INTEGRATED COTTON MANAGEMENT: A MODEL SYSTEM FOR CENTRAL ARIZONA

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Abstract

This project outlines an example of an irrigated cotton production system for a representative location in central Arizona (Maricopa; elev. 1,175 ft). The system integrates all current guidelines & recommendations disseminated by the University of Arizona. Adjustments in this `strategic outline will be required for actual implementation due to the crop growth, pest infestations, and weather conditions encountered during the season. Changes in this system also would be necessary to design a similarly integrated system for other locations or other transgenic varieties in Arizona.

Cotton Advisory System

Arizona Cooperative Extension publishes weekly cotton advisories for 14 locations starting in February. Planting Date Advisories are used during the spring planting period. Crop Development Advisories are produced once the crop is established. These 1-page reports include a site-specific, graphic representation of the growing season in relation to heat units, an insect update, a weather summary & 5-day forecast, & an agronomy update. Local county agents then add more information & distribute the advisories.

Planting Date Advisory

The planting date advisory identifies suitable windows for planting of each cotton maturity class according to heat unit accumulations since 1 January. Insect, weather & agronomy updates are also provided.

Cotton Development Advisory

The cotton development advisory provides HU-based developmental timelines for cotton planted on 5 representative planting dates; weather forecasts, water-use estimates, and agronomy & insect updates.

Crop Sanitation & Plow-Up

Deny habitat for boll weevil: Arizona eradicated the boll weevil by 1991 & remains weevil-free through the implementation of a "Plower" program.

Destroy cotton residue early: Arizona (ADA) has requirements that the crop be destroyed by zone-specific deadlines. For this area, this must be done by 15 February in order to plant on 1 March.

Maintain thorough sanitation: Many pests or potential pests depend on year-round availability of host. Removal of crop & weed residues post-season can eliminate boll weevil, pink bollworm, whitefly, Lygus & disease habitats.

Preseason Soil Samples

Collect 30–40 soil cores / field for analyses of

fertility:
pH, ECe, Ca, Mg, Na, K, P, ESP,
NO3--N, Zn, Fe (see adjacent table);

particle size & organic matter content:
for determining preemergence
herbicide rates;

root knot nematodes:
for preplant nematicide decisions.

If there are root-knot nematodes present in the soil samples, apply Telone II® at 5 GPA as a preplant fumigant at least 10–14 days before planting. No other nematicide is recommended.

Heat Units

Heat Units (base 86°/55°F) are a central tool for the success of this strategy. The UA-CES maintains a network of weather stations for near real time delivery of weather information (AZMET).

Agronomists, biometeorol-ogists, & entomologists use this information to show growers how biological events such as crop & pest development can be reliably predicted by weather trends.

Land Preparation & Planting Date Management

List fields & shape beds: prepare for dry planting by providing a clean & uniform bed to accommodate "water-up" irrigation.

Plant seed at proper depth: about 1/4 in. deep.

Plant under 'early optimum' conditions:
25 March for this location or about 450 HU after 1 January.

Criteria for 'early optimum':
- 400–600 HU after 1 January
- soil temperature minima > 60°F
- favorable 5-day forecast (~80°/48°F).

Use proper seeding rate: for this variety, around 14 lbs. seed / A.

Variety Selection

Consider high yield potential: In AZ this is the primary factor for selecting a variety. Other important factors include: potential for significant weed or insect pressures, fiber properties of the variety, crop maturity, & past experience with the variety. For example, weeds might be better managed through the use of Roundup Ready® or BXN® transgenic varieties.

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Select a transgenic 'Bt' variety: for this location, because of the probability of damaging levels of pink bollworm. This variety reduces the need for oversprays against this & several other lepidopteran pests. Plant a non-Bt cotton refuge on at least 20% of the acreage.

Characteristics of DP 33B:

- strong yield potential & high turnouts
- well-adapted to Arizona
  - good heat tolerance
  - strong in-season plant vigor (height potential)
- Bollgard® gene provides protection against PBW
- smooth leaf produces better grades & is less attractive to WFs
- medium to long maturity class
- good fiber qualities
- small seeds can result in lower seedling vigor

Preplant, Preemergence Herbicides

Effective cultivation & strategic herbicide use is the foundation for successful weed management.

For grass & small seeded broadleaf weeds: Most weed control programs should include a dinitroaniline herbicide (e.g., Trifluralin 4EC @ 0.5 lb ai / sprayed A in coarse textured soils) applied & incorporated in a band during final bed preparation or broadcast on flat ground & incorporated prior to bed preparation.

Banding the DNA (Treflan®, Prowl®, Trifluralin) herbicide saves money.

First Postemergence Herbicides

If broadleaf weeds are present: apply Staple® (1.8 oz. / sprayed acre + 0.5% non-ionic surfactant) when the largest weeds are at the 1–2 leaf stage. Band applications over-the-top of 1–2 leaf cotton reduce costs. Cotton larger than 3–4 true leaves should be sprayed with 2 nozzles / crop row.

Grass weeds: can be controlled using Fusilade DX®, Poast Plus®, or Select®.

Remove weeds in-furrow by cultivation.

Stand Evaluation & Scouting

Goal: 40,000 plant / A (3 plants / ft)

Stand counts: count plants in 13'1" lengths of row (1/1,000 of an acre for 40 in. rows); repeat 20–30 times per field.

Acceptable range: 25,000–60,000 ppa

Examine seedling vigor: look for stand uniformity & root condition (elongation, health & color; symptoms of Rhizoctonia & other seedling diseases)

Scout early season insects & weeds: look for thrips & their damage (but check for sandblasting). Aphids, beet armyworms, striped flea beetles, banded-winged whiteflies & mites can be present, but rarely require control at this time. Look for weed escapes & early competition.

Nitrogen Management

(Feedback Approach)

Establish a practical yield goal (= 3 bales / A)

At 60–70 lbs. N / bale (per A), a 3 bale yield target has a total N requirement of ~ 180 lbs N per A, so...

From this total N requirement, subtract NO3--N available as:

- residual soil NO3--N in top 6" (soil test)
- irrigation NO3--N (ppm X 2.7 = lbs. / A-ft.)

Then, apply remaining N in split fertilizer applications (2–3 times)

- during N application window (pinhead square – peak bloom or ~ 600–2,000 HUAP).

Use plant monitoring / mapping to help adjust N fertilizer applications for plant condition.

First Post-Plant Irrigation

Goal: apply the first post-plant irrigation at about 900 HUAP, but consider the large number of acres to be irrigated.

Detect first pinhead square (at 700 HUAP): in coarse-textured or shallow soils, the first post-plant irrigation is needed as early as 700 HUAP, especially under windy or drying conditions. Cool or wet conditions can delay the need for the first irrigation.

Don't delay beyond 1200 HUAP: young plants are damaged; earliness & yield are negatively impacted.

Monitor soil moisture levels in top 2 ft.: apply water by the time of 50% depletion of plant-available water; also monitor HU accumulations, E.T. estimates (AZMET) & crop development, & estimate irrigation interval for peak use in July.

In-Season Weed Control

If small weeds are present & cotton is of sufficient size (see photo): use precision guided cultivation to within 1.5–2 in. of the row & use in-row weeding tools to remove weeds until layby.

Alternative: use Staple to control broadleaf weeds (e.g., morningglory) & use Fusilade DX, Poast Plus, or Select to control grasses. Post-direct sprays at the base of cotton plants in a narrow band with a precision guidance system.

Substantial morningglory infestations may require a residual herbicide applied at layby (e.g., Prometryn 4L @ 1.2–1.6 lb ai / A in coarse soils; for small emerged weeds, add 0.5% non-ionic surfactant).

Lygus Management

Manage early season sources: Safflower, alfalfa, & weeds can release large numbers of Lygus into squaring cotton. Treat safflower before it dries down, strip-cut or block-cut alfalfa, & control weeds in ditchbanks & fallow areas.

Sample cotton: at least 100 sweeps per field. Also, split squares & look for damaged floral structures. Use effective

solo materials (organophosphate or carbamate) when 15–20 total Lygus / 100 sweeps or 25% damaged squares & nymphs are present. Rotate chemistry, but avoid pyrethroids.

Whitefly & Insecticide Resistance Management

Monitor/manage early season sources: Sample/treat appropriately & destroy post-harvest crop residue promptly, especially spring melons.

Sample adults & nymphs in cotton: on at least 30 leaves per field.

Use insect growth regulators (IGRs) first: when there are 1 large visible nymph / disk (40% infested) AND 3–5 adults per leaf (40–57% infested with > 2 adults). Use each IGR once & in sequence in chronically infested areas.

Follow an insecticide resistance management (IRM) plan: Limit, diversify & partition insecticide use. Use at least 1 effective non-pyrethroid when needed. Do not use pyrethroid combinations or any active ingredient more than twice
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Monitoring Crop Development

Use Pix® applications: to control growth & crop vigor when indicated by fruit retention & height:node ratios; reference center baselines from published UA guidelines.

Anticipate monsoon: Monsoon conditions begin in July & intensify in August. Heat stress (especially high nighttime temperature & humidity) leads to fruit abortion & often peaks near 1 August. Our strategy completes as much of the fruiting cycle as possible before the onset of monsoon conditions.

Identify cut-out: Cut-out occurs around 2700 HUAP, depending on vigor & fruit load. Cut-out can be easily identified by counting the nodes above the top, 1st position, white flower (NAWF). When NAWF is less than 5, the crop is rapidly moving into cut-out.

Determine timing of final irrigation: adequate soil-water will be needed for the development of the last set of bolls intended for harvest. Final irrigations will be around 600 HU after cut-out.

Defoliation Management

Monitor/Estimate soil water status: apply defoliants when plant-available water is about 70% depleted.

- Rule of thumb: apply at twice the late-season irrigation intervals.
- Example: if late-season interval is 10 days, apply defoliants about 20 days after the final irrigation.

Manage/Monitor nitrogen status: petiole NO3--N concentrations should be < 3,000 ppm.

Adjust rates for weather conditions: plant responses to defoliants are temperature-dependent. Alter rates according to the estimated HU accumulations for the 14-day period following application.

Integrated Cotton Management (Summary)

University recommendations are often offered in a singular fashion, assuming all other crop inputs are managed appropriately. This depiction attempts to integrate all components in a complete, "systems" approach. The three major components are:

1) optimizing the first cycle fruit set,
2) avoidance of late season insect pests,
3) avoidance of inclement weather (monsoon).

We plan for lint yields of about 3 bales / A in this example, based upon past experience & research with this system and a reasonable weather pattern.

Profitability is the ultimate measure of a system's success; profitability depends on:

- crop management,
- input costs,
- market value of the crop.

Acknowledgments

The Integrated Cotton Management team is an interdisciplinary group of over 20 research & extension faculty. These faculty are housed in 9 county offices, 3 agricultural centers, and 6 campus departments. This group is responsible for the development and dissemination of cotton management recommendations for Arizona. Thanks to all of these members who have helped to generate, validate, implement, and disseminate these recommendations—the basis of this model system.