Occurrence and Impact of Soybean Vein Necrosis Disease in Delaware

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Abstract

Soybean Vein Necrosis disease (SVNd) is a recently described, thrips-vectored, viral disease of soybeans. Little is known of the epidemiology, impacts, and management needs/options for SVNd. We surveyed 50 full and double crop soybean fields in the 2015 season for appearance and severity of the disease. In addition, two small plot research trials were conducted separately to examine the impacts of 1) insecticides and 2) variety and planting date effects on viral expression and yield. In 2015, 72% of Delaware soybean fields had detectable levels of SVNd by R5-R6, with 69% of full season and 93% of double crop fields affected. Although insecticide treatments significantly reduced thrips numbers there were no effects on SVNd symptomology. SVNd severity indices were greater in double crop vs full season beans (5.46 vs 2.43). In the full season trial, the varieties H42-13R2, 74B42R, and H37-14R2STS had significantly lower SNVd indices than other tested varieties. In the double crop system SVNd indices were significantly lower in variety 74B42R. In both systems, SVNd indices were greatest in the varieties MA3516NRR2 and SG3644. Regression analyses indicated a significant negative linear relationship between log SVNd index and yield. Survey results indicate that SVNd can be present at high levels in Delaware fields and may be greater in double crop systems. Our data are the first to document the effects of variety and planting date on SVNd and its associated effects on yield, and indicate that the virus may potentially impact yield to some degree. Based on our results, planting date and variety selection may be effective SVNd management practices if required in the future.

Introduction

In 2011, a new Tospovirus causing Soybean Vein Necrosis disease (SVNd), was identified in Maryland and Delaware soybean fields (1). Soybean Vein Necrosis Virus is acquired by Soybean thrips during the first two larval stages and transmitted in a persistent, propagative manner (2) Symptoms of SVNd include vein clearing or necrosis, which can spread over the entire foliar surface over time (Fig. 1). SVNd has been associated with grain quality in Midwestern soybean production regions (2); however, the significance of SVNd on Mid-Atlantic soybean production remains unclear.

Fig. 1. Examples of SVNd symptoms on foliage. Symptoms tend to follow the leaf vein and progress outward over time. Photos: N. Kleczewski

Objectives:

1. Document SVNd occurrence and severity in Delaware soybeans planted in full and double crop production systems
2. Examine the effects of SVNd on soybean yield using replicated, small plot studies

Materials and Methods

Survey

A total of 50 fields throughout Delaware, comprised of 30 full season and 20 double crop fields surveyed twice to target early (vegetative or early reproductive) and late (mid-to late pod fill) stages in development. Twenty sites consisting of 3 row feet were haphazardly selected and assessed for the incidence of plants with SVNd. Symptomatic trifoliates were collected, placed on ice, and shipped overnight to Agdia Inc. for confirmation of the virus through Enzyme Linked Immunosorbant Assays (3). Data were analyzed using repeated measures ANOVA (JMP 12.0).

Trial 1 Effects of Thrips on SVNd and Yield

A trial was conducted to examine the impact of thrips numbers on SVNd and yield. Thrips numbers were manipulated through application of a neonicotinoid seed treatment and sequential foliar insecticide application. The design was a RCBD with six replications per treatment. Treatments included: 1)untreated control, 2) neonicotinoid (Gaucho, 2 fl oz / hundred weight) seed treatment (s), 3) S + V5 foliar application of spinosad (Blackhawk; 2 oz./A); 4) S+V5 + R1, 5) S+V5 + R1 + R3, and 6) S + V5 + R1 + R3 + R5. Treatments were applied to each row of each plot with a CO_2 pressurized backpack sprayer equipped with a three nozzle boom delivering 54 gpa. Thrips were monitored every 7-14 days until a week after R5. At R6, SVNd was determined by assessing incidence of foliar symptoms from 10 randomly selected plants located at the center of each plot. Twenty trifoliates were selected from the upper 1/3 of the plot canopy and rated for percent foliar severity. Disease index was calculated using the formula index =(Incidence x severity) x 100. Plots were harvested and yields adjusted to 13% moisture. Virus was confirmed in symptomatic tissue by Agdia, Inc. Thrips counts were analyzed using repeated measures ANOVA. Yield, SVNd index, and total thrips data were analyzed using a random mixed model analysis of variance (JMP 12.0).

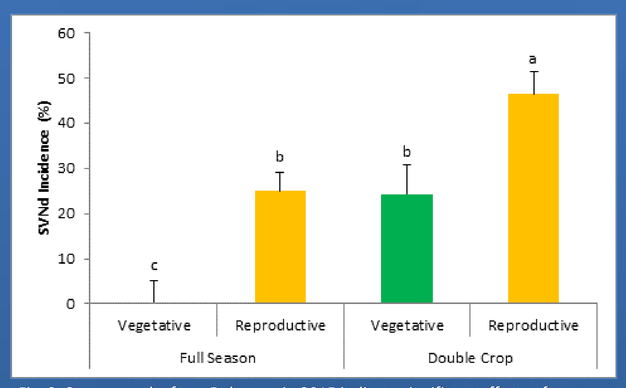

Fig. 2. Survey results from Delaware in 2015 indicate significant effects of cropping system on SVNd incidence over time. The incidence of SVNd during the vegetative stages of growth in double crop beans was similar to the incidence during late, reproductive stages of full season beans. Different letters indicate significant treatment differences using Fisher's Protected LSD (α=0.05).

Table 1. Effects of sequential applications of Blackhawk insecticide (2 oz./A) and seed Gaucho treatment on thrips numbers, SVNd severity, and yield.

Treatment	No. Thrips per 20 Leaflets						Total Thrips	SVNd Index	Yield (bu/A)
	3-Aug	10-Aug	17-Aug	25-Aug	11-Sep	15-Sep			
control [x]	3	12 a[y]	7	26	22 a	10 ab	80 a	0.035	33
Seed treatment (S)	5	11 a	6	24	15 bc	11 a	71 ab	0.069	36
S+V4	5	6 b	9	28	15 bcd	9 abc	72 ab	0.037	35
S+V4+R1	5	5 bc	7	22	19 ab	9 ab	66 b	0.051	36
S+V4+R1+R3	3	2 c	6	23	13 cd	7 bc	54 c	0.055	35
S+V4+R1+R3+R5	5	6 bc	6	20	10 d	6 c	52 c	0.068	35
P(*F*)	NS	<0.0001	NS	NS	<0.001	0.028	<0.001	NS	NS

[x]Planted on 7/15/2015; Foliar applications of Blackhawk (2 oz. /A) occurred on 8/6, 8/18. 8/27, and 9/8 2015. [Y]Treatment means not sharing the same letter are significantly different using Fishers LSD (α=0.05)

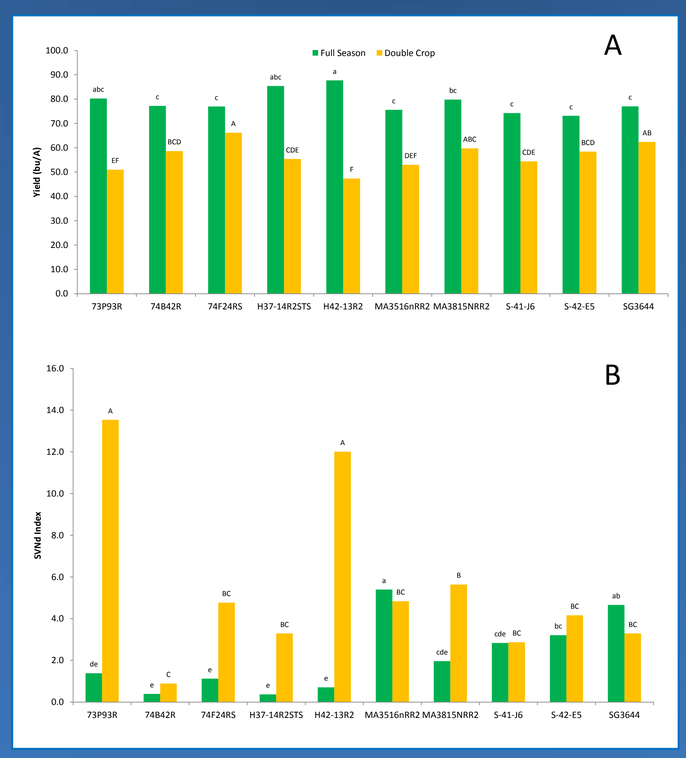

Fig. 3A-B. Yield and SVNd Response of ten soybean cultivars planted in full season and double cropping systems in 2015. A) Yields significantly differed between cultivars, with full season yielding better than double crop, as expected. B) Cultivars significantly differed in SVNd response. In general, SVNd was lower for most cultivars in full season plantings when compared to double crop plantings. The cultivar 74B429 contained significantly less SVNd in both full season and double crop plantings. Treatment means within the same capitalization scheme not sharing the same letter are significantly different using Fishers LSD (α=0.05)

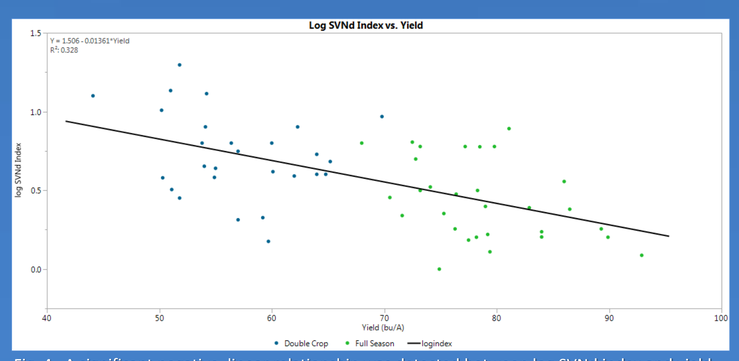

Fig. 4. A significant negative, linear relationship was detected between log SVNd index and yield for ten soybean varieties planted in full season and double crop systems.

Trial 2 Effects of variety and planting date on SVNd

The 2015 UMD soybean variety trial was used to assess the impacts of variety and cropping system on SVNd severity and yield. All cultivars were planted in a full season and double crop production system at the Wye Research and Education center located in Queenstown, MD in a random complete block design with three reps per variety. Ten cultivars were selected from the variety trials based on degree of symptom expression. SVNd index was calculated as in Trial 1. Plots were harvested and yields adjusted to 13% moisture. Data were analyzed using a random mixed model analysis of variance (JMP 12.0).

Results

Survey results indicated that 72% of fields had detectable levels of disease by R5-R6, with 69% of full season and 93% of double crop fields affected (data not shown). Statistical analyses indicated significant effects of evaluation time and cropping system on SVNd severity [Cropping System x Stage at Rating P(*F*) = 0.014]. SVNd developed earlier and to a greater degree in double crop soybeans compared to full season soybeans (Fig. 2). In the full season systems, SVNd incidence at the reproductive stage was similar to the vegetative stage in double crop systems .

Insecticide treatments significantly reduced thrips up to seven days after treatment on three of the six assessment dates [Time x Treatment; P(*F*) <0.0001] . Plants receiving three or four foliar insecticide applications had significantly lower total numbers of thrips than other treatments (Table 1). However, thrips reduction did not impact SVNd index or yield (Table 1). Overall, SVNd levels for this trial were very low.

Yield and SVNd index were significantly impacted by soybean cultivar for both cropping systems (Full season and double crop P(*F*) <0.0001; Fig. 3A-B). SVNd index was lowest for cultivar 74B42R in both cropping systems. For a given cultivar, SVNd index was greater for the double crop system when compared to the corresponding full season system in seven of the ten cultivars rated. Across all varieties and systems we detected a moderate, but significant negative linear relationship between log SVNd index and yield [P(*F*) <0.0001; Fig. 4].

Discussion

Our results show that SVNd can be prevalent in soybeans grown in the Mid-Atlantic. Survey and research plot trials support the hypothesis that double crop soybeans may be impacted by SVNd to a greater degree than full season beans. Double crop beans are planted later in the growing season, which may result in exposure to higher levels of thrips and therefore increased SVNd earlier in plant development. Our results show that soybean cultivars may vary significantly in disease expression. Of the ten cultivars examined, disease expression was consistently and significantly lower in cultivar 74B42R when compared to other tested cultivars. Our data showed a moderate, but significant relationship between SVNd index and yield. To our knowledge, this is the first report of a negative yield impact associated with SVNd. Although insecticides did reduce thrips numbers, the reduction was not sufficient to reduce SVNd. The potential role of insecticides for SVNd management remains unclear. Our data indicate that cultivar and planting date may be useful components for SVNd management.

Acknowledgements. We would like to thank Dr. Jason Wight for assisting with the variety trial and Nate Smith and Chris Ramage for technical assistance. This project was supported by the Agriculture and Food Research Initiative Crop Protection ad Pest Management-Extension Implementation Competitive Grant no. 2014-70006-22539 from the USDA National Institute of Food and Agriculture to JW and NK, and a Delaware Soybean Board Grant to NK, BC, and JW

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