Rice Notes

University of California ~ Cooperative Extension

SUTTER/YUBA COUNTIES, 142A GARDEN HIGHWAY, YUBA CITY, CA 95991, (530) 822-7515, FAX (530) 673-5368
SACRAMENTO COUNTY, 4145 BRANCH CENTER ROAD, SACRAMENTO CA 95827, (916) 875-6913, FAX (916) 875-6233
Placer County, 1147 'E' Avenue, Auburn CA 95603, (530) 889-7385, Fax (530) 889-7397

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Early Season Observations

Chris Greer, UCCE Rice Farming Systems Advisor

Rice seeding is off to an early start this season with the extremely dry spring we have had. USDA-NASS estimates that we are 2% planted as of April 21st but I suspect that we are further ahead than that. What a difference it makes when we have a dry spring in which to prepare rice seedbeds. Usually we view this as a luxury. However, too much of a good thing can sometimes get us into trouble. Sometimes we plant rice because we can rather than planting it on a date that will minimize risks and optimize the chance of a successful crop.

This urge to plant early is widespread and contagious in California this season. As of April 22nd there has been a significant amount of rice planted and preparation of other fields seems to be proceeding rapidly. UC Cooperative Extension recommends a preferred seeding date of April 20 to May 25 and an optimum seeding date of May 1 to May 10 for most California rice varieties. Very early planted rice may be subject to environmental conditions that are unfavorable for rice growth and development and possibly predispose the plants to disease and other pests.

My first concern with early planted rice is getting a healthy stand established. Early planted rice is often in jeopardy of struggling through cool temperatures which slow germination and seedling emergence. Under these conditions plants may be predisposed to seedling diseases and rice seed midge under water seeded conditions. The best way to avoid these pests is by planting when temperatures have risen to a point that favors rapid seed germination and stand establishment.

We may also see some sickly looking rice early in the season under cool conditions. That fact is rice is a warm season plant and cold weather interferes with the normal biological functioning of the rice plant. This may often appear as nutrient deficiencies when the plant is not able to regulate the uptake or utilization of nutrients even when they are present in sufficient quantities. The best cure for these "yellows" is the return of warm weather that will promote vigorous growth in your crop.

Good luck with the 2008 rice season!

Phosphate and Rice-field Algae

David Spencer, Ecologist, USDA-ARS Exotic and Invasive Weeds Research Unit

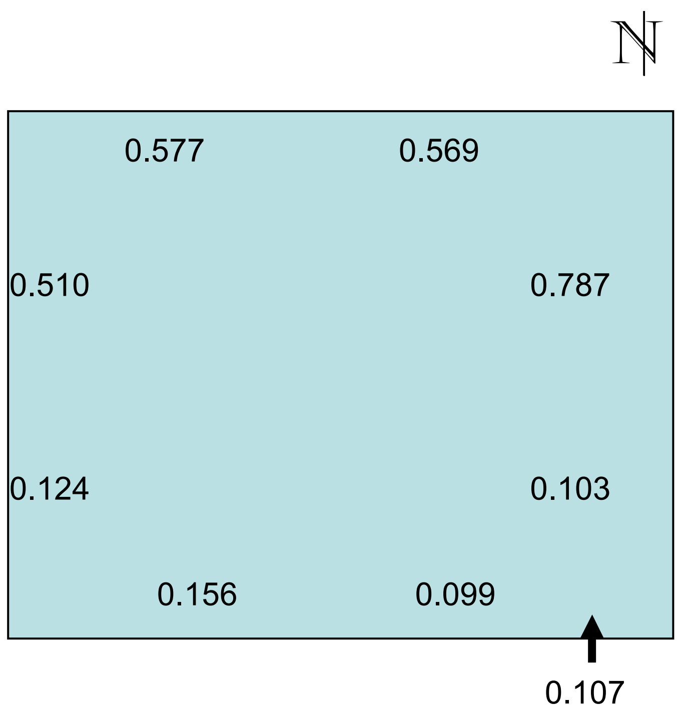
One approach to managing excessive algal growth is to alter the environmental conditions that support this growth. One strategy involves reducing abundance of what is often the limiting nutrient for algae in freshwater systems, phosphate. With the help of cooperators, we collected 63 water samples from rice fields and analyzed the samples for phosphate.

The results showed that phosphate levels ranged from 0.002 to 1.036 parts per million and that just over half (54%) of the water samples had phosphate levels that would limit the growth of the so-called black algae, *Nostoc spongiaeforme*. On May 9, 2007 we collected water samples from a rice field within 48 hours of flooding, but before water had been transferred out of the field. This field had phosphorus applied to the surface, but it was not incorporated into the soil. Phosphate levels in the water increased (up to five times that of the incoming water) as the water moved across a field, from south to north (Figure 1).

These results demonstrate that applying inorganic phosphorus to the field's surface without incorporating it into the soil results in much higher phosphate levels in the water. This inorganic phosphorus would directly support algal growth.

The combined results of an algal growth experiment (that showed the levels of phosphate that limited growth of *Nostoc spongiaeforme)*, the measurements of phosphate levels in initial rice field water samples, and the data showing that phosphate levels in rice field water increased in a field where the phosphorus fertilizer was surface applied but not incorporated, provide strong evidence to support the notion that incorporating phosphorus fertilizer would lead to reduced phosphate levels in rice field water and subsequent reduced growth of algae, especially the so-called "black algae," *Nostoc spongiaeforme.*

Figure 1. Phosphate (mg/L) in rice field water, 48 hours after water started entering the field.



Understanding Nitrogen Losses Due to Early Field Drainage

Luis Espino, Colusa County UCCE Rice Farm Advisor, and
Bruce Linquist, Project Scientist, Plant Sciences Department, UC Davis

Due to recent challenges in weed control, water management during early rice growth stages has suffered significant changes. New herbicides are being used, and some of these are contact herbicides that do not translocate inside the plant killing only the part of the plant covered by the spray. To achieve good weed control with contact herbicides the field must be fully drained to expose weeds to the herbicide.

Early draining and reflooding of rice fields affect the way nitrogen (N) behaves in the soil. N management guidelines for California were developed for fields that were flooded before planting and remained flooded until harvest. Draining and reflooding fields early in the season can cause severe losses of N. To better understand how this happens, it is necessary to understand how N behaves in flooded soils.

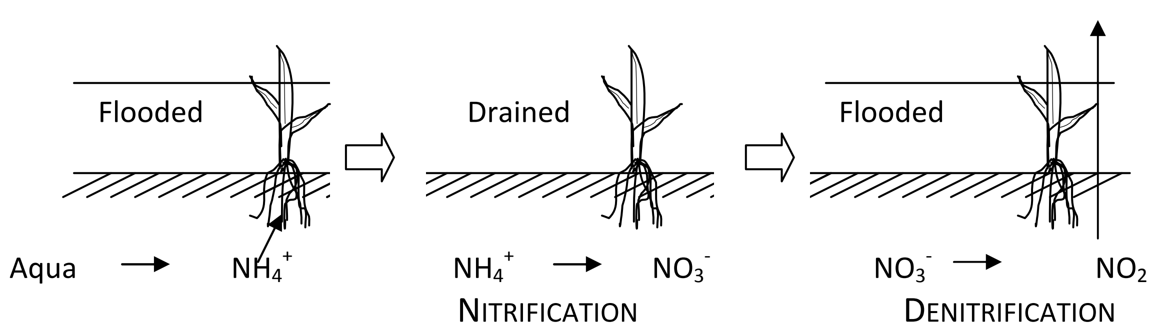
N in flooded soils

N can be taken up by plants in two forms: NH_4^+ (ammonium ions) and NO_3^- (nitrate ions). Any fertilizer applied to the soil needs to change into any of these two N forms to be absorbed by the rice plant. Under anaerobic conditions (lack of oxygen), as in flooded rice fields, NH_4^+ is stable and accumulates, while NO_3^- is very unstable and is lost to the atmosphere. Because of this, under flooded conditions rice mostly uses NH_4^+.

Flood-Drain-Reflood

In California, most fields are fertilized with N in the form of aqua ammonia injected into the soil before planting. Under flooded conditions, aqua produces NH_4^+, which is taken up by the plant. When the field is drained, conditions change from anaerobic to aerobic (presence of oxygen). Under aerobic conditions, soil microbes use the NH_4^+ and turn it into NO_3^-. This process is called NITRIFICATION. Nitrification does not change the amount of N in the soil, just its form. Later, when the field is reflooded, the soil microorganisms can't use oxygen anymore, and instead use NO_3^-, transforming it into NO_2 (nitrous oxide) and other N gases that can be lost to the atmosphere. This process is called DENITRIFICATION.

The whole process is summarized in the following diagram:



Thus, draining a field does not cause loss of N, but just accumulation of NO_3^-. N is only lost after the field is reflooded.

Reducing N loss due to reflooding

Research conducted during 2006 and 2007 at the Rice Experiment Station (Biggs) and in commercial rice fields with different soil types and straw management practices has yielded very interesting results. Experiments showed that during the drain period N in the form of NO_3^- accumulates at an average rate of 1.8 lbs/acre/day. As explained above, after reflooding this N is susceptible to losses due to denitrification. It only took 7 days for the accumulated NO_3^- to disappear from the soil. N uptake and yield reductions were observed in some of the fields that were flooded-drained-reflooded, most likely due to N losses and/or drought stress caused during the drain.

These results show that by minimizing the length of the drain period as much as possible significant N losses can be avoided. Research will continue in the coming years to develop improved strategies of N application in fields where early drains are used.

Straw Incorporation and Nitrogen Management*

Luis Espino, Colusa County UCCE Rice Farm Advisor

The reduction of rice straw burning brought many changes in the way straw is managed in California rice fields. Research has been conducted to determine how changes in straw management impact other areas of rice production, such as soil fertility. In many fields rice straw is being incorporated after grain harvest while in others straw is being removed and used out of the field. Research has shown that the incorporation or rice straw can have beneficial effects on soil fertility. A study conducted in the Sacramento Valley concluded that after 5 years of straw incorporation, N application rates could be reduced 25 lbs/acre.

Rice straw can have significant amounts of macro and micro nutrients:

Nutrient content of rice straw in lbs/acre (assumes 10,000 lbs of straw/acre)

N	P	K	S	Ca	Mg	Na	Cl	B	Zn	Cu	Mo
68	14	77	10	28	18	78	8	0.15	0.41	0.31	0.02

When incorporating rice straw, many of the nutrients extracted by the rice plant are being returned to the soil and, after the straw is decomposed, will be available for plant uptake. Straw incorporation increases microbial biomass N, that is, N being used by microbes in partially broken-down straw residues. It is this portion of N that will be readily available for crop uptake.

After a few years of straw incorporation, a fraction of the N from synthetic fertilizers (fertilizer N) applied to the field is “captured” by soil microorganisms. These microorganisms compete with the plant to use the fertilizer N. At the same time, N is being released from the microbial biomass formed by the incorporation of rice straw, and this N replaces the fertilizer N in the soil solution and is taken up by the rice plant. Research has shown that when straw is incorporated more fertilizer N will be available after one season of being applied than when straw is removed.

Straw incorporation also can affect weed density. When compared to burned fields, fields where straw was incorporated had higher density of grassy weeds, especially watergrass. However, when fields were winter flooded, watergrass density was reduced. It is thought that this reduction may be due to the foraging activity of waterfowl.

*Adapted from Bird, J. A., A. J. Eagle, W. R. Horwath, M. W. Hair, E. E. Zilbert and C. van Kessel. 2002. Long-term studies find benefits, challenges in alternative rice straw management. California Agriculture 56: 69-75.