Disentangling the Foliar Disease Complex of Processing Lima Bean in New York

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INTRODUCTION

The predominant disease affecting foliage of processing lima bean in New York is a tan spot disease complex which causes substantial defoliation, necroses on stems and superficial necrotic lesions on the pods. To date, the foliar disease complex has been attributed to two fungi: *Boeremia exigua* var. *exigua* and *Didymella americana*. Symptoms of tan spot are initially discrete, necrotic, circular lesions that are brown in color (Fig. 1). These lesions rapidly coalesce to form larger necrotic areas and, with age, progress to develop a lighter tan-colored center in which fruiting bodies of the fungi (pycnidia) are found. Later in the season, crop health can also be substantially compromised by diseases affecting the pods. The two most prevalent pod diseases in New York are white mold caused by *Sclerotinia sclerotiorum* and gray mold caused by *Botrytis cinerea.* Other important diseases of lima bean found elsewhere in the United States, including downy mildew caused by *Phytophthora phaseoli* have not been reported in New York.

Fig. 1. Tan spot symptoms on lima bean leaves caused by the fungus, *Didymella americana.*

Differences in the pathogens encountered and climatic conditions between western New York and other processing lima production areas (e.g. Delaware and California) mean that many of the findings and agronomic recommendations are not directly transferable to this production system. The rapid development and implementation of disease management strategies is vital for the continued success of the New York processing lima bean industry. The objectives of this study were to: (i) quantify the prevalence and incidence of tan spot in lima bean fields; and (i) quantify the impact of tan spot on production in New York.

MATERIALS AND METHODS

Prevalence and incidence of tan spot. Disease severity was assessed in ten and five lima bean fields in the Genesee Valley region in 2015 and 2016, respectively. At each assessment time (up to nine times/season) disease intensity was quantified. In one field in 2016, disease incidence was monitored in blocks of different varieties (184-85, C Elite, Kingston, and Cypress). At the first assessment (two to four true leaves) in each field, disease incidence was calculated by counting the number of plants with symptoms in up to 40 arbitrarily selected plants. At subsequent assessments, plants had multiple stems and individual plants were difficult to differentiate. Individual stems were therefore used as the primary sampling unit for all subsequent assessments. In these assessments, two locations were arbitrarily placed within the crop approximately 30 m apart. Along each row (~ transect), a stem was arbitrarily selected at 0.5 m intervals to a maximum of 20 m (n = 40 assessments/transect). On each stem, the number of diseased and healthy leaves were counted. The average incidence of diseased stems was calculated across both transects at each assessment.

Effect of tan spot on yield. Two completely randomized block trials with five replications of each treatment and a nontreated control were conducted in commercial lima bean fields in each of 2015 and 2016. Each plot ranged between 15 and 20 feet long × 4 rows wide. One row separated plots between blocks and 4-feet sections separated plots within rows. Fungicides were applied to the plots with a carbon dioxide-pressurized backpack sprayer using four flat fan TJ 8002VS nozzles spaced at 19 inches. Treatments were two foliar applications for the control of tan spot, two flowering applications for the control of pod diseases; foliar and pod disease control (four applications); and a nontreated control. The fungicide, Headline® (pyraclostrobin) was applied for the control of tan spot on the foliage at the recommended rate of 9 fl oz/A. The fungicide, Endura® (boscalid) was applied for the control of pod diseases (white and gray molds) at the recommended rate of 11 oz/A.

The effect of fungicides on disease incidence was quantified prior to harvest on each of 20 stems per plot. On each stem, the number of diseased and healthy leaves were counted to calculate disease incidence (diseased leaves/total leaves × 100). The effect of fungicides on the number of pods was assessed within three days of commercial field harvest. Pods were manually removed from plants within four 0.5 m sections within each plot and weighed. Fifty pods from each plot were also randomly sub-sampled and weighed to calculate the average weight of one pod. The presence of tan spot and other disease was also noted on each of the pods and average pod disease incidence calculated on a plot basis. The effect of fungicide on disease incidence, total weight of pods, individual pod weight, and average disease severity on leaves was statistically analyzed.

RESULTS

Prevalence and incidence of tan spot. In 2015, foliar disease was identified in all fields at the first assessment (two to four true leaves) in varying severities. In the majority of fields, disease spread at an exponential rate and continued to increase over time until at the final assessment prior to harvest, disease incidence was at least 80% in most fields. These fields were all located in the southern production region (LeRoy/Piffard) but were also planted to two varieties, Cypress (4 of 5 fields) and Maestro (1 of 5 fields). The high rainfall in June led to replanting of fields in areas of a lighter soil type which were concentrated in the Kendall region. These fields were planted with different varieties to those in the southern region (e.g. 184-85, C-Elite and Kingston). In Cypress and Maestro fields, disease severity was consistently higher than in other varieties and exponentially increased throughout the season (Fig. 1). In 2016, disease incidence was consistently higher in the 'Cypress' block than in the blocks and fields planted to the varieties, 184-85, C Elite, and Kingston (Fig. 2).

Fig. 1. Temporal changes in disease severity according to variety within individual processing lima bean fields across the Genesee Valley in 2015.

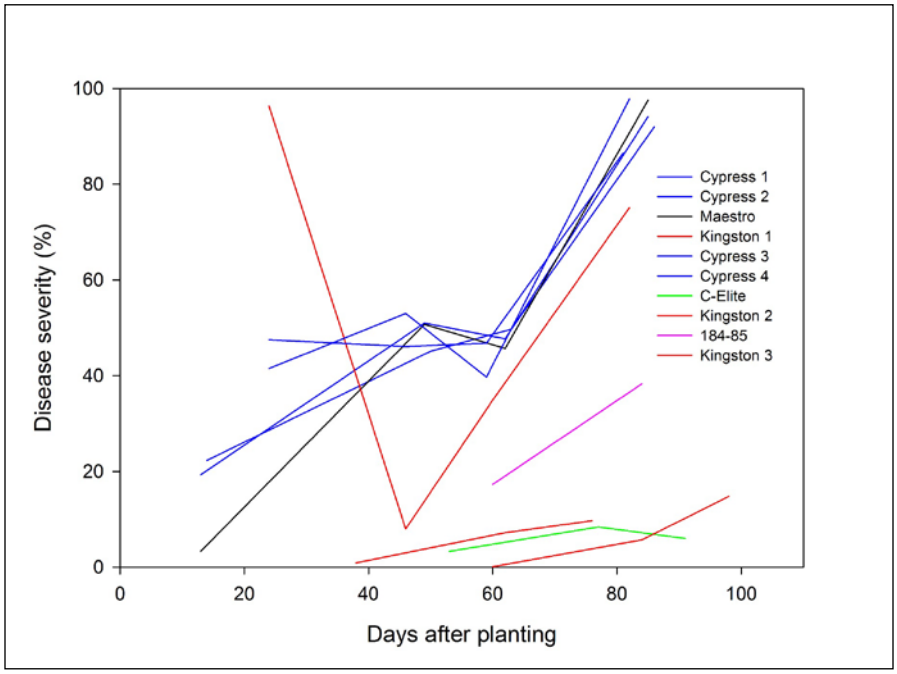
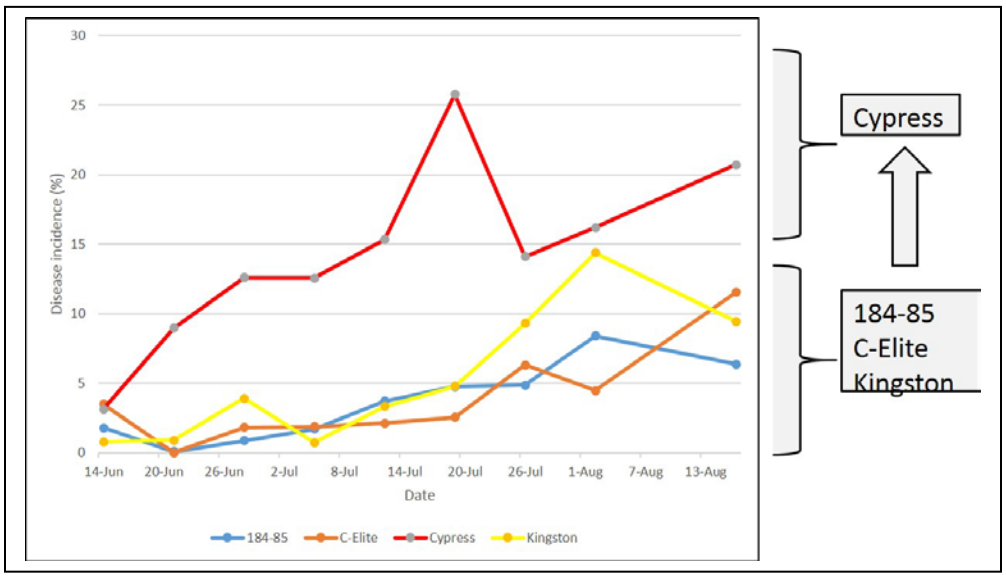


Fig. 2. Temporal changes in disease incidence in different processing lima bean varieties in 2016.



Effect of tan spot on yield. *2015.* Application of fungicides significantly reduced disease incidence in both trials and increased the number of leaves per stem (Table 1). In trial 1 (var. Cypress), disease incidence was significantly reduced on an average of 54.5% by all fungicide treatments compared to nontreated plots, which were not significantly different between each other. In trial 2 (var. Maestro), disease incidence was also significantly reduced by fungicides compared to nontreated plots by an average of 57.3% and the number of leaves per stem was increased by an average of 54.2%. In both trials, fungicide application had no significant effect on pod weight and the average weight of one pod (Table 1).

2016. In trial 3 (var. Cypress), application of fungicides irrespective of timing significantly reduced disease incidence compared to nontreated plots (Table 1). Fungicide application also correspondingly increased the number of leaves produced on each stem compared to nontreated plots and was significantly higher in plots receiving all four applications for the control of tan spot (foliar + pod disease control). In trial 4 (var. 184-85), fungicide application, irrespective of timing, also significantly reduced disease incidence by 83% compared to nontreated plots (Table 1). Fungicide application also significantly increased the number of leaves produced on stems by 26.8% and was not significantly affected by timing. In both trials, fungicide application did not have a significant effect on the weight of pods produced and average weight of one pod (Table 1).

DISCUSSION

The significant decrease in disease intensity from application of fungicides across all four trials conducted in 2015 and 2016 provided further evidence of the role of plant-pathogenic fungi in the foliar disease complex affecting processing lima bean in western New York. In 2015, isolations conducted from diseased leaves and pods sampled from these locations suggested the majority (>80%) of lesions were associated with the presence of the fungus, *Didymella americana*. This fungus has previously been shown to be pathogenic within our laboratory studies and cause similar symptoms to those observed. The significant reduction in defoliation

(average number of leaves produced on each stem) also suggests that at high intensity this disease has the potential to reduce green leaf area of plants from abscission. However, the absence of a significant increase in the total weight of pods and average weight of one pod suggests that processing lima beans are highly resilient to the loss of green leaf area and this disease may not affect yield and productivity. These findings suggest that although the incidence of foliar disease is affected by variety, control of the foliar disease complex may not be economically warranted.

Further Work. The long-term goal of our lima bean pathology program is to tailor the disease management recommendations for production in western New York.

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Table 1. Effect of fungicides on tan spot incidence, the number of leaves per stem, and lima pod yield components in western New York in 2015 and 2016.

Treatment	Leaves per stem	Disease incidence (%)	Pod weight (g)	Average weight of one pod (%)
Trial 1 (2015 – var. Cypress)				
Foliar only	10.2 a	38.1 b	1,247	3.8
Pods only	11.1 a	37.4 b	1,335	3.9
Foliar + Pod	11.1 a	30.2 b	1,161	3.7
Nontreated	5.0 b	77.3 a	1,093	3.9
P =	0.004	<0.001	Not significant	Not significant
Trial 2 (2015 – var. Maestro)				
Foliar only	10.3 a	26.8 b	1,007	3.8
Pods only	11.4 a	29 b	1,031	3.9
Foliar + Pod	11.7 a	25.4 b	1,105	4.1
Nontreated	7.2 b	63.4 a	994	4.0
P =	0.001	0.004	Not significant	Not significant
Trial 3 (2016 – var. Cypress)				
Foliar only	10.6 c	4.4 b	864	3.3
Pods only	12.5 b	4.2 b	572	3.0
Foliar + Pod	13.8 a	3.2 b	724	3.3
Nontreated	8.2 d	16.3 a	668	3.3
P =	<0.001	<0.001	Not significant	Not significant
Trial 4 (2016 – var. 184-85)				
Foliar only	20 a	2.6 b	1,320	3.4
Pods only	19.6 a	4.6 b	1,568	3.3
Foliar + Pod	21.3 a	1.9 b	1,460	3.6
Nontreated	16 b	25.7 a	1,660	3.5
P =	0.004	<0.001	Not significant	Not significant