WATER ALLOCATION STRATEGIES WHEN IRRIGATION SUPPLIES ARE LIMITED

Dr. Howard Neibling, P.E.[1]

ABSTRACT

A computer-based planning tool (ET Planner) was developed for Southern Idaho conditions to help farmers match the combined water demand for several crops to the anticipated water supply. Although timing and magnitude of crop water use will vary depending on location, results should generally apply to similar areas in the inter-mountain west. Two applications to Southern Idaho conditions are discussed. 1) Yield reduction due to late-season drop in water supply on fields served by a single irrigation system can be minimized by splitting acreage between alfalfa and a short-season crop like spring grain. If water can be shifted from one field to another during the season, then splitting fields into short and long-season crops is not necessary to meet crop water demands. 2) The planner can also be used to select a mix of crops for the area served by an irrigation system if season-long cutback in water supply is anticipated.

Key Words: alfalfa, drought, irrigation, water management, water use

INTRODUCTION

Irrigation water supplies can be reduced due to a number of factors including prolonged drought, seasonal or long-term groundwater decline, or legal re-allocation of water. Because of its long period of water demand, alfalfa is more prone to yield reduction than are shorter-season crops. However, if water shortages are anticipated, the cropping mix for a farm can be modified to maintain alfalfa production under many reduced-water scenarios.

A computer-based planning tool was developed to help growers match seasonal Crop ET (evapo-transpiration) for different cropping mixes to anticipated water supplies. Daily crop ET for a number of crops grown in Southern Idaho was incorporated into the planner for Parma, Twin Falls, Picabo Aberdeen, Rexburg , Idaho and for Afton, WY. ET was calculated by the U.S. Bureau of Reclamation

---

[1] H. Neibling, Extension Water Management Engineer, Twin Falls R & E Center, P.O. Box 1827, Twin Falls, ID 83303-1827; Email: hneiblin@uidaho.edu;
In: Proceedings, 2006 Western Alfalfa & Forage Conference, Sponsored by the Cooperative Extension Services of AZ, CA, CO, ID,MT, NV, MN, OR, UT, WA, WY. Published by: UC Cooperative Extension, Agronomy Research and Extension Center, Plant Sciences Department, University of California, Davis 95616. (See http://alfalfa.ucdavis.edu for this and other alfalfa proceedings.)

AGRIMET system using the Penman ET equation as modified by Wright, 1982. The variation in length of irrigation season and time of peak ET among crops shown in **Figure 1** can be used to select a mix of crops to fit available water supply.

ET PLANNER INPUTS

A sample input /output screen is shown in **Figure 2**. ET Planner locations of Parma, Twin Falls, Picabo, Aberdeen and Rexburg were chosen to span the Snake River Plain in Southern Idaho. The Afton, WY location can be used for the Bear Lake area of Southeast Idaho. Acres of each crop to be grown under the sprinkler system can be entered in boxes down the left side of the screen. The planner has the option of stopping irrigation after first, second or 3rd cutting of alfalfa. The date of last full irrigation water can be input through a drop-down calendar box. Additional input of type of sprinkler irrigation (pivot, set system, or both), initial water supply in gpm/ac and percent of full water available after cutback are also entered.

SOFTWARE APPLICATIONS

One pivot of Alfalfa. The seasonal ET pattern for alfalfa at Twin Falls is shown in Figure 2. The water supply, based on 6.5 gpm/ac (a typical design for the area), is shown as the solid horizontal line at 37 ac-in. Note that water supply is adequate to meet peak ET during mid-season. The alfalfa curve shown is actually 80% of the calculated peak ET to allow for ET reduction during and after cutting, so at times the system may not be able to meet peak ET. However, for season-long planning purposes, the “average” ET curve of 0.8* max ET is appropriate.

The situation where water supply is reduced by half starting on August 1, is shown in **Figure 3.** Notice that the ET is greater than supply from August 1 until September 16. The area under the ET curve and above the water supply curve during this time period represents the shortfall in water. Since most pivots in the intermountain west are designed to meet about 80% of maximum ET, any water stored in the root zone will probably be used by the time of irrigation cutoff so the shortage of about 376 acre inches or 2.89 inches over the 130-ac pivot will result in water stress and yield reduction. Based on the relationship of 5 inches of irrigation water required to produce 1 ton of alfalfa hay at Kimberly (Hill et al., 1982), estimated lost production is about 0.6 T/ac, or 78 tons of hay for the pivot.

One pivot, half spring grain, half alfalfa. The situation shown in **Figure 3** can be remedied if a short-season crop like spring grain is also grown in the farming operation. If so, half the pivot can be planted to a short-season crop like spring grain, and the rest to alfalfa. From Figure 1, the ET curve for spring grain drops to zero before August 1. This is shown in the ET Planner format in Figure 4. When the pivot is divided into 65 acres of spring grain and 65 acres of alfalfa, the composite curve is shown in Figure 5. Note that by splitting the cropping mix into a full season and short season crop, the 50% water supply reduction can be accommodated without water stress or yield loss for either the grain or alfalfa.

The above analysis is valid when the pivot is stand-alone, with a dedicated water supply. If two or more pivots can be inter-connected, full pivots of each crop can be grown by shifting water as needed.

Spring grain and corn with 80% seasonal water on wheel lines. In some situations water may be reduced to less than full delivery for the entire season. The seasonal ET pattern in relation to water supply is shown in Figure 6 for alfalfa and Figure 7 for spring grain and Figure 8 for the combination. For most soils, the length and magnitude of the deficit would exceed soil moisture storage so some water stress would be experienced. Because of the difference in timing of peak ET, the combination of crops has less of a daily ET deficit during mid season and the length of deficit is also less.

Spring grain and corn with 80% seasonal water, pivot. Seasonal ET patterns in relation to water supply are shown in Figure 9 for corn and Figure 10 for the combination. The deficit is 2.8 inches for spring grain alone, 1.8 inches for corn alone, and only 1.0 inch for the combination. Again, because of the difference between corn and spring grain in time of peak, combining the two crops on one pivot reduces crop water deficits and accompanying yield reduction.

REFERENCES

Hill, R.W., R.J. Hanks and J.L. Wright. 1982. Crop Yield Models Adapted to Irrigation Scheduling Programs. Research Report 99. Utah Agricultural Experiment Station, Logan, UT. 90 pp plus appendices.

Wright, J.L. 1982. New Evapotranspiration Crop Coefficients. J. of the Irrig. And drainage Div, ASCE. 108:57-74.

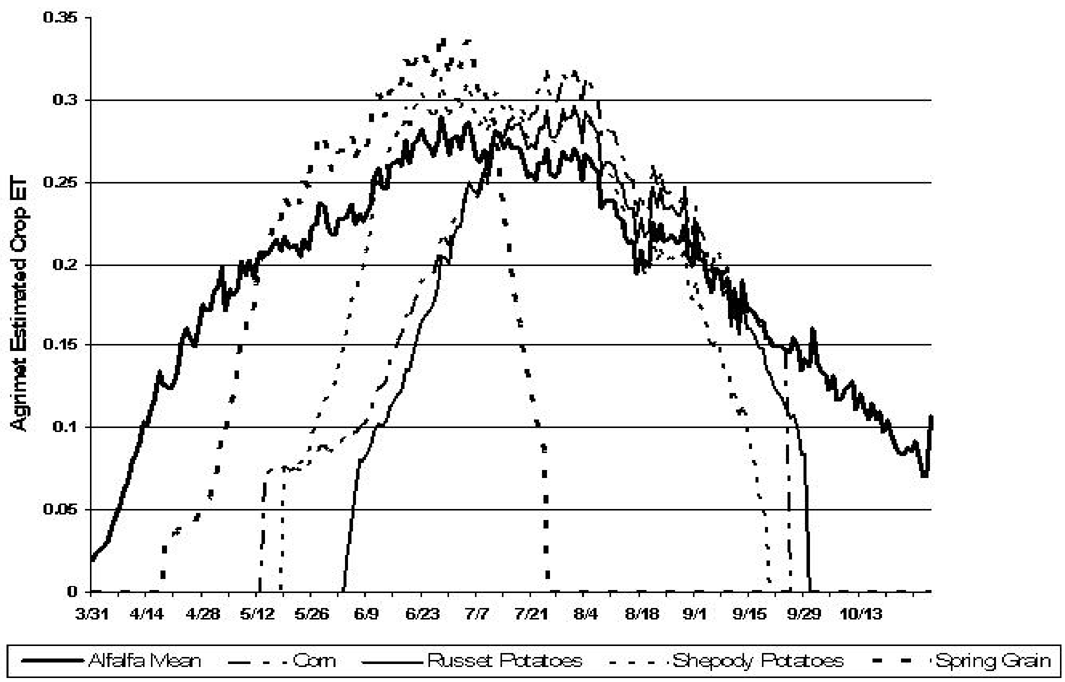

Figure 1. Average 30-year ET for Magic Valley crops.

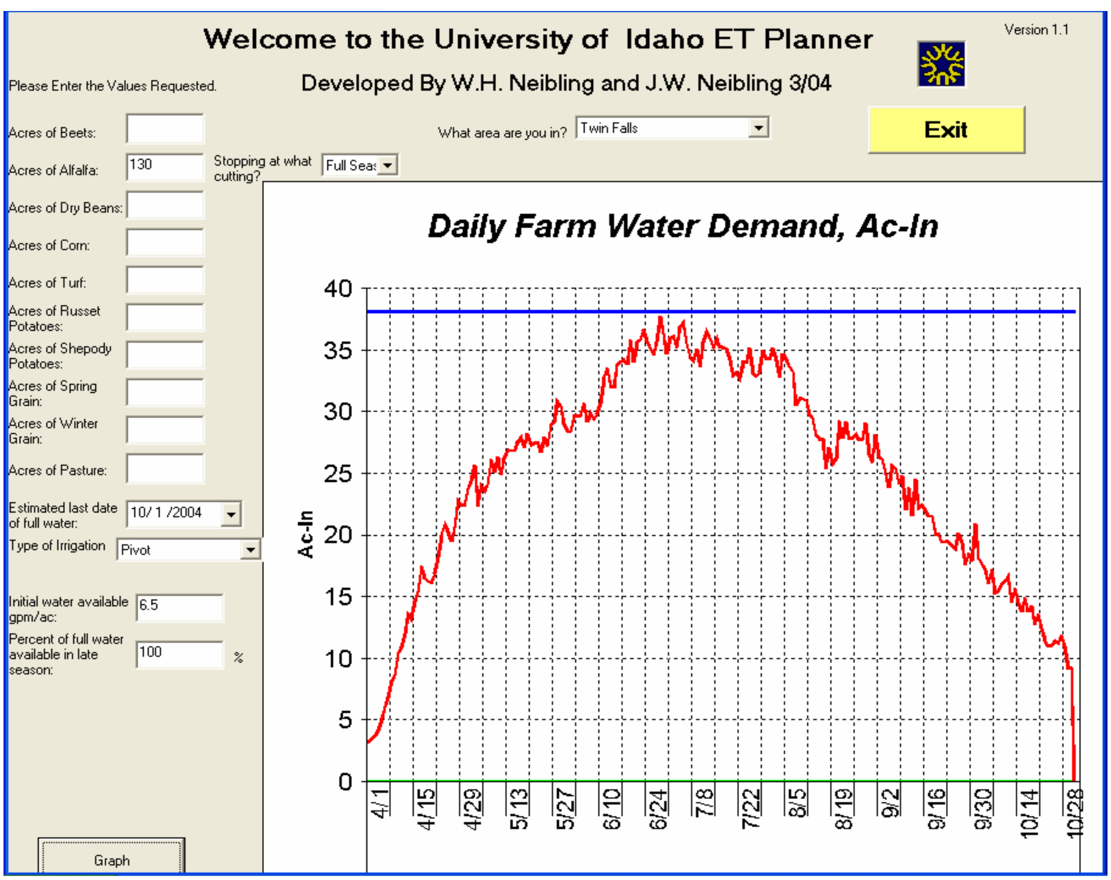

Figure 2. Sample display for ET Planner input /output screen.

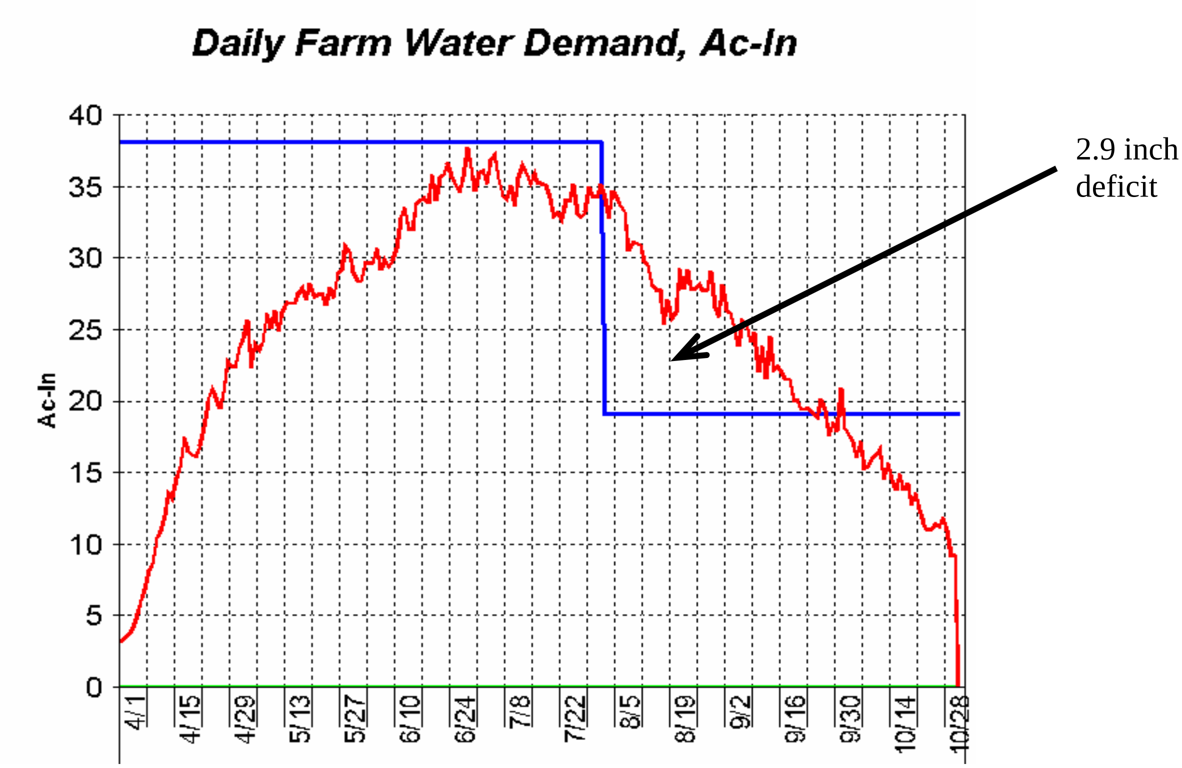

Figure 3. Seasonal ET and water supply for 130 acres of alfalfa at Kimberly, ID 8/1 cutback to 50% irrigation water.

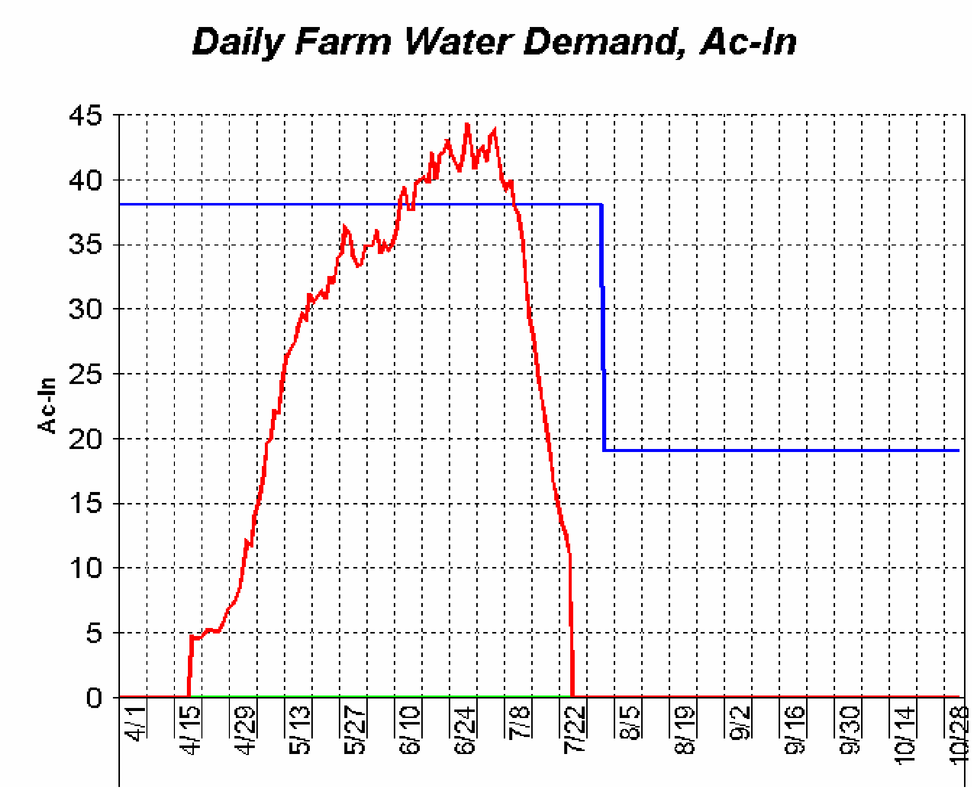

Figure 4. Seasonal ET and water supply for 130 acres of spring grain at Kimberly, ID 8/1 cutback to 50% irrigation water.

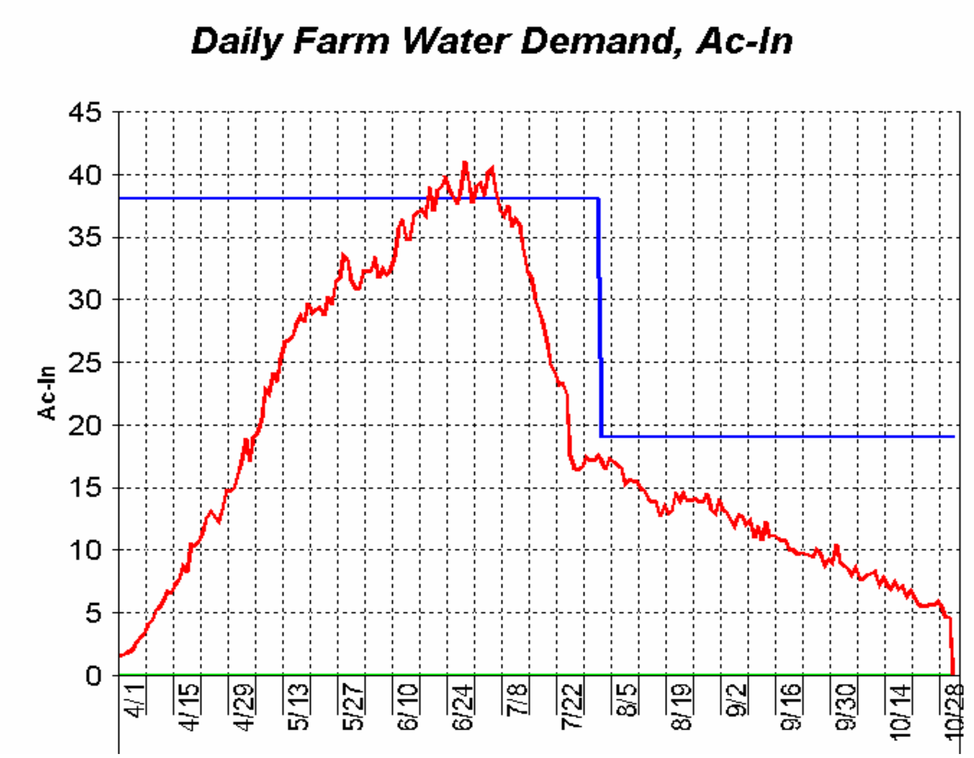

Figure 5. Seasonal ET and water supply for 65 ac spring grain and 65 ac alfalfa at Kimberly, ID, 8/1 cutback to 50% irrigation water.

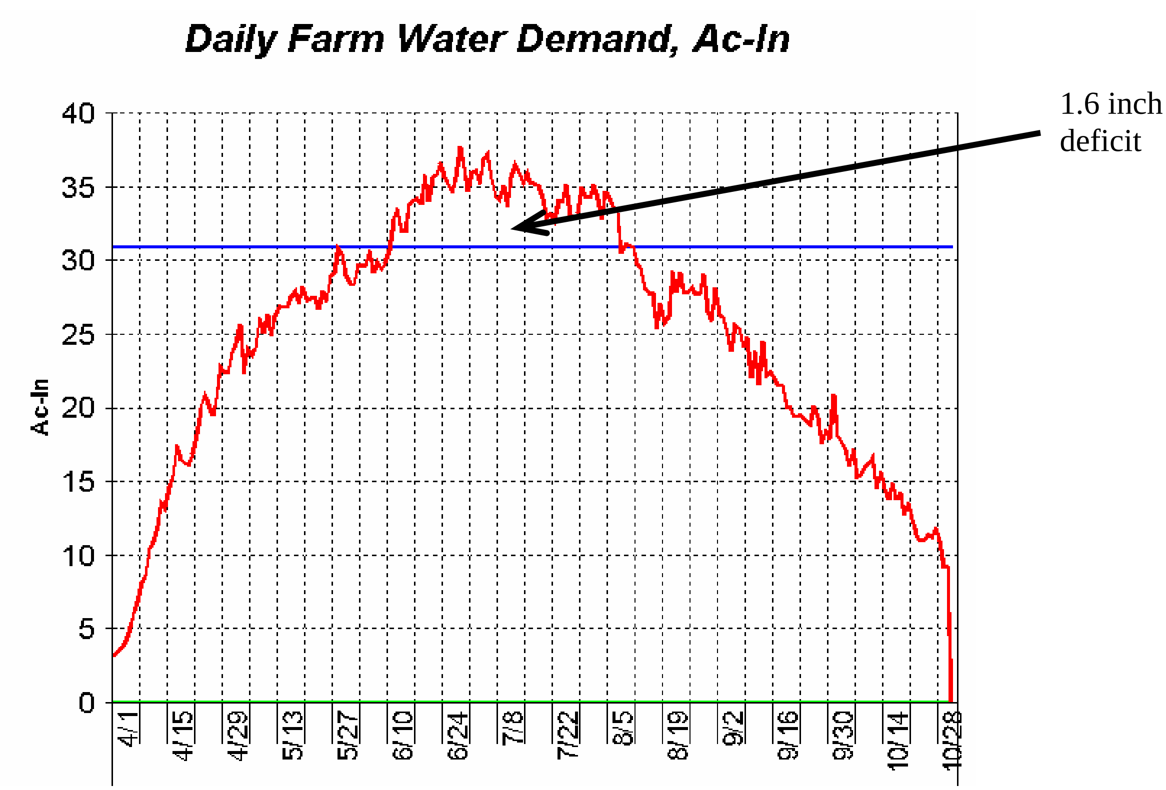

Figure 6. Seasonal ET and water supply for 130 acres of alfalfa at Kimberly, ID, 80% irrigation water for season, wheel line.

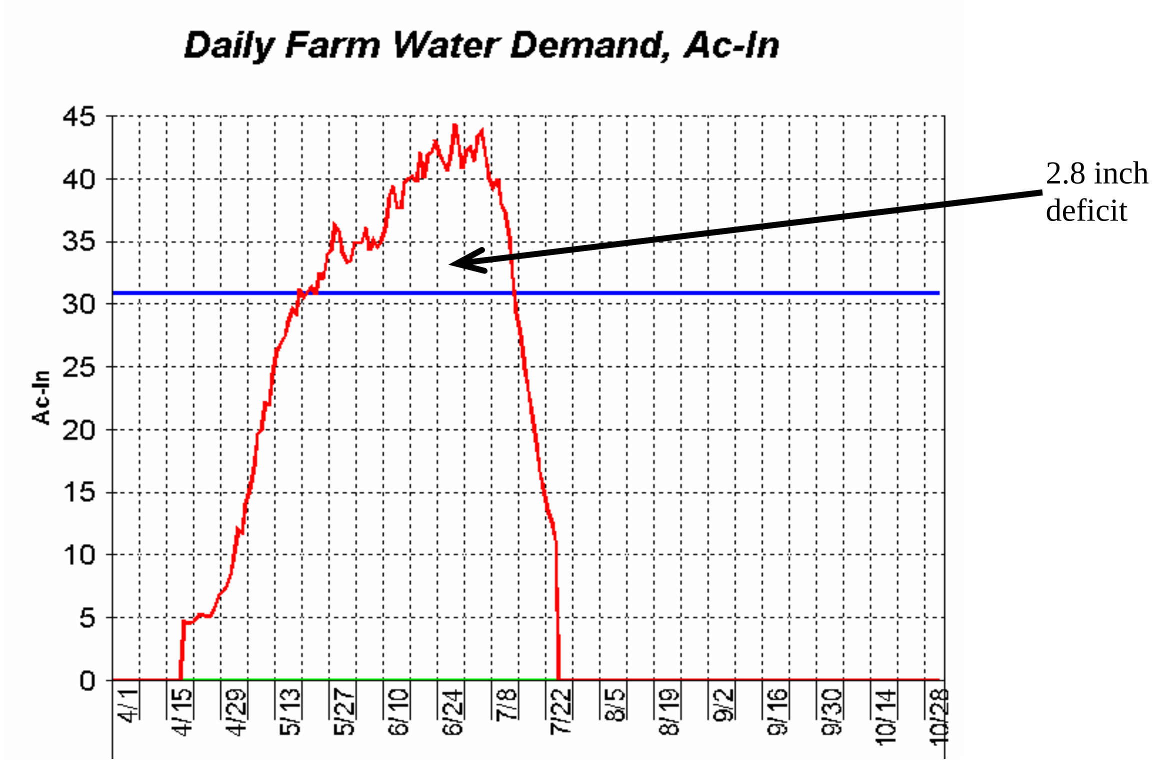

Figure 7. Seasonal ET and water supply for 130 acres of spring grain at Kimberly, ID, 80% irrigation water for season , wheel line.

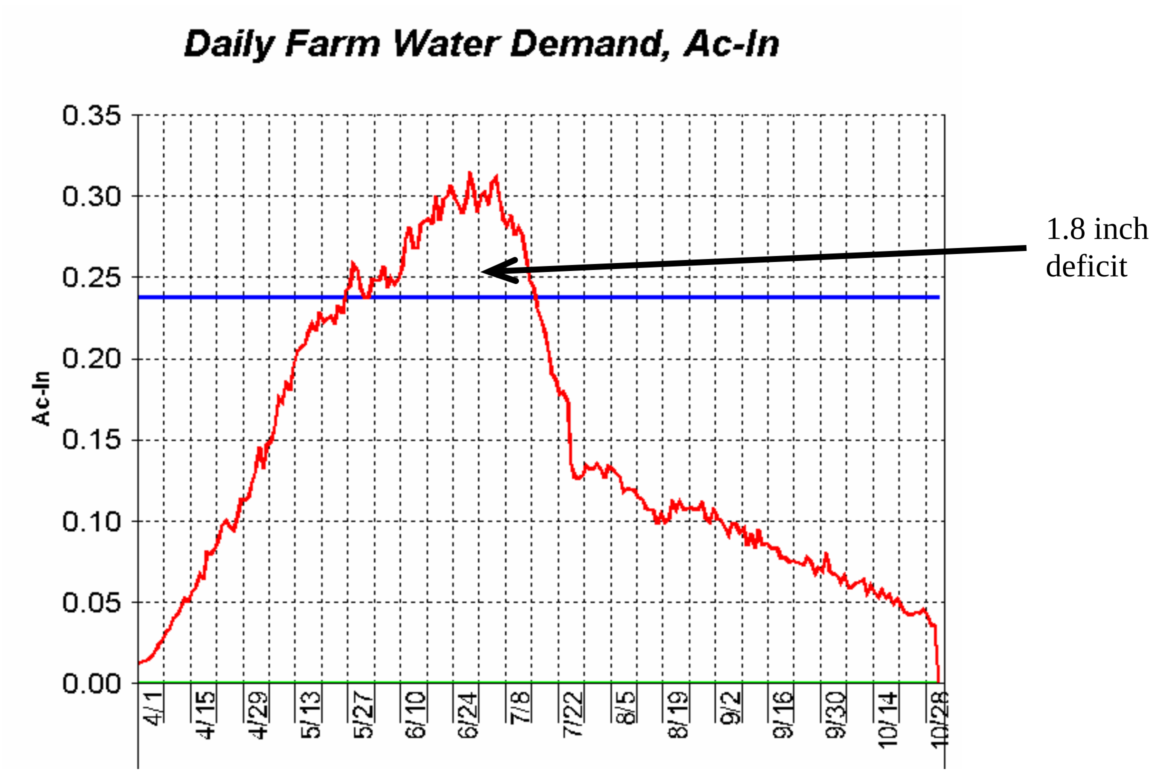

Figure 8. Seasonal ET and water supply for 65 ac spring grain and 65 ac alfalfa at Kimberly, ID, 80% irrigation water for season , wheel line.

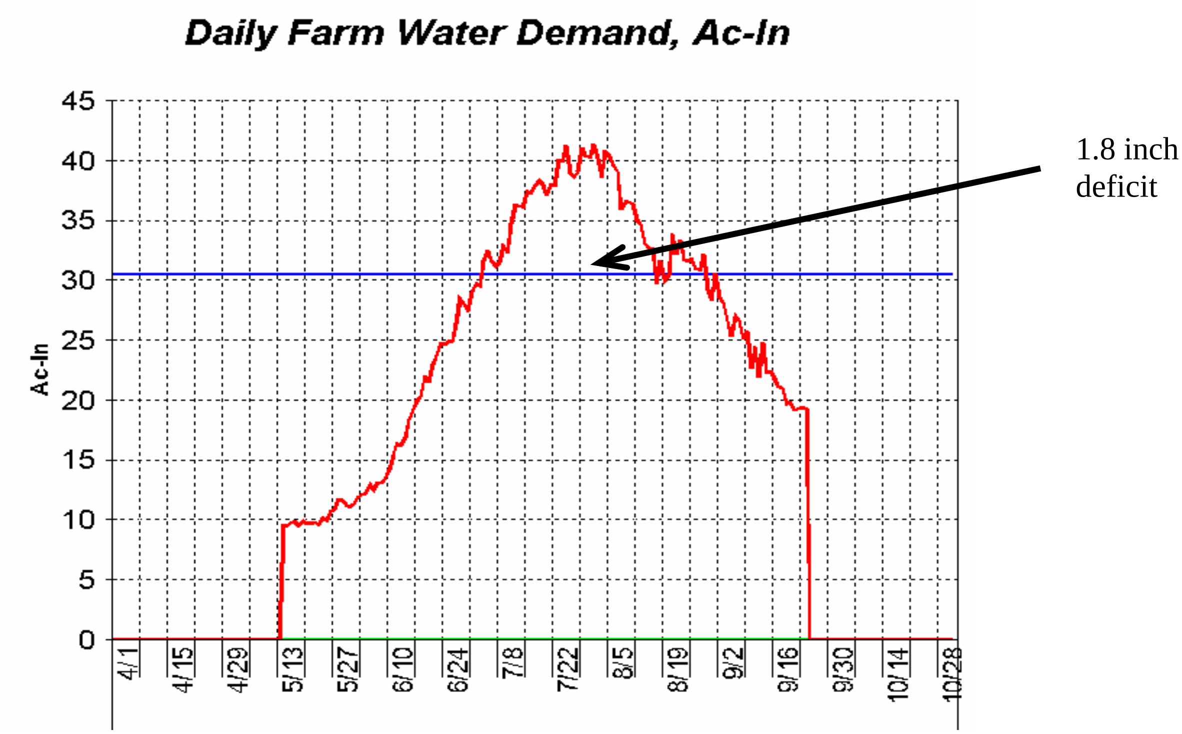

Figure 9. Seasonal ET and water supply for 130 acres of corn at Kimberly, ID, 80% irrigation water for season, pivot.

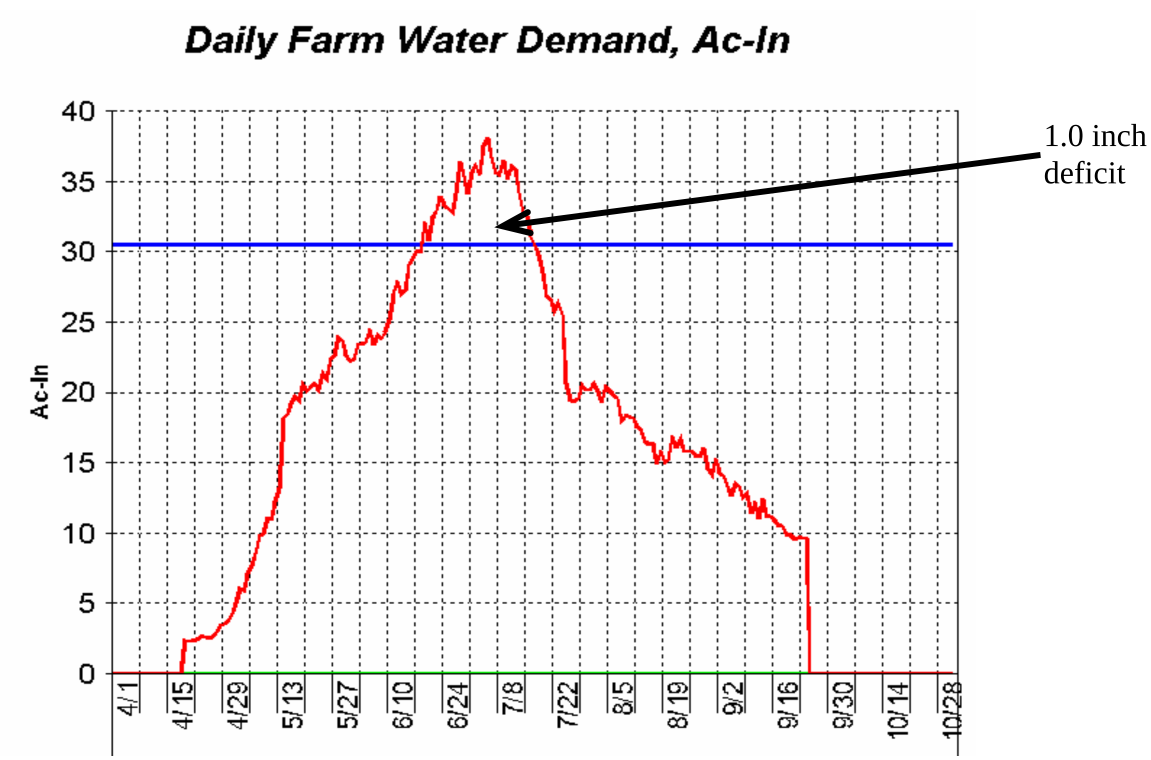

Figure 10. Seasonal ET and water supply for 65 ac corn + 65 ac grain at Kimberly, ID, 80% irrigation water for season, pivot.