Alternatives to Temik 15G for Management of Root-knot Nematodes

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Introduction: Root-knot nematodes infest at least 40% of the cotton acreage in the Southern High Plains. Prior to 2011, many cotton producers used Temik 15G (aldicarb) to manage nematode problems. Alternative methods of nematode control include: nematicide seed treatments (Aeris, Avicta), fumigation (Telone II, Vapam), crop rotation (peanut), and using partially resistant cultivars (Deltapine 174RF, Phytogen (PHY) 367WRF, Stoneville (ST) 4288B2F, and ST 5458B2F). A test was initiated in 2011 to examine the chemical and varietal components of nematode control at two sites, and was funded by the Plains Cotton Improvement Program. This project was continued in 2012 at four sites, and funded by the Texas Cotton State Support Committee.

Chemical treatments in all tests are:

1) None (no insecticide or nematicides)
2) Cruiser (insecticide only)
3) Avicta Complete Cotton (insecticide, nematicide, and extra fungicide protection)
4) Cruiser on seed, plus Vydate CLV (insecticide/nematicide) at the 4-5 leaf stage
5) Avicta Complete Cotton on seed, plus Vydate CLV
6) Temik 15G at 5 lbs/acre in the furrow at planting
7) Cruiser on seed and fumigation with Telone II (3 gal/acre) before planting.

Varieties in the test include Fibermax (FM) 9160B2F as a susceptible variety at all sites; PHY 367WRF as a partially resistant variety at Whiteface and Brownfield; and ST 5458B2F as a partially resistant variety at Brownfield, Lamesa, and Seminole.

All sites were planted with four row plots, 33-36 feet long, with a factorial arrangement of all treatments, in a randomized complete block design with six replications. Data collected included plant stand, galls/root at 35 days after planting, root-knot nematode density in August, and yield.

Results:

Lamesa (LAM12): The root-knot nematode pressure was low at this site early in the season, with an average of 1.7 galls for FM 9160B2F and 1.2 galls/root for ST 5458B2F (Table 1). There was no chemical effect on galls/root (Table 2), root-knot nematode density (Table 3), yield (Table 4), or net value (yield x loan value – chemical and variety costs) (Table 5). Buildup of the nematode population during the season was good, with an average of 9,446 root-knot/500 cm^3 soil for FM

9180B2F and 3,883 root-knot/500 cm^3 soil for ST 5458B2F (Table 1). The partially resistant ST 5458B2F yielded more (1,302 lbs of lint/acre) than FM 9160B2F (1,262 lbs of lint/acre, Table 1). However, the net value was higher for FM 9160B2F ($713/acre) than for ST 5458B2F ($687/acre) in 2012 (Table 1). The average values for all variety/chemical combinations for galls/root, root-knot nematode density, yield and net value for Lamesa are in Table 6.

Table 1. Effect of variety[1] on root galling, root-knot nematode (RK) density, lint yield, and value ($)/acre (lint yield x loan value) for six locations[2].

	Galls		RK/500 cm^3 soil		Lint yield		Yield x loan ($/a)	
Location	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**
WF11	5.2 a[3]	4.0 a	9,538 a	1,090 b	1,115 b	1,241 a	1,026 b	1,131 a
WF12	1.4 a	0.3 b	4,418 a	615 b	700 b	742[4] a	381 b	401 a[1]
SEM11	13.3 a	10.0 b	23,777 a	8,147 b	804 b	1,002 a	721 b	865 a
SEM12	1.2 a	0.5 b	10,690 a	2,291 b	1,096 a	1,093 a	544 a	543 a
LAM12	1.7 a	1.2 b[4]	9,447 a	3,883 b	1,262 b	1,302 a[5]	713 a	687 b
BF12	7.0 a	3.3 c	14,295 a	6,851 b	556 b	606 a	284 b	308 a
		5.0 b		8,354 b		578 ab		278 b
Average	**5.3**	**3.5**	**12,351**	**4,462**	**870**	**938**	**565**	**602**

[1]The susceptible (S) variety was Fibermax 9160B2F. The partially resistant (R) variety was either (Stoneville 5458B2F or Phytogen 367WRF). At the BF12 site, both partially resistant varieties were tested, with PHY 367WRF as the top entry and ST 5458B2F as the bottom entry.
[2]There were two locations in 2011 (WF11= Whiteface 2011 and SEM11 = Seminole 2011), and four locations in 2012 (WF12, SEM12, LAM12 (Lamesa, 2012), and BF12 (Brownfield 2012).
[3]Different letters indicate significant differences between varieties within a location, at $P = 0.05$, unless otherwise indicated.
[4]$P \leq 0.054$.
[5]$P = 0.077$.

Table 2. Effect of nematicides on root galling at approximately 35 days after planting at six locations[2] tested in 2011 or 2012.

Chemical[1]	WF11	WF12	SEM11	SEM12	LAM12	BF12	Average
None	4.6 a[3]	0.7 a	13.8 a	1.6 a	1.9 a	5.5 a	4.7
Insecticide (I)	1.8 a	1.5 a	12.8 a	0.3 a	0.9 a	5.7 a	3.8
NST[1]	5.5 a	0.5 a	11.6 a	1.1 a	1.4 a	5.2 a	4.2
I + Vydate (V)	1.2 a	1.2 a	13.2 a	0.5 a	1.6 a	3.8 a	3.6
NST + V	4.7 a	0.6 a	13.1 a	1.0 a	1.6 a	4.4 a	4.2
Temik 15G	7.1 a	0.7 a	6.1 b	0.2 a	1.6 a	5.5 a	3.5
I + Telone II	4.2 a	0.6 a	5.3 b	0.8 a	1.2 a	5.4 a	2.9

[1]Insecticide was Cruiser, NST was Avicta Complete Cotton, which was a nematicide seed treatment (Avicta 500) that also included an insecticide (Cruiser) and fungicide combination (Dynasty). Vydate CLV (17 oz/acre) was included as an over-the-top banded nematicide at the 4-5 leaf stage. Temik 15G (aldicarb) was applied at 5 lbs/acre in the furrow at planting. Telone II (3 gal/a) was applied in the bed before planting (number of days varied with location) at a depth of 12 inches and then seed was treated with Cruiser to provide insect protection.
[2]There were two locations in 2011 (WF11= Whiteface 2011 and SEM11 = Seminole 2011), and four locations in 2012 (WF12, SEM12, LAM12 (Lamesa, 2012), and BF12 (Brownfield 2012).

[3]Different letters indicate significant differences between varieties within a column at $P = 0.05$.

Table 3. Effect of nematicides on root-knot nematode density/500 cm^3 soil in August at six locations[2] tested in 2011 or 2012.

Chemical[1]	WF11	WF12	SEM11	SEM12	LAM12	BF12	Average
None	10,390 a[3]	2,320 a	17,835 a	4,278 a	4,112 a	11,740 a	8,446
Insecticide (I)	5,240 a	3,510 a	12,315 a	3,932 a	8,035 a	14,200 a	7,872
NST	4,190 a	1,270 a	21,330 a	3,928 a	3,960 a	8,339 a	7,170
I + Vydate (V)	150 b	2,660 a	16,095 a	7,009 a	4,437 a	6,349 a	6,117
NST + V	6,480 a	2,930 a	18,240 a	11,300 a	10,703 a	8,052 a	9,618
Temik 15G	5,350 a	3,967 a	14,670 a	8,033 a	10,325 a	7,343 a	8,281
I + Telone II	5,280 a	960 a	11,700 a	6,952 a	5,083 a	12,810 a	7,131

[1]Insecticide was Cruiser, NST was Avicta Complete Cotton, which was a nematicide seed treatment (Avicta 500) that also included an insecticide (Cruiser) and fungicide combination (Dynasty). Vydate CLV (17 oz/acre) was included as an over-the-top banded nematicide at the 4-5 leaf stage. Temik 15G (aldicarb) was applied at 5 lbs/acre in the furrow at planting. Telone II (3 gal/a) was applied in the bed before planting (number of days varied with location) at a depth of 12 inches and then seed was treated with Cruiser to provide insect protection.
[2]There were two locations in 2011 (WF11= Whiteface 2011 and SEM11 = Seminole 2011), and four locations in 2012 (WF12, SEM12, LAM12 (Lamesa, 2012), and BF12 (Brownfield 2012).
[3]Different letters indicate significant differences between varieties within a column at $P = 0.05$.

Table 4. Effect of nematicides on lint yield (lbs/a) at six locations[2] tested in 2011 or 2012.

Chemical[1]	WF11	WF12	SEM11	SEM12	LAM12	BF12	Average
None	1,158 a[3]	726 a	857 a	1,126 a	1,229 a	598 a	949
Insecticide (I)	1,136 a	716 a	888 a	1,137 a	1,254 a	544 a	946
NST	1,201 a	736 a	850 a	1,101 a	1,285 a	579 a	959
I + Vydate (V)	1,214 a	735 a	981 a	997 a	1,299 a	558 a	964
NST + V	1,131 a	719 a	926 a	1,120 a	1,329 a	604 a	972
Temik 15G	1,123 a	674 a	886 a	1,078 a	1,266 a	588 a	936
I + Telone II	1,285 a	741 a	934 a	1,099 a	1,314 a	592 a	994

[1]Insecticide was Cruiser, NST was Avicta Complete Cotton, which was a nematicide seed treatment (Avicta 500) that also included an insecticide (Cruiser) and fungicide combination (Dynasty). Vydate CLV (17 oz/acre) was included as an over-the-top banded nematicide at the 4-5 leaf stage. Temik 15G (aldicarb) was applied at 5 lbs/acre in the furrow at planting. Telone II (3 gal/a) was applied in the bed before planting (number of days varied with location) at a depth of 12 inches and then seed was treated with Cruiser to provide insect protection.
[2]There were two locations in 2011 (WF11= Whiteface 2011 and SEM11 = Seminole 2011), and four locations in 2012 (WF12, SEM12, LAM12 (Lamesa, 2012), and BF12 (Brownfield 2012).
[3]Different letters indicate significant differences between varieties within a column at $P = 0.05$.

Table 5. Effect of nematicides on net value[1] ($/acre) at six locations[2] tested in 2011 or 2012.

Chemical[3]	WF11	WF12	SEM11	SEM12	LAM12	BF12	Average
None	1,059 a[4]	320 a	664 b	485 a	596 a	226 a	558
Insecticide (I)	1,031 a	306 ab	709 ab	482 a	602 a	205 ab	556
NST[1]	1,082 a	309 ab	638 b	457 ab	611 a	199 b	549
I + Vydate (V)	1,097 a	311 ab	783 a	407 bc	622 a	185 b	568
NST + V	1,013 a	295 ab	705 ab	460 ab	629 a	203 ab	551
Temik 15G	1,010 a	274 b	661 b	444 ab	599 a	197 b	531
I + Telone II	1,093 a	245 c	643 b	389 c	561 a	130 c	510

[1]Net value is the (yield (lbs of lint/acre) x loan value) – variety cost ($74.35/acre) – chemical cost. Chemical costs for Cruiser was $8.10/acre, Avicta Complete Cotton was $16.20/acre, Cruiser + Vydate CLV = $13.65/acre, Avicta Complete Cotton + Vydate CLV = $21.75/acre, Temik 15G = $17.50/acre, and Cruiser + Telone II = $82.80/acre.
[2]There were two locations in 2011 (WF11= Whiteface 2011 and SEM11 = Seminole 2011), and four locations in 2012 (WF12, SEM12, LAM12 (Lamesa, 2012), and BF12 (Brownfield 2012).
[3]Insecticide was Cruiser, NST was Avicta Complete Cotton, which was a nematicide seed treatment (Avicta 500) that also included an insecticide (Cruiser) and fungicide combination (Dynasty). Vydate CLV (17 oz/acre) was included as an over-the-top banded nematicide at the 4-5 leaf stage. Temik 15G (aldicarb) was applied at 5 lbs/acre in the furrow at planting. Telone II (3 gal/a) was applied in the bed before planting (number of days varied with location) at a depth of 12 inches and then seed was treated with Cruiser to provide insect protection.
[4]Different letters indicate significant differences between varieties within a column at $P = 0.05$.

Table 6. Measured variables at Lamesa in 2012 for each combination of chemical treatment and variety (Average of six replications).

Variety[1]	Chemical[4]	Plants /ft. row	Galls/ root	RK[2]/ 500 cc soil	Lbs of lint/acre	Net value[3] ($/acre)
FM	None	1.79	2.1	4,760	1,187	601
FM	Insecticide (I)	1.45	1.1	7,070	1,211	641
FM	NST	2.16	1.3	5,020	1,296	622
FM	I+Vydate (V)	1.89	1.7	6,827	1,293	632
FM	NST+Vydate	2.25	2.2	18,980	1,289	608
FM	Temik 15G	2.22	2.4	14,430	1,240	588
FM	I+Telone II	2.13	1.2	9,040	1,320	596
ST	None	2.09	1.7	3,463	1,270	603
ST	Insecticide (I)	1.96	0.7	9,000	1,298	581
ST	NST	2.15	1.6	2,900	1,273	642
ST	I+Vydate (V)	2.48	1.6	2,047	1,306	626
ST	NST+Vydate	2.36	1.0	2,427	1,368	590
ST	Temik 15G	2.32	0.8	6,220	1,293	533
ST	I+Telone II	2.23	1.2	1,127	1,309	596

[1]FM is Fibermax 9160B2F, ST is Stoneville 5458B2F.
[2]RK is root-knot nematode.
[3]Net value is the (yield (lbs of lint/acre) x loan value) – variety cost ($74.35/acre) – chemical cost. Chemical costs for Cruiser was $8.10/acre, Avicta Complete Cotton was $16.20/acre,

Cruiser + Vydate CLV = $13.65/acre, Avicta Complete Cotton + Vydate CLV = $21.75/acre, Temik 15G = $17.50/acre, and Cruiser + Telone II = $82.80/acre.
[4]Insecticide was Cruiser, NST was Avicta Complete Cotton, which was a nematicide seed treatment (Avicta 500) that also included an insecticide (Cruiser) and fungicide combination (Dynasty). Vydate CLV (17 oz/acre) was included as an over-the-top banded nematicide at the 4-5 leaf stage. Temik 15G (aldicarb) was applied at 5 lbs/acre in the furrow at planting. Telone II (3 gal/a) was applied in the bed before planting (number of days varied with location) at a depth of 12 inches and then seed was treated with Cruiser to provide insect protection.

Whiteface 2012 (WF12): The root-knot nematode pressure was low at this site this year, as seen with the low gall ratings (Table 1). There was a variety response to all measured variables, with the susceptible variety having more galls/root and higher density of root-knot nematode than the partially resistant PHY 367WRF (Table 1). PHY 367WRF had higher yield and better net value than the susceptible FM 9160B2F (Table 1). Chemical treatments did not affect root galls (Table 2), root-knot nematode density (Table 3), or lint yield (Table 4). However, the most profitable treatment was the nontreated check, while the fumigation treatment had the lowest net value and Temik 15G had the second lowest net value (Table 5). All variety/treatment combinations are presented in Table 7.

Table 7. Measured variables at Whiteface in 2012 for each combination of chemical treatment and variety (average of six replications).

Variety[1]	Chemical[4]	Plants /ft. row	Galls/ root	RK[2]/ 500 cc Soil	Lbs of Lint/acre	Net value[3] ($/acre)
FM	None	2.4	1.1	4,533	708	311
FM	Insecticide (I)	2.5	2.7	6,680	668	281
FM	NST	2.2	0.7	1,420	698	290
FM	I+Vydate (V)	2.4	2.1	5,120	710	299
FM	NST+Vydate	2.4	1.0	5,120	717	294
FM	Temik 15G	2.4	1.1	6,293	681	279
FM	I+Telone II	2.6	1.0	1,760	716	233
PHY	None	2.7	0.4	107	744	329
PHY	Insecticide (I)	2.5	0.4	340	764	331
PHY	NST	2.6	0.3	1,120	774	329
PHY	I+Vydate (V)	2.6	0.3	200	760	324
PHY	NST+Vydate	2.5	0.3	740	722	295
PHY	Temik 15G	2.7	0.4	1,640	668	270
PHY	I+Telone II	2.4	0.3	160	765	258

[1]FM is Fibermax 9160B2F, PHY is Phytogen 367WRF.
[2]RK is root-knot nematode.
[3]Net value is the (yield (lbs of lint/acre) x loan value) – variety cost ($74.35/acre for FM or $76.54 for PHY) – chemical cost. Chemical costs for Cruiser was $8.10/acre, Avicta Complete Cotton was $16.20/acre, Cruiser + Vydate CLV = $13.65/acre, Avicta Complete Cotton + Vydate CLV = $21.75/acre, Temik 15G = $17.50/acre, and Cruiser + Telone II = $82.80/acre.
[4]Insecticide was Cruiser, NST was Avicta Complete Cotton, which was a nematicide seed treatment (Avicta 500) that also included an insecticide (Cruiser) and fungicide combination

(Dynasty). Vydate CLV (17 oz/acre) was included as an over-the-top banded nematicide at the 4-5 leaf stage. Temik 15G (aldicarb) was applied at 5 lbs/acre in the furrow at planting. Telone II (3 gal/a) was applied in the bed before planting (number of days varied with location) at a depth of 12 inches and then seed was treated with Cruiser to provide insect protection.

Seminole (SEM12): Root-knot nematode pressure was light early in the season at this site, based on early season gall ratings (Table 1), but did build up adequately over the course of the season. Galls/root and root-knot nematode density was affected by variety (Table 1), where the susceptible variety had higher numbers than the partially resistant ST 5458B2F. Yield and net value (yield x loan value) was similar between both varieties (Table 1). Chemical treatment did not affect galls/root, root-knot nematode density, or yield (Tables 2-4). However, net value was highest for the non-nematicide treatments (untreated check and Cruiser seed treatment) and lowest for plots treated with Temik 15G or Telone II (Table 5). The individual variety/treatment combinations are presented in Table 8.

Table 8. Measured variables at Seminole in 2012 for each combination of chemical treatment and variety (average of six replications).

Variety[1]	Chemical[4]	Plants /ft. row	Galls/ root	RK[2]/ 500 cc soil	Lbs of Lint/acre	Net value[3] ($/acre)
FM	None	2.8	2.8	4,840	1,158	500
FM	Insecticide (I)	2.9	0.3	6,500	1,167	496
FM	NST	3.0	1.1	5,260	1,099	455
FM	I+Vydate (V)	2.8	0.7	12,720	977	397
FM	NST+Vydate	2.9	1.6	20,240	1,070	435
FM	Temik 15G	3.1	0.3	13,890	1,141	474
FM	I+Telone II	2.9	1.2	11,377	1,058	368
ST	None	2.9	0.4	3,717	1,094	470
ST	Insecticide (I)	2.9	0.4	1,363	1,108	469
ST	NST	3.2	1.1	2,597	1,103	458
ST	I+Vydate (V)	3.1	0.4	1,298	1,017	418
ST	NST+Vydate	3.0	0.5	2,360	1,170	486
ST	Temik 15G	3.1	0.2	2,177	1,015	413
ST	I+Telone II	2.8	0.4	2,527	1,140	410

[1]FM is Fibermax 9160B2F, ST is Stoneville 5458B2F.
[2]RK is root-knot nematode.
[3]Net value is the (yield (lbs of lint/acre) x loan value) – variety cost ($74.35/acre) – chemical cost. Chemical costs for Cruiser was $8.10/acre, Avicta Complete Cotton was $16.20/acre, Cruiser + Vydate CLV = $13.65/acre, Avicta Complete Cotton + Vydate CLV = $21.75/acre, Temik 15G = $17.50/acre, and Cruiser + Telone II = $82.80/acre.
[4]Insecticide was Cruiser, NST was Avicta Complete Cotton, which was a nematicide seed treatment (Avicta 500) that also included an insecticide (Cruiser) and fungicide combination (Dynasty). Vydate CLV (17 oz/acre) was included as an over-the-top banded nematicide at the 4-5 leaf stage. Temik 15G (aldicarb) was applied at 5 lbs/acre in the furrow at planting. Telone II (3 gal/a) was applied in the bed before planting (number of days varied with location) at a depth of 12 inches and then seed was treated with Cruiser to provide insect protection.

Brownfield (BF12): Root-knot nematode early season populations were not quite as low at Brownfield as at the other three sites in 2012, but they still were not as high as desirable to show response of nematicides treatments. Most variables measured were affected by variety (galls, root-knot nematode density, yield, and net value, Table 1). Chemical treatment did not affect galls (Table 2), root-knot nematode density (Table 3), or yield (Table 4). However, there was an interaction between variety and chemical treatment with respect to net value (Table 9). In all three varieties, net value was poorer for Telone II than most other treatments, due to the small yield response to this product and high cost of the product. Other differences were inconsistent between varieties. For example the seed treatment Cruiser plus Vydate was among the best treatments with FM 9160B2F, but was one of the poorer treatments for PHY 367WRF (Table 9).

Table 9. Measured variables at Seminole in 2012 for each combination of chemical treatment and variety (average of six replications).

Variety[1]	Chemical[4]	Plants /ft. row	Galls/ root	RK[2]/ 500 cc Soil	Lbs of Lint/acre	Net value[3] ($/acre)
FM	None	2.3	8.6	17,940	582	234 a[5]
FM	Insecticide (I)	2.2	7.8	23,700	486	181 bc
FM	NST	2.2	6.3	10,540	520	181 bc
FM	I+Vydate (V)	2.1	5.5	8,080	578	200 ab
FM	NST+Vydate	2.0	6.4	14,653	555	165 bc
FM	Temik 15G	2.3	8.2	8,590	572	197 ab
FM	I+Telone II	2.2	6.1	16,560	601	151 c
PHY	None	2.1	4.9	8,220	621	239 a
PHY	Insecticide (I)	2.3	4.1	4,500	568	222 a
PHY	NST	2.0	3.0	4,970	617	210 ab
PHY	I+Vydate (V)	1.8	2.6	3,167	549	177 b
PHY	NST+Vydate	2.0	2.7	4,783	644	228 a
PHY	Temik 15G	2.1	2.6	8,140	622	223 a
PHY	I+Telone II	2.0	3.3	14,180	624	158 c
ST	None	2.7	3.1	9,060	591	204 a
ST	Insecticide (I)	2.6	5.3	14,400	577	213 a
ST	NST	2.5	6.2	9,507	600	206 a
ST	I+Vydate (V)	1.9	3.2	7,800	548	176 a
ST	NST+Vydate	3.0	4.2	4,720	613	215 a
ST	Temik 15G	2.7	5.8	5,300	569	171 a
ST	I+Telone II	2.0	6.9	7,690	550	80 b

[1]FM is Fibermax 9160B2F, PHY is Phytogen 367WRF, ST is Stoneville 5458B2F.
[2]RK is root-knot nematode.
[3]Net value is the (yield (lbs of lint/acre) x loan value) – variety cost ($74.35/acre) – chemical cost. Chemical costs for Cruiser was $8.10/acre, Avicta Complete Cotton was $16.20/acre, Cruiser + Vydate CLV = $13.65/acre, Avicta Complete Cotton + Vydate CLV = $21.75/acre, Temik 15G = $17.50/acre, and Cruiser + Telone II = $82.80/acre.

[4]Insecticide was Cruiser, NST was Avicta Complete Cotton, which was a nematicide seed treatment (Avicta 500) that also included an insecticide (Cruiser) and fungicide combination (Dynasty). Vydate CLV (17 oz/acre) was included as an over-the-top banded nematicide at the 4-5 leaf stage. Temik 15G (aldicarb) was applied at 5 lbs/acre in the furrow at planting. Telone II (3 gal/a) was applied in the bed before planting (number of days varied with location) at a depth of 12 inches and then seed was treated with Cruiser to provide insect protection.
[5]Different letters indicate significantly different net values, within a variety (P=0.05).

Summary for 2012

Variety performance was weaker in 2012 than in 2011, which was probably due to much lower root-knot nematode populations early in the growing season. Partially resistant cultivars usually had higher yields in 2012 than the susceptible FM 9160B2F though not in every case. In 2011 the yield advantage of the partially resistant varieties to root-knot nematode was much higher than the susceptible variety. However, in 2012, the partially resistant variety had a higher yield in 3 of 4 sites, and similar yield in one site as the susceptible variety. In 2011, the partially resistant variety returned approximately $124/acre more than the susceptible variety (based yield x loan value). In a very weak nematode year (2012), the partially resistant variety returned approximately $4/acre more than the susceptible variety.

In general, chemical performance was poor to none in 2012, so the "best" treatment was to use no chemical control of nematodes or thrips. Fumigation with Telone II did not provide for much of a yield boost, and had a very high cost ($82.80/acre for fumigation plus Cruiser treated seed). This resulted in a lower net return than all other treatments, consistently. Probably with the low nematode pressure, fumigation would not have been cost effective, but also there have been problems in getting optimal application of fumigation. This product should go out in moist, but not wet soil, and the soil should not receive irrigation or rain for at least 48 hrs after application. We have made the applications either in dry soil (before prewatering), or in wet soil during the prewatering phase, so this treatment probably hasn't gotten a fair test. The other chemical treatments were applied adequately. Vydate CLV was a fairly consistent treatment in 2011, but did not look effective in 2012, though it may have been that early season nematode pressure was too low for Vydate CLV to act on anything. The only treatment that is "season-long" is resistant variety, and they were effective as seen with the significant reductions in galls/root and root-knot nematode density in August at all sites.