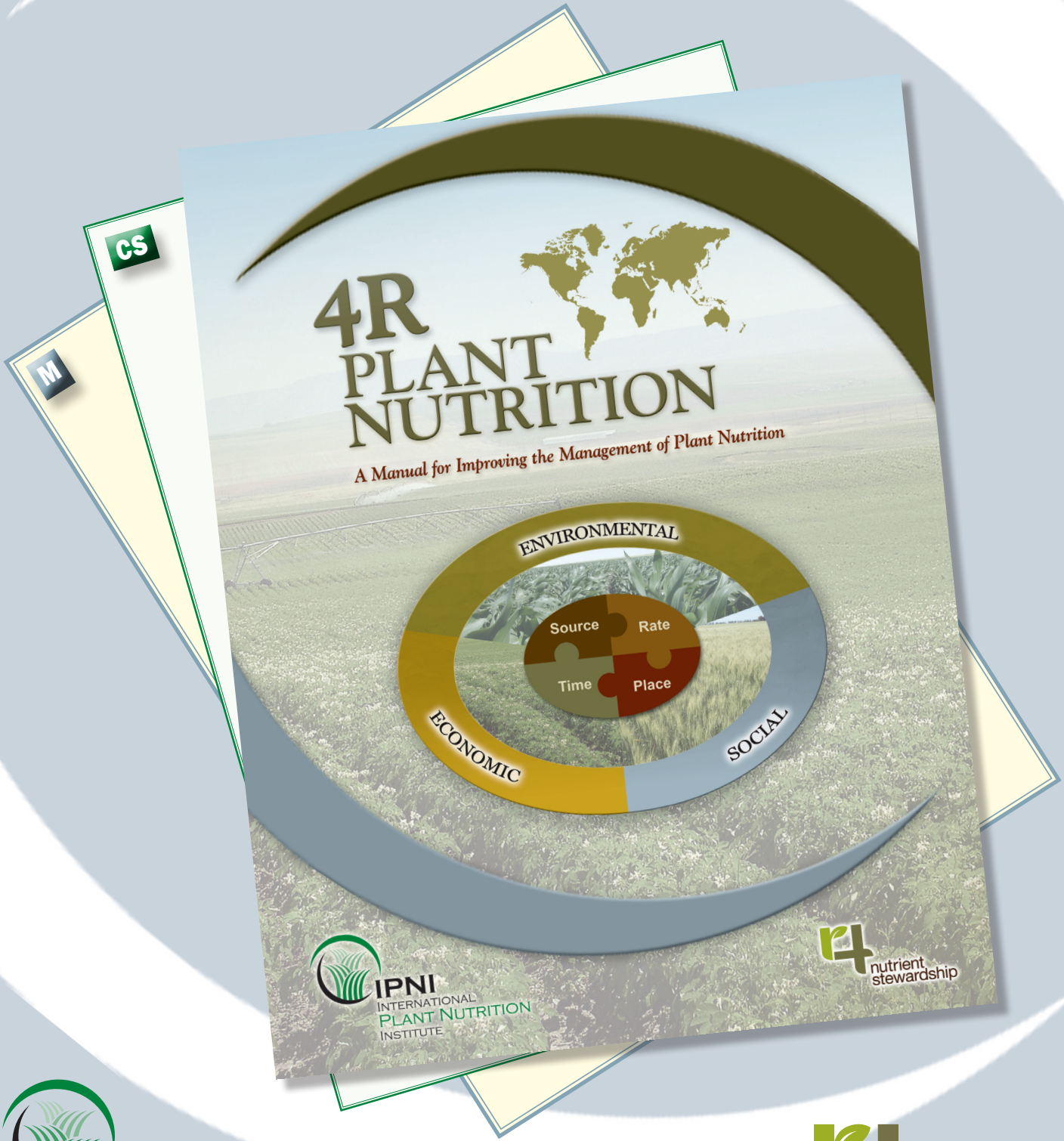
4R PLANT NUTRITION

Guidelines for Modules and Case Studies



IPNI
INTERNATIONAL
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INSTITUTE

nutrient
stewardship

Guidelines for Modules and Case Studies August 2013

Contributions are invited worldwide from qualified users of the Manual. Qualified individuals include certified professionals in crop advising and agronomy (e.g., Certified Crop Advisers), extension specialists in soil fertility, and research scientists at universities and research institutions.

1. The objective is to describe specific practices related to principles explained in one of the chapters of the Manual, or to provide background information supporting the principles.
2. Title – should express in a nutshell the "take-home" learning objective, identify the crop, nutrient, and country, and be brief (12 words or less).
3. Write text using an active voice (e.g., "farmers applied N" instead of "N was applied by farmers") as much as possible, and focus on the main points related to the learning objective.
4. Ensure the source, rate, time and place of nutrient application are adequately described.
5. Try to make clear the relationship between the management practice and the resulting improvement in nutrient-related sustainability performance.
6. Make each item self-explanatory. The manual text cannot refer to the item, but the item can refer to the manual text if necessary.
7. Use metric, U.S. or local units, as appropriate for the intended audience. Submit data for charts and tables in spreadsheet files to allow full precision for making conversions.
8. All items submitted will be subject to IPNI scientific and editorial review.
9. Consult Style Notes for Better Crops for details of style, and page A-9 of the 4R Plant Nutrition Manual for abbreviations. **All submissions can be sent to 4Rmanual@ipni.net**.
10. References – Include within the page limit, and keep them as simple as possible; in most cases author-date-source only. It is presumed that the item will sufficiently describe the study to the extent that the reference title would be redundant. Hyperlinks to web resources will be available in electronic formats, but not shown in text.
11. Author recognition: Name, affiliation and country of one corresponding author is to be included at the bottom of the first page, with date of submission.
12. Editorial process: Articles are reviewed by the IPNI VP responsible for the region to which they refer (Americas and Oceania, Eastern Europe/Central Asia and Middle East, or Asia and Africa).
13. Publication: Once reviewed, accepted, and formatted, a PDF version is posted online immediately, and can be included in subsequent future printings of the 4R Plant Nutrition Manual.
14. Policy on proprietary products, tools and programs: The IPNI policy is patterned after those followed by peer reviewed journals. Use generic terms without trade names whenever possible. However, use of proprietary names is acceptable and advised in certain situations. More specifically:
    a. Publication or project titles should be free of proprietary names.
    b. Authors should consider whether the particular product, tool or program is essential to the outcome of the research or to generate the specific impact being discussed.
    c. Articles reporting results of studies designed specifically to compare proprietary products will normally need to indicate both trade names and company names.
    d. When proprietary names are included in a module or case study, a disclaimer should also be included. The following wording is recommended: "Trade names and company names are included for the benefit of the reader and do not imply any endorsement or preferential treatment of the product by the authors or IPNI."
    e. Any claims made or suggested for efficacy of a specific product, tool or program must be supported by citation of a relevant publication in a recognized scientific peer-reviewed journal.

Modules

Modules aim to provide experimental data or specific technical information related to the scientific principles discussed in one of the chapters of the 4R Plant Nutrition Manual. Their purpose is to demonstrate that the principles relate to effects that have been measured in the real world.

1. Length of one-half page per module preferred; one full page possible if necessary.
2. Provide adequate background information to serve as basis for expectation of the size of response shown. For example, give soil test levels for K when crop yield response to applied K is shown, or provide information on the size of a rainfall event if nutrient losses in runoff are shown.
3. Include simple self-explanatory tables and/or figures, with captions.

Sample half-page module for Chapter 5, Right Time:

Module 5.3-1 Spring applied N increases N recovery and profit for corn in southern Minnesota. A long-term U.S. Corn Belt study conducted in Waseca, MN compared fall application of ammonia with and without a nitrification inhibitor (N-Serve, or nitrapyrin) to spring preplant application without the nitrification inhibitor. The table below shows the result of this 15-year study. In short, the data show that applications of N (as ammonia) in the late fall with the nitrification inhibitor and spring preplant were best management practices. However, it should be noted that when spring conditions were wet the spring application resulted in substantially greater yield and profit than fall+N-Serve. Overall, the least risky timing option was spring preplant, followed by fall+N-Serve, with fall (no inhibitor) being the most risky and least efficient. Thus, N application for corn should be avoided in areas with warm/open winters, and where it is appropriate it should be delayed until soil temperature is below 50°F and expected to continue cooling so as to slow nitrification in the fall and avoid increased nitrate leaching and/or denitrification. Use of a nitrification inhibitor can help further delay nitrification, but even with an inhibitor, fall application, where appropriate, should be delayed until soil temperature cools. **Source:** Randall, G. 2008. *In* Proc. 20th Annual Integrated Crop Manag. Conf., Dec. 10-11, Iowa State Univ., Ames. p. 225-235.

Parameter (mean of 15 years, 1987 to 2001)	Time of N Application		
	Fall	Fall + N-Serve	Spring
Yield (bu/A)	144	153	156
Economic return over fall N ($/A/yr)[1]	-- --	$28	$48
Flow-weighted NO_3-N (mg/L) in tile drainage water	14.1	12.2	12
Nitrogen recovery in grain (%)[2]	38	46	47

[1] Based on N @ $0.70/lb N; N-Serve = $8.00/A; Corn = $4.00/bu
[2] Nitrogen content of the corn grain as a percent of the amount of fertilizer N applied.

Trade names are included for the benefit of the reader and do not imply any endorsement or preferential treatment of the product by the authors or IPNI.

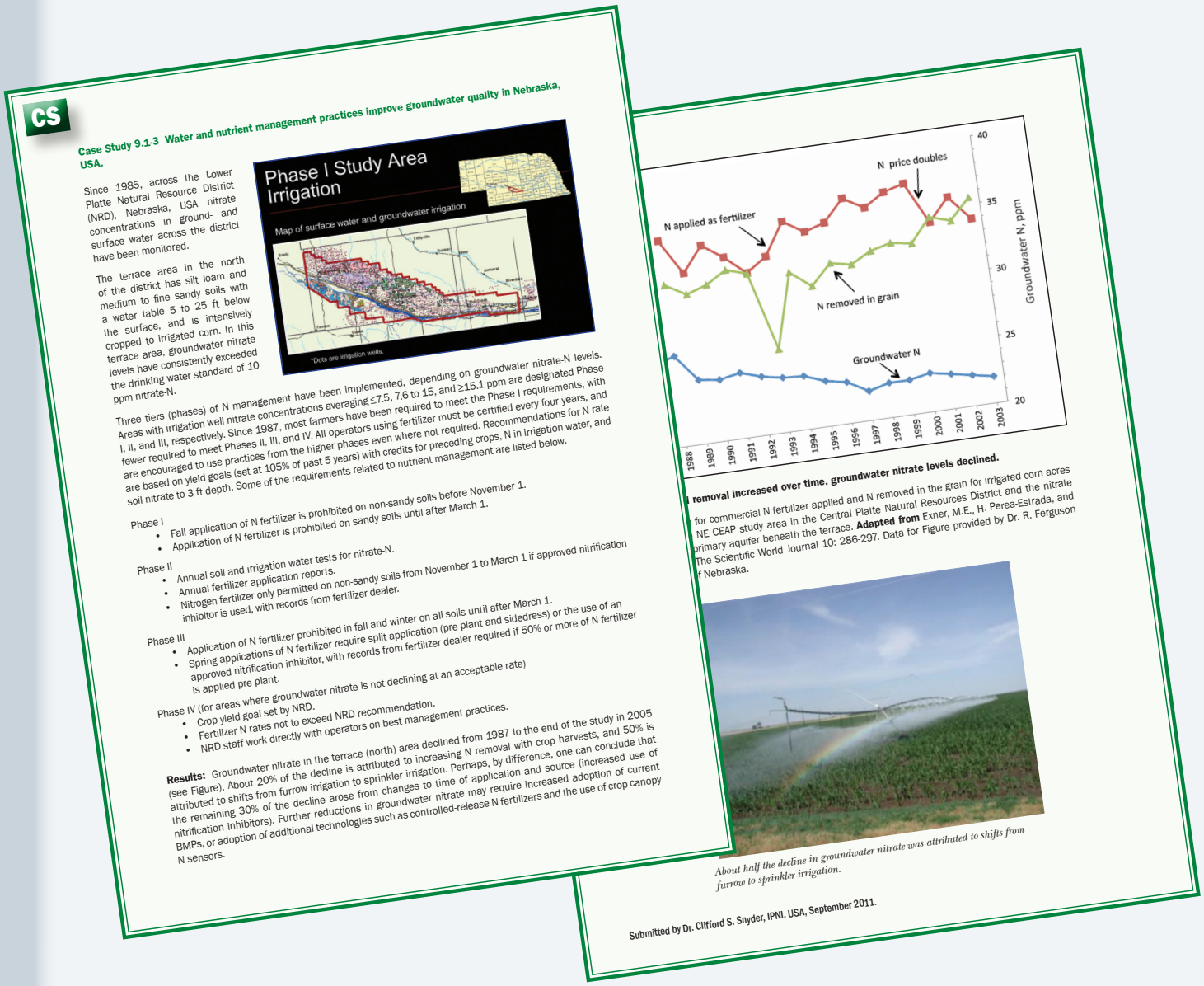
Submitted by Dr. W. Mike Stewart, IPNI, USA, February 2011.

Case Studies

Case studies aim to describe situations in which the application of scientific principles related to nutrient stewardship has helped to resolve real-world issues. They should relate to the principles discussed in one of the chapters of the 4R Plant Nutrition Manual. These case studies may range in scale. Some may describe changes implemented by a producer or a producer and adviser on a single field or farm. Some may involve larger groups of people or organizations workings across a region or watershed. All should describe how nutrient application practices relate to outcomes in terms of economic, environmental and social performance of a plant- or crop-based production system. Keeping them brief, to the point, and memorable facilitates their use in training. Where documentation of detail is required, reference to longer articles in Better Crops or peer-reviewed scientific publications is encouraged.

1. Length: one page or two pages.
2. Keep paragraphs short, and give a heading for every 2-4 paragraphs.
3. Include photos and/or tables and/or figures, with captions.

Sample two-page case study for Chapter 9, Nutrient Management Planning and Accountability:



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Case Study 9.1-3 Water and nutrient management practices improve groundwater quality in Nebraska, USA.

Since 1985, across the Lower Platte Natural Resource District (NRD), Nebraska, USA nitrate concentrations in ground- and surface water across the district have been monitored.

The terrace area in the north of the district has silt loam and medium to fine sandy soils with a water table 5 to 25 ft below the surface, and is intensively cropped to irrigated corn. In this terrace area, groundwater nitrate levels have consistently exceeded the drinking water standard of 10 ppm nitrate-N.

Phase I Study Area Irrigation

Map of surface water and groundwater irrigation

*Dots are irrigation wells.

Three tiers (phases) of N management have been implemented, depending on groundwater nitrate-N levels. Areas with irrigation well nitrate concentrations averaging ≤7.5, 7.6 to 15, and ≥15.1 ppm are designated Phase I, II, and III, respectively. Since 1987, most farmers have been required to meet the Phase I requirements, with fewer required to meet Phases II, III, and IV. All operators using fertilizer must be certified every four years, and are encouraged to use practices from the higher phases even where not required. Recommendations for N rate are based on yield goals (set at 105% of past 5 years) with credits for preceding crops, N in irrigation water, and soil nitrate to 3 ft depth. Some of the requirements related to nutrient management are listed below.

Phase I
- Fall application of N fertilizer is prohibited on non-sandy soils before November 1.
- Application of N fertilizer is prohibited on sandy soils until after March 1.

Phase II
- Annual soil and irrigation water tests for nitrate-N.
- Annual fertilizer application reports.
- Nitrogen fertilizer only permitted on non-sandy soils from November 1 to March 1 if approved nitrification inhibitor is used, with records from fertilizer dealer.

Phase III
- Application of N fertilizer prohibited in fall and winter on all soils until after March 1.
- Spring applications of N fertilizer require split application (pre-plant and sidedress) or the use of an approved nitrification inhibitor, with records from fertilizer dealer required if 50% or more of N fertilizer is applied pre-plant.

Phase IV (for areas where groundwater nitrate is not declining at an acceptable rate)
- Crop yield goal set by NRD.
- Fertilizer N rates not to exceed NRD recommendation.
- NRD staff work directly with operators on best management practices.

Results: Groundwater nitrate in the terrace (north) area declined from 1987 to the end of the study in 2005 (see Figure). About 20% of the decline is attributed to increasing N removal with crop harvests, and 50% is attributed to shifts from furrow irrigation to sprinkler irrigation. Perhaps, by difference, one can conclude that the remaining 30% of the decline arose from changes to time of application and source (increased use of nitrification inhibitors). Further reductions in groundwater nitrate may require increased adoption of current BMPs, or adoption of additional technologies such as controlled-release N fertilizers and the use of crop canopy N sensors.

N price doubles
N applied as fertilizer
N removed in grain
Groundwater N
Groundwater N, ppm
40
35
30
25
20
1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003

removal increased over time, groundwater nitrate levels declined.

for commercial N fertilizer applied and N removed in the grain for irrigated corn acres NE CEAP study area in the Central Platte Natural Resources District and the nitrate primary aquifer beneath the terrace. **Adapted from** Exner, M.E., H. Perea-Estrada, and The Scientific World Journal 10: 286-297. Data for Figure provided by Dr. R. Ferguson f Nebraska.

About half the decline in groundwater nitrate was attributed to shifts from furrow to sprinkler irrigation.

Submitted by Dr. Clifford S. Snyder, IPNI, USA, September 2011.