Cooperative Extension
Colorado State University, Fort Collins, Colorado 80523

Colorado State University

AGRON-O-GRAM

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THE GUIDE TO FERTILIZER RECOMMENDATIONS IN COLORADO REVISED

The Guide to Fertilizer Recommendations in Colorado, Colorado State University Coop. Ext. Bulletin No. XCM-37 (1991), has just been revised. A file copy of the Guide is being sent to each county by the Bulletin Room. Additional copies can be ordered by County Extension Offices and Departments for \$3.25 each. The Guide will be sold to the public for \$4.75 each (including postage).

The revised Fertilizer Guide has a number of improvements. The tables have been organized by crop (irrigated and/or dryland). The old guide had an irrigated crops section and a dryland crops section which required referring back and forth to compare fertilizer recommendations for certain crops. New tables have been developed for *Grass, Grass-Legume Hay, Pasture and Mountain Meadows* (pages 12-13), as well as tables for *Revegetation of Disturbed Lands* (page 15). Recent Department of Agronomy research has improved fertilizer recommendations for Millet (*Proso and Pearl*, page 18) and *Spring Nitrogen Recommendations for Winter Wheat* (page 27). The new guide has recommendation tables for *Vegetables* (page 28-30) and *Turf* (page 32), making the guide considerably more useful.

Sound fertilizer recommendations require continual soil test correlation work, necessitating minor fertilizer guide changes. In addition, a three year soil test summary of farm samples is included in the Appendix.

It is our intention to revise the fertilizer guide every two or three years. Suggestions for improvement are welcome. (Follett)

WHEN TO REPLACE YOUR ALFALFA STAND

When should I replace my old alfalfa stand is a question asked by alfalfa producers. Due to the high cost of establishing a new stand, an old stand might yield somewhat less and still be the most profitable, assuming hay quality is equal. The decision of whether to replace an old alfalfa stand should be determined by several factors, with economics being the highest priority.

The following equation, provided by Oran Hesterman of Michigan State University, is designed to tell the minimum necessary yield from and old stand to at least equal the profit from a new stand:

$$HY_{OS}=\frac{(HP\times HY_{NS})-VCP_{NS}+VCP_{OS}-EC/n}{HP}$$

Where:

HP =anticipated hay price
HY_{OS} =expected old stand yield
HY_{NS} =expected new stand yield
VCP_{OS}=variable cost (old stand)
VCP_{NS}=variable cost (new stand)
EC =establishment costs
n =life of new stand

For example, assume a $80/T hay price and an average yield of 4.5 T/acre from a new stand lasting 5 years. These are reasonable estimates if the stand is properly maintained. Also assume that variable costs for the old and new stand are similar ($159/acre). This coonsists of $35/acre for fertilizer, $24/acre for irrigation, and harvest costs of $25/acre for each of 4 cuttings. Establishment costs of $58/acre, consisting of $36 for seed, $10 for tillage and seeding, and $12 for herbicide. If these numbers are entered into the above equation the following results are obtained:

$$HY_{OS}=\frac{(\$80\times4.5)-\$159+\$159-\$58/5}{\$80}$$

HY_{OS} = 4.4 T/acre

This means that if you expect to harvest at least 4.4 T/acre from the existing stand, your most profitable decision is to maintain the stand for another year. Obviously, information from your own field should be used in making these decision. A PC software program called Reseed, utilizing these functions, is available from Michigan State University Cooperative Extension Service Software Distribution Center, East Lansing, MI, 48824. The program requests the user to input information about the existing stand and new stand as well as accounting for the changing value of money when making the calculations.

The agronomic traits which determine whether to reseed are stand age, stand density, stand uniformity, and weediness. Most alfalfa stands, if seeded properly (using a well-adapted variety) on well drained soils, fertilized and irrigated adequately, and if not cut too intensively, should produce respectable yields for several years. However, sometimes longevity is not a good indicator of when to reseed. Stands of 10 years in age might produce 8 T/acre while three-year-old stands may yield only 2 T/acre. When alfalfa is seeded at 12 lbs/acre of PLS, approximately 70 seeds/ft^2 are planted. It's not uncommon for 20 to 40 plants/ft^2 to establish in the seeding year. What's the minimum number of plants required to maintain a productive stand? Experience has shown that approximately 2-5 plants/ft^2 are needed to maintain yields and compete with weeds. However, varietal resistance to pests is important in determining minimum plants required to maintain a stand. Stand uniformity is also important in determining when to reseed. If areas exist within fields with few plants, these areas will be prone to weed invasion. Since weeds reduce forage quality, it may be advisable to reseed these fields.

(Adapted from an article by Oran Hesterman in the spring 1989 Haymaker, a publication of W-L Research, Inc., Bakersfield, CA) (Shanahan)

SUSTAINABLE DRYLAND AGROECOSYSTEMS

Thinking in terms of ecosystems is relatively new for agronomists, soil scientists and growers. An agroecosystem implies that mankind has manipulated the ecosystem for purposes other than the processes of nature. Fencing, rotational and deferred grazing and fertilization are all examples of conversion to agroecosystems.

The advantage of thinking in these broader terms is that one considers the "whole" and the relationships of all its "parts". On the other hand, as technology becomes more and more complex, the possibility of farmers integrating all the "parts" into a system for their farms becomes more difficult.

Thinking in terms of agroecosystems allows direct questions about long-term sustainability of current and future practices. Factors involved range from erosion control to economics, and one must consider short-term survival as well as sustainability over the longer term.

The agroecosystem dominating the Great Plains has been wheat and other small grain monoculture with summer fallowing. The poor quality of this agroecosystem has been building for years. Cultivation practices in many cases have left the soil bare for much of the summer fallow period, with little protection during early growth stages, causing erosion by wind and water. Even without fallow periods, maximum tillage has encouraged soil organic matter loss. (Systems containing fallow decrease soil organic matter content faster than does continuous cropping).

Technology advances in tillage practices and herbicide use have doubled water storage and crop yield in fallow systems, but precipitation use efficiency is still low. Sixty percent of precipitation during the fallow period is lost.

Summer fallowing in semiarid regions has allowed movement of large quantities of nitrate-N to soil layers below the root zones of the common dryland crop plants. Literally hundreds of pounds of nitrate-N now lie in the vadose zone of our Central Plains soils. Continued fallow with improved water conservation techniques will move this nitrate to deep soil profiles and water tables.

The use of monoculture wheat has resulted in increased grassy weed populations such as jointed goatgrass, downy brome, especially when conservation tillage practices are adopted for erosion control.

Now, what can we do to use precipitation more efficiently and provide an economically sustainable and environmentally safe future for ourselves and our region?

Research addressing these questions involves application of crop rotations with decreasing amounts of summer fallow to a selected climate gradient and across a soil continuum in each climate zone. All rotations are practiced with the best water-conserving techniques available, involving no-till seedbed preparation and minimal disturbance at planting. Twenty years ago, research showed that changing from moldboard plowing to no-till added about 6 extra inches of stored water. During the summer, some soils reached field capacity well before wheat seeding, promoting nitrate-N loss. The solution? Planting a spring crop would take advantage of extra-stored water.

Increasing crop intensity in three- and four-year rotations has increased the amount of crop residue returned to the soil. Organic matter levels in longer rotations have begun to improve when compared to wheat-fallow. These increases are particularly interesting because at the time of sampling, the rotations had only been in place for four years.

Using the extra water stored under no-till increases grain production/inch of precipitation if rotations other than wheat-fallow are used (Figure 1).

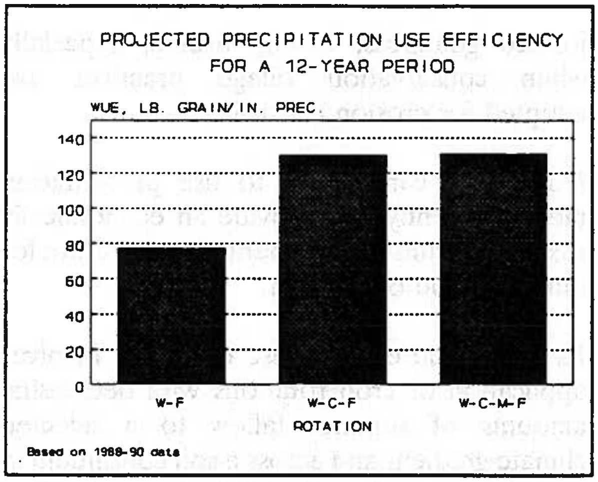

Figure 1

Using 12-year yield projections, the three- and four-year rotation are projected to have 75% more grain yield than the W-F rotation (Figure 2) - showing effectively doubled precipitation use efficiency.

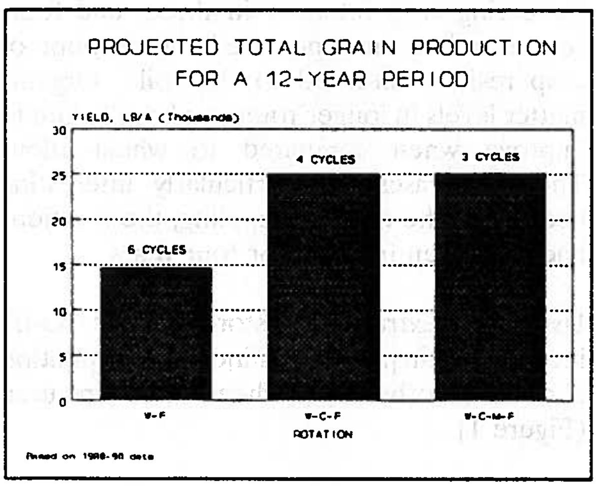

Figure 2

No matter how environmentally sound or soil conserving a system is, economic stability is of equal importance. Using average grain prices, we calculated the gross return for each rotation for the projected 12 years (Table 1).

Table 1 Average yields from no-till cropping systems, 1988-90.

Rotation	Wheat	Yields Corn	Millet
	- - - - - - - - -	Bu/A	- - - - - - - -
W-F	41		
W-C-F	42	67	
W-C-M-F	46	67	38

In conclusion, results to date in our dryland agroecosystem research indicate that conversion to no-till practices necessitate a change to more intense crop rotations with fewer fallow periods. Precipitation use efficiency can be doubled with the extended rotations, and these changes can also decrease weed problems, conserve soil, even restore organic matter to some extent--and provide larger economic return to the farmer (Table 2).

Table 2 Projected net income comparison for dryland crop rotation.

Comparison	Projected % Increase in Net Income
Tilled W-F vs No-Till W-C-F	67
Tilled W-F vs No-Till W-C-M-F	120
No-Till W-C-F vs No-Till W-C-M-F	32

Adapted from article by: Kate Jones, Colorado Conservation Tillage Assn. News (Jan, 1991). Research Information from G.A. Peterson and D.G. Westfall, Dept. of Agronomy, Colorado State Univ. (Follett)

WATER QUALITY EXTENSION

The Extension Service's effort in groundwater quality has been expanded by the involvement of Dick Tinsley as the Water Quality

Extension Specialist. Dick is responsible for implementing Senate Bill 126. Dick has been with CSU's international programs for over 11 years. Over the next several months, he will be meeting with various groups in an effort to develop the "Best Management Practices" (BMPs) for groundwater protection. He has already met with groups in Montrose and Alamosa. Dick's concerns are mostly nitrates, but does include pesticides. He is interested in ways of reducing the amount of chemicals applied and reducing the potential for chemical movement into the watertable by increasing the irrigation application efficiency. His approach to developing the BMPs is to facilitate discussions with user groups. This will include growers, recreational managers, lawn care contractors, water users, etc. During these meetings Dick likes to review current fertilizer and irrigation practices for opportunities for making improvements. He is very concerned that the BMPs developed be feasible and not erode grower profit margins. It is expected that most BMPs will be consistent with the current practices of most progressive growers. Dick would appreciate the opportunity to meeting with any of these groups. If included in a program, he has a 30 minute presentation on the provision of Senate Bill 126, and would like an opportunity for about a 45-60 minute workshop discussion. (Croissant)

THE USE OF RANGE TESTS

Most experiments are designed to evaluate multiple treatments. There are several ways to make statements regarding the significance of difference among the set of treatment means. If you want to make specific preplanned comparisons among the set of possible comparisons, the LSD or contrast comparison techniques are good. However, often the researcher can not make preplanned comparisons because he/she does not have specific treatments to compare to. An example of this type of experiment would be a variety trial, in which there is no check variety, and the researcher just wants to choose the best variety. In these situations, a range test should be used to group the range of means which are not significantly different, rather than to declare significance between specific pairs of means.

The most common range tests are the 1) Duncan's Multiple Range Test (DMR), 2) Student-Newman-Keul's test (SNK), and 3) Tukey's w procedure. The basic difference between these range tests and the LSD is that the critical value used to declare significance increases as the number of means increases. Therefore, the critical value to declare significance between the largest and smallest mean is larger for range tests. The larger critical value protects the researcher from declaring significance between means, when in fact the means are not significantly different. Each range test protects against false declarations of significance somewhat differently. Thus, they can be ranked for their ability for protection against false declarations of significance. That ranking is Tukey's > SNK > DMR. One must be cautious about being too conservative about false significance, because as the test becomes more protective against false declaration of significance, it also becomes unable to detect significant differences when in fact the differences are real. Hence, there is a trade off between being too conservative against stating false significance and not being able to detect real differences.

The formulas for each of these range tests are given in most basic experimental design texts such as *Principles and Procedures of Statistics* by Steel and Torrie. Range tests are as easy to compute as the LSD. Therefore, one should use the appropriate test to determine significance among a group of means and/or consult with a statistician when there is a question as to which is the most appropriate test to use to separate a group of means statistically. (Brick)

SOIL MICRONUTRIENTS

The Soil Testing Laboratory frequently receives inquiries about what is considered a high level of micronutrients in soil. The concentration of micronutrients such as zinc (Zn), iron (Fe), manganese (Mn), and copper (Cu) have to be quite high before they become toxic. Zinc toxicity in soils, for example, occurs at a concentration of about 70 ppm as determined from an ammonium bicarbonate-DTPA extract. Occasionally, the Soils Lab has received samples with Zn levels at 20-40 ppm; however, the effect on plant growth would be minimal.

There are few toxic effects from high Fe due to the rapid conversion of applied Fe to insoluble, unavailable forms of Fe in the soil. Soils can frequently contain 3-5% total Fe and still have a minimal effect on plant growth. Toxicity due to Mn or Cu is generally not found in soils where the pH is above 6.5. Even levels of 20-30 ppm of Cu or Mn do not appear to be toxic to plants. Most toxicity due to Mn occurs as a result of over-fertilization with Mn fertilizers. Toxic levels of Cu in the soil could result from extensive use of copper-based fungicides.

It is rare to extract several hundred ppm of any of the micronutrients from calcareous soils. However, it is not uncommon to obtain levels of micronutrients in the 30-50 ppm range, especially in horticultural soils. Soils with 30-50 ppm Zn, Fe, Mn or Cu should not present too much problem with most plants. Care should be taken not to add more micronutrients either as fertilizer or organic matter if the micronutrient content is high in the soil. If the micronutrient content of a calcareous soil is high, the levels of other nutrients such as N, P, and K may also be high, indicating the sufficient fertilizer or organic matter was added to the soil. (Self)

AGRON-O-GRAM Survey

On the last page is a very short survey requesting information on the content of subsequent newsletters. Please take a few minutes to respond to it and return to me. (Croissant)

Where trade names are used, no discrimination is intended, and no endorsement by the Cooperative Extension Service is implied.

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Sincerely,

Robert L Croissant

Robert L. Croissant
Extension Agronomist - Crops

AGRON-O-GRAM SURVEY

The following survey requests information so that we may serve you better with the **Agron-O-Gram** newsletter. Please check the appropriate places and make future topic suggestions, then return the survey to **Bob Croissant, Agronomy Department, CSU, Ft. Collins CO 80523.** Thanks for your ideas and needs. Name and county are optional.

Our intended **Agron-O-Gram** information use is:
(Check all those appropriate and rank eg., 1 highest).

☐ Quick brief topics for radio or TV.

☐ Complete topics for newsletters, columns, handouts.

☐ Detailed studies and reports on specific topics.

☐ Other______________________________________

Specific topics I need most: (Please list and rank, 1 highest)

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