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1) Cyst nematode screening methods, indexes and their uses.

The threat of the soybean cyst nematode, *Heterodera glycines* Ichinohe, to soybean in the North Central States of the United States is continuing and will likely increase in severity with time. Southern states have dealt with this pest for a number of years and states with large acreages have designed screening methods to detect and test for nematode resistance.

This report describes the screening method used at the Northeast Research and Extension Center, Keiser, Arkansas. There have been no cyst nematodes detected at Keiser (NEREC) and, because of this, it was decided by the cooperative team members not to screen for cyst nematode on soybean lines, bulks and other material at Keiser. We, therefore, have been sending our material to Arkansas State University at Jonesboro, AR, and to the University of Arkansas at Fayetteville, AR, for screening purposes.

At Jonesboro, personnel have collected soil from the "hottest" areas available with which to screen soybeans. Soil has been collected from an area in Missouri and other areas that are reported to contain a mixture of races 3, 4 and "5". Race "5" has been reported to infect 'Bedford', a maturity group V cultivar with resistance to races 3 and 4 of cyst nematode. At Jonesboro, no direct attempt has been made to screen for specific races using specific soybean cultivars or Plant Introductions (PIs) to separate the cyst nematode races.

At Fayetteville, Dr. Riggs has developed a technique, over a number of years, to separate and screen soybean breeding material for the specific races of cyst nematode. The Fayetteville program tests soybean material against 'Lee' cultivar - the susceptible commercial check, 'Pickett' cultivar - an older cultivar resistant to race 3, 'Peking', Bedford, PI 88788, PI 90763J and PI 90763R. Cyst counts taken from the roots of Lee cultivar are taken as 100% susceptible and the average counts taken from the tester lines (i.e., Pickett, Bedford, Peking, PI 88788, PI 90763J and PI 90763R) and the soybean material to be screened are divided by the average counts from Lee cultivar to obtain a susceptibility index relative to Lee, a standard soybean type in the southern U.S.

At Jonesboro, six frequency classes have been established (0, 1, 2, 3, 4, 5) for visual screening of each tested pot of soybean. 0 class represents no cysts present on the root ball, class 1 = 1 to 5 cysts present, class 2 = 6 to 10 cysts read, class 3 = 11 to 20 cysts read, class 4 = 21 to 30 cysts observed and class 5 = 31 or more cysts present on the root ball.

We have taken the Fayetteville Lee cultivar race-specific susceptibility indexes and the Jonesboro field screening class observation and combined them to give a rather complete picture of the susceptibility or resistance (or tolerance) of each line or bulk screened. A plant breeder, by using these procedures, can detect resistance or susceptibility to specific races and to field populations of cyst nematode that threaten soybean producers in commercial soybean growing areas. We have included appropriate checks after each 20 or 30 entries and do not identify the entries until the screening procedures have been completed. Computer assistance would speed the computation

of the Jonesboro data to obtain the "resistance index." If raw data were keypunched into a programmed system for the indexes, the operation would be greatly enhanced.

An example of specific data is given in Table 1 using Bedford and experimental lines to demonstrate how the indexes are obtained. By subtracting the Fayetteville indexes from 100, a "resistance index" would be obtained rather than a "Lee susceptibility index."

By using the above procedures, researchers may obtain data that will lead to new approaches for solving the mechanism of resistance of such lines as PI 90763, PI 88788 and Peking. The resistance is likely to be a combination of biochemical and biophysical factors and will have to be bred into soybean. If the resistance mechanism is purely biochemical, a compound might be synthesized to give "field resistance" and breeders could concentrate on yield factors. However, the resistance complex probably will involve both chemical and physical structures of the root not yet defined.

Possible current uses of the combination of the specific race screen and the "field screen" include the following:

- 1) Reselection within Bedford to obtain higher resistance levels than that currently obtained and possibly reducing the amount of black seed and "bleeding hilas" now found in Bedford.
- 2) Achieve more thorough resistance levels to known races of cyst (1) and to the "hottest," newest, most damaging populations present within specific field areas (2).
- 3) Compare efficacy of "race screening" versus "field screening" methods and to compare both methods to the "petri dish" technique currently in use. Our concern with the "petri dish" technique would be whether or not the infection at days 3 to 10 in the petri dish would simulate the actual infection ontogeny that occurs in the field. That is, do "petri dish" techniques represent, accurately, when economic infection levels occur in the field and, if not, why not?
- 4) Race changes can be observed, particularly from the field soil used for the "field resistance" screen and reselection for new specific races would then be appropriate.
- 5) Detection of the effect of the "Arkansas rotation" recommendations on specific races can be monitored easily and, if changes seem appropriate in either the host soybean alleles for resistance or the crop rotation recommendations, they could be done.
- 6) New research opportunities will appear when plant pathologists/nematologists and plant breeders are involved in a team effort required by this type of program. Biological control of the *Heterodera* spp. and other control methodologies will be forthcoming but require a monitoring program as described above.
- 7) Improved explanation of the genetics of nematode resistance should be facilitated since better control of "field" populations and individual races would be available.

Table 1. Soybean cyst nematode data obtained from Fayetteville and Jonesboro, AR, screening locations

Fayetteville - (race-specific screen)

Entry No.	Race 3 replications					Ave.	Susceptibility Index	Race 4 replications					Ave.	Susceptibility Index
	1	2	3	4	5			1	2	3	4	5		
1 (Lee)	200	460	480	208	320	334	100.0	320	1280	960	720	1080	1072	100.0
2 (Bedford)	1	6	10	13	10	8	2.4	40	60	200	280	--	145	13.5
3	15	4	12	20	38	18	5.4	200	72	144	168	124	142	13.2
4	5	24	160	8	8	41	12.3	144	132	100	84	104	113	10.5
5	22	4	2	0	200	46	13.8	120	92	172	104	128	123	11.5

Jonesboro - (Field resistance screen)

Entry No.	Surviving plant number	Susceptibility class					Infection class "points" assigned					(A)	(B)	(C)	Resistance index 100-(C)		
		0	1	2	3	4	5	0	1	2	3	4	5	Possible 100% infection*		Total actual points	Potential infection index - % (B)÷(A)x100
		1 (Lee)	N/A <sup>a</sup>	--	--	--	--	--	--	--	--	--	--	--		--	--
2 (Bedford)	8	1	4	3	0	0	0	0	4	6	0	0	0	40	10	25	75
3	4	0	0	4	0	0	0	0	0	8	0	0	0	20	8	40	60
4	2	0	0	2	0	0	0	0	0	4	0	0	0	10	4	40	60
5	10	0	0	7	3	0	0	0	0	14	9	0	0	50	23	46	54

\*Plant number x 5 (worst infection level).

<sup>a</sup>N/A = Not applicable.

