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COMPARATIVE ASSESSMENT OF MAIZE GRAIN YIELD UNDER DIFFERENT IRRIGATION TECHNOLOGIES, HYBRIDS AND PLANT DENSITIES IN THE GREAT ISLAND OF BRĂILA, ROMANIA IN 2026

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Abstract. *The objective of this study was to descriptively compare maize (Zea mays L.) grain yield performance across diverse irrigation technologies, commercial hybrids, and nominal plant densities in the Great Island of Brăila, Romania, during the 2026 growing season. A three-factor field arrangement included four distinct water-management treatments (rainfed control, drip irrigation, sprinkler lateral, and travelling-gun irrigation), five hybrids (P0710, P0900, P1441, P1570, and P9975), and two target plant densities (60,000 and 80,000 plants ha−1), producing 40 unique treatment combinations. Three 5-m² harvest subsamples were collected within each plot, totaling 120 observations. Grain yield data were extracted from the spreadsheet's STAS-adjusted yield field. The overall mean yield reached 8,108 kg ha−1. Specifically, mean yields were 6,020, 7,052, 9,726, and 9,634 kg ha−1 for the rainfed, drip, sprinkler-lateral, and travelling-gun treatments, respectively. The highest individual hybrid mean was recorded for P0710 at 12,210 kg ha−1. Across all evaluated treatments, the lower nominal density demonstrated a higher mean yield than the higher density. Because irrigation volumes differed among systems and each treatment combination was represented by a single experimental plot, these findings describe observed empirical associations rather than establishing independent causal or statistically significant treatment effects. Nevertheless, the results provide a robust first-year evidence base for designing future replicated irrigation–hybrid–density trials.*

Keywords: *Zea mays* L.; *irrigation method; hybrid; plant density; grain yield.*

INTRODUCTION

Maize yield depends on water, radiation, nutrients and genotype. Closing yield gaps while improving resource efficiency is a major agronomic objective (FOLEY et al, 2022; MUELLER et al, 2021; LOBELL et al, 2009). Under water limitation, irrigation timing and amount strongly influence yield (DARYANTO et al, 2016; HOWELL et al, 2002; CAKIR, 2004; FARRE & FACI, 2009).

Crop water demand is commonly assessed through evapotranspiration and crop coefficients (ALLEN et al, 1998). Irrigation-system comparisons must also account for applied volumes, timing and uniformity (HOWELL et al, 2002; CAKIR, 2004; FARRE & FACI, 2009; ALLEN et al, 1998; ZWART & BASTIAANSSEN, 2004). Density responses vary with environment and hybrid (ASSEFA et al, 2016; TESTA et al, 2016; SANGOI, 2001; TOKATLIDIS & KOUTROUBAS, 2004), while breeding has improved tolerance to crowding and stress (DUVICK, 2005; TOLLENAAR & LEE, 2002).

The Great Island of Brăila is an important irrigated region in southeastern Romania. This study evaluates maize grain yield in 2026 under different irrigation technologies, hybrids,

and target plant densities, while distinguishing between harvest subsamples and independent experimental replicates.

MATERIALS AND METHODS

The 2026 trial at SCDA Brăila, Great Island of Brăila, followed a 4 × 5 × 2 factorial arrangement: A1 rainfed, A2 drip, A3 sprinkler lateral and A4 travelling gun; hybrids B1 P0710, B2 P0900, B3 P1441, B4 P1570 and B5 P9975; and target densities C1 60,000 and C2 80,000 plants ha−1. The 40 combinations each occupied one plot.

Three 5-m² harvest areas within each plot provided 120 subsample observations. Plot yield was the arithmetic mean of its three subsamples; factor means were calculated from plot means. Grain yield was expressed on a standard moisture basis, although the moisture-correction procedure could not be independently verified. Recorded traits included ear number, grain moisture content, test weight, thousand-kernel weight, protein content, and starch content. As treatment combinations lacked independent experimental replication, comparisons were restricted to descriptive analyses, without inferential ANOVA or p-values.

Recorded irrigation totals were 970.5 m³ ha−1 for drip (346.7 + 311.9 + 311.9), 1,300 m³ ha−1 for sprinkler lateral (600 + 400 + 300), and 1,000 m³ ha−1 for travelling gun (300 + 400 + 300). These totals do not represent crop evapotranspiration.

Analyses used STAS-adjusted yield consistently, rather than mixing it with unadjusted harvest yield. Differences were expressed in kg ha−1 and as percentages relative to the stated comparator.

Balanced representation allowed factor-level averages to be computed from the 40 plot means. Although 120 subsamples were recorded, the experimental unit was the plot, not the harvest area.

An exploratory irrigation-response index was calculated as (irrigated mean yield − rainfed mean yield) / recorded irrigation volume (kg m−3). This is an apparent yield-increment ratio, not evapotranspiration-based water productivity or a causal irrigation effect (HOWELL et al, 2002; ALLEN et al, 1998; ZWART & BASTIAANSSEN, 2004).

Interpretation is limited by one plot per treatment combination, unequal irrigation amounts, possible stand-density deviations and field heterogeneity. Randomized, independently replicated trials with measured soil water and application uniformity are required for statistical inference.

RESULTS AND DISCUSSION

Mean STAS yield across 120 subsamples was 8,108 kg ha−1 (range 2,821–17,126 kg ha−1). This range describes individual harvest areas, not plot means.

Irrigation technology

Mean yields were 6,020 kg ha−1 (A1), 7,052 (A2), 9,726 (A3) and 9,634 (A4). Relative to rainfed plots, gains were 17.1%, 61.6% and 60.0%, respectively. A3 and A4 differed by only 92 kg ha−1.

The A3 treatment received 30% more irrigation water than A4 (1,300 versus 1,000 m³ ha−1), despite similar mean yields. Unequal amounts, timing, distribution uniformity and field conditions prevent attribution of differences solely to equipment.

The lower drip mean may reflect application timing, root-zone wetting, uniformity or plot heterogeneity; these remain untested explanations. Future trials should separate delivery technology from irrigation depth.

Table 1

Mean maize grain yield and irrigation water applied under different irrigation treatments in the Great Island of Brăila, 2026.

Treatment	Mean yield (kg ha−1)	Difference vs A1 (%)	Applied irrigation (m³ ha−1)
A1 rainfed	6,020	control	0
A2 drip	7,052	+17.1	970.5
A3 sprinkler lateral	9,726	+61.6	1,300
A4 travelling gun	9,634	+60.0	1,000

Hybrid performance

Hybrid means were 12,210 kg ha−1 for P0710, 9,191 for P0900, 7,359 for P1441, 6,027 for P9975 and 5,753 for P1570. P0710 exceeded P0900 by 3,019 kg ha−1 and P1570 by 6,457 kg ha−1.

These are site- and season-specific rankings, not evidence of stable regional yield potential. P0710 merits replicated evaluation across environments (DUVICK, 2005; TOLLENAAR & LEE, 2002).

Table 2

Comparative mean grain yield of five maize hybrids under different irrigation regimes and planting densities in the Great Island of Brăila, 2026.

Hybrid	Mean STAS yield (kg ha−1)
P0710	12,210
P0900	9,191
P1441	7,359
P1570	5,753
P9975	6,027

Nominal plant density and joint responses

The 60,000 plants ha−1 target averaged 8,851 kg ha−1 versus 7,364 at 80,000 plants ha−1: a 1,487 kg ha−1 advantage (20.2% relative to the higher-density mean). The lower target outyielded the higher under every irrigation regime, with differences ranging from 553 kg ha−1 (A2) to 2,351 kg ha−1 (A1).

These are target, not necessarily realized, populations. Emergence and survival differences could confound density comparisons; actual stand counts should be considered before drawing management conclusions.

Lower-density advantages varied among hybrids: P0710 2,713; P1441 2,168; P0900 1,218; P1570 965; and P9975 372 kg ha−1. These descriptive patterns warrant replicated genotype × density testing.

Table 3

Comparative mean maize grain yield at two target plant densities in the Great Island of Brăila, 2026.

Target density	Mean STAS yield (kg ha−1)
60,000	8,851
80,000	7,364

Table 4

Interaction between irrigation technology and target plant density on mean maize grain yield (kg ha⁻¹) in the Great Island of Brăila, 2026

Irrigation	60,000 plants ha−1	80,000 plants ha−1
A1	7,195	4,844
A2	7,328	6,775
A3	10,446	9,006
A4	10,437	8,832

The 13 June stand counts indicate that some realized populations were below target. Consequently, Table 4 compares assigned density treatments, not verified final stands. Density optima depend on hybrid and environment (ASSEFA et al, 2016; TESTA et al, 2016; SANGOI, 2001; TOKATLIDIS & KOUTROUBAS, 2004).

Irrigation × hybrid patterns

P0710 led under all four irrigation regimes, reaching 14,983 kg ha−1 with A3 and 13,509 with A4, compared with 9,835 under A1. P0900 yielded 12,315 kg ha−1 under A3 versus 5,691 under A1.

P1441 peaked under A3 (9,134 kg ha−1), whereas P1570 and P9975 peaked under A4 (7,451 and 6,994 kg ha−1). Such hybrid-specific patterns are descriptive, not statistically established interactions.

Table 5

Comparative mean maize grain yield (kg ha⁻¹) of five hybrids under four irrigation regimes in the Great Island of Brăila, Romania, 2026

Hybrid	A1	A2	A3	A4
P0710	9,835	10,512	14,983	13,509
P0900	5,691	7,356	12,315	11,402
P1441	5,501	5,984	9,134	8,816
P1570	4,202	5,111	6,248	7,451

P9975	4,870	6,296	5,947	6,994

Highest-yielding treatment combinations

The leading combination was A3B1C1 (sprinkler lateral × P0710 × 60,000 plants ha−1), averaging 15,404 kg ha−1. A4B1C1 reached 15,071 and A3B1C2 reached 14,563 kg ha−1. These unreplicated plot means cannot establish an optimum.

Notably, rainfed A1B1C1 also ranked among the five highest combinations (12,858 kg ha−1), illustrating the importance of hybrid and density when interpreting irrigation means.

Table 6

Top five treatment combinations for mean maize grain yield (kg ha⁻¹) under different irrigation regimes, hybrids and plant densities in the Great Island of Brăila, Romania, 2026.

Treatment code	Mean STAS yield (kg ha−1)
A3B1C1	15,404
A4B1C1	15,071
A3B1C2	14,563
A3B2C1	13,402
A1B1C1	12,858

Grain quality and yield components

Across harvest subsamples, mean grain moisture was 24.70%, hectoliter weight 62.13 kg hl−1, thousand-kernel weight 266.0 g, protein 7.83% and starch 75.21%. These are descriptive quality measures.

The minimum starch value of 7.5% is unusually low and requires verification against laboratory records. No biological inference should be based on this entry until checked.

Table 7

Descriptive statistics of maize grain quality and yield-related traits across all experimental treatments in the Great Island of Brăila, Romania, 2026

Trait	Mean	Minimum	Maximum
Grain moisture (%)	24.70	18.50	30.00
Hectoliter weight (kg hl−1)	62.13	54.40	67.80
Thousand-kernel weight (g)	266.00	177.50	400.40
Protein (%)	7.83	7.00	10.00
Starch (%)	75.21	7.50	77.90

Ears per 5 m²	37.81	26.00	48.00

Exploratory yield increment per unit of applied irrigation water

Apparent yield increments per cubic metre of applied irrigation water were 1.06 kg m−3 (A2), 2.85 (A3) and 3.61 (A4). They compare observed treatment means and are not measured crop water-use efficiencies.

A rigorous water-productivity assessment would require rainfall, soil-water balance, irrigation uniformity, runoff or drainage and evapotranspiration estimates (ALLEN et al, 1998; ZWART & BASTIAANSSEN, 2004).

Table 8

Comparative irrigation water productivity expressed as maize grain yield gain per unit of irrigation water applied in the Great Island of Brăila, Romania, 2026

Technology	Yield gain vs rainfed (kg ha−1)	Gain / irrigation (kg m−3)
A2	1,032	1.06
A3	3,706	2.85
A4	3,615	3.61

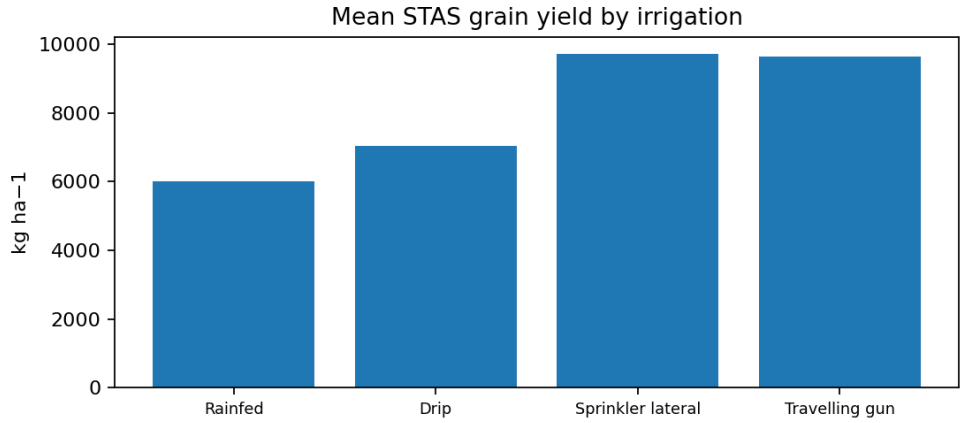


Figure 1. Mean STAS grain yield by irrigation. Descriptive treatment means; no independent plot-level replication

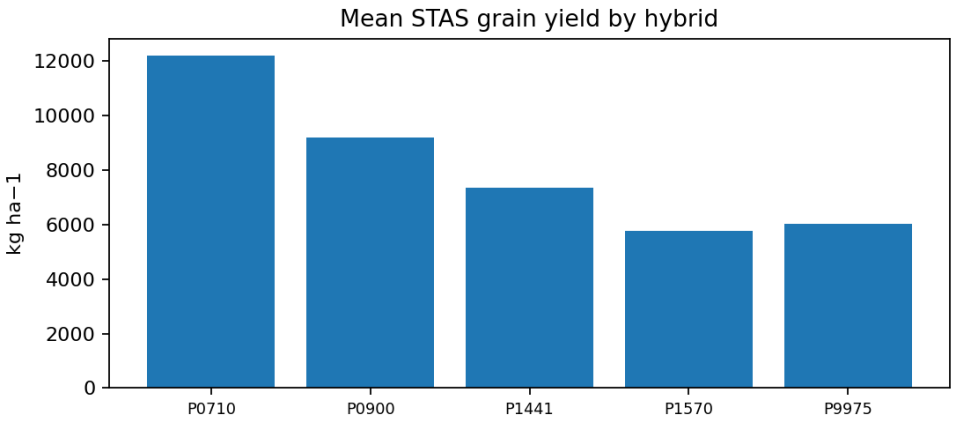


Figure 2. Mean STAS grain yield by hybrid. Descriptive treatment means; no independent plot-level replication

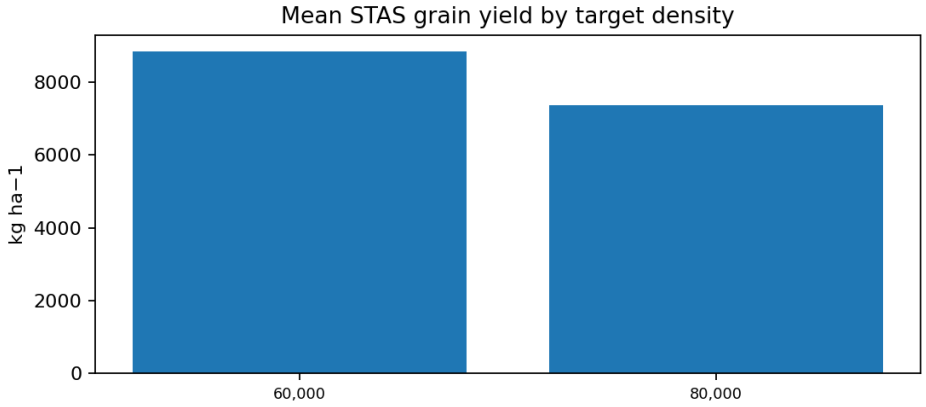


Figure 3. Mean STAS grain yield by target density. Descriptive treatment means; no independent plot-level replication

CONCLUSIONS

In the 2026 Great Island of Brăila trial, A3 and A4 showed the highest irrigation-category mean yields, P0710 led the hybrid means, and the 60,000 plants ha−1 target outyielded 80,000 plants ha−1. The highest plot mean was A3B1C1 (15,404 kg ha−1). Unequal irrigation volumes, potential stand deviations and the absence of independent plot replication restrict these results to descriptive associations. Randomized replicated experiments measuring soil water, application uniformity and realized plant density are required before management recommendations can be made.

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