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MANAGEMENT OF LATE COTTON IN 2003

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Most areas of the Texas High Plains received substantial rainfall and, unfortunately, severe weather events during the months of May and June. Many fields were destroyed and replanted to cotton or were badly damaged. These fields are substantially "behind" in terms of development. Many producers must now decide how to best manage this cotton in order to produce acceptable yield and fiber quality.

Assessing Crop Potential

A. Stands

Optimum stands range from 35,000 to 50,000 plants per acre (2.5 to 4.0 plants per row-foot in 40-inch rows). Stands as low as 20,000 plants per acre (1.5 plants per foot) are acceptable. Consider plant condition in counts and do not include "cripples" in stand evaluation. Skips are also an important consideration. Note that adjacent plants can compensate for 2-3 foot skips but maturity may be delayed. However, longer skips can reduce yields. Some studies were conducted several years ago at the Texas A&M Research and Extension Center at Lubbock by Dr. Don Wanjura, Agricultural Engineer, USDA-ARS, and Dr. James Supak, Extension Agronomist-Cotton. These tests evaluated the effects of skips ranging from 1 to 8 feet in length.

Table 1. The effects of skippy stands on cotton yields, 1981-1984.

Treatment	Average stand, plants/row-ft	Lint yield, lb/acre	Yield decrease, %
Normal stand	4	438	--
25% stand loss	3	382	12.8
50% stand loss	2	324	26.0

B. Yield and Quality Potential

The first consideration is to recognize that some yield and quality reductions are likely to occur because of the delayed plantings. The magnitude of yield losses that can be expected during an "average" year are shown in Figure 1. Yield potential begins to decline rapidly after June 1 in the northern counties and after June 10-15 in the southern regions of the High Plains. The data presented in this figure are now several decades old, and although new varieties and management techniques may change this somewhat, this is probably still a good guideline.

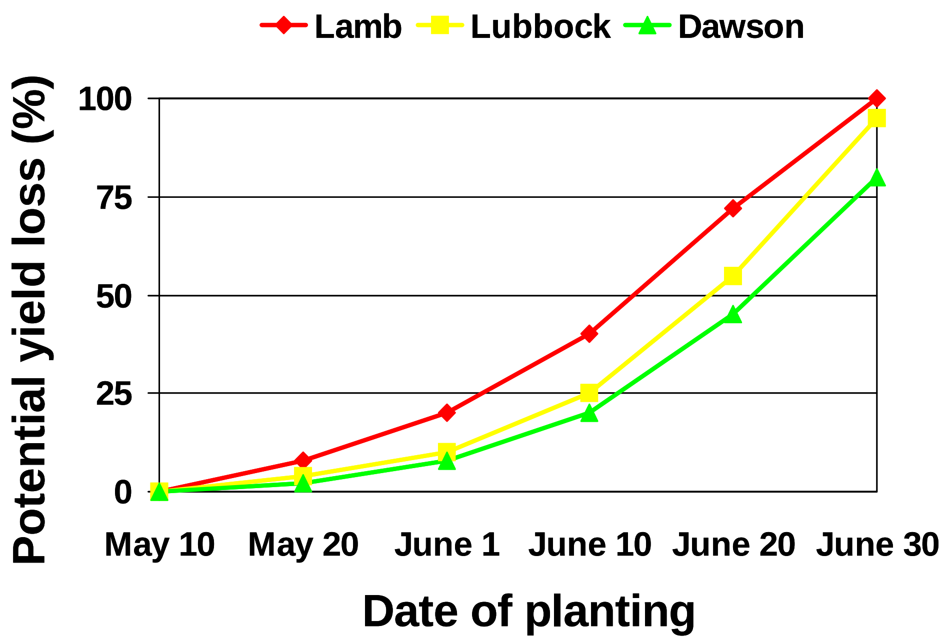

Figure 1. Influence of planting date on potential yield loss during an "average" year in the Texas High Plains.

Growing conditions in June are typically better than in late April and May. Can the late emerging crop "catch up?" Some years ago, Dr. J. D. Bilbro, agronomist with the USDA-ARS compared the rate of development of irrigated cotton planted in May and June at the Texas A&M Research and Extension Center at Lubbock. The results of these studies are presented in Tables 2-5. Although the June planted crop came up to a stand faster and started squaring and blooming in a fewer number of days, it was unable to catch up with May planting in terms of boll development.

Table 2. Mean agronomic and economic data from a multi-year irrigated date of planting study at Lubbock, 1960-1965 (Bilbro and Ray, 1969).

Planting date	Yield, lb/acre	Lint turnout, %	Color, grade	Staple, 32nds	Mic, units	Base loan value, $/lb	Mic discount, $/lb	Actual loan value [1,2], $/lb	Total value, $/acre	Ginning cost [3], $/acre	Net value, $/acre
May 15	866	22.0	41	30.2	3.5	0.4210	0	0.4210	364.59	61.01	303.57
June 1	800	22.4	41	30.4	3.3	0.4210	-180	0.4030	322.40	55.36	267.04
June 10	662	21.8	31	29.9	3.3	0.4265	-180	0.4085	270.43	47.07	223.36
June 20	442	18.3	42	29.2	3.0	0.3960	-335	0.3625	160.23	37.44	122.79
June 30	225	14.4	33	29.0	2.5	0.3860	-1115	0.2745	61.76	24.22	37.54

[1] 2001 USDA loan chart used to determine lint value.
[2] Assumes leaf grade 4.
[3] Assumes $1.55/cwt ginning costs.

Table 3. Development of cotton as influenced by planting date at Lubbock.

	For May 1 planting		For June 7 planting	
Events	Days after planting	Calendar date	Days after planting	Calendar date
Planting to stand	10	May 10	6	June 13
Appearance of first true leaf	19	May 19	15	June 22
Appearance of first square	47	June 19	41	July 18
Appearance of first blooms	69	July 11	63	August 9
Peak bloom period	97-104	August 8-15	74-84	August 20-30
Most effective fruiting period	69-104	July 11-August 15	63-84	August 9-30
First open boll	125	September 5	125	October 10
25% open bolls	151	October 1	151	November 5
50% open bolls	167	October 17	161	November 15
75% open bolls	186	November 5	171	November 25

Table 4. Days from planting to white bloom decrease as planting date is delayed.

Planting date	Prebloom period, days
4/10	88
4/20	77
5/1	68
5/10	63
5/20	57
6/1	54
6/10	53
6/20	53
6/30	53

About 4 weeks of blooming are needed to set the "average" crop. Moisture and temperature are key factors in producing good yields and quality fiber. The effective boll setting period for May planted cotton normally extends from around July 10 to August 20. This time frame also corresponds to the most favorable day and night temperature regimes for fiber and seed development. In contrast, the effective boll setting period for June planted cotton is typically restricted to roughly a 3-week period in August. In the southern counties this period can be extended 7 to 10 days whereas in the northern counties it is likely to be even shorter.

Table 5. Typical High Plains crop setting pattern.

Week of blooming	Percent of crop set
1	10
2	30-35
3	30-35
4	15-20

Blooms occurring after August 15 have low probability of producing mature bolls. Blooms set during the first week of September are often expected to contribute to final yields. However, studies conducted in the late 1970s by Dr. Don Wanjura, USDA-ARS Agricultural Engineer, and Oliver Newton, Agricultural Meteorologist with the Texas Agricultural Experiment Station, show that at Lubbock, a bloom occurring on August 30 will develop into a fully matured boll in only 1 year out of 7 - about 14% of the time (Table 6). Some adjustments have to be made for location; in the Lamesa area, for example, the same bloom is likely to produce a mature boll in at least 1 out of 3 years. A warm, open fall could significantly modify these relationships. Above normal, late season temperatures could provide the additional heat units for more complete development of later planted crops. Recent work using COTMAN, a cotton management program developed at the University of Arkansas with funding from Cotton Incorporated, indicates that a bloom requires at least 850 heat units in order to produce a quality boll. Blooms set as late as September 1 may contribute to yield but quality will likely be poor (low micronaire).

Table 6. Boll maturation periods for blooms set between July 5 and August 30 for 1975-1978[1].

Date of white bloom	7/1	7/15	7/30	8/5	8/10	8/15	8/20	8/25	8/30
Bloom period (bloom to open boll, days)	50	53	61	64	68	68	--	--	--
Probability of maturing boll, %	100	100	100	100	100	71	36	29	14

[1]To approximate probability for Plainview area, use value in column to the right of the appropriate bloom date; for the Lamesa area, use value in column to the left.

Plant mapping can be used to help monitor the progress of the crop and determine some important crop factors. Entering bloom with a high percentage of fruit retention and healthy leaves will be important. Make sure that square thieves do not take the first fruit. Good to excellent boll retention during the first 3 weeks of blooming will be critical. This implies that a well fruited plant with good leaf area, minimal moisture stress, a root system undamaged by cultivation or sidedressing is a necessity. Nodes above white flower (NAWF) is an important plant mapping measurement and indicator of crop vigor and yield potential. NAWF is defined as the number of mainstem nodes to the terminal above a first position white flower. The terminal is defined as the uppermost node with a leaf that is at least an inch in diameter. Normally, for stripper-type varieties, we expect a minimally stressed crop to have at least 8 NAWF (and preferably more) at first bloom (Figure 2). Premature cutout is probable as NAWF reaches 4-5, especially with short-season varieties, unless sufficient irrigation is applied or rainfall is obtained to keep the plants vigorous. With the severe environmental conditions and crop development set-backs we have encountered, we will likely face lower yield potential than normal in many areas of the High Plains.

Generally speaking, at early bloom, 80% of the yield potential is already on the plant, and first position fruiting sites are extremely important components of final yield. We like to see at least 85% square retention going into the first week of bloom. Many times, High Plains fields will enter the bloom period with square retention greater than that. In a normally-fruited irrigated crop, about 80% of total yield is derived from first position fruit, 15% from position 2, with the remaining 5% composed of position 3 and vegetative bolls. Dryland boll production will generally come from first position fruit, unless an exceptional year is encountered which allows the crop to set, hold, and mature second (and/or greater) position fruit.

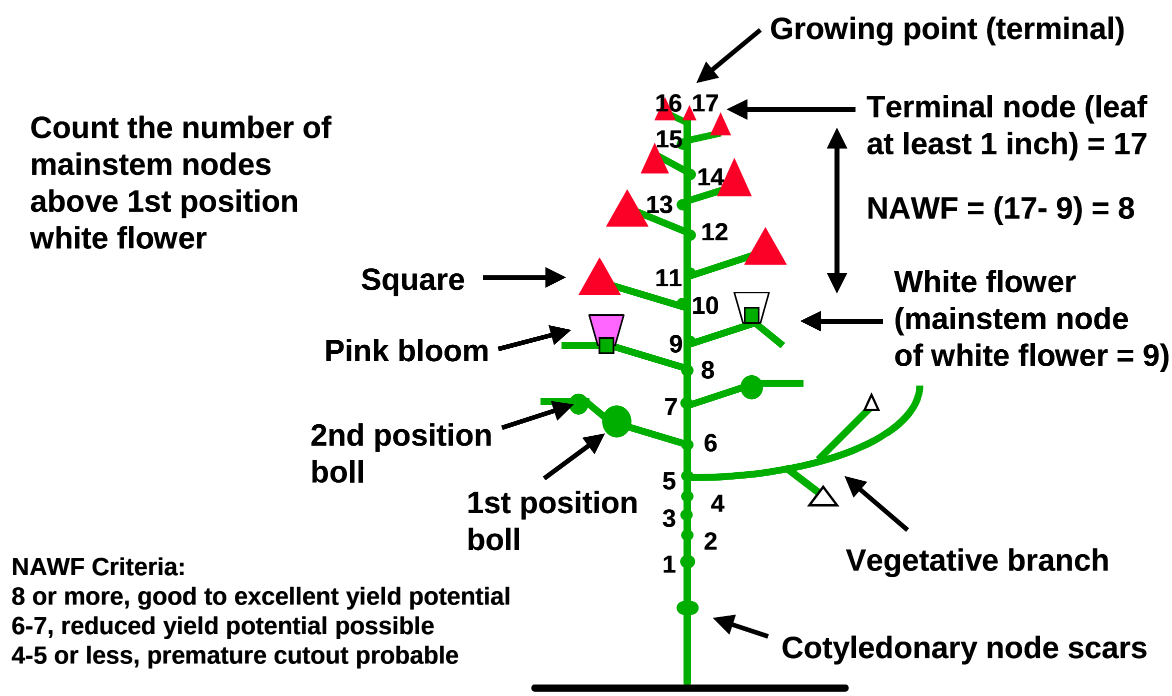

Figure 2. Determination of nodes above white flower.

Plant health is another factor to consider. Fields with high levels of seedling diseases may continue to lose lateral roots and stunted plants throughout the season. Chronic disease may further delay the fruiting and boll retention in these fields. Late maturing cotton is more likely to be damaged by verticillium wilt infection. Late season verticillium wilt can reduce micronaire. Yields may also be reduced if fields are affected early. Verticillium wilt is favored by cool air and soil temperatures, wet soils, and excessive nitrogen fertility status. Heavy irrigations should be avoided if cool weather is anticipated.

Managing for Earliness

If it is assumed that "average" conditions will prevail for the remainder of the year, it follows that with a short effective fruiting period and somewhat less yield potential, June planted cotton is likely to require fewer inputs. Producers should protect early fruit from insect damage if necessary to keep retention high. The crop should have adequate and timely water and nitrogen to promote early fruit retention.

Reducing the potential for negative cultural practice impacts is important. Be careful with cultivations as they may cause root pruning and thus delay in development. Avoid use of over-the-top herbicides such as MSMA, or other herbicide practices that could cause crop injury and/or delay development. Watch for closure of the Roundup over-the-top application window for Roundup Ready varieties and expect yield loss if applied after 4-leaf stage. Our research data indicate a potential yield loss of up to 20% if applications are made over-the-top after the 4-leaf stage. The Roundup label states that herbicide applications may be made using precision post-directed or hooded sprayers through layby. The spray should be directed to the bottom of the plants, with minimal contact of the spray with the leaves. Nozzles should be placed in a low position with a horizontal spray pattern directed under the cotton leaves to contact weeds in the row, and low spray pressure – less than 30 psi, should be used.

Applications of nitrogen (N) are likely to stimulate growth and promote fruit retention. A one-bale cotton crop will actually remove about 45 lb of actual N per acre, but due to inefficiencies in uptake and in the soil, about 50-60 lb N/acre are actually required. It is important to not over fertilize with N if reduced yield potential is anticipated. This is due to the fact that it makes late cotton more difficult to manage on the back side of the season. Some late-season insect problems, such as aphids, can be aggravated by high N status plants. Assess the yield potential of your specific fields and make N fertilization adjustments accordingly. In fields that received preplant fertilizer treatments based on yield expectations for May planted cotton, no additional fertilizer will likely be needed. Exceptions could include fields in the "sandyland" regions where leaching of N may have occurred. Such fields along with those that were not late planted that have not been fertilized prior to planting could likely benefit from sidedress applications of nitrogen. Apply sidedress fertilizers as early as practical (but before bloom), and take care to minimize root pruning during application. If you have an N fertilizer recommendation program intended for a May planted crop, it might be appropriate to reduce the amount applied. Most High Plains soils typically provide sufficient N to produce about 200 pounds of lint and it takes about 10-12 pounds of nitrogen fertilizer to produce 100 pounds of lint. If the yield potential is reduced by one-fourth of a bale to compensate for late planting, then also reduce the nitrogen rate by 10 to 15 pounds per acre. Benefits from low rates of foliar fertilizers are questionable.

Figure 3 shows a typical N uptake curve for cotton and corresponding crop development stages for normally developed cotton. With the environmental damage encountered by some fields, the time to various growth stages will likely be longer. Suggestions for applications of approximate percentages of total N are also shown. Fertigation is a practice that is gaining in popularity in the High Plains. Injection of UAN (urea-ammonium nitrate, 32-0-0) solutions into irrigation systems works very well to supply the N needs of the developing crop. This type of N management fertigation scenario has been used and validated for the last several years at the Lamesa AGCARES facility using alternate furrow LEPA irrigation. To obtain maximum utilization of applied N, the total amount of N should probably be applied prior to peak bloom.

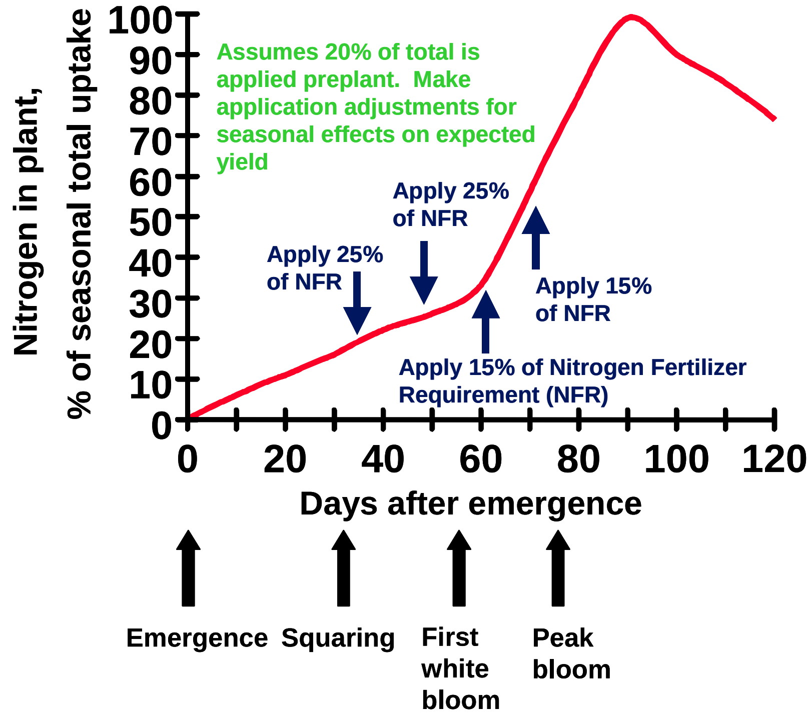

Figure 3. Nitrogen uptake curve for a typical High Plains cotton crop.

Remember - it takes about 60 lb N/acre to produce each bale of yield, and many irrigated fields with very low NAWF at early bloom will likely not have the potential to "ring the bell". So prudent use of N fertilizer will be important, especially due to the fact that excess N has been noted by some entomologists to increase the likelihood of aphid problems.

Irrigation is another concern. From planting to square initiation (about 35-40 days after planting with normally developed cotton), crop water use is less than 0.1 inches/day. Plant water requirements are low due to limited leaf area. Most of the water used is extracted from the top foot of soil. Much of the water consumed from the system is due to evaporation losses. From the square to early bloom stage, (about 40-75 days after planting) crop water use increases to about 0.1 to 0.3 inches per day. During this time, transpiration exceeds evaporation, and moisture extraction occurs mainly from the top two feet of soil. From early bloom to first open boll stage (about 75-120 days after planting), crop water use is about 0.25 to 0.35 inches/day. During this period of time, the plants have reached maximum leaf area and root density, and moisture can be extracted from the entire soil profile. Fruit production, retention, and shedding are closely related to availability of soil moisture. Production is optimized with an available moisture status that allows uninterrupted development of fruiting sites while avoiding excessive vegetative development, and minimizing fruit shed.

Late cotton must be provided as much early season stress relief as possible. Early maturing varieties can tolerate and even require irrigation during early squaring stages (1/3 grown squares) to promote growth and fruit retention. Early irrigation is probably justifiable if soil moisture is limiting. With good soil moisture, consider delaying irrigation until early bloom. The goal is to maintain soil moisture levels to provide a healthy leaf canopy at least through mid-August. Then water stress can be used to hasten cutout. LEPA and drip irrigation are very suitable for managing water stress in this manner. Deficit irrigation with these systems could be extended later into the season to minimize fruit shed and decline in crop condition. Producers should consider terminating furrow irrigation by mid-August to avoid generating excessive growth and setting bolls that have minimal probability of reaching maturity.

Mepiquat chloride (MC) will not help plants compensate for earlier weather and disease damage or for late planting. Under good growing conditions, MC may increase fruit retention, control plant growth and promote earliness. MC should not be applied if crop is under any stresses including moisture; weather; severe mite, insect, or nematode damage; disease stress; herbicide injury; or fertility stress. DO NOT use MC on cotton that is stressed or likely to be stressed. MC can impact crop earliness through better early season fruit retention. This may not be a major consideration with a late planted crop. Typically, discounting problems with insects or severe weather, a high percentage of the early developing fruit is normally retained. Improving retention of later set fruit may not greatly influence yield as these bolls may not have time to reach maturity. Results from our replicated testing indicate that we obtained from 5 to 15% reduction in plant height (compared to the control) from 16 oz of 4.2% a.i. MC material applied in up to 4 sequential 4-oz/acre applications starting at match head square and ending at early bloom. We have been able to "shave" about 1 node from the growth of the main stem at some locations, which can result in about 3-5 days earlier cutout. We have not observed consistent yield increases from any of the MC materials we have investigated, including those with the *Bacillus cereus* additive. A good boll load will normally help control plant growth. Fields with poor early-season fruit retention, excellent soil moisture, and high nitrogen fertility status may be candidates for poor vegetative/fruiting balance and should be watched carefully. Growers who have planted picker varieties (many of which are more indeterminate than most of our stripper types) and have conditions resulting in high growth potential may be concerned. Growth potential of some of these varieties is considerably greater than many of our stripper types. For brush roll header stripper harvest, 28 to 32-inch tall plants optimize stripper harvesting efficiency. If possible, target a maximum plant size of about 32 inches for picker varieties under high input irrigation (drip or high capacity pivots). If plants get larger than 36 inches, harvest efficiency and productivity drop significantly. The best growth regulator is a well fruited crop.

A number of insect control issues will face cotton producers with late cotton. There is considerable variation in growth stages between fields in some communities and lack of uniformity in plant growth even in individual fields were earlier weather adversity bought crop development to a standstill. Because of this, producers will not have it easy in applying standard management practices between fields. Insect problems that develop will be very patchy and the abundance of weeds produced by our June rains could produce additional insect pest problems. Luckily, insect problems have been minimal once thrips were no longer a concern.

When it comes to insect management in late cotton the pendulum can swing in two diverse directions. The first would be to manage cotton insect problems aggressively to insure that all early-produced squares and later bolls are retained to insure the earliest possible crop. The other end of the pendulum swing would be to back way off from managing insects in order to minimize dollars spent on a possible low yielding crop. Either approach could be correct if only we knew what the weather would be in July through September.

Most of the northern crop of June planted cotton will be trying to make blooms into harvestable bolls in August and early September. The crop development information above would indicate that we need four weeks of blooms to make an average crop under average weather conditions (long-term weather). This would indicate that under these conditions, producers from Lubbock north will be facing the very real prospect of achieving a below average yield this year. But if weather conditions cooperate again for the 7th year in a row, producers could be blessed with a few more heat units than long term weather records would predict. If this is the case than a more aggressive management style might be in order (if you have the money).

Producers can commit one of three common mistakes concerning insect management in late cotton: 1) manage insects as if it is a normal year, 2) decide not to spray no matter what happens, or (3) try to mature every fruiting form they can set until a killing frost. Any of these approaches can lead to disaster. The correct approach is to base decisions on realistic projected yields and scouting reports. Don't manage insect problems aggressively if you don't intend to water or fertilize as needed.

Insect control becomes very uncertain once yield potential drops below 200 - 250 pounds per acre. To insure minimum insect problems, producers will need to set an early crop, push for rapid maturity and crop termination. The worst-case scenario would be to have a lush, late maturing crop where yield hinges on protecting bolls from beet armyworms, bollworms and plant bugs well into September. This is when problems with these pests are most intense (because of population build up) and management is very expensive.

Early season management consists of doing those things that maximize square set and later boll protection. This would involve controlling fleahoppers and early Lygus bug infestations to insure at least 85 percent set of 1st position squares during the first weeks of squaring. This would take a very aggressive management approach and would require a good understanding of insect induced versus environmental induced square loss. If either fleahoppers or Lygus bugs are approaching threshold levels, don't wait for square set to fall below an acceptable level. Once this occurs you will never be able to recover since there is no time left to compensate for these losses. Be especially watchful of fields near alfalfa, weedy borders and bar ditches, and in fields that have weed problems with lanceleaf sage and silverleaf nightshade (whiteweed). These are situations where bug problems can develop over night. Also, if these areas are cut or mowed, expect rapid movement of these pests into your adjacent cotton fields.

Because late cotton can mean late applications for fleahoppers, be aware of the potential for enhanced bollworm or beet armyworm problems where you spray. Bollworms and beet armyworms will not be late in arriving in our area so that any insecticide that removes most of the natural enemies in a sprayed field might be a candidate for increased caterpillar problems. Selecting the right insecticide and a lower rate could avert this potential disaster. Centric, Trimax (also Provado) and Vydate and lower rates of Orthene (and Acephate) or dimethoate would be likely choices.

The potential for aphid problems is quite high in late cotton. Because fruiting is so delayed, there may not be a sufficient boll load to draw down nitrogen levels in leaves at the time aphids become serious pests. This usually occurs beginning in August. Plants with higher nitrogen levels often have the heaviest aphid infestations. Prudent nitrogen fertility management can help mitigate this situation. Also the avoidance of any unnecessary insecticide applications for other pests could delay the buildup of damaging aphid numbers. Several insecticides, especially the pyrethroids, are known to "flare" aphids. Damaging infestations of aphids during the bloom and boll filling stages can significantly reduce yields. Aphids present when cotton bolls open can deposit contaminating sticky honeydew on the lint, causing later problems at the mill.

Late bollworm problems will be concentrated in the later fields. Producers can create less favorable conditions for bollworm survival and establishment by terminating irrigation by mid-August and doing those crop management practices which result in early cut out. This would eliminate young, pest vulnerable bolls and squares that feed small worms and Lygus bugs. Use a lower treatment level for June cotton than May planed cotton if interested in a more aggressive management approach. The threshold would still start at 8,000 ¼ inch or smaller caterpillars per acre during squaring and up to peak bloom. At this time forward use 10,000 small caterpillars per acre until the last harvestable bolls are at least 450 or more heat units past bloom. This could represent a month or more during the cooler days of September and early October. Bolls should be safe from Lygus bugs and probably even beet armyworms once 350 heat units have accumulated past cutout or bloom. These heat unit thresholds were developed for the COTMAN model.

For most regions of the High Plains, fields that start bloom in July still have excellent yield potential and with the favorable price, producers should not be hesitant to spend dollars on needed inputs. Late July to early August blooming fields will be hard pressed to make bountiful yields north of Lubbock. However, dollars cannot buy heat units, and thus fields that enter bloom in August should be scrutinized closely before additional capital is spent on what has already been an expensive and slow start. See cotton insect management guides for more complete discussion of management and insecticides.

Appropriate harvest aid chemical selection and timely harvest coupled with excellent open fall conditions have allowed us to capture high yield and quality over the last few years. Much of the payoff has been derived from the judicious use of harvest aid materials. This year, crop conditions will likely be such that we will need to take advantage of all heat units available. This means that many fields will likely be "up against the wall" in terms of maturity. For higher yield potential fields, conditioning rates of boll opening materials (ethephon) followed by a sequential paraquat application or a freeze may be the best strategy. Lower yielding cotton may best be targeted with an initial low rate of paraquat followed by a sequential application of a higher paraquat rate or a freeze. Keeping track of cutout dates (where NAWF = 5 during a steep decline) and calculating heat units (basically using the BOLLMAN portion of the COTMAN management program) can help producers "zero in" on which fields may reach maturity (850 heat units past cutout) first. Then an appropriate harvest aid program can be initiated to terminate the crop and get it harvested in a timely manner. Late planted cotton runs the risk of fiber quality problems including low micronaire, and if an early freeze is encountered, perhaps poor color, and increased bark contamination. If a early killing freeze is obtained, then expect low turnout. Micronaire is a function of fiber maturity and there is nothing we can do to increase the rate of fiber development and we are at the mercy of heat unit accumulation and open skies. However, fine-tuning cotton strippers by reducing the aggressiveness of the stripper rolls by widening the settings can result in less foreign material in the bur cotton and reduce bark contamination potential. For more on this refer to the Extension publication: High Plains and Northern Rolling Plains Cotton Harvest Aid Guide available at the Lubbock Center Web site: http://lubbock.tamu.edu.

In all likelihood, the late crop across much of the High Plains will result in reduced yield and fiber quality. Over the last several years, many fields have entered bloom in early July and the payoff from added inputs has been readily obtained. Betting large amounts of inputs on cotton reaching first bloom in August is a risky proposition. With some management adjustments and good growing conditions for the remainder of the season, the detrimental effects on yield and quality can hopefully be minimized.

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