

# NC-42 and NC-43: Root-Knot Nematode-Resistant Cucumber Germplasm

S. Alan Walters<sup>1</sup> and Todd C. Wehner<sup>2</sup>

Department of Horticultural Science, North Carolina State University, Raleigh, NC 27695-7609

Kenneth R. Barker<sup>2</sup>

Department of Plant Pathology, North Carolina State University, Raleigh, NC 27695-7616

*Additional index words.* *Cucumis sativus*, disease resistance, cucurbit, *Meloidogyne arenaria*, *Meloidogyne javanica*, vegetable breeding

Root knot caused by *Meloidogyne* spp. is a serious disease of cucumber (*Cucumis sativus* L.) in the southeastern United States. In North Carolina, root-knot nematodes destroy =11% of the cucumber crop annually (St. Amand and Wehner, 1991). Since *M. arenaria* (Neal) Chitwood and *M. javanica* (Treb) Chitwood are often associated with cucumbers grown in this region (Alabama Agr. Expt. Sta., 1960), genetic resistance is an important breeding objective. In our breeding program for nematode resistance, we consider a selection resistant if it has a gall index rating (0% to 100% of roots galled) consistently below 15%, 10 weeks after being inoculated with root-knot nematodes. Walters et al. (1993) identified resistance in cucumber germplasm to several root-knot nematodes, and we are now releasing two inbreds resistant to root knot: NC-42 and NC-43. Two other cultigens, 'Mincu' and PI 215589, have also been identified as resistant and are included as comparisons for this germplasm release (Table 1). 'Mincu' is one of the parents of NC-43 (Fig. 1), and PI 215589 is similar to NC-42 in that it is an accession of *C. sativus* var. *hardwickii* (R.) Alef. (Table 1).

NC-42 is a selection of *C. sativus* var. *hardwickii* accession LJ 90430 (from the U.S. Dept. of Agriculture program formerly located in La Jolla, Calif.). It has a high level of resistance to four important root-knot nematodes: *M. arenaria* races 1 and 2, *M. javanica*, and *M. hapla* Chitwood (Table 1). Data will not be presented for *M. hapla* since all cultigens tested so far were resistant (Walters et al., 1990). NC-43 is a selection of *C. sativus* var.

*sativus* 'Southern Pickler', and is resistant to *M. arenaria* race 2 (Table 1). The resistance based on gall indices in NC-43 to *M. arenaria* race 2 is moderate and, thus, not as good as the resistance in NC-42. However, NC-43 has a more acceptable fruit type than does NC-42, which has few horticulturally useful traits.

Nematode reproduction factor (RF) (Wehner et al., 1992) was used to verify resistance in the two germplasm releases. RF is a method to measure resistance and is calculated as final nematode density/initial nematode density. An RF value >1 indicates that the infected plant is a good host for the nematode, whereas an RF value <1 indicates that the plant is a poor host. NC-42 had RF values of 0 for the four root-knot nematodes, and NC-43 had an RF value of 0 for *M. arenaria* race 2 (Table 1). RF values can differ on cucumber cultigens that have similar gall indices, as is evident on the susceptible cultigens infected with *M. javanica* (Table 1). This difference can occur for several reasons, including the effects of larger root systems and root necrosis. Large root systems have more galls than smaller root

systems while having similar gall index ratings. Root necrosis is caused by secondary pathogens entering roots through areas opened by nematodes. Those pathogens destroy root tissue, which results in reduced nematode reproduction (Walters et al., 1992).

NC-42 and NC-43 are the first cucumber inbreds to be released with root-knot nematode resistance, and are available to plant breeders interested in resistance to *M. arenaria* or *M. javanica*. NC-42 should be used only to develop resistant cultivars, but NC-43 could be used directly by growers willing to accept its limitations in fruit yield and quality. NC-43 is not significantly different from 'Wisconsin SMR-18' for *M. arenaria* race 2 resistance based on gall indices, but based on RF, NC-43 is resistant and 'Wisconsin SMR-18' is susceptible (Table 1). The data from the germplasm test clearly show the advantage of NC-43 over 'Wisconsin SMR-18' and 'Sumter' (Table 1).

## Origin

NC-42 was produced by selection followed by self pollination starting with the original bulk of LJ 90430 for five generations to obtain an inbred line with high resistance to *M. javanica* and *M. arenaria* race 1 and 2. LJ 90403 is a selection from PI 183967, an accession of *C. sativus* var. *hardwickii* (Fig. 1).

NC-43 was produced by selection followed by self-pollination starting with a bulk of available seed sources of 'Southern Pickler' for six generations to obtain an inbred line with high resistance to *M. arenaria* race 2. 'Southern Pickler' resulted from the cross of 'Producer' × 'Ohio MR 17' and has 'Mincu' in its background as the source of resistance (Fig. 1).

The two releases are inbred lines with stable expression of root-knot nematode resistance. Plants within each inbred do not vary more than a few percentage points for root gall index.

Table 1. Resistance of cucumber cultigens to root-knot nematode (*Meloidogyne arenaria* races 1 and 2 and *M. javanica*).

Cultigen	Nematode species							
	<i>M. arenaria</i> r1		<i>M. arenaria</i> r2			<i>M. javanica</i>		
	Gi <sup>z</sup>	RF <sup>z</sup>	Gi <sup>z</sup>	RF <sup>z</sup>	GTGi <sup>y</sup>	Gi <sup>z</sup>	RF <sup>z</sup>	GTGi <sup>y</sup>
NC-42 <sup>x</sup>	11	0	8	0	11	10	0	8
NC-43	33	3	13	0	23	30	6	63
Mincu	31	5	14	0	18	41	3	63
PI 215589 <sup>x</sup>	23	6	17	0	---	46	19	---
Sumter	43	10	33	2	57	48	25	58
Wis. SMR 18	29	13	23	2	51	40	33	65
Mean	28	6	18	1	48	36	14	60
LSD ( $P \leq 0.05$ )	11	10	12	1	12	16	27	9

<sup>z</sup>The experiment was performed once and was set up as a split plot in a randomized complete-block design with four replications. Plants were rated for resistance using the gall index system (Gi = 0 to 100 % of roots galled) and reproduction factor (RF) 12 weeks after planting or 10 weeks after inoculation. Reproduction factor (RF) = (Final nematode density)/(Initial nematode density) and calculated as final number of eggs in roots/5000 (number of eggs inoculated/pot).

<sup>y</sup>GTGi = Germplasm test gall index rating (from Walters et al., 1993). Data from this test were single plant means of five replications.

<sup>x</sup>*C. sativus* var. *hardwickii*.

Received for publication 18 Jan. 1996. Accepted for publication 22 July 1996. The use of trade names in this publication does not imply endorsement by the North Carolina Agricultural Research Service of the products named, nor criticism of similar ones not mentioned. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

<sup>1</sup>Graduate Assistant.

<sup>2</sup>Professor.

