JTN-5109: Soybean Germplasm Resistant to Nematode Population Infecting cv. Hartwig

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INTRODUCTION

Soybean cyst nematode (SCN), *Heterodera glycines* Ichinohe, is a pervasive soybean [*Glycine max* (L.) Merrill] pest worldwide (Wrather et al., 2001). In the United States, SCN is the most damaging pest on soybean, causing estimated yield losses of nearly 94 million bushels (2.5 billion kilograms) in 2007 (Wrather and Koenning, 2009). Genetic resistance has been the most effective means of controlling the pest. Nematode populations, however, are genetically variable and have adapted to reproduce on resistant cultivars over time because resistance primarily traces to two soybean accessions: PI 88788 and Peking (Diers and Arelli, 1999). Cultivar Hartwig was released with comprehensive resistance to most populations of SCN. Hartwig was developed from a backcross program of cv. Forrest[3] with PI 437654 as the SCN donor parent. Recently, a virulent population of SCN was selected for its reproduction on Hartwig (Young, 1998). Similar SCN populations were also found in Missouri, Illinois, and Tennessee (Niblack, 2005; Heinz, 2004; Newman, 2004; Personal communications).

Soybean PI 567516C is a recent introduction from China that was found resistant to the virulent nematode population, however, it is agronomically highly undesirable (Young, 1999; Arelli and Young, 2005). Additionally, PI 567516C is resistant to Races 1 and 3 (HG Types 2.5- and 0, respectively). Chen et al. (2006) reported that PI 567516C is genetically diverse from most sources of SCN resistance including Peking, PI 88788 and PI 437654.

Hartwig is a major source of resistance in Southern cultivars. It is highly beneficial to introgress resistance genes from PI 567516C into Hartwig for developing improved germplasm with more comprehensive resistance to known nematode populations, especially those parasitizing PI 437654-derived cultivars.

MATERIALS & METHODS

Breeding Methodology:

Seeds for cv. Hartwig and PI 567516C were obtained from the USDA soybean curator and crosses made to develop F_2 derived families. Breeding methodology included a combination of pedigree and mass selection together with by-line selection for advancing families.

Selection of Progenies with Resistance:

A virulent nematode population was developed from a mass mating of SCN Race 2 (HG Type 2.5-) females with SCN Race 5 (HG Type 1.3-) males. Eggs resulting from the cross were cultured on Hartwig and then on cv. Hutcheson in alternate generations for nearly 14 cycles, followed by 30 continuous generations of reproduction on Hartwig until the Female Index (FI) was nearly 100%. This population was named LY1. The reaction of the LY1 nematode population on indicator lines is included in table (1).

Ten plants from each $F_{2:5}$ family and indicator lines were grown in the greenhouse using an established method (Arelli et al., 2000) for determining resistant progenies (Table 2). DNA was harvested using Whatman FTA® cards (GE Healthcare), and resistance for these lines was confirmed using marker assisted selection (MAS). Three SSR markers: Satt592, Satt331, and Sat_274, on Linkage Group 'O' have confirmed resistance with a combined efficacy of 90% (Figure 1).

Table 1. Virulent nematode (LY1) Female Indices and reactions for indicator lines.

Soybean Line	FI %	Reaction
PI 548402 (Peking)	83.0	Susceptible
PI 88788	45.0	S
PI90763	92.0	S
PI 437654	260.0	S
PI 209332	172.0	S
PI 89772	55.0	S
PI 548316 (Cloud)	130.0	S
PI 548658 (cv. Lee 74)	100.0	S

Table 2. Virulent nematode (LY1) Female Index means and ranges for JTN-5109 and parental lines

Soybean Line	FI % Mean	FI % Range
PI 567516C (R)	7.0	0.0 - 11.0
cv. Hartwig (S)	152.0	84.0 - 220.0
JTN-5109	5.3	2.6 - 8.0

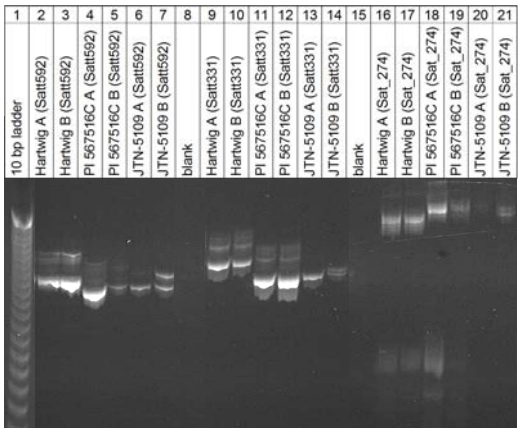

Figure 1. This acrylamide gel photo shows the reaction of JTN-5109 and parental lines Hartwig and PI 567516C to the SSR markers identified on Linkage Group 'O'. Note that the second sample of JTN-5109 produces a double band, but that overall the reaction of JTN-5109 is consistent with the resistant parent, PI 567156C.

RESULTS & DISCUSSION

Agronomically desirable plants from line J01-074 were selected in 2003 and sub-selections were made in 2005. After resistance was confirmed, JTN-5109 was developed from this material in 2008. In our evaluations, most resistant families were agronomically undesirable for seed coat color, plant type, and lodging. Further selections have not eliminated, but reduced these undesirable traits. JTN-5109 is a maturity group V soybean with purple flowers and grey pubescence. Seeds are slightly greenish in color and plant height is approximately 31 inches. In 2008 evaluations, yield was 26 bushels/acre (1,747 kilograms/hectare) compared to 29 bushels/ acre (1,949 kilograms/hectare) for cv. 5601T. One hundred seed weight was 8.4 grams and seed quality was 2 on a scale of 1-5.

Soybean line PI 567516C is the only known source of resistance to the virulent nematode population (LY1) which infects PI 437654 and its derived cultivars including Hartwig. Hartwig is the only known soybean with broad resistance available to several nematode populations. We have developed JTN-5109 with more comprehensive resistance to the LY1 virulent nematode population in a Hartwig background. This germplasm should be useful to soybean breeders as a valuable source material for breeding assistant cultivars in different maturity groups.

ACKNOWLEDGEMENTS

This work was supported, in part, by the Monsanto Company and Tennessee Soybean Promotion Board. The authors thank Lisa Fritz and Dana Pekarchick for their efforts.

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