Project No. RM-8

ANNUAL REPORT
COMPREHENSIVE RESEARCH ON RICE

January 1, 1995 - December 31, 1995

PROJECT TITLE: Estimating the Amount of Nitrogen Fertilizer Required by a Nitrogen Deficient Rice Crop.

PROJECT LEADER AND PRINCIPAL UC INVESTIGATORS:

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LEVEL OF 1995 FUNDING: $23,000

OBJECTIVES AND EXPERIMENTS CONDUCTED TO ACCOMPLISH OBJECTIVES:

Main Objective.
To develop rapid applicable methods to determine with sufficient accuracy the amount of nitrogen required to optimize grain yield at various growth stages and degrees of N-deficiency.

Summary of 1995 Research Objectives and Accomplishments.
Field experiments were conducted to establish the yield response to different levels of topdress nitrogen at different growth stages and various rates of basal nitrogen. Data from these experiments will be used to estimate the parameters required in the nitrogen model which will be included in the future release of CALEX/Rice.

Five basal nitrogen rates (0, 50, 100, 150, and 200 lb/ac) were used to simulate different levels of nitrogen status. Four rates of nitrogen (0, 50, 100, and 150 lb/ac) were topdressed at three different rice phenostages (Mid-Tillering, Panicle Initiation, and 50% Heading). Experiments were conducted at

Dingville, Sutter County and at a field near Butte Creek, Colusa County. M202 was used for both locations. Half of the 20' by 10' was harvested while the other half was used for destructive subsampling during the season. Grain yield adjusted to 14% moisture content and lodging are shown in Tables 1 and 2 and illustrated in Figures 1-3.

Among the basal N rates without any topdress N, maximum grain yield was about 9,000 lbs/ac at 100 lb N/ac for both locations. Plots with a basal treatment of less than 100 lbs/ac were N deficient and plots with a basal treatment of more than 100 lb N/ac have excessive N content. Topdress application of nitrogen significantly increased the yield of N deficient crops. The yield of crops with 0 basal application visually showing the greatest degree of N deficiency was increased to the same level as that of crops with optimum basal N when topdressed at either mid-tillering or panicle initiation (PI). Topdress application at heading of N deficient crops resulted in a small but significant yield increase. In Sutter county, the highest grain yield was obtained by a topdress application of 100 lb N/ac at PI to crops with a basal application of 100 lb N/ac. The best timing of topdress application of N deficient crops was at PI, followed by mid-tillering and lastly at heading. In Colusa county, a topdress application of 150 lb N/ac at PI to unfertilized plots and plots with a 50 lb/ac basal N resulted in a yield increase of 4000 lbs/ac, significantly surpassing the yield of crops with optimum basal N. The highest yield in Colusa was 12000 lb/ac obtained with a basal application of 50 lb N/ac followed with a topdress appplication of 150 lb N/ac at PI. For both locations, grain yield of crops with excessive N content was not significantly affected with various levels of topdress nitrogen. Lodging and moisture content at harvest increased with higher levels of basal and topdress nitrogen application. Preliminary tests of the nitrogen model (not shown) suggests that in cool years or late planting, a low basal N rate followed by a high topdress application at PI is the best strategy for maximizing grain yield. This strategy minimizes spikelet sterility caused by the combined effect of cold temperature exposure and high nitrogen uptake at PI. Rice crops with adequate to excessive N uptake at PI are more susceptible to cold temperature induced spikelet sterility than crops with lower N. This year was a relatively cool planting season.

Table 1a. Grain yield of M202 crop at Dingville, Sutter County.

Basal N Rate (lb/ac)	Growth Stage	Topdress N Rate (lb/ac)	Moisture Content at Harvest (%)	Yield at 14% MC (lb/ac)	Lodging (%)
0	Mid-Till	0	16.10	6190	1
0	Mid-Till	50	16.57	7900	1
0	Mid-Till	100	17.20	8377	1
0	Mid-Till	150	17.73	8993	1
0	PI	0	16.10	6190	1
0	PI	50	16.27	6917	1
0	PI	100	16.85	8385	1
0	PI	150	17.00	8649	1
0	Heading	0	16.10	6190	1
0	Heading	50	16.75	6516	1
0	Heading	100	16.57	6869	1
0	Heading	150	16.75	6907	1
50	Mid-Till	0	16.85	8543	1
50	Mid-Till	50	17.53	9160	3
50	Mid-Till	100	18.02	9189	1
50	Mid-Till	150	18.88	9802	1
50	PI	0	16.98	8543	1
50	PI	50	17.30	9572	1
50	PI	100	17.65	9896	1
50	PI	150	18.27	10121	3
50	Heading	0	17.40	8543	1
50	Heading	50	17.82	8649	1
50	Heading	100	18.40	9086	1
50	Heading	150	18.73	9357	3
100	Mid-Till	0	18.93	9252	3
100	Mid-Till	50	19.38	9524	8
100	Mid-Till	100	19.75	9993	10
100	Mid-Till	150	20.73	10010	15
100	PI	0	18.88	9252	3
100	PI	50	19.40	9983	13
100	PI	100	19.77	10916	20
100	PI	150	19.95	10808	40

Table 1b. Grain yield of M202 crop at Dingville, Sutter County.

Basal N Rate (lb/ac)	Growth Stage	Topdress N Rate (lb/ac)	Moisture Content at Harvest (%)	Yield at 14% MC (lb/ac)	Lodging (%)
100	Heading	0	19.20	9252	3
100	Heading	50	19.70	9058	3
100	Heading	100	19.43	9464	6
100	Heading	150	20.45	9131	10
150	Mid-Till	0	20.38	8950	21
150	Mid-Till	50	20.25	8701	25
150	Mid-Till	100	21.23	8619	33
150	Mid-Till	150	21.63	8410	38
150	PI	0	20.63	8950	21
150	PI	50	20.98	8349	43
150	PI	100	21.07	8556	55
150	PI	150	20.90	8949	70
150	Heading	0	20.18	8950	21
150	Heading	50	20.48	9050	20
150	Heading	100	20.82	8982	23
150	Heading	150	21.13	8711	45
200	Mid-Till	0	21.20	7954	34
200	Mid-Till	50	22.02	7688	60
200	Mid-Till	100	21.78	8005	60
200	Mid-Till	150	22.48	7695	60
200	PI	0	21.55	7954	34
200	PI	50	21.85	7865	58
200	PI	100	22.48	7566	60
200	PI	150	22.38	8229	75
200	Heading	0	21.68	7954	34
200	Heading	50	21.85	8315	43
200	Heading	100	22.05	8086	33
200	Heading	150	22.32	8343	53
LSD5% between topdress rates			**0.76**	**573**	**13**
LSD5% between basal rates			**1.11**	**948**	**20**

PI = panicle inititiation, Mid-Till = mid-tillering

Table 2. Grain yield of M202 crop near Butte Creek, Colusa County.

Basal N Rate (lb/ac)	Growth Stage	Topdress N Rate (lb/ac)	Moisture Content at Harvest (%)	Yield at 14% MC (lb/ac)	Lodging (%)
0	PI	0	18.00	6261	8
0	PI	50	18.40	7939	15
0	PI	100	18.45	8544	28
0	PI	150	18.60	10003	24
50	PI	0	19.56	8037	28
50	PI	50	20.62	9258	85
50	PI	100	20.34	11518	85
50	PI	150	20.38	12195	80
100	PI	0	20.25	8913	61
100	PI	50	20.28	9491	90
100	PI	100	20.64	9509	90
100	PI	150	20.48	9926	93
150	PI	0	20.05	8396	81
150	PI	50	20.25	9468	90
150	PI	100	20.28	9082	90
150	PI	150	20.46	8409	90
200	PI	0	21.32	8110	84
200	PI	50	21.25	8109	83
200	PI	100	21.48	7382	93
200	PI	150	21.36	7099	93
LSD5% between topdress rates			**ns**	**728**	**18**
LSD5% between basal rates			**1.25**	**1124**	**30**

CONCISE GENERAL SUMMARY OF CURRENT YEAR'S RESULTS

For nitrogen deficient rice crops, grain yield can be increased by about 3,000 - 4,000 lbs/ac. In these experiments, the yield of rice crops applied with optimum basal N were significantly surpassed by topdress applications. A basal application of 50-100 lb N/ac followed by a topdress application of 100-150 lb N/ac at PI produced the highest yield of about 10,000-12,000 lbs/ac while the highest yield obtained under basal application without any topdressing is only 9,000 lbs/ac at a rate of 100 lb N/ac. Lodging did not increase with the amount of topdress nitrogen applied to N deficient rice crops, however, significant increases in lodging were observed when crops with adequate and excessive N were topdressed. Topdress application around panicle initiation was best, followed by mid-tillering and lastly at 50% heading. The yield response to topdress application is best described by a saturation curve instead of a parabolic pattern. A higher rate of topdress nitrogen did not result in significant changes in grain yield of crops having an excessive amount of basal nitrogen but lodging and moisture content at harvest significantly increased. Yield component parameters and plant tissue analysis needed to improve the nitrogen model currently being processed. The nitrogen model will then be validated and used to determine the most efficient amount of topdress nitrogen to improve the yield of nitrogen deficient crops.

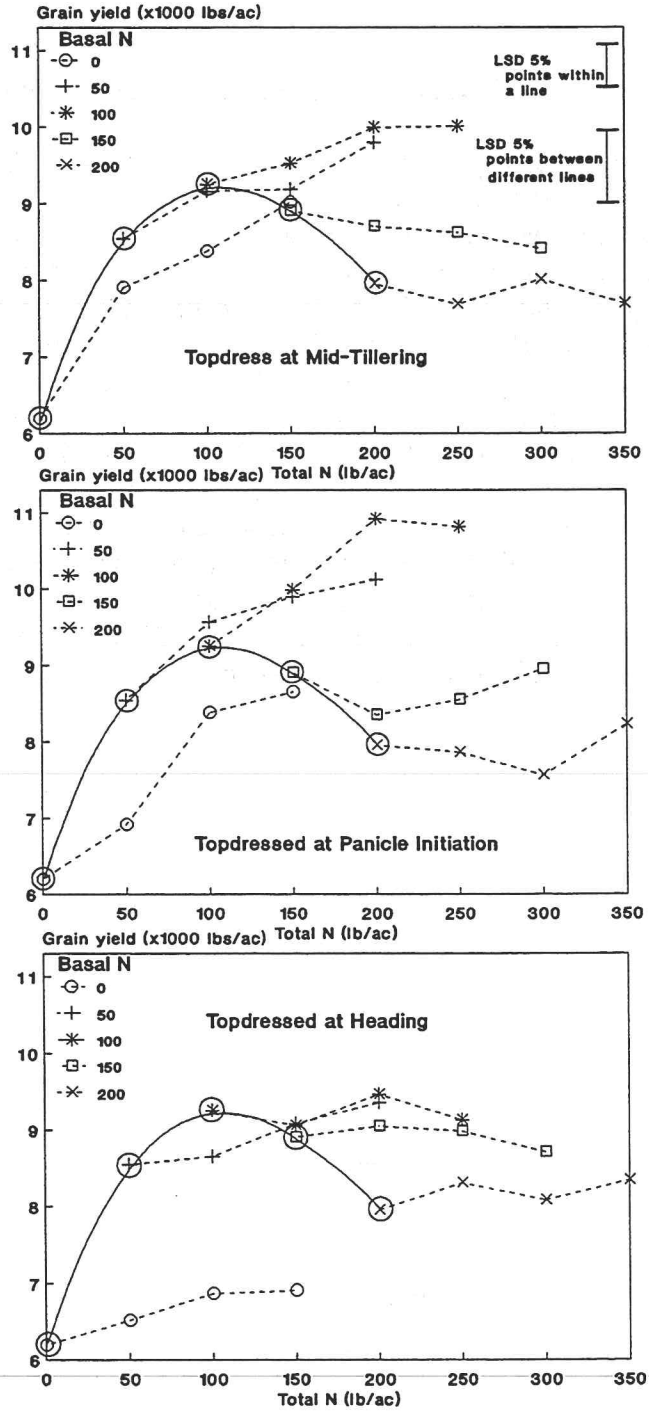

Figure 1. Grain yield response of M202, Sutter County, 1995.
Note: The circled point of each set of line is the basal rate followed by a topdress of 50, 100 and 150 lb N/ac.

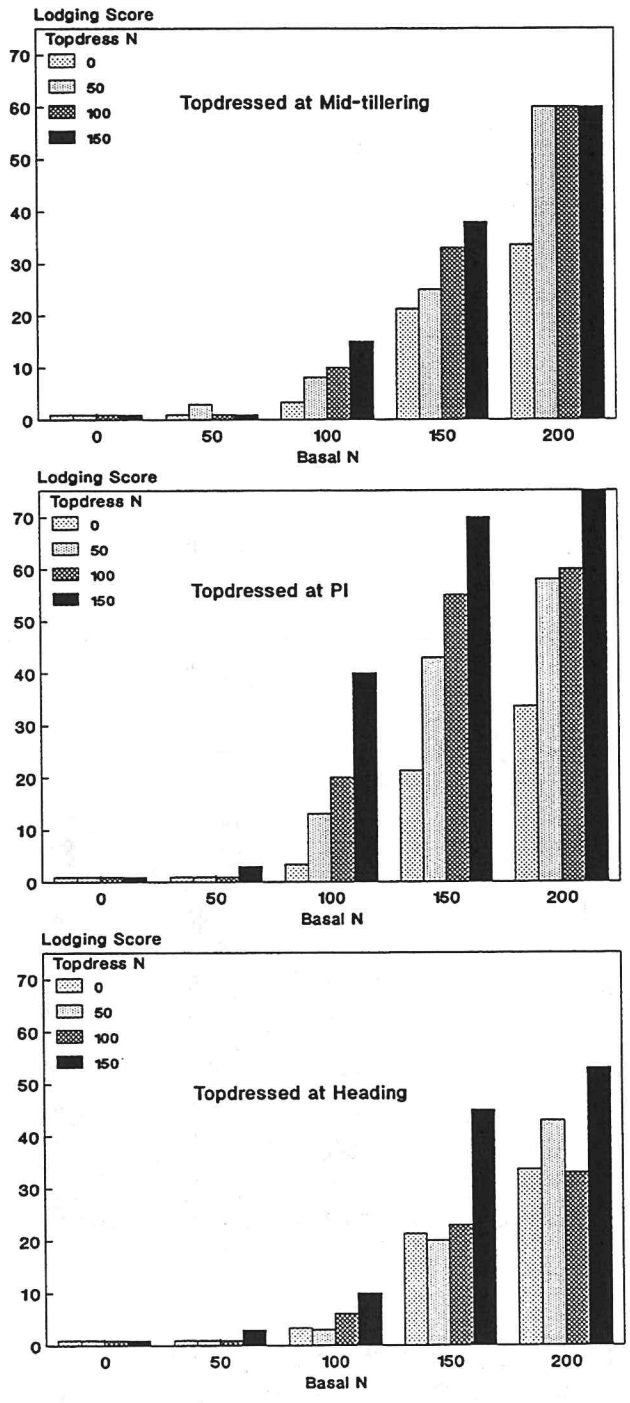

Figure 2. Lodging score of M202 in Sutter County, 1995.

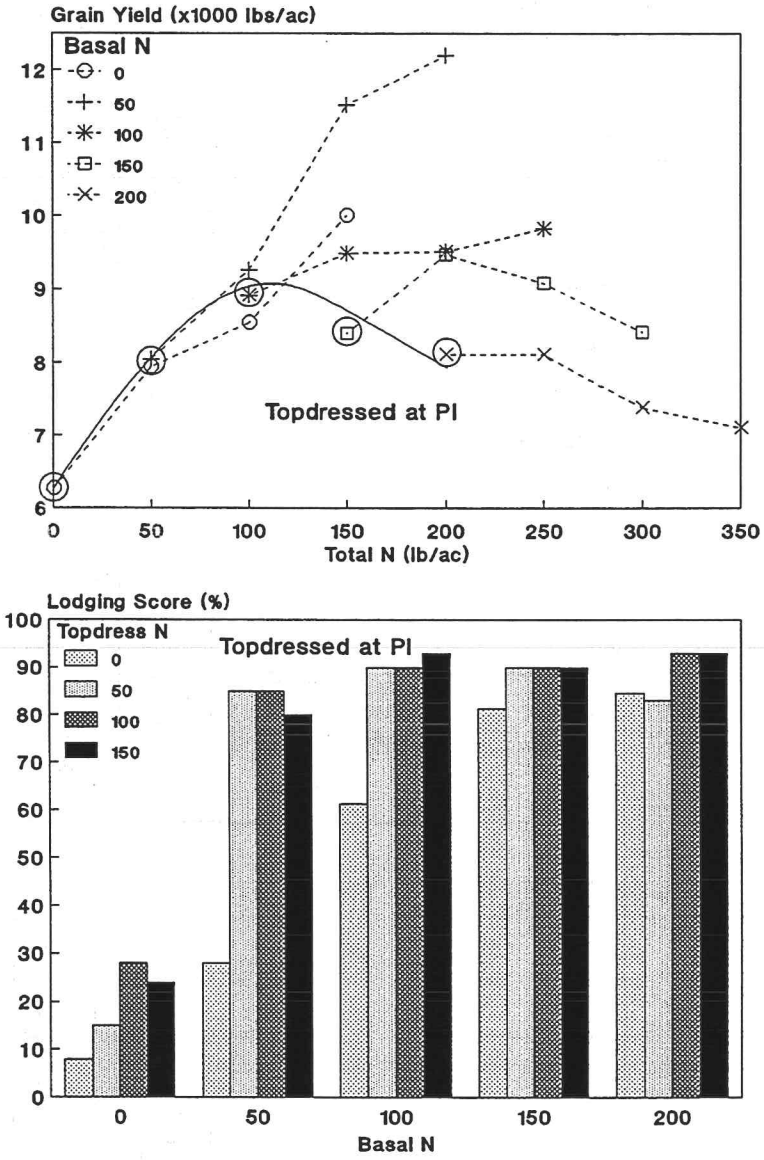

Figure 3. Grain yield and lodging score of M202 near Butte Creek, Colusa County, 1995.