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COMPARATIVE ANALYSIS OF DRIP AND SPRINKLER IRRIGATION IN AUTUMN WHITE CABBAGE

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ABSTRACT:

This study evaluates the technical and economic efficiency of drip and sprinkler irrigation in autumn white cabbage cultivation under the pedoclimatic conditions of Însurăței, Brăila County. The crop was grown in 2024 on 0.5 ha, divided into two equal plots of 0.25 ha. Drip irrigation produced larger cabbage heads, higher yield and better profitability in all technological loss scenarios. Under 10% losses, drip irrigation reached 124.34 t/ha and a gross profit of 38,590.74 lei/0.25 ha, compared with 101.76 t/ha and 30,121.78 lei/0.25 ha under sprinkler irrigation. The results indicate that drip irrigation is the more efficient option for small and medium farms in drought-prone areas.

INTRODUCTION:

- Climate change and drought risk make irrigation a key technological factor in vegetable production.
- Autumn white cabbage has high water requirements, especially during intensive growth and head formation.
- In south-eastern Romania, inefficient water application can reduce yield and increase fuel and production costs.
- Objective: to compare drip and sprinkler irrigation in terms of yield, resource use and economic efficiency.

MATERIAL AND METHOD:

- Location: Însurăței, Brăila County, Romania; Bărăgan Plain conditions.
- Year and area: 2024; total analysed area 0.5 ha.
- Experimental variants: drip irrigation on 0.25 ha and sprinkler irrigation on 0.25 ha.
- Biological material: local cultivar Varză de Buzău, established after oat.
- Planting scheme: 0.70 m between rows × 0.35 m between plants; about 10,000 plants/variant.
- Measurements: cabbage head weight, diameter, circumference, viable plants and estimated yield.
- Economic indicators: gross income, gross profit, benefit-cost ratio and economic return.
- Technological loss scenarios: 0%, 3%, 5% and 10%.

Variant	Irrigation system	Area	Main comparison
V1	Drip irrigation	0.25 ha	Localized water supply
V2	Sprinkler irrigation	0.25 ha	Conventional wetting

Experimental organization:

Item	Description
Location	Însurăței, Brăila County
Area	0.5 ha; two equal plots
Crop	Autumn white cabbage
Spacing	70 cm × 35 cm
Samples	3 representative samples/variant

Main determinations:

Category	Observed indicators	Output
Agronomic	Head weight; diameter; circumference	Yield/ha
Resources	Water and fuel consumption	Use efficiency
Economic	Income; profit; B:C ratio; return	Profitability

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RESULTS AND DISCUSSIONS:

1. Yield under technological loss scenarios

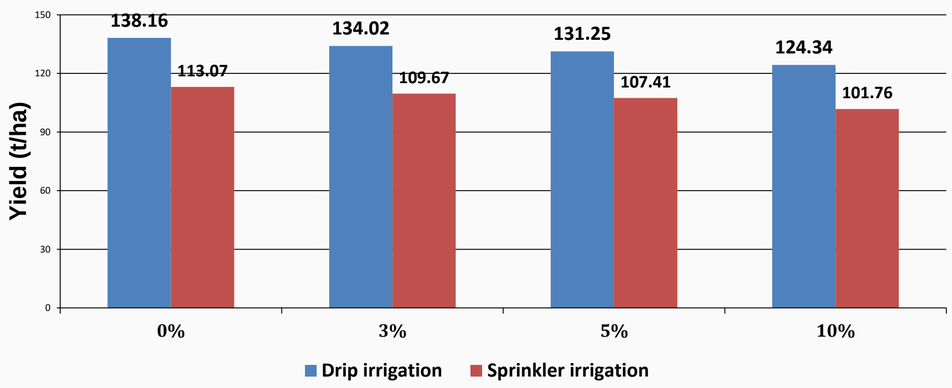

Figure 1. Drip irrigation maintained a higher yield in all loss scenarios

2. Water and fuel consumption

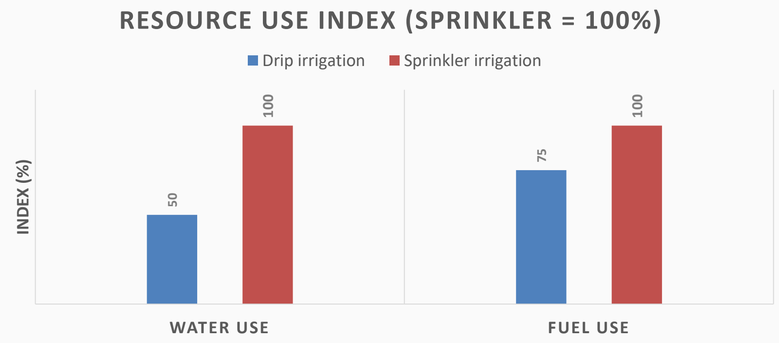

Figure 2. Drip irrigation used 50% less water and 25% less fuel

Sprinkler irrigation used twice as much water and more fuel. Under drought risk, this difference directly affects production costs.

3. Economic performance at 10% technological losses

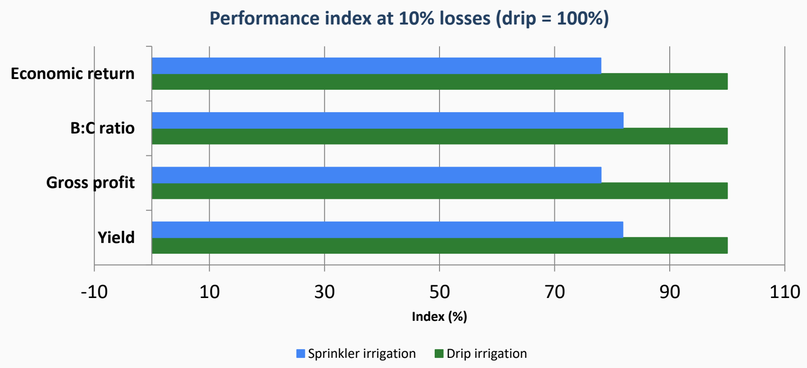

Figure 3. Drip irrigation generated higher gross profit and B:C ratio

When drip irrigation is treated as the 100% reference, sprinkler irrigation remains behind for yield, profit, B:C ratio and economic return.

cm **Average head circumference:**
Drip = 78.67 cm; Sprinkler = 66.00 cm

kg **Average head weight:**
Drip = 3.45 kg/head; Sprinkler = 2.83 kg/head

! **Key message: localized water supply improved yield, profitability and resource-use efficiency.**

CONCLUSIONS:

- Drip irrigation was superior to sprinkler irrigation for autumn white cabbage under the conditions of Însurăței.
- The drip system increased average cabbage head weight from 2.83 to 3.45 kg/head.
- Yield reached 138.16 t/ha without losses and remained 124.34 t/ha even with 10% technological losses.
- Sprinkler irrigation required twice as much water: 6,400 m^3 compared with 3,200 m^3 for drip irrigation.
- At 10% losses, gross profit was 38,590.74 lei/0.25 ha under drip irrigation and 30,121.78 lei/0.25 ha under sprinkler irrigation.
- The benefit-cost ratio confirmed the economic advantage of drip irrigation: 5.80 vs. 4.75 in the 10% loss scenario.
- Drip irrigation is recommended for small and medium farms aiming to reduce water use and increase profitability.
- Further multiannual studies on larger areas are needed to validate the results.