



# Agronomic Guidelines for Pima Cotton Production in Arizona

American Pima (*Gossypium barbadense* L.) cotton production has historically been a very important feature of Arizona cotton production. The first commercial crop of extra-long staple cotton in Arizona was produced in 1912 (McGowan, 1961). A total of 11 extra-long staple varieties have been developed and released for production in Arizona and the desert Southwest. Pima S-1 was released in 1951 after development of a selection from a series of crosses involving Sea Island, Pima, Tanguis, and a variety of Stoneville Upland (*G. hirsutum* L.) cotton (Bryan, 1955).

These crosses provided a broad germplasm base for the development of improved fiber and yield characteristics for further Pima selections. Subsequently, five additional Pima varieties have been released: Pima S-2, 1960; Pima S-3 and S-4, 1966; Pima S-5, 1975; and Pima S-6, 1983 (Turcotte and Feaster, 1988). Improvements in each successive release have provided higher yield potentials through increasing heat tolerance and earliness. Improved heat tolerance and earliness have been beneficial to lower elevation areas (below 2,500 ft.), and improved earliness has been a benefit to higher elevation areas (above 2,500 ft.) (Niles and Feaster, 1984). Continued improvements in yield potential through increasing heat tolerance and earliness, while maintaining or improving fiber properties, is an ongoing goal within the Pima breeding program for the development of future variety releases (Turcotte and Feaster, 1988).

With the interest and activity in Pima cotton production in Arizona, perhaps an outline of some of the major points concerning some of the agronomic factors involved in the production of Pima cotton in Arizona would be in order. Newcomers and veterans to the Pima production process recognize that differences do exist between Upland and Pima in terms of growth habits and management. Even with the release of Pima S-6 in 1983, Pima remains to be more indeterminate than its Upland relatives, a factor which figures very predominantly in several aspects of its management.

## Planting Date and Rate

A series of experiments have been conducted in the past several years, where Pima S-6 was included as a variety planted at four locations, with four to five planting dates at each. Locations included Yuma, Maricopa, Marana, and Safford. Dates of planting ranged from late February to early April at Yuma, late March to early June at Maricopa, and very early April to early June dates at both Marana and Safford. The planting dates were separated by about 14 days in each case. The results are fairly consistent among these tests with regard to the yield response of Pima S-6 to date of planting. Even though Pima seeds are generally regarded as being more cold tolerant, they emerged and became an established stand best when planted in suitable warm soil conditions. Such conditions could be generally described as 60-65°F in the zone of seed placement for several days prior to and after planting, with a well-prepared seedbed. We also found from these experiments that Pima S-6 tended to perform best when planted early, and realized rather consistent declines in yield with delayed plantings as used in these experiments. The point to be taken is that planting of Pima S-6 is probably best for as early a date as conditions will allow. This is to say generally that late March to April plantings are best for most areas,

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and that delays past that time may be quite costly in terms of yield potentials. For Yuma, this possibly could be extended to say that Pima plantings should optimally occur from late February to the first of April.

Another way of describing optimum planting dates is by the use of heat units (HU) using 86 and 55°F upper and lower limits. A range of about 300 to 900 HU accumulated since January 1 at any given Arizona location, can best describe the time frame for Pima (or full-season Upland varieties) plantings that provide an optimum for yield potential. This range of accumulated HU may vary by calendar date from year to year, and by location; but can provide a better measure of seasonal patterns. By the time 300 HU have been accumulated, adequate soil temperatures likely will have been reached. This does not eliminate the need for monitoring soil temperatures and weather forecasts, but serves as a guideline for planting.

Other things learned from these experiments included the fact that as Pima was planted later (greater than 900 HU accumulated since Jan. 1) plants grew taller, more vegetative, and less productive. This is seen as a plant response to greater amounts of heat (heat units) being accumulated in shorter periods of time, which causes greater internode length, larger leaves, and a lesser tendency to begin fruiting. So a delayed planting of Pima will tend to bring about taller, more vegetative plants, with lower yield potential, after causing a grower a degree of concern and difficulty in management. In fact, as HU accumulations since January 1 exceed 700, yield potentials from subsequent Pima plantings become increasingly marginal as vegetative tendencies under warm weather conditions become more likely.

Acceptable plant populations for Pima cotton range from approximately 20,000 plants per acre (ppa) to 50,000 ppa. Optimum populations range from about 25,000 ppa to 40,000 ppa. Pima plants typically have long fruiting branches, with as many as eight fruiting sites per branch. Therefore, Pima plants have a very flexible nature in terms of compensating for varying plant populations, and maintaining high yield potentials. High plant populations (greater than 50,000 ppa) can lead to plants that are tall, vegetative, and generally poor in total fruit (boll) retention per plant. Therefore, high populations contribute to plants that are difficult to manage for high fruit retention, and delay maturity (decrease earliness).

Pima cotton typically has been grown on a 40 inch row spacing, which is generally accommodating to the wide branching nature of the plants. At present, insufficient data are available to determine the advantages or disadvantages associated with the use of 30-inch-row spacings. Further research with more determinate Pima selections may prove to be of benefit under narrow (30-inch) row systems in an effort to improve earliness with this type of cotton.

## Irrigation

Probably one of the most difficult decisions to make in a Pima production season is the time to initiate the first irrigation. Plant water stress itself is a tool that many veteran Pima growers have found useful with pre-S-6 varieties, and also sometimes with S-6, to control vegetative growth. However, most successful Pima S-6 growers currently do not intentionally water stress a Pima crop at any time except during very early periods in the season. This is usually just prior to the first irrigation. Just how much to stress a Pima crop at this time is a very good question and a delicate one. It does not appear that anyone has established some easily measured point at which enough stress has been incurred and irrigation is needed before serious harm is done. This still remains a somewhat “artistic” act that Pima cotton producers must carry out. Most Pima growers and researchers agree that an imposed water stress should be avoided up to the time one is preparing the crop for termination.

Substantial data on consumptive use patterns of Pima versus Upland cotton are not available. However, on a daily basis, Pima cotton requires essentially the same amount of water as its Upland counterparts do. Any differences in total water used on a Pima crop probably occurs later in the season when an additional one (or two) irrigation(s) may be provided to mature later-set bolls. In terms of water management throughout the course of the season, Pima S-6 is usually managed very much like full-season Upland varieties.

## Fertility Management (N)

With the abundance of HU that Arizona cotton crops commonly accumulate, the two main controls an Arizona cotton grower has are water and nitrogen (N) fertilizer. Keeping the plant in good condition with regard to water relations through the season is an obvious objective. Since the control of the vegetative/reproductive balance is particularly critical in Pima, one must also consider the N fertilization of Pima in a unique light. Many producers and researchers agree that Pima is sensitive to excessive N levels, and can convert extra growth to pure vegetation without any trouble. In fact, many Pima growers purposely avoid fields where a high level of residual available N ( $\text{NO}_3^-$ -N) will be present. This should be a point of consideration for growers placing Pima in a field after vegetable or alfalfa crops.

Guidelines have been developed for managing N fertility in Pima by use of petiole sampling in-season. The Arizona Cooperative Extension publication 8373: *The Cotton Petiole: A Nitrogen Fertilization Guide* (Pennington and Tucker, 1984) outlines procedures and ranges in petiole nitrate -N ( $\text{NO}_3^-$ -N) levels for management through the growing season. In

comparison to Upland levels of petiole nitrates, Pima levels should be somewhat lower throughout the season (approximately 40 percent lower). Caution should particularly be taken to avoid excessive levels of  $\text{NO}_3^-$ -N in the Pima petioles early in the season, to avoid excessive vegetative growth before fruit set begins. Further details describing N management for Upland and Pima cotton are provided in Arizona Cooperative Extension publication 9024: *Nitrogen Management in Arizona Cotton Production* (Silvertooth and Doerge, 1990).

## Pest Management

In terms of insects, weeds, and diseases; the general cases that pertain to Upland cotton can be transferred to Pima. However there are a few points of difference. Pima bolls seem to be more susceptible to pink bollworm (*Pectinophora gossypiella* (Saunders)) damage than Upland. This is primarily due to Pima bolls maintaining a higher moisture content and softer boll walls that are prone to pink bollworm damage over a longer period of time. Pima bolls are not sufficiently hardened until 35 to 40 days after bloom (800 to 900 HU).

The sweet potato whitefly (*Bemisia tabaci* (Gennadius)) is becoming a pest of concern in both Upland and Pima cotton production. Concern is particularly associated with the diminished quality that results from the sooty mold and the stickiness of the lint that may be caused by the honeydew secreted by whiteflies. Pima cotton has appeared to some to be more attractive to whitefly populations. Regardless of the degree and cause of attractiveness, we know that whiteflies and Pima are not good companions. Pima is an indeterminate plant, often grown in a long, full-season setting. When whitefly populations characteristically grow at nearly exponential rates late in the season, very little remedy appears to be available at present. Termination, defoliation, and quick removal of the crop has proven to be a good alternative to growers faced with this problem. This is one point causing interest in evaluating the length of season a Pima cotton crop requires for optimum economic return, and the option of early termination. Particularly considering the strong emphasis that quality has in Pima production systems.

In terms of disease control, Pima cotton has demonstrated several differences to Upland. Pima cotton is often thought of as being more susceptible to Texas Root Rot than Upland cotton. Probably due to a deeper rooting tendency, and due to the fact that Pima plants often don't accomplish a significant fruit set until later in the season. Many growers avoid fields known to have substantial Texas Root Rot kill patterns. Pima also has been cited as being more prone to developing *Alternaria* Leaf Spot, a fungal pathogen which attacks the leaves of the plant. This however, has not yet developed into a problem of any broad extent in Arizona.

## Termination and Defoliation

In order to obtain the highest possible returns on a Pima crop, one must maintain the highest quality lint as possible. The quality of harvested lint is often a result of the preparation and picking process at the end of the season. Accordingly, the late season management of the crop, and the defoliation of the crop affect the timeliness in which the cotton is harvested from the field. The choice and timing of defoliant chemicals that are applied certainly are important in achieving satisfactory defoliation. But other factors such as the late season plant-water status, the N fertility status, and the boll load that the crop plants are carrying have a definite impact on the way a cotton crop defoliates. This is true of both Upland and Pima due to their perennial nature, but particularly Pima with its robust and indeterminate growth pattern.

By using chemical defoliant, one is attempting to enhance the natural physiological process of plant senescence and leaf abscission. Defoliation requires a degree of natural senescence which can be brought along to some extent by the development of water stress late in the season. Plants carrying a good boll load also naturally senesce a little more rapidly. A certain degree of physiological activity is needed to realize the effects of chemical defoliant, and also to have a sufficient green leaf weight to actually drop the leaf from the plant once an abscission layer is developed. Otherwise, leaves may be burnt but not dropped, leading to a possible trash problem.

Recent research conducted in an effort to develop better guidelines for Pima cotton would reinforce these points. Exceedingly dry Pima plants are difficult to defoliate (usually leaving intact, burnt leaves), while fresh, lush growth also is very difficult to slow down and defoliate, and has strong regrowth tendencies. Developing a slight water stress following termination encourages senescence, but too much will hinder defoliation efforts. Allowing three to four weeks (depending on soil water holding capacity) after the final irrigation before defoliant applications, generally provides adequate plant senescence to accommodate defoliation.

Late season N levels that are high also can cause the plant to maintain strong vegetative growth. Based upon the guidelines mentioned previously, petiole  $\text{NO}_3^-$ -N levels should be drawn down below 3,000 ppm prior to defoliation. This will not cause a yield-limiting decline in N fertility, while allowing for a stronger trend in plant senescence.

## Summary

Not every aspect of Pima cotton production has been addressed in this bulletin. However, a discussion of the points in Pima production where principal differences exist in comparison to Upland cotton

production has been attempted. Basic agronomics are essential for producing both the quantity and the quality required for successful Pima production in Arizona.

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