Stemphylium Leaf Blight severity and onion yield in relation to nitrogen-fixing bacteria and nitrogen fertilization

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Introduction

Stemphylium vesicarium, the causal agent of Stemphylium Leaf Blight (SLB), is a major constraint to onion production in the Holland Marsh. SLB symptoms begin as necrotic lesions on older, senescing leaves that expand and coalesce, leading to premature defoliation, reduced photosynthetic capacity, and yield loss. Higher nitrogen (N) fertilizer rates have been shown to reduce SLB severity, likely by delaying leaf senescence. However, onions grown on the muck soils of the Holland Marsh rarely respond to additional synthetic N, as mineralization typically provides sufficient N for optimal yield. Moreover, due to the crop's shallow root system, excess synthetic N application is prone to leaching. Commercially available nitrogen-fixing endophytic bacteria offer a potential strategy to maintain or enhance N status and reduce SLB susceptibility while lowering synthetic N inputs.

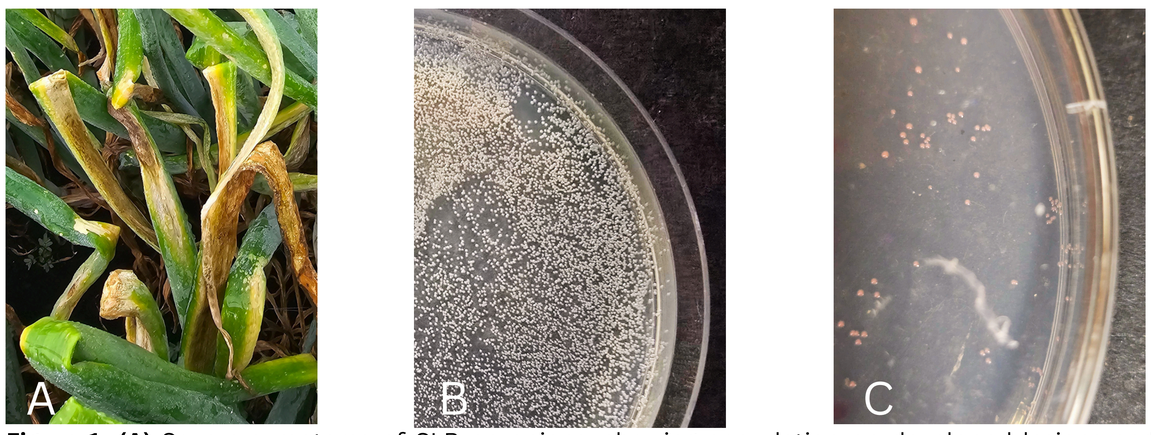

Figure 1. (A) Severe symptoms of SLB on onions, showing sporulation on developed lesions and significant leaf dieback. **(B)** and **(C)** Cultures of *Gluconacetobacter diazotrophicus* and *Methylobacterium symbioticum SB23*, the bioactive ingredients in Envita and Utrisha-N treatments, respectively.

Objectives

To evaluate how increasing N fertilizer rates and foliar application of nitrogen-fixing endophytic bacteria, applied in conjunction with reduced N rates, affect:

1. The severity and progression of SLB throughout the growing season
2. Crop nitrogen status and its relationship to SLB severity, and
3. Total and marketable yield.

Methods

- A field trial was conducted at a muck soil site (organic matter: 71.4%; pH: 5.8) in the Holland Marsh at the Ontario Crops Research Station – Bradford (44°02'21.0"N 79°35'48.8"W) during the 2025 growing season.
- Onions were direct-seeded on 6 May into plots consisting of two 7 m-long beds, each containing four double rows spaced 0.4 m apart. Treatments were arranged in a randomized complete block design with four replicates.
- Treatments consisted of onions fertilized with preplant N at 0%, 50%, and 100% of the provincially recommended rate (90 kg N ha^{-1}; OMAFRA); 50% N with the addition of *Gluconacetobacter diazotrophicus (Envita; 0.73L ha^{-1})* or *Methylobacterium symbioticum SB23 (Utrisha-N; 333g ha^{-1})* applied as foliar sprays at the fourth and fifth leaf stages, respectively; and 50% preplant N with a side-dressing of N (30 kg ha^{-1}; OMAFRA) applied at bulb initiation. Preplant fertilizer applications were incorporated into plots prior to seeding on 5 May.
- Throughout the season:
  - The youngest, fully expanded leaves from 20 onions in the middle rows of each experimental unit were collected for analysis of nitrogen content.
  - The three oldest leaves from 20 onions in the middle rows of each experimental unit were assessed for Stemphylium leaf blight (SLB) severity based on the area of leaf tissue displaying leaf dieback.
- On 10 September, two 2.34 m rows of onions—one from each of the two middle rows of both beds in each treatment block—were harvested. On 3 October, onions were sorted into size categories and weighed to determine total and marketable yields.

Results

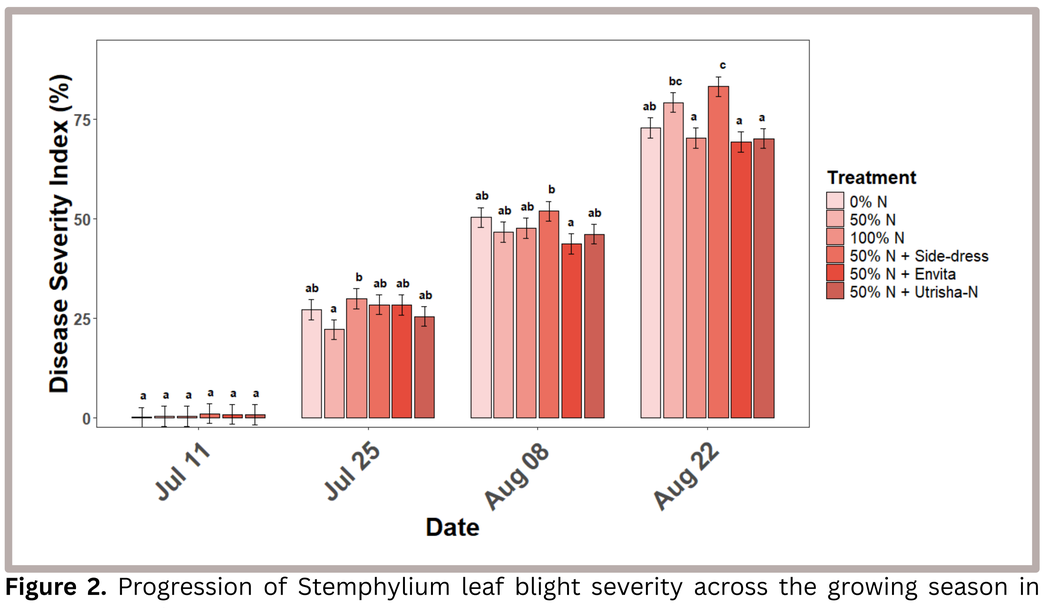

Figure 2. Progression of Stemphylium leaf blight severity across the growing season in response to nitrogen management treatments.
Columns with the different letters at each sampling date are significantly different, Protected LSD test.

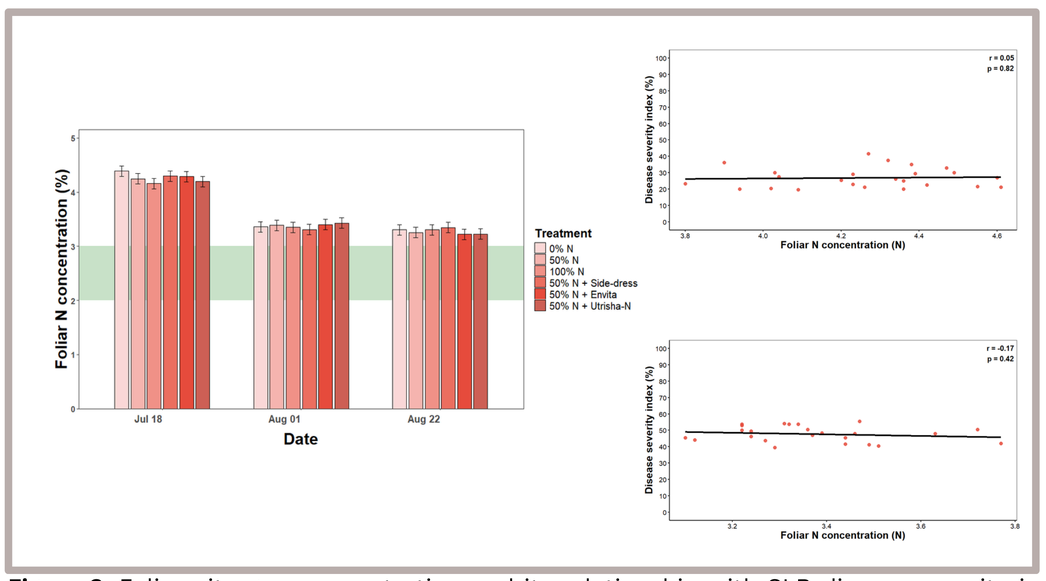

Figure 3. Foliar nitrogen concentration and its relationship with SLB disease severity in onion under different nitrogen management treatments.
(A) Mean foliar N concentration at three sampling dates (July 18, August 8, and August 22) across nitrogen management treatments. The green-shaded region represents the sufficiency range for optimal onion N status (2.0–3.0 % N; OMAFA). **(B)** and **(C)** Relationships between foliar N concentration measured on August 8 and August 22 and the corresponding DSI ratings assessed approximately one week after each sampling date.

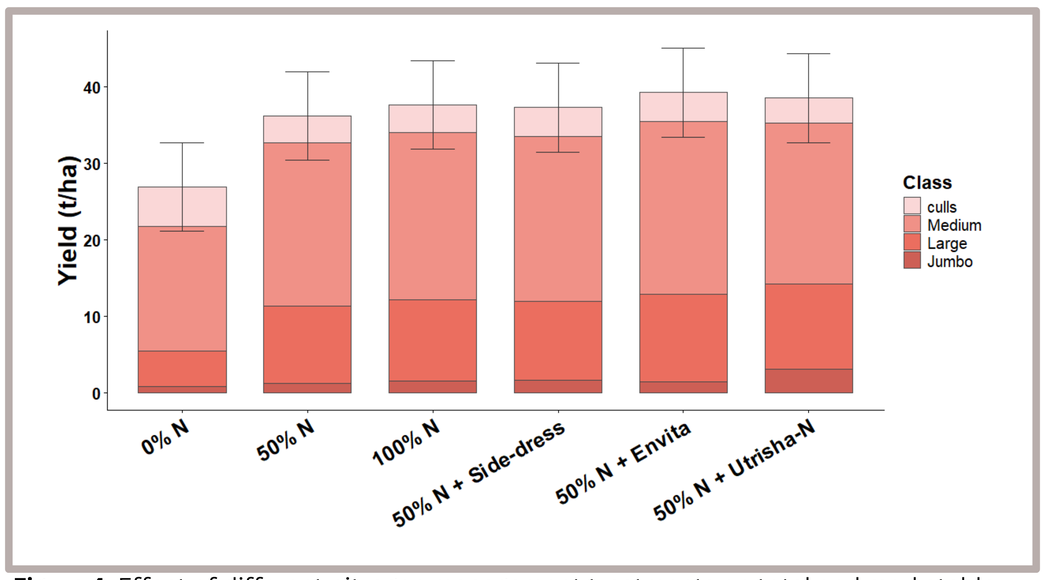

Figure 4. Effect of different nitrogen management treatments on total and marketable onion yield.
Marketable yield includes all size categories, except culls.
No statistically significant difference was noted between treatments with regard to total or marketable yield, nor in the proportion of onions in any of the size categories

Conclusion

- Higher available N (100% preplant N or 50% N + foliar endophyte) tended to reduce SLB severity compared to 0% and 50% N, though differences were not significant.
- Side-dressing N at bulb initiation increased SLB severity, indicating that late N availability may enhance disease susceptibility.
- Foliar N and SLB severity were not correlated, likely due to minimal variation in foliar N or weak dependence of SLB on crop N status.
- Yields did not differ among treatments; all maintained foliar N above critical levels, suggesting soil mineralization on muck soils supplied adequate N; even at reduced fertilization rates.