Asparagus Response to Water and Nitrogen

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ABSTRACT

The relationships of asparagus yields to varying levels of water and nitrogen were determined. Maximum yields of 345, 560 and 300 crates/acre were produced for asparagus crowns that were 3, 4 and 5 years old, respectively. A total seasonal water depletion rate of 98 inches was calculated for the fern growing season. Optimum nitrogen applications were estimated at approximately 350-400 lb/ac.

INTRODUCTION

Asparagus production in the desert Southwest is totally dependent on irrigation to supply the water requirements. Nitrogen is a critical nutrient that is required to obtain maximum yields. If farm managers are to maximize returns, they must have information which will relate yield to different levels of water and nitrogen.

MATERIALS AND METHODS

A self-moving lateral sprinkler irrigation system was modified to accurately apply 9 levels of water and nitrogen. The amount of water applied ranged from 50% to 150% and the nitrogen levels varied from 33% to 167%; 100% was the optimum level for both the applied water and nitrogen. The optimum applied amount of water (100%) was determined by using a neutron moisture meter to schedule irrigations so that an adequate moisture level was maintained. Tissue analysis verified that adequate levels of nitrogen were maintained in the plant tissue in those plots where 100% nitrogen was applied. This study was conducted at the University of Arizona Yuma Mesa Agricultural Center. The soil was a Superstition sand with a infiltration rate of approximately 3 inches per hour.

'Meadowland Select' asparagus seed was planted in a nursery during July 1979 to obtain crowns for transplanting. These crowns were transplanted on 7 Feb. 1980, at a depth of 6 inches in rows spaced 12 inches apart, on beds 68 inches apart. The crowns were spaced 10 inches apart in each row resulting in a population of 18,500 plants/acre. The crowns were planted on flat beds, rather than using the commercial practice of raised beds. An overhead sprinkler irrigation system applied the water so furrows were not needed. The irrigation system applied water at a high rate for a short duration, exceeding the soil infiltration rate. By planting on flat beds, the irrigation water was more uniformly distributed in the soil profile.

The differential irrigation and nitrogen treatments were imposed about two months after the crowns were transplanted. Initially all plots received the same amount of water and nitrogen fertilizer to insure uniform plant establishment. The asparagus fern was grown until late October, when the irrigations were terminated to induce plant dormancy. The plants used up the remaining soil water; the ferns dried, usually by mid-December. The dried fern was removed by burning; the soil surface was then rototilled to a depth of 3 inches to remove any remaining dried asparagus stocks and to prepare the surface so emerging spears could be easily harvested.

Approximately 7 inches of water was applied to all plots in late January to refill the soil profile. Soil temperatures usually warmed sufficiently so that asparagus spears were harvested by early February. All harvests lasted for 60 consecutive days; then the asparagus was allowed to fern and grow until late October, when the

irrigations were again terminated. The first harvest season (1981) lasted only 29 days because the transplants were only one year old; the crown and root system had not fully developed to sustain a 60-day harvest. The 1982, 1983 and 1984 harvests lasted for 60 days.

RESULTS AND DISCUSSION

Crown survival and fern growth were exceptional; growth exceeded of 6 feet the first year for those plots that received adequate water and nitrogen. In subsequent years, the fern growth exceeded 8 feet. Typically, irrigation water was applied three times weekly during the fern growing season. The total seasonal moisture depletion during the fern growing season was calculated to be 98 inches for the 1982 and 1983 growing seasons.

The maximum daily soil water depletion was 0.55 inches, which occurred from late June through early August. The total soil moisture depletion during the 60-day harvest season was 0.87 inches for 1984, which resulted in a daily depletion rate of only 0.01 inches.

Irrigations during the harvest season may not be required to replace soil moisture. Spear emergency can be reduced for a short period after an irrigation because soil temperature is reduced. Irrigations could be required for other cultural practices, such as: to prevent spear damage from blowing sand; to firm the soil to improve foot traffic; or to cool the soil surface during hot weather to prevent the spear brackets and growing tips from becoming ferny before they reach a marketable length.

Nitrogen fertilizer was injected into the irrigation water weekly from April to mid-September. Nitrogen was applied soon after the last harvest when the spears started to fern. The amount of water and nitrogen applied each month is listed in Table 1 for the 100% water and nitrogen applied treatment. The amounts of water and nitrogen applied to the other treatments are proportional to the amounts listed in Table 1.

All asparagus spears were trimmed to 9 inches in length and into seven commercial sizes, as defined by the California Agricultural Code for loose asparagus. Badly misshapen spears or those with growing tips that were not fairly compact were graded as culls.

Table 1. Monthly water and nitrogen applications to the 100% treatments.

	1981		1982		1983		1984	
MON	inch	lb/ac	inch	lb/ac	inch	lb/ac	inch	lb/ac
Mar	2.2	25	6.7	25	-	-	-	-
Apr	3.0	18	6.5	38	3.8	37	6.3	39
May	5.0	38	8.6	37	8.3	50	13.4	81
Jun	10.0	38	10.2	32	16.2	71	19.6	88
Jul	17.3	10	14.6	49	17.8	54	19.3	49
Aug	13.8	62	13.4	38	13.4	48	18.1	64
Sep	10.7	-	11.3	12	14.0	48	17.5	28
Oct	4.6	-	6.5	-	8.6	-	7.8	-
Nov	-	-	-	-	-	-	-	-
Dec	-	-	-	-	-	-	-	-
Jan	8.7	33	3.0	-	7.2	-	7.0	-
Feb	3.4	-	11.5	-	2.2	-	0.6	-
Sum	78.6	224	92.3	231	91.5	308	109.6	349

For this study, harvested spears were trimmed so that no white color showed. The numbers and weights of each size and the culls were recorded daily from each plot. Total asparagus yields were determined for each growing season by adding the amount harvested each day for all the sizes. The yield contours in crates/ac were determined over the range of water and nitrogen applied and are shown in Figure 1 for the four growing seasons. An asparagus crate is equivalent to 30 pounds.

The results shown in Figure 1 for the 1981 harvest suggest that insufficient water and nitrogen applications were made during the previous growing season to obtain maximum yield. The 1982 maximum yield was 345 crates/ac when 105 inches of water and 330 lb/ac of nitrogen were applied. The asparagus yields were substantially greater in 1983; a maximum yield was 560 crates/ac for an application of 110 inches of water and 480 lb/ac of nitrogen. In 1984 the maximum yield was 300 crates/ac, with 120 inches of water and 520 lb/ac of nitrogen were applied. The average amount of water applied to obtain maximum yield was about 110 inches. If water applications were reduced to 98 inches (a 10% reduction) the yields would still be 98% of the maximum. Nitrogen applications could also be reduced to 350-450 lb/ac and the yields would still be 90% of the maximum. Using actual water and nitrogen costs, the farm manager can optimize returns from the relationships shown in Figure 1.

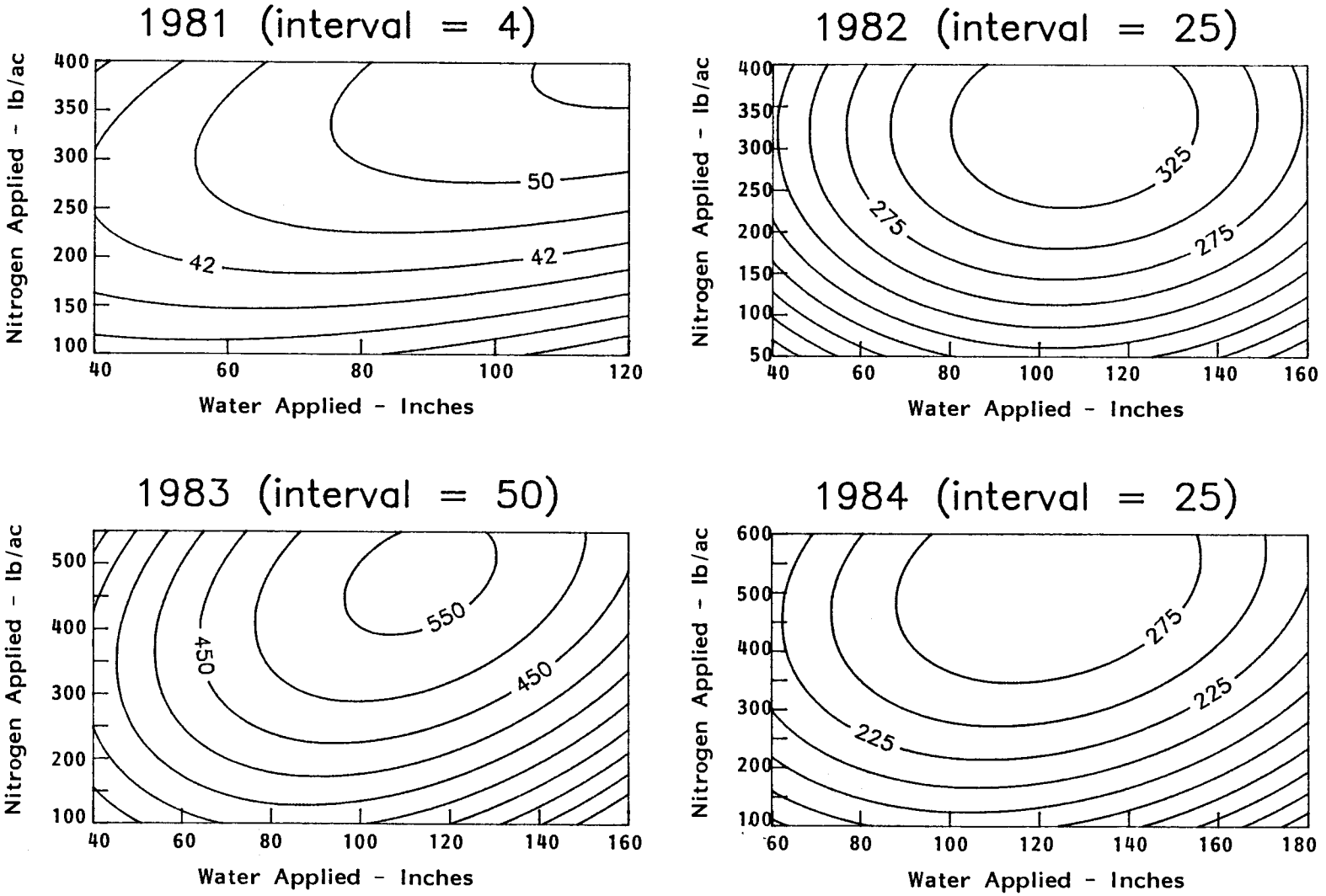

Figure 1. Asparagus yield response to Water and Nitrogen in crates/ac.