Chapter

6

DD50 Rice Management Program

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The DD50 program was developed in the 1970s to help rice farmers accurately time mid-season 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 mid-season N application. Today, the DD50 continues to be used by Arkansas rice growers to time over 26 management decisions in rice production. Programs similar to the Arkansas DD50 have been developed in other Mid-South rice-producing states.

Midseason N application timing is no longer as important as it was 30 years ago due to development of shorter season, stiff-strawed cultivars. Optimum grain yield for currently-produced cultivars requires more preflood N and is less dependent on midseason N. However, the DD50 remains a vital program and source of information for pest management, timing of N, and overall production of new varieties.

The DD50 is a modification of the growing degree-day concept, which uses temperature data to predict rice development. The growing degree-day

Table 6-1. Grower participation in the DD50 computer rice management program.

Year	Producers	Fields	Acres	% of Total Acres	Year	Producers	Fields	Acres	% of Total Acres
	number participating					number participating			
1978	540	N/A	N/A	N/A	1998	2,069	11,287	800,851	53.9
1979	1,320	3,456	237,362	23.3	1999	1,925	11,458	805,199	49.6
1980	1,620	4,285	240,000	18.8	2000	1,710	9,946	690,504	49.0
1981	2,000	6,166	472,148	30.7	2001	1,859	11,774	814,038	50.2
1982	2,150	7,595	528,796	39.8	2002	1,809	10,468	716,567	47.6
1983	2,110	6,549	396,417	43.3	2003	1,552	9,562	673,693	46.3
1984	2,563	8,161	536,194	46.6	2004	1,552	9,393	672,490	43.3
1985	2,723	10,053	650,201	61.9	2005	1,337	9,112	648,870	39.7
1986	2,769	12,233	803,121	78.7	2006	1,252	7,753	339,051	40.2
1987	2,746	8,887	547,904	54.2	2007	1,066	6,564	493,508	37.2
1988	2,711	10,359	644,754	53.3	2008	1,000	6,079	432,860	31.1
1989	2,775	9,760	646,470	56.7	2009	988	6,160	451,070	30.5
1990	2,668	11,250	695,897	58.0	2010	1,039	7,158	533,307	30.3
1991	2,695	11,679	753,282	59.8	2011	602	3,723	257,067	22.7
1992	2,522	12,096	816,643	59.2	2012	655	4,145	331,099	26.7
1993	2,326	10,945	689,447	56.1	2013	600	3,482	260,567	24.4
1994	2,537	13,273	872,330	61.4	2014	660	4,498	337,725	22.9
1995	2,580	13,028	871,743	65.1	2015	487	3,164	254,235	19.8
1996	2,084	10,349	741,794	63.4	2016	528	3,609	300,676	19.8
1997	2,107	11,441	784,966	56.5	2017	415	2,651	212,527	19.4

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 significantly increase the speed of plant development.

Weather data is collected at over 30 sites across Arkansas. To account for weather differences among geographic locations, DD50 predictions are calculated based on temperature data collected from locations closest to the specific fields based on the county selected for the field.

The DD50 program accounts for cool temperatures that may delay development during seedling growth for early-seeded rice (emerging before May 1) by adding 50 DD50 units to thresholds up to ½-inch internode elongation. The final adjustment made by the DD50 is to add 5 days between the normal predicted dates for 50% heading and 20% grain moisture to account for slower moisture loss from rice panicles for rice that heads after September 1.

Equation 1

$$DD50 = \frac{\text{Daily Maximum Temp} + \text{Daily Minimum Temp}}{2} - 50$$

Maximum temperature = 94°F if maximum temperature is >94°F.
Minimum temperature = 70°F if minimum temperature is >70°F.

How to Use the DD50

The Rice DD50 program can be used by individual producers who manage their own crops, by consultants with multiple clients, or by county agents for producers within their county. To participate in the DD50 rice management program, two options are available to producers or consultants. The first option is for producers or consultants to log onto the Cooperative Extension Service website and enter their fields directly at http://DD50.uaex.uada.edu/. The second option is for producers to submit their cultivar, acreage, and emergence date information of each rice field to their local county Extension office to enter into the program and send the report to the producer. It is preferred that producers and consultants set up an account and enter their own fields so that they may check the program for updates as the season and the program information progress. An online DD50 User's Guide is available to individuals who access the program through the internet.

Emergence is defined as the time 8 or more plants per square foot for varieties or 4 or more plants per square foot for hybrids (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 plants have shoot lengths of ½ to ¾ 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. It may be necessary to manage the two areas of the field separately if emergence dates differ greatly.

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 vary considerably across years. Those with enrolled fields will be notified when current year temperature data significantly differs from the predictions based on 30-year average temperature data. In general, the events predicted by the DD50 should be accurate within plus or minus two days for dry-seeded rice.

The accuracy of the DD50 is influenced by management practices and variations of weather within each zone. For example, delaying the flood or preflood N, overfertilization, herbicide injury and/or nutritional deficiencies may slow rice development, resulting in the DD50 predicted dates occurring later than actual plant development. Water-seeded rice often develops at a faster rate than dry-seeded rice because the floodwater buffers the effect of air temperature extremes. The accuracy of the DD50 is also dependent on use of the correct emergence date, cultivar 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 with management decisions. Therefore, growers are

Table 6-2. DD50 accumulations from recent years compared to the 30-year average accumulation at Stuttgart, Arkansas.

Date	30-Year Mean	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	cumulative heat units										
March 16-31	113	53	251	105	108	59	89	292	50	46	130
April 1-15	161	228	80	123	86	239	230	243	142	136	256
April 16-30	226	297	201	188	265	232	252	220	211	214	221
May 1-15	285	248	371	244	268	338	254	349	209	292	323
May 16-31	377	414	359	384	338	420	347	432	393	355	366
June 1-15	408	410	427	458	399	471	476	378	398	396	403
June 16-30	441	439	457	436	476	471	466	453	452	433	458
July 1-15	447	447	430	446	450	464	465	455	399	423	423

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 cultivars. Rice cultivars of differing maturity emerging on the same day differ in the rate of physiological development throughout the season. In general, cultivars do not differ in the amount of time required to reach the 4- to 5-leaf stage. The time required from 50% heading to physiological maturity or harvest moisture is also assumed to be constant among grain types. Long-, medium- and short-grain cultivars are allowed 35, 40, and 50 days, respectively, from 50% heading to 20% grain moisture for flowering, ripening (grain fill), and moisture loss from grains. The time (date) of heading, kernel characteristics, canopy structure, and precipitation can influence the time required for grain to reach 20% moisture. The major difference in growth among cultivars occurs either between the 4- to 5-leaf stage and ½-inch IE or ½-inch IE and 50 % heading stages. Farmers are encouraged to use the DD50 to help plan rice seeding and harvest dates of different cultivars.

Table 6-3. Days required for ten rice cultivars, emerged on May 1, to reach specific growth stages.

Cultivar	Growth Stage			
	4-Leaf	½" IE	50% Heading	20% Moisture
	cumulative days to reach growth stages†			
CL151	19	48 (29)	76 (28)	111 (35)
CL153	19	49 (30)	80 (31)	115 (35)
CL172	19	53 (34)	81 (28)	116 (35)
Diamond	19	53 (34)	80 (27)	115 (35)
LaKast	19	53 (34)	78 (25)	113 (35)
Roy J	19	56 (37)	86 (30)	121 (35)
RT CLXL745	19	50 (31)	76 (26)	111 (35)
RT XP753	19	48 (29)	76 (28)	111 (35)
Jupiter	19	58 (39)	81 (23)	121 (40)
Titan	19	54 (35)	78 (24)	118 (40)

† Days between growth stages in parentheses.

The DD50 program 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 cultivar and expected emergence dates. In addition, state and county information concerning cultivar acreage and percentage of rice at critical development stages are 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. The 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/consultants 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 System Division of Agriculture or that these products are recommended over other

suitable alternatives. Suggested timing for pesticides on the DD50 assumes 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 MP44, Recommended Chemicals for Weed and Brush Control, for specific recommendations.

Growth Stages

Beginning and Optimum Tillering, Apply Early/Preflood – 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 timeframe 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 attempt to let the soil dry, but flood immediately if additional wetting occurs. This date is 510 DD50 units in length or about three weeks before the predicted time of ½-inch IE, depending on cultivar. This provides about three weeks for plant uptake of fertilizer N before panicle differentiation (½-inch IE) occurs. For cultivars 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. Therefore, ½-inch IE may occur sooner than three weeks after flooding.

Beginning Internode Elongation (BIE) – This corresponds to 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 when the midseason N fertilizer application window begins. Although the timing of BIE differs among varieties, the DD50 uses 210 DD50 units or about 7 days before ½-inch IE as the predicted date

½ inch IE – This is the growth stage corresponding to panicle differentiation (PD) when panicles are about 2 millimeters long and separation between nodes is ½-inch. This is the first growth stage DD50 accuracy can be visually checked. This growth stage is measured for all cultivars 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 ½-inch IE. Management practices such as time of N fertilizer application, emergence date, time of flooding, other nutritional factors, temperature, and pesticide applications can affect the accuracy of this predicted date.

50% Heading – This is the 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 ½-inch IE.

Drain Date – A date to drain the field in preparation for harvest is provided. 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, 30, and 40 calendar days after 50% heading for long, medium, and short grain cultivars, respectively. Drain dates are delayed an additional 5 days for rice heading after September 1.

20% Grain Moisture – The approximate date that grain will be at 20 percent moisture and ready for harvest is provided. Actual grain moisture and harvest date may vary 5 to 10 days, depending on weather conditions, management, cultivar, and stand uniformity. This time is based on 35, 40, and 50 calendar days after 50% heading for long, medium, and short grain cultivars, respectively. Predicted 20% grain moisture dates are delayed an additional 5 days for rice heading after September 1. Actual time that grain reaches 20% moisture may be plus or minus 5 days of that predicted.

Herbicides

Aim or Grandstand-R – Aim or Grandstand can beapplied to rice from the 2-to-3-leaf growth stage up to the ½-inch IE growth stage. To avoid injury, do not apply after ½-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 DD50 is for the 2-to 3-leaf stage as labeled for dry-seeded rice.

Beyond – The preferred cutoff date for Beyond occurs at BIE for Clearfield hybrids and BIE+14 days for Clearfield varieties. DO NOT apply Beyond to non-Clearfield cultivars. Beyond can be applied to Clearfield rice only following at least one application of Newpath or Clearpath herbicides.

Blazer + Propanil Tank Mix – The safe dates to apply Blazer tank mixed with Propanil. Blazer may antagonize Propanil activity. This timeframe 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 cannot be applied after the boot stage.

Blazer or LockDown – LockDown is a biological herbicide (fungus) specifically used to control northern jointvetch (curly indigo). LockDown is not compatible with many pesticides. The LockDown label recommends against tank mixes of LockDown and other herbicides (including Blazer), insecticides, fungicides, and liquid nitrogen fertilizers. Best activity will be obtained under high humidity and flooded field conditions. Apply before northern jointvetch flowers. This timeframe is also the recommended time for application of Blazer (alone) for coffeebean control. The timeframe begins 400 DD50 units before ½-inch IE and ends 15 days (450 DD50 units) before 50% heading as specified by the Blazer label. LockDown may actually be applied until rice begins to head. LockDown application during the predicted time allows adequate time for control of northern jointvetch.

Grasp – The preferred cutoff date, which is based on the 60-day pre-harvest interval (PHI) as required on the herbicide label. This is calculated back from the date of 20% grain moisture.

Londax – The 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.

Permit – The preferred cutoff date, which is based on the 48-day pre-harvest interval (PHI) as required on the herbicide label. This is calculated back from the date of 20% grain moisture.

Phenoxys, 2,4-D – The safe dates to apply 2,4-D or MCPA are indicated on the DD50 report. Maximum IE should not exceed ½-inch. Apply midseason N within five days after phenoxy application to aid in plant recovery. The window for application length depends on rice cultivar.

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.

Provisia – The safe dates to apply Provisia herbicide to tolerant rice cultivars are indicated on the DD50 report. Provisia herbicide can be applied to Provisia rice cultivars from the 1-leaf growth stage up to the BIE growth stage. To avoid potential injury, do not apply Provisia after panicle initiation (BIE). DO NOT apply Provisia herbicide to non-Provisia cultivars.

Regiment – Regiment can be applied to rice from the 3-leaf growth stage up to the BIE growth stage. To avoid injury, do not apply Regiment until the 3rd leaf is fully expanded and do not apply after panicle initiation (BIE).

Ricestar – Ricestar can be applied to rice from the 1-leaf growth stage up to the BIE growth stage. To avoid potential injury, do not apply Ricestar after panicle initiation (BIE).

Other

Rice Water Weevil (RWW) Alert – A date range is not provided for rice water weevil management due to differences in flood management of specific fields. Instead, it is included as a note to remind of the critical timing to scout for rice water weevil leaf scars. Begin scouting flooded rice fields for adult leaf feeding scars the first 7 days after flooding for dry-seeded rice. If warranted, insecticide applications must be made 7-10 days after flood establishment for rice water weevil control.

Straighthead – The 10- to 14-day period to have rice fields dried (stressed) for straighthead prevention is provided. The first date is NOT a drain date. Drain in sufficient time to allow for adequate drought stress on rice during the predicted timeframe and reestablish a flood before ½-inch IE. Notice the short interval between

early N application and the straighthead control period for very-short-season cultivars, like Cocodrie. Cultivars that are highly susceptible to straighthead are given 400 DD50 units (about 14 days) for drying. Cultivars less susceptible to straighthead are given a 10-day window (300 DD50 units). Cultivar susceptibility ratings are noted on the DD50 report.

Midseason N – The time to apply midseason N (if required) should be made after BIE and at least 3 weeks after the preflood N has been incorporated by the flood. This window begins 1 day after predicted BIE. It is recommended that midseason N be applied in a single application. Recent research shows that rice response to midseason N is equal if applied from BIE to 21 days after BIE as long as it has been at least 21 days since the preflood N was incorporated by the flood. When rice is very N deficient at midseason a second application may be desirable and should be made 7 days after the initial application.

Apply Boot N – The RiceTec hybrids have a recommendation for an N application at the boot to late boot growth stage. The predicted time for this application is 390 DD50 units in length and begins about 17 days prior to 50% heading and ends at 50% heading. Other cultivars may also benefit from boot N applications if midseason N was not managed properly.

Sheath Blight – Begin scouting for sheath blight at BIE and stop prior to 50% heading during the dates provided. Length of the scouting period depends on cultivar maturity. Treatment before ½-inch IE and after the last predicted date is not recommended. Cultivar susceptibility ratings are noted on the DD50 report.

Apply Tilt for Kernel Smut Prevention – The fungicide Tilt or other propiconazole-containing products should be applied in this window for prevention of kernel smut on very susceptible or susceptible cultivars. Cultivars rated as moderately susceptible to tolerant will have a "Not Recommended" statement instead of application dates. The decision to apply Tilt for kernel smut prevention should be based on cultivar susceptibility, marketing, and field history. This timeframe 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% heading and ends about 4 days before 50% heading. Fungicide applications for kernel smut are recommended for AB647, Cheniere, CL111, CL151, CL153, Cocodrie, Diamond, Francis, Jazzman-2, LaKast, Mermentau, Rex, RT 7311 CL, RT CLXL745, Roy J, Taggart and Wells.

Apply Tilt for False Smut Prevention – The fungicide Tilt or other propiconazole-containing products should be applied in this window for prevention of false smut on very susceptible cultivars; and if conditions favor, cultivars that are susceptible. The decision to apply Tilt for false smut prevention should be based on cultivar susceptibility, marketing, and field history. This timeframe is strictly for prevention since false 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% heading and ends about 4 days before 50% heading. Fungicide applications for false smut are recommended for Diamond, PVL01, RT Gemini 214 CL, RT XP760 and Thad. Application is recommended for most other cultivars only if conditions favor.

Blast – The first time listed to scout for blast 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% 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 10% headed for the timing of the first fungicide application. The second critical stage should coincide with about 75% panicle emergence from the boot, but the panicle base (neck) must still be in the boot. Fields should be scouted for blast during the entire season. Cultivar susceptibility ratings are noted on the DD50 report.

Stink Bugs – The period to begin scouting for rice stink bugs by sweep net begins immediately after 50% eading and continues until at least 60% of kernels have reached the hard dough stage (kernels are straw-colored). Treat if threshold populations are found during this time. Threshold is 5 stink bugs per 10 sweeps the first two weeks of heading and 10 per 10 sweeps the second two weeks of heading.

Apply Early / Preflood N (Beginning – Optimum Tillering)	**5/17/2018 - 5/25/2018**
Final recommended time to apply preflood N if early N delayed	**6/4/2018**
Rice Water Weevil Alert: Scout for Rice Water Weevil leaf scarring the first 7 days after flooding. Timing is critical (see MP144).	
Diamond has no rating for straighthead, have soil dry between:	**6/3/2018 - 6/17/2018**
Beginning internode elongation (green ring):	**6/15/2018**
1/2-inch internode elongation:	**6/21/2018**
Apply midseason N to varieties after Make application AFTER beginning internode elongation AND at least 3 weeks after preflood N incorporated by flood.	**6/16/2018**
Scout for sheath blight: (Diamond is rated susceptible to sheath blight.)	**6/15/2018 - 7/15/2018**
Apply boot N to hybrids	**NOT Recommended**
Apply Tilt for kernel smut prevention (see MP192) (Diamond is rated susceptible to kernel smut.) Treatment Recommended.	**7/2/2018 - 7/15/2018**
Apply Tilt for false smut prevention (see MP192) (Diamond is rated very susceptible to FALSE smut.) Treatment Recommended.	**7/2/2018 - 7/15/2018**
Critical scouting time for blast symptoms.(see MP192) (Diamond is rated susceptible to blast.)	**6/15/2018 - 7/21/2018**
1st critical stage for neck blast fungicide application:	**7/12/2018**
2nd critical stage for neck blast fungicide application:	**7/21/2018**
Scout for rice stink bug between:	**7/20/2018 - 8/23/2018**
50% Heading:	**7/19/2018**
Drain field: Consider approximate date and grain maturity (2/3 straw colored kernels on loam soil and 1/2 straw colored kernels on clay soil).	**8/13/2018**
Approximate time of 20% grain moisture	**8/23/2018**

Herbicide Application Information

Apply Ricestar Between	**5/8/2018 - 6/15/2018**
Apply Provisia between	**NOT recommended**
Apply Regiment Between	**5/12/2018 - 6/15/2018**
Apply AIM or Grandstand - R between	**5/12/2018 - 6/21/2018**
Apply Blazer + Propanil between	**5/12/2018 - 6/15/2018**
Apply Londax between	**5/8/2018 - 6/24/2018**

Apply Blazer or Lockdown for coffeebean/NJV control	**6/8/2018 - 7/4/2018**
Propanil cut-off date	**6/15/2018**
Beyond cut-off date:	**NOT recommended**
Apply Phenoxy (2,4 - D) between	**6/11/2018 - 6/21/2018**
Grasp cut-off date	**6/24/2018**
Permit cut-off date	**7/6/2018**

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