

# 5 – DD50 Computerized Rice Management Program

Nathan Slaton and Rick Norman

The DD50 program was developed in the 1970s to help rice farmers precisely time midseason nitrogen (N) applications. The ability to predict growth stage, specifically internode elongation (IE), reduced physical labor required to sample fields to determine the accurate time for midseason N application. Today, the DD50 is used by about 2,000 Arkansas rice growers on more than 60 percent of the state's rice acreage (Table 5-1). Programs similar to the Arkansas

DD50 are used in other mid-south rice producing states. Midseason N application timing is no longer as important as it was 25 years ago due to development of shorter season, stiff-strawed varieties. Current varieties require more pre-flood N and grain yield is less dependent on midseason N. However, the DD50 remains a vital program and source of information for pest management, timing of N and production of new varieties.

**Table 5-1. Grower Participation in the DD50 Computer Rice Management Program**

Year	Producers	Fields	Acres
	number participating		
1978	540	N/A	N/A
1979	1,320	3,456	237,362
1980	1,620	4,285	240,000
1981	2,000	6,166	472,148
1982	2,150	7,595	528,796
1983	2,110	6,549	396,417
1984	2,563	8,161	536,194
1985	2,723	10,053	650,201
1986	2,769	12,233	803,121
1987	2,746	8,887	547,904
1988	2,711	10,359	644,754
1989	2,775	9,760	646,470
1990	2,668	11,250	695,897
1991	2,695	11,679	753,282
1992	2,522	12,096	816,643
1993	2,326	10,945	689,447
1994	2,537	13,273	872,330
1995	2,580	13,028	871,743
1996	2,084	10,349	741,794
1997	2,107	11,441	784,966
1998	2,069	11,287	800,851
1999	1,925	11,458	805,199

The DD50 is a modification of the growing degree day concept which uses temperature data to predict rice development. The growing degree day concept is a measure of a day's thermal quality for plant growth based on air temperature. Equation [1] is used to calculate a day's thermal growing quality. The Arkansas program uses a maximum of 32 growing degree units that may be accumulated in a single day. Daily low and high temperatures are used to account for the fact that temperatures above these thresholds do not result in faster plant development.

The DD50 program accounts for cool temperatures that may delay growth and development during seedling growth for early-seeded rice by adding 50 DD50 units to thresholds up to 1/2 inch IE. Another adjustment made by the DD50 is to add 5 days between the normal predicted dates for 50 percent heading and 20 percent grain moisture to account for slower moisture loss from rice panicles for rice that heads after September 1.

## EQUATION [1]

$$DD50 = \left[ \frac{\text{Daily Maximum} + \text{Minimum Temperature}}{2} \right] - 50$$

Maximum temperature = 94°F if maximum temperature is > 94°F

Minimum temperature = 70°F if minimum temperature is > 70°F

Arkansas weather data is collected at four sites – Hope, Keiser, Rohwer and Stuttgart – to account for weather differences among geographic locations.

## How to Use the DD50

To participate in the DD50 computer rice management program, producers submit the variety, acreage and emergence date of each rice field to their local county Extension office. Emergence is defined as the time 8 to 10 plants per square foot (seedlings less than 1 inch tall) have emerged from the soil for dry-seeded rice. In dry-seeded rice, DD50 accumulation begins the day plants first emerge from the soil. The coleoptile (shoot) has a white tip upon emergence before photosynthesis begins to produce chlorophyll (green color). In water-seeded rice, emergence is defined as the time when 8 to 10 plants per square foot have shoot lengths of 1/2 to 3/4 inch.

Establishing an emergence date can be difficult in the case of uneven emergence. In this situation, record the date at which a sufficient number of plants have emerged to ensure that replanting is not required. If rice emerged at two distinct times in separate areas within a field, rather than average the two dates, submit dates for each emergence time.

At the beginning of the season, the DD50 operates using 30-year temperature averages. The DD50 is continually updated with the current year's weather data to improve accuracy. Average daily temperatures and resulting cumulative heat units have varied considerably in recent years (Table 5-2). Updated DD50 printouts, using current year temperature data, are provided to farmers when temperatures deviate from the 30-year average and result in DD50 predictions that vary from the 30-year average by three or more days. In general, the events predicted by the DD50 should be accurate within plus or minus 2 days.

The accuracy of the DD50 is influenced by management practices and variations of weather within each zone. For example, delaying the flood or pre-flood N, under/over fertilization, herbicide injury and/or nutritional deficiencies may alter rice development, resulting in the DD50 predicted dates occurring earlier or later than actual plant development. Water-seeded rice often develops at a faster rate than dry-seeded rice because flood water buffers the effect of air temperature extremes. The accuracy of the DD50 is also dependent on use of the correct emergence date, variety name and uniformity of stand. The DD50 program is not intended as a substitute for scouting fields, but rather a set of guidelines to assist growers

**Table 5-2. DD50 Accumulations from Four Recent Years Compared to the 30-Year Average Accumulation at Stuttgart, Arkansas**

Date	30- year	1989	1991	1992	1997
<b>ten-day cumulative heat units</b>					
April 1-10	85	66	142	49	101
May 1-10	177	116	163	158	159
June 1-10	288	259	290	245	222
July 1-10	305	278	315	302	292

with management decisions. Therefore, growers are encouraged to manually check the plant growth stage before making management decisions where growth stage is extremely important.

## Uses of the DD50

Today the DD50 program assists growers with 26 management decisions based on growth stage, including herbicide application, critical times to scout and spray for insects and diseases and N application. The DD50 program is a very important tool for farmers growing new varieties. Rice varieties of differing maturity emerging on the same day differ in the rate of physiological development throughout the season (Table 5-3). In general, varieties do not differ in the amount of time required to reach the 4- to 5-leaf stage. The time required from 50 percent heading to

**Table 5-3. Days Required for Five Rice Varieties, Emerged on May 1, to Reach Specific Growth Stages**

Variety	Growth Stage			
	4-Leaf	1/2" IE	50% Heading	20% Moisture
cumulative days to reach growth stages <sup>†</sup>				
Bengal	19	57 (38)	83 (26)	128 (45)
Cocodrie	19	48 (29)	80 (32)	115 (35)
Drew	19	55 (36)	83 (28)	118 (35)
Jefferson	19	54 (35)	78 (24)	113 (35)
Starbonnet	19	72 (53)	95 (23)	130 (35)
Wells	19	55 (36)	81 (26)	116 (35)

<sup>†</sup>Days between growth stages in ( ).

physiological maturity or harvest moisture is also assumed to be constant among grain types. Long, medium and short grain varieties are allowed 35, 45 and 50 days, respectively, from 50 percent heading to 20 percent grain moisture for flowering, ripening (grain fill) and moisture loss from grains. The time (date) of heading, kernel characteristics and canopy structure can influence the time required for grain to reach 20 percent moisture. The major difference in growth among varieties occurs either between the 4- to 5-leaf stage and 1/2 inch IE or 1/2 inch IE and 50 percent heading stages. Farmers are encouraged to use the DD50 to help plan rice seeding and harvest dates of different varieties.

The DD50 is also a useful tool in predicting peak harvest periods for grain elevator operators and farmers. Farmers can use the DD50 to coordinate planting and harvest schedules based on the variety and expected emergence dates. In addition, state and county information concerning variety acreage and percentage of rice at critical development stages can be summarized by the DD50 program, providing invaluable information on Arkansas rice production.

## Explanation of the DD50 Printout

The DD50 provides predicted dates for timing 26 management practices (see example). Following is an explanation for each management practice and the predicted dates. The date or range of dates predicted for each procedure should be used as a guideline. Since factors other than temperature can influence the rate of rice development, farmers should check each field in random spots to ensure DD50 accuracy. The listing of a pesticide application window does not always mean that the pesticide is recommended by the University of Arkansas. Suggested timing for pesticides on the DD50 assume federal and state labeling. However, label revisions can occur at any time. Before using any pesticide, always read and follow the directions and precautions printed on the label. Refer to the MP44, *Recommended Chemicals for Weed and Brush Control*, for specific University recommendations.

## Growth Stages

**Beginning and Optimum Tillering, Apply Early/Preflood N** – Predicted dates indicate the best time to apply early nitrogen to stimulate tiller formation. Tillering begins at the 4- to 5-leaf growth stage. An ammonium N source should be

applied to a dry soil and flooded immediately. The time frame of early N application is the predicted dates for which 350 to 550 DD50 units have accumulated.

**Final Recommended Time to Apply Preflood N if Early N is Delayed** – Early preflood N applications are often delayed by wet soil conditions during the above optimum recommended dates. Research has shown that early or preflood N may be delayed by several weeks without a loss of grain yield. If wet soil conditions persist, growers should apply N to the moist soil by this predicted date and flood immediately. This date is 510 DD50 units in length or about three weeks before the predicted time of 1/2 inch IE. This provides about three weeks for plant uptake of fertilizer N before panicle differentiation (1/2 inch IE) occurs. For varieties with a relatively short vegetative growth period, such as Cocodrie, this predicted time occurs very soon after the predicted time for beginning and optimum tillering.

**Beginning Internode Elongation (BIE)** – The time to begin checking for joint (internode) movement. Beginning IE corresponds approximately to the green ring stage or panicle initiation and signifies the change from vegetative to reproductive growth. This is also the time to measure plant area with the Rice Gauge to refine midseason N needs. Although the timing of BIE differs among varieties, the DD50 uses 210 DD50 units or about 7 days before 1/2 inch IE as the predicted date.

**1/2" IE** – Growth stage corresponding to panicle differentiation (PD) when panicles are about 2 millimeters long. This is the first growth stage DD50 accuracy can be visually checked. This growth stage is measured for all varieties included in the DD50 program in replicated research trials over a range of seeding dates to establish the mean number of accumulated DD50 units required to reach 1/2 inch IE. Management practices such as time of N fertilizer application, emergence date, time of flooding, other nutritional factors, temperature and pesticide applications can effect the accuracy of this predicted date.

**50 Percent Heading** – Growth stage when 50 percent of the panicles have partially emerged from the boot. This is the second growth stage DD50 accuracy can be visually checked. Accuracy and threshold development are similar to that described for 1/2 inch IE.

## Example of DD50 Printout

University of Arkansas  
Cooperative Extension Service  
Rice DD50 Report

Nathan Slaton  
USDA - DB NRRC  
Stuttgart, AR 72160

October 13, 2000

Field name: Rice Produ	(1 acres)	Field # 1
Variety: Wells		County: Arkansas (ST)
Emergence date: 5/ 2		DD50 weather zone: 11

\*\*\*\* Predicted dates for timing specific management practices in rice \*\*\*\*

Beginning and Optimum Tillering: Apply Early/Preflood N.....	5/20 - 5/29
Final recommended time to apply preflood N if early N delayed...	6/ 7
Rice Water Weevil Alert:	5/29 - 6/ 6
High risk of infestation, at flood scout first 7 days for leaf scars.	
Wells is rated moderately susceptible for straighthead.	
Have soil dried between.....	6/10 - 6/21
Begin checking for beginning of internode elongation.....	6/18
Measure rice for plant area to adjust midseason N rate	6/18
Predicted 1/2 inch internode elongation:.....	6/25
Apply 1st midseason N split between:.....	6/19 - 6/25
(May apply all midseason N as a single application)	
(Optional) Apply 2nd midseason N between:.....	6/25 - 7/ 2
Scout for sheath blight symptoms*.....	6/18 - 7/19
(Wells is rated moderately susceptible for sheath blight.)	
Apply Tilt for kernel smut prevention*.....	7/ 6 - 7/19
(Wells is rated moderately resistant for kernel smut.) Treatment	NOT recommended.
Critical scouting time for blast symptoms*.....	7/16 - 8/ 1
(Wells is rated susceptible for blast.)	
1st critical stage (approximate) for fungicide application*...	7/16
2nd critical stage (approximate) for fungicide application*...	7/25
* See explanation for disease control measures in MP192	
Scout for rice stink bug between:.....	7/24 - 8/27
Predicted date for 50% Heading:.....	7/23
Draining field .....	8/18
Approximate time of 20% grain moisture:.....	8/28

### Herbicide Application Information

Apply Whip Between:.....	Not recommended
Apply Grandstand - R between.....	5/16 - 6/25
Apply Blazer+Propanil tank-mix between:.....	5/16 - 6/18
Apply Londax between:.....	5/11 - 6/28
Apply Blazer or Collego for coffeebean/NJV control.....	6/11 - 7/ 8
Propanil application cut-off date.....	6/18
Recommended Ordram application cut-off date.....	6/25
Apply Phenoxy (2,4 - D) between:.....	6/18 - 6/25

This report has been produced through the joint efforts of the Agricultural Experiment Station and the Cooperative Extension Service using weather data supplied by the Southern Regional Climate Center - Louisiana State University.

**Drain Date** – An alert to drain the field in preparation for harvest. Pumping may be ceased about 10 to 14 days earlier provided there is adequate water on the field to prevent drought stress which could reduce grain yield and milling quality in some years. Consider soil type, weather conditions and maturity differences within the field when ceasing pumping and draining for harvest. The listed time is based on 25, 35 and 40 calendar days after 50 percent heading for long, medium and short grain varieties, respectively. Drain dates are delayed an additional 5 days for rice heading after September 1.

**20 Percent Grain Moisture** – The approximate date that grain will be at 20 percent moisture. Actual grain moisture and harvest date may vary 5 to 10 days depending on weather conditions, management, variety and stand uniformity. This time is based on 35, 45 and 50 calendar days after 50 percent heading for long, medium and short grain varieties, respectively. Predicted 20 percent grain moisture dates are delayed an additional 5 days for rice heading after September 1. The actual time that grain reaches 20 percent moisture may be plus or minus 5 days of that predicted.

## Herbicides

**Blazer + Propanil Tank Mix** – The safe dates to apply Blazer tank mixed with propanil. Blazer may antagonize Propanil activity. This time frame begins at the 3-leaf growth stage for Blazer and ends with the cut-off date for Propanil, which is at the end of tillering. When applied alone, Blazer can not be applied after the boot stage.

**Blazer or Collego Application** – Collego is a biological herbicide (fungus) specifically used to control northern jointvetch (curly indigo). Collego is not compatible with many pesticides. The Collego label recommends against tank mixes of Collego and other herbicides including Blazer. Best activity will be obtained under high humidity and flooded field conditions. Apply before northern jointvetch flowers. Fungicides may also reduce the activity of Collego. Check the most recent label or with a company representative for specific recommendations concerning timing of Collego and fungicide applications. This time frame is also the recommended time for application of Blazer (alone) for coffeebean control. The time frame begins 400 DD50 units before 1/2 inch IE and ends 15 days (450 DD50 units) before 50 percent heading as specified by the Blazer label. Collego

may actually be applied until rice begins to head. Collego application during the predicted time allows adequate time for control of northern jointvetch.

**Grandstand-R** – Grandstand can be applied to rice from the 2- to 3-leaf growth stage up to the 1/2 inch IE growth stage. To avoid injury, do not apply after 1/2 inch IE. For water-seeded rice, Grandstand cannot be applied until rice has reached the 3- to 4-leaf stage. The beginning date listed on the Arkansas DD50 is for the 2- to 3-leaf stage as labeled for dry-seeded rice.

**Londax** – Application window for Londax begins at the 1-leaf stage and ends with the 60-day pre-harvest interval (PHI). Apply Londax and Propanil for yellow nutsedge control within 10 days prior to flood establishment. For aquatic weed control, apply in the static flood when aquatics are emerging for best control.

**Ordram** – The recommended cutoff date for Ordram application is 1/2 inch IE to avoid possible injury to rice. Ordram application for grass control made after this time will not likely provide benefits to the crop. Some varieties are sensitive to Ordram and are indicated on the DD50 printout as “Not Recommended.”

**Phenoxy** – The safe dates to apply 2,4-D or MCPA. Maximum IE should not exceed 1/2 inch. Apply the first midseason N application within 5 days after phenoxy application to aid in plant recovery. The window for application length depends on rice variety.

**Propanil** – The preferred cutoff date occurs at BIE. Injury may occur if applied after the cutoff date. The labeled cutoff restriction for Propanil is at the end of tillering.

**Whip** – Apply only from 4-leaf rice to the cutoff date for safe application. Cutoff date refers to either the labeled 65-day PHI or to the growth stage restriction of 1/2 inch IE (whichever comes first). Varieties listed as “not recommended” on the Whip 360 label are indicated as “Not Recommended” on the DD50 printout.

## Other

**Rice Water Weevil (RWW) Alert** – Indicates the risk for rice water weevil infestation. Rice water weevil flight muscle development is influenced by temperature and can be predicted by the DD64. Therefore, the risk assessment of

infestation – high, medium or low – is based on timing adult RWW flights and the vulnerable growth stage of dry-seeded flooded rice. Begin scouting flooded rice fields for adult leaf feeding scars during the predicted time frame to determine the need for appropriate control measures for adult weevils. Since the loss of Furadan 3G, no current pesticides are labeled for post-flood application control of RWW larvae.

**Straighthead** – The 10- to 14-day period to have rice fields dried (stressed) for straighthead prevention. The first date is NOT a drain date. Drain in sufficient time to allow for adequate drought stress on rice during the predicted time frame and reestablish a flood before 1/2 inch IE. Notice the short interval between early N application and the straighthead control period for very-short-season varieties, such as Cocodrie, on the DD50 printout. Varieties that are highly susceptible to straighthead are given 400 DD50 units (about 14 days) for drying. Varieties less susceptible to straighthead are given a 10-day window (300 DD50 units). Variety susceptibility ratings are printed on the DD50 printout.

**Measure Rice for Plant Area** – The plant area board (PAB) or “Rice Gauge” should be used at this time to measure rice for plant area (size) and adjustment of the midseason N rate. The measurement time coincides with BIE or green ring. Measurements made 3 to 4 days before or after the recommended growth stage may be 10 to 20 percent low or high, respectively. Internodes should be checked before PAB measurements are taken to ensure they are taken at the proper growth stage. For additional information on rice plant area measurements refer to the “Efficient Use of Fertilizer” section.

**Midseason N** – The time to apply midseason N (if required) should be during the first time for midseason N. This first N application window begins 1 day after predicted BIE and ends at the predicted 1/2 inch IE. Midseason N may be applied as a single application during this first period. Recent research shows that rice response to midseason N is equal if applied at or between BIE and 1/2 inch IE. When rice is very N deficient

at midseason, a second split application may be desirable and should be made during the “Optional Second Midseason Period” which begins at 1/2 inch IE and ends 7 days later.

**Sheath Blight** – Begin scouting for sheath blight at BIE and stop prior to 50 percent heading. Length of the scouting period depends on variety maturity. Treatment before 1/2 inch IE and after the last predicted date is not recommended. Variety susceptibility ratings are printed on the DD50 printout.

**Apply Tilt for Kernel Smut Prevention** – The fungicide Tilt should be applied in this window for prevention of kernel smut on highly susceptible varieties. Varieties rated as susceptible to tolerant will have a “Not Recommended” statement in addition to application dates. The decision to apply Tilt for kernel smut prevention should be based on variety susceptibility, marketing and field history. This time frame is strictly for prevention since kernel smut cannot be scouted for prior to heading. The labeled cut-off date for Tilt application is late boot or beginning of panicle emergence from the boot. The predicted time is 390 DD50 units in length and begins about 17 days before 50 percent heading and ends about 4 days before 50 percent heading.

**Blast** – The first time listed to scout for symptoms is the critical period to determine if blast is present and plan for treatment. The first critical stage should coincide with the late boot stage about 200 DD50 units before 50 percent heading. If foliar blast lesions have been detected, this is the approximate time for the first fungicide application to protect the emerging panicle. Rice should be about 50 percent headed for timing of the first fungicide application. The second critical stage should coincide with 80 to 90 percent panicle emergence from the boot. Blast should be scouted for during the entire season.

**Stinkbugs** – The period to begin scouting for rice stinkbugs by sweep net. Begin scouting immediately after 50 percent heading and continue until grain is mature. Treat if threshold populations are found during this time.