7-1986

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Soil Science News & Views

Vol. 7, No. 6, July 1986

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An experiment was conducted for a period of three years, 1982, 1983 and 1984, in order to evaluate the effects of soil water stress and irrigation on growth, yield and quality of burley tobacco at Spindletop Farm, Lexington. The variety KY 21 was grown all three years. Three treatments were used in the experiment: (1) check, rainfall only, not irrigated, (2) well watered, rainfall plus supplemental irrigation, and (3) water stressed beginning 50 days after transplanting. The soil of treatment 3 was covered with black plastic to prevent rainfall from entering the soil.

The rainfall from June 1 through September 31 was below normal all three years. The rainfall during the growing seasons and normal rainfall during the growing season are given in Table 1. Supplemental irrigation was added in all three years to the well-watered treatment. In 1982, rainfall in July and August was 8.3 (3.3 and 5.0) inches. The distribution of rain in 1982 resulted in a very good growing season. In 1983 11.8 inches of rain fell in May, the normal amount of rain during the month of May being 4.1 inches. July and August were extremely dry throughout Kentucky. The distribution of rain during June and through the first few days of July was slightly above normal in 1984. Mid-July is just prior to bloom and topping; after mid-July non-irrigated tobacco was water-stressed.

During the month of May in every year with few exceptions, the soil profile will hold the maximum amount of water that it will hold except for a few brief periods of time, 4 to 6 days after rainfall events. Therefore, almost every year the soil at tobacco transplanting holds essentially all the plant extractable water in the rooting depth that it will hold. The Maury silt loam has only about 5.5 inches of plant extractable water in the rooting depth. This is lower than most well-drained, well-structured silt loam soils.

Figure 1 shows the dry-weight of leaves for the control and well-watered treatments sampled several times during the growing seasons of 1982 and 1983. As can be seen for 1982, the dry-weight of the leaves of the well watered treatment was significantly higher than the control at topping time through harvest as well as the cured leaf. In 1983 the treatments were significantly different even at 42 days after transplanting. The dry weight of the cured leaves of the well-watered treatment was

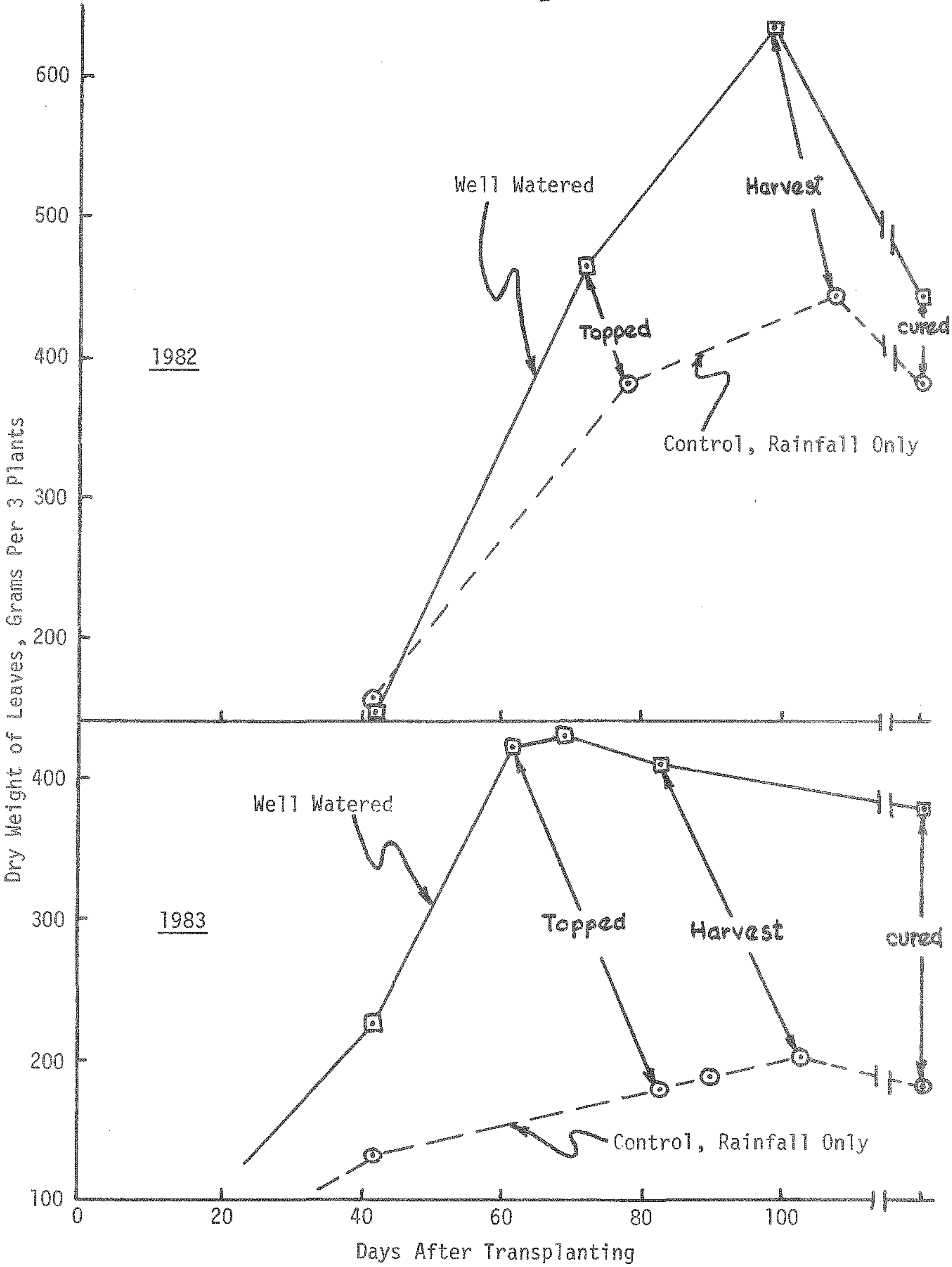

Figure 1. Dry weight of leaves during the growing seasons of 1982 and 1983 for control and well watered treatments.

Table 1. Normal monthly rainfall during the tobacco growing season, rainfall, and amount of irrigation water added to well-watered treatment.

		1982		1983		1984[1]		
Month	Normal	Rainfall	Irrigated	Rainfall	Irrigated	Rainfall	Irrigated Full Season	Irrigated After Bloom
	inches							
June	4.2	1.8	-	3.3	0.6	4.8	-	-
July	4.7	3.3	2.4	1.3	2.7	3.7	5.4	-
Aug.	3.3	5.0	2.8	1.8	3.3	1.3	3.2	7.8
Sept.	2.6	1.5	0.3	0.4	-	1.5	-	-
Total	14.8	11.6	5.5	6.8	6.6	11.3	8.6	7.8

[1] In 1984 the control treatment was replaced by a treatment where the tobacco was water stressed until after bloom then irrigating after bloom.

Table 2. Cured leaf yields, value, and quality as based upon average support price of the Federal Grade of burley tobacco (KY 14).

Year and Treatment	Yield	Value	Ave. Price	Irrigated Water Added
	lbs/ac	$/ac	$/100 lbs	inches
1982				
Control, rainfall only	2750	5150	187	0
Well watered	3000	5500	183	5.5
Water stressed[1]	2450	4600	188	0
1983				
Control, rainfall only	1125	1375	122	0
Well watered	2850	5125	180	6.6
Water stressed[1]	1250	1600	128	0
1984				
Well watered	3000	5200	173	8.6
Irrigated after bloom[1]	2500	4500	180	7.8
Water stressed[1]	1800	3100	172	0

[1] Soil was covered with black plastic 21 days after transplanting to prevent rain water from entering the soil. The plastic also prevented soil water evaporation.

twice as high as for the control. However, the ratio of the two treatments was 2.5 for the stripped leaf (2850÷1125 = 2.5), see Table 2. The data points in the Figure are estimated from 12 plants (3 plants per plot, 4 plots) per treatment while the cured leaf yields are estimated from 192 plants per treatment.

The reason the dry weight of the cured leaf is lower than the harvest dry weight is that during the curing process there is a loss of carbon from the stalk as well as the leaf. There is no net change in the amount of nitrogen in the stalk plus the leaf. However, there is a net translocation of nitrogen compounds from the leaf to the stalk during the curing process. Generally, the greater the loss of carbon and thus dry weight of the leaf during the curing process, the better the quality of the leaf.

Cured leaf yields, value per acre, and average price (a measure of quality) are shown in Table 2. Overall, the growing season in 1982 was much better than either 1983 or 1984. The lack of rain in 1983 was a castastrophe unless one could irrigate rather frequently. In 1984, irrigating after bloom increased yields 700 pounds per acre but still yielded 500 pounds per acre less than the well-water treatment.

The water-stressed treatments were covered with black plastic three weeks after transplanting all three years. The black plastic prevents rain water from entering the soil as well as loss of soil water by evaporation and the only loss of water from this treatment is through the plant as transpiration. At capacity the available soil water in the rooting depth will provide sufficient water to last from transplanting to two weeks prior to topping to one week after topping depending upon the weather. In 1982 some rain water entered the soil through holes in the plastic and the weather during the growing season was relatively cool and humid which reduced the amount of water transpired by the tobacco. In 1983, on the other hand, rain water did not enter the soil and the weather was exceptionally hot which increased the amount of water transpired. The weather in 1984 was intermediate to 1982 and 1983 causing the transpiration to be intermediate between 1982 and 1983. During a normal growing season in Kentucky on well drained silt loam soils, soil-water evaporation amounts to approximately 45 percent of the total evapotranspiration and transpiration amounts to approximately 55 percent of total evapotranspiration during the growing season.

Quality, as measured by federal support price of the federal grade, is not as clear from the data in Table 2 as one would expect. In 1982 price of the tobacco grown on the water-stressed and control treatments was better than on the well-watered treatment; however, gross value of the tobacco from the well-watered treatment was $5500 per acre as compared to $4600 per acre for the water-stressed treatment and $5150 per acre for the control treatment. In 1983, the well-watered treatment had a much higher value than either the water stressed or the control treatment. Tobacco of the well-watered treatment in 1984 was of lower quality than the irrigated-after-bloom treatment but was higher in value on an acre basis.

In summary, water stress to plants occurs for one or more periods during almost every growing season; 1983 was a year in which plants were under severe water stress during the last two-thirds of the growing season. Any time plants suffer even short periods of water stress, dry matter accumulation of the plant will be decreased with the magnitude of the decrease being dependent upon the severity and duration of water stress.

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