# 2012 Evaluation of Blackeyes as a Rotational Crop in a Subsurface Drip Irrigation

C.A. Frate[1], L.J. Schwankl[2], S.C. Mueller[3],

Becky Phene[2], Walter Martinez[1], Kerista Hernandez[1], Yvonne Lopez[1], and Katherine Wilson[1]

Subsurface drip irrigation (SDI) is being used on an increasing number of acres on the west side of the San Joaquin Valley for cotton and tomatoes. Although the economic return from blackeye cowpeas would not justify installation of subsurface drip for their sake, growers who already have SDI for other crops might want to plant blackeyes. In addition, the amount of water applied is easier to control with subsurface drip compared to furrow irrigation making it easier in trials to evaluate the impacts of different timing and amount of water on blackeye production. The trial described below was the first year looking at subsurface drip irrigation on blackeyes at the UC Kearney Research and Extension Center.

## METHODS

The trial was conducted at the UC Kearney Research and Extension Center, Parlier, CA, in a Hesperia coarse loam soil. Due to a wet and cool spring, harvest of the preceding winter forage in the field to be used for the trial was delayed, pushing back the intended planting date from early May into June. After the forage harvest, the field was disked and furrowed out on 30-in centers. The drip tape (Bowsmith Bigfoot, 5/8", 8 mil, 12" emitter spacing, 0.45 gpm/100ft.) was installed at a depth of 8-10 inches in the center of each bed. This trial was the first at Kearney with subsurface drip and it was unknown if the water would sub up towards the soil surface to germinate seeds. The entire trial was pre-irrigated with furrow irrigation, prior to running any water through the drip lines which were still being configured and connected to deliver the desired treatments. Treflan Pro 5 (1 pt/A) and Dual Magnum (1.5 pt/A) were incorporated as beds were reformed and mulched on June 6.

The blackeye cowpea variety CB 46 was planted on June 7 at a seeding rate of 35 lb/A. Some of the seed was planted too shallow and did not germinate so all the drip lines were run and the furrow plots were irrigated again to establish a uniform stand. There was some trouble with a few of the drip lines because, when the field was pre-irrigated by furrow prior to running water through the subsurface lines, some of the soil settled and "set" on the flat tape. The drip system was run for three hours to force water through the lines. Eventually all but two of the lines in the harvest rows became fully functional. These additional irrigations for stand establishment and drip line function changed one of the intended treatments from a pre-bloom stress to a timing treatment for delivering 100% Evaporation transpiration (ET).

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[1] C.A. Frate, W. Martinez, K. Hernandez, Y. Lopez, and K. Wilson, UC Cooperative Extension, Tulare County, 4437 S. Laspina St., Tulare Ca 93274; [2]L.J. Schwankl and B. Phene, Dept. of Land, Air & Water Resources, UC Davis located at, Kearney Research & Extension Center; [3]S.C. Mueller, UC Cooperative Extension , Fresno County. Email: cafrate@ucanr.edu, **IN**: University of California Dry Bean Research 2012 Progress Report published by the California Dry Bean Advisory Board, 531-D North Alta Avenue, Dinuba CA 93618 and online at: http://beans.ucanr.org/.

Plots were 4 rows wide and 200 feet long. Yield data were collected from the middle 97 feet of the center two rows of each plot. “Drive rows,” irrigated by SDI, were established throughout the trial to allow for insecticide spray applications. These rows also served as buffers on either side of furrow irrigated treatments. Four subsurface drip irrigation treatments and one furrow irrigation treatment were replicated 4 times in a randomized complete block design.

Treatments consisted of: SDI at 75% ET; SDI at 100% ET every 2-4 days; SDI at 100% ET daily; SDI at 125% ET; and furrow irrigation. The blackeye ET used as the standard was that detailed by W.R. DeTar in his publication “Crop coefficients and water use for cowpea in the San Joaquin Valley of California.” [2] The DeTar crop coefficients (Kc) were used with the reference ET (ETo) values from the CIMIS (California Irrigation Management Information System) station located on the Kearney Research and Extension Center. Crop ET was determined as:

$$ETcrop = ETo \times Kc$$

In addition to scheduling irrigations using ET information, soil moisture information was collected to aid in irrigation scheduling. In one of the replications, Irrometer Watermark blocks installed at 6 in, 1 ft, 2 ft, 3 ft, and 4 ft depths, were placed in each of the irrigation treatments for a total of 5 soil moisture monitoring sites. The soil moisture blocks were connected to a Watermark data logger that collected readings every 8 hours.

Lygus bug populations were monitored and managed to keep the population below threshold levels. The entire trial was sprayed on July 6, 2012 with 1 lb/A Lannate and 0.5 pt/A buffer to control cowpea aphids primarily but also lygus bugs. An application of Macho 2.0 at 2.8 fl oz/A with Latron B 1956 at 2 fl oz/A was made on July 24 to control aphid and lygus. On August 2 and August 27, Lannate at 1 lb/A and a buffer at 1 pt/A were applied to control lygus bugs. Another lygus bug application of Warrior II at 1.92 oz/A and Latron B 1956 at 2 fl oz/A was sprayed on August 13. Due to repeated sprays for lygus bugs, leafminer populations began to surge. They were treated on Sept. 10, 2012, with Eipmek 1.5 at 12 oz/A. All applications were applied in 50 gal/A.

On September 28, harvest rows were cut and covered with nets to protect pods from birds. Beans were threshed on October 16. Beans were separated from trash using a series of large screens to remove debris and weighed. A seed splitter was used to obtain 5 lb samples that were passed through several smaller screens. All seeds passed through the 24/64 screen; all but a very few went through the 20/64 screen. Most of the seed did not pass through the 11/64 x ¾ oblong screen but dirt and peewees fell through. A 100 gram subsample of the seed caught on the 11/64 x ¾ oblong screen was evaluated for lygus damage, splits, and trash. Each blackeye seed in the 100 gram sample was evaluated and sorted into one of six categories; no damage, 1 lygus sting, 2 or more lygus stings, worm damage, stained or split, or trash. After the blackeyes were sorted into the categories each category was weighed and beans were counted.

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[2] DeTar, W.R. 2009. Crop coefficients and water use for cowpea in the San Joaquin Valley of California. Agricultural Water Management 96 (2009) 53-56.

## RESULTS

### Irrigation

The ET treatment amounts were the target irrigation amounts but applied water varies slightly due to the complications of managing actual irrigation events. The following table details the targeted and actual irrigation amounts.

Table 1. Irrigation amounts and treatment ET for five irrigation treatments, 2012 blackeye SDI trial, UC Kearney REC, Parlier, CA.

| Treatment | Estimated ET (in) | Applied Water (in) | Actual ET % |
|---|---|---|---|
| 75% ET | 13.30 | 11.90 | 67 |
| 100% ET 2-4 days | 17.73 | 16.28 | 92 |
| 100% ET Daily | 17.73 | 16.85 | 95 |
| 125% ET | 22.16 | 20.66 | 117 |
| Furrow | 17.73 | 22.0 | 125 |

The irrigation amounts in Table 1 do not include the pre-season stored soil moisture also available to the plants. This stored soil moisture, a result of pre-irrigation for plant germination, could be as much as 1.5 inches per foot for the Hesperia loam soil at the experimental site. The majority of the water uptake for the blackeyes occurred in the top 2 feet of soil (Figures 1-5 at the end of the report), resulting in 4 additional inches of stored soil water being available to the plants.

### Yield

There were no visual differences in growth among the treatments and the treatments did not have an impact on yield (Table 2). This would indicate that even the 75% ET treatment provided sufficient water for full blackeye production. This is further confirmed by the soil moisture information that shows that even the 75% ET irrigation treatment (Figure 1) retained sufficient soil moisture for full production throughout the season.

Table 2. Average yield of blackeyes from 2012 blackeye SDI trial, UC Kearney REC, Parlier, CA.

| Treatment | Weight after first screening (lbs/plot) | Weight as lbs/acre |
|---|---|---|
| 75% ET | 42.9 | 3,853 |
| Drip 100% ET 2-4 days | 39.4 | 3,539 |
| 100% ET daily | 42.6 | 3,828 |
| Drip 125% ET | 42.4 | 3,810 |
| Furrow | 44.1 | 3,961 |
| P-Value (0.05) | 0.247 | |
| LSD (0.05) | NS | |
| Coefficient of Variation (%) | 6.6 | |

## Quality

Data on lygus bug stings, worm damage and splits are listed in Table 3. There were no significant differences among treatments for any damage category.

Table 3. Blackeye damage evaluation based on a 100 gram subsample of each plot, 2012 SDI trial, UC Kearney REC, Parlier, CA.

| | No Damage | | 1 Lygus Sting | | 2 or More Lygus Stings | | Worm Damage | | Stained or Split | | Trash |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment | Weight (g) | Bean Count | Weight (g) | Bean Count | Weight (g) | Bean Count | Weight (g) | Bean Count | Weight (g) | Bean Count | Weight (g) |
| 75% ET | 85.6 | 419 | 3.0 | 15 | 8.3 | 45 | 1.0 | 5 | 2.2 | 11 | 0.1 |
| Drip 100% ET every few days | 86.3 | 436 | 3.1 | 16 | 8.2 | 47 | 0.7 | 4 | 1.7 | 9 | 0.2 |
| 100% ET daily | 84.2 | 429 | 5.0 | 26 | 8.2 | 45 | 1.0 | 6 | 1.6 | 8 | 0.3 |
| drip 125% ET | 86.4 | 439 | 3.6 | 18 | 7.7 | 46 | 0.8 | 5 | 1.5 | 8 | 0.1 |
| furrow | 82.6 | 418 | 4.8 | 25 | 10.3 | 58 | 1.1 | 7 | 1.4 | 7 | 0.0 |
| P-Value (0.05) | 0.397 | 0.226 | 0.321 | 0.304 | 0.355 | 0.417 | 0.893 | 0.876 | 0.427 | 0.474 | 0.333 |
| LSD (0.05) | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| CV % | 3.7 | 3.5 | 43.2 | 42.2 | 21.3 | 22.4 | 73.0 | 66.9 | 37.2 | 35.0 | 118.0 |

## DISCUSSION AND SUMMARY

There are 3 possible explanations for the lack of irrigation amount impact on yield and size. First, the irrigation amounts, supplemented by stored soil moisture supplied by the pre-irrigation, were sufficient to satisfy crop ET. However, it would still be expected that the 75% ET (67% ET actual) would show signs of soil moisture depletion later in the season, but this was not the case.

A second explanation is that the crop coefficient values used may be over-estimates. The actual blackeye ET would therefore be less then calculated. The peak crop coefficient values from the DeTar work were in the neighborhood of 1.25. This is a high crop coefficient value, as high as any accepted crop coefficient values for any agricultural crop.

Finally, there was only a single soil moisture monitoring site for each irrigation treatment, so there could be error in the soil moisture information. The soil moisture monitoring results appear to be quite good though, indicating the expected response to irrigation events and showing substantial response at the 6 inch and 12 inch depths while showing a lesser response at the greater depths. It is felt that the soil moisture data is quite reliable.

Analysis of the project's results indicates to the PI's that the crop coefficients that were used may be too high and that the actual blackeye ET may be less than current information states.

We acknowledge and thank the field staff at the UC Kearney REC without whose assistance we could not have conducted this trial.

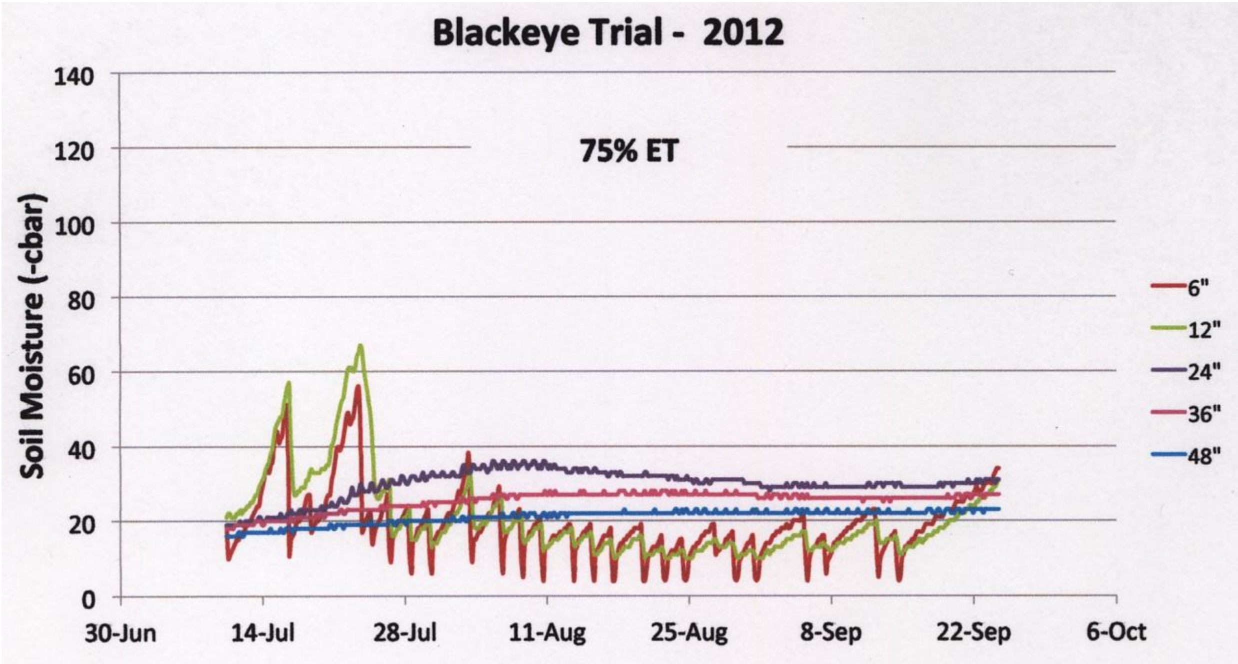


Figure 1. 2012 season soil moisture levels in the 75% ET irrigation treatment. The soil moisture was monitored using Watermark soil blocks connected to a Watermark data logger.

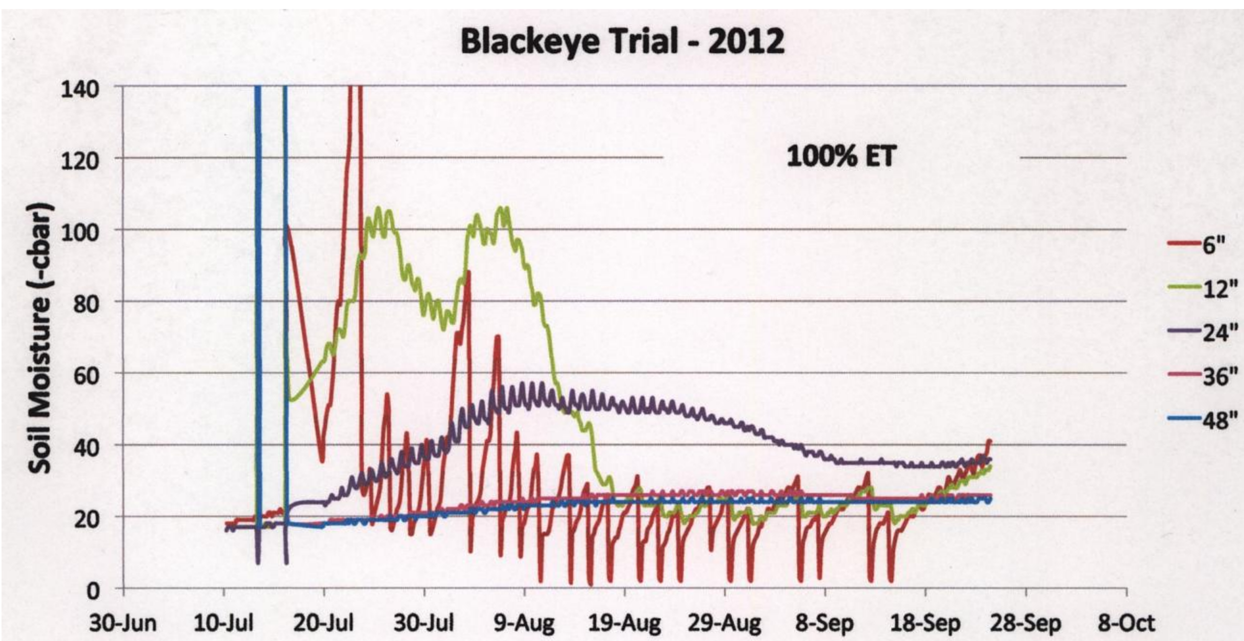


Figure 2. 2012 season soil moisture levels in the 100% ET irrigation treatment. The soil moisture was monitored using Watermark soil blocks connected to a Watermark data logger.

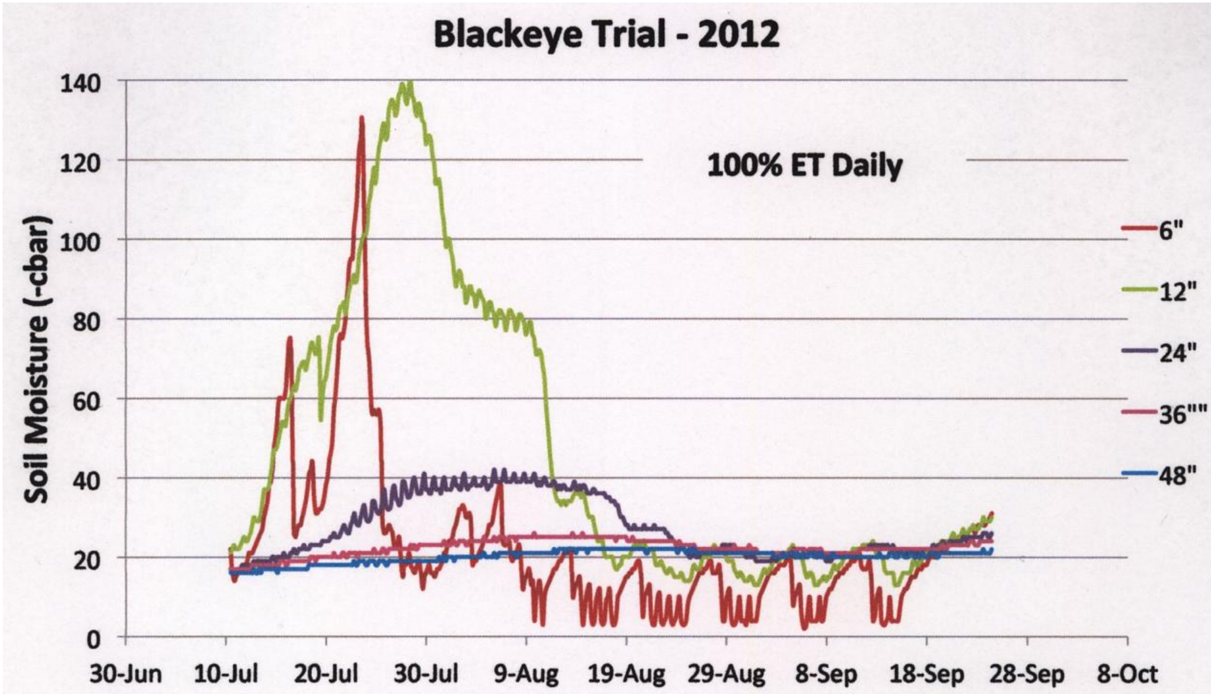


Figure 3. 2012 season soil moisture levels in the 100% ET, daily application irrigation treatment. The soil moisture was monitored using Watermark soil blocks connected to a Watermark data logger.

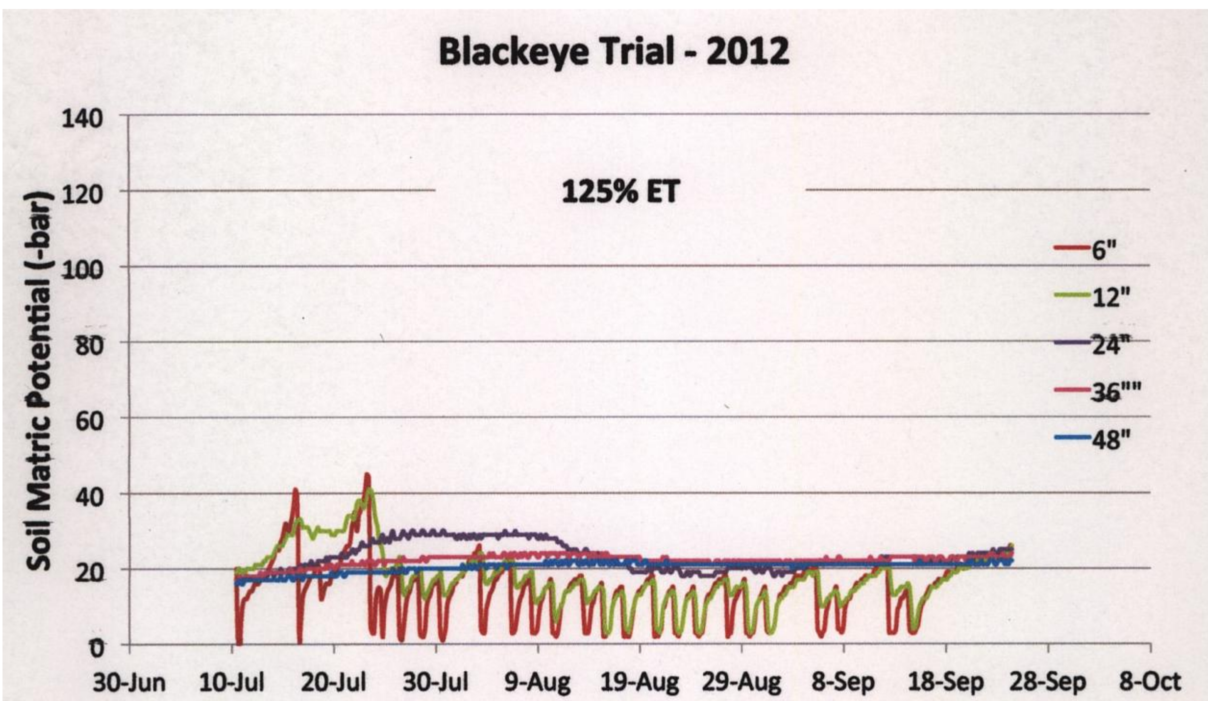


Figure 4. 2012 season soil moisture levels in the 125% ET irrigation treatment. The soil moisture was monitored using Watermark soil blocks connected to a Watermark data logger.

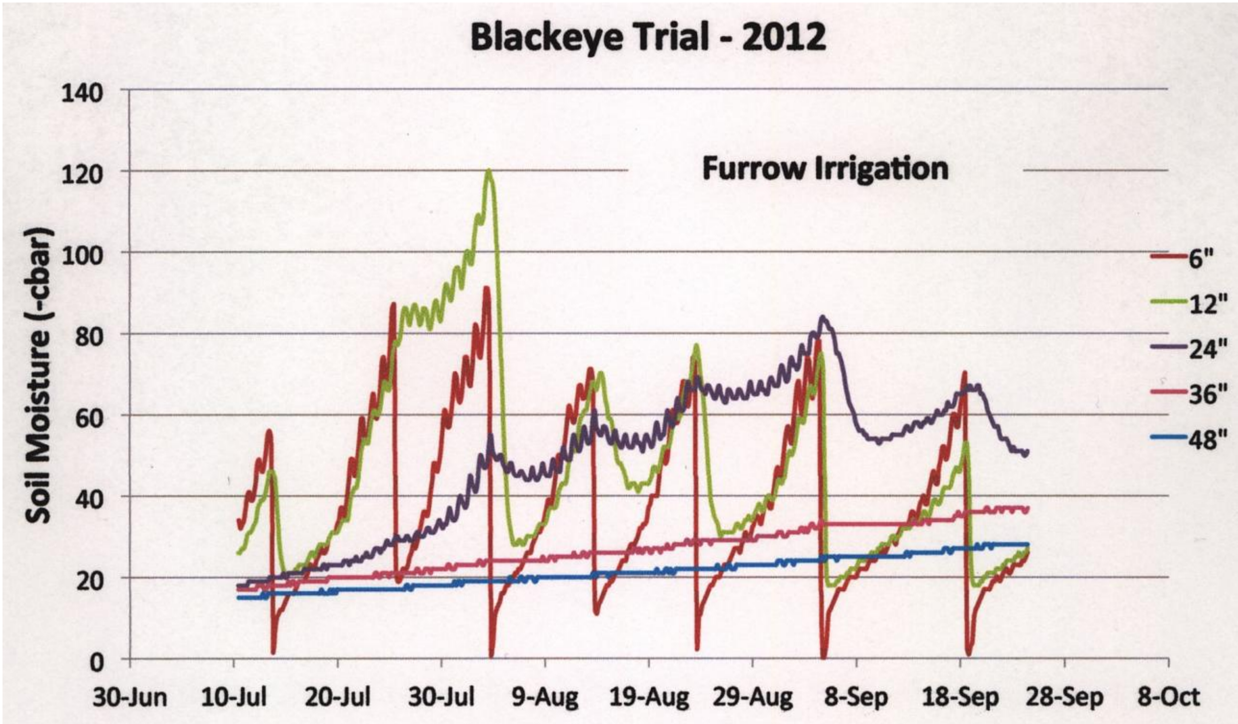


Figure 5. 2012 season soil moisture levels in the furrow irrigation treatment. The soil moisture was monitored using Watermark soil blocks connected to a Watermark data logger.