

## Effect of Partial Strip Drip Irrigation System and Compost on Some Properties of Gypsiferous Soils in the Growth and Productivity of Maize (*Zea mays* L.)

Osama Subhi Ahmed, Hiba Abdullah Kareem

Department of Soil and Water Resources, College of Agriculture, University of Tikrit

Emails: , oa230026pag@st.tu.edu.iq hiba\_kreem@tu.edu.iq,

### Abstract

A field experiment was conducted at the Experimental Station of the Department of Soil and Water Resources, College of Agriculture, University of Tikrit (Salah Al-Din, Iraq) during the autumn season of 2024 in a gypsiferous soil. Maize (ZP-GLORYA, Serbian origin) was grown to evaluate full conventional irrigation versus alternate partial strip drip irrigation combined with compost levels (0%, 1%, 2%) in a randomized complete block design (RCBD) with three replications. The results showed that combining compost with alternate partial strip drip irrigation enhanced water use efficiency, increased crop productivity, and improved physical properties of gypsiferous soil (1–4). These findings highlight the potential of partial strip drip irrigation and compost to improve productivity and sustainability in gypsiferous soils.

**Keywords:** Drip irrigation; Alternate strip irrigation; Compost; Maize; Gypsiferous soil

### Introduction

Freshwater scarcity in Iraq is a major challenge for irrigated agriculture. With increasing global cultivated areas, available water is often insufficient to meet crop demands (1). Alternate Partial Root-zone Drip Irrigation (APRDI) has been shown to improve water and fertilizer use efficiency while maintaining yield. APRDI may save ~30–35% of irrigation water with only slight yield reduction (2), and can increase water and nitrogen-use efficiencies in sweet-waxy maize (3). Integrating APRDI with K–Zn fertigation enhanced physio-biochemical responses and yield under arid conditions (4), and PRD approaches may also improve fruit quality (4). Drip irrigation—particularly subsurface—reduces weed density and dry biomass compared with surface methods (6–9). In drip systems, soil moisture is highest near the emitter, declining horizontally and vertically with distance; partial irrigation increased water-use

efficiency of maize (11–12). Gypsum is abundant in arid soils; high gypsum content can degrade soil physical and chemical properties (13).

### Material and Methods

The field experiment was carried out at the research station of the College of Agriculture, University of Tikrit (latitude 43.38°N, longitude 34.40°E, elevation 129 m). Soil samples (0–30 cm) were collected from five random locations within the experimental area, air-dried, and sieved through a 2 mm mesh. Analyses followed standard methods (14–20, 22–23). Two irrigation systems were compared (alternate partial strip drip vs. full strip irrigation) and three compost levels (0%, 1%, 2%), arranged in RCBD with three replications. Data were analyzed by ANOVA (RCBD split-plot layout) and

means compared using an appropriate multiple range test at 0.05 significance.

**Table. Physical and chemical properties of the experimental soil (0–30 cm)**

Unit	Value	Property
g kg <sup>-1</sup>	611	Sand
g kg <sup>-1</sup>	250	Silt
g kg <sup>-1</sup>	137	Clay
—	Sandy loam	Texture
Mg m <sup>-3</sup>	1.72	Bulk density
Mg m <sup>-3</sup>	2.65	Particle density
%	42.2	Porosity
dS m <sup>-1</sup>	3.45	EC
—	7.81	pH
mmol L <sup>-1</sup>	3.18	Calcium
mmol L <sup>-1</sup>	5.13	Magnesium
mmol L <sup>-1</sup>	3.5	Sulfur
g kg <sup>-1</sup>	5.2	Organic matter
g kg <sup>-1</sup>	261	Calcium sulfate (CaSO <sub>4</sub> )
g kg <sup>-1</sup>	117.5	Calcium carbonate (CaCO <sub>3</sub> )
%	15.23	Water at 1500 kPa
%	18.37	Water at 33 kPa
mg kg <sup>-1</sup>	22.54	Available N
mg kg <sup>-1</sup>	6.36	Available P
mg kg <sup>-1</sup>	117	Available K
cmolc kg <sup>-1</sup>	12.86	CEC

### Compost

Compost is a partially or fully decomposed organic material produced from plant and animal residues under controlled conditions. It enhances soil fertility and structure, increases the soil's capacity to retain water and nutrients (N, P, K), and supports beneficial biota (24–26).

**Table 2. and chemical properties of compost**

Unit	Value	Property
—	5.5–6.5	pH (1:5)
dS m <sup>-1</sup>	0.4–1.1	EC (1:5)
%	85	Organic matter
%	40–75	Moisture
%	<15	Ash content
%	<2	Sodium chloride
Von Post scale	H2–H7	Degree of decomposition

### Results

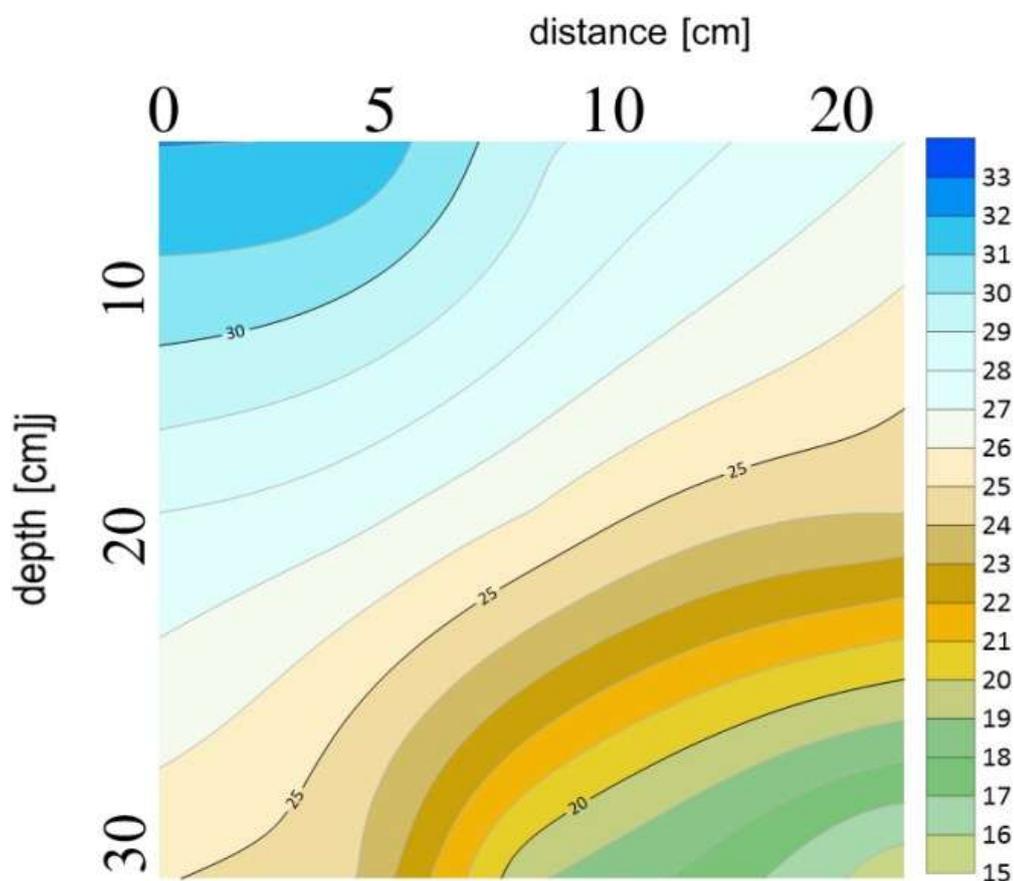
Moisture distribution within the soil profile (0, 10, 20, 30 cm horizontally; 5, 10, 20 cm vertically) 24 h after irrigation was affected by emitter discharge and lateral spacing. Surface layers showed higher volumetric moisture near the emitter, decreasing with horizontal and vertical distance, consistent with previous findings (17–19). Under, surface moisture averaged ~22% (peak ~22.16% at 10 cm depth, 0 cm distance), while deeper layers dropped to ~8% (~8.28% at 30 cm depth, 20 cm distance). For I1C1, surface moisture averaged ~30% (peak ~30.27% at 10 cm depth, 0 cm distance), decreasing with depth to ~16% (~16.15% at 30 cm, 20 cm). I1C2 reached up to ~35% at the surface (~34.21% at 10 cm, 0 cm). Enhanced lateral wetting with higher discharge and closer laterals likely increased horizontal flow relative to vertical movement (19).

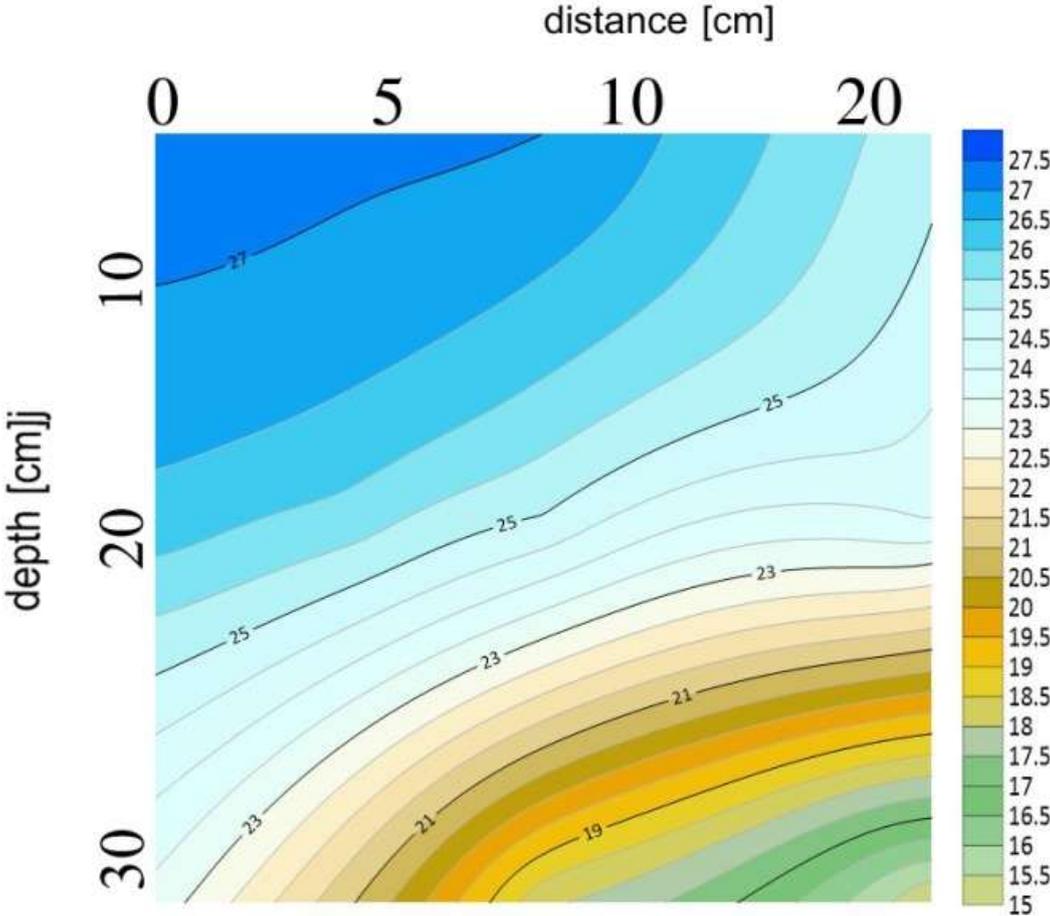
In alternate irrigation (I2), surface moisture averages generally decreased while deeper layers increased compared with I1: I2C0 averaged ~20.5% (surface) versus ~7.5% (deep), I2C1 ranged ~27.5% (surface) to ~15% (deep), and I2C2 reached ~33% (surface) and ~15% (deep). Larger discharge promoted lateral spread, increasing horizontal moisture more than vertical (20).

Available water (Aw) (%) was significantly affected by irrigation strategy and compost level. I1 showed higher Aw values than I2, and compost increased Aw further; the highest Aw (16.58%) occurred under I1C3, while the lowest (12.02%)

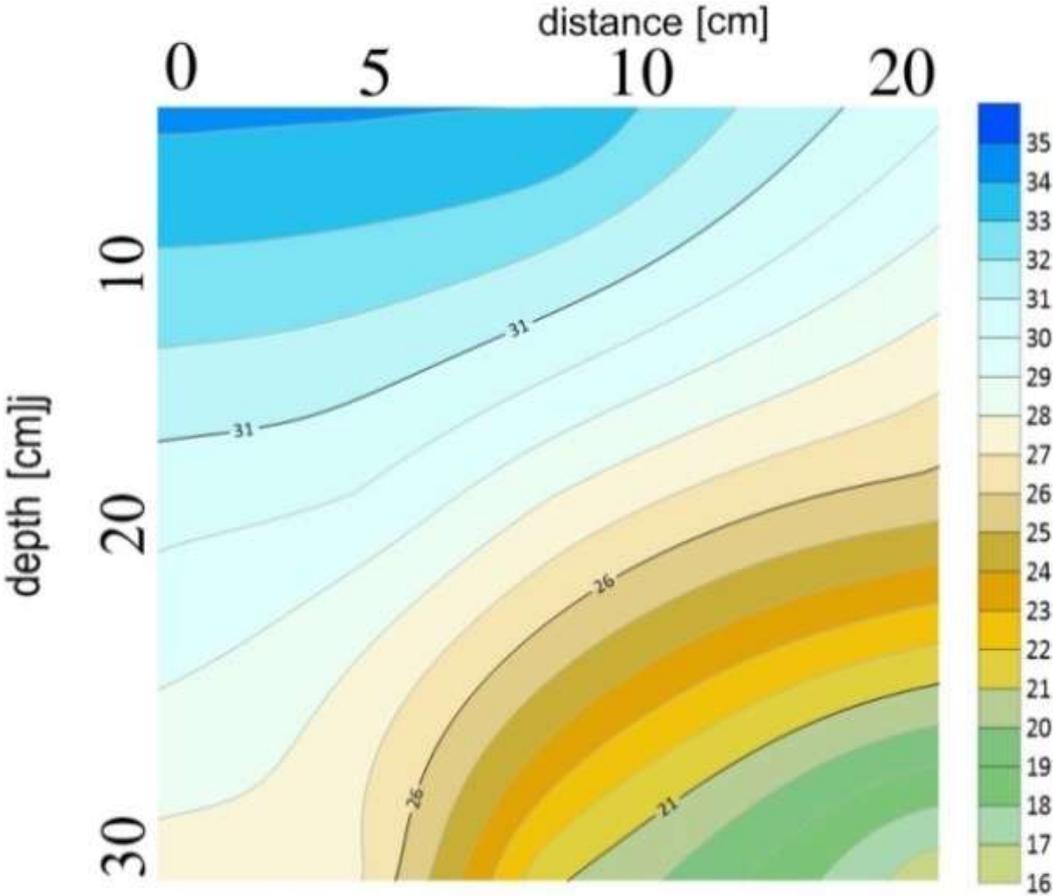
occurred at C0 (21). Field capacity (FC) also increased with compost, reaching 32.04% at I1C2, while the minimum values at C0 under I1 and I2 were 25.97% and 24.79%, respectively (21). Moisture at wilting ( $r\Phi$ ) increased with compost; I2C3 recorded 18.69%, versus 13.45% and 13.86% at C0 under I1 and I2 (22–24). Saturation moisture ( $s\Phi$ ) was highest at I2C3 (63.85%) and lowest at C0 (45.76%) under I1; compost improved water retention at saturation and storage capacity (25–26).

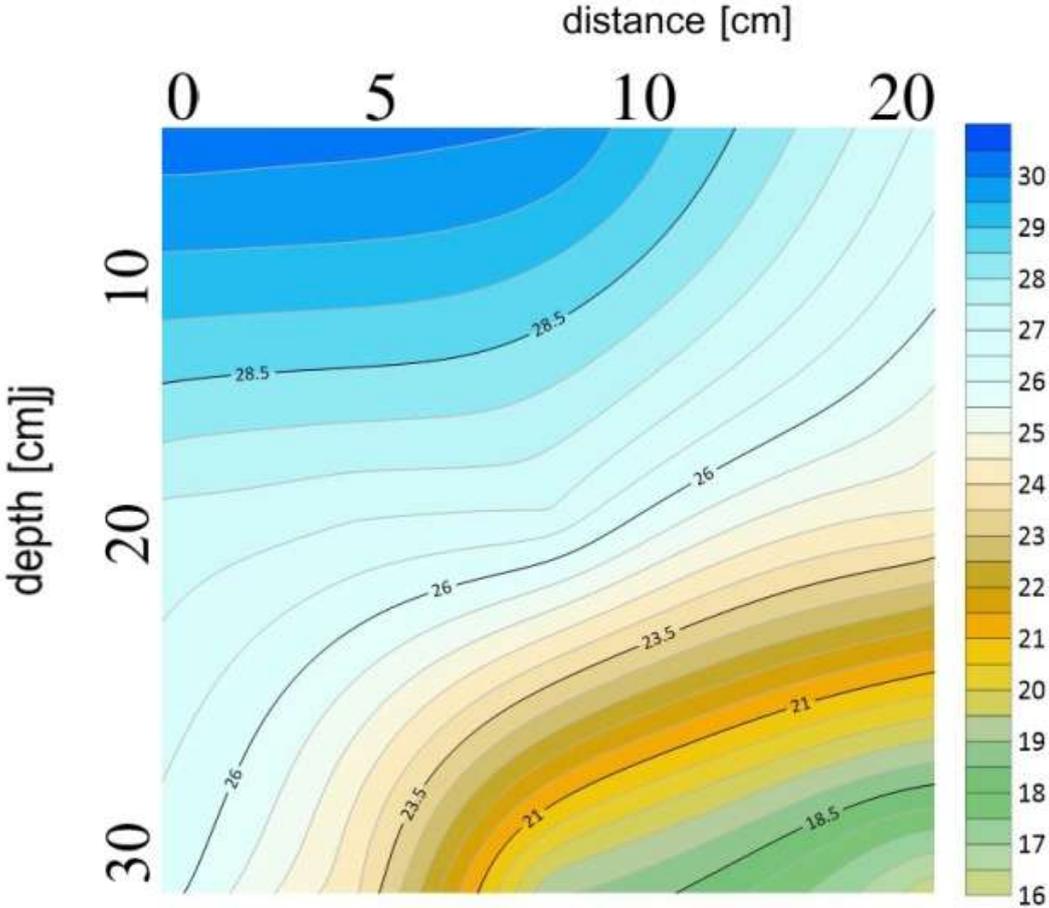
(25–26).

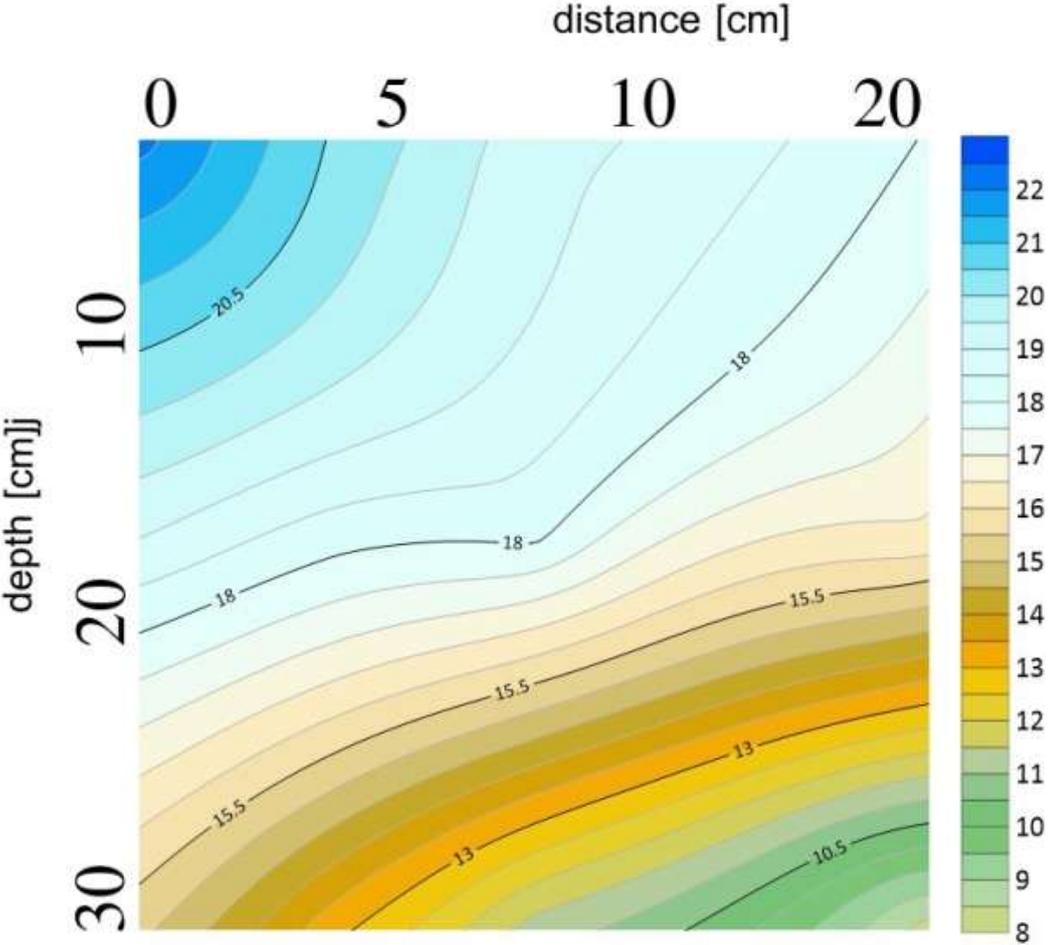


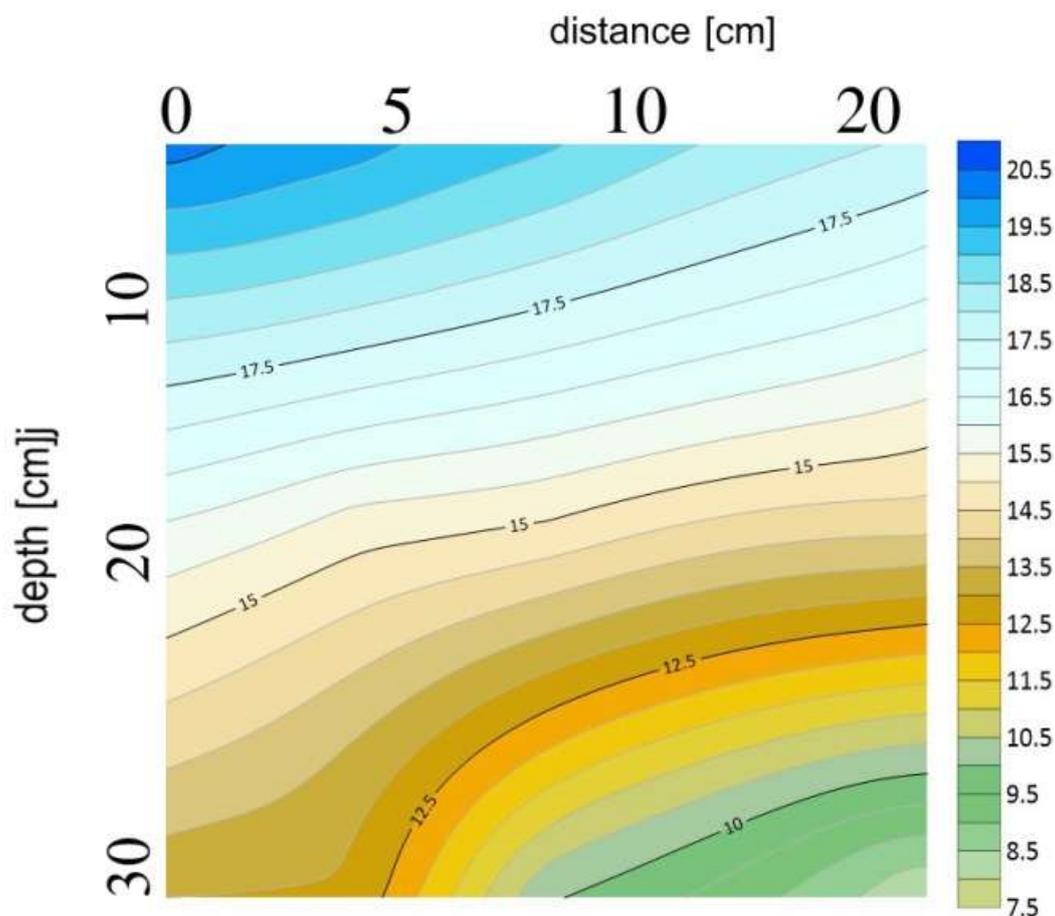


Distribution of soil moisture content between alternating irrigation lines









### Distribution of soil moisture content between alternating irrigation lines

#### A4

Alternate partial strip irrigation increased leaf area, shoot dry weight, and total dry matter of maize.

It reduced water losses by ~50% compared with full irrigation.

Alternate irrigation achieved a total yield of

9,119 kg ha<sup>-1</sup> compared with 7,145 kg ha<sup>-1</sup> under full irrigation.

Compost application had a significant effect on total yield; 2% compost (C2) outperformed C0 and C1, averaging 9,793 vs. 6,489 and 8,115 kg ha<sup>-1</sup>, respectively

### Recommendations

Adopt alternate strip irrigation as an effective water-saving technique.

Apply 2% compost to improve fertility and productivity of gypsiferous soils.

Promote alternate strip irrigation concepts for managing root-zone water and expanding the irrigated area with saved water.

Integrate compost use in extension programs and support local production.

should be acknowledged.

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