | $MgSO_4$ | $Na_2SO_4$ | $K_2SO_4$ | $CaSO_4$ |
| **Pre-monsoon** | | | | | | | |
| Range | 0.10-0.50 | 0.20-1.00 | 0.10-0.60 | 0.20-0.90 | 0.04-0.21 | 0.01-0.09 | 0.10-0.40 |
| Average | 0.30 | 0.72 | 0.24 | 0.68 | 0.12 | 0.05 | 0.16 |
| SD | 0.10 | 0.20 | 0.15 | 0.16 | 0.04 | 0.02 | 0.10 |
| **Post-monsoon** | | | | | | | |
| Range | 0.10-040 | 0.20-0.90 | 0.10-0.30 | 0.20-0.80 | 0.03-0.19 | 0.01-0.08 | 0.07-0.24 |
| Average | 0.19 | 0.54 | 0.16 | 0.51 | 0.10 | 0.04 | 0.15 |
| SD | 0.10 | 0.19 | 0.07 | 0.16 | 0.04 | 0.02 | 0.05 |

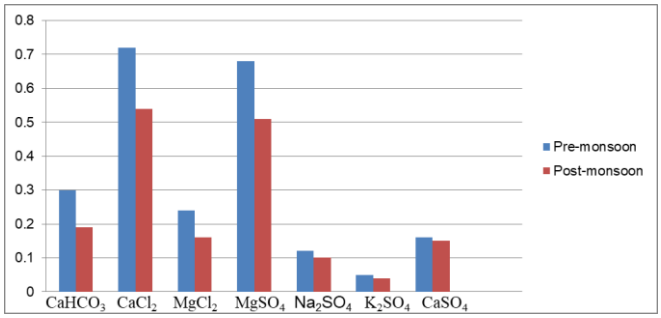


**Fig 2:** Season wise variation in salt accumulation (me $L^{-1}$) in soil

## Conclusion

Among The analyzed cations in soil, $Ca^{2+}$ was highest followed by $Mg^{2+}$, $Na^{+}$ and $K^{+}$ and whereas anions showed the trend of $SO_4^{2-}$ followed by $Cl^{-}$, $HCO_3^{-}$ and $CO_3^{2-}$. The dominant accumulated salt in soil was $CaCl_2$ followed by $MgSO_4$, $CaHCO_3$, $MgCl_2$, $CaSO_4$, $Na_2SO_4$ and $K_2SO_4$. The ionic concentration and salt accumulation in soil was high in pre-monsoon than post-monsoon season. In post-monsoon season ion leached out with rainfall water beyond the root zone.

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