WILD RICE PRODUCTION AND SEED RESEARCH - 1990

E.A. Oelke and M.J. McClellan[1]

Department of Agronomy and Plant Genetics

The 1990 growing season was cooler in all wild rice growing areas than 1989. The total growing degree days (GDD) averaged 239 less than for 1989 (Table 1), however 1990 averaged 32 GDD more than the 50-year averages ("normal"). The temperatures were cool during the early part of the growing season (April and May), warm in June, and cool again during July and August.

Table 1. Growing degree days[a] comparisons for 1989, 1990 and normal.

Month	Aitkin			Grand Rapids			Crookston		
	1989	1990	Normal	1989	1990	Normal	1989	1990	Normal
	GDD								
April	94	64	114	83	30	107	136	82	132
May	424	331	414	454	335	381	574	468	438
June	928	726	677	654	719	634	741	818	710
July	928	808	871	953	831	817	1069	907	900
August	830	766	785	811	810	733	965	963	850
Total	2934	2695	2861	2955	2725	2672	3485	3238	3030

[a] $\frac{\text{Maximum temp.} + \text{Minimum temp.}}{2}$ - 40°F; data from Mark Seeley, Soil Science Dept., Univ. of Minn.

Total precipitation was lower compared to both 1989 and normal (Table 2). It was especially dry in May in all areas and in July at Crookston. August also was drier compared to 1989 and normal. Generally it was a more ideal climate for wild rice than 1989 resulting in higher per acre yields even though the plant populations were low in some fields due to seed germination loss during the winter.

[1]Professor and Senior Research Plot Technician, respectively.

Table 2. Precipitation comparisons for 1989, 1990 and normal[a].

Month	Aitkin			Grand Rapids			Crookston		
	1989	1990	Normal	1989	1990	Normal	1989	1990	Normal
	---------- GDD ----------								
April	2.32	2.94	2.27	2.32	2.12	1.99	0.39	2.22	1.39
May	3.90	1.39	3.39	3.19	.96	3.16	4.56	0.71	2.20
June	5.66	5.25	3.83	4.64	4.51	3.79	2.71	5.83	3.61
July	0.62	2.13	4.79	2.74	3.23	4.12	0.56	0.48	3.17
August	6.27	2.18	4.19	4.54	2.14	3.38	3.76	3.01	3.04
Total	18.77	13.87	18.47	17.43	12.76	16.44	11.98	11.25	13.41

[a]Data from Mark Seeley, Soil Science Dept., Univ. of Minn.

Total paddy wild rice production in Minnesota was more in 1990 compared to 1989 mostly because of higher per acre yields (Table 3). California production was also higher but only slightly compared to 1989.

Table 3. Minnesota and California paddy wild rice production[a] (1000 processed pounds).

Year	Production		Year	Production	
	Minnesota	California		Minnesota	California
1968	36	0	1980	2320	400
69	160	0	81	2274	500
70	364	0	82	2697	880
71	608	0	83	3200	2500
72	1496	0	84	3600	3800
73	1200	0	85	4200	7900
74	1036	0	86	5100	9000
75	1233	0	87	4200	4200
76	1809	0	88	4000	3500
77	1031	0	89	3978	4000
78	1761	100	90	4600	4200
79	2155	200			

[a]1968-1982 Minnesota values from Winchell and Dahl and 1983-1990 from Minnesota Department of Agriculture; California values from Marcum, Cooperative Extension Service, University of California.

The total value of the 1990 crop is estimated at $7.82 compared to $6.56 million for 1989. The increase is due to increased production and price. The highest value was in 1986 when production was the highest and prices $0.90 more per pound than in 1990 (Table 4).

Table 4. Processed wild rice harvested and value from cultivated fields in Minnesota

Year	Production	Price	Value
	1,000 lb	$/lb	$ Millions
1968	36	3.30	0.12
1969	160	2.55	0.41
1970	364	2.80	1.02
1971	608	2.70	1.64
1972	1,496	2.30	3.44
1973	1,200	2.05	2.46
1974	1,036	2.37	2.46
1975	1,233	2.50	3.08
1976	1,809	2.70	4.88
1977	1,031	4.35	4.48
1978	1,761	5.10	8.98
1979	2,155	5.01	10.80
1980	2,320	4.47	10.37
1981	2,274	3.79	8.62
1982	2,697	3.41	9.20
1983	3,200	3.35	10.72
1984	3,600	3.30	11.88
1985	4,200	2.97	12.47
1986	5,100	2.60	13.26
1987	4,200	1.50	6.30
1988	4,000	1.65	6.60
1989	3,978	1.65	6.56
1990	4,600	1.70 (est.)	7.82

Research

The 1990 research focused on weed control, crop rotation, shading effects on wild rice yield, and effects of drying wild rice seed before storage on seed viability and storeability. The research was conducted on plot land and in laboratories of the University of Minnesota, at Grand Rapids and St. Paul, and on specially designed research paddies on the Vomela Wild Rice Farms near Aitkin.

Weed Control Research

The weed control effort was concentrated on the attempt to control giant burreed with fall applications of herbicides. Giant burreed was established by planting rootstocks into a paddy at Grand Rapids in the spring of 1987. The paddy was flooded each year to allow the giant burreed to become well established. On August 21, 1990, which is the normal time to harvest wild rice, the giant burreed plants were trimmed with a hedge trimmer leaving a 30-inch stubble. This is the normal height of the stubble left after harvesting wild rice with combines. The upper part of the giant burreed leaf was beginning to die back; however, this was removed by trimming and the remainder or lower part of the leaf was still green. The plot size was 10 by 20 ft and the experimental design was a randomized complete block with three replications. The herbicides were applied with a hand CO_2 sprayer at 25 psi at a total volume of 30 gal/A.

The herbicides applied were glyphosate (Roundup) at 1/2, 1 and 2 lb ai/A and 2,4-D amine and MCPA with and without crop oil at 1 and 2 lb ai/A. Some visual injury was evident from the herbicides six weeks after treatment. We will be closely monitoring giant burreed growth this spring to see which treatments, if any, were effective in controlling giant burreed.

In another area of weed control, we were able, through the Minnesota Department of Agriculture, to obtain a Section 18 for use of 2,4-D amine in wild rice. We are pursuing this again for 1991. In addition, we have received approval and funding from IR-4 (Interregional Research Project No. 4, New Jersey) to pursue labeling of MCPA for use in wild rice. We will be collecting more residue data in 1991 and asked for clearance for the 1992 growing season.

Sustainable Agriculture

A Sustainable Agricultural Grant was obtained by George Shetka and the University of Minnesota from the Minnesota Department of Agriculture to initiate research for comparing continuous wild rice production to rotating wild rice with another crop or fallow every other year. The experiment was established in the six 2-acre wild rice research paddies on the Vomela Wild Rice Farm near Aitkin. All six paddies were in wild rice production during 1989. After wild rice harvest all six paddies were rotovated. Three of the paddies were fertilized in the fall for wild rice production in 1990. Two hundred fifty pounds of 1-5-40-5S were applied before rotovating; while 19 gallons of 22-7-0 were injected after tillage.

In the spring of 1990, the other three paddies were divided into three strips. One strip was left fallow all summer, one strip was planted to alfalfa, variety 'Nitro,' while the third strip was planted to two varieties of spring canola. One variety of canola was 'Legend,' medium maturing while the other was a very early variety, 'Parkland.' The Legend seed was supplied by Interstate Seed Company and Parkland seed by Dr. Downey of Canada. The canola and alfalfa strips were fertilized with 15 lb/A of P and 100 lb/A of K. In addition, the canola strips received 100 lb/A N and the alfalfa strips 20 lb/A N. The fertilizer was incorporated with a field cultivator before planting.

Seeding was delayed until May 21 because of wet fields. The canola was seeded at the rate of 11.5 lb/A with a 12-ft press-wheel grain drill with 6 inch spacing between rows.

Alfalfa was seeded at the rate of 19 lb/A with a Brillion seeder.

One of the three 2-acre wild rice paddies was lost to crayfish, thus yields were only obtained from two of the paddies. The wild rice was harvested with the grower's combine on August 22. Also, wild rice plant density was high in one of the other paddies resulting in lower yields. The average wild rice yield at 40% moisture was 595 lb/A which was lower than expected even with two applications of Tilt (Table 5). Part of the reason for low yields may have been due to lack of nitrogen which was evident in one of the paddies with the higher plant density, and to diseased plants.

We were successful in establishing both canola and alfalfa in the peat soil. Both grew well except for small areas that were too wet. We hand harvested small areas of both crops. The remainder of the crop was incorporated into the soil in the fall. The Parkland canola flowered very early resulting in short (30 in.) plants and low yield (Table 5). This variety is too early for the Aitkin area. The Legend canola variety was taller (40 in.), later and yielded more than Parkland. However, the yield was still not as much as needed for economical canola production. We feel, however, that earlier planting could result in better yield. We had to delay planting because of some seepage from the adjacent flooded paddies. Also smartweed was present in canola which might be reduced if canola were planted earlier.

We were able to establish a good stand of alfalfa; however, in one paddy smartweed reduced the growth of alfalfa. We were able to reduce the smartweed competition some by mowing the smartweed just above the alfalfa on July 20. We harvested 3 X 20 ft areas on August 28 to obtain an estimate of alfalfa yield. We obtained 0.65 ton per acre (Table 5) with good quality (Table 6). It might be possible to obtain one cutting of hay from the alfalfa and still allow for enough nitrogen to be added to the soil for next year's wild rice crop. The alfalfa was tilled into the soil on September 19.

Wild rice was seeded into the three paddies in the fall that had the canola, alfalfa and fallow strips. All six paddies will be in wild rice in 1991. No fungicide will be used on the three paddies that were out of wild rice in 1990. Data will be collected on wild rice growth, disease incidence and yield in 1991. Water quality measurements will also be made on each paddy. An economic analysis will be made at the conclusion of the experiment in 1992.

Table 5. Wild rice, alfalfa and canola yields in crop rotation experiment-Aitkin, 1990.

	Canola[b]		Alfalfa[c]
Wild rice[a]	Legend	Parkland	Nitro
	lb/A		
595	792	303	1294

[a]40% moisture.
[b]Plants/ft^2 for Legend = 19.6 and for Parkland = 12.1.
[c]Plants/ft^2 = 15.4; harvested on 8/28.

Table 6. Alfalfa quality when harvested on August 28.

CP	ADF	NDF	DM	P	CA	K	MG
			%				
14.3	42.3	54.5	93.5	.32	1.25	3.06	.35

Influence of Shade During Grain Fill on Yield of Wild Rice

The third year of a 3-year experiment was completed at St. Paul on the effect of reduced light during grain fill on yield of wild rice.

Growers have experienced lower yields when long periods of cloudy days occur during grain fill. This trial was conducted to see if reduced light during grain fill could result in lower yield. The trial was similar to the one conducted in 1987 and 1989. The study was conducted utilizing 4 ft x 4 ft boxes that were 1 ft deep. The boxes were lined with black plastic sheeting and filled with 8 inches of greenhouse soil mix. The soil was fertilized with 40 lb/A N (urea) plus 6 lb/A of Fe chelate. Four rows of wild rice were seeded on May 4, 1 ft apart, into each box after which the boxes were flooded to the top. After the plants were in the 3- to 4-leaf stage the rows of plants were thinned to one plant every 2 inches. On July 14, when the plants were in late boot to early flowering, black plastic mesh screening that reduced light by 47% was placed over all boxes except the controls. The center two rows were harvested for grain yield and plant measurements. Grain was hand stripped 3 times beginning on August 7 and ending on August 21. There were 7 replicates and the experimental design was a randomized complete block. There were 3 light regimes; one with no shading during grain fill, one with the mesh removed after 2 weeks and another with the mesh removed after 4 weeks.

During 2 of the 3 years, yield was reduced by shading the plants even for 2 weeks. In the other year yield was reduced by 4 weeks of shading. The results from this 3 year experiment indicates that yields can be reduced by long periods of reduced sunlight which could be the case during long periods of cloudy weather.

Table 7. The effects of reducing natural light by 47% during grain fill on wild rice yield and plant characteristics, St. Paul, 1990.

Weeks of light reduction after flowering	Plant height	Plant number	Dry wt/ plant	Stem/ plant	Grain yield[a]
	cm	no./ft^2	gm	no.	lb/A
0	89	2.8	11.6	5.6	1656
2	84	2.6	11.2	4.8	1178
4[b]	86	2.7	11.1	4.6	1078
LSD .05	NS	NS	NS	NS	370

[a]40% moisture. [b]Harvested on this date.

Seed Storage and Handling

The results from the seed storage experiment reported in the 1989 report indicated that wild rice seed could be dried down to 9% moisture and still germinate even after 18 months of dry storage at 28°F. However it was still necessary to store the seeds for an additional 3 months in water at 38°F to obtain germination. A similar experiment was conducted starting in the fall of 1989 except with fewer seed moisture levels and comparing dry storage at 28°F and water storage at 38°F.

Seeds of the K2 variety were air-dried on a laboratory bench at room temperature for 10 days starting on 9/11/89. The room temperature was 70-75°F and the relative humidity was 40%. Seed was divided into 24 lots (6 sampling dates and 4 replicates). Twenty-four subsamples (1-pint bottle of seed) were taken immediately and 24 every other day for a total of 6 sampling dates. The 1-pint jars were sealed with silicone and immediately placed in a chamber kept at 28°F. In addition, at each sampling date 4 similar-sized samples were placed in plastic bags filled with water and stored at 38°F. Seed moisture was determined at each sampling date and when samples were removed from dry storage. Seed moisture content was determined by drying for 7 days in a forced air oven at 150°F.

Every 6 months, one subsample from each replicate of each seed moisture was removed from dry storage. Germination measurements were made immediately and after 3 months of additional storage in 38°F water. Germination was also determined for the seeds stored in 38°F water for the entire storage period. Germination was measured by placing 100 seeds into a petri dish filled with water and kept at 72°F. Seeds were determined to be germinated when the coleoptile had grown longer than the length of the seed.

The germination results for the first 15 months of the experiment are presented in Table 8.

Table 8. Germination percentage after dry storage at 6 moisture levels for 6 and 12 months followed by 3 months of storage in water compared to storage in water for 9 and 15 months, St. Paul.

Drying time	Seed moisture	Months dry at 28°F[a]		Months in water at 38°F	
		6	12	9	15
hrs	%	germination %			
0	34.0	65.0	47.0	25.2	0.2
65	25.8	30.2	28.2	25.5	1.0
96	20.4	35.5	33.8	15.5	0.8
148	15.0	37.5	32.0	11.5	0.2
185	11.4	38.2	15.8	8.2	0.5
233	8.6	27.0	16.0	5.5	0.0
Mean		38.9	28.8	15.2	0.4
LSD .05	0.9	18.1	20.8	5.8	NS

[a]Germination obtained after an additional 3 months in water at 38°F; less than 0.5% germination immediately after 6 or 12 months dry storage averaged over the 6 moisture levels.

After 6 months of dry storage and then 3 months of wet storage germination was best at the highest seed moisture, however germination was similar for the other seed moisture levels. This was also true for 12 months of dry storage and then 3 months of wet storage. The average germination was lower after 12 months of dry storage compared to 6 months of dry storage. Storing the seeds dry for a period of time was better than comparable storage length in water. Very little (1% or less) germination was obtained immediately when seeds were removed from dry storage after 6 or 12 months. Cold 38°F water storage for a period of time appears necessary to release dormancy after dry storage even at the higher seed moisture. We will continue to remove samples every 6 months from storage for a period of 3 years.

Based on the 1990 results and those from 1987-89 it appears that wild rice seed could be stored dry for a period of time thus increasing the storage life of wild rice seeds. This would be beneficial in maintaining germplasm for longer periods than we presently can in water storage.

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