

# GLOBAL SYMPOSIUM ON SALT-AFFECTED SOILS

20 - 22  
October, 2021  
Virtual meeting



**The management of subsurface drip irrigation (SDI) by unconventional water  
in pistachio orchards in severe soil salinity and alkalinity condition**

*Abdolhamid Sherafati*

# Irrigation of pistachio orchards in Iran

❑ Irrigation of Iranian pistachio orchards is faced with two challenges:

1-water shortage and

2-water and soil salinity

❑ The average annual amount of water used to irrigate pistachio orchards is 7,000 cubic meters per hectare

❑ Approximately 95% of pistachio orchards are Traditional irrigation method.

❑ In Traditional irrigation method:

1- water losses are very high,

2-The accumulation of salt is more in the surface layer of soil (to 50 cm depth) and also

3-the roots are more dispersed in the surface layer of soil.

# Traditional irrigation method:



**Figure 1: Traditional irrigation method: High salinity (left) and low salinity (right)**

# Description of the good practice

## The subsurface drip irrigation (SDI) method with unconventional water

- ❑ This method was first implemented in 2011 in northeastern Iran (Pistachio Research Station).
- ❑ Water salinity increased from about 9 dS m<sup>-1</sup> (2011) to about 14.17 dS m<sup>-1</sup> (2019).
- ❑ Other chemical properties of water are presented in [Table 1](#).

**Table 1:** Characteristics of water used for subsurface drip irrigation

| Year | EC<br>(dS/m) | pH  | (CO <sub>3</sub> ) <sup>2-</sup> | HCO <sub>3</sub> <sup>-</sup> | Cl <sup>-</sup> | Ca <sup>2+</sup> | Mg <sup>2+</sup> | Na <sup>+</sup> | SAR         |
|------|--------------|-----|----------------------------------|-------------------------------|-----------------|------------------|------------------|-----------------|-------------|
|      |              |     | meq/lit                          |                               |                 |                  |                  |                 |             |
| 2011 | <b>8.6</b>   | 6.8 | 0                                | 2.5                           | 56              | 18.8             | 6.3              | 59              | <b>15.3</b> |
| 2013 | <b>11.5</b>  | 7.4 | 0                                | 1.9                           | 85.5            | 24.7             | 13.9             | 68.2            | <b>15.5</b> |
| 2015 | <b>11.7</b>  | 7.6 | 0                                | 3                             | 85              | 24               | 15.2             | 80.7            | <b>18.2</b> |
| 2017 | <b>12.2</b>  | 7.3 | 0                                | 3.2                           | 91.5            | 25.6             | 14.4             | 78.6            | <b>17.6</b> |
| 2019 | <b>14.17</b> | 7.5 | 0                                | 1.8                           | 135.5           | 36               | 20               | 85.1            | <b>16.1</b> |

# Context of the practice

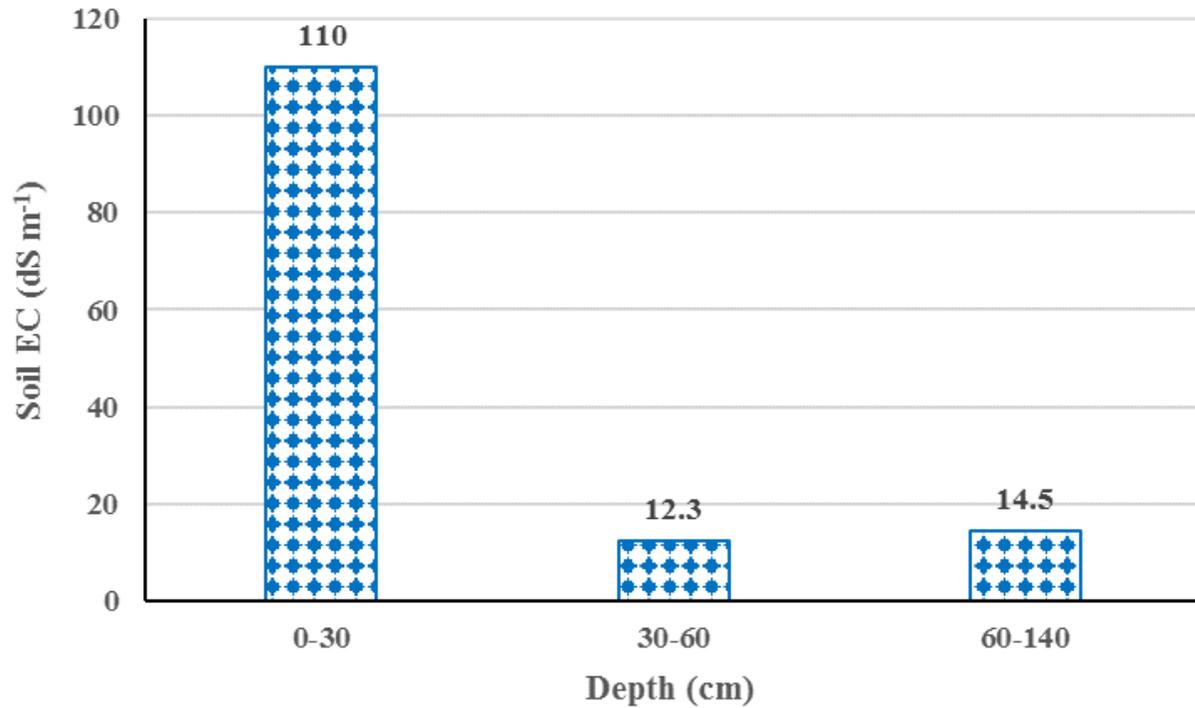
- The seedlings were planted in the Pistachio Research Station (2011) with the 58° 45' 19" and 34° 57' 12" geographical attributes.
- pipeline (16 mm.) was implemented at a depth of 70 cm and a distance of 120 cm from both sides of the seedlings.
- The droppers were placed one meter apart and their flow rate was 4 L h<sup>-1</sup> at a pressure of two atmospheres.
- The consumption of water has reached nearly 2500 m<sup>3</sup> ha<sup>-1</sup> after the eighth year of implementation (2020).

# The effect of subsurface drip irrigation with saline water on soil chemical properties

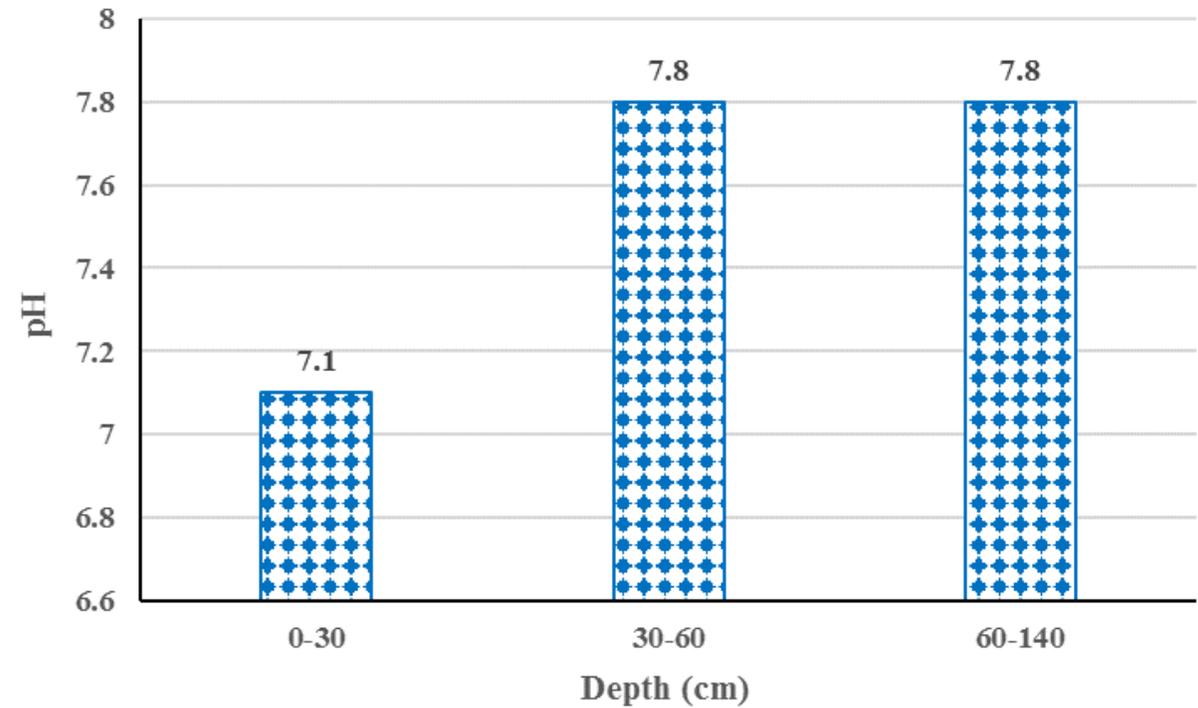
**Table 2:** Chemical properties of soil in subsurface drip irrigation method, seven years after implementation (2017)

|         | Depth  | pH  | EC                 | T.N.V | OC   | Sand | Silt | Clay | Texture |
|---------|--------|-----|--------------------|-------|------|------|------|------|---------|
| Unit    | cm     | -   | dS m <sup>-1</sup> | %     | %    | %    | %    | %    | -       |
| Depth 1 | 0-30   | 7.1 | 110                | 15.3  | -    | -    | -    | -    | -       |
| Depth 2 | 30-60  | 7.8 | 12.33              | 14.3  | -    | -    | -    | -    | -       |
| Depth 3 | 60-140 | 7.8 | 14.52              | 16.5  | 0.17 | 36   | 42   | 22   | Loam    |

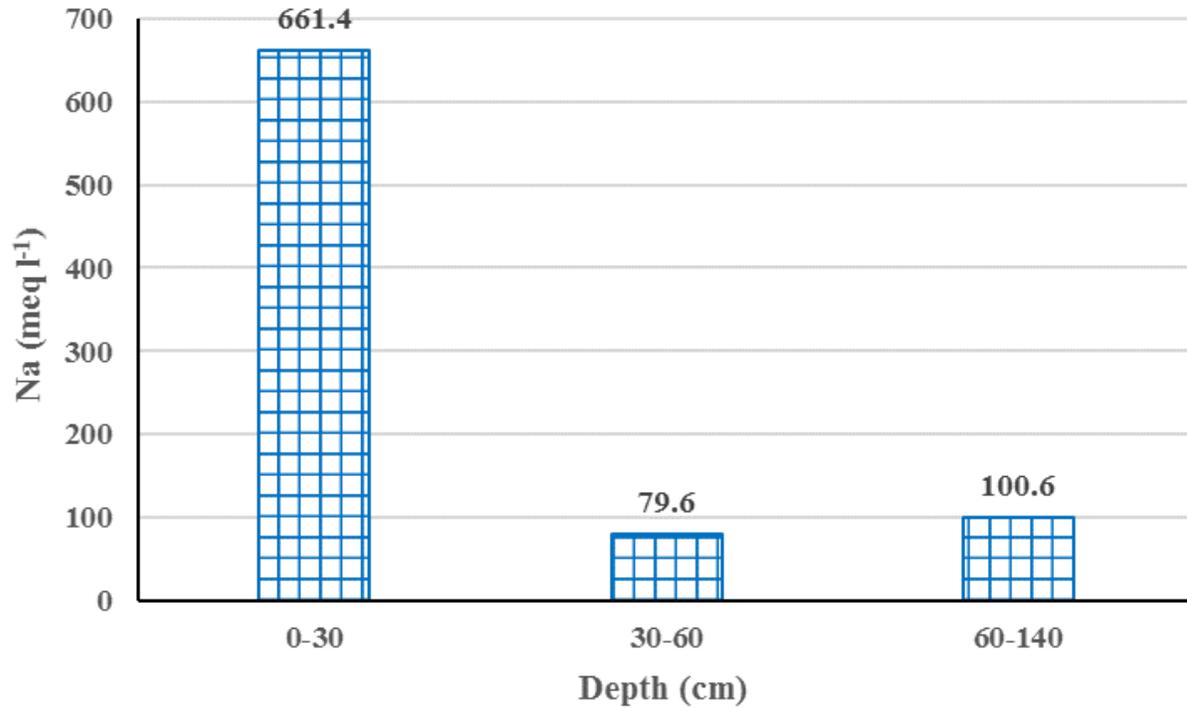
|         | Depth  | Ca                  | Mg                  | Na                  | S.A.R | Cl                  | SO <sub>4</sub>     |
|---------|--------|---------------------|---------------------|---------------------|-------|---------------------|---------------------|
| Unit    | cm     | meq L <sup>-1</sup> | meq L <sup>-1</sup> | meq L <sup>-1</sup> | -     | meq L <sup>-1</sup> | meq L <sup>-1</sup> |
| Depth 1 | 0-30   | 180                 | 135                 | 661.4               | 52.7  | 775                 | 280                 |
| Depth 2 | 30-60  | 20                  | 20                  | 79.6                | 17.8  | 90                  | 20                  |
| Depth 3 | 60-140 | 22                  | 20                  | 100.6               | 21.9  | 100                 | 32                  |



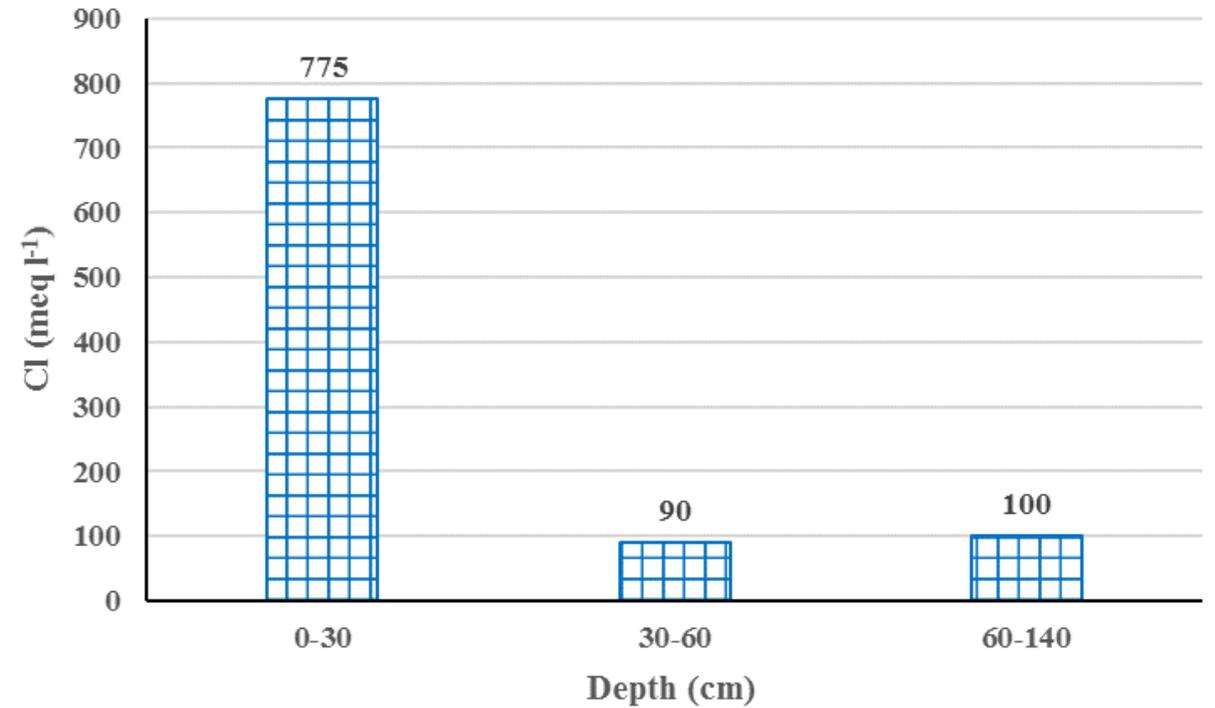
**Figure 2:** The effect of subsurface drip irrigation with saline water on soil salinity (EC) at different depths



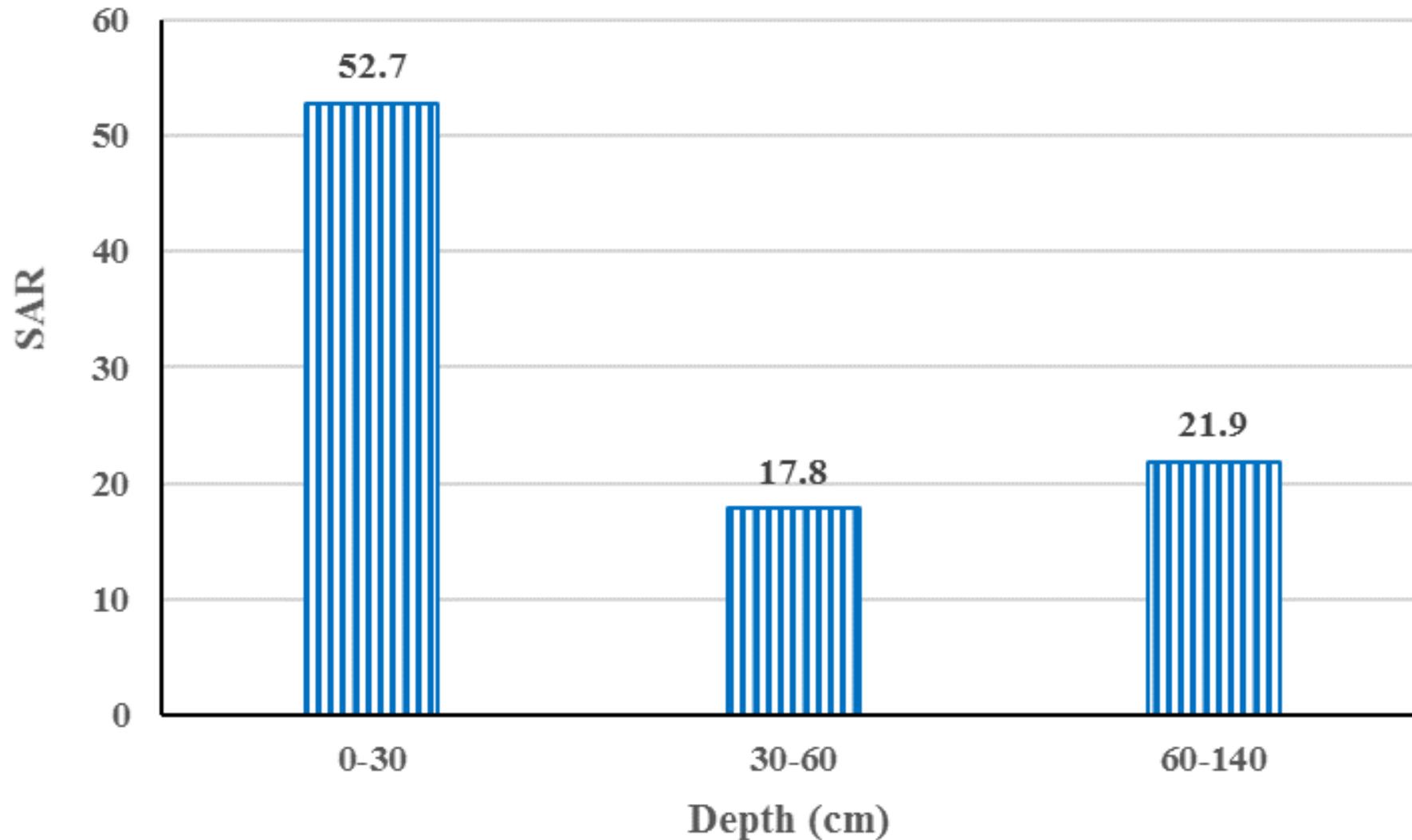
**Figure 3:** The effect of subsurface drip irrigation with saline water on soil pH at different depths



**Figure 4.** Effect of subsurface irrigation on exchangeable sodium (meq L<sup>-1</sup>) at different soil depths



**Figure 5.** Effect of subsurface irrigation on chloride (meq L<sup>-1</sup>) at different soil depths



**Figure 6** - The effect of subsurface drip irrigation on the sodium adsorption ratio (SAR) at different soil depths

**Table 3:** Advantage of subsurface drip irrigation over surface irrigation in pistachio orchards

| Title   | Subsurface drip irrigation | Traditional irrigation |
|---|----------------------------|------------------------|
| Root penetration                                  | Very much >140 cm          | Low, about 70 cm       |
| Root dispersion                                   | Very much                  | Mean                   |
| Most salt accumulation                            | Surface layer, 0-30 cm     | 0-100 cm               |
| Probability facing the trees with salinity stress | Low                        | Much                   |
| Water consumption                                 | ≤3500 cubic m              | >7000 cubic m          |
| Production Costs/ha                               | 1410\$                     | 2120\$                 |
| Net income  | 12800\$                    | 11200\$                |



**Figure 7:** Uniform distribution and deep expansion of pistachio roots in subsurface drip irrigation



**Figure 8:** The highest root density is observed in surface irrigation to a depth of about 60 cm



**Figure 9:** Movement of water to the soil surface in SDI method



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**Thanks for your attention**

