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Epidemiology of leaf spot diseases in barley and yield loss estimation under no-till management in Morocco

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INTRODUCTION & AIM

Barley (*Hordeum vulgare L.)* is a crucial cereal crop worldwide, but its productivity is significantly hindered by foliar diseases, posing challenges to sustainable agriculture. Controlling these diseases is particularly important in no-till farming systems due to the pathogens thriving in crop residues and persistent soil moisture, potentially leading to considerable yield losses (Jardine et al., 2000).

This study aims to examine the epidemiology of barley diseases under no-till conditions in Morocco, exploring factors influencing disease spread and developping suitable management strategies.

METHOD

Crop and Management

- Local six-row barley variety, direct-seeded
- Basal fertiliser: 1.5 qx/ha of NPK (10% N, 30% P, 10% K) applied at sowing.
- Crop rotation: Barley/forage.

Fungicide Application

- At the early heading stage (GS=50) on 1ha (other on 1ha was used as a control)
- Systemic fungicide: 200 g/L azoxystrobin + 80 g/L cyproconazole.

Harvest and Yield Assessment

- At maturity, 20 linear meters are harvested per hectare (treated and untreated)
- Parameters measured: Above-ground biomass, Grain yield, Thousand-kernel weight (TKW)

Location

- Ouled Boughadi, 30 km from Khouribga in Morocco
- Conducted on a 2-hectare no-till platform with a history of conservation agriculture
- 2023-2024 cropping season

Measurements and Assessments

Measurements were taken before and after foliar treatment at: Tillering (GS 25), end of stem elongation (GS 39), early heading (GS 50), end of heading (GS 58), and milk stage (GS 73-75)

- ✓ Disease Severity: Visual evaluation using James and Shih (1973) scale.
- ✓ NDVI (Normalized Difference Vegetation Index): with a GreenSeeker sensor.

RESULTS & DISCUSSION

Cropping season conditions

The 2023-2024 cropping season in Morocco, characterized by delayed rainfall, prolonged drought, and extreme temperature fluctuations, disrupted autumn crop sowing and production cycles, resulting in reduced yields and altered disease development in the trial.

Diseases appeared

This study site experienced low overall final foliar disease severity (15% total), with net blotch at 6.5%, powdery mildew at 5.5%, and scald at 3.2%. Smut and root rot were present in trace amounts (Figure 1).

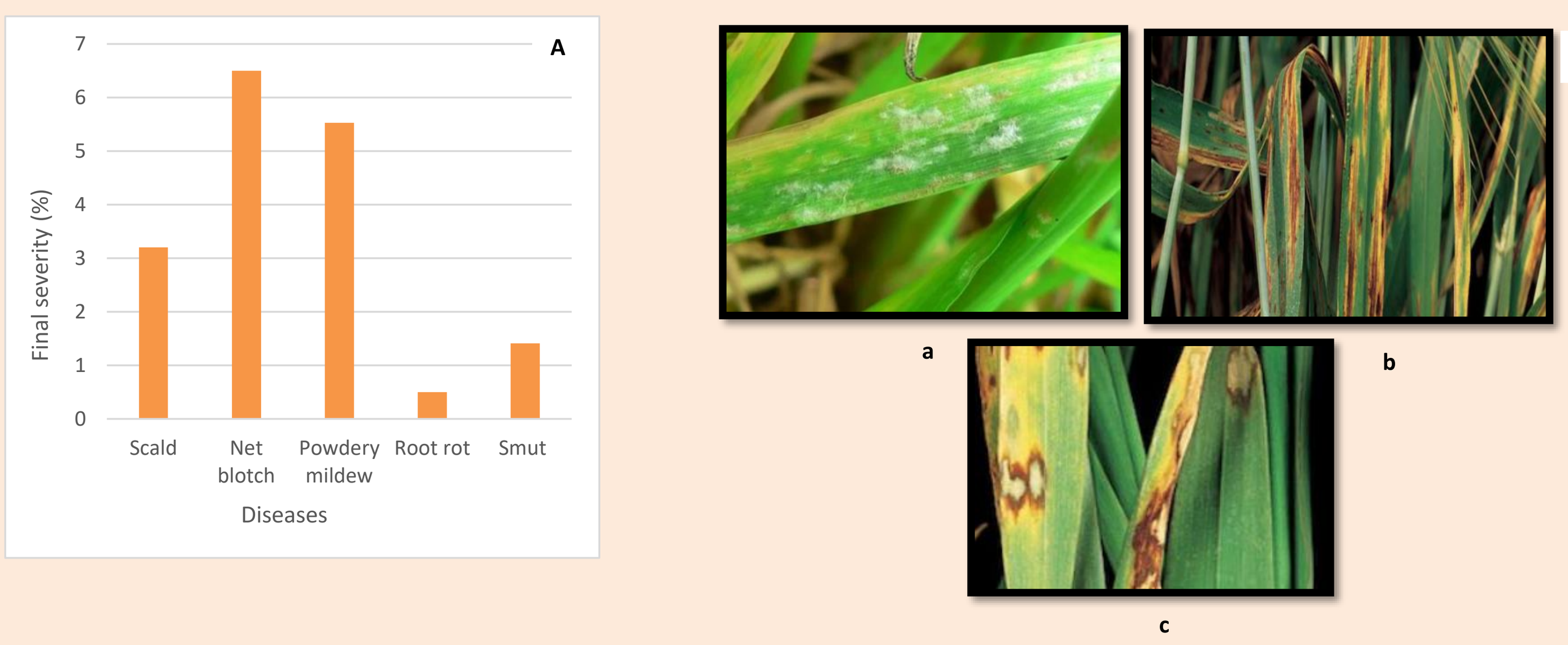

Figure 1. Barely diseases appeared during the 2023-2024 cropping season (A) and means of the severity of each disease observed on barley crops at the platform (B); a: powdery mildew, b: net blotch and c: scald.

Yield and thousand-kernel weight

- ❖ Although the fungicide reduced the disease severity, this did not increase grain yield, thousand-kernel weight (TKW), or dry biomass (Figure 4). This indicates that the disease was not this study's primary factor limiting grain production.
- ❖ The abiotic stress affecting the region and the country more broadly had a greater impact on grain yield, TKW, and dry biomass than the disease itself. Additionally, research has shown that when disease pressure is low, treated plots might not experience a significant reduction in yield (Jones, 1995; Tremblay et al., 2016).

Diseases epidemiology

- ❖ Foliar treatment reduced disease severity at adult plant stages (Figure 2) but did not affect the NDVI, whose values for treated and untreated plots were 0.33 and 0.36, respectively.
- ❖ The reduction in NDVI values was only observed through the growing stages (Figure 3), showing that NDVI changes were linked to plant growing stages rather than the fungicide treatment.
- ❖ No correlation was found between disease severity and NDVI (Figure 3), as drought stress influenced NDVI independently of diseases.

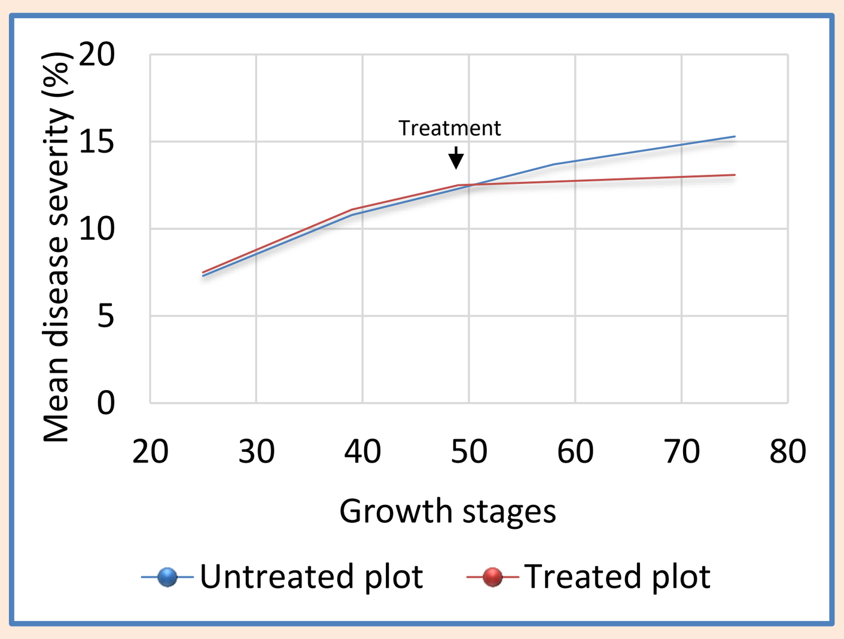

Figure 2. Average disease progress curves in untreated and treated plots under no-till system.

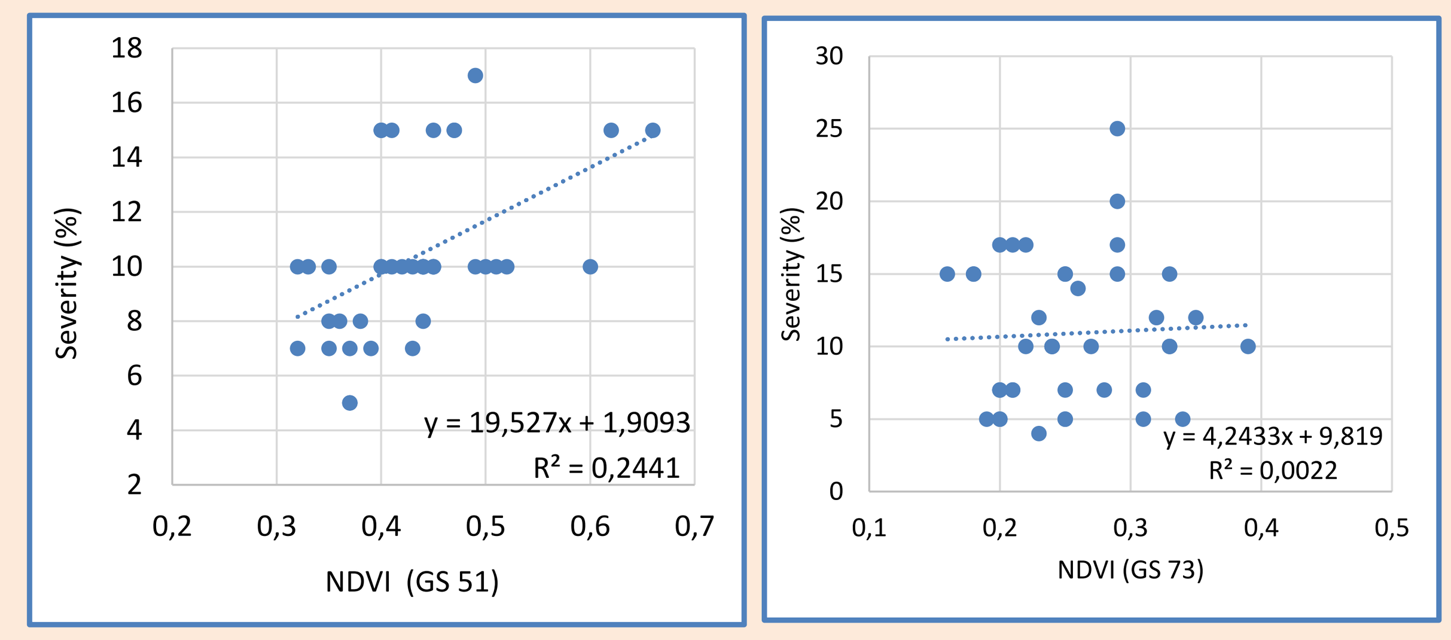

Figure 3. Correlation between disease severity and NDVI before (GS 51) and after chemical treatment (GS 73) under no-till system.

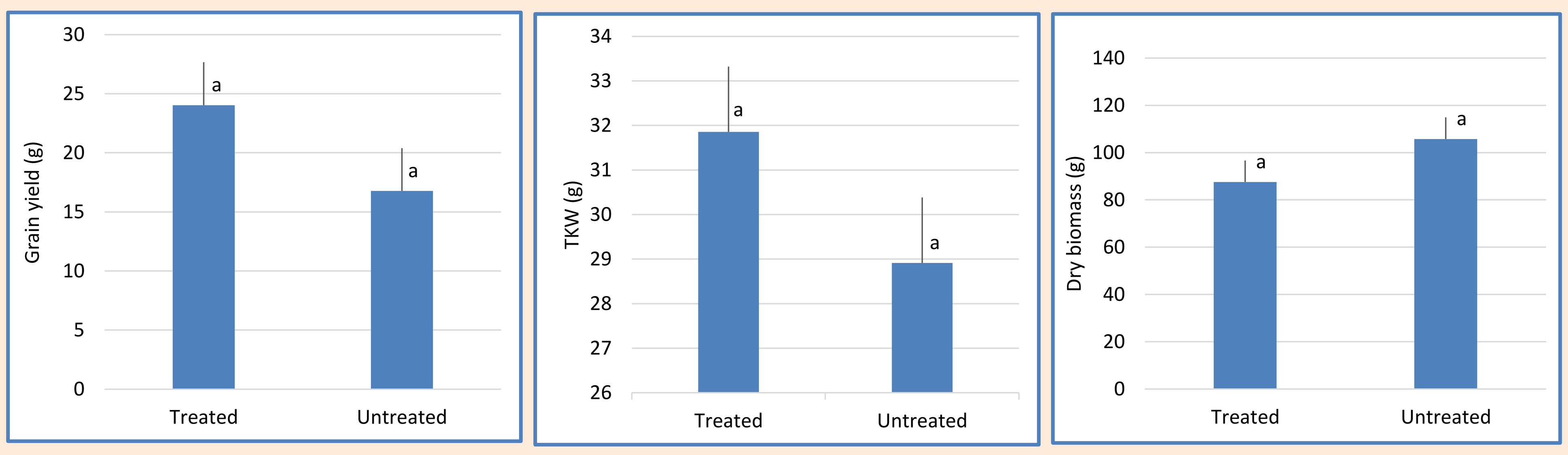

Figure 4. Means of grain yield, thousand-kernel weight, and dry biomass (in grams) obtained from treated and untreated barley plots under no-till system. The same letters indicate no significant difference.

CONCLUSION

- ❖ The effect of disease on yield losses was closely related to the potential yield of the cropping season, which, in turn, depended on climatic conditions.
- ❖ In years with low disease severity, foliar treatments in direct seeding are not cost-effective.
- ❖ Although NDVI is an effective tool for monitoring vegetation, its capacity to detect and quantify disease severity can be limited by various factors. A more comprehensive approach incorporating additional indicators may be necessary to fully understand the relationship between disease severity and crop health measured by NDVI.

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