Shafter Research and Extension Center

Cotton Field Day

University of California
Shafter Research and Extension Center

17053 North Shafter Avenue
Shafter, CA 93263

Tuesday , September 21, 2004

Sponsored by:

- *University of California Cooperative Extension*

  and

- *USDA Agricultural Research Service*
  Western Integrated Cropping Systems Research Unit

University of California
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WELCOME

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UNIVERSITY OF CALIFORNIA
SHAFTER RESEARCH & EXTENSION CENTER

Cooperating Institutions:
- University of California, Agriculture & Natural Resources
- University of California Cooperative Extension
- University of California, Davis
- United States Department of Agriculture, Agricultural Research Service, Western Integrated Cropping Systems Research Unit
- Kern County Department of Agriculture

The information contained in this booklet was assembled for distribution at the 2004 Cotton Field Day (September 21) at the Shafter Research & Extension Center. The following items are included for your information:

- Summaries of approved 2004 Research Projects, including those featured at the Cotton Field Day. The researcher contact information is included, where available, should you require more information.
- List of all approved Research Projects for 2004 at the Shafter Research & Extension Center, plus the names and phone numbers of the Project Leaders.
- Maps of the field station showing 2004 project locations for both the Main Station and the "South 40".
- A listing of the current members of the Shafter Research & Extension Center Research Advisory Committee (RAC). The RAC meets to discuss station operation, allocation of resources, facility needs, and research priorities. Comments regarding station research activities should be directed to this committee.

ACKNOWLEDGEMENTS
The dedication of the University of California and USDA-ARS staff at the Shafter Research & Extension Center is gratefully acknowledged for all their work on the projects you see both at this station and at off-site locations, and for putting on this Field Day. A special thank you to CA Planting Cotton Seed Distributors (CPCSD) for use of the tour trailers. And finally, we would like to acknowledge our valued sponsors, as this Field Day would not be possible without their ongoing support.

We are also very grateful for the continued financial support of the many cooperators in the Cotton Industry who contribute to the facilities and research support at the Shafter REC, including:

- CA Crop Improvement Association
- University of California, Davis – Agronomy and Range Science Department
- United States Department of Agriculture – Agricultural Research Service
- County of Kern Government Agencies
- University of California, Davis – Entomology Department
- Grower/Cooperators
- PCA's, Advisors & Consultants
- Cotton Incorporated
- CA Department of Food & Agriculture
- Cotton Pest Control Board
- San Joaquin Valley Cotton Board
- CA Cotton Growers & Ginners Associations
- Cotton industry chemical suppliers and support staff
- Representatives of cotton seed companies
- Supima Association

We welcome you to the Shafter Research & Extension Center and thank you for attending the Cotton Field Day. If we can provide you with additional information about on-going projects or activities here at the Research Center, please feel free to contact us.

Bob Hutmacher
Extension Agronomist
Shafter REC/UC Davis

Brian Marsh
UCCE Farm Advisor
Shafter REC Director

Michael McGuire
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USDA-ARS, Shafter REC

Shafter Research and Extension Center

AG futures

SUMMER INTERNSHIP PROGRAM 2004

Theme Statement

The annual Ag Futures Conference introduces outstanding high school students, who have an agricultural background and interest, to current research and educational activities being conducted by the University of California.

The conference goal is to expand the awareness and improve the student's understanding of the exciting world of the agricultural and environmental sciences. Our hope is to encourage these students to seriously consider the wide variety of career opportunities developing in today's agriculture and to permit the college or university of their choice to assist them in achieving their goals.

The **Ag Futures Conference** is held annually at the Shafter and Desert Research and Extension Centers.

The University of California Agricultural Futures Summer Intern program provides high school students the opportunity to study with researchers from the U.C. Division of Agriculture and Natural Resources and USDA - ARS. The eight-week program is designed as an intensive educational experience for high school juniors and seniors interested in the agricultural and biological sciences. Interns will actively participate in on-going research, and gain valuable knowledge through the scientific investigation process. A faculty member will mentor the intern and provide the guidance and instruction necessary for the student to perform his/her research.

Sarah Walker from Highland High School was the 2004 Ag futures intern. Dr. Michael McGuire served as her mentor.

Funding for the Shafter Research and Extension Center 2004 Ag Futures Internship Program was provided by The Exchange Club of Stockdale

Disclaimer: Discussion of research findings necessitates using trade names. This does not constitute product endorsement, nor does it suggest products not listed would not be suitable for use. Some research results included involve use of chemicals which are currently registered for use, or may involve use which would be considered out of label. These results are reported but are not a recommendation from the University of California for use. Consult the label and use it as the basis of all recommendations.

Lygus Dispersal within Fields and Migration between Fields

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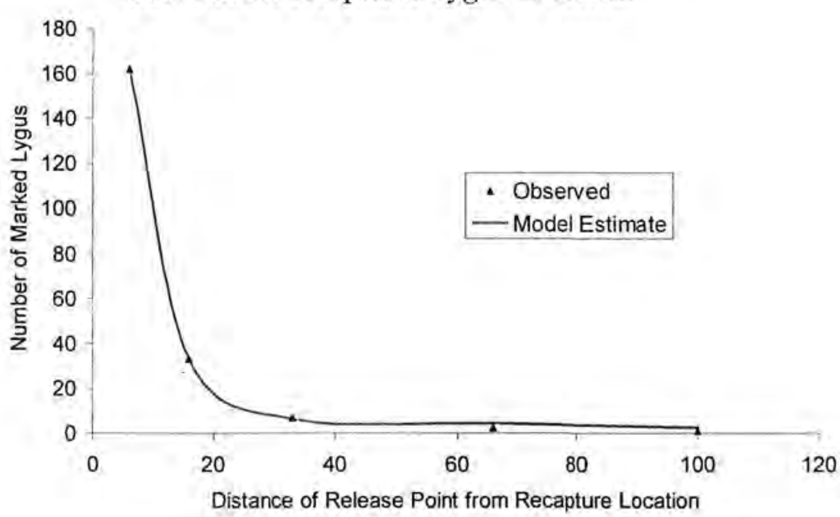
Lygus bugs play a pivotal role in cotton pest management. They cause direct damage to bolls, and their control with broad spectrum pesticides disrupts natural enemies and induces outbreaks of secondary pests. Cotton pests and their natural enemies move within cotton fields and migrate between the field and adjacent areas. Quantitative knowledge of the movement of *Lygus* bugs is lacking in the field. Understanding of the dispersal and host finding behavior of these pests and their natural enemies is needed for density predictions and reliable IPM. The accurate measurement of pest and natural enemy density depends on understanding their spatial distribution. This work can help pest management by characterizing between and within field movement of *Lygus*. This will also be important for the selection and conservation of *Lygus* parasitoids.

This study measured movement of western tarnished plant bug. Mark-recapture studies have measured of movement of *Lygus* bugs moving within cotton fields and between alfalfa and cotton. Simulation models of dispersal have also been constructed that can quantify the effect of plant condition and weather on observed dispersal patterns. The experiments provide a valuable link between pest management practices and the migratory behavior of *Lygus*. Mark-recapture experiments are an effective way to acquire data that may show density, mortality and dispersal in field situations. Generally, a trapping web (see figure) was used to sample insects dispersing from a central release point.

About 17,400 *Lygus* were released and 371 marked bugs were recaptured. The figure below shows an example of an analysis that was used for *Lygus* recaptures in cotton. The preliminary analysis has produced several conclusions.
(1) In mid-season cotton, *Lygus* move about 20 feet per day.
(2) The average lifespan of 13 days was used to predict a lifetime displacement of 1170 feet.
(3) In alfalfa, *Lygus* did not move as much, with predicted lifetime movement around 911 feet.
(4) *Lygus* preference for alfalfa over cotton was clear. Marked and released *Lygus* were recaptured in alfalfa at 10 times the rate in cotton.
(5) The proportion of *Lygus* moving long distance was about 10% greater in cotton, suggesting transient migration through cotton.

Curve fit for recaptured *Lygus* in cotton.



UCCE Approved Acala and Pima Variety Trials

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Cooperators: Ron Vargas, Tome Martin-Duvall (UCCE-Madera and Merced Counties); Steve Wright, Gerardo Banuelos (UCCE-Tulare County); Bruce Roberts (UCCE-Kings County); Dan Munk, Jon Wroble (UCCE-Fresno County); Brian Marsh (UCCE-Shafter REC and Kern County); Mark Keeley, Raul Delgado (Shafter REC)

The objectives of these studies with Acala and Pima varieties are to evaluate approved Acala varieties and Pima varieties submitted for testing under different environmental conditions and management across the San Joaquin Valley region of California. In order to provide a reasonable limit on the number of varieties in the tests, the entries include newly-approved varieties (approved by the San Joaquin Valley Cotton Board) for the current year, varieties released last year that are in their second year of testing, plus the top 4 or 5 previously-approved varieties (in terms of planted acreage). The new varieties are the focus of tests, but only remain in tests for a minimum of two years following release unless that variety moves into the top 4 or 5 varieties in planted acreage. Released varieties also may not show up in tests if companies request that the variety is for a special market and don't want it in multiple location testing, or when seed supplies are inadequate. The Pima tests focus on approved varieties, but in the past two years have also included a non-approved hybrid that has been of interest due to yield performance.

Objectives were to evaluate varieties in terms of growth characteristics, yield performance, and HVI lint quality under different environmental conditions and management. We are limited as to type of measurements that can be made within these trials based upon funding available to run the trials. Yield and HVI data are collected in replicated plots of all trials and locations, while plant growth data focuses on mapping data from a more limited number of locations and timings. Pima variety trials are supported largely from general research funds of UCCE Specialists and Farm Advisors, and in part through grants from the Supima Association. Approved Acala trials are conducted with joint funding from Cotton Incorporated State Support Committee and participating seed companies, plus support from the University of CA. These projects give growers a continuously-updated comparison of newly-available varieties versus varieties which have been available for one or more years. These trials continue to be conducted at a wide range of field sites due to repeated commitments and participation of UCCE Farm Advisors. We feel that grower confidence in utility of these tests is improved with the large number of test locations and we hope to continue as willing growers, UCCE personnel and funds allow in the future.

Approach for 2004. Two test locations at University Research Centers (UCCE Shafter and West Side) were used in both Acala and Pima variety trials, plus grower field locations at 4 added fields (Pima) and 6 additional sites (Acala trials). Large-scale Acala trial test sites are on grower fields in Kern, Kings, Tulare, Fresno, Madera and Merced counties. The large-scale Pima test locations are in Kern, Fresno and Merced County. Approved Acala and Pima varieties included in 2004 trials are shown in Table 1.

Table 1. Entries in 2004 Pima variety trials and Approved Acala variety trials

Type	Seed Company	Varieties	Type	Seed Company	Varieties
Acala	CPCSD	Maxxa, Riata RR, Sierra RR Ultima, Summit, Ultima EF	Pima	Public variety	S-7
	Phytogen	Phy-72, Phy-78		Phytogen	Phy-76
	Delta Pine	DP-6207, DP-6100 RR		Delta Pine	DP-744, DP-HTO, DP-340
	United Ag Prod	OA-265 BR		Olvey & Assoc	OA-353
CA Uplands for comparison (DP-444 BR & FM-960B2R) - (Shafter and West Side sites only) – only in Acala trials				Hazera	HA-195 (hybrid)

Lint yield and fiber quality summaries or newsletter articles can be downloaded from the UC Cotton web site: http://cottoninfo.ucdavis.edu. In addition, fiber quality data summaries covering prior years of trials on the more recently available CA Upland varieties can also be accessed on this web site. Basic summaries of yield information from Pima and Acala trials of UC and San Joaquin Valley Cotton Board trials operated by Dr. Shane Ball of the University of CA can also be accessed at this web site.

Table 2. **PIMA VARIETY TRIALS (Farm Advisor & Specialist Trials) - 2003.** Lint yields (in lbs/acre) by test location and average gin turnout across all locations. Average lint yields across all sites are expressed as pounds of lint per acre and as percent of yield average for variety "S-7" (the SJV Cotton Board Approved Pima "standard"). Average yields across locations shown in bold italics and underlined are from SJV Cotton Board tests in years prior to 2003 (Dr. Shane Ball, UC-Shafter REC, Coordinator).

Seed Company	**Variety**	**Lint Yields at Specific Test Plot Locations** *(in lbs / acre)* *Row spacings also shown*						**Average Lint Yield** *(lbs / acre)*	**Average Gin Turnout** *(%)*	**Average Lint Yields by Year of Trial** *(as a % of variety "S-7" yields)*					
		40" rows **Shafter REC**	*40" rows* **West Side REC**	*38" rows* **Kern Co.**	*38" rows* **Kings Co.**	*30" rows* **Fresno Co.**	*30" rows* **Merced Co.**			1998	1999	2000	2001	2002	2003
Public variety	**S-7**	1093	1324	876	1276	1103	1098	**1128**	**31.2**	100	100	100	100	100	**100**
Phytogen Seed Co.	**Phy-76**	1206	1335	1054	1375	1067	1232	**1212**	**30.6**	***97***	***99***	***98***	102	121	**107**
Delta & Pine Land	**DP-744**	1116	1381	1024	1568	1039	1013	**1190**	**31.8**	***110***	92	110	104	116	**105**
Delta & Pine Land	**DP-340**	1239	1478	907	1489	1143	1075	**1222**	**31.7**	***107***	***111***	***104***	106	114	**108**
Delta & Pine Land	**DP-HTO**	1018	1417	901	1354	1049	1070	**1135**	**33.4**	102	95	104	96	100	**101**
Hazera Seed Co.	**HA-195**	1791	1851	1502	1525	1262	1927	**1643**	**32.0**	-*	-*	-*	***170***	***159***	**146**
Mean		1244	1464	1044	1431	1111	1236	**1255**	**31.8**						
LSD 0.05		97	151	58	106	137	59	54	0.4						
C.V.(%)		5.2	6.8	3.7	4.9	8.2	3.2	7.0	2.2						
P		0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000						

Acknowledgements. The efforts of UC Cooperative Extension and County staff, UC Shafter and West Side REC in operating these trials out of the individual county Cooperative Extension offices is gratelfully acknowledged. Partial financial support in running these trials was received from the University of CA Cooperative Extension, University of CA at Davis, participating seed companies, Cotton Incorporated State Support Committee (Acala trials), and Supima Association (Pima trials). We are grateful for this support. Our thanks is extended to the many grower cooperators who generously put up with numerous extra requests and work , all to help provide this information to their fellow growers.

Table 3. **APPROVED ACALA VARIETY TRIALS – 2003.** Lint yields, gin turnouts, statistical analyses in 2003 Acala Approved Variety Trials (9 Approved Acala entries at 8 locations). For comparison purposes, CA Upland varieties Delta and Pine Land Co. "DP-5415 RR" and Bayer Fibermax "FM-989 BR" were also included in the Shafter and West Side REC trial locations.

Seed Company	Variety	**Lint Yields at Specific Test Plot Locations**—*row spacings as shown*								**Average Lint Yield**		Average Gin Turnout
		40" rows **Shafter REC** *(lbs/ac)*	*40" rows* **West Side REC** *(lbs/ac)*	*40" Rows* **Kern County** *(lbs/ac)*	*40" Rows* **Kings County** *(lbs/ac)*	*30" Rows* **Tulare County** *(lbs/ac)*	*40" Rows* **Fresno County** *(lbs/ac)*	*30" Rows* **Madera County** *(lbs/ac)*	*30" Rows* **Merced County** *(lbs/ac)*	**Across all Sites** *(lbs/ac)*	**As % of variety Maxxa**	*(%)*
CPCSD	**Maxxa**	1357	991	1522	1222	1258	1188	1303	1654	1312	100	33.9
Phytogen	**Phy-72**	1781	1362	1648	1463	1456	1484	1394	1863	1556	119	32.7
CPCSD	**Riata RR**	1583	1190	1547	1339	1422	1319	1431	1744	1447	110	34.5
CPCSD	**Ultima**	1572	994	1511	1275	1282	1155	1312	1669	1346	103	35.1
Delta and Pine Land	**DP-6207**	1517	1188	1519	1330	1280	1487	1365	1702	1424	109	32.9
Delta and Pine Land	**DP-6100 RR**	1491	1089	1372	1226	1130	1312	1150	1516	1286	98	31.4
Phytogen	**Phy-78**	1609	1662	1513	1423	1478	1675	1378	1849	1573	120	32.3
CPCSD	**Summit**	1339	1107	1603	1266	1322	1178	1366	1632	1352	103	34.7
CPCSD	**Sierra RR**	1571	1313	1513	1319	1291	1386	1351	1696	1430	109	34.0
Mean		**1536** (above Acalas only)	**1211** (above Acalas Only)	**1528**	**1318**	**1324**	**1354**	**1339**	**1703**	**1414** (above Acalas only)	108	**33.5**
Bayer Fibermax	**FM-989 BR**	1444	966	-	-	-	-	-	-	1205* (only 2 sites)	103* (only 2 sites)	34.3*
Delta and Pine Land Co.	**DP-5415 RR**	1603	1320	-	-	-	-	-	-	1462* (only 2 sites)	126* (only 2 sites)	34.5*
LSD 0.05 0.05		138	126	82	46	69	123	79	89	32		0.3
C.V. (%)		6.2	7.3	3.7	2.4	3.6	6.2	4.0	3.6	4.4		1.5
Probability (P)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000

* data from these varieties not included in over-location averages or statistics

Control of *Lygus hesperus* with *Beauveria bassiana*

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Project Cooperator: Neal Hudson, same address; 661-746-8008. Nhudson@pw.ars.usda.gov

Justification and Problem Statement

Lygus hesperus continues to be one of the most damaging pests of cotton in the San Joaquin Valley. *L. lineolaris*, a closely related species is quickly becoming the primary pest of cotton in the Southeast US. Current controls consist of the application of broad spectrum pesticides that may also impact natural enemies. The depletion of natural enemies may lead to increases of other pests such as aphids, whiteflies and spider mites later in the season. A control that is selective for Lygus would be a benefit to the cotton industry. Both Lygus species are infected, in nature, by a fungus called *Beauveria bassiana*. *B. bassiana* occurs worldwide, and is used commercially. Tests in our laboratory and in published reports suggest that the commercial products are not very effective against either Lygus species (Noma and Stickler 2000; Steinkraus and Tugwell 1997). Surveys for *B. bassiana* done in 2000-2002 revealed widespread prevalence of the fungus (McGuire 2002). *B. bassiana* was found in all SJV counties at all times of the year. Fungal isolates have been cultured and laboratory tests demonstrate a large variation in activity against Lygus and ability of the fungus to grow at high temperatures. Parallel work in Mississippi has revealed similarities and fungal strains will be exchanged to determine which strains have activity against both species.

Objectives:

1) Determine activity of *B. bassiana* isolates against *L. hesperus* under field conditions.
2) Determine effects of formulation and application timing of *B. bassiana* on Lygus populations.
3) Determine impact of application of *B. bassiana* to Lygus populations in alfalfa on subsequent infestation of surrounding cotton fields.
4) Determine impact of application of *B. bassiana* to Lygus populations in cotton (third year).

Procedure:

Year 1: Two new isolates of *B. bassiana* will be tested against a commercial *B. bassiana* product (Mycotrol) and a chemical pesticide. Replicated plots will be established in alfalfa where Lygus populations are consistently high. Plots will be approximately 50' long by 75' wide and each treatment will be replicated 4 times. At SREC, there are two alfalfa fields each with four 75' wide checks. These fields are strip cut such that two checks are cut every two weeks. Therefore, the experiment will have to be set up in both fields, using two checks in each. Each check will be divided up into 5 plots and used as a block. Lygus populations will be estimated before spraying in each block using standard 50-sweep samples. Applications of pesticides will be made using standard techniques. Lygus populations will be estimated at 4, 7, 10, and 14 days after application using a 10 sweep sample in the middle of each plot. In addition, samples of 50 adults and 50 nymphs will be collected from each plot to estimate infection levels. To ensure *B. bassiana* infections are due to sprayed strains, not endemic strains, molecular markers will be used to identify the infections. This work is currently in progress and a specific PCR SCAR marker has already been identified for Mycotrol (Castrillo et al. 2003). In addition to Lygus, other insects will be enumerated and infections determined. This test will be repeated using the other checks in both fields. To determine if *B. bassiana* is replicating in the field, samples will be taken at 30 and 60 days after application.

Year 2: Based on results from Year 1, a single *B. bassiana* strain will be selected and extensively tested. Replicated plots will be established in alfalfa as in year one and sampling will be similar. Tests will involve different rates of spores and different formulations. Currently the commercial product suggests the use of 10^{12} spores per acre. Treatments of the new strain will include 10^{12}, 10^{11} and 10^{10} spores per acre. In addition, formulations of *B. bassiana* constructed in coordination with ARS scientists in Mississippi and Illinois, will be tested. Formulation is an essential factor in persistence and infectivity of any insect pathogen and must be tested under field conditions. In an alfalfa field separate from the rate tests, up to three new formulations will be tested at a single spore rate.

Year 3: Treatment of Lygus in alfalfa may lead to reductions of migrating populations but it is important to determine two things. First, does application of *B. bassiana* against Lygus in alfalfa impact movement of lygus into cotton and do infected individuals move as readily as uninfected individuals? Second, will *B. bassiana* be effective in controlling Lygus populations if applied to cotton? To test the first hypothesis, alfalfa plots that border cotton will established. Plots will be established based on the area available and a single high dose of *B. bassiana* will be sprayed. Transects from alfalfa into cotton will be established and Lygus will be collected at 5 points along the transect at 20 feet intervals. Prevalence of infection will be determined as in Year 1 and Lygus populations will be estimated with 10-sweep samples in between the transects to determine movement of the insects. Applications will be made approximately 21 days after alfalfa cutting. Samples will be taken along the transects 7 and 14 days after application. 8 days after application, the alfalfa will be harvested to force Lygus into moving. To test the second question, replicated plots will be established in cotton. Treatments will consist of the single *B. bassiana* strain and a chemical control. Sampling will be done at 4, 7, 10, 14 days after application as above and will include estimates of natural enemies in addition to Lygus. Prevalence of infection will be determined as above.

Previous Work and Present Outlook

The use of *B. bassiana* to control insects has been the subject of many investigations that have led to commercial products. In the early 1990's, extensive work including some at SREC was conducted to determine if *B. bassiana* could control whiteflies in cotton. With the advent of the neonicitinoids, this work was halted. However, work with *B. bassiana* against Lygus continued in Arkansas (Steinkraus and Tugwell 1997), Idaho (Noma and Strickler 1999, 2000, and Vermont (Liu et al 2002, 2003). In all situations, the commercial product seemed to be effective under laboratory conditions but failed to control Lygus in the field. However, a strain of *B. bassiana* isolated from *L. lineolaris* (Steinkraus and Tugwell 1997) did a pretty good job of controlling *L. lineolaris* in the field suggesting that isolates of the fungus collected from the host in its habitat may be more effective than other strains. Similarly Liu et al. (2002) demonstrated significant pathogenicity differences among *B. bassiana* isolates against *L. lineolaris.* During 2001 and 2002 surveys of California *L. hesperus* populations revealed the presence of relatively high numbers of *B. bassiana* infected individuals (McGuire et al. 2001, McGuire 2002). In some samples, more than half the collected bugs were infected but, typically, less than 10% of the population was affected. These data suggest that *B. bassiana* may play an important role in nature in regulating *L. hesperus* populations but, more importantly, the fungus may be used to proactively control the population before economic damage occurs. The fact that any *B. bassiana* was discovered under the hot dry conditions of the SJV is surprising and the strains have yielded interesting and important differences from most known strains of the fungus. Work in our laboratory and in the Stoneville facility has produced evidence to suggest the new strains recently isolated from California *L. hesperus* populations and Mississippi *L. lineolaris* populations may be better adapted to the target pest than the commercial strain. Some assays revealed 100 fold higher activity against *L. hesperus* than the commercial strain. In addition, local strains could grow at temperatures as high as 35°C whereas the commercial strain did not grow at temperatures above 32° C. These laboratory assays only go so far to determine potential of the new strains as effective mycoinsecticides and field testing is a necessity.

CALIFORNIA UPLAND COTTON
ADVANCED STRAINS VARIETY TRIALS

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Variety trial yield and fiber quality results are the focus of these trials conducted at both Shafter and West Side Research and Extension Centers. As the yield and fiber quality data for the current year does not become available until well after the field day, a listing is provided of both the entries included in the 2004 field trials as well as a data summary of the 2003 efforts (provided as an example of ongoing data collected in this trial).

2004 Activities – at Shafter and West Side REC sites. This testing program was downsized to small plot trials at UC Shafter and UC West Side Research and Extension Centers beginning in 2002 in response to both reduced grower interest in alternatives to Approved Acalas and inadequate funding to continue large grower field trial activities conducted from 1998 through 2001. The project investigators are appreciative for the participation by seed companies and the UC Research Centers in providing support for ongoing testing of non-Acala Uplands. The actual varieties included in 2004 trials are shown in Table 1, but yield and lint quality data will not be available on 2004 studies until December 2004. Summary results will be posted on our UC cotton web site: http://cottoninfo.ucdavis.edu and in January 2005 issue of the *California Cotton Review* newsletter.

Table 1. Entries in 2004 CA Upland Advanced Strains trials at UC Shafter and West Side Research and Extension Center sites.

Seed Company or Breeder	Variety or Entry #		Seed Company or Breeder	Variety or Entry #
Phytogen	Phy-72			
Bayer / Fibermax	FM-960B2R		Syntech Seed Comp.	Syn-0651
	FM-966 LL			Syn-2226
	FM-958 LL			Syn-2534
	FM-960 RR			Syn-7184
Stoneville / Emergent	ST-5454 B2R			
	ST-4575 BR		USDA-ARS lines (Ulloa and Percy)	03MU-1023
	ST-4686 RR			03MU-1034
	ST-6636 BR			03MU-1050
	ST-6848 RR			03MU-1052
	ST-5242 BR			03MU-1301
Olvey and Associates	OA-85			03MU-1304
				03MU-1306
Delta & Pine Land Co.	DP-444 BR			03MU-1332
	DP-555 BR			03MU-1414
	DP-494 RR			03MU-1424
	DP-434 RR			03MU-1430
	DP-432 RR			03MU-1089-6

* NOTE: Acala variety included for comparison purposes (Phy-72 is not a CA Upland variety)

2003 Activities. Two variety trials (small-scale plot studies) were done on CA Upland cotton varieties in the San Joaquin Valley, and results (yield, HVI quality) are covered in reports available at the previously mentioned website. Data shown here will only cover the "Advanced Strains" CA Upland trials from 2003, with these trials conducted only at the West Side and Shafter REC locations. The tests do not overlap those underway in other SJVCB or UCCE variety trials.

Table 2. Lint quality characteristics of 2 Acala varieties (Phytogen "Phy-72"and CPCSD "SIERRA") and 21 CA Upland varieties in **University of CA Specialist "CA Upland Advanced Strains" variety trial (SHAFTER REC site) in 2003**. **Values shown are averages across 4 field replications at the University of CA Shafter REC in 2003.** All analyses were run on seedcotton collected during field harvests with commercial spindle pickers in 4 field replications per variety at each site. Six pound samples were then run through the Shafter REC research gin, and HVI analyses of lint samples were conducted at the USDA classing office in Visalia, CA.

Seed Company or Breeder	Variety	Micro-naire	Length (in.)	Strength (g/T)	Unif. Index (UI)	Manual Classing Leaf Grade	HVI Trash	Color RD	Color + B
Phytogen	**Phy-72 (Acala comparison)**	4.03	1.22	32.7	84.0	2.0	0.20	80.3	9.35
CPCSD	**Sierra (Acala comparison)**	3.50	1.15	32.2	82.8	2.8	0.25	81.8	9.00
Bayer / Fibermax	**FM-960 BR**	3.55	1.12	32.6	82.0	2.3	0.18	83.5	8.28
Bayer / Fibermax	**FM-989 BR**	3.55	1.16	31.8	82.8	2.3	0.23	82.8	8.25
Bayer / Fibermax	**FM-989 RR**	3.35	1.14	34.1	83.0	2.0	0.20	82.8	8.78
Bayer / Fibermax	**FM-991 RR**	3.85	1.17	32.3	82.8	2.0	0.15	82.8	8.40
Stoneville	**STX-0202 B2R**	3.48	1.14	29.0	81.8	3.3	0.35	80.3	9.20
Stoneville	**STX-0203 BR**	3.83	1.12	27.1	83.0	2.3	0.18	82.3	9.18
Stoneville	**STX-0204 BR**	3.55	1.09	27.5	82.3	2.5	0.25	82.0	8.73
Stoneville	**ST-5303 R**	3.90	1.13	31.8	83.0	1.8	0.15	82.3	8.85
Stoneville	**ST-5599 BR**	3.50	1.13	30.7	81.5	2.5	0.23	80.5	9.20
Olvey & Assoc.	**OAX-300 BR**	3.85	1.07	25.9	81.5	1.5	0.10	82.5	9.40
Olvey & Assoc.	**OAX-303**	3.95	1.13	27.8	82.8	2.0	0.13	82.5	8.90
Olvey & Assoc.	**OA-85**	3.93	1.14	29.2	82.3	2.8	0.25	82.0	8.95
Delta & Pine Land	**DPLX-03X177 R**	3.43	1.16	32.6	82.3	3.0	0.25	81.5	8.73
Delta & Pine Land	**DP-444 BR**	3.38	1.13	28.5	82.3	2.5	0.20	82.0	8.83
Delta & Pine Land	**DP-493**	3.68	1.15	30.9	82.0	2.5	0.20	82.5	8.48
Delta & Pine Land	**DP-555 BR**	3.55	1.16	29.5	81.8	2.0	0.18	84.0	8.08
Delta & Pine Land	**DP-5415 RR**	3.73	1.17	30.6	83.0	2.0	0.13	82.8	8.45
CPCSD	**FM-20415-167**	3.65	1.18	32.7	83.0	2.0	0.20	83.3	8.38
CPCSD	**FM-20414-97**	3.33	1.18	33.7	82.3	2.5	0.23	84.0	8.15
CPCSD	**FM-20414-213**	3.25	1.12	31.0	80.8	2.3	0.18	83.5	8.28
CPCSD	**FM-20414-214**	3.85	1.17	32.5	82.8	2.3	0.15	83.3	8.10
Average *(CA Uplands only)*		**3.63**	**1.14**	**30.6**	**82.3**	**2.3**	**0.20**	**82.5**	**8.65**
LSD (0.05)		0.36	0.03	1.2	1.0	0.6	0.08	1.0	0.31
C.V. (%)		7.1	1.6	2.8	0.8	18.9	29.3	0.9	2.5
P		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* NS = not significant: LSD indicates that values separated by the amount shown (or more) are significantly different: C.V. (%) indicates amount of variation in data (higher number = more variable data); P value is indicator of probability of statistical differences.

Table 3. **CALIFORNIA UPLANDS ADVANCED STRAINS (Farm Advisors & Specialist Trials) – 2003.** Lint yields (in lbs/acre and as % of Approved Acala variety "Phytogen-72") by test location and average gin turnout for each variety in *2003 California Upland Advanced Strains Variety (UCCE Cooperators: R. Hutmacher, B. Marsh, M. Keeley, R. Delgado, S. Ball, F. Leal, E. Scott and J. Ross in fields at the UC Shafter & West Side Research & Extension Centers).*

Seed Company Or Breeder	Variety Name or Number	*40" rows* Shafter REC (Kern County) Lint Yields		*40" rows* West Side REC (Fresno Co.) Yields		Average Lint Yields Across 2 Locations		Average Gin Turnout Across Two locations
		(lbs lint per acre)	(as % of Phy-72 Yield)	(lbs lint per acre)	(as % of Phy-72 Yield)	(lbs lint per acre)	(as % of Phy-72 Yield)	(%)
Phytogen	**Phytogen-72** (Acala for comparison)	1487	100.0	1058	100.0	1273	100.0	33.0
CPCSD	**Sierra** (Acala variety for comparison)	1351	90.9	981	92.7	1166	91.6	33.6
Bayer / Fibermax	**FM-960 BR**	1400	94.1	1249	118.1	1325	104.1	33.5
Bayer / Fibermax	**FM-989 BR**	1350	90.8	1025	96.9	1188	93.3	33.1
Bayer / Fibermax	**FM-989 RR**	1295	87.1	922	87.1	1109	87.1	34.0
Bayer / Fibermax	**FM-991 RR**	1338	90.0	783	74.0	1061	83.3	32.5
Stoneville	**STX-0202 B2R**	1245	83.7	1109	104.8	1177	92.5	31.9
Stoneville	**STX-0203 BR**	1600	107.6	1530	144.6	1565	122.9	34.6
Stoneville	**STX-0204 BR**	1443	97.0	1193	112.8	1318	103.5	32.5
Stoneville	**ST-5303 R**	1352	90.9	1221	115.4	1287	101.1	33.9
Stoneville	**ST-5599 BR**	1235	83.1	1406	132.9	1321	103.8	32.7
Olvey & Assoc.	**OAX-300 BR**	1556	104.6	1484*	140.3*	1520*	119.4	34.9 *
Olvey & Assoc.	**OAX-303**	1302	87.6	1179	111.4	1241	97.5	35.4
Olvey & Assoc.	**OA-85**	1541	103.6	1531	144.7	1536	120.7	35.7
Delta & Pine Land Company	**DPLX-03X177 R**	1115	75.0	969	91.6	1042	81.9	34.1
Delta & Pine Land Company	**DP-444 BR**	1374	92.4	1477	139.6	1426	112.0	34.6
Delta & Pine Land Company	**DP-493**	1366	91.9	985	93.1	1176	92.4	34.6
Delta & Pine Land	**DP-555 BR**	1456	97.9	1002	94.7	1229	96.5	35.2
Delta & Pine Land	**DP-5415 RR**	1375	92.5	1020	96.4	1198	94.1	33.6
CPCSD	**FM-20415-167**	1359	91.4	981	92.7	1170	91.9	31.6
CPCSD	**FM-20414-97**	1391	93.5	1095	103.5	1243	97.6	33.3
CPCSD	**FM-20414-213**	1343	90.3	979	92.5	1161	91.2	33.0
CPCSD	**FM-20414-214**	1313	88.3	958	90.5	1136	89.2	33.7
Average		**1373**		**1121**		**1247**		**33.7**
LSD (0.05)		153		144		108		0.6
C.V. (%)		7.9		9.1		8.7		1.9

Management of Root-knot Nematode with novel chemistry

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1. Abstract

Management of cotton root-knot nematode (Meloidogyne incognita) is essential in those areas that produce cotton on sandy to sandy-loam soils. The primary management approach to root-knot nematode involves cultural approaches including crop rotation and use of a resistant variety in Acala production. Chemical approaches are limited but new products are becoming available. These products require evaluation under the controlled conditions that Shafter Research and Extension Center offers.

2. Justification and Problem Statement

Cotton root-knot nematode (Meloidogyne incognita) continues to be key soil pest on SJV cotton. Cotton is most susceptible during the early stages of development when the pest invades the developing root system causing a reduction in tap root and main lateral roots. This damaged root system compromises the plant's ability to take-up water and nutrients leading to reduced yield potential. In recent years, new pest control products have become available. This trial will evaluate novel chemistries or application methods for protecting seedling cotton against root-knot nematode invasion. SREC is an ideal location because of the presence of the pest, soil type, control of production and willingness to accept high levels of damage

3. Previous Work and Present Outlook

Management of cotton root-knot nematode (Meloidogyne incognita) is essential in those areas that produce cotton on sandy to sandy-loam soils. The primary management approach to root-knot nematode involves cultural approaches including crop rotation and use of a resistant variety in Acala production. Crop rotation is a proven approach but is not available to all growers. Some fields develop economically important root-knot populations within a year of returning to cotton. Some growers do not have the ability to rotate out of cotton or are not setup for alfalfa or dry bean production. Pima producers do not have access to resistant varieties and Acala growers are not eager to use a resistant variety that does not have the yield and quality attributes that the current market demands.

Currently registered nematicides include Temik© and Telone© Temik is used at-planting to protect the developing seedling root system. Yield results have been demonstrated under low to moderate populations. At higher populations, the protection is insufficient. Telone II is also registered and is very effective at reducing nematode populations. However, the cost is prohibitive and the allowable useage within a township limit its usefulness.

New products that could be cost effective are becoming available. In 2003, a new product from Syngenta was evaluated at SREC. Cal Agri products has a product that has been evaluated in Louisiana with promising results for nematode control. This trial will evaluate this product and contrast its efficacy against several standards.

4. Objectives:

Contrast alternative nematode control product, Cal Agri 50 , on yield, root damage, and final nematode population to Temik and untreated check.

DOUBLE-ROW COTTON PLANTINGS ON 30 INCH, 40 INCH BEDS: COMPARISONS WITH SINGLE ROW COTTON PLANTINGS

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Project Summary. This project at Shafter REC is part of a multi-location trial that has been conducted for over five years to evaluate the potential of a change in cotton planting configurations on growth, yield potential and quality. The bulk of the field evaluations in years prior to 2002 were done by two main groups: (1) Dr. Bill Weir of UCCE – Farm Advisor Emeritus from Merced County in cooperation with San Juan Ranch and Bowles Farms in western Merced County, and (2) trials conducted by Hutmacher, Keeley and Delgado with cooperation from staff for multiple years at Shafter and West Side REC locations. In 2002 through 2004 we conducted additional trials in other grower fields in different parts of the SJV. Goals were to provide field evaluations across a broad range of soil types and production conditions. Some of the multi-year information will be summarized in an article to be prepared for an issue of the California Cotton Review to be published this winter.

In an attempt to further decrease production costs of cotton, a unique variation of ultra narrow row production was initiated in Merced County in 1998. These efforts have been variously called the "California version of ultra narrow row" or "Double-Row 30 inch cotton". The planting configuration used has been two seed lines of cotton, seven to ten inches apart, on a 30 inch bed. Yield information is available for multiple years of study and will briefly be reviewed here. In looking at the potential for cost savings, it is worthwhile to consider what the crop and weed growth expectations and management principles are with the double-row 30 inch cotton planted at a fairly high population density. The management approach used assumes that with the double-row, high density planting:

- Cotton should more effectively compete with weeds and achieve earlier row closure and shading of beds and furrows than with single-row plantings, resulting in less need for cultivation and perhaps herbicides
- Higher plant densities mean that fewer bolls are required per plant to achieve the same yield, as long as average boll size is not significantly affected

At the sites near Dos Palos represented by the lint yields summarized in Table 1, grower records of expenses and changes in production costs with the single versus double-row 30 inch production methods were carefully recorded. The records indicated that an average of $43.00 per acre was saved using the double-row 30 inch bed configuration in place of the single-row 30 inch configuration. Cost savings in the field studies ranged from about $25.00 to over $70.00 per acre.

Savings Potential versus Increased Costs. Savings were generally found in reduced number of field tractor operations, including fewer cultivations with higher density double-row beds, and fewer openings and closings of irrigation ditches under furrow irrigation at the study sites. With the management approaches used with the double-row 30 inch cotton to date, there does not appear to be any increased costs or additional savings in fertilizer requirements, defoliation or harvesting costs. Additional costs incurred with switching to the double-row system as described here can include costs of additional seed needed for high density planting, initial costs and operating costs for a planter suitable for this configuration, and technology fees (if the grower decides to use a transgenic herbicide tolerant variety). Although data is not conclusive at this point, more applications and higher rates of Mepiquat chloride growth regulator may be useful to help manage growth and earliness of double-row 30 inch cotton and keep defoliation and harvesting problems to a minimum.

Table 1. Average lint yields and percent yield increase with double-row 30 inch planting configuration in replicated grower field studies near Dos Palos, CA from 1998 through 2002.

	Average Lint Yield (lbs/acre) * across all sites for the year in Merced Co. trials		
Year	Single Row 30-Inch Beds	Double Row 30-inch beds	Average Percent Yield Increase in Double-Row
1998	1123	1256	8.4
1999	1300	1475	8.8
2000	1976	2114	7.3
2001	1548	1837	15.7
2002	1849 estimate	1940 (estimate)	4.9

Yields in Other Test Locations – including Shafter REC

More than 1000 acres of double row 30 inch cotton were planted in 2001 through 2003 at various location in the San Joaquin Valley (mostly in the northern San Joaquin Valley) using either a "Monosem" brand planter designed to precisely place seeds in two lines as close as 7 inches apart, or variations on the sled planter used in the earlier years of field trials. Sites have been initiated at several other locations in other areas of the San Joaquin Valley in recent years also to investigate the potential utility of the double-row planting concepts. Two of these locations have been small plot studies done since 1999 at the University of CA West Side and Shafter Research and Extension Centers. The Shafter trials have been single versus double-row 30 inch studies, while those at the West Side site have been single versus double-row 40 inch studies. Yield results from most of these trial sites are shown in Table 2.

Additional Considerations—Double-Row 30 Inch. Many, but not all of the test locations to date have been with herbicide-resistant transgenic cotton (Roundup-Ready). However, the comparison tests done to date with conventional varieties and a more traditional weed management program have shown similar potential for favorable yield responses and some cost savings, so a herbicide-resistant transgenic cotton may be a good choice, but does not appear to be a requirement, for this system. It is important to note that all field trials and Merced County grower fields monitored to date have been harvested using conventional spindle pickers. During the initial year of tests (1998), some double picking was required due to picker adjustment and bed height problems, but otherwise most harvest operations have been single picks. No significant, consistent differences in fiber quality, leaf trash or other quality issues have been identified in HVI analyses conducted to date on single-row 30 versus double-row 30 comparisons in replicated trials or grower fields. Yield improvements at other test sites shown in Table 2 have not always been as consistent as those achieved in the Dos Palos area of Merced County. At the West Side REC site, it should be noted that these were 40 inch single versus double row comparisons, and plant populations in the double row plantings averaged 52,000 (1999), 61,000 (2000) and 53,000 plants per acre (2001), while the Merced County studies averaged over 75,000 plants per acre in double-row plantings. The ability to deal with concerns for retaining adequate soil moisture in the bed edges where seed will be planted should be considered one of the key criteria to factor in when deciding if the double-row 30 inch concept could work out for individual growers and field sites.

Table 2. Average lint yields and percent yield increase with double-row 30 inch planting configuration in other field studies (various locations and years).

	Average Lint Yield (lbs/acre)		
Location	Single Row 30" average	Double Row 30" average	Yield increase (+) or Yield decrease (-) with double row plantings
Merced Co.			
Fld #2 2001	1329	1504	12
Fld #3 2001	1056	1132	7
Other Merced sites shown other table			
Madera Co.			
Fld #1 2001	(4280) *	(4320)	1
Fld #2 2001	(4423) *	(4540)	3
2003	1511	1524	< 1
West Side REC			
1999 (40")	1104	1083	- 2
2000 (40")	1654	1709	3
2001 (40")	1553	1485	- 4
2002 (Riata RR)	1733	1801	4.0
2002 (DP 6100RR)	1633	1668	2.1
2002 (Phy-78)	2085	1951	-6.4
2003	1307**	1368**	5
Shafter REC			
1999	1520	1652	9
2000	1428	1355	- 5
2001	test incomplete due to poor stand		
2002 (Riata RR)	1527	1712	12.1
2002 (DP6100 RR)	997	1073	7.6
2002 (Phy-78)	1913	1991	4.1
2003	1189	1162	- 2
Tulare County			
2002 (one farm site)	1730 **	1825 **	5
2003 (one farm site)	1560 **	1540 **	- 1.5

* yields shown in parentheses are seedcotton yields / ** = estimated yields (analysis not finalized)

2004 Efforts. Tests were again planted for comparison studies in Madera, Merced, Fresno County grower sites plus the sites at the West Side and Shafter REC locations. We worked with Monosem planting equipment as well as growers in trying to get additional field sites for replicated comparisons of single versus double-row 30 inch cotton in multiple sites from Merced County down through Kern County. There were numerous discussions with growers and some complications with the equipment being set up for 30 inch double rows while some growers were interested also in double row plantings on a 38 or 40 inch bed configurations. All 2004 field trials were set up on 30 inch beds. Some of these alternative bed spacings may be evaluated in future years depending upon equipment availability and grower interest. These wider beds will be of interest for future evaluations, since wider beds may help with a recurring problem in assurance of adequate soil moisture in some 30 inch beds planted to the 30 inch configuration.

INFLUENCE OF IRRIGATION REGIME ON YIELD OF MAXXA AND PHYTOGEN-72

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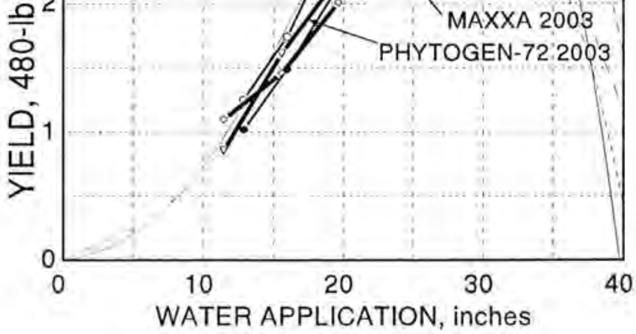
Many Acala cottons go rank when over-irrigated, and the final yield is often less than maximum. Under-watering also reduces yield. The goal of this project was to find the depth of water application that would maximize yield. This is the end of the third season of an experiment in field 41A of the south 40, with 6 different application rates, using daily irrigation with a subsurface drip irrigation system. A RCB split plot design was used with 2 reps to compare Maxxa to PhytoGen-72. Each of the main treatment plots is 8 rows wide (30" row spacing) by 328 ft long. The application rates varied from 33% of normal to 144% of normal. The yields for the first two years are shown in the figure below. In order to smooth out the curves, a polynomial was fitted to each. PhytoGen-72 required 2-3 inches less water than the Maxxa to achieve maximum yield, and in both years the yield on the PhytoGen-72 was higher than Maxxa, so the water-use efficiency was much higher with PhytoGen-72. On the other hand, PhytoGen-72 was much more sensitive to over-watering. Backing off to the left of the peak by reducing the water by 5% caused a 1% reduction in yield on both varieties.



Title: Germplasm evaluation of cotton accessions from the U.S. Cotton Germplasm Collection, USDA-ARS (Landraces of Mexico)

Part of project P36 (Project 36 is located field 17 (P67)).
Mauricio Ulloa and James Frelichowski
USDA-ARS, WICS Res. Unit, Cotton Enhancement Program.
Project Cooperators:
Universities and USDA-ARS Geneticists/ Breeders.

The *Gossypium hirsutum* gene pool from Mexico encompasses a wide range of habitats and is one of the primary sources for improvement of most of the Acala and Upland cotton growing in the world today. Despite the existence of large collections of landraces of *G. hirsutum*, they are poorly evaluated and difficult to characterize for their value in the collection and potential for cotton improvement. Seed of 439 accessions of landraces, collected from 18 states throughout Mexico from a period of 1946-1997, were planted. These landraces will also be evaluated in a winter nursery in Mexico to ensure accurate evaluations of morphological characteristics (i.e. flowering & fruiting) if funding is available. Molecular markers are being developed at the USDA-ARS, Cotton Enhancement program molecular laboratory from DNA sequences information of cotton that are polymorphic among genotypes of *G. hirsutum.* DNA markers are being developed in cotton for a range of basic and applied scientific objectives in plant improvement. Plant breeders find them useful as a selection tool in monitoring alien genome introgression in cotton breeding programs. Variation in the cotton collections detected by both methods (morphological and molecular data) will be compared to see the value of morphological and genetic markers to characterize the collections, and for possible associations of markers with genes for cotton traits.

NATIONAL COTTON SEED TREATMENT and COMPANY ENTRY COTTON SEED TREATMENT TRIALS

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Project Summaries. Seed treatment evaluations were done in 2004 at Shafter and West Side REC test locations for several reasons:

(1) to have a California location to participate in tests done at a national level for new and continuing seed treatments for cotton as part of the National Standards Seed Trt Test; and
(2) for University of California trials on select treatments likely to be widely available, or under consideration for future use under CA cotton production conditions by several large seed treatment companies

Prior to 2001, these trials were done in conjunction with CA Cotton Planting Seed Distributors and consulting Plant Pathologist Dr. Dick Garber of Shafter, and trial locations have been on the CPCSD farm facility or on farmer fields. Beginning in 2001 and continuing through 2004, these trials were moved to field locations at both the Shafter and West Side REC test locations. The national standards trial was conducted only at the Shafter REC facility, while the company-entry evaluations were repeated at both Shafter and West Side Research and Extension Center sites in 2004. Starting this year (2004) , we also started including a company-entry Pima cotton seed treatment trial at Shafter and West Side REC in addition to the Upland tests. Only the Shafter REC data will be summarized for this report, although the West Side REC data can be made available upon request to Bob Hutmacher.

Company Entry Seed Treatment Trial. Trials were conducted using the variety CPCSD "Maxxa" The 2004 planting season was characterized by good planting conditions during much of the March and April primary planting periods. No really cold weather conditions prevailed during planting or weeks after planting, but there were some brief periods of cool and in some locations wet conditions. On the planting dates used at Shafter and West Side REC sites, the first plantings of the trials in March were abandoned and had to be replanted due to untimely rains which produced severe soil crusting between planting and emergence. A second, later planting in April was the one reported on for the trials this year. Despite what was generally fairly warm and good conditions during and after the second plantings, it can be seen in the Tables that follow (Company Entry and National Stds trials - 2004) that percentage seedling emergence and survival were significantly reduced in the untreated controls when compared with the seed treatments. In general, the greatest effect was on poor initial germination and emergence in the untreated control, with relatively poor additional emergence occurring with later counts. Statistical presentation of the data is available upon request from the authors.

National Standards Cotton Seed Treatment Trial. The National Standards trial in CA matches that done in all other U.S. cotton producing states, and will be summarized nationally in cooperation with Dr. Craig Rothrock, a Plant Pathologist with the University of Arkansas. As in the Company entry trials, untreated controls showed significantly lower emergence and survival than chemical treatments, but unlike the Company Entry trials, there was a much lower range of average emergence noted in this trial. Plans are to continue with similar trials at the Shafter and West Side locations in 2005 if resources allow, incorporating any new treatments developed and ready for testing.

Table 1. Company Entry Cotton Seed Treatment Trial data from ACALA and PIMA tests at Shafter REC, 2004. The varieties grown in the study were CPCSD "Maxxa" in the Acala trial, and Phytogen "Phy-76" in the Pima trial. The planting date was April 9, 2004 and the data averages shown below are for stand counts done on May 10. A similar trial was conducted at the West Side Research and Extension Center near Five Points, CA in Fresno County (data not shown here).

Treatment Number	Treatment Description (rates shown in parentheses)	ACALA TRIAL Average surviving seedlings for treatment (as a percent of the number planted)	Standard Deviation	PIMA TRIAL Average surviving Seedlings for treatment (as a percent of the number planted)	Standard Deviation
1	Nontreated (untreated control)	63.5	2.0	65.1	1.9
2	NuFlow-ND (14.5oz/cwt) + NuFlow-M (1.75oz/cwt)+ WECO 0257 (0.65 oz/cwt) + Apron XL-TL (1.0 oz/cwt)	73.8	1.2	75.1	1.5
3	NuFlow-ND (14.5oz/cwt) + NuFlow-M (1.75oz/cwt)+ WECO 0257 (0.65 oz/cwt) + Apron XL-TL (1.0 oz/cwt) + BioStim C (0.25 oz/cwt)	74.0	1.4	74.0	3.0
4	NuFlow-ND (14.5oz/cwt) + NuFlow-M (1.75oz/cwt)+ WECO 0257 (0.65 oz/cwt) + WECO 4004 (0.60 oz/cwt)	76.7	2.0	76.6	2.7
5	RTU Baytan-Thiram 1.76FL (195.5 ml/100kg) + Allegiance 2.65 FL (48.9 ml/100kg)	69.9	3.9	70.1	2.9
6	Baytan 30 2.65 FL (32.6 ml/100kg) + Argent (97.79 ml/100 kg) + Allegiance LS (78.24 ml/100 kg)	74.3	1.8	75.4	2.7
7	L1226 (41.73 ml/100kg) + L0030 (97.7 ml/100 kg) + L1008 (78.24 ml/100 kg)	75.2	0.6	74.2	2.9
8	L1028 (2.5 g AI/100 kg) + L1226 (41.73 ml/100 kg) + L0020 (65.2 ml/100 kg) + L0037 (20.86 ml/100kg)	73.7	2.0	76.3	2.5
9	L0037-A1 (32.6 ml/100kg) + L0020-A1 (65.2 ml/100 kg) + L1226 (41.73 ml/100kg) + L0030 (65.2 ml/100kg) + L1080 (32.6 ml/100kg)	73.0	2.0	74.1	2.2
10	Vitavax 34 3.34 FL (195.5 ml/100kg) + L1226 2.65 FL (41.73 ml/100kg) + L0030 (65.2 ml/100kg) + L0020 (65.2 ml/100kg) + L1080 (32.6 ml/100kg)	76.8	2.8	75.0	2.9

Table 2. National Standard Cotton Seed Treatment Trial data from test at Shafter REC, 2004. Variety grown in the study was a Delta Pine Upland variety used at all locations across the western U.S. (DP 451 B/RR) The planting date was April 9, 2004 and the data averages shown below are for stand counts done on May 10-13.

Seed Treatment Materials	Treatment rates (corresponds to the order of materials shown in left column) – in oz	Average surviving Seedlings for treatment - on May 10-13 (as a percent of the number planted)	Standard Deviation
Baytan 30 + Argent 30 + Allegiance LS	0.5 + 1.5 + 1.2	81.0	1.2
L1226 + L0030 + Allegiance LS	0.64 + 1.5 + 1.2	81.8	2.9
RTU Baytan Thiram + Allegiance FL	3.0 + 0.75	82.9	1.6
L1226 + L0020 + L0037	0.64 + 1.0 + 0.32	81.7	1.9
L0020 + L0288 + L0189	0.75 + 0.2 + 3.0	84.0	2.3
Apron XL-TL + WECO 0257	1.0 + 0.65	82.1	1.7
Apron XL-TL + WECO 0257 + NuCoat	1.0 + 0.65 + 7.5	81.3	2.1
Apron XL-TL + WECO 0257 + Nu-Flow M	1.0 + 0.65 + 2.5	83.9	2.6
Apron XL-TL + WECO 0257 + Nu-Flow M + NuCoat	1.0 + 0.65 + 2.5 + 7.5	81.1	2.2
Dynasty	3.1	79.7	2.6
Dynasty	3.9	83.0	1.8
Dynasty + Systhane 40 WP	3.1 + 0.84	82.5	2.2
HM 0403 + Apron XL-TL	0.142 + 1.0	78.5	2.6
HM 0403 + HM 0404 + Apron XL-TL	0.142 + 4.0 + 1.0	80.1	3.4
Vitavax-PCNB + Allegiance	6.0 + 0.75	75.9	2.1
RTU-PCNB	14.5	74.1	2.9
Allegiance	1.5	75.4	2.2
Nontreated – untreated control	---	69.2	2.3

Management of Key Cotton Arthropod Pests with Insecticides and Acaricides

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INTRODUCTION

The silverleaf whitefly (SLWF) and cotton aphid are not new insects to the SJV, but only in recent years have late-season populations of both of these pests become widespread. The silverleaf whitefly was first found in the SJV in 1992. The SLWF has continued to adapt to SJV conditions and cropping patterns and starting in 2001 SLWF populations expanded greatly both in severity and particularly in range. Populations in significant numbers occurred farther northward and westward into the SJV. This has pushed the whitefly into the primary cotton production area. The cotton aphid occurred sporadically in cotton throughout the 1970's and 1980's but damaging populations were rare. Early-season populations in the late 1980's and early 1990's were researched by Rosenheim and co-workers. Populations developed into a significant mid-season pest of SJV cotton and reduced lint yields in the mid-1990's with 1995 and 1997 being the most severe years. Late-season populations occurred occasionally during this period although impacts on lint quality were rare. However, in 2001, late-season populations occurred in many areas and contributed to the sticky cotton phenomena.

The specific studies summarized in this report, management of late-season infestations of SLWF and cotton aphids and mitigation of sticky cotton, were started at the Shafter REC in 2002. Work continued in 2003 and studies are in progress now in 2004. Specifically studies have included insecticide efficacy on late-season aphid/SLWF populations and threshold levels for cotton aphids and sticky cotton.

SUMMARY

<u>Efficacy Studies</u>: The first test was applied on 10 Aug. 2003 at the onset of boll opening (~10% open bolls). The second test was applied on 25 Sept. when about 90% of the bolls were open and this was about 7-10 days before defoliation. This is a critical period in the SJV for protecting lint quality. Aphid populations were quantified for 14-17 days after treatment (DAT). Ten fifth main stem node leaves (counting from the terminal) were collected from each plot on each sample date and aphid numbers were determined in the laboratory.

In the August test, the pretreatment population in this test was 25.8 aphids per leaf. The Astandard@ aphid products, Lorsban, Vydate, Centric, Furadan, Thiodan, Curacron, Leverage, Provado, and Assail were evaluated. Calypso and F1785 were the primary experimental materials evaluated. At 1 DAT, the best control, numerically, was provided by Furadan with Assail (0.025 and 0.05 lbs. AI/A) and Thiodan also providing at least 75% control. The population had declined substantially by the 3 day evaluation but Furadan, Assail (0.025 and 0.05 lbs. AI/A), and Thiodan were still highly effective. Lorsban, Vydate, and F1785 (0.054 lbs. AI/A) increased in effectiveness and provided similar percentage control as the best treatments.

A second aphid control study was conducted in Sept and was applied on 25 Sept. when about 90% of the bolls were open. This was about 7-10 days before defoliation. Both cotton

aphids and silverleaf whiteflies infested the plot area. Pretreatment levels were 12.9 aphids/leaf and 9.7 SLWF nymphs/leaf in this test. At 4 DAT, cotton aphid control was provided by the Curacron and Assail treatments but SLWF nymphal populations were unaffected by the treatments.. Populations at 7 DAT had increased slightly especially for SLWF levels (doubled). Assail (96%) and F1785 (~89%) provided very good aphid control. SLWF nymph levels were greatest in the untreated plots. The best control was seen in the Diamond, Danitol + Orthene, and V-10112 treatments but this was in the 40-50% range. Populations continued to increase at the 14 DAT sampling. The untreated plots averaged 18.1 aphids/leaf and 24.9 SLWF nymphs/leaf. Assail and F1785 clearly provided the best aphid control (98%). SLWF nymphal populations were reduced by all treatments except Centric. However, V-10112, Oberon, Diamond, and Danitol + Orthene were clearly more effective than the other treatments.

In summary, some new, useful materials are in development for aphids and whiteflies. F1785 appears to be very active on aphids. V-10112, Diamond, and Oberon reduced populations of late-season whiteflies at a time when activity is needed and difficult.

Optimal Timing for Late-season Aphid Applications: Studies were conducted to investigate the relationship between the number of cotton aphids and lint stickiness and therefore the optimal time to treat for cotton aphids. After the development of a low cotton aphid population near the time of initial boll opening, sets of plots were treated at weekly intervals with either Assail 70WP (1.1 oz./A) or Warrior (3.84 fl. oz./A) to control and to flare aphid populations, respectively. Application dates (and corresponding percentage open bolls) were Sept. 4 (50% open bolls), Sept. 11 (75% open bolls), Sept. 18 (90% open bolls), Sept. 25 (95% open bolls), and 1 Oct. (at defoliation). Untreated plots and one additional treatment in which Assail was applied on 4 and 18 Sept. were also included. Aphid populations were quantified from samples of the 5th MSN leaves at weekly intervals. Cotton lint was hand-harvested, ginned, and stickiness determined at the International Textile Center.

Aphid populations increased in untreated plots from an average of 1.1 per leaf on 4 Sept. to 36.8 per leaf in mid-Oct. Aphid-day accumulation over the 6 weeks of this test showed values from 96.7 (Assail applied on 4 and 18 Sept.) to 925.8 (Warrior applied on 4 Sept.). Untreated plots totaled 514.8 aphid-days. Therefore, the treatments worked well for altering the aphid populations as desired. Thermodetector ratings of lint exposed to these aphid levels ranged from 24 to 49.8 sticky spots. Using the criteria of Perkins and Brushwood, these would all be classified as sticky lint. The treatment with two applications of Assail had the fewest sticky spots. A second harvest of selected treatments was done on 4 Nov. following 0.26@ rainfall on 1 Nov. Sticky spots were reduced by 49% by this precipitation.

These results differ from the study done in 2002 when about 250 aphid-days was the threshold value that resulted in 10 sticky spots (using that as the criteria for stickiness). With a 6 week lint exposure period, aphid numbers of ~6 per leaf would be the threshold. However, in 2003, aphid-day numbers as low as ~100 still resulted in sticky spot values considerably higher (more than double) the 2002 values. Previous work by Rosenheim suggested aphid populations of 10-15 per leaf as causing sticky cotton in California. One difference between the 2002 and 2003 studies was that the plots also had a light SLWF infestation in 2003. SLWF nymphs per leaf averaged 1.1 at the start of the study (4 Sept.) and increased to 20-30 nymphs per leaf on 15 Oct. However, Naranjo and co-workers showed no relationship between SLWF populations and cotton lint stickiness with nymphal populations up to 100-fold that seen in our study. Ongoing studies in 2004 are designed to examine aphid and SLWF populations and stickiness.

Screening Program Development to Evaluate Varietal Potential for Seed Coat Fragments

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1. Abstract

A three-year field study is requested for the Shafter Research and Extension Center to evaluate the utility of modifications in specific management practices (planting date, irrigation rate and cutoff date management, and harvest aid timing and practices) on the development of and level of seed coat fragment problems (measured by several methods). These field evaluations would be done in several varieties previously identified (in SJV Cotton Board tests) as differing (low, moderate, high) in tendency to produce seed coat fragments as measured by several methods. The evaluations would focus on determining if a specific mix of management practices could be identified that would increase the consistency in expression of seed coat fragment problems. This could serve to both identify production management practices to avoid in years or with varieties more prone to development of seed coat fragment problems as well as help in developing a field screening procedure to better evaluate varieties for susceptibility to seed coat fragment problems.

2. Justification and Problem Statement

The presence of seed coat fragments as cotton lint is separated from seed can be an important factor impacting value of the raw and finished product. Seed coat fragment issues and potential price discounts can occur at several levels of processing of fiber, from the beginning stages of ginning on into yarn spinning and fabric production. At the level of ginned seedcotton, samples representing bales are evaluated directly from the gin in HVI classing by the US Department of Agriculture. Seed coat fragments can be part of a code 31 "call" in high volume instrumentation (HVI) classing done by the USDA classing office, and if it occurs can result in a discount in the price paid to growers. Seed coat fragments can also become a problem at the point of processing lint for yarn and eventually fabric production at mills, with either large or small seed coat fragments having potential to cause imperfections in final processing as the fiber goes into the mills to be made into yarn and other products.

In San Joaquin Valley Acala cottons, seed coat fragment problems at the level of calls made by the USDA classing office as well as some concerns expressed by mills have shown some tendencies for increases during the past ten or more years. Potential causes of problems with seed coat fragments have been investigated in scattered studies done over the past two decades in a wide range of locations in the U.S. and elsewhere, but few of the studies have been conducted in California. Factors which have been implicated as having potential to impact seed coat fragment amounts and frequency of detection include:

-varieties and genetic background
- production practices and environmental conditions
- genetic or production management or pest problems that impact production of immature seed, small seed or more extreme desiccation of seed during development
- weather and crop conditions at harvest, including temperature ranges and low humidity
- module storage conditions prior to ginning
- cotton condition at ginning time (seed moisture content, trash content and need for cleaning)
- some aspects of picking and ginning operations

Some apparent recent increases in the number of bales called for seed coat fragments in USDA classing offices, and increases in the perception of seed coat fragments in cotton reaching the mills from California have increased calls to identify the sources of the problems and calls to make some progress in turning around any developing trends toward increases in seed coat fragments. There is some evidence that several specific varieties have been the source of the majority of the seed coat fragment calls from the USDA classing office in recent years, suggesting that most problems could be taken care of in the marketplace by just avoiding plantings of those varieties. It is important to recognize, however, that seed coat fragment calls by the USDA classing office are a very low incidence problem, with generally less than 5% of the total bales of the most-affected varieties having the problem in the worst of years. To make the picture even more complicated, UC and San Joaquin Valley Cotton Board data done at the level of yarn spinning also suggests that there are numerous other varieties approved or considered for approval as commercial varieties in the past five or six years that also show significant tendencies toward higher seed coat fragments than most varieties approved in earlier years. Concerns for the potential for seed coat fragment problems was a primary basis for some difficult decisions on variety approval made in this year's San Joaquin Valley Cotton Board deliberations.

One of the primary difficulties that will remain in any evaluation of seed coat fragment problems in individual varieties or groups of varieties comes with the fact that occurrence of seed coat fragments in quantities high enough to produce a USDA classing office call or consistent identification of problems at the mill are likely to remain a very low incidence problem even with the most seriously impacted varieties. This has been the history of these problems, suggesting that under the typical management practices of most farmers most years, you will not see many instances of seed coat fragment problems significant enough to produce a discount-level problem. This situation makes it a hard problem to investigate in field studies under grower conditions.

We propose to initiate a study in which planting date, irrigation amount and cutoff management, and harvest aid management practices will be manipulated to try to produce conditions which may more consistently bring the expression of seed coat problems. Goals would be to test if management practices could be identified which could more consistently be used to screen varieties for potential for seed coat fragment problems. Additional funding will be pursued to allow collection of

3. **Previous Work and Present Outlook:**
Most of the basic background discussion of this problem was covered in the prior section (#2). Some of the most comprehensive public data currently available to assess seed coat fragment levels is available in reports of the University of CA in the San Joaquin Valley Cotton Board reports of recent years. This data can be used to identify seed coat fragment levels for individual varieties entered in the testing program as expressed by several measurement methods. The data can also be used to assess year-to-year differences in seed coat fragment levels, some of which can be attributed to environmental and crop production conditions within any given year, with some also attributable to the shifting mix of varieties included in the approved variety trial evaluations across years.

Available San Joaquin Valley Cotton Board / University of CA data sets suggest trends toward increasing seed coat fragment levels (as measured using the Trash-Cam 50 approach) in varieties included in the testing program in recent years. Ongoing evaluations of these data sets may help in assessing the degree to which any trends are more related to environmental or prevailing management conditions in given years versus changes in varieties, but are not likely to fully resolve this question.

It is the opinion of the proposed Principal Investigators of this trial that the efforts proposed here could assess the utility of a potential screening approach for sensitivity to seed coat fragment problems.

4. **Objectives:**
Several objectives can be approached in this project, including: (1) evaluation to help determine if a specific mix of management practices (planting date, irrigation management practices, harvest aid management practices) could be identified and used in a controlled field test to increase the consistency in expression of seed coat fragment problems; (2) begin to answer the question of whether or not these identified production management practices are ones to avoid or modify in years or with varieties more prone to development of seed coat fragment problems; (3) assess this approach as a field screening procedure to better evaluate varieties for susceptibility to seed coat fragment problems.

Remote Sensing for Detection of Spider Mite and Cotton Aphid in SJV Cotton

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Introduction

Arthropod management practices in California cotton production involve the use of various insecticides and acaricides for protection of yield and quality. Cotton aphid control relies mainly on the neonicotinoid insecticides but organophosphate and carbamate insecticides are also used. Spider mite control relies on acaricides and the chemical types used for both cotton aphids and mites are important for resistance management considerations due to their mode of actions.

Precision agricultural methods have the potential to positively impact San Joaquin Valley (SJV) cotton. If the area where pests are located within fields can be known, pesticide applications can potentially be greatly reduced both in frequency and in amount. Spider mite and cotton aphid infestations in the SJV tend to be heterogeneous, with some areas of high infestation and some areas of negligible infestations in fields. However, the currently available ground sampling methods make it impossible to detect all infestations within the large fields of the SJV. Thus, arthropod management decisions are currently made on an inter-field basis rather than an intra-field basis.

Remote sensing is a precision tool that can detect wavelengths of energy to provide a sundry of information including: plant coverage versus soil coverage, plant health, soil type, etc. To provide relative information on plant vigor, this information can be converted into a vegetation index on an intra-field basis up to one to several meters in resolution. The wavelengths used and reflectance detected is also precise enough to detect plant response to different types of plant injury caused by different arthropod pest damage and other factors.

There is no vegetation index or techniques available for detection of arthropods in cotton grown in the SJV, where spider mites and cotton aphids have been recent problem pests. Previous studies at the Shafter Research and Extension Center have shown that spider mite damage can be detected with the use of remote sensing; however, threshold levels important to using remote sensing as a management tool have not been established. A successful treatment program that could be reduced to micro-units has the potential to decrease the amount and frequency of pesticide applications.

Materials and methods

Field plots were infested with natural populations of cotton aphids (*Aphid gossypii* Glover) and spider mites (*Tetranychus spp.* Koch). Differential populations were established in plots using selective pesticides, as well as targeted materials to flare certain arthropods, in 2003 and 2004. The plots had both cotton aphids and spider mites, neither pest, an intermediate number of mites and a high number of aphids, spider mites individually, and aphids individually. Another test used high levels of nitrogen favor aphid populations. Plots received differing levels of nitrogen over 3 week periods. A Capture treatment was added in 2003 and a Warrior treatment was added in 2004 to the sub-plots to flare aphid populations, while other sub-plots contained low aphid levels.

Ground-truthing data were collected by sampling arthropods of interest at weekly intervals within the plots for both experiments. Both cotton aphids and spider mites were sampled in 2003 by collecting 10-leaf samples per plot and counting the individuals in the laboratory; 20-leaf samples were collected in 2004. Leaves were washed onto a fine mesh sieve and the retained material back-washed onto filter paper for storage and later quantification of spider mite number.

In 2004, two similar sleeve cage experiments were performed by enclosing an un-infested leaf with floating row cover material. This allowed light to pass through, kept non-target arthropods out and the arthropods of interest inside the cage. For the first experiment, each leaf was infested with either 10 spider mites, 10 aphids, 10 spider mites and 10 aphids, or was left un-infested. For the second experiment, each leaf was infested with either 20 spider mites, 20 aphids, 20 spider mites and 20 aphids, or was left un-infested. Each day after the start of the infestations, scans were taken on each leaf using a spectroradiometer, in cooperation with the USDA, to quantify leaf reflectance. Additionally, the number of aphids and mites were quantified and the cages were maintained free of natural enemies. Finally, scans on each leaf were taken using a chlorophyll meter, in cooperation with the USDA, to quantify the amount of chlorophyll in each leaf. The spectral data will be analyzed and compared to the arthropod numbers and chlorophyll amount.

Flight data were collected, over the field plots, using both multispectral, Shafter Airborne Multispectral Remote Sensing System (SAMRSS), and hyperspectral, Airborne Visible Near Infrared (AVNIR), camera systems in 2003. Flight data were collected on 4 dates in 2004, using a multispectral camera system contracted through InTime, Inc. Additionally, the spectroradiometer was used to quantify leaf reflectance in each plot. Finally, scans on each leaf were taken using the chlorophyll meter to quantify the amount of chlorophyll.

From the flight data in 2003, a Normalized Density Vegetation Index (NDVI), Normalized Near Infrared Index (NNIR), Normalized Red Index (NR), Optimized Soil Adjusted Index (OSAVI), Chlorophyll Index (MCARI), Green Differential Vegetation Index (GDVI), Green-Peak reflectance value (550 nm), Normalized Green Index (NGI), Phytochemical Reflectance Index (PRI), Normalized Water Index (NWI), Ratio Vegetation Index (RVI) and several of my own indices were then calculated for the hyperspectral data. The indices calculated using the multispectral system, were the NDVI, NNIR, GDVI, Green peak reflectance value, and RVI, in 2003. The data have yet to be analyzed for the flights in 2004. These indices and reflectance values were each analyzed using two-way analysis of variance (ANOVA). Tukey's test, at $\alpha=0.05$, was used to separate means when significant differences were detected ($P<0.05$) by ANOVA. The ground data from the field plots were compared to the index and reflectance values using regression analysis, and it was attempted to determine at what point plant stresses from aphids and/or spider mites could be detected, if at all with the index and reflectance values.

Results- 2003

In the field test involving spider mites and aphids, all index values calculated using the SAMRSS and AVNIR data were not significant, except for those near the green-peak. Using the SAMRSS data, mite infested plots and those infested with both mites and aphids had significantly lower reflectance values at 550nm than did un-infested plots. Using the AVNIR data, at 579nm, rather than 550nm, mite infested plots had significantly lower reflectance values. The average reflectance values were lower for plots infested with both aphids and mites at 579nm (but not significantly different). For both the SAMRSS and AVNIR data, plots infested with aphids had lower reflectance values at 550nm and 579nm, respectively, but there were no significant differences among treatments (Fig. 1).

No correlations were found between the SAMRSS and AVNIR index values and mite numbers, including the significant green-peak values, even after transformation. Similarly, no correlations were found between the values and aphid numbers, even after transformation.

In the test involving nitrogen and aphid numbers, in 2003, no correlation was found between the SAMRSS values for all indices and the aphid numbers. The AVNIR data were unavailable for use because the image quality was affected by wind on the flight date of interest. However, the aphid numbers were lower than expected even after the attempt to flare them in sub-plot with Capture. The numbers ranged from 0.25 to 16.8 aphids per leaf in the sub-plots, with an average of 4.15 aphids per leaf per sub-plot.

Discussion

Not all indices are useful detectors of plant health for spider mite or aphid damage on cotton in the SJV. When the reflectance values for each of the individual treatment plots are averaged together into treatment groups, the majority of differences in reflectance can be seen in the infrared bands and water bands. There are may be indices that can use the near infrared bands and water bands to detect arthropod damage, as has been done by Fitzgerald and cohorts here at the Shafter Research and Extension Center. However, based on my research, the green peak may prove to be the band of choice to detect arthropod damage. Hopefully, using the data from this year, variation can be significantly reduced and a better vegetation index can be used in the future to elucidate early spider mite and cotton aphid infestation in the SJV.

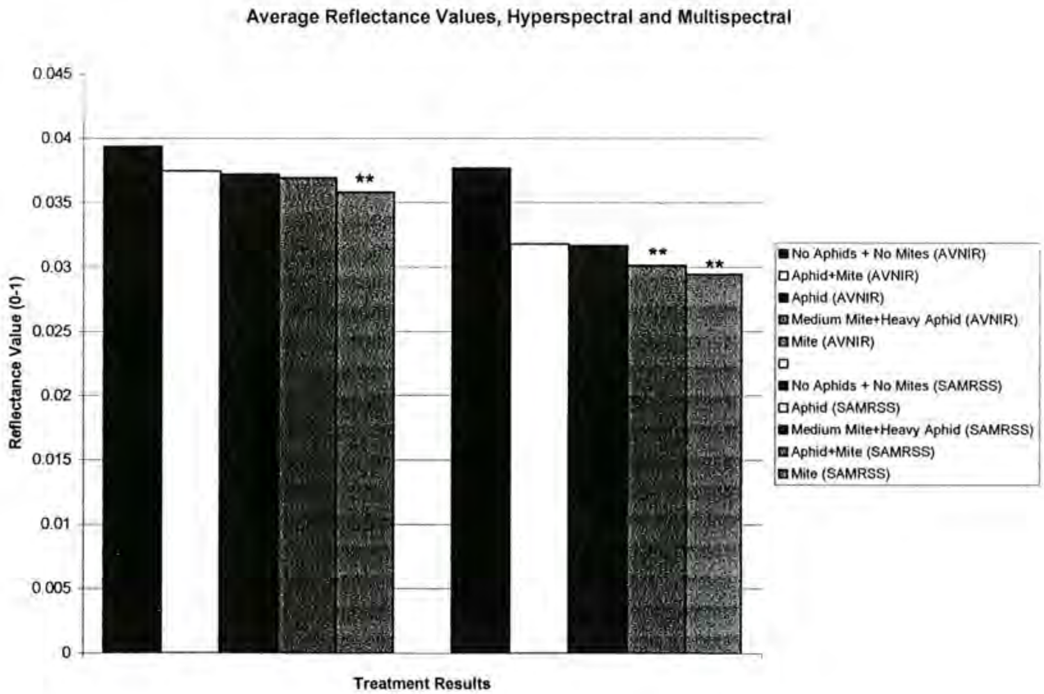

Fig. 1- There were significantly lower reflectance values at 579nm (hyperspectral, AVNIR) for mite infested cotton versus un-infested cotton. There were significantly lower reflectance values at 550nm (multispectral, SAMRSS) for both mite infested cotton and cotton infested with both aphids and mites than un-infested cotton.

Low Pressure Drip Irrigation

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Abstract:
Maximizing application efficiency (Ae) of irrigation systems depends mostly on the irrigation manager's ability to:

1. Reduce and/or eliminate runoff.
2. Reduce deep percolation below the root zone.
3. Overcome the infiltration variability of the soil surface.
4. Optimize irrigation scheduling.

Presently, the subsurface drip irrigation (SDI) method is the only method capable of giving a manager this ability but to do so it requires excellent design and intensive management. A new advance in drip irrigation has been recently developed in Israel. This approach may provide the capabilities of SDI in fulfilling the above requirements for improving Ae but with less stringent demands on precise design and intensive management and at a lower cost than SDI. The low pressure system (LPS) is installed just below the soil surface, it operates at very low flow and pressure and it can stay on for longer periods of time without generating runoff or deep percolation. This project will test the validity of these claims with cotton by comparing the performance of LPS with four bed spacing/line placement treatments. Performance will be measured by carefully monitoring plant, soil and water variables, calculating evapotranspiration, measuring water applied, crop yield and quality and system distribution uniformity Seminars and press releases will be used to disseminate the information to water agencies, extension services and growers.

Justification:
In California (DWR Bulletin 160-98), conservative predicted population increase (+15.4%) may cause agricultural applied water to decrease by 4% between 1995 and 2020. In addition, in the central portion of the San Joaquin Valley of California, due to lack of drainage outflow and the rising of saline water tables, several thousand acres of agricultural land are scheduled to go out of production and this will threaten the economy and welfare of small surrounding cities as well as that of the State of California. Throughout the cotton belt where warm weather attracts population and industry, similar conditions and decline of aquifer levels (such as the Ogallala aquifer) are also decreasing availability and quality of water used for irrigated agriculture. Properly designed and managed drip irrigation systems have been shown to increase application efficiency of irrigation systems and could help alleviate the decreasing water availability for irrigated agriculture in the cotton belt. The LPS technology has many potential technical, energy and economic advantages over standard drip and subsurface drip irrigation. These advantages need to be documented by research and demonstrations.

Previous Work and Present Outlook:
Years of research by the USDA and others have documented the soil and water conservation advantages of drip irrigation and subsurface drip irrigation. Recently, the LPS technology was developed in Israel by Netafim Irrigation. The LPS irrigation has been under commercial demonstration in Israel, Australia and the USA. The LPS technology has shown a high potential for economically improving application efficiency of irrigation systems under sandy soil conditions in areas where water is scarce and/or expensive or where deep percolation to groundwater could be damaging. Because the LPS operates at pressures ranging between 2-4 psi, the energy required for operation is minimal. Rigorous research is needed to compare the LPS method to furrow irrigation and to ensure the viability of this technology.

Objectives:

1. Demonstrate the validity of the LPS technology for economically growing crops while improving irrigation application efficiency (Ae) where:

$$Ae = \frac{Water\_used}{Water\_applied} * 100$$

2. Compare crop yield and quality, economics and Ae of LPS to similar results achieved with furrow (or other) irrigation systems.

3. Provide "recipe"-style recommendations to grower so that he can easily implement LPS technology.

Title: Population development, Selection, and Evaluation for Heat Stress and Study of Seed Coat Fragments.

P67 (Project 67 is located field 20 (P36)).
Mauricio Ulloa
USDA-ARS, WICS Res. Unit, Cotton Enhancement Program.
Project Cooperators:
Richard Percy (USDA_ARS, AZ) & Lloyd May (Univ of Georgia). In Addition, Dr. Robert Hutmacher (UC Davis, CA), and Dr. Ed Hughs, (USDA/ARS, NM) Ginning Lab Director.

The primary objective of this research is to identify/develop broadly adapted Acala and Upland improved cotton germplasm with potential heat stress tolerance, better fiber quality, and lint yield, broadening the genetic base of cotton. A second objective is to investigate cotton seed coat fragment production and its genetics under different environments.

Summary

Cotton is routinely grown in the hot, irrigated areas of the far Western U.S., and these extended periods of high temperature can reduce cotton (*Gossypium hirsutum* L. and *G. barbadense*) lint yield, even with adequate irrigation conditions. At least for Pima cotton, yield increases have been attributed to improved heat tolerance. Heat Stress is an abiotic stress associated to high temperatures in the desert far west where the daytime temperatures during the cotton production season can exceed 42 degree C. Extended periods of extremely high temperatures are common in these areas during the critical stage of peak flowering. When temperatures in the San Joaquin Valley reach temperatures above normal during the critical stage of peak flowering, California growers suffer the consequences of reduced yield by these cotton varieties weaknesses to heat. In 2003, potential lines were evaluated for heat tolerance in a replicated nursery; four genetically diverse populations for fiber quality and heat tolerance were created using double crosses; advanced generation progeny were evaluated for yield and fiber performance at Maricopa, AZ, Tifton, GA, and Shafter, CA. The lines selected for advancement had fiber lengths that were generally superior to two Acala check cultivars. Yield data is presented in Table 1 from the three locations. Fourteen lines were identified for advancement to replicated testing across locations (Maricopa, AZ, Tifton, GA, and Shafter CA) in 2004. At the UC Research and Extension Center in Shafter previously selected cotton entries are being grown in a replicated trail, and yield and fiber data will be collected for further assessment and possible germplasm releases.

In addition, one undesired product mixed with fibers is seed coat fragments (SCF) which are produced when they are torn off the seed during the ginning process. SCF are fiber impurities that cause problem during the high-spinning process, and start raising some concerns in the textile industry. SCF thus remain in the fiber up to the spinning phase and it is here where SCF cause breakages or result in the production of yarn with many imperfections. The different organizations involved in the spinning industry are now

convinced that productivity can only be improved if SCF are reduced or eliminated. California Acala Cotton is known to produce the best cotton in the US. Improved germplasm with reduced or no SCF production will help U.S. cotton exports, and eventually California growers by providing varieties with low or no level of SCF in their cotton production. As the first step to investigate SCF and in cooperation with the companion heat stress research the beginning SCF project will take place in 2004. Additional cotton entries were added to the heat stress replicated trail across locations (Maricopa, AZ, Tifton, GA, and Shafter CA). Harvested seed cotton from all entries will be subjected to SCF, ginning, and fiber tests. Data will be collected for further assessment.

Table 1. Yields of Fourteen Selected Progeny Lines at Maricopa, AZ, Tifton, GA, and Shafter CA in 2003[a].

	Maricopa AZ		Shafter CA	Tifton GA
Designation	fiber	adjusted fiber[b]	seedcotton	seedcotton
	lbs/acre	lbs/acre	lbs/plot	lbs/plot
FMAX958/SG248-8-5	1773	230	34.4	4.8
FMAX958/SG248-8-6	1769	226	32.1	4.5
FMAX958/SG248-20-4	1410	-56	26.1	5.7
FMAX958/SG248-20-6	1602	136	28.7	0.8
FMAX958/SG248-20-8	1753	182	-	7.1
FMAX958/SG248-35-3	1488	-26	28.6	5.6
FMAX958/SG248-37-1	1571	57	-	4.1
FMAX958/SG248-37-5	2008	395	30.0	5.2
FMAX958/SG248-37-13	1634	-62	-	4.1
FMAX958/SG248-46-4	1669	177	-	3.8
PD97006/SG248-5-2	1604	104	-	5.7
PD97006/SG248-11-3	1473	-63	23.9	2.4
PD97006/SG248-31-3	1357	-174	-	5.7
PD97006/SG248-42-3	1444	-463	33.9	5.5
Check average	1558	0	30.0	4.4

[a]Only 35 of the 70 lines tested at Maricopa AZ and Tifton GA were tested at Shafter CA in 2003, due to unavailability of seed.

[b]Yields of progeny were adjusted by taking the average yield of the three adjacent check plots and subtracting the resulting value from the progeny yield.

Pest and natural enemy mark-recapture studies of dipsersal in beans and between alfafla and beans

Jay Bancroft, Research Ecologist, ARS, Shafter, CA 661-746-8003

1. Abstract.

This study will measure movement and migratory behavior of western tarnished plant bug (its natural enemies) in beans and bwrween beans and alfalfa. Mark recapture will expand upon techniques developed last year in cotton and alfalfa. The absolute abundance, immigration, and emigration from the field will be measured. Cage studies with the parasitoid Peristenus stygicus will measure the impact on Lygus compared to regulation by existing natural enemies.
If pesticides are needed I will coordinate with Brian to suspend experiments at that time. If border rows with alfalfa can remain unsprayed (say 10 rows), then experiments on migration between crops will be better facilitated.

2. Justification and Problem Statement:

Arthropod pests are a major problem for beans. Pests and their natural enemies move within fields and migrate between the field and adjacent areas. Quantitative knowledge of the movement of these pests and their natural enemies is lacking in the field. Better understanding of the movement of these pests and their natural enemies is needed for assessing the reliability of density estimates and subsequent IPM. Improved techniques are now available for studying field scale movement of these organisms. Quantitative understanding of the complex dispersal and host finding behavior of these of pests will also enhance precision agriculture.

3. Previous Work and Present Outlook:

Dispersal is poorly understood because of the labor-intensive nature of the experiments. General studies of within-field dispersal have been performed for Lygus by Goodell, Fleischer, and Hagler. Some lab studies have also documented host-searching behavior of the pests and parasitoids in laboratory studies. These serve as a guide to host-plants preferences and how dispersing insects may form congregations in the field. The experiments will provide a valuable link between migration theory and the practice of pest management.

4. Objectives:

1. Examine the natural movement and abundance of Lygus in relation to location in field and time of year.
2. Test the imapct of biological control by Peristenus stigicus on Lygus compared to natural regulation.
3. Measure the behavior of Peristenus stigicus in bean, which will be compared with field behavior in alfalfa and cotton.

5. Procedure:

Mark-recapture experiments are an effective way to acquire data that may show density, mortality and dispersal in field situations. The dispersal of marked Lygus within the field will be tested, as well as between the bean and adjacent alfalfa. Standard measures of plant residence time and behavioral attributes will be taken. This may include the manipulation of Lygus densities to examine response by Peristenus. Abundances in time and space will be analyzed in models that account for predators, weather, and host condition (bean plant or Lygus density).

Management of Root-knot Nematode

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This project has the following two objectives:

1. Evaluate new products for management of root-knot nematode on carrots.

2. Evaluate the effectiveness of trap crops for management of root-knot nematode on carrots.

Root-knot nematodes (*Meloidogyne* sp.) are widely distributed throughout California and are the most important nematode pest of carrot. Current control methodology relies on the use of Metam sodium and Telone II.

The potential for loss of the standard chemical nematicides due to various environmental concerns is great enough to warrant a continued search for alternatives. Each year, a number of "promising" candidates are promoted by various sources. These include chemical nematicides, and what are termed natural or novel products or soil amendments. Even though many of these may not prove to be efficacious, demonstrating this by comparison to a standard nematicide treatment provides valuable justification for maintaining current registrations. Such a process succeeds in sorting out those that do truly have potential for nematode management. A trial is currently in progress to evaluate several new products.

Trap cropping is a nematode management technique that has been tested periodically since the late 1800's. A susceptible host is planted and larvae of a sedentary parasitic nematode such as root-knot are induced to enter and establish a feeding site. Once this has occurred, and the female begins to mature, she is unable to leave the root. The plants are then destroyed before the life cycle of the nematode can be completed, trapping nematodes within the root. By itself, trap cropping is not likely to provide the same level of control as a chemical nematicide such as Telone II, because not all nematodes are induced to enter the roots. However, the potential for loss of registration of this and other chemical nematicides for various environmental reasons is great enough that the use of two or more other techniques in combination, that will each provide partial control of the nematode population is warranted. A trap crop trial is currently in progress.

The majority of the carrots grown in California are grown in Kern County and the Shafter station provides climatic and cultural conditions similar to those in local grower fields.

Development of host plant resistance to Lygus feeding damage in alfalfa, beans and cotton.

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Justification and Problem Statement Lygus bugs (Order Hemiptera, suborder Heteroptera, family Miridae) are a serious pest of many agricultural crops, including alfalfa, beans, and cotton. Lygus bugs feed on various plant tissues using piercing and sucking mouthparts. During penetration and feeding, saliva (containing many enzymes and amino acids) from the bug is injected into the target tissue in a "lacerate-and-flush" action. Damage is manifested in tissue necrosis, distortion and abscission of fruits, growth retardation, and discoloration. This damage is due to maceration by the salivary enzymes, principally polygalacturonase (PG). Producers of these crops currently treat extensively with insecticides to control these pests. In the absence of either chemical or effective biological control (including genetic resistance), Lygus bug feeding will result in nearly total destruction of a crop. Lygus bugs readily develop resistance to agricultural chemicals, particularly organophosphates. Furthermore, many of the effective insecticides are organophosphates and their long-term labeling is uncertain. Therefore, development of host plant resistance to the Lygus bug is a priority. However, attempts to develop genetic resistance have not resulted in effective economic control of Lygus. We have verified that damage to bug feeding is associated with the PG in the bug's saliva, and we have determined that PG inhibitor proteins (PGIP) capable of inhibiting crude preparations of polygalacturonase from *Lygus hesperus* (PG_L) are present in cotton (also alfalfa and dry beans). We have developed methods of "harvesting" Lygus saliva. Using this material we have determined that more than one PG_L and amylase are increased in cotton plant tissue following Lygus feeding.

A whole plant screening protocol for PGIP in cotton has been developed and the technique is being improved to include screening for Lygus bug amylase inhibitors. We propose to continue to advance our knowledge of the mechanism of Lygus bug damage (for the purpose of improving the screening protocol) and to apply the screening protocol to identify and select, using conventional plant breeding, lines with superior levels of PGIP activity and amylase inhibition, and develop plant breeding and genetic information focused on reduction (elimination) of damage, caused during and after Lygus feeding, by salivary enzymes. Ultimately we expect to develop, test, and make available, cotton genetic stocks that resist Lygus bug PG_L and amylase (A_L) induced feeding damage.

The project needs to be conducted at Shafter Research and Extension Center (SREC) because it is the most suitable location to grow diverse lines of cotton.

1. **Objectives**

   Conduct a survey of cotton germplasm sources to identify most useful sources of polygalacturonase and amylase inhibitor proteins (PGIP and AIP, respectively) in cotton.

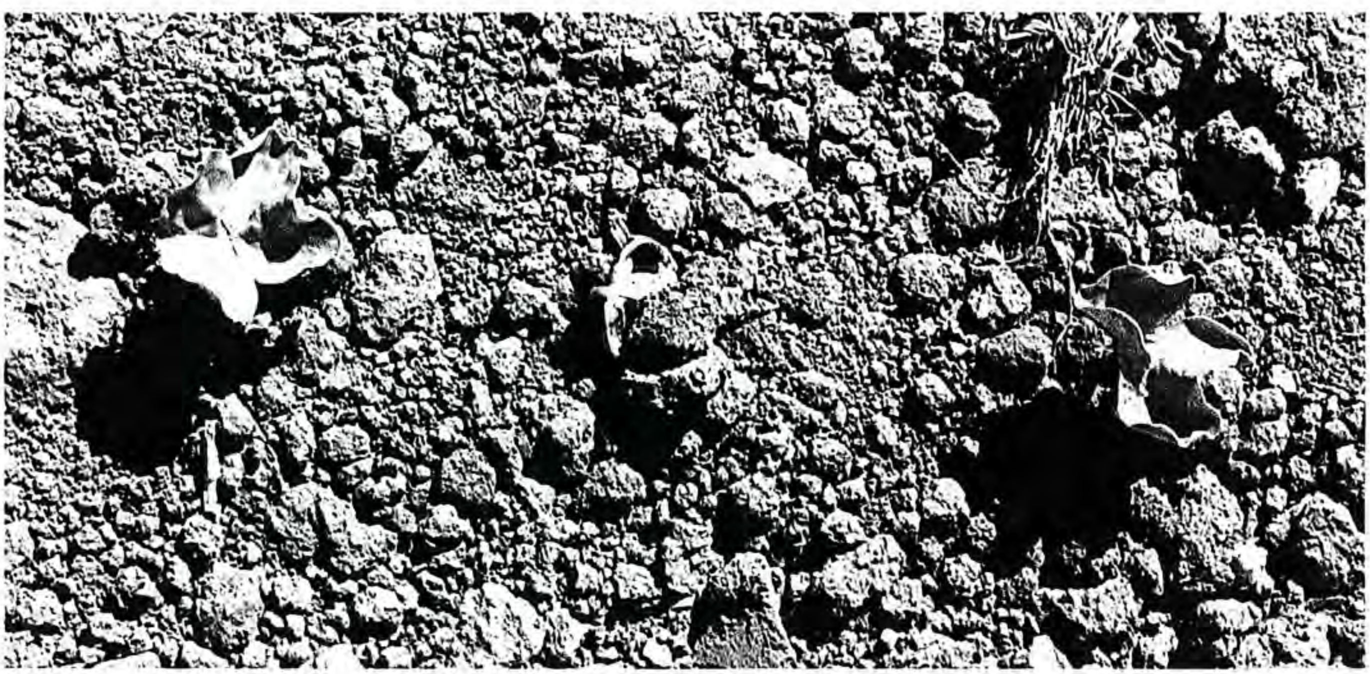
2. **Procedure**

   The experimental design will be a randomized complete block design in a 1-acre field. "Treatments" will be different plant introductions. These are being grown for the sole purpose of screening for potential source of PGIP and AIP . Standard crop management will be needed. When the cotton plants are beginning to bloom, leaf tissue will be collected from representative plants of each cotton accession. The samples will be frozen on dry-ice, transported to UC Davis and analyzed in the laboratory. It will be desirable to maintain the field even after tissue collection so that potentially desirable genotypes can be resampled for purposes of verification. There is no plan to harvest lint or seed from these plantings.

3. **Previous Work and Present Outlook**

In a preliminary study using microinjection with a pressure probe (11), Shackel and Teuber (unpublished) injected three compounds (PG [not from Lygus], sodium azide, and 1-aminocyclopropane-1-carboxylic acid [ACC, the metabolic precursor to the gaseous plant hormone ethylene]) into the peduncle of alfalfa inflorescences. These compounds were selected based on the hypothesis that PG may induce bud necrosis and/or that ethylene production may be involved in the necrosis that is associated with feeding (ACC synthesis can be induced by PG). When observed 25 days after treatment, buds injected with PG showed aberrant development. They were straw-colored and incompletely developed - typical of Lygus damage. Buds developing at the same time, but on untreated stems or on untreated plants showed no symptoms. During the past two years we have refined the injection process and have clearly demonstrated the ability to cause "Lygus like" symptoms on cotton plants injected with crude preparations of Lygus saliva. We have also made substantial progress in characterizing the Lygus salivary content, We have collected, concentrated, and fractionated the salivary enzymes. Studies are in progress to determine the exact contribution that each component is making to the development of Lygus feeding damage. A screening protocol has been adapted from the protocol initially developed for alfalfa. That protocol was successfully used in 2001and 2002 to evaluate ~1554 cotton accessions representing a broad range of materials. Importantly significant variation was identified for PGL inhibition and we have developed preliminary information to indicate that inhibitors of amylase are also present in cotton. Germplasm sources with the highest levels of PGIP activity have been identified and are being incorporated into the development of breeding populations that exhibit inhibitory activity against Lygus salivary enzymes. We are hopeful that these lines will lead to the development of commercially desirable germplasm that is resistant to the Lygus bug.

There are over 7,000 accessions representing 40 species in the world collection of cotton. New world species *Gossypium barbadense* (1,065 accessions) *Gossypium hirsutum* (4,360 accessions) represent a very large proportion of this collection. We are systematically working through these materials and expect to continue to identify sources of high inhibition. The project might expand over the next three years as desirable materials are identified.



Shafter Cotton Field Day, Sept. 21, 2004

UC Riverside Blackeye Improvement Program-Activities at Shafter

Philip Roberts, Professor, Dept. of Nematology and Jeff Ehlers, Research Specialist, Dept. of Botany and Plant Sciences, (909) 787-3706: jeff.ehlers@ucr.edu

Blackeyes are a well-adapted and generally profitable rotation crop for many cotton growers in the southern San Joaquin Valley, but improved blackeye varieties are needed for the California blackeye industry to remain competitive with other producing areas such as the High Plains of Texas. The major objectives of the UCR Blackeye Varietal Improvement program are to develop blackeye bean varieties and complementary management methods that increase grower profits through increased yield and grain quality, and decreased production costs. The Shafter Station has been an ideal, representative yield-testing site for the products of our breeding program for the last ten years. As a result of these efforts, we released the blackeye variety California Blackeye No. 27 (CB27) in 1999. CB27 has high yield potential, heat tolerance, improved broad-based resistance to root-knot nematodes (*Meloidogyne incognita* and *M. javanica*) and resistance to the two races of Fusarium wilt present in California (Table 1). CB46 has resistance to one race of Fusarium wilt and to only one of three strains of root-knot nematodes present in California. CB27 also has grain that is brighter white than CB46 and larger in size.

In 2004 there were three blackeye field experiments on the Shafter Research Station:

1. Advanced Blackeye Trial: We are evaluating the grain yield and grain quality of 8 advanced blackeye breeding lines from the UCR breeding program, along with the standard variety 'CB46' and the newer variety 'CB27'. Most entries in this trial have resistance to two races of Fusarium wilt and some have stronger resistance to root-knot nematodes than CB46 (Table 1); all have excellent seed quality and high yield. Several entries are later in maturity than CB46 and are expected to have much greater yield potential. This trial is also being conducted at the Kearney Research and Extension Center.

2. Advanced Blackeye Breeding Line Nursery: We are evaluating 100 advanced lines from our breeding program. These lines combine the best features of existing blackeye varieties. Selection of lines for further testing will be based on their having a high-yielding plant type, desirable grain quality, resistance to root-knot nematodes, Fusarium will and 'early cut-out'. Selected lines will be included in replicated yield trials in 2005 and in future years.

3. Strip plots of CB46, CB27, UCR 539, and UCR 524. Four-row, 300 foot-long strip plots of CB46, CB27, UCR 539, and UCR 524 were of sown on May 5 on 1 acre block. UCR 524 and UCR 539 are promising blackeye breeding lines that have been tested for several years in small plot evaluations. Each varietal strip was replicated three times. Observations of the maturity, yield potential and extent of ground cover were made. UCR 524, a blackeye line with very large seed was judged to be promising and merits additional testing in 2005.

Table 1. Source pedigree, nematode resistance, days to maturity and seed weight (g/100 seeds) of 8 blackeye breeding lines selected for inclusion in Advanced Trials conducted at Shafter and Kearney in 2004.

Source	Pedigree	Days to maturity	Nematode resistance	Seed weight
2003-Sh-27	UCD9259/96-11-522	86	Rk	23.5
2003-Sh-31	UCR 53/AB105	90	Rk+	22.2
2003-Sh-40	CB46/99-8-622-2	100	Rk+	25.0
2003-Sh-46	CB46/99-8-622-2	100	sus	24.5
2003-Sh-49	CB46/99-8-622-2	90	Rk+	22.4
2003-Sh-50	CB46/99-8-622-2	90	Rk	25.5
2003-Sh-57	UCR 24/99-8-622-2	90	sus	22.6
2003-Sh-65	97-15-769/H8-8-9	95	sus	20.2
CB27		86	Rk+	21.4
CB46		90	Rk	19.9

** Rk- Phenotype indicates entry carries gene Rk or equivalent (CB46 is known to carry gene Rk).
Rk+=Rk+rk3- Entry probably carries both Rk and rk3 genes.

Table 2. Resistance/tolerance features of CB5, CB27, CB46 and promising breeding lines developed at UCR and grown in observation strip plots at Shafter in 2004

	Fusarium wilt		Root-knot nematodes		
			M. incognita		
Entry	Race 3	Race 4	avirul.	virulent	*M. javanica*
CB5	No	No	Yes	No	No
CB46	Yes	No	Yes	No	No
CB27	Yes	Yes	Yes	Yes	Yes
UCR 539	Yes	No	Yes	Yes	Yes
UCR 524	Yes	Part.	Yes	No	No

avirul. = avirulent, effectively controlled by gene *Rk;* virulent = not effectively controlled by gene *Rk* alone; Yes+=less root galling than CB27; Less gall=less galling than CB46, similar in galling to CB27 at Kearney *M. javanica* site in 2000.

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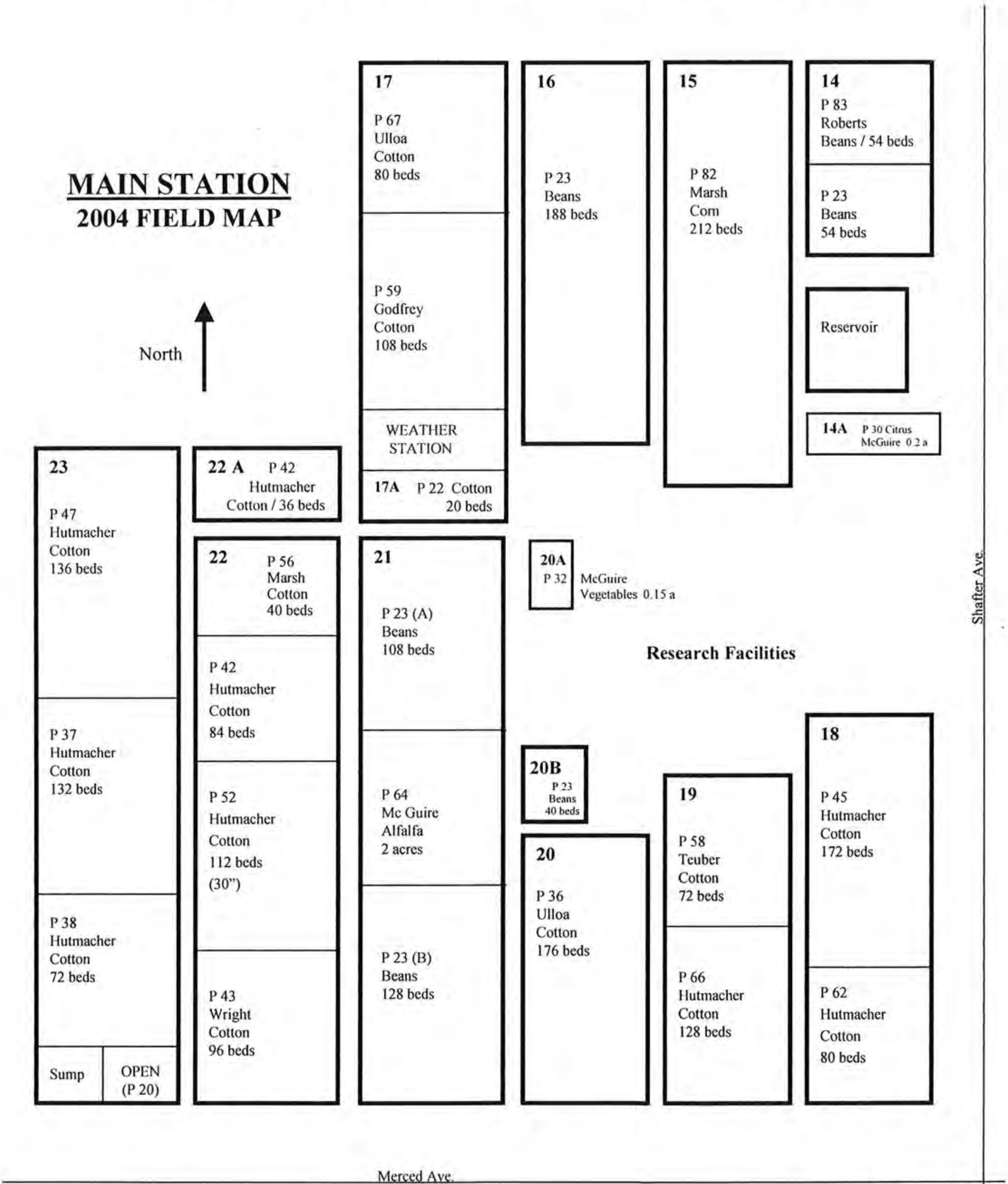

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4-15-04

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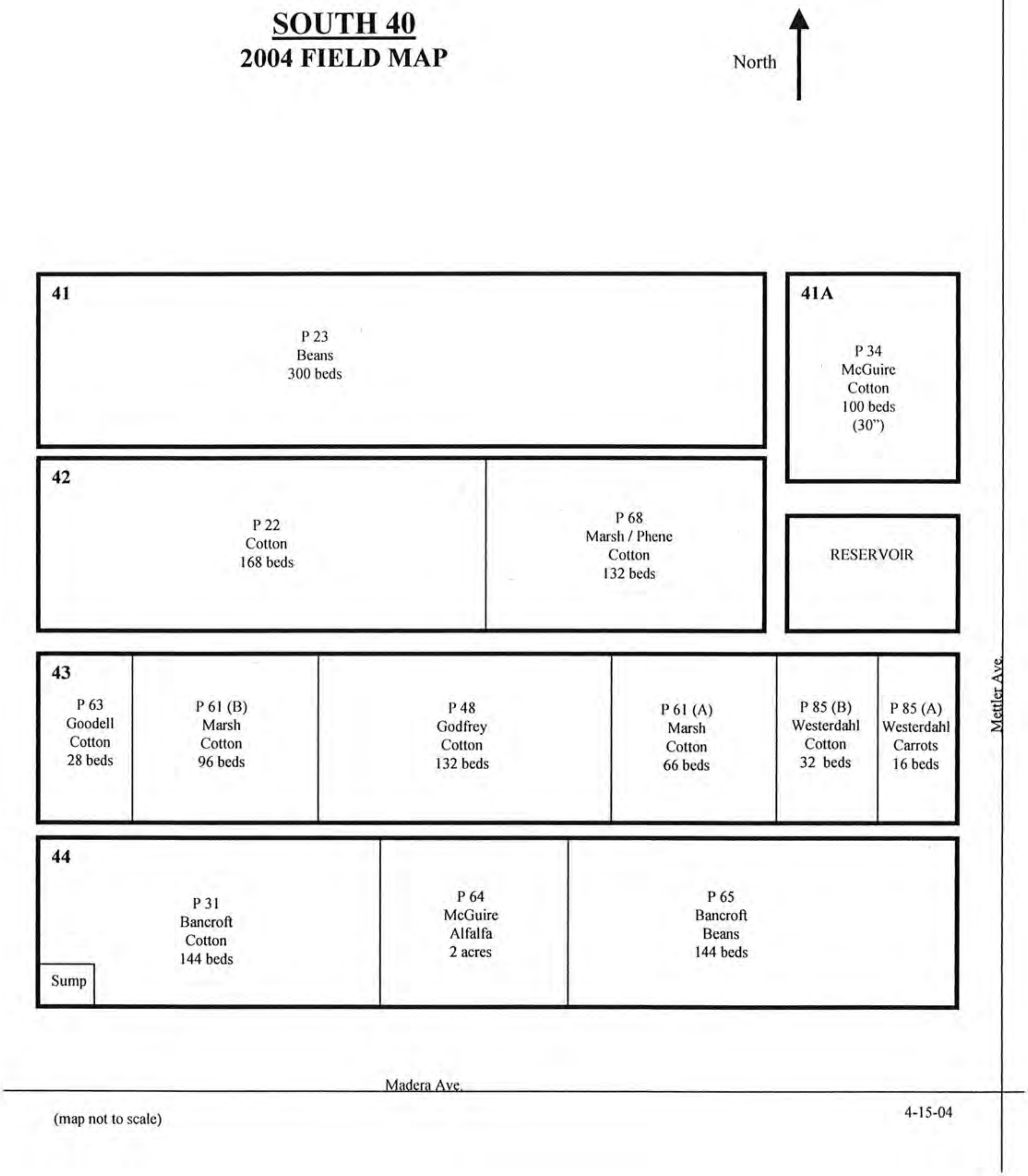
SOUTH 40
2004 FIELD MAP



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4-15-04

2004 Shafter REC Approved Research Projects

PRJ	TITLE	LEADER	PHONE	EMAIL
31	Pest & Natural Enemy Mark Recapture Studies for Experimental Test of Movement Behavior in Cotton	Jay Bancroft	661-746-8003	jsbancroft@pw.ars.usda.gov
32	Use of Vegetables and Citrus for Introduction of Biocontrols for Cotton Aphid	Michael McGuire	661-746-8001	mmcguire@pw.ars.usda.gov
34	Detection of Water Stress for Irrigation Management of Cotton	Michael McGuire	661-746-8001	mmcguire@pw.ars.usda.gov
36	Western Cotton (Acala, Upland, Pima) Germplasm Enhancement for Agronomic, Fiber Traits, & Pest Resistance	Mauricio Ulloa	661-746-8009	mulloa@pw.ars.usda.gov
37	SJV Approved Acala Variety Trials	Bob Hutmacher	661-746-8020	rbhutmacher@ucdavis.edu
38	SJV Approved Pima Variety Trials	Bob Hutmacher	661-746-8020	rbhutmacher@ucdavis.edu
42	National & Company Cotton Seed Treatment Trials	Bob Hutmacher	661-746-8020	rbhutmacher@ucdavis.edu
43	Preventing Sticky Cotton: Defoliation & Late Season Insect Mngmt	Steve Wright	559-685-3309	sdwright@ucdavis.edu
45	California Uplands Advanced Strains Screening Trial	Bob Hutmacher	661-746-8020	rbhutmacher@ucdavis.edu
47	Deficit Irrigation Impacts on Acala & CA Upland Cotton	Bob Hutmacher	661-746-8020	rbhutmacher@ucdavis.edu
48	Mngmt of Key Cotton Arthropod Pests with Insecticides & Acaricides	Larry Godfrey	530-752-0473	ldgodfrey@ucdavis.edu
52	Double-Row, High Density versus Conventional Cotton Plantings	Bob Hutmacher	661-746-8020	rbhutmacher@ucdavis.edu
56	Cotton Weed Control	Brian Marsh	661-868-6210	bhmarsh@ucdavis.edu
58	Development of host plant resistance to Lygus feeding damage in alfalfa, beans and cotton	Larry Teuber	530-752-2461	lrteuber@ucdavis.edu
59	Evaluation of Remote Sensing Techniques to Improve Sampling and Mngmt of Cotton Aphids & Spider Mites in SJV Cotton	Larry Godfrey	530-752-0473	ldgodfrey@ucdavis.edu
61	Cotton Seed Insecticide Evaluation	Brian Marsh	661-868-6210	bhmarsh@ucdavis.edu
62	Agronomic Testing of Enhanced Roundup-Ready Upland Cotton	Bob Hutmacher	661-746-8020	rbhutmacher@ucdavis.edu
63	Management of Root-knot Nematode with novel chemistry	Pete Goodell	559-646-6515	ipmpbg@uckac.edu
64	Control of *Lygus hesperus* with *Beauveria bassiana*	Michael McGuire	661-746-8001	mmcguire@pw.ars.usda.gov
65	Pest and natural enemy mark-recapture studies of dipsersal in beans and between alfafla and beans	Jay Bancroft	661-746-8003	jsbancroft@pw.ars.usda.gov
66	Screening Program Development to Evaluate Varietal Potential for Seed Coat Fragments	Bob Hutmacher	661-746-8020	rbhutmacher@ucdavis.edu
67	Population development, Selection, and Evaluation for Heat Stress and Study of Seed Coat Fragments	Mauricio Ulloa	661-746-8009	mulloa@pw.ars.usda.gov
68	Evaluation of Low Pressure Irrigation Systems (LPS) for Cotton and Comparison to Furrow Irrigation	Brian Marsh	661-746-8020	bhmarsh@ucdavis.edu
82	Corn Silage Hybrid Performance Trial	Brian Marsh	661-868-6210	bhmarsh@ucdavis.edu
83	Breeding Improved Pest Resistant Blackeyes and other Cowpeas	Phil Roberts	909-787-4222	philip.roberts@ucr.edu
85	Mngmt of Root-knot Nematode	Becky Westerdahl	530-752-1405	bbwesterdahl@ucdavis.edu

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