UTILIZING AG-CARES
TO ENHANCE COTTON PRODUCTION AND PROFITABILITY
FOR THE TEXAS SOUTHERN HIGH PLAINS

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Wayne Keeling, Randy Boman, Terry Wheeler, James P. Bordovsky,
Kevin Bronson, and Megha N. Parajulee

Texas Agricultural Experiment Station
Texas Cooperative Extension
Lubbock, TX

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INTRODUCTION

For Texas High Plains cotton producers to compete in an increasing competitive world market, new technology must be adapted that can improve cotton yields, fiber quality, and maintain profitability. The AG-CARES research validation farm provides a unique opportunity to evaluate precision (site-specific) agriculture, conservation tillage cropping systems, new cotton varieties, and weed, insect and nematode management strategies for reducing production costs. The AG-CARES site is ideally suited to evaluate these technologies in an on-farm setting.

Previous research at AG-CARES has shown large differences in net return per acre due to variety selection, cropping system, and level of irrigation applied. Longer-season "pickers" type varieties have produced higher yields with improved fiber quality over conventional stripper varieties. Increased returns have been produced with a peanut-cotton rotation. Questions arise as to how to best utilize a limited irrigation supply, either to spread irrigation over the entire acreage or to reduce acreage and concentrate water for either higher per acre production or reduced pumping. Three irrigation levels (base, base -25% and base +25%) will be established within these irrigation treatments most promising varieties (Roundup Ready vs. Roundup Ready/Bollgard stacked gene) will be planted. Insect and nematode populations as influenced by irrigation level will be monitored.

Yield and profitability of dryland production as influenced by variety, row pattern (solid vs. skip-row) and plant populations (2, 4, and 6 seeds/ft.) will be determined.

An AG-CARES website will be maintained to timely communicate research results, best management practices, daily and historical weather data, and in-season crop management information to area producers and crop consultants.

The successful partnership that has evolved at the AG-CARES site provides an ideal location to evaluate and demonstrate these new technologies for area producers.

Objectives:

1) Determine effects on whole-farm profitability of factors including variety selection, cropping system, and irrigation system (LEPA, subsurface drip) and levels.
2) Evaluate the interaction of LEPA and subsurface drip irrigation and tillage levels on variety performance, and insect, nematode, and weed management.
3) Compare seeding rates, row pattern, variety selection, to optimize yield and profitability of dryland cotton.
4) Operate an AG-CARES website to communicate research results, best management practices, weather data, and in-season crop management information.

RESULTS AND DISCUSSION

The 2006 growing season was hot and dry, with below average rainfall received from January - August. These conditions resulted in failed dryland plantings (no stand or very limited cotton emergence) across much of the dryland areas of the South High Plains. Dryland trials were abandoned at AG-CARES for this reason.

In-season irrigation began in early June due to lack of May - June rainfall and continued until rain was received in late August. Rains in late August and early September helped finish the irrigated crop but were too late for dryland fields that had achieved a stand.

A wide range of experiments were conducted at AG-CARES in 2006. Results will be presented for variety comparisons as affected by both LEPA and sub-surface drip irrigation and root-knot nematode studies.

Cotton Variety Performance as Affected by Subsurface Drip Irrigation (SDI)

Four Roundup Ready Flex/Bollgard II (B2RF) varieties were grown under two irrigation levels. Irrigation levels were based on maximum pumping capacities of 0.17" and 0.25"/day. These levels totaled 19.8" and 25.3"/A including preplant, stand establishment, and in-season. Cotton was planted May 11 and Caparol was applied preemergence at 1 q/A. Two applications of Roundup WeatherMax POST were made to control weeds. Plots were machine harvested on October 31 and grab samples were collected and ginned to determine lint turnout and fiber quality.

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When averaged across SDI irrigation treatments, lint yields ranged form 1467 to 1661 lbs/A (Table 1). Highest lint yields were produced with DP 143B2RF. When averaged across varieties, high yields were produced with the higher irrigation treatment.

Table 1. Effects of variety and SDI levels on lint yields at AG-CARES, Lamesa, TX, 2006.

Variety	M	H	Avg.
	------------------------lbs lint/A-----------------------------		
ST 4554 B2RF	1465	1857	1661 AB
DP 143 B2RF	1492	1951	1721 A
BCG 4630 B2RF	1404	1774	1589 AB
FM 9063 B2RF	1433	1501	1467 B
	1449 b	1771 a	

When averaged across irrigation treatments, gross revenues ($/A) ranged from $782 to $896/A, with no difference between varieties (Table 2). Gross revenues were increased 22% with the higher irrigation treatments.

Table 2. Effects of variety and SDI levels on gross revenues at AG-CARES, Lamesa, TX, 2006.

Variety	M	H	Avg.
	------------------------lbs lint/A-----------------------------		
ST 4554 B2RF	781	1012	896 A
DP 143 B2RF	769	999	884 A
BCG 4630 B2RF	765	973	869 A
FM 9063 B2RF	776	787	782 A
	773 b	943 a	

This data will be further analyzed by cooperating agricultural economists to evaluate irrigation costs, to define net returns between varieties and irrigation levels.

Cotton Variety Performance as Affected by Low-Energy Precision Application (LEPA)

The same four B2RF varieties planted in the SDI trial were also evaluated under LEPA irrigation. Three irrigation levels were compared with in-season irrigation amounts of 8.0”, 12.6”, and 16.8”/A. Cotton was planted May 1 and harvested October 28. Weeds were controlled with Prowl PPI and two Roundup WeatherMax POST treatments. At harvest, grab samples were collected and ginned to determine lint turnout and fiber quality.

When averaged across the three irrigation treatments, lint yields ranged from 757 to 1001 lbs/A, with the highest yields produced with ST 4554B2RF. (Table 3). When averaged across varieties, yields increased as irrigation levels increased from the low to medium level. The highest irrigation treatments produced similar yields to the medium level treatment.

Table 3. Effects of RRF/BGII variety and LEPA irrigation levels on cotton lint yields at AG-CARES, Lamesa, TX, 2006.

	L	M	H	Avg.
Variety	---lbs lint/A---			
ST 4554 B2RF	654	1234	1115	1001 A
DP 143 B2RF	602	955	936	849 B
BCG 4630 B2RF	556	1074	1072	900 AB
FM 9063 B2RF	544	791	936	757 B
	589 b	1013 a	1028 a	

Gross revenues were calculated by multiplying lint yield x lint loan value. When averaged across LEPA irrigation levels, all four varieties produced similar ($391 - $460) (Table 4) per gross revenues. For all varieties, gross revenues were higher with the medium irrigation treatment compared to the low. The high water treatment did not increase gross revenues compared to the medium irrigation treatment. Further economic analysis will compare returns between SDI and LEPA trials.

Table 4. Effects of RRF/BGII variety and LEPA irrigation levels on gross revenues at AG-CARES, Lamesa, TX, 2006.

	L	M	H	Avg.
Variety	---$/A---			
ST 4554 B2RF	310	577	494	460 A
DP 143 B2RF	290	437	468	398 A
BCG 4630 B2RF	260	535	569	454 A
FM 9063 B2RF	276	424	515	405 A
	284 b	493 a	511 a	

<u>Rook-Knot Nematode Management</u>

There were a number of activities aimed at root-knot nematode management in 2006 including: 1) testing varieties for yield under root-knot nematode stress; 2) screening germplasm from John Gannaway for yield, fiber quality, and nematode reproduction; 3) determine the affect of chemical treatments (infurrow and seed treatments) on yield and nematode reproduction; 4) determine the influence of variety by water by Temik 15G on yield and nematode reproduction; 5) determine the influence of crop rotation (cotton versus peanut or sorghum) and Temik 15G rate on cotton yield, root galling and nematode reproduction; 6) determine the influence of cover crop (none versus wheat, rye, and oats) on cotton yield, root galling, and nematode reproduction; and 7) determine the influence of Temik 15G alternatives (fumigation, infurrow fungicide, and AVICTA complete pack) from the previous year on the next year’s cotton yields, root galling, and nematode reproduction. The last objective is a concern where biodegradation of Temik 15G is occurring.

1) Variety testing: Varieties which had relatively low population densities (i.e. partially resistant to root-knot nematode) in the fall included Phytogen 485WRF, Phytogen 745WRF, and Acala NemX (a partially resistant check). It is important to stress to producers that they want to select varieties that yield well under root-knot nematode pressure, and also do not blow up the population density of the nematode. Partially resistant varieties do not necessarily have to yield better than susceptible varieties, but they will bring a long-term benefit by reducing the nematode population density for the next year's cotton crop.

2) A number of lines which involved crosses between high yielding, root-knot nematode resistant germplasm and germplasm with better fiber properties were selected at AGCARES for high yield, good fiber quality, and little galling on the roots. A total of 158 selections were made. These are currently being screened in the greenhouse for nematode resistance. There have been requests by cotton breeders in commercial seed companies for the root-knot nematode resistant parent material because of its high yield potential combined with high levels of resistance. However, we would prefer to release germplasm that also has good fiber properties. The resistance originally came from the Auburn releases. Dr. Ping from Georgia has developed markers for that resistance, so we are approaching a time when commercial seed companies can use this type of germplasm and marker assisted selection techniques to keep it in their varieties.

3) A large number of small plot experiments were conducted with products from Bayer Crop Sciences, Syngenta, and Dupont, including new formulations of AVICTA complete pack, formulations of Bayer's new seed treatment nematicide Aeris, and Vydate as an over-the-top application after either Temik 15G or AVICTA complete pack is applied at planting. There was also a large-plot test comparing no protection to Temik 15G and AVICTA complete pack. In all cases, none of the products were better than the untreated check. No nematicide was effective at AGCARES in 2006. This is probably due to the extremely hot and dry conditions early in the season.

4) A large plot, variety by water experiment was conducted. Within these large plots, small plots (35.5 ft. long) were treated with Temik 15G (3.5 lbs/acre) or without Temik 15G. The plots were monitored for root-knot nematode population density and yield. Temik 15G did not impact yield or nematode density in 2006. The water treatment alone affected root-knot nematode midseason density. The high and moderate water treatments had more nematode reproduction (10,016 and 8,509 root-knot eggs/500 cm^3 soil) than the low water treatment (2,539 eggs/500 cm^3 soil). This difference might be real, or it might be due to the drier soil being more difficult to sample correctly.

5) A crop rotation study was conducted during 2005 and 2006. In 2005, areas were planted in cotton, peanut, and sorghum, with eight replications per crop area, arranged in a randomized complete block design. Then in 2006, the entire area was planted in cotton, but within each 2005 crop area, 1/3 was treated each with 0, 3.5 or 5 lbs of Temik 15G/acre. The intention was to determine if Temik 15G efficacy could be improved by crop rotation and also identify and differences introduced by the crop rotation to yield and nematode density. The entire area was planted with a wheat cover crop between the 2005 and 2006 season. It appears that we had some reproduction on the cover crop during the winter, because even the area that was in peanut in 2005 had quite a high population of root-knot nematode by midseason of 2006. Typically, peanut will reduce the nematode population by > 90%, and it will take longer than 2 months to build the numbers up again. Temik 15G rate in 2006 had no impact on any measured attributes. Yield was highest for cotton following sorghum (1,052 lbs of lint/acre) compared with cotton following peanut (970 lbs of lint/acre) and cotton following cotton (967 lbs of lint/acre). It was surprising that cotton following sorghum, gave a significant yield boost of 85 lbs of lint/acre, but cotton following peanut did not give a yield boost. Again, the reproduction on the winter cover crop may have offset the benefits of a peanut rotation due to nematode reduction. The yield boost of cotton following sorghum is probably not sufficient to offset the economics of sorghum production the previous year compared with cotton production in 2005. Since, sorghum gave a better response than peanut, even though they both had a wheat cover crop, there may be other factors particular to sorghum that

gave the boost in yield to cotton. The crop rotations did not have a significant affect on galls/root or nematode reproduction at midseason.

6) The effect of different cover crops versus no cover crop was studied in 2005 and 2006. In each year, there were three rates of Temik 15G (0, 3.5 and 5 lbs/acre) applied to each cover crop treatment. The results were quite different between years. In 2005, there was no impact of cover crop (none versus wheat, rye, and oats) on nematode reproduction or yield, however, there were significantly higher yield and lower galls/root where Temik 15G was applied at either 3.5 or 5 lbs/acre compared with the 0 rate. In 2006, the oat cover grew better in reps 1-5 than in reps 6-8. So, reps 1-5 were analyzed separately from reps 6-8. In reps 1-5, there was more reproduction of root-knot nematode at midseason on all the cover crops (ranging from 8,056 to 10,360 root-knot/500 cm^3 soil), compared with the no cover treatments (2,464 root-knot/500 cm^3 soil). In this area, cotton where Temik 15G at 3.5 or 5 lbs/acre was applied, yielded significantly (P=0.07) higher (971 and 973 lbs of lint/acre) than where Temik 15G was not applied (885 lbs of lint/acre). However, in the area where reps 6-8 were (approximately 107 ft. north of reps 1-5), there was no response of Temik 15G to any measured parameter. In this area, cover crops significantly affected yield and nematode reproduction (Table 5). In this case, yield was higher with a poorly formed oat cover or no cover than with a wheat or rye cover. Nematode reproduction and galls/plant were higher for the cotton planted with all cover crops than with no cover. However, nematode samples were only taken in the oat cover crops where there was an oat cover and the areas that had absolutely no oat survival, did not get sampled. Yield, was obtained from all plots (even where the oats failed to survive at all). The galls/root are an excellent indication of early season nematode pressure, and evidence that there was less nematode pressure in the no cover crop (reps 6-8) part of the field. It is likely that the warm weather during the 2006 winter months led to some reproduction where there were cover crops planted and resulted in more nematode pressure at planting in those sections of the field. Since nematicide control was very poor in 2006, the combination of a cover crop and little to no nematode chemical control hit the field with a double whammy. Winter temperatures can possibly be used to predict when the cover is providing a host for root-knot nematode. However, it is unclear whether the prediction of the situation would be sufficient to plow up the cover crop. In most years, a nematicide at planting would offset the extra nematode pressure.

Table 5. Affect of wheat, rye, and a poorly grown oat cover, versus no cover on cotton yield, root-knot nematode midseason population density and galls/root at 35 days after planting.

Cover crop	Lbs of lint/acre	Root-knot nematode per 500 cm^3 soil at midseason	Galls/ root at 35 days
Oat	1,233 a	19,507 a	4.5 ab
None	1,075 ab	2,493 b	0.3 b
Wheat	1,036 b	21,773 a	6.7 a
Rye	918 b	11,080 ab	7.3 a

7) Alternatives to Temik 15G and affect on efficacy of Temik 15G the following year.
This study was conducted to address whether Temik 15G efficacy could be improved by using other chemical nematode control measures in the previous year, or fungicides that may affect microbes in the soil. The treatments in the previous year included Temik 15G at 0, 3.5, and 5 lbs per acre, both in the presence and absence of the infurrow fungicide Abound FL. Other treatments included fumigation with Telone II and the nematicide seed treatment AVICTA complete pack. In 2006, the area where each of the 2005 treatment combinations were applied, was treated with three rates of Temik 15G (0, 3.5 and 5 lbs/acre). Yield, nematode reproduction and galls/plant at 45 days after planting were measured. The yield in 2006 was partially a function of some treatments in 2005. Temik 15G rate in 2006 did not affect yield, but did affect galls/plant (Table 6). The treatments in 2005 did appear to impact yield in 2006, though there was no affect

on nematode reproduction or galls/root in 2006 (Table 7).

Table 6. Impact of Temik 15G rate in 2006 on cotton yield, nematode reproduction and number of galls/plant.

Temik 15G lbs/acre in 2006	Lbs of lint per acre in 2006	Galls/plant at 45 days
0	880	15.7 a
3.5	866	9.7 b
5	842	11.5 b

Table 7. Effect of 2005 treatments on yield, root-knot nematode density at midseason, and galls/root in 2006.

Treatment description applied in 2005	Lbs of lint per acre
Temik 15G = 0	968 a
Temik 15G = 3.5 lbs/a	924 ab
AVICTA complete pack	912 abc
Abound FL + Temik 15G=5 lbs/acre	863 bcd
Abound FL + Temik 15G=3.5 lbs/acre	830 bcd
Telone II (fumigant) at 3 gals/acre	820 cd
Abound FL	807 d
Temik 15G at 5 lbs/acre	782 d

These 2005 treatment affects on yield are very difficult to understand. The biggest question for producers are whether using AVICTA complete pack in one year will allow them better efficacy the following year with Temik 15G. In other words, would rotation of chemistry be of benefit in improving the performance of Temik 15G. There is probably little problem with microbial degradation of AVICTA since it is a new product. Microbial degradation of Temik 15G is not a huge problem in the High Plains, but is probably occurring, especially in some fields with a history of Temik 15G use at high rates (Wheeler, Leser, and Keeling, not published). Since the 2006 rates of Temik 15G were not very effective (due to weather), it is not possible to answer the question of whether rotation of chemistries will improve efficacy of Temik 15G the following year. It is interesting that certain 2005 treatments appeared to yield better across all Temik 15G rates in 2006, but not really relevant to the questions being asked

AG-CARES Website

A website, http://ag-cares.tamu.edu, was created to deliver research results, daily weather data, and crop management information throughout the growing season (Figure 1).

Figure 1. AG-CARES webshot.