USING PLANT MAP DATA TO IDENTIFY EARLY-SEASON MANAGEMENT PROBLEMS IN COTTON

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Abstract

Monitoring cotton growth in season can be an effective component in the farm management decision-making process. Several Fresno County fields were compared and related to long-term crop reference data established for the San Joaquin Valley. The use of established plant mapping procedures enabled us to identify two of the five monitoring sites as having undesirable soil characteristics. These soil limitations impeded growth and development of the Acala Maxxa cultivar. Early-season plant monitoring assisted in identifying those sites having low vigor and fruit retention characteristics and collect additional data in season to assist in identifying management decisions that would improve current and future crop productivity.

Introduction

Plant mapping is a relatively new tool that can be used by the agronomist and grower to better understand crop growth and development characteristics over the course of a growing season. Basic plant parameters, such as plant height, number of vegetative and fruiting nodes, and location of fruiting bodies, are useful in this analysis. In the San Joaquin Valley, large data sets have been used to establish crop reference values for several plant parameters (Kerby and Hake, 1994). These plant mapping references can be useful in identifying specific factors responsible for plant performance. In many instances, cultural management practices can be modified to reduce the impact of factors limiting crop productivity.

Methods

The 1995 study sites were established at three locations in Fresno County. Composite soil samples were taken at each site from the top foot. Soil salinity and nutrient analyses were conducted with the results of the surface sample summarized in Table 1. The current cultivar standard, Acala Maxxa, was mapped two to three times during the bloom period using the computer program California Cotton Manager (Munier, et al, 1994) for in-season mapping while the California Plant Mapper (Plant, et al, 1994) was used for the final plant map at each study site. In-season input parameters include plant height, number of vegetative nodes, number of fruiting nodes, fruit retention on the top five fruiting branches, fruit retention on bottom five fruiting branches, and number of nodes above white flower. Fruiting characteristics refer to first position fruit only. A twenty-plant sample was used from four locations in each field. Planting date for each site was April 11 for WS-Ir and salinity plots and April 28 for M and M Farms. Heat unit estimates indicate approximate 75 degree day units difference between April 11 and April 28. Date of first bloom each field is as follows: WSFS (stressed) July 6, WSFS (low stress) July 7, M and M Farms July 15, salinity high July 1, and salinity low July 4.

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Node Development

Although early-season heat unit accumulation was similar at each site, plant height varied tremendously in the five study sites monitored in late June and throughout July. Cotton monitored on June 30 at the West Side Research and Extension Center was 23 inches tall while the M and M site had plants 8.3 inches tall, Table 2. Plant height in the saline soils' trial ranged from 10.6 inches in the high salinity blocks to 16.1 inches in the low salinity areas. The water stress trial indicated no difference in the plant height or number of fruiting branches by June 30. However, the fruiting branch number on June 30 was lower at the M and M site and the high salinity block. In addition, consistent patterns of reduced plant height in season was observed at the M and M Farm site and high salinity site. By season's end, the water stressed high salinity and M and M Farms sites produced the shortest plants with the high salinity block producing a 32-inch plant. Unstressed cotton at the WSFS site yielded a 58-inch plant.

As with plant height, the WSFS site and low salinity site had the more advanced nodal development, Table 3. The M and M site and high salinity fields, however, produced 4.2 and 7.0 fruiting branches compared to the 9.9 produced at the WSFS site on June 30. These two sites remained the most undeveloped throughout the season.

The height-to-node ratio index demonstrated its value in identifying early- season vigor problems but, by late season, this index is less revealing regarding crop vigor and performance. As a result of the cool spring temperatures, early-season HNRI values showed moderately-low to low vigor at all study sites. But, as the season progressed, HNRI values rebounded at the WSFS and low salinity site. Low HNRI levels were sustained late season at the high salinity and M and M sites. A slightly higher HNRI was observed for the water stress site when compared to the unstressed site July 11 indicating a compensation of the fruiting branch number as plant height was reduced. HNRI was further increased as the season and crop stress levels progressed. Final plant mapping revealed a 95 percent HNRI in the water-stressed condition compared to 86 percent in the unstressed condition. Contrastingly, however, final mapping in the salinity site showed a 93 percent HNRI compared to 73 percent in the highly saline field.

Fruit Retention

Fruit retention at most sites was favorable until late season. The WSFS site, for instance, maintained a 94 percent retention on the top five fruiting branches just prior to bloom and beyond the first bloom. Similar high square retention values were observed in the salinity and M and M sites. Most of the square retention problems that existed came as bottom fruiting branches lost a substantial number of developing bolls late in the season. Significant boll drop of the bottom fruit occurred during and following late July. With the exception of the high salinity block, final retention at the bottom crop was at or below the 50 percent level. Boll drop at the M and M site indicated a consistent decline in lower boll retention following the July 11 date, with final bottom five retention of 26 percent. Differences between sites cannot be explained by planting date, or degree day accumulations. Soil analysis indications can explain some soil factors responsible for reduced crop vigor. With all indications of low vigor problems at the M and M site, a more thorough investigation of soil quality was conducted at all sites in mid-season.

Soil Sampling

The more detailed soil analysis revealed some potential problems with soil salinity with respect to crop growth and productivity. Although we expected to see high salt levels on the WSFS five-site, spring soil sampling failed to reveal high sub-sursurface salinity levels at the M and M site. The M and M site showed high salinity levels in the 2-foot level and below. Soil salinity ranged from 6.2 to 7.9 dS/m in the 2- to 3-foot zone of the soil profile. These levels are in excess of reported threshold salinity for cotton and are likely to influence crop vigor and productivity. Because the cotton crop must compete with these soluble salts for water, the osmotic gradient from soil solution to plant root becomes unfavorable for plant water uptake. Because of cotton's limited ability to osmotically adjust to increasing soil salinity, crop water stress becomes the primary limitation to vegetative plant growth and development. Studies by Grimes, 1970, and Munk, 1993, have shown that the cotton crop has a demonstrated ability to modify its carbohydrate partitioning by increasing photosynthate content to the fruiting bodies at the expense of vegetative growth. This mechanism is consistent with the data obtained at two of the five study sites.

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Table 1. Surface soil characteristics, including electrical conductivity (R) exchangable sodium percentage (ESP), organic matter content (OM), and cation exchange capacity (CEC).

EC Location 100g	ESP sD/m	%OM	CEC	%Clay Meq/
M & M 46	1.78	11	2.11	44.5
Salinity-L 22	2.03	7	0.44	22.0
Salinity-H 22	8.12	11	0.44	22.0
WSFS 34	0.43	3	0.71	29.5

Table 2. Observed plant height in inches for Acala Maxxa at fivelocations.

Mapping Dates			Location	6/30
7/11	7/21	10/1		
WSFS-S	23.1	33.2	--	42.4
WSFS-U	23.1	34.0	--	59.7
M & M	8.3	17.8	27.4	40.2
Salinity-H	10.6	--	28.9	32.0
Salinity-L	16.1	--	38.2	48.0

Table 3. Fruiting branch number observed at five Fresno County study locations.

Mapping Dates				
Location	6/30	7/11	7/21	10/1
WSFS-S	9.9	12.2	--	15.6
WSFS-U	9.9	12.7	--	25.7
M & M	4.2	7.8	11.0	19.4
Salinity-H	7.0	--	13.0	15.3
Salinity-L	8.3	--	15.2	18.2

Table 4. Height to node ratio indexed to unstressed SJ-2 cotton in the San Joaquin Valley.

Mapping Dates			Location	6/30
7/11	7/21	10/1		
WSFS-S	87%	97%	--	95%
WSFS-U	87%	93%	--	86%
M & M	75%	88%	80%	73%
Salinity-H	66%	--	77%	73%
Salinity-L	77%	--	86%	93%

Table 5. Fruit retention percentage of top 5/bottom 5 fruiting branches on first position fruit.

Mapping Dates			Location	6/30
7/11	7/21	10/1		
WSFS-S	94	94/81	--	/45
WSFS-U	94	95/71	--	/39
M & M	77	89/55	79/45	/26
Salinity-H	82	--	92/81	/69
Salinity-L	80	--	86/70	/53

Table 6. Soil salinity charactereistics of five study sites expressed as electrical conductivity Ec (dS/m) from a saturated soil paste extract.

Sampling Depths				
Location	1'	2'	3'	4'
WSFS-S	0.43	0.47	0.59	0.86
WSFS-U	0.43	0.47	0.59	0.86
M & M	1.80	6.20	7.90	7.30
Salinity-H	8.10	9.20	8.20	7.50
Salinity-L	1.40	0.92	1.10	1.00

Table 7. Seed cotton yield at 5 San Joaquin Valley locations expressed in lbs/acre.

Location	Seed Cotton (lbs/acre)
WSFS-S	2092
WSFS-U	2407
M & M	2446
Salinity-H	2895
Salinity-L	3047