Stream Water Levels Affect Field Water Tables and Corn Yields

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ABSTRACT

A section of land about 1800 m wide and 4000 m along Mitchell Creek in Edgecombe and Pitt Counties, North Carolina, was studied for three years, 1980, 1981, and 1982. During 1980 and 1981 the deep channel in these sandy soils caused a water table drawdown of about 3 m near the stream. The water table was affected 884 m away. Corn yields near the creek were one-half those at 800 m from the creek. Stress-day indices varied inversely with yield. In 1982 a fabric dam, filled with water that automatically controls water levels in the creek and allows floods to pass, was installed in the creek. Stream water level control caused a significant rise in water table levels in the fields, and corn yields were 23% more than yields without water table control within 488 m of Mitchell Creek. This increased value of yield in 1982 will pay for the high costing prototype dam in about 15 years if these results continue.

INTRODUCTION

There are between 15 to 25 million ha of drained farm land in the humid region of the U.S. and about 3.4 million ha of drained sandy loam, and organic wetland soils in the South Atlantic Coastal Plain of North Carolina, South Carolina, Georgia, Florida, and Alabama (Wenberg and Gerald, 1982). It is estimated by Soil Conservation Service personnel that there are another 1.5 million ha of these soils in Virginia, Maryland, Delaware, and New Jersey.

The available water-holding capacity of these sandy soils is about 3 cm/30 cm of soil or less. Therefore, when the water table is greater than 1.5 m below the surface, the root zone can hold only enough water to supply crop needs for approximately 4 to 7 days. Consequently, these sandy soils become droughty when the water table is drained too far below the soil surface. However, artifical drainage is necessary for trafficability in the spring and fall and to protect crops from excessive soil water conditions during wet periods. Improved drainage channels are also needed for flood protection.

Controlling the stream water levels is considered to be a system of controlled drainage and subirrigation or a total water management system. French scientists, Bordas and Mathieu (1931) reported higher yields for a controlled water table system than for other irrigation systems. Morris (1949) concluded that in the future all artificial drainage may be controlled drainage.

Kalisvaart (1958) reported on controlling stream water levels for subirrigation in the Zuiderzee Poldus, Netherlands, where only agricultural land with low water-holding capacities needed irrigation, and in fields where the subsoil consists of deep and very permeable low terrace sands, "as a rule, subirrigation (reversible drainage) was the most suitable method" for irrigation.

In the United States, data on controlled drainage and subirrigation can be gleaned from past drainage research. For example, Wesseling (1974), in 21 of 35 cases reported yields decreased when the water table was maintained below certain levels from the surface. Water table depth for maximum yields varied with crops and soil classifications. However, for all soils classified as loams, sandy loams, and loamy fine sands, he showed that there was a water table depth at which maximum yields were obtained and for any depth greater or lesser, yields were decreased.

Corn yield (Fig. 1) decreased from 100 to 45% of maximum yield when the water table in sand, sandy loam, and silty clay loam soils rose from 80 to 15 cm below the surface (Wesseling, 1974). Likewise, when the

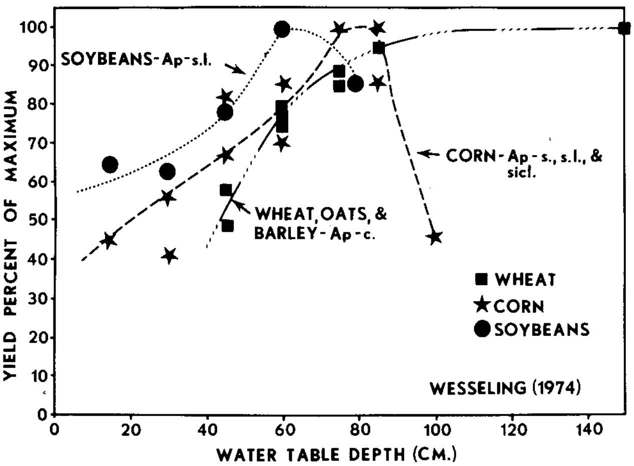

Fig. 1—Percent of maximum yield for field crops vs. water table depth under steady water table conditions.

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water table fell from 80 to 100 cm below the surface, corn yields decreased from 100 to 45% of maximum. Soybean growing on sandy loam soils were similarly affected. Vegetable crop yields on sandy soils followed about the same trends as corn and soybeans (Wesseling, 1974). Yields of wheat, oats, and barley growing on clay soil were somewhat similarly reduced for a rise in water table, but a water table depth of 150 cm was required to obtain 100% of maximum yield. The fact that there were no yield decreases as the water table receded in clay soils indicated that the capillary rise is greater in clay soils than in sandy soils and that available water-holding capacities of the clay soils (6.4 cm/30 cm of soil) are higher than in sandy soils (1.5 to 5 cm/30 cm of soil) (Turner et al., 1971).

In the Mid-Atlantic Coastal Plain, soils that are relatively dry during one period may be excessively wet during another as a result of erratic rainfall distribution and soil conditions. Drainage is needed during periods of excessive rainfall, but when sandy soils are drained too rapidly or too deeply, drought stress will develop unless it rains again within 4 to 7 days (Doty et al., 1975b; Reicosky et al., 1976). An example of this condition is the Conetoe Drainage District in North Carolina where 26,000 ha of land are drained in a Public Law 566 drainage project constructed in 1967. Several thousand ha of cropland that once were flooded several times a year are now protected, but channels over 3.0 m deep were necessary to drain parts of the district. Although flooding is no longer a problem, overdrainage near deep channels is believed to increase drought stresses and reduce crop yields. Farmers are investing in irrigation systems, and wells are being deepened to obtain water for domestic use from the lowered water table. Problems are developing because of a lack of water to supply the ever growing number of irrigation systems along the streams.

Control of the variation in the stream water level during nonflood stages and the fast of flood flows are being studied on a project located in Pitt and Edgecombe Counties, North Carolina. This paper will evaluate the effects of deep ditches on field water table levels in sandy soil and give the 1982 results of controlling the stream water levels on field water table levels and corn yields.

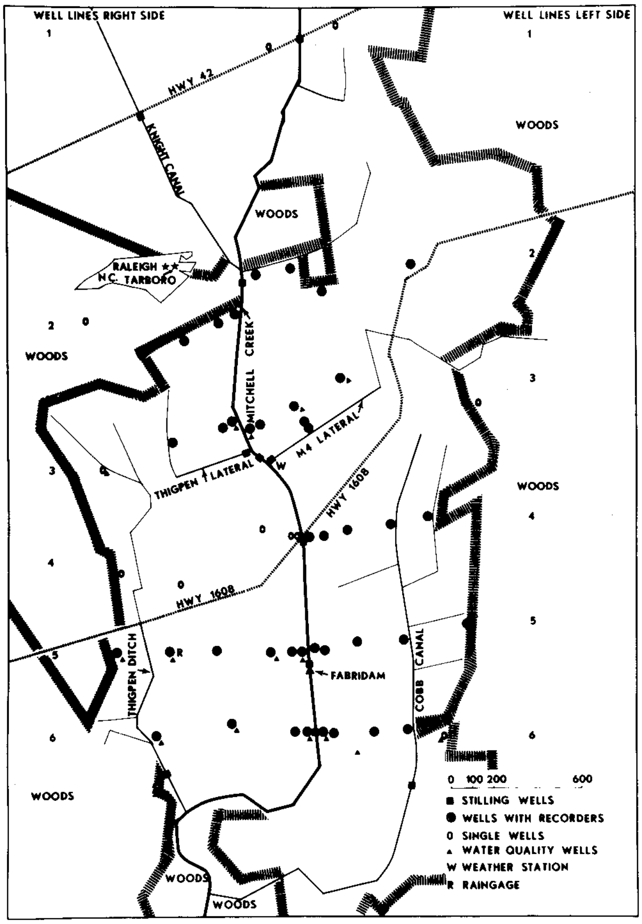

Fig. 2—Project sketch showing stream channel system and equipment locations on Mitchell Creek (scale is in meters).

PROJECT DESCRIPTION AND PROCEDURE

The water management study area is a 3.2-km section of Mitchell Creek (Fig. 2). The area, about 800 ha, is flat-to-gently rolling with no more than a 1.5-m difference in elevation. The soil series, Altavista, Augusta, Cape Fear, Conetoe, Portsmouth, Roanoke, State, Tarboro, and Wahee, were mapped and rechecked for each yield sample site by the Soil Conservation Service. The soils are poorly-to somewhat-excessively drained, formed in sandy fluvial and marine sediments. They are underlain by a coarse sandy aquifer at a depth of about 1.5-m. The coarse sand is underlain by a layer of consistent blue clay ranging in depth from 4 to 8 m below the surface.

Six lines of water table observation wells were installed perpendicular to the creek on each side. Well locations ranged from 10 to 970 m from the channel (Fig. 2). Forty wells were equipped with water level recorders, and 22 were read manually each week. There were 12 stream gaging sites equipped with stage recorders, seven on Mitchell Creek, three on intersecting channels, and two on channels paralleling Mitchell Creek. Manual flow measurements were made at five of these sites about twice weekly. Other sites were measured about once a month. Hydraulic conductivity was measured at 13 points by the open-end field permeability test with a drill rig (U.S. Dept. of Int., 1974) at randon sites over the area.

A Fabridam (a patented water level control structure by Fabridam Engineering, N. M. Imbertson and Assoc., Inc., Burbank, CA, and the first of its type in the Southeast)(Fig. 3) was installed across Mitchell Creek about midway of the study area and put into operation on April 2, 1982. The water inflatable fabric dam (2.7 m high), about 6 m wide at the bottom of the creek bed and 13 m wide at bank height, automatically controls the water level in the creek upstream. The Fabridam is capable of collapsing during flooding which allows the channel to return to maximum flow capacity. It can control the water level in the channel to a depth of 2.45 m or to an elevation of 11.75 m above mean sea level (MSL). For example, if the control level is set at 11.45 m above MSL and a flood raises the upstream level to an elevation of 11.60 (0.15 m rise), the Fabridam begins to deflate, but will maintain control between 11.45 and 11.60 m. If the flood level continues to rise, another valve opens and the Fabridam deflates faster, but automatic controls keep it between 11.45 and 11.62 m. If the flooding continues and the upstream water level reaches

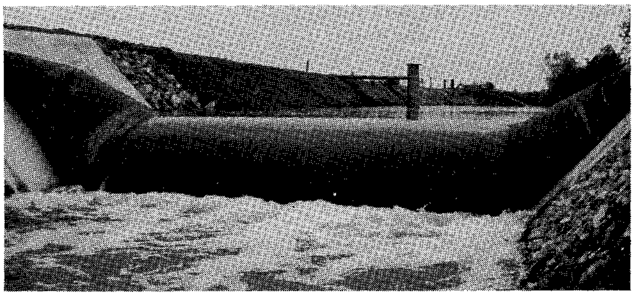

Fig. 3—The Fabridam on Mitchell Creek looking upstream.

11.65 m (0.20 m rise), a 20.3-cm diameter syphon will deflate the Fabridam at a rate of about 0.06 m/min until there is no restriction in the channel. When the flood passes and the syphon breaks, the Fabridam inflates to the original setting of 11.45 m.

Corn yields were sampled by hand from 3 x 2 m plots at two replications near the water table observation wells (Fig. 2). Yields (grain at 15% moisture) are reported in two ways: (a) before the Fabridam was installed (1980 and 1981) at distances of 0 to 50 m, 51 to 100 m, 101 to 200 m, 201 to 400 m, 401 to 600 m, 601 to 800 m, and greater than 800 from the channel and (b) after the Fabridam was installed in 1982, the yield sample sites were separated into four treatments (a) no water level control with and without irrigation and (b) water table control by the Fabridam with and without irrigation. For the 1982 corn yield data, the nonirrigated data were collected at distances of 0 to 50 m, 51 to 100 m, 101 to 200 m, 210 to 300 m, 301 to 400 m, 401 to 500 m and greater than 500 m from the channel. Average yields were regressed against distance from the channel for data obtained before and after Fabridam installation. The 95% confidence limits were based on all sample sites, not just on the averaged data (Equation [9.13], Steel and Torrie, 1960).

Stress-day index (SDI) (Hardjoamidjojo and Skaggs, 1982) was determined for each site where corn yields were measured to show the effects of water table depth on drought and yield. The SDI in this paper is defined by:

$$SDI = \sum_{i=1}^{n} \left\{ 1 - \frac{ET_i}{(SPE_i)(Kc_i)} \right\} \quad \ldots\ldots\ldots\ldots [1]$$

where:

ET_i = calculated evapotranspiration for day i

SPE_i = screened pan evaporation for day i (Doty, 1980)

Kc_i = crop factor Kc (Soil Conservation Service, 1967; Doty 1980)

The daily evapotranspiration (ET_i), which depends on the water table depth, soil moisture conditions, and the soil water characteristics at the site is calculated by:

$$ET_i = \begin{Bmatrix} (SPE_i)(Kc_i), \ AW_{i-1} + F_i \geq (SPE_i)(Kc_i) \\ AW_{i-1} + F_i, \ AW_{i-1} + F_i < (SPE_i)(Kc_i) \end{Bmatrix} \ldots [2]$$

where:

AW_{i-1} = available water in the root zone for day i-1 and when i is the planting day AW_{i-1} is assummed to be the maximum available water in the root zone (MAW_i).

F_i = upward flux of water into the root zone calculated assuming steady state flux (Skaggs, 1981). In some cases, it was necessary to extrapolate F_i past the depth for which samples for soil water characteristics were taken. For example, near the channel, the water table position was greater than 2.0 from the surface. F_i was then calculated from the unsaturated relationships estimated from curves for each layer.

The surplus water (S_i), (runoff, lateral loss, and deep seepage) at the site for day i is then calculated by:

$$S_i = \begin{Bmatrix} 0 & , AW_{i-1} \leq MAW_i \\ AW_{i-1} - MAW_i & , AW_{i-1} > MAW_i \end{Bmatrix} \ldots\ldots\ldots [3]$$

where:

MAW_i = Maximum available water in the root zone for day i-1 based on soil water characteristics which is a function of soil type, water table position, and rooting depth. Since rooting depth and water table position change throughout the growing season, the amount of MAW is changing daily.

Therefore, the available water in the root zone (AW_i) for day i can then be calculated by:

$$AW_i = AW_{i-1} + R_i + F_i - S_i - ET_i \quad \ldots\ldots\ldots\ldots [4]$$

where:

R_i = rainfall for day i

and the other terms are as previously defined. This process is then continued through day n which is considered the day of harvest.

RESULTS AND DISCUSSION

Effect of a Deep Ditch on Water Table

Data were collected in 1980 and 1981 without water level controls to determine the effect of deep ditch drainage on the water table. The 3 to 4 m deep channels are excellent for drainage and flood control, but frequently cause overdrainage in these deep sandy soils after the flood passes. Figure 4a shows the maximum and minimum water table elevations on each side of the creek for well line No. 5. The gradient towards the channel on the water table surface extends to the measured distance of 884 m on the right side looking downstream and to 696 m on the left side which indicates that water is being drained laterally by the creek at a distance of at least 884 m. The water table slope towards the channel is greater from 0 to 400 m than from 400 to 800 m from the creek. Similar water table slopes occurred about 1200 m upstream at well line No. 3 (Fig. 4b) where the soil surface is relatively flat. A water table elevation of about 12 m (0.8 to 1.0 m below the surface) represents an optimum water table depth at which corn can be grown without aeration problems (Wesseling 1974, and Benz et al. 1981). Thus, in these fields, the difference from 12.0 m above MSL to the lowest water table elevations which ranged from 9.5 to 11.0 m on December 17, 1981, represents a drop of 1 to 2.5 m in the water table near the channel. This water drop was caused by dry weather conditions and drainage to the deep channels (overdrainage) in these sandy soils along Mitchell Creek in 1980 and 1981 (Fig. 4a, b).

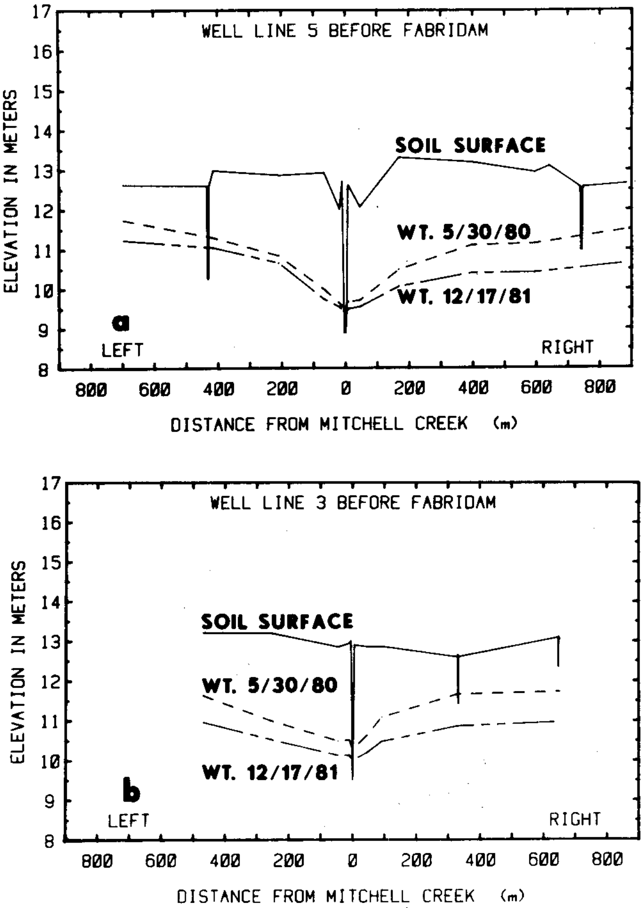

Fig. 4—Water table and soil surface elevations above mean sea level in relation to distance from Mitchell Creek (a) at well line No. 5 and (b) at well line No. 3, before installation of the Fabridam.

Time sequences, of stream elevation and water table elevations at distances of 18 m and 594 m from the creek, along well line No. 5 are shown in Fig. 5. At the beginning of data collection in 1980, the water table elevation was about 11.5 m at 594 m from the creek, which is lower than the elevation at which the water table should be maintained on this soil for maximum yield. The water table continued to drop through the remainder of 1980 and 1981, and the minimum elevation was about 10.7 m, 1.3 m below the desired 12-m elevation. A well 18 m from the creek was about 2.4 m below the desired water level throughout 1980 and 1981.

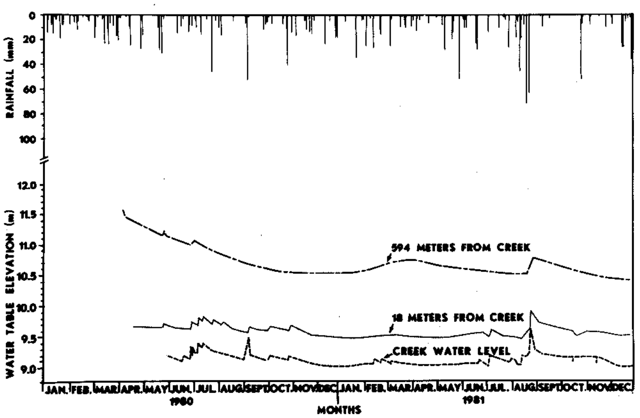

Fig. 5—Stream water level and soil water table elevations above mean sea level at 18 and 594 m from Mitchell Creek for 1980 and 1981.

The elevation of the water level in the creek was less than 9.6 m throughout 1980 and 1981. Results were similar at well line No. 3 about 1200 m upstream.

The hydraulic conductivity of the soil 0 to 1.2 m deep layer ranged from 0.07 to 9.5 m/day, the 1.2 to 2.1 m layer ranged from 0.11 to 42.7 m/day, and the 2.1 to 7.5 m layer ranged from 0.0 to 58.0 m/day. The blue clay layer varied 4 to 8 m in depth from the surface, but the hydraulic conductivity was always negligible.

Stress-Day Index and Corn Yield

The average stress-day indices for the corn growing season for the sites where corn was sampled for yield in 1980 and 1981 were plotted against the average distance from Mitchell Creek (Fig. 6a). Stress, as indicated by stress-day index, is related to the distance from the creek. Near the creek there were about 70 days during the growing season when full ET for the corn crop was not available, but at 700 m from the creek there were less than 20 days that full ET was not supplied. This was because the water table near the creek was drawn down too low by the deep drainage channel.

The relationship of corn yield to the distance of the sample site from Mitchell Creek shows that corn yields increased with distance from the creek (Fig. 6b) in 1980 and 1981. Corn grain yields (at 15.5% moisture) of 4.8 t/ha were measured at 25 m from Mitchell Creek and increased at the rate of 0.1 t/ha for each 18.7 m (1 bu/38 ft) away from the creek up to 9.0 t/ha at a distance of 852 m from the creek. The yield-distance relationship (Fig.

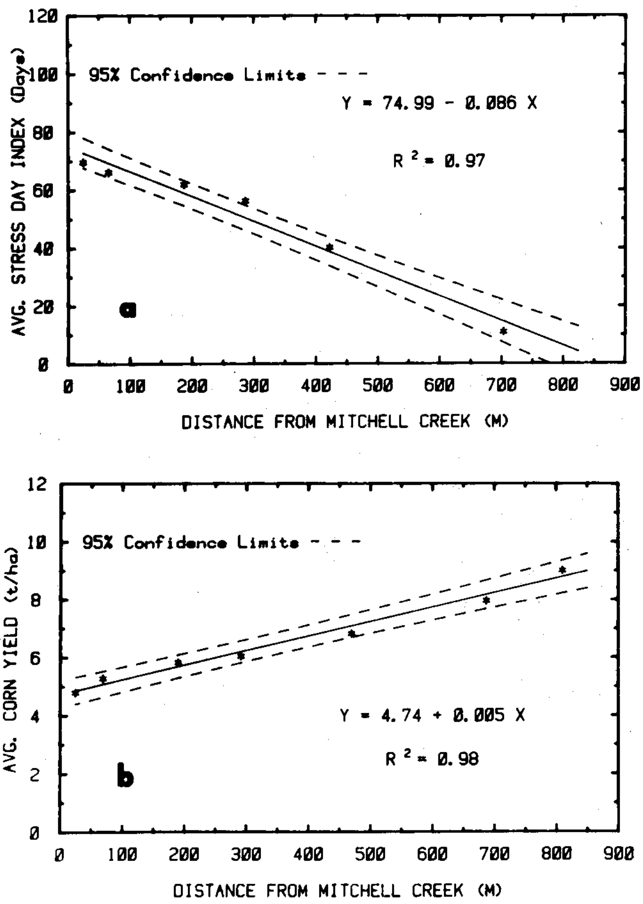

Fig. 6—Relationship between (a) average stress-day-index and (b) average corn yield at distances of 0-50, 51-100, 101-200, 201-400, 401-600, 601-800, and greater than 800 m from Mitchell Creek.

6b) together with the inverse SDI-distance relationship (Fig. 6a) show that the corn crop for 1980 and 1981 growing seasons had more drought stress (SDI=70) and lower yields (4.8 t/ha) where the water table was farther from the soil surface near the creek (Fig. 4a, b). There was considerably less drought stress (SDI=11) and higher yields (8.6 t/ha) at 800 m from the creek, because the water table was closer to the soil surface and more water was available to the corn plants. This shows the effects of overdrainage in these sandy soils by the deep channels required for the flood control system.

The correlation between measured corn yields and calculated stress-day index based on screened-pan evaporation, soil water characteristics, and water table depth was $R^2 = 0.99$ (Fig. 7). A 79% increase in grain yield was gained by an 84% decrease in SDI. Water table levels varied over the two-year period, but the maximum and minimum water table depth for a SDI of 11 was between 1.4 and 0.8 m (Fig. 4), and the corn yield was 8.6 t/ha. This is in the range of the water table depth for best corn yield, 6.6 t/ha, reported by Benz et al. (1978). The maximum and minimum water table depth for a SDI of 70 was between 2.8 and 2.5 m from the soil surface (Fig. 4), and the corn yield was 4.8 t/ha. This corresponds to Benz et al. (1978) who reported a similar reduced corn yield of 3.0 t/ha from a deep water table. Doty et al. (1975a) showed that corn silage yields increased by 1.1 t/ha for each additional day, between 25 and 55 days during the 91 days before harvest, that the water table was 1.07 m or less from the surface.

Overdrainage of these low water-holding capacity sandy soils by deep channelization can be corrected by controlling water tables at about 1.5-m depth or less. The water table can be controlled in two ways: (a) drainage channels can be constructed at less than 1.5 m deep which may fill with weeds and debris and cause flooding, or (b) automatic control structures can be provided to control the water table level on channels large and deep enough to handle flood flows.

Effects of Deep Channels with Water Level Controls

The Fabridam installation (Fig. 3) was completed April 2, 1982, and the water level in the stream was controlled at 10.67 m above MSL until May 28 when the level was raised to 11.28 m. The control level was raised to 11.55 m on July 6 and maintained at that level for the rest of the season. Several large rainfall events caused fluctuations of the dam height, but the floods passed easily. During an 80 mm rain on August 11-12, 1982, the Fabridam operated seven times.

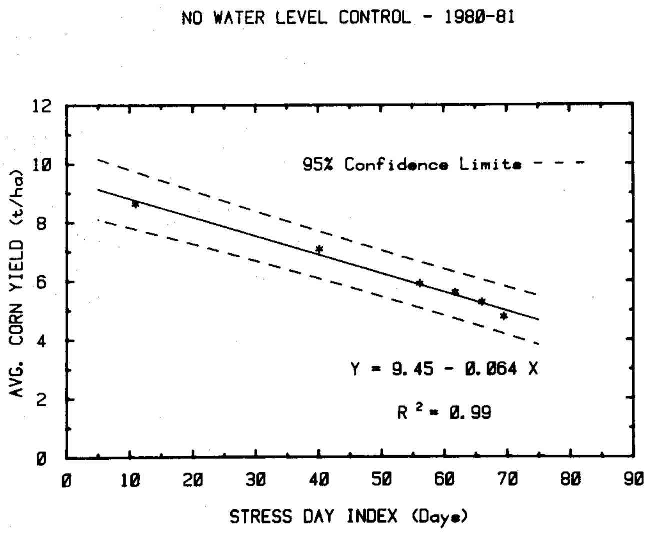

Fig. 7—Relationship of average corn yield to stress-day-index for the 1980-81 growing season in sandy soils in the Mitchell Creek watershed.

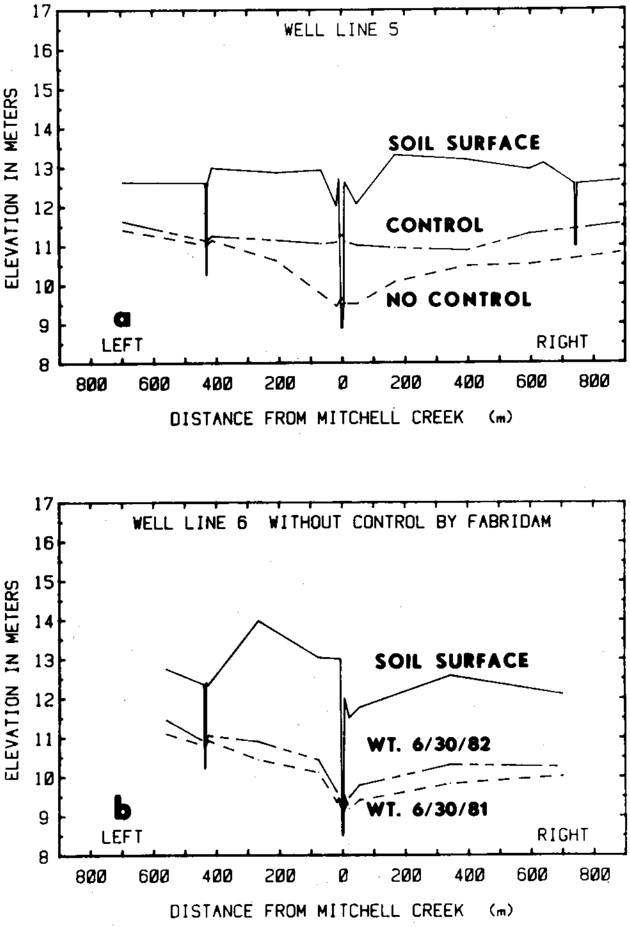

Fig. 8—Water table and soil surface elevations above mean sea level in relation to distance from Mitchell Creek for the high water use periods, June 30, 1981, before the Fabridam was installed and June 30, 1982, after the Fabridam was installed at (a) well line No. 5 above the Fabridam, and (b) well line No. 6 below the Fabridam.

Corn water use requirement is greatest from silking to ear fill stages. The last of June was a high water use period for corn for both 1981 and 1982 at the research site. Water table elevations for June 30, 1981, without water level control and for June 30, 1982, with Fabridam water level control are shown in Fig. 8a for well line 5, about 90 m upstream from the Fabridam. Near the stream the water table was about 1.5 m closer to the soil surface in 1982 than in 1981, and at about 400 m on either side of the channel the water table was about 0.5 m closer to the surface in 1982 than in 1981. The controlled stream water level in Mitchell Creek produced an almost flat water table, and most of the variations in depth to the water table were because of the changes in soil surface elevations (Fig. 8a). Similar results were found about 1200 m upstream from the Fabridam. Doty (1980) showed that corn growing on a Goldsboro sandy clay loam soil received ample water for good production with the water table less than 1.4 m from the surface.

Below the Fabridam, the stream level was not affected by the stream water level control (Fig. 8b). Generally, the June 30 water table was higher in 1982 than in 1981 due

TABLE 1. AVERAGE CORN YIELD DATA FOR THE FOUR WATER MANAGEMENT SYSTEMS ON MITCHELL CREEK FOR 1982

Water management system	Mean corn yield	
	Nonirrigated	Irrigated
	-------- t/ha --------	
No water level control	6.931 c*	8.289 b
Controlled water level	8.321 b	10.326 a

*Yield followed by the same letter are not significantly different at the 10% level for the DMRT test.

to rainfall, but the water table level patterns were similar. Nearer the stream, the water table was 2.4 to 3.7 m from the soul surface while between 500 and 700 m from the creek, the water table was 1.5 to 2.5 m from the surface.

Corn Yield vs. Distance From Channel

Data for 1982 were the first yield results with water level control in the channel. Average corn yields from four water management systems are compared in Table 1. Without irrigation, crops where the water level was controlled produced 20% more corn than the check, i.e. without control. Irrigation applied to the crops without water level control (check) produced only 20% more yield than nonirrigated fields. With 6.3 cm irrigation water applied to the surface, soils where the water level was controlled produced 33% more corn than the check. The water table was about 1.0 m to 2.0 m from the surface on the water level control system area. Benz et al. (1978) also showed an increase in irrigated corn yield when the water table was greater than 1.8 m from the surface. The 10.33 t/ha (164 bu/a) farmer-produced corn yield on the irrigated fields with stream water level control (Table 1) compares favorably with the highest observed yield of 10.70 t/ha (170 bu/a) in 1971 or the projected potential yield of 11.10 t/ha (177 bu/a) for the Tidewater Research Station, about 100 miles east of Mitchell Creek (Hardjoamidjojo and Skaggs, 1982).

North Carolina State University recommends 54,000 to 69,000 plants/ha for nonirrigated corn. Rhoads (1982) showed yields of 14.5 t/ha (230 bu/a) under irrigation at 90,000 plants/ha on a sandy soil in Florida. Plant populations for the Mitchell Creek area were in the range of 37,000 to 57,000 plants/ha for nonirrigated fields and 49,000 to 72,000 plants/ha in the irrigated fields. Therefore, using higher plant populations in the area should increase yields.

Without stream water level control in the channel, yields increased with distance away from the creek in 1982 (Fig. 9a), the same as in 1980 and 1981 (Fig. 6b). The linear regression line had a slope of 0.007. This compares to a slope of 0.005 for the 1980-81 data. Even though 1982 was an excellent corn producing year without water level control, only 4.9 t/ha (78 bu/a) of grain was produced near the channel with the water table 2.7 m from the surface. At 550 m from the creek, 8.4 t/ha (134 bu/a) of corn was produced with a water table 1.7 m from the surface. On a Hecla sandy loam soil in North Dakota, Follett et al. (1974) reported average corn yields of 4.5 t/ha when the water table was from 1.9 m to 2.9 m and 8.4 t/ha when the water table ranged from 0.7 m to 1.9 m for the two-year study period.

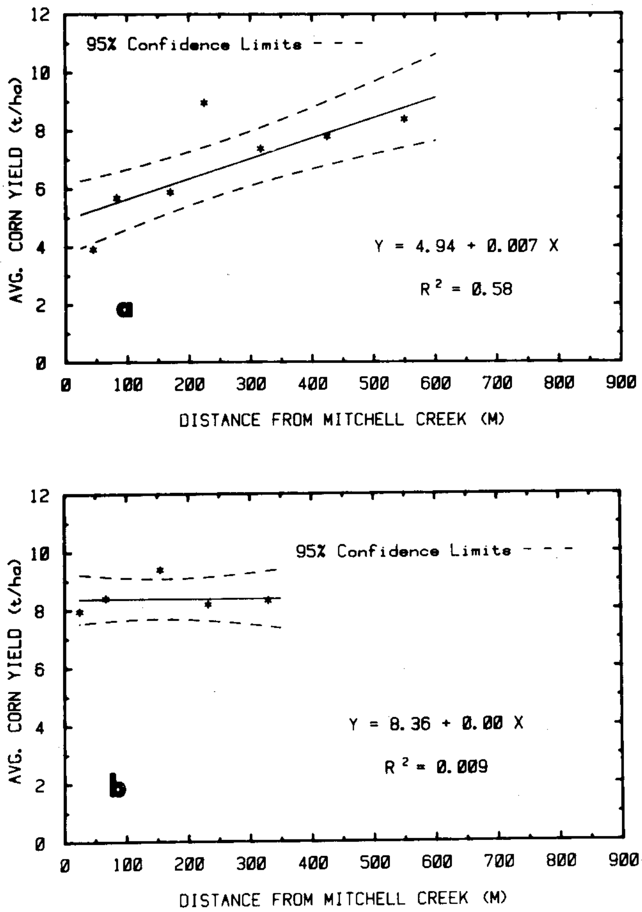

Fig. 9—Relationship of average corn yield for the 1982 growing season to distance from Mitchell Creek (a) below the Fabridam with uncontrolled water level in the stream and (b) with water levels controlled in the stream by the Fabridam.

Above the Fabridam no corn was planted beyond 330 m from the creek, and distance from the creek had no effect on yield (Fig. 9b). The mean yield was 8.4 t/ha (134 bu/a), almost the same as without water level control at 550 m from the creek. This shows that stream water level control increased yields near the deep channels. In addition, flooding was controlled with up to 80 mm of rainfall. The water table was less than 0.7 m from the surface for 2- to 3-day periods at well sites in low elevations. A clogged surface outlet into a drainage ditch ponded water temporarily, but drained readily after the outlet was cleared.

Economic Analysis of Water Table Control

Farmers and action agency personnel want to know how water table control will affect the pocketbook. The distance from the Creek that stream water level control affected corn yields in 1982 was determined as the point of intersection of the regression line with controls (Fig. 9b) and the regression line without controls (Fig. 9a), 488 m=(8.36 - 4.94/0.007), where 8.36 t/ha is the average corn yield above the Fabridam, 4.94 t/ha is the projected yield at the creek, and 0.007 t/ha/m is the slope of the regression line without controls (Fig. 9a). The average corn yield at the creek to the intersection of the regression lines, 488 m from the creek, was then determined as the midpoint yield, [6.65 t/ha = 4.94 + (0.007 x 0.5 x 488)] (Fig. 9a). According to water table data, stream water levels were effective at least 2,070 m upstream from the dam, therefore, the area covered would be 488 m on each side of the creek for 2,070 m upstream or 202 ha. The Fabridam cost $248,700 installed. Based upon 1982 data only, the average increase in yield with stream water level control was 8.36 - 6.65 = 1.71 t/ha on 202 ha. At a crop value of $98.40/t ($2.50/bu), this yield increase amounts to an increased annual income of $33,989. Annual payments for the Fabridam at 10 percent interest for 15 years is $32,697. Thus, on these sandy soils, structures as expensive as the Fabridam will pay for themselves over a 15-year period and leave a balance of $1,293 for maintenance and management. This does not include the fact that water was also available for irrigation of an additional 142 hectares of land. These results are very encouraging.

CONCLUSIONS

When the water table falls about 1.5 m below the surface of sandy soils, yields are reduced below the maximum. Other studies have shown this from small plots (Benz et al., 1978, 1981; Wesseling, 1974; Williamson and Kriz, 1970), and this study confirms their results on a field basis.

In 1980 and 1981, the 3-m deep channel affected the water table 884 from the creek. Overdrainage was shown by the drought stress of the crops near the creek, and corn yields were affected. These effects were observed on all soil series where corn yields were measured.

Stream water levels were controlled at an elevation of 11.25 m in 1982, and the water about 1 to 2 m below the soil surface was relatively flat. On the average, the water table in the area was about 0.65 m higher after the stream water level was raised about 1.25 m.

Corn yields were affected by stream water level control and higher water tables. Nonirrigated corn yields above the Fabridam were 20% greater than those below the Fabridam. Irrigated corn yields above the Fabridam were 33% higher than those below the Fabridam. The SDI was closely related to yield in 1980 and 1981 showing that water furnished from the water table was important during these dry years.

Preliminary economic analysis of yield and cost data of the $248,700 Fabridam shows its cost to be feasible for stream water level control. Based on 1982 data only, the use of an expensive water level structure should pay for itself in 15 years at 10% interest with a surplus balance of $1,293 per year for maintenance and management.

Overdrainage is occurring in the low water-holding capacity sandy soils with high hydraulic conductivities and deep channelization throughout the Southeast. Shallow channels would probably decrease overdrainage, but maintenance, flood control, and proper drainage during wet periods are some unsolved problems that would still exist. Engineering design criteria must be established for future planning of water resource projects that will provide proper drainage and flood control during wet periods and still maintain water in the soil profile and in the stream channels during dry periods. Thus, water for crop needs would be supplied by capillary rise in the soil and/or be available for irrigation pumping.

Design of water level control structures can be critical in streams subject to flooding. These structures must automatically pass flood water when excessive rainfall occurs. The possible economic effects of an automatic and more expensive stream water level control structure has been discussed, and the limited data show both cost and operation to be advantageous. The technology is currently available to permit the use of automatic control of stream water levels that result in reduced risk of loss of property while also providing increased agronomic return.

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