United States Department of Agriculture

National Agricultural Statistics Service

Research and Development Division
Washington DC 20250

RDD Research Report
Number RDD-06-01

March 2006

Using Personal Digital Assistants for the 2004 Cotton Objective Yield Survey

Kathy Neas
Jubal Molina
Jason Hardegree
Michael W. Gerling

EXECUTIVE SUMMARY

In the fall of 2003, the North Carolina Field Office (NC FO) and the Research and Development Division studied the use of personal digital assistants (PDAs) for the 2004 Cotton Objective Yield Survey (COY). The NC field enumerators were provided with PDAs to record COY data on them instead of on paper forms. The goals of the study were to develop a user-friendly data collection instrument to operate on a PDA which field enumerators could successfully record COY data into and securely transmit the data to the NC FO. This project also investigated if using PDAs would improve the data collection process, provide the collected data to the office staff quicker, improve data quality, and be cost effective.

The NC FO developed a process for field enumerators to collect COY data using PDAs. Each NC FO field enumerator team (composed of two people) was supplied with a PDA. Training went fairly smoothly, despite the fact that the majority of field enumerators had never used a computer prior to the training session. Data collection was virtually problem-free. Data transmission, however, had some problems. If PDA data collection use continues, the data transmission process will require streamlining, while at the same time maintaining NASS security standards. After the data collection phase, field enumerators stated that they would prefer a device that could handle dirt and rain. Overall, the field enumerators were able to record the data onto the PDA and securely transmit the data to the field office for processing.

The project demonstrated that PDAs can successfully be used by field enumerators for the Cotton Objective Yield Survey.

RECOMMENDATIONS

1. Recommend the North Carolina Field Office continue to explore the use of personal digital assistants (PDAs) for field data collection and administrative activities.

2. Improve field office tracking of office staff time and costs related to implementing PDAs for data collection for subsequent years following the initial investment.

3. Recommend that micro-level, interactive editing tools be created to clean the data more efficiently prior to the mainframe edit. Using PDAs provided data faster which revealed the need for these enhanced processing tools.

Using Personal Digital Assistants For The 2004 Cotton Objective Yield Survey[1]

Kathy Neas, Jubal Molina,
Jason Hardegree, Michael W. Gerling

Abstract

The National Agricultural Statistics Service (NASS) conducts hundreds of surveys (annually, monthly and in some cases weekly) on United States and Puerto Rico agriculture for the purpose of making estimates on crops, livestock, production practices, economics, etc. One of the monthly surveys is the Cotton Objective Yield Survey. Field enumerators typically record the data for this survey on paper forms and mail them to the field office for processing. The collected survey data allow NASS to forecast cotton yields and determine the amount of acreage to be harvested.

In the fall of 2003, NASS' North Carolina Field Office and the Research & Development Division combined efforts to explore the use of personal digital assistants (PDAs) in place of the paper forms.

The goals of the study were to develop a user-friendly data collection instrument to operate on a PDA which field enumerators could successfully record COY data into and securely transmit the data to the NC FO. The project also investigated if using PDAs would improve the data collection process, provide the collected data to the office staff quicker, improve data quality, and be cost effective.

Key Words: Data Collection, Agriculture**,** PDA

[1] Kathy Neas (Agricultural Statistician), Jubal Molina (Computer Specialist), Jason Hardegree (Agricultural Statistician) are with the National Agricultural Statistics Service – North Carolina Field Office, located at 2 W. Edenton Street, Raleigh, NC 27767. Michael W. Gerling (Mathematical Statistician) is with the National Agricultural Statistics Service - Research & Development Division, located at Room 305, 3251 Old Lee Highway, Fairfax, VA 22030.

1. INTRODUCTION

The National Agricultural Statistics Service's (NASS) mission is to provide timely, accurate and useful statistics on United States and Puerto Rico agriculture. To accomplish this purpose, NASS conducts hundreds of surveys on agriculture (crops, livestock, production practices, farm economics, etc).

The Cotton Objective Yield Survey (COY) is conducted monthly beginning in July and continues through cotton harvest. Historically, field enumerators have recorded the survey data on paper forms and mailed them to NASS Field Offices for processing.

In the fall of 2003, NASS' North Carolina Field Office (NC FO) and the Research & Development Division (RDD) started to explore the use of personal digital assistants (PDAs) to replace the paper forms.

The goals of the study were to develop a user-friendly data collection instrument to operate on a PDA which field enumerators could successfully record COY data into and securely transmit the data to the NC FO. The project also investigated if using PDAs would improve the data collection process, provide the collected data to the office staff quicker, improve data quality, and be cost effective.

2. WHY RESEARCH PORTABLE ELECTRONIC DEVICES FOR DATA COLLECTION NOW?

NASS actively seeks ways to improve its business practices to gain efficiencies in data collection and improve the quality of its data products.

In the early 1990s, the laptop was the primary option in the portable electronic devices (PEDs) market. However, over the last seven years, personal digital assistants, tablet PCs, convertibles, Web pads, and smart phones have become more readily available and are now being used by private companies and government agencies for data collection and daily business activities.

NASS has a history of research into the use of portable electronic devices in data collection (Eklund 1991, 1993, 1994). In the late 1980s and early 1990s, computer assisted personal interview (CAPI) research projects proved that data could be successfully collected using laptop computers and transmitted to a central location for further processing. At the time, several barriers prevented adoption of this technology into NASS' operational program. Among these were battery life, data transmission speeds, cost of the laptops, and the limited number of field enumerated surveys for which they could be used.

Since NASS first researched PEDs in the 1980s, technological advancements have been made in the area of CAPI. Data transmission speed and battery life have improved. At the same time, prices of PEDs have been decreasing, even as the devices are becoming more powerful (Gerling 2004).

In the summer of 2002, the NC FO conducted a State Fair Climate Survey. As part of the agreement with the North Carolina State Department of Agriculture, PDAs were provided to collect the data. The NC FO designed a data collection instrument and successfully used the PDAs to conduct the survey. This success caused the NC FO to look beyond the state fair survey to additional data collection and administrative applications.

Hence, in the fall of 2003, the NC FO and the RDD began investigating the use of personal digital assistants for the Cotton Objective Yield Survey.

3. COTTON OBJECTIVE YIELD SURVEY OVERVIEW

The Cotton Objective Yield Survey Program began in the late 1950s. The survey's purpose is to provide accurate data to forecast cotton yields and the amount of cotton acreage harvested in the United States. Yields are forecast by modeling recorded plant counts and measurements from sampled field units.

Cotton fields are statistically sampled from data collected by NASS' June Agricultural Survey. The COY is composed of four forms (A, B, C and E). Forms A, B, and E are completed by the field enumerators while Form C is completed by office staff. Form A is completed during the initial interview with the operator, while Form B is completed monthly until the cotton is harvested. Form E is completed after the cotton is harvested in the sampled fields. This study, however, focused only on Form B, the form used for the monthly plant counts and measurements.

The sample plot in each sampled cotton field is composed of two units. Unit 1 is physically located by a pre-determined number of rows and paces inside the sampled field. Unit 1 is composed of two sections of rows located beside each other. These sections are 13 feet and 10 feet in length. Unit 2 is also physically located by a pre-determined number of rows and paces in the same field. Unit 2 is also composed of two sections as described for Unit 1.

Starting in July, and continuing through October, or until the crop is harvested, enumerators return to the units each month to make plant and fruit counts of the cotton plants within the units and record findings on a Form B. These forms are then mailed to the field office where the data are reviewed, keyed, edited and analyzed.

4. PERSONAL DIGITAL ASSISTANTS

Personal digital assistants, commonly called PDAs, are mini-computers used to keep track of appointments, read e-mail, and review documents. Typically, PDAs are about 4 - 5.5 inches long, about three inches wide and 0.5 to 1 inch deep. This small size, combined with a weight of only 4 to 7 ounces, makes the device easy to handle. Data input typically occurs by the use of a stylus, (pen-like writing instrument used for data entry and screen navigation). Figure 1 shows a picture of a typical PDA and stylus (not to scale).

Figure 1:

5. WHY COTTON OBJECTIVE YIELD SURVEY?

The Cotton Objective Yield Survey was selected for field-testing PDA data collection for several reasons.

First, the COY is a survey that requires field enumeration.

Second, since this was the first time PDAs would be used to collect field data, a

questionnaire with relatively few pages was desired. Being only two pages, Form B fits this criterion. See Appendix A for a copy of the COY Form B.

Third, the paper version of Form B does not contain any questions displayed in a table format. In general, tables cannot be fully displayed on a PDA's small screen.

Fourth, the Form B is used month after month for the enumeration period, July through cotton harvest. This allowed the developer to focus on developing and testing one data collection form.

One additional factor was that the data being collected don't require any contact with the farm operator. Hence, if any problems occurred with the PDA, the enumerator could correct the problems without feeling rushed by the farm operator.

A data collection instrument for Form A was constructed but, due to time constraints, wasn't able to be tested and therefore wasn't used.

6. HARDWARE

Hewlett Packard (HP) PDAs were selected because the North Carolina FO already had ten HP iPAQ 3850 PDAs from the State Fair Climate Survey Project. Using similar hardware from the same company allowed the data collection instrument and data security to be designed around one platform. However the HP iPAQ 3850 was no longer available, so eight HP iPAQ 2210s were purchased so that each enumerator team was equipped with a PDA. The iPAQ 2210 was the least expensive and most comparable model to the iPAQ 3850 at the time. The term iPAQ, a registered trademark of HP, is used throughout the rest of the paper to denote the PDA being utilized in the project.

CompactFlash telephone modems were purchased so that the PDAs could transmit data over telephone lines through the NASS Access Server to the field office. The NASS Access Server is used for secure dial-up access to NASS computer systems; for this project it allowed enumerators to transmit data to and from the NC FO local area network. Also, rugged cases were purchased for eight of the PDAs to protect them from the elements.

Table 1 shows the breakdown of the hardware used for the COY project.

Table 1: Hardware Utilized

Hardware	Number
HP iPAQ 3850	10
HP iPAQ 2210	8
CompactFlash Telephone Modems	18
Rugged Cases	8
Stylus (Extra)	10

7. SOFTWARE

Visual Basic was chosen as the programming language for the data collection instrument since the software is compatible across iPAQ and PC platforms, and the NC FO had a computer specialist experienced with Visual Basic.

Encryption was necessary to ensure confidentiality of the data. The software Sentry 20/20 was selected because it was inexpensive, compatible with the iPAQ's platform and allowed the data to be encrypted and password protected. Eighteen copies were purchased, one for each iPAQ. A host copy of Sentry 20/20 was also purchased to provide the NC FO the capability to decrypt the transmitted data.

Each of the iPAQs was also password protected to ensure data security in case of theft or loss.

To transfer data from the field to NC FO's server, File Transfer Protocol (FTP) client software was required. FTP is the standard format for exchanging files over the Internet. In general, FTP is the process one uses to upload files to or download files from a server. Scotty FTP was selected because the software worked well in the iPAQ environment.

Slim Pocket and CedeFTP were also tested but both products had some functionality problems and were more cumbersome than Scotty FTP.

Dot Pocket was purchased for controlling the iPAQs through a PC, developing the data collection instrument, and for training purposes. Dot Pocket also allowed the developer to view the data collection instrument on a desktop computer, which made it easier for development and demonstrations.

Table 2 shows the software and number of copies utilized for the study.

Table 2: Software

Software	Number of Copies
Visual Basic	1
Sentry 20/20	18
Sentry 20/20 Host	1
Scotty FTP	18
Dot Pocket	1

8. DATA COLLECTION INSTRUMENT

As noted earlier, Visual Basic was the development software selected to build the data collection instrument. The instrument followed the paper form as closely as possible. Skip logic on the paper form was included in the instrument. Edits were included to check the validity of the data at the point of collection and thereby reduce enumerator errors and improve data quality.

The instrument was initially tested on a desktop computer before being placed on the iPAQ.

To access the programs on the iPAQ, the enumerator had to enter his/her username and password. After logging in, the enumerator's ID and his/her supervisory enumerator's ID, which were pre-stored on the iPAQ, as well as the date and time were automatically captured with the data being

collected. Figures 2, 3 and 4 show screenshots of the instrument as it appears on the iPAQ.

Figure 2: After the enumerator successfully logs into the iPAQ, the following screen appears, allowing the enumerator to access Form B.

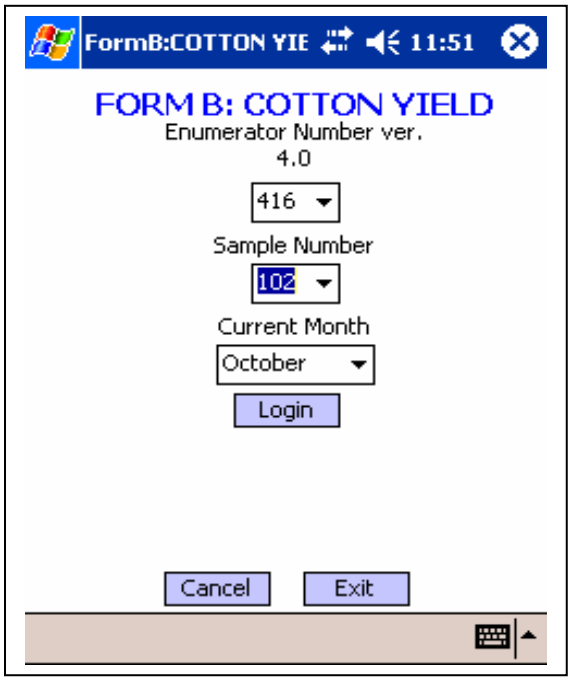


Figure 3: Form B's Unit Location Code Question.

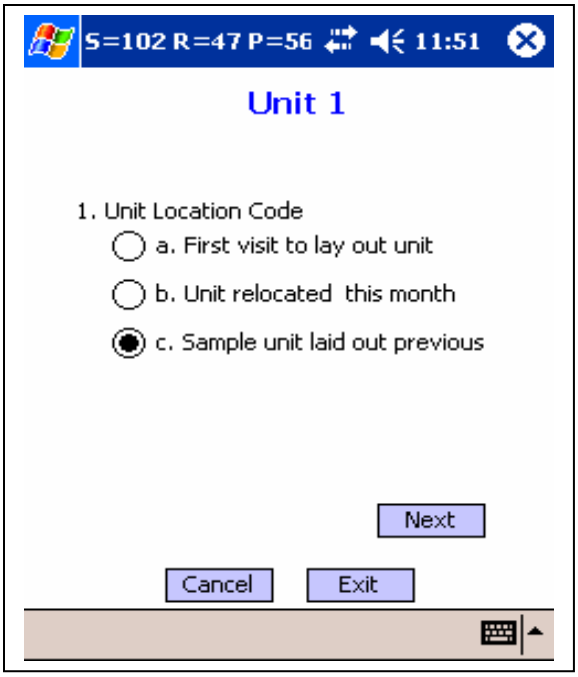
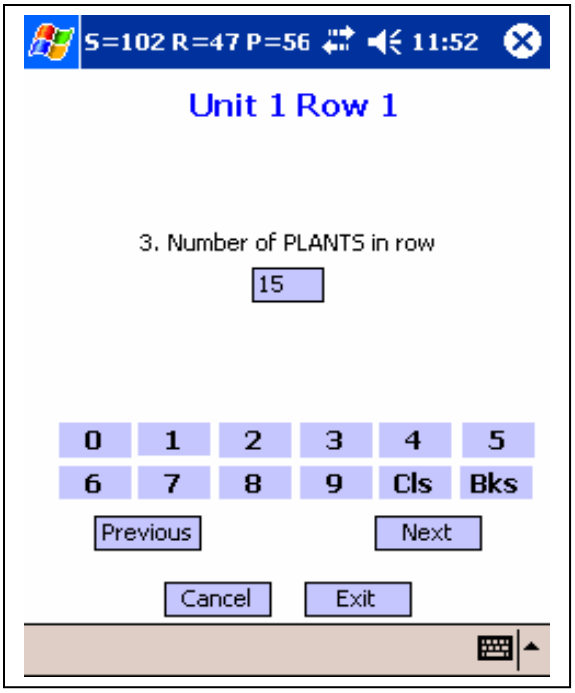


Figure 4: Enumerator uses the on-screen number pad to enter the value of the answer of the question.



With the data collection instrument being new, some bugs were detected after deployment. The NC FO staff had to troubleshoot some of these problems without seeing the iPAQs and only relying on the enumerator's words. Afterwards, the NC FO suggested that software to remotely access the enumerator's iPAQ would have helped by visually seeing the problem on the iPAQ.

9. TRAINING

From the start, the NC FO realized that many of the field enumerators had little or no computer experience. To better prepare the field enumerators, the NC FO staff introduced a prototype of the data collection instrument to the supervisory field enumerators in January of 2004. The data collection instrument was later modified based on the feedback received from these supervisory field enumerators.

In May of 2004, a four-hour PDA training session was held with the twenty-two COY field enumerators and supervisors. The data collection instrument programmer and the statistician supervising COY demonstrated the latest version of the instrument and updated the instrument based on the enumerators' comments.

During July 8-9, 2004, the survey training workshop was conducted for the Cotton Objective Yield Survey.

The morning of the first day was spent reviewing procedures to complete the various COY forms and visiting a nearby cotton field to practice laying out sample units. In the afternoon, training focused on using the iPAQs. Since the NC FO field enumerators work in pairs for COY, each pair was supplied with an iPAQ. The instructor quickly discovered that computer technology terms with which he was very familiar, such as 'mounting and dismounting the volume' and 'synching up', were well beyond his audience's experience and knowledge level. He was then able to make his presentation less technical so that non-computer users could easily comprehend. Initially, the field enumerators had difficulty entering their passwords. Those who had never used a computer were, at times, lost and became a little frustrated. This was due to unfamiliarity with using a stylus.

On the second day, the field enumerators returned to the same cotton field and used the iPAQs to collect practice data. Those who continued to have problems using the stylus were eventually able to enter the data successfully into his/her iPAQ.

After the field exercise, each pair of enumerators was scheduled to practice transmitting their collected data back to the NC FO. This required the enumerator to log into the NASS Access Server over the telephone line. However, the server was not functioning at the time. Hence, a hardcopy of the instructions was reviewed in place of the live practice.

Along with the formal training, enumerators were provided handouts that covered daily instructions, transmission instructions, and troubleshooting tips. Instructions for downloading updates to the iPAQ were also provided in case a problem was found with the data collection instrument. In such an event, the NC Field Office could update the software instrument and place this update on the field office's server for the enumerators to access and download.

Separate instructional handouts for the HP 3850 and HP 2210 were developed to accommodate each model. Appendix B contains a copy of the data transmission instructions for the HP 3850.

Overall, enumerators felt that the training workshop was informative. Most felt that as their experience with the iPAQs

increased, their comfort level with the iPAQs would improve. Enumerators appreciated the step-by-step instructions and wanted more troubleshooting scenarios included.

A week after the enumerator workshop, the NASS Access Server's problem was corrected. This allowed the NC FO staff to conduct three mini-training sessions to demonstrate how to transmit data. After the training, each enumerator was able to successfully transmit data.

10. FIELD DATA COLLECTION

Twenty-two field enumerators used the iPAQs for field data collection. Enumerators worked in pairs for collecting COY data. The COY sample size was 120.

11. DATA TRANSMISSION FROM THE FIELD TO THE OFFICE

First, enumerators charged the batteries on their PDAs. This was to avoid the PDA going into "hibernation" mode to save battery life. During "hibernation" mode, the screen darkens and the enumerator is unable to track the transmission. Second, they inserted the provided CompactFlash telephone modem into the iPAQ, connected a working telephone line to the modem, and restarted the iPAQ. Third, they connected to the NASS Access Server and accessed the iPAQ's FTP client software. Last, they uploaded the data to the NC FO's Server.

During several days, due to problems with the NASS Access Server, data transmission was not possible. The problem was resolved by replacing the server with a newer model.

Sometimes enumerators evoked a lock-out on the NASS Access Server by entering an incorrect password multiple times. This required personnel from NASS' Information Technology Division to reset the password.

Occasionally, an enumerator would also enter an incorrect password and thus lock himself/herself from gaining access to the NC FO server. This required the NC FO to manually unlock the enumerator's account.

Some enumerators were overwhelmed by the number of steps required to transmit data. For the HP 3850 and HP 2210, 38 and 34 steps, respectively, were required to maintain data confidentiality and network security.

Once the data reached the NC FO, an interface was developed to handle incoming files, view the transmitted data, and track refusals and completed samples. See Appendix C.

12. OBSERVATIONS AND PERSPECTIVES

This section details the perceptions and thoughts of the field enumerators and observations of staff from the NC FO, RDD and Census and Survey Division.

12.1 FIELD ENUMERATORS

In February 2005, the 22 field enumerators were sent a feedback form to obtain their perspective on using PDAs for the COY research project. See Appendix D for a copy of the enumerator feedback form. Sixteen enumerators returned the feedback form with information. The remaining six enumerators were neutral with no suggestions to use or not. The results were as follow:

When asked if they would like to use iPAQs to record other types of survey data in

the future, it was an even split, 50 percent (8 enumerators) indicated "yes" and the other half, "no". Of those wanting to use the iPAQ again, only one had no prior computer experience. For those that preferred not to use the iPAQ, three enumerators did not have prior computer experience. When asked if they would want to use the iPAQ again specifically for COY, 14 did and 2 did not.

Ten enumerators recorded the COY data onto the paper form, and later entered the data into the iPAQ just outside the field. Five enumerators entered the data directly into the iPAQ while in the field, and one entered the data at various locations.

The enumerators felt that there was a reduced number of calls from the field office concerning their work since the iPAQs' edits showed any errors while they were collecting the data. The enumerators also liked not having to rush to Federal Express to mail the paper forms.

However, there were four issues that the enumerators did not like about the iPAQs. First, the 34 to 38 steps necessary to encrypt and transmit the data seemed rather lengthy. Second, some enumerators had difficulty reading the iPAQ's screen due to sun glare. Third, enumerators did not like finding errors in the program, despite the field office's best efforts to provide a downloadable fix that day or the next. Finally, some enumerators were worried about protecting the iPAQ from the elements, like rain and dirt, and hence, wanted a more durable device. Four enumerators suggested that a belt clip/holster for the iPAQ might help in protecting the device from being dropped while removing/inserting the device from a pant/coat pocket.

Only one enumerator stated that the iPAQ's battery life was insufficient and suggested that a car charger should be provided.

Enumerators did not express any concerns over the security of the iPAQ. They were confident that the security procedures would be sufficient. They did feel that the data were as secure, if not more, than a paper questionnaire.

Regarding future uses of the devices, seven enumerators indicated that they would like short questionnaires such as the Quarterly Agricultural Survey on the iPAQ for data collection. The authors acknowledge that a Quarterly Agricultural Survey's questionnaire consists of 8 or more pages, making it a questionable candidate for an iPAQ application.

12.2 STAFF OBSERVATIONS

Staff from the NC FO, RDD, and the Census & Survey Division observed and/or worked with some of the field enumerators. In general the field enumerators appeared comfortable using the iPAQs. One enumerator commented that using the stylus was not much different than using paper and pencil. There were two distinct ways that the field enumerators used the iPAQs. The first way was by recording the data directly into the iPAQ. The second way was by entering the data onto the paper form first and then inputting the data into the iPAQ. Those that waited until the end felt that this way was faster for them. During one of the data collection observations, the iPAQ was accidentally dropped in the dirt, but luckily displayed no ill effects. Also, the data collection instrument would not allow Unit 2's data to be entered before Unit 1. This caused the field enumerators to adhere to the proper data collection procedures. Although, they could have recorded Unit 2's data on paper and then enter the data into the iPAQ, this idea wasn't thought of.

13. FINDINGS

Twenty-two enumerators successfully recorded the COY data into their iPAQs and transmitted the data to the NC FO.

The use of automated edits allowed most errors to be caught during data collection. Historically, errors were caught when the field office reviewed the completed forms or after the data were keyed and processed through a mainframe computer edit. This led to trying to contact the enumerator via telephone to resolve the issue. If the enumerator couldn't be contacted, the objective yield survey statistician had to make his/her best decision with the given information.

Some examples of errors that were corrected before data transmission are recording Row 2 data into Row 1, recording Unit 2's data before Unit 1, and entering the incorrect date or enumerator ID. Even for those enumerators who first recorded the data onto the paper form and later transferred the information into the iPAQ, many errors were caught and corrected.

Utilizing the iPAQs provided enumerators additional time to collect the data. In the past, the field enumerators had to reduce the data collection period by two days in order to allow for mailing the forms to the field office. This two-day window was needed for office staff to receive the forms via Federal Express, review the forms and correct any problems. By having the data transmitted the same day they were collected, the field office could review the data the same day or the next morning. This provided the field enumerators with an additional two days of data collection.

The need for keying completed forms in the field office was eliminated, since all data were electronically submitted from the field.

There was only one problem involving hardware resulting in an iPAQ becoming inoperable. This occurred when an iPAQ got wet in the pocket of an enumerator's rain jacket. This iPAQ did not have a rugged case which might have prevented it from being damaged.

14. BENEFITS & COSTS

This section examines the benefits and costs of using PDAs for collecting Cotton Objective Yield Survey data.

14.1 BENEFITS

Using personal digital assistants to collect COY data has several benefits. These include:

- Reduced data collection errors, saving office staff and enumerators' time and mileage to revisit sample plots. This resulted in an estimated $700 in savings.
- Provided additional time for enumerators to collect the data.
- Eliminated $3,500 in Federal Express costs in mailing completed forms to the office. This includes saved enumerator salary and mileage to ship the forms.
- Eliminated office data entry. This resulted in an estimated $800 savings (salary and benefits).
- Enabled preliminary data analysis to begin sooner since the statistician did not have to wait for the forms to be

received in the mail.

- PDAs can be re-used for next year's COY as well as other projects. The life span of the iPAQs utilized is 3-5 years, according to Hewlett Packard's Technical Support Center. This helps spread the initial hardware and software costs over time.

14.2 COSTS

The total cost for the project was $26,550. Hardware and software accounted for $5,850. Not included in these figures is the cost ($6,000) of the ten iPAQs which were acquired for another project.

No additional costs were incurred for the enumerator training workshop since the iPAQ training was incorporated into the overall COY workshop. However, three mini-training workshops were held a few days after the formal workshop to review the transmission process with enumerators. Each training session lasted an average of four hours. This additional training was necessary since the NASS Access Server wasn't operational during the enumerator training workshop. Total cost for enumerator and Field Office staff salaries, benefits, and travel was estimated at $2,700.

Salaries and benefits for the NC FO staff to research and develop the project, including developing the instrument and the data transmission/encryption process, creating instructions/handouts for the enumerators, training enumerators and answering calls from enumerators who had trouble using the iPAQs and/or transmitting the data, was approximately $18,000.

Finally, one iPAQ, as noted earlier, was damaged and would need to be replaced for next year's survey.

Table 3 shows the breakdown of these costs.

Table 3: iPAQ Project Costs

Item	Quantity	Cost $
HP3850	10	0
HP2210	8	3,200
Modem	18	1,050
Sentry 2020	18	700
Scotty FTP	18	450
Scotty FTP - Host	1	25
Dot Pocket	1	25
Rugged Cases (HP3850)	8	400
Training (Transmission)		2,700
Office Staff (Salary and Benefits)		18,000
Total		26,550

14.3 COST/BENEFIT CONCLUSION

It was difficult to conduct a precise cost/benefit analysis because of the subjective nature of many of the benefits and the inability to define the exact amount of cost savings. Putting a value on improved data collection procedures and the ability to analyze data more quickly is fairly subjective. Table 4 summarizes the estimated costs and savings in 2004.

Table 4: Estimated Costs versus Savings

Item	Cost $	Savings $
Hardware/Software	5,850	
Research and Development	18,000	
Training	2,700	
Federal Express		3,500
Sample Plot Revisits		700
Editing, Keying		800
Total	26,550	5,000

Enumerator cost per sample was $445 when the iPAQ technology was introduced in 2004. Comparing this cost with 2003's costs per sample ($453), when paper forms were used, shows that the savings per sample is trivial.

Hence, for the PDA project there was a $21,500 short-fall ($5,000 minus $26,500) in using the iPAQs.

Before this report was published the NC FO conducted the 2005 COY, the following looks at a five year cycle incorporating the additional cost information obtained in 2005.

The $18,000 in staff resources to research and develop the COY iPAQ program in 2004 was reduced to approximately $3,000 to maintain and improve the technology in 2005.

The total cost in year 1 was $26,550. The total cost for year 2 was $3,500. The projected costs in years 3-5 are estimated at $3,500 per year. (Three thousand dollars for office staff salaries and benefits to manage/maintain the data collection instrument and $500 for one replacement iPAQ per year.) Thus, the projected total out-of-pocket expenses for the first five years are estimated at $40,550.

However, eliminating Federal Express shipments, reducing additional sample plot revisits, and eliminating manual editing and data entry costs saved $5,000 in the first year. This equates to a total of $25,000 in savings over five years.

Hence, utilizing the iPAQ technology only for COY would cost an additional $15,550 over five years compared with the standard way of collecting data using the paper questionnaire only.

Note: In 2005, the cost per sample was $352. Compared with 2004's cost per sample of $445, this is a $93 in savings per sample. The reasoning for these substantial savings is still under review but if some of these savings are attributed to the iPAQ, then these additional savings will negate some of the $15,550 deficit.

15. LESSONS LEARNED

Data transmission speed was not a problem, but the number of steps required for transmission was cumbersome. A majority of the steps were associated with encrypting the data before transmission and authentication to the NASS Access Server. A future goal is to streamline the encryption/transmission process. This goal is more obtainable as NASS moves away from the NASS Access Server to a virtual private network. Problems were also encountered with enumerators incorrectly entering their passwords.

A PDA case that could be clipped on a belt would help the enumerators with accessing the PDA to record counts. This would provide a significant advantage over taking it in and out of a pocket.

If further expansion of PDA usage to other FOs is to occur, a back-up to the NASS Access Server is needed. Since the server was down during training, a live example of data transmission could not be shown, however, the NC FO had developed a hard-copy of the

transmission instructions.

16. FUTURE OF PDAS FOR DATA COLLECTION IN NASS

The future of PDAs for data collection within NASS needs additional investigation. Applications, like field enumerator timesheets, are currently being investigated by the NC FO. As more uses for PDAs are found, the benefit to cost ratio will improve, thereby opening the possibility of expanding the use of PDAs to additional field offices.

17. REFERENCES

Eklund, Bruce 1991, "Mobile Computerized Data Entry for the Livestock Prices Received Survey", SRB 91-10, United States Department of Agriculture, National Agricultural Statistics Service.

Eklund, Bruce 1993, "Computer Assisted Personal Interviews: Experience and Strategy", STB-93-01, United States Department of Agriculture, National Agricultural Statistics Service.

Eklund, Bruce 1994, "Computer Assisted Personal Interviewing, Office Data Processing, and the June Agricultural Survey", STB-94-01, United States Department of Agriculture, National Agricultural Statistics Service.

Gerling, Michael 2004, "A New Look into Portable Electronic Devices for Field Data Collection in the National Agricultural Statistics Service", White Paper-05-01, United States Department of Agriculture, National Agricultural Statistics Service.

Appendix A

Cotton Objective Yield Survey – Form B

UNITED STATES DEPARTMENT OF AGRICULTURE
NATIONAL AGRICULTURAL STATISTICS SERVICE

Form Approved
O.M.B. Number 0535-0088
Expiration Date 10/31/05
Project Code 104
QID - 120032B

FORM B: CORN YIELD COUNTS -- 2004

YEAR,CROP,FORM,MMDD (1-7)	
443 __ __ __ __	

Date (_____)

Has operator applied pesticides with organophosphorous content to the sample field? ( ) YES ( ) NO
If YES, enter latest application date _____ *and name of pesticide* _____.

UNIT LOCATION CODE

1. a. First visit to lay out unit . . . . . Code 1
   b. Unit relocated this month . . . . . Code 2
   c. Sample unit laid out previously . . . . . Code 3

Enter Code

UNIT 1	UNIT 2
302	307

Go to Item 3 when coded 3; otherwise go to Item 2.

ROW SPACE MEASUREMENTS

	UNIT 1	UNIT 2
2. a. Measure distance from stalks in Row 1 to stalks in Row 2 . . . . . **Feet & Tenths**	303 . ___	304 . ___
b. Measure distance from stalks in Row 1 to stalks in Row 5 . . . . . **Feet & Tenths**	305 . ___	306 . ___

MATURITY CODE

	For Month	Use Area Beyond	Maturity Code	Maturity Code
	Aug 1	Unit 1, Row 1	Pre-Blister . . 2	Dough 5
Designated Measurement Areas:	Sept 1	Unit 1, Row 2	Blister 3	Dent 6
	Oct 1	Unit 2, Row 1	Milk 4	Mature 7
	Nov 1	Unit 2, Row 2		

Husk the first 5 ears or silked ear shoots beyond the unit in the designated measurement area and examine for maturity. Enter the maturity code in the box for the corresponding ear, sum the five maturity codes and enter the total in cell 301.
If ears or silked ear shoots are not yet present, CHECK ( ) and complete Item 8 only.

Ear Number					Total of 5 ears
1	2	3	4	5	
					301

3. **Maturity code** of first 5 ears or silked ear shoots . . . . . .

3a. Will harvest occur within 3 days? . . . . . NO Go to Item 3b.
( ) YES Complete Items 8, 11, 12, 13, & 14.

3b. Are three or more ears in maturity code 7? . . . NO Go to Item 3c.
( ) YES Complete Items 8, 11, 12, 13, & 14.

3c. Does Cell 301 equal 23 or more? . . . . . NO Go to Item 3d.
( ) YES Complete Items 4, 5, 6, 7, 8, & 11.

3d. Does Cell 301 equal 13 to 22? . . . . . **( ) NO Complete Items 8, 9, 10, & 11.**
( ) YES Complete Items 4, 5, 6, 8, 9, 10, & 11.

	Ear Number				
	1	2	3	4	5
4. **Maturity code** of each of the first 5 ears Code 3 or higher (Copy maturity from Item 3. Replace Code 2 ears with next code 3 or higher.) . . . . . **Code**	320	321	322	323	324
5. Average **length of kernel rows** (Item 4 ears) . . . . . **Inches & Tenths**	326 . __	327 . __	328 . __	329 . __	330 . __
6. **Diameter of the ear** one inch from the butt of the Cob. (Item 4 ears) . . . . . **Millimeters & Tenths**	336 . __	337 . __	338 . __	339 . __	340 . __

7. Are 3 or more ears (Item 4) in maturity code 6 or 7?
   ( ) **NO Continue** with Item 8.
   ( ) YES -- (1) Harvest the first 5 ears beyond the unit which are coded 6 or 7.
   (2) Place the third and fourth ears in a cloth bag.
   (3) Place the other three (first, second, and fifth) ears in another cloth bag.
   (4) Place the bag with the third and fourth ears in the bag with the other three ears.
   (5) Complete a sample ID tag and mail to the **Regional Lab.**
   (6) **CHECK HERE ( )** when complete.

COUNTS WITHIN 15 FOOT UNITS

	UNIT 1		UNIT 2	
	ROW 1	ROW 2	ROW 1	ROW 2
8. Number of **stalks**	331	332	333	334
9. Number of **stalks with ears** or silked ear shoots (Item 9 cannot exceed Item 8 for any row)	341	342	343	344
10. Number of **ears** and silked ear shoots (Item 10 MUST equal or exceed Item 9 for any row)	351	352	353	354
11. Number of **ears** with evidence of **kernel formation** (Item 11 cannot exceed Item 10 for any row)	361	362	363	364

HARVESTING SAMPLE UNITS

	UNIT 1 ROW 1	UNIT 2 ROW 1
12. HUSK and TAG the 3rd and 4th ears in Row 1 of both units. Husk remaining ears and weigh ALL ears with grain in Row 1 of each unit regardless of maturity stage. **Number of ears** husked with grain (include 3rd and 4th ears) . . . . **Number** VERIFY: Cell 312 = 361 and 313 = 363.	312	313
13. **Weight of ears** with grain from Row 1 of each unit include 3rd and 4th ears, exclude weight of containers) . . . . . **Pounds & Tenths**	314 . __	315 . __

14. Place 3rd and 4th ears of Row 1 in separate plastic bags for each unit. After completing Items 12 and 13, send Form B to the State Office and send 3rd and 4th ears to the Regional Lab.

14a. Did you leave the ears of corn where the operator requested? ( ) YES ( ) NO

Enumerator Comments: _____

_____

_____

Enumerator _____

Did a supervisor assist you in working this sample? ( ) YES ( ) NO

Enumerator Number	390
Supervisor Number	391
STATUS CODE	380

Appendix B

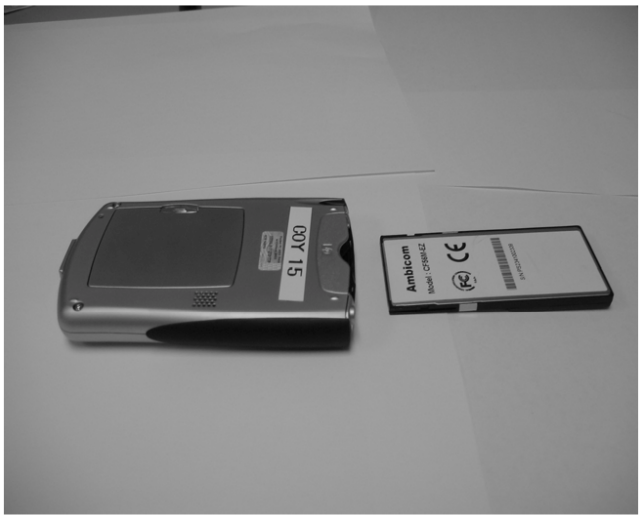
Transmission Instructions For The HP 3850

TRANSMISSION INSTRUCTIONS for IPAQ 3850

1- Make sure your IPAQ is charging. (plugged in to a power outlet)

2- Connect your Modem to your Compact flash slot. Take out the protective cover.

3- Insert the card on the empty slot.

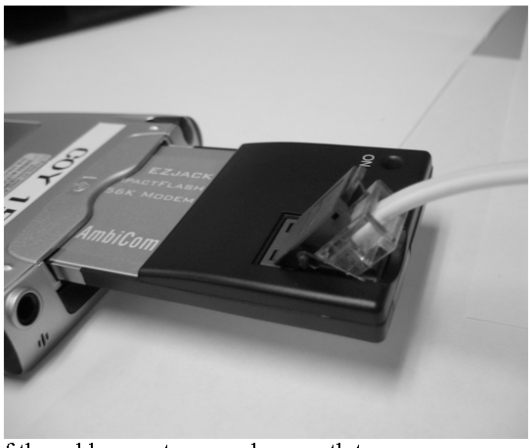


4- Push the modem slowly until it reaches the end.

5- Connect your Modem to your phone line. (You cannot use the phone while you transmit data)

a-Open the phone line tab on the modem.

b- Connect the phone cable to the modem



c- The other end of the cable goes to your phone outlet.

6- Turn on your IPAQ by clicking on the button at the top right corner of your IPAQ.

7- Click with the stylus on the Start Flag

8- Click on Sentry 2020

a- If you see a set of keys (gray and yellow) click on cy.raw with the stylus until you see a menu.

b- Click on Dismount.

c- If you don't see a set of keys proceed to the next step.

9- Click on the Start Flag.

10- Click on Settings.

11- Click on the Connections Tab (Lower right corner).

12- Click on the Connections icon (Top right corner).

13- Under Internet Settings click on the Connect button.

14- Click on the OK button. (Do not type anything in this box).

15- Click on the hide button

16- When you see a login screen, type in ….

Your username beside "username:"
Your password beside "password:"
Click OK.

17- You will see letters and symbols appear on the screen. It means you are connected.

18- Click on the OK Button at the top right corner.

19- If you see a Hide button click on it.

20- Click with the stylus on the Start Flag (Microsoft's window logo)

21- Click on Ruksun Scotty FTP

22- Click on Server

23- Click on Connect

24- Double-click (fast) on the nc sso icon.

25- Click on the Local Tab (left side)

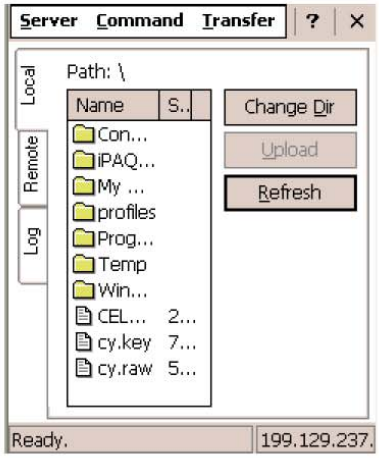
26- Click once on the cy.key file

27- Click on the upload button (right side).

28- Click once on the cy.raw file

29- Click on the upload button (right side).

30- You will see a message that tells you that it is transferring cy.raw and the percent done. (This is shown at the bottom of the Ruksun Scotty screen). The transfer may take 3 to 5 minutes…be patient. If your screen goes dark during transfer, gently tap the screen once to see the screen.



31- When it reaches 100%, it will complete the transfer. After that it will say Ready.

32- Click the X on the top right corner

33- Click on the OK on the top right corner

34- Click on the bidirectional arrows keys, which are located in your task bar at the top or bottom of the screen.

35 Click Disconnect

36- Unplug your modem

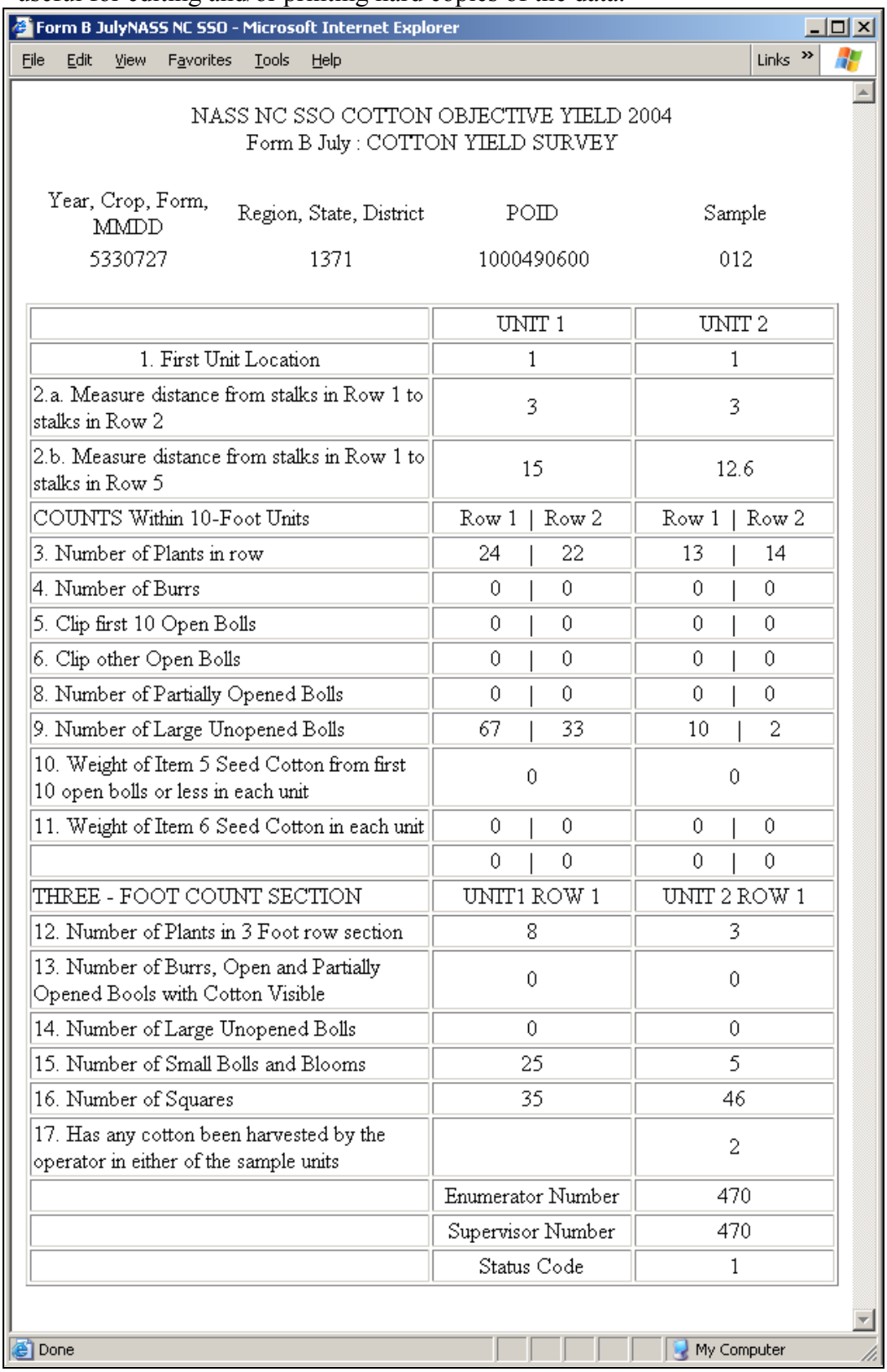
37- Remove the Modem by pulling on the card gently.

38- Replace the Modem cover. (From step 2).

Appendix C

Screen Shots of the Data Administrative Program

Screenshot of the data interface used to view the transmitted data. This was useful for editing and/or printing hard copies of the data.

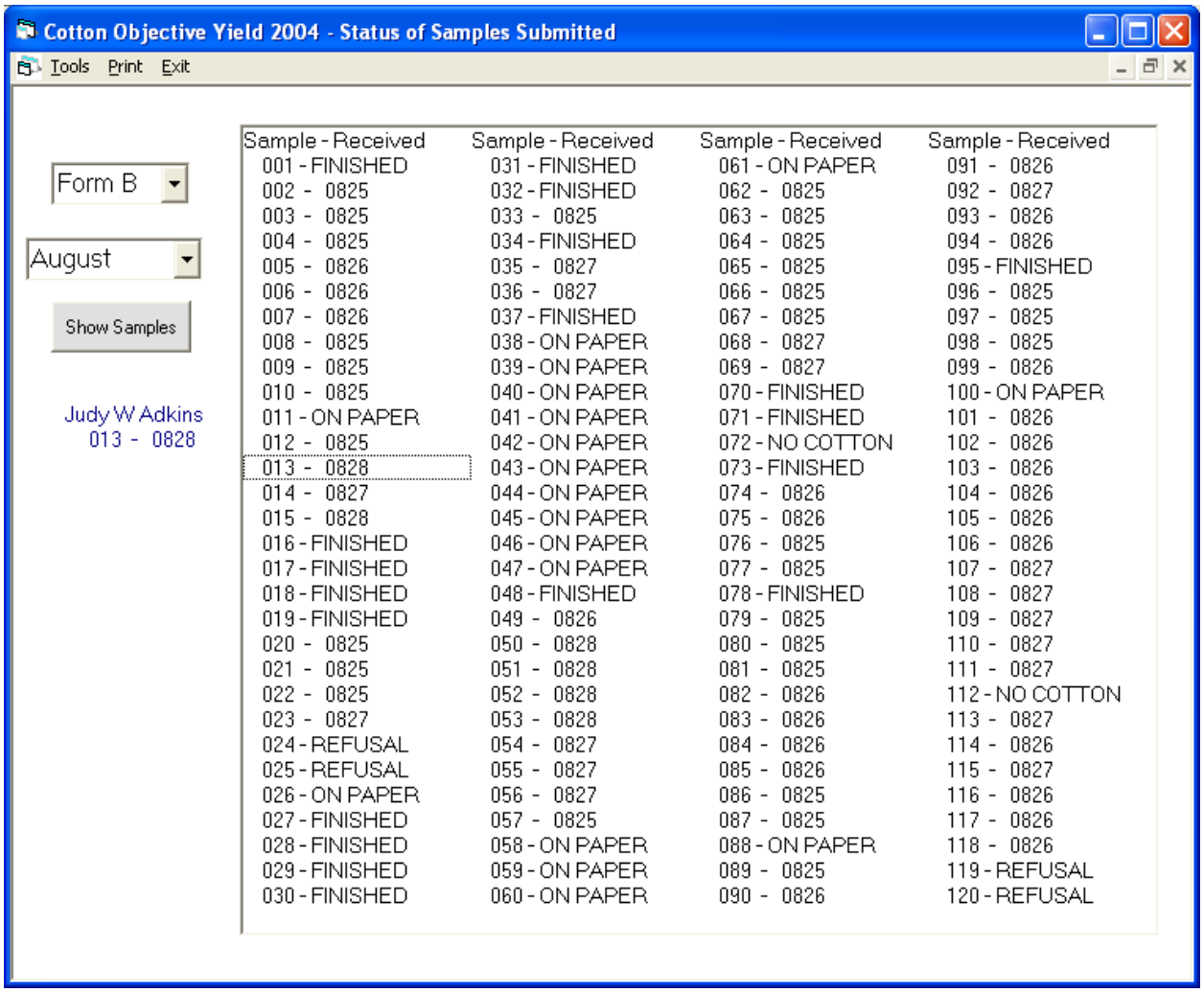


NASS NC SSO COTTON OBJECTIVE YIELD 2004
Form B July : COTTON YIELD SURVEY

Year, Crop, Form, MMDD	Region, State, District	POID	Sample
5330727	1371	1000490600	012

	UNIT 1	UNIT 2
1. First Unit Location	1	1
2.a. Measure distance from stalks in Row 1 to stalks in Row 2	3	3
2.b. Measure distance from stalks in Row 1 to stalks in Row 5	15	12.6
COUNTS Within 10-Foot Units	Row 1 | Row 2	Row 1 | Row 2
3. Number of Plants in row	24 | 22	13 | 14
4. Number of Burrs	0 | 0	0 | 0
5. Clip first 10 Open Bolls	0 | 0	0 | 0
6. Clip other Open Bolls	0 | 0	0 | 0
8. Number of Partially Opened Bolls	0 | 0	0 | 0
9. Number of Large Unopened Bolls	67 | 33	10 | 2
10. Weight of Item 5 Seed Cotton from first 10 open bolls or less in each unit	0	0
11. Weight of Item 6 Seed Cotton in each unit	0 | 0	0 | 0
	0 | 0	0 | 0
THREE - FOOT COUNT SECTION	UNIT1 ROW 1	UNIT 2 ROW 1
12. Number of Plants in 3 Foot row section	8	3
13. Number of Burrs, Open and Partially Opened Bools with Cotton Visible	0	0
14. Number of Large Unopened Bolls	0	0
15. Number of Small Bolls and Blooms	25	5
16. Number of Squares	35	46
17. Has any cotton been harvested by the operator in either of the sample units		2
	Enumerator Number	470
	Supervisor Number	470
	Status Code	1

Screenshot of the Sample Status Screen used in tracking refusals, missing and completed samples. By being able to query collection months, this served as a comprehensive reference for sample status. Data for the selected sample and month could be viewed by double clicking on the sample of interest



Appendix D

Enumerator Feedback Form

Evaluation of the IPAQ
For Data Collection
February 14, 2005

1. Would you like to use the IPAQ for the next Cotton Objective Yield in the field to record counts? Why or why not?

2. Would you like to use the IPAQ for the next Cotton Objective Yield in some capacity? How would you use it?

3. What other field data collection surveys could the IPAQ be used for?

4. Explain how you (and your partner) recorded counts into the IPAQ (i.e. at home, at edge of field, in the field, etc). Looking back, would you have changed how you recorded the data?

5. From your perspective, what we some of the benefits of using the IPAQ?

6. From your perspective, what we some of the obstacles you encountered? And your suggestion on any correction to them that we could make for 2005.

7. Have you used a computer (any type) before?

   _____ Yes _____ No

8. How would you rate the ease of use of the IPAQ in the field?

   ___ very easy ____ easy _____ difficult _____ very difficult

9. How would you rate the overall ease of use of the IPAQ?

   ___ very easy ____ easy _____ difficult _____ very difficult

10. Please comment on each of the following areas:

Durability of PDA (drops, rain, dust, mud)

Battery Life

Data Transmission

Security of the IPAQ

Training

Instructions/Hand-Outs

****

General comments:

_____

_____

_____

_____

Enumerator Name/Date: _____