Growing Irrigated Cotton

Introduction

Cotton production is critical globally as a source of fiber, livestock feed and other products. While it is most commonly associated with fiber/textile uses, the seed is a valuable byproduct of cotton harvest. It can be used for cattle feed and processed into other food and feed products.

The top three cotton-producing countries are India (5.8 million metric tons), the United States (4.0 million metric tons) and China (3.5 million metric tons). The U.S. is the leading cotton exporter, exporting more than 3.2 million metric tons in 2018/19.

This guide discusses some of the considerations in growing irrigated cotton.

Seed And Plant Selection

Selecting appropriate genetic material is a key part of successful cotton production. There are two categories: “Upland”, or short-staple, cotton; and “Pima”, or long-staple, cotton. Upland cotton is the most commonly-planted type, making up 95% of the cotton grown world-wide. Pima cotton has quality advantages over Upland cotton, so it has a higher selling price, but its production is limited to specific climates; also it generally produces lower yields of lint.

Cotton varieties have historically been bred to optimize production in local areas, so tend to be well-adapted to specific soils and climatic conditions. There may be slight differences in cultural practices, as well, for given soil types, terrain and climates. For example, pima cotton generally requires a warmer, longer growing season, so it may not be suitable for some areas.

Egyptian cotton is the same species as Pima, but is generally considered superior in quality due to the unique climate and management system used to produce it. For the purposes of this guide, we will generally refer to Upland cotton, unless otherwise indicated.

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In addition to the type of cotton grown, another key decision is the selection of genetic characteristics to use. Genetically Modified (GM) varieties have been developed, and are in widespread use, in 2020 over 80% of the US cotton seed was GM, that include genetic resistance to various insects and herbicides. This allows farmers to greatly reduce the number and amount of herbicides and insecticides used to produce a crop. This has certain biological, environmental and economic benefits, which many producers have embraced.

Some prefer to avoid use of these varieties, for various reasons. The "conventional" varieties are also widely available with a large number of traits suited to particular soils, climates, and management needs. As a result, an early decision to make is whether to generally embrace GM varieties or to use non-GM varieties.

Planting

As in most crops, good germination and early vigor are important. Cotton should be planted in warm, moist soil from either rainfall or pre-plant irrigation, with a forecast of warm weather to enhance emergence. Soil temperature should be at least 18° C (65° F) at 20 cm (8 in) depth.

Planting depth is variable, and ranges from 2 – 6 cm (3/4 - 2 ¼ in), depending on conditions and management system. Cotton is typically planted in rows 75 – 100 cm (30 – 40 in) apart. In-row seed spacing varies from 10 cm (4 in) in irrigated systems to 15 cm (6 in) in arid, rainfed systems. This leads to planting populations of 64,000 – 128,000 seeds/ha (26,000 – 52,000 seeds/A), depending on row width.

Fertility

Local soil conditions will determine crop fertility needs, but we always recommend following Best Management Practices (BMP) to optimize yield, maximize profit and sustain long-term productivity. One of these practices is regular soil testing. Due to crop withdrawal and annual weather variations, it is wise to perform soil tests at least every 2 – 3 years, and base fertilizer applications on the results.

As with most agricultural crops, Nitrogen (N), Phosphorous (P) and Potassium (K) are the three nutrient elements generally considered to be "macronutrients"—that is, plants demand significantly greater amounts of these than other nutrients. This is not intended to be an exhaustive discourse on plant nutrition (or any other production practice), but a general overview.

The University of Georgia points out that N requirements by the cotton crop are greatest during the fruiting period (squaring and boll formation). If the crop does not get enough N, yield and quality will be reduced. Excess N, on the other hand, will promote rank growth and boll rot, and can delay maturity, which will make defoliation difficult and will also reduce quality and yield.

According to University of Missouri data, correct N fertilization will result in abrupt development of N deficiency in mid-to-late August, which helps mature the crop for harvest. Texas A&M recommends applying all N at two weeks following emergence for rainfed or furrow-irrigated cotton. For pivot-irrigated cotton, they recommend a 40 kg/ha (30 lb/A) application of N preplant, with the remainder applied in 40 kg/ha doses via fertigation during the period from first square through early bloom.

Phosphorous is not very mobile, so is generally applied as a preplant treatment. Soil tests for P vary by region, due to soil and climate. A certified laboratory and consultant should know the most appropriate soil test to use for a given field. The uptake of P is affected by cool temperatures, due to low solubility and slow root growth, so many plants have a tendency to exhibit P deficiency early in the season, when soils are cool and plants are small.

Potassium (referred to as K due to its label on the periodic table of elements) plays a critical role in plant development and health. It is highly correlated to the boll-set period of growth, and adequate K is needed to maintain adequate water pressure for fiber elongation.

K deficiency can also lead to increase problems with various leaf spot diseases. Split applications of K are not recommended, as they show no agronomic or economic advantage in most studies. Since cotton burrs are high in K, Texas A&M notes that "burr strippers" on cotton stripper harvesting heads can help maintain soil K fertility. Soil test values above 200 ppm K preclude the need for additions of fertilizer K.

Beyond these "Big 3", the next-highest use nutrient is often sulfur (S). Like nitrate, S can be leached through the soil, so soil tests may have limited value. Deficiencies of S are most common on deep, well-drained, sandy soils with low organic matter (OM) content. Some studies theorize that S deficiencies have, and will continue to, increase due to removal of S from coal and diesel fuels during the past few decades. This has reduced the amount of S deposited via the atmosphere through "acid rain" and exhaust fumes.

Most S is contained in the organic matter of a soil, so cultural practices that build OM content can help maintain long-term fertility. The University of Georgia recommends application of 12 kg/ha (10 lb/A) of S. Texas A&M recommends applying 1/20th of the N application.

Micronutrients are elements that are critical for plant growth and development, but are required in much smaller amounts than the previously-mentioned elements. Since the amounts of these nutrients are small, both in need and in supply, their availability is critical. In general, nutrient availability is significantly affected by soil pH. Each micronutrient has a "preferred" range of pH that optimizes its availability to plants. In general, the range of 6.0 – 6.5 is considered a good "all-purpose" pH for nutrient availability. A good pH management system (liming) should take this into account.

Pest Management

Weeds, insects and diseases are issues common to all Ag producers. The pressure on an individual field will depend on soil, crop and climate. Regular scouting is important to effectively manage crops and deal with issues as they arise. A well-planned Integrated Pest Management (IPM) program is an important tool to maintain good crop productivity. Frequent scouting will help define pest pressure and economic thresholds for treatment. Cotton should be scouted at least once each week, and twice each week once blooming has begun.

Whether the pest in question is weed, insect or disease, knowledge of Economic Injury Level (EIL, or the lowest pest incidence that will cause economic damage) and Economic Threshold (ET, the pre-determined number that justifies treatment) are critical pieces of information. Pesticide applications should be made dependent on actual field conditions, not on a scheduled plan. A good IPM plan will include factors beyond simply applying chemicals.

It will also include genetic selection (choosing varieties that are disease-resistant) and cultural practices. Examples of cultural practices that can help with an IPM program include fall stalk destruction (reduces overwintering boll weevil population); pre-plant vegetation management (removing cover crops and weeds > three weeks prior to planting minimizes cutworm infestations); field border maintenance (timely mowing can reduce weedy host areas for insects); and managing for early crop maturity (early maturity decreases the period of susceptibility to pests).

Adoption of good IPM practices delays and reduces the incidence of pesticide resistance in insect, weed and pathogen pests, extending the practical life of valuable products for pest management. It also reduces potential damage to off-site plants and animals, and improves profitability.

Irrigation

Valley is the founder of the entire pivot irrigation industry. We have helped generations of growers overcome watering challenges with the most durable machines and most reliable technology available.

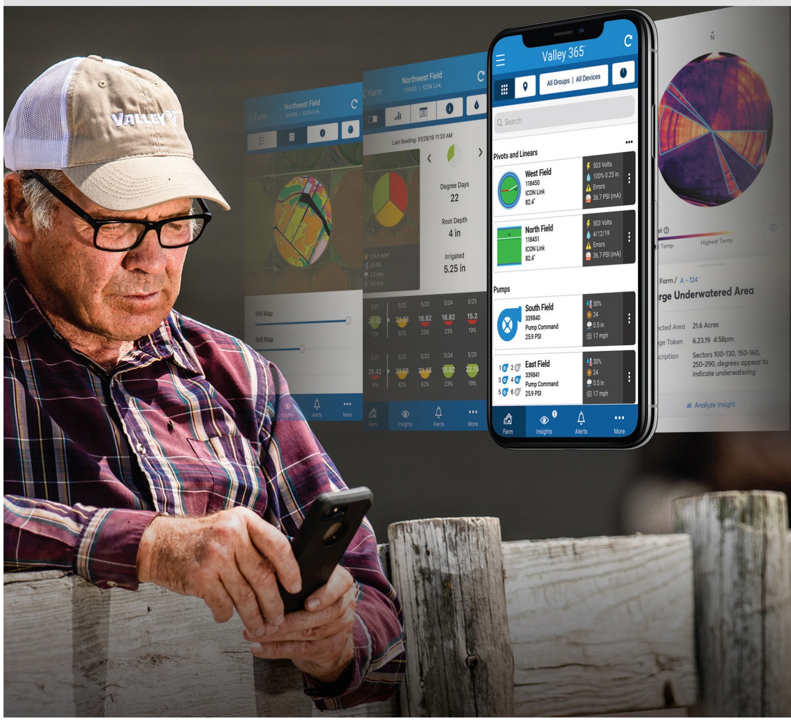
Although cotton is a drought-tolerant crop, and it developed in arid climates, irrigation can improve both quantity and quality of the fiber harvested, especially in areas with varying times of drought during critical growth periods and in sandy soils. As with most crops, there are varying periods of water use during the crop growth cycle. In general, the fruiting period (squaring to first boll opening) is the peak water use period for the plant.

Excess irrigation is neither necessary nor desired, especially early in the season, since this can lead to excessive vegetative growth, and late season over-irrigation can lead to boll rot. However, water stress early can reduce mainstem node development and, thus, fewer nodes above white flower at first bloom, which can reduce yield potential. Over-irrigating late in the season can exacerbate boll rot, as well as wasting water. The University of Georgia recommends no irrigation after 10% of the bolls are open.

This sensitivity to soil water conditions means that proper crop water management is critical to optimal production. Close attention to water conditions (rain, irrigation events and crop water use) are necessary to irrigate appropriately.

We recommend using the “Checkbook Method” for scheduling irrigation. The approach is similar to managing a checkbook in personal finance. The soil water balance is similar to the checking account balance, with rainfall and irrigation events treated as deposits and crop water use treated as withdrawals. The producer determines the minimum acceptable “balance” of water stored in the soil to avoid crop loss, and irrigates to avoid this maximum allowable depletion.

In this system, the critical measurements are rainfall, irrigation and crop water use. Obtaining the first two are relatively simple, but crop water use is difficult to define with certainty. As a result, many tools have been developed that allow producers to estimate daily crop water use, based on local weather conditions. Still, such estimates include some errors, which can become pronounced over long time periods. As a result, soil water sensors are a popular method to check the soil water status. This allows producers to correct their irrigation schedule before stress occurs, and prevents unnecessary irrigation.



Harvest

After a long (~160 days) growing season, harvest is one of the most critical operations of the production cycle. In preparation for harvest, it is common to apply harvest aids to the crop. This process defoliates the crop, making harvest easier. It also suppresses regrowth, spurs bolls to open, removes juvenile growth and desiccates weeds.

At this point in the cropping year, the primary risk is rain, which can cause quality problems, rot and poor harvest conditions. Cotton should be harvested at or below 12% moisture. Depending on the harvest system used, rectangular multi-bale modules or round, wrapped modules formed by the picker are produced and stored until transported to the gin. Proper management is needed during storage to maintain cotton quality.

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The Pioneer in Ag Sustainability

Growing cotton is a labor- and capitol-intensive process. Success requires diligence, attention to detail and correct application of many agronomic principles. This guide is not intended to be a comprehensive text, but rather a brief introduction to several of the areas to consider. Several land-grant universities in cotton-growing regions of the United States, as well as Cotton Incorporated, have several resources available for further research.

At Valley, we were helping growers achieve sustainability from our beginning in 1954. As the population increases and farmable land disappears, every innovation we introduce helps produce greater yields while using fewer resources. Our solutions are engineered to be efficient, conserving water and energy, and transforming the way food and fiber are grown.

Our technology and leading dealer network assure that growers around the globe have access to innovations that can transform local communities. From the recyclable steel in our machines, to our cloud-based connected crop management, to innovations that harness the sun's power and apply water and protectant precisely, Valley is the leader in sustainable irrigation.

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