Cotton Water Use and Lint Yield in Four Great Plains Soils
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ABSTRACT
The development of earlier maturing, cool temperature tolerant varieties of cotton (*Gossypium hirsutum* L.) has allowed cotton production to expand into regions with shorter, cooler growing seasons. The objective of this research was to evaluate the interactive effect of soil type, irrigation, and meteorological conditions on the water use and lint yield of cotton grown in four U.S. Great Plains soils. Cotton was grown in 2005 through 2007 in 48 weighing lysimeters which contained clay loam, silt loam, sandy loam, or fine sand at Bushland, TX, with irrigation beginning after emergence. The seasonal heat units (HU) from planting to harvest were 1010°C in 2005, 1075°C in 2006, and 985°C in 2007. From seedling to beginning boll development, reference evapotranspiration averaged 7.6 mm in 2005, 8.5 mm in 2006, and 6.7 mm in 2007. Lint yield was significantly related to open boll number at harvest in all soils and years. Averaged cotton lint yields for the 2005 and 2007 full and deficit irrigation treatments were significantly larger in the fine sand (160 g m⁻²) than in the other soils (126 g m⁻²). In 2006, cotton lint yield in the fine sand was significantly smaller (101 g m⁻²) than the average of the other soils (147 g m⁻²). Cotton lint yield increased in the silt loam soil and decreased in the fine sand as seasonal HU increased. Early season meteorological conditions which influenced square shedding and boll development may have affected lint yields interactively with soil texture and irrigation.

The unreliability and scarcity of precipitation has caused cotton producers in the Great Plains to use irrigation to provide the water needed to achieve profitable yields. In areas where planting into a full soil water profile is unlikely because of lack of sufficient precipitation, early season irrigation is often necessary for crop emergence. Early season irrigation, however, also has the potential of cooling the soil below optimal temperatures for cotton growth, especially when planting in a shortened growing season when temperature is already growth limiting (Grimes and El-Zik, 1990). Irrigation increases the heat capacity of a soil, and the upper root zone of soils with higher water holding capacities will be slower to warm after irrigation compared with those with a lower water holding capacity. Soil temperature affects both the rate and thoroughness with which a plant root system permeates soil (Kaspar and Bland, 1992). Grimes et al. (1978) pointed out that vegetative development of cotton early in the season affects plant responses through the entire growth period and that good early growth is needed for heavy fruiting. Too low or too high temperature can result in square shedding (Grimes and El-Zik, 1990), and retention of the first squares is critical in regions with short growing seasons because these are the fruit most likely to accumulate sufficient HU to mature. Buttar et al. (2007) found

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Abbreviations: DAP, days after planting; DOY, day of year; ET, evapotranspiration; ET₀, reference evapotranspiration; HU, heat units.
that the when the first irrigation was delayed by 14 d, seed cotton yield of cotton increased by an average of 13% over 3 yr in a loamy sand. Jalota et al. (2006) simulated the interactive effects of soil texture, precipitation, and deficit irrigation on cotton yield and found that yield declined less in coarse-textured soil than in fine-textured soil as irrigation amount was reduced.

Management strategies are needed to maximize lint yields of the more drought-tolerant cotton so that it can replace maize as irrigation supplies decline. In a semiarid climate with a short-ened growing season, we hypothesized that soil texture, irrigation, and meteorological conditions might interactively affect the water use and increase lint yield of cotton grown in four Great Plains soils. The soil types ranged from fine sand to clay loam, with irrigation beginning early in the growing season.

**MATERIALS AND METHODS**

The experiment was conducted at the Soil-Plant-Environment Research (SPER) facility, USDA-Agricultural Research Service, Conservation and Production Research Laboratory, Bushland, TX (35°11' N, 102°06' W, 1170 m elevation above mean sea level). The SPER facility was located in a 0.25-ha field with a 0.25-ha field with a rain shelter facility in which there were 48 weighing lysimeters containing four different soil series. The lysimeters were 1.0 m by 0.75 m, and 2.4-m deep and contained monolithic cores to about a 2.3-m depth with a vacuum drainage system in the bottom. The lysimeters were arranged in two pits, with each pit containing two side-by-side rows of 12 lysimeters each. Soil series were randomly located within each pit. There were 12 lysimeters of each soil series. The rain shelter was a metal building 13 by 18 m by 3.7-m high, with a control system that automatically initiated building movement over the lysimeters when about 1 mm of rain was detected. Complete details concerning the monolithic core collection techniques and SPER facility can be found in Schneider et al. (1993) and Tolk et al. (2005).

The lysimeter mass was measured using deck scales (DS3040-10K, Weigh-Tronix, Fairmont, MN). The deck scales were excited and measured by a data acquisition system (CR-7X, Campbell Scientific, Inc., Logan, UT). Lysimeter scale mass data were acquired on a 0.1-Hz sampling interval and composited into 30-min means for output. The deck scales were calibrated after installation, and the calibration checked yearly before the cropping season. Calibration results were reported in water depth equivalence (mm), with 0.75 kg of mass representing 1 mm water depth equivalence based on a water density of 1.0 Mg m~3. A typical root mean squared error (RMSE) of the calibration was 0.09 mm. Complete calibration procedures can be found in Tolk et al. (2005). The 30-min output of the deck scales was used to measure any gain in mass due to water infiltration such as irrigation or precipitation and loss of mass due to drainage or evapotranspiration (ET). The lysimeters were drained periodically using a vacuum pump attached to the drainage system on each lysimeter. Daily ET was calculated as the change in soil water storage calculated from the difference in lysimeter mass recorded at midnight of consecutive days, plus any water added as precipitation and irrigation and minus any drainage during that period.

Heat units were computed as the mean of the daily maximum and minimum air temperatures minus the base temperature of 15.6°C (Peng et al., 1989; Wanjura et al., 2002). Air temperatures were measured at a weather station with irrigated, cool season grass about 1000 m from the SPER facility.

The climate at Bushland is typical of the semiarid High Plains, which has a high annual evaporative demand of ~2600 mm (based on Class A pan evaporation) and precipitation averaging about 470 mm. About 70% (350 mm) of the precipitation occurs from May to September when evaporative potential averages ~1520 mm. Wind direction is predominately from the south-southwest. During the experiment, the lysimeter area was surrounded by similarly cropped cotton for about 30 to 35 m in the prevailing wind direction. About 450 m of dryland grain sorghum was south of the SPER facility, and a heterogeneous landscape of grassland, playa, and irrigated and dryland cropland extended more than 1700 m to the southwest.

**Agronomy**

The lysimeters were planted with cotton (Delta and Pine Land Co., ‘DP-2280’, Monsanto Co., St. Louis, MO) in 2005, 2006, and 2007 at a density of 13.3 plants m~2 in a single row down the center of each lysimeter, which maintained a 0.75-m row spacing with the adjacent lysimeters and surrounding cropped area. The crop was planted on Day of Year (DOY) 158 (7 June) and harvested on DOY 313 (9 November) and DOY 322 (18 November) in 2005. It was planted on DOY 145 (25 May) and harvested on DOY 304 (30 Oct.) in 2006, and planted on DOY 157 (6 June) and harvested on DOY 291 (18 October) in 2007. The lysimeters were fertilized according to recommendations based on soil analyses before planting for each soil. Plant nutrients were applied in broad bands on either side of the plant row. Tillage was done by hand to a depth of about 0.2 m. The cotton in the lysimeters was hand harvested, and the bolls ginned.

Irrigation amounts were determined using the crop coefficient approach based on reference evapotranspiration (ET~0~) (Doorenbos and Pruitt, 1975; Jensen et al., 1970; Allen et al., 1998) adjusted with crop coefficients developed at Bushland, TX for cotton (Howell et al., 2006). Irrigation treatments in 2005 and 2006 were 100% (T-100) and 50% (T-50) replacement of adjusted ET~0~ with the T-100 treatment simulating full irrigation and the T-50 treatment simulating deficit irrigation. Two additional soil water treatments were created by irrigating the lysimeters before planting to have either about 125 or 200 mm plant available water in the anticipated root zone. The irrigation treatments in 2007 were 100, 50, 25 (T-25), and 0% (T-0) replacement of adjusted ET~0~, with the T-25 irrigation treatment also simulating deficit irrigation. Irrigation treatments were changed in 2007 to provide a greater range in irrigation treatments. The lysimeters were uniformly irrigated in 2007 to about 150 mm plant available water in the root zone before planting. There were three replicates of each irrigation treatment or irrigation treatment/soil water treatment combination in each soil type. Irrigation applications were applied twice weekly using pressure-compensating point source drip irrigation emitters. Irrigation began at planting.

**Soils**

Soil types were Pullman clay loam (fine, mixed, superactive, thermic Torrertic Paleustolls) from Bushland, TX; Ulysses silt loam, with irrigation beginning early in the growing season.
loam (fine-silty, mixed, superactive, mesic Aridic Haplustolls) from Garden City, KS; Amarillo sandy loam (fine-loamy, mixed, superactive, thermic Aridic Paleustalfs) from Big Spring, TX; and Vingo fine sand (coarse-loamy, mixed, superactive, mesic Aridic Paleustalfs) from Dalhart, TX. The textural analyses by depth are shown in Fig. 1. The soils were selected to provide a range of textural classes of agricultural soils. The Amarillo, Pullman, and Ulysses soil series each are extent on about 1,340,000 ha and the Vingo on about 50,000 ha of the southern and central Great Plains.

The Pullman soil series is a deep, well drained, very slowly permeable soil that formed in calcareous clayey materials. It has a moderate to high water-holding capacity depending on the depth to the calcium carbonate horizons, which begin at about 1 to 1.5 m, and it has a dense Bt layer at about 0.8 m. The Ulysses soil series is a very deep, well drained, moderately permeable upland soil that formed in calcareous loess and has a high water-holding capacity. The Amarillo soil series is a deep, well drained, moderately permeable soil that formed in calcareous loamy materials that has a moderate water-holding capacity, calcium carbonate horizons beginning at about 1 m, and relatively high bulk densities. The Vingo soil series is deep, well drained, moderately rapidly permeable soil formed in sandy materials of eolian origin. Estimated water holding capacities to 2.2 m are 277 mm for the Amarillo sandy loam, 273 mm for the Pullman clay loam, 300 mm for the Ulysses silt loam, and 176 mm for the Vingo fine sand (Ratliff et al., 1983).

**Soil Temperature**

Soil temperature was measured from DOY 127 (7 May) to DOY 146 (26 May) in 2009 by inserting two copper-constantan subminiature thermocouple probes (Omega Engineering, Inc., Stamford, CT) at 0.15 m in a lysimeter containing Vingo fine sand and two probes into a lysimeter containing Ulysses silt loam. The probes were measured by a data acquisition system (CR-7X, Campbell Scientific, Inc., Logan, UT) and the data were acquired on a 0.1-Hz sampling interval and composited into 30-min means for output. Irrigation application amounts of ~35 mm were applied on DOY 133 (13 May) and DOY 142 (22 May).

**Statistical Procedures**

Linear regression analysis was performed using a general linear regression model (Sigmaplot for Windows, v. 10, Systat Software, Inc., San Jose, CA). To determine whether the linear relationship differed among years, the difference among years of the slope and intercept of the lint yield and seasonal ET and lint yield and open boll number at harvest relationships were analyzed using the procedures outlined by Freese (1964). Measurements of lint yield, open boll number, and lint per boll compared among soil types in each year were analyzed using the General Linear Model procedures of PROC GLM (SAS Institute, 1985). Mean separations were computed using the Ryan–Einot-Gabriel-Welsch multiple range test which controls Type 1 experimental error. The measurements comparing among years within each soil type and irrigation treatment (T-100 and T-50) were analyzed using a mixed linear model PROC Mixed (Littell et al., 1996) with years as the main effect.

**RESULTS**

The seasonalHU from planting until harvest or first frost were 1010°C in 2005, 1075°C in 2006, and 985°C in 2007 (Fig. 2). The 20-yr average seasonal HU accumulated from 15 May through 15 October for Bushland, TX is 1090 (±235) °C. The three seasons varied in their distribution of HU and average ETo within the season, which was divided into four crop developmental periods: 0 to 30 d after planting (DAP) (seedling development), 31 to 60 DAP (floral initiation), 61 to 90 DAP (boll development), and 90+ DAP (boll maturation) (Peng et al., 1989). In the first 30 DAP, HU accumulation was 269°C in 2005, 302°C in 2006, and 217°C in 2007, and average daily ETo was 7.9 mm for 2005, 9.9 mm for 2006, and 6.8 mm for 2007. From 31 to 60 DAP (floral initiation), cumulative HU were 549°C in 2005, 582°C in 2006, and 476°C in 2007, and average daily ETo was 7.3 mm for 2005, 7.1 mm for 2006, and 6.6 mm for 2007. Cumulative HU were 789°C in 2005, 876°C in 2006, and 760°C in 2007, and average daily ETo was 5.2 mm for 2005, 6.4 mm for 2006, and 6.7 mm for 2007 during boll development from 61 to 90 DAP.

The T-50 and T-100 irrigation treatments were used in the three cropping seasons. In the 2005 T-100 irrigation treatment (Table 1), the lint yield of cotton in the Vingo soil (171.9 ± 17.3 g m⁻²) was significantly larger (P < 0.05) by 15% than the lint yield of the cotton in the Pullman soil (146.6 ± 147.2 g m⁻²) with similar water holding capacities of 277 mm for the Amarillo sandy loam, 273 mm for the Pullman clay loam, 300 mm for the Ulysses silt loam, and 176 mm for the Vingo fine sand (Ratliff et al., 1983).
In the 2007 T-100 irrigation treatment, the lint yield of the cotton in the Vingo soil (191.6 ± 11.8 g m⁻²) was significantly larger (P < 0.05) than the lint yield of the cotton in the Ulysses soil by 27% and the cotton in the Pullman by 23%. In 2007, the lint yield of the cotton in the Amarillo soil (176.1 ± 20.2 g m⁻²) was similar to that in the Vingo soil, and the cotton in those soils had a significantly larger number of open bolls compared with the cotton in the Pullman and Ulysses soils. There were no significant differences in the amount of lint per boll among soil types in any year in the T-100 irrigation treatment.

In the 2006 T-100 irrigation treatment, the maximum lint yield of 183.5 (± 24.7) g m⁻² was produced by the cotton in the Ulysses soil, followed by a similar lint yield of 166.8 (± 16.0) g m⁻² produced by the cotton in the Pullman soil. The lint yield produced by the cotton in the Vingo soil (98.2 ± 13.3 g m⁻²) was 46% smaller and the lint yield from the Amarillo soil (152.5 ± 25.8 g m⁻²) was 17% smaller than the maximum lint yield of the cotton in the Ulysses soil. There were significantly fewer open bolls in the crop in the Vingo soil compared with the crops in the other soils.

When comparing each soil type's T-100 yield components among years (Table 1), the lint yield of the cotton in the Pullman soil was similar in 2005 and 2007 but was significantly larger in 2006 with a 14% increase in lint yield in 2006 compared with 2005 and 2007. The maximum number of open bolls (121 ± 8 bolls m⁻²) produced by the cotton in that soil type also occurred in 2006. The lint yield of the cotton in the Ulysses soil was also similar in 2005 and 2007, but lint yield was 32% larger and open boll number was 39% larger in 2006 compared with 2007. This was reversed for the cotton in the Vingo soil, which produced significantly larger lint yields and open boll number in 2005 and 2007 compared with 2006.

The yield increases in the Pullman and Ulysses soils were primarily due to the increase in the number of open bolls rather than the lint yield per boll. Comparing among years in the Pullman soil, the lint yield per boll in 2006 (1.38 ± 0.09 g boll⁻¹) was significantly smaller than 2005 (1.91 ± 0.18 g boll⁻¹) and 2007 (1.65 ± 0.23 g boll⁻¹), but 2006 produced the largest lint yield. For the cotton in the Ulysses soil, lint yield per boll in 2006 (1.46 ± 0.13 g boll⁻¹) was significantly smaller compared with 2005 (1.97 ± 0.15 g boll⁻¹) but similar to the lint yield per boll in 2007 (1.55 ± 0.05 g boll⁻¹) but 2006 produced the largest yield. The lint yield per boll was also significantly smaller in 2006 in the Amarillo and Vingo soils compared with the lint yield per boll in 2005 and 2007.

For the T-50 irrigation treatment (Table 2), the cotton in the Vingo soil produced at least 20% more lint yield in 2005 compared with lint yields from the cotton in the Amarillo, Pullman, and Ulysses soils and at least 56% more lint yield in 2007 compared with the cotton in the Pullman and Ulysses soils. In 2006, the cotton in the Vingo soil produced the numerically smallest yield (103.7 ± 6.4 g m⁻²), which was similar to the Vingo lint yield (98 ± 13 g m⁻²) in the T-100 treatment for that year. Comparing among years within each soil type, the cotton in the Amarillo, Pullman, and Ulysses soils tended to have the largest lint yields and open boll number and the smallest lint per boll in 2006 compared with the other 2 yr.

The irrigation treatments in 2007 also included T-0 (no irrigation) and a T-25 (25% replacement of adjusted ETo) treatment. The T-0 irrigation treatment produced no yield with a seasonal measured ET of 210 mm in the Pullman soil and with...
a seasonal measured ET of 247 mm in the Ulysses soil. An ET of 261 mm did produce 34 g m\(^{-2}\) of lint yield in the Amarillo soil, and an ET of 253 mm produced a lint yield of 42 g m\(^{-2}\) in the Vingo soil. The T-25 irrigation treatment produced lint yields of 42 g m\(^{-2}\) (335 mm ET) in the Pullman soil, 55 g m\(^{-2}\) (349 mm ET) in the Amarillo soil, 103 g m\(^{-2}\) (429 mm ET) in the Ulysses soil, and 115 g m\(^{-2}\) (391 mm ET) in the Vingo soil.

Lint yield and ET were regressed across all irrigation treatments for each year within each soil type to determine whether the two were significantly related and, if a linear relationship existed, whether the linear relationship was similar among years (Fig. 3). The regression of lint yield and ET produced significant linear relationships \((P < 0.01)\) each year for the cotton in the Pullman and Ulysses soils. For the cotton in the Amarillo soil, lint yield was significantly related \((P < 0.01)\) to ET in 2005 and 2007, but only weakly related \((P = 0.07)\) to ET in 2006. The ET and lint yield relationship for the cotton in the Vingo soil ranged from no relationship \((P = 0.2)\) in 2006 to significantly related \((P < 0.01)\) in 2007. In the Pullman and Amarillo soils, the analysis of the slopes and intercepts of the ET and yield relationship showed that there were no significant differences in lint yield response to ET between 2005 and 2007, but there was a significant difference in response between 2006 and the other 2 yr. The analysis showed no differences in the slopes and intercepts of the ET and lint yield relationship across all irrigation treatments in the Ulysses soil, and there were differences slopes and intercepts of the ET and lint yield relationship each year for the crop in the Vingo soil.

The lint yield was significantly related \((P < 0.01)\) to open boll number across all irrigations in all four soils (Fig. 4). The relationship varied significantly in either slope or intercept among years within each soil except for a similar response between 2005 and 2007 for the crops in the Pullman soil. The slopes were similar among years for the crops in the Ulysses and Amarillo soils, but the intercepts were significantly different. For the crops in the Vingo soil, the 2005 and 2007 slopes were similar, but all other comparisons including the intercept, were significantly different.

**DISCUSSION**

The average lint yield of 147 g m\(^{-2}\) for 2005 and 2007 from the crops in the Pullman soil was comparable to the fully irrigated lint yield of 150 g m\(^{-2}\) reported by Howell et al. (2004) but 23% larger than the 123 g m\(^{-2}\) reported by Colaizzi et al. (2006a), both in the Pullman soil at Bushland, TX. Upland cotton lint yields in interior valley regions of CA given in Grismer (2002) averaged 133 g m\(^{-2}\), while maximum lint yield from cotton grown in a soil with a high clay content in Turkey was 65.3 g m\(^{-2}\) (Karam et al., 2006). Tennakoon and Milroy (2003) determined a 2-y industry average cotton lint yield for Australia of 180.6 g m\(^{-2}\).

Orgaz et al. (1992) and Tennakoon and Milroy (2003) found positive linear relationships between ET and lint yield up to about 700 mm of ET where the relationship flattened out. Dagdelen et al. (2009) reported a positive linear relationship for seed cotton yield through a maximum water use of 753 mm. Karam et al. (2006) determined that lint yield and ET were negatively related. Grismer (2002) found that yield was only weakly correlated to ET in studies performed in CA and AZ. Howell et al. (2004) reported an ET and lint yield relationship that was linear 1 yr and curvilinear the next for Bushland, TX, and Basal et al. (2009) also reported a curvilinear relationship.

Howell et al. (2004) reported cotton yields of 150 g m\(^{-2}\) at Bushland, TX where HU did not exceed 1130ºC. The seasonal HU for the 2005 to 2007 cropping seasons were at least 17% fewer than the 1300 HU that Wanjura et al. (2002) suggested were needed for maximum lint yield. The lint yield of 191.6 (±11.8) g m\(^{-2}\) produced by the crop in the Vingo soil in 2007 (991ºC) was 22% larger than the maximum yield of 157 g m\(^{-2}\) reported by Wanjura et al. (2002) which was produced in a year with seasonal HU of 1238ºC.
Lint yield has been found to increase linearly with seasonal HU in a short season environment (Morrow and Krieg, 1990) when water stress was minimized (Peng et al., 1989). The lint yields tended to be larger in the coarse-textured soils in the year with the smallest seasonal HU (2007, 991°C) and significantly larger in the fine-textured soils in the year with the largest seasonal HU (2006, 1075°C). The difference in lint yield response to seasonal HU and soil texture in this study is shown by comparing the crops in the Ulysses and Vingo soils (Fig. 5). In 2007, the crop grown under the T-100 irrigation treatment in the coarse-textured Vingo soil produced 38% more lint yield than the crop in the fine-textured Ulysses soil. The difference in lint yield in 2005 between soil types was reduced to 10% in 2005 when seasonal HU increased by 19°C to 1010°C. In 2006, the lint yield response to the two texture classes reversed from that in 2007, with the crop in the Ulysses silt loam producing 87% more lint yield than the crop in the Vingo fine sand. The decrease in lint yield in the Vingo soil and the increase in lint yield in the Ulysses soil as seasonal HU increased also occurred in the T-50 irrigation treatment (Fig. 5).

The difference among years in seasonal HU was at most 86°C, but the distribution in HU among growth stages varied among years (Fig. 2). In the first 30 DAP, there were 92°C more HU in 2006 compared with 2007 and by 60 DAP this difference had increased to 120°C. Peng et al. (1989) found that lint yield was positively correlated to HU accumulated during the period 31 to 60 DAP. Vigorous early season vegetative growth is needed for heavy fruiting (Grimes et al., 1978). Early season root development can be adversely affected by cool soil temperatures (McMichael and Quisenberry, 1993) produced by early irrigation combined with the cool air temperatures of a short growing season (Buttar et al., 2007). A decline in squaring and excessive square shedding can also be due to temperature effects or too much or too little soil moisture (Grimes and El-Zik, 1990). The number of open bolls at harvest was significantly related to lint yield. The ratio of open to total number of bolls was about 90% for all irrigation treatments, soil types, and years (data not shown). In a short season environment, the retention of early squares and their development into open bolls was an important factor in lint yield production.

The crop in the Vingo soil produced 10 to 20% more open bolls at harvest in 2005 and 2007 compared with the crops in the Pullman and Ulysses soil which suggests that there was more vigorous early season growth in that soil (Grimes et al., 1978). This may be due warmer early season soil temperatures in the sand compared with the finer-textured soils because of the Vingo’s coarse texture and low water holding capacity required less heat capacity to warm the soil, especially following an irrigation. Colaizzi et al. (2006b) reported that warmer soil temperatures during crop establishment due to limited soil wetting by subsurface drip irrigation compared with sprinkler irrigation was generally thought to increase cotton lint yields. Measured at 0.15 m, the bare soil temperature of the Vingo warmed more rapidly under both wet and dry conditions and was as much as 3.5°C higher compared with that in the Ulysses soil (Fig. 6).

But in 2006, which had the greatest number of HU accumulated by 60 DAP, the crop in the Vingo soil produced 34% fewer open bolls at harvest and 49% less lint yield in the T-100 irrigation treatment compared with lint yields of that treatment in 2007. The T-100 irrigation treatment received 50% more irrigation than the T-50 irrigation treatment yet the ET of the two treatments was similar at 546 (±30) mm for the T-100 irrigation treatment and 529 (±29) mm for the T-50 irrigation treatment. There also were no differences in lint yields between the two irrigation treatments (Tables 1 and 2) indicating a lack of lint yield response to increasing irrigation.

**CONCLUSIONS**

Lint yield was significantly related to open boll number at harvest in all soils and years. Lint yield was also significantly related to ET except for the cotton in the Amarillo and Vingo soils in 2006. In a short season environment, the retention of early squares and their development into open bolls was an important factor in lint yield production. From seedling to beginning boll development (0–60 DAP), ETo averaged 7.6 mm in 2005, 8.5 mm in 2006, and 6.7 mm in 2007, and cumulative HU were 549°C in 2005, 582°C in 2006, and 476°C in 2007.
The crop lint yields in the coarse-textured Vingo and Amarillo soils tended to larger compared with cotton lint yields in the fine-textured Pullman and Ulysses soils in 2005 and 2007 compared with 2006. The cotton in the fine-textured soils tended to produce larger lint yields compared with the cotton in the coarse-textured soils in 2006. Lint yield did respond to seasonal HU, with lint yield increasing for the cotton in the Ulysses soil and decreasing for the cotton in the Vingo soil as seasonal HU increased. Early season meteorological conditions which influenced square shedding and boll development may have affected lint yields interactively with soil texture and irrigation.

REFERENCES


