Soil Conditioning Rating Indices for Major Irrigated and Non-Irrigated Crops grown in the Western United States

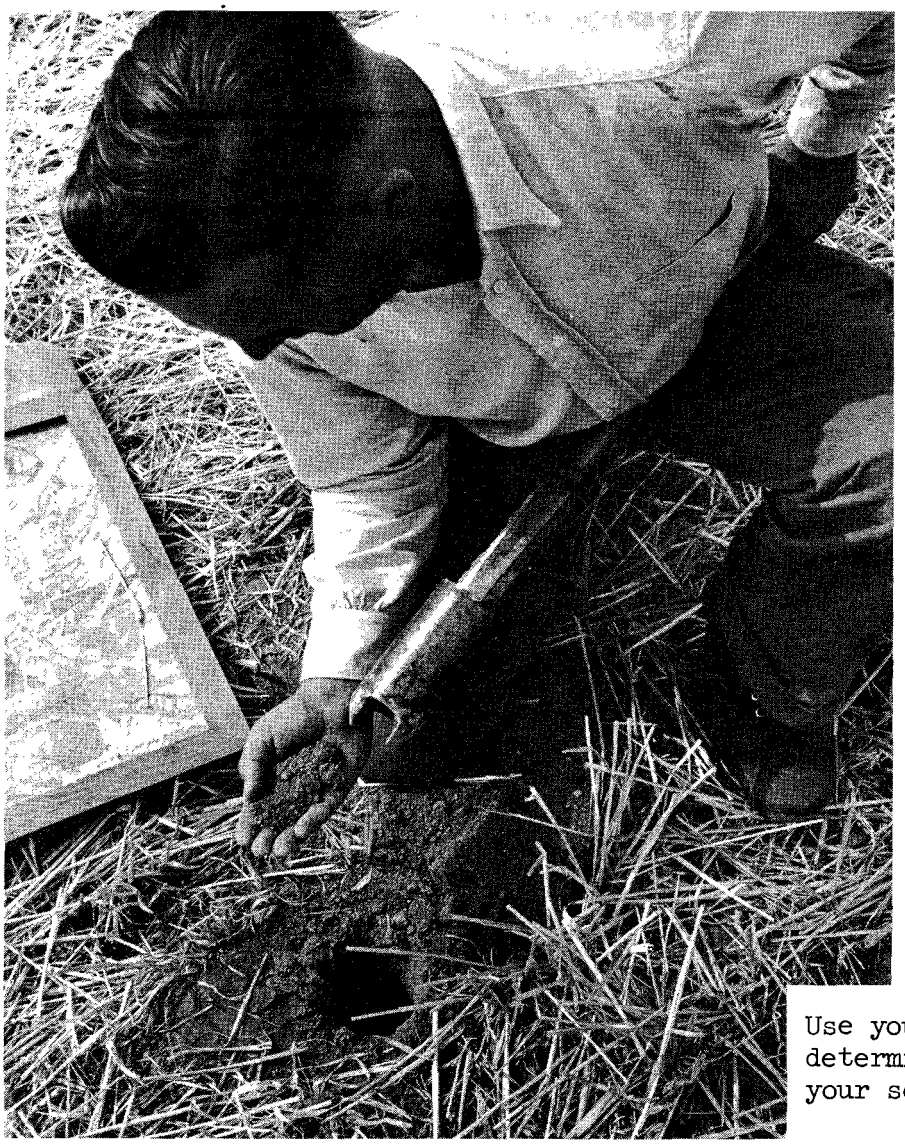
Grass-legume sod crops maintain and improve soil conditions.

5-1634-10

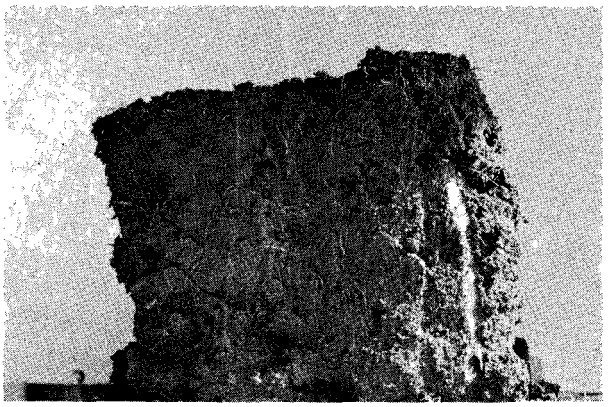
SOIL CONSERVATION SERVICE · U.S. DEPARTMENT of AGRICULTURE

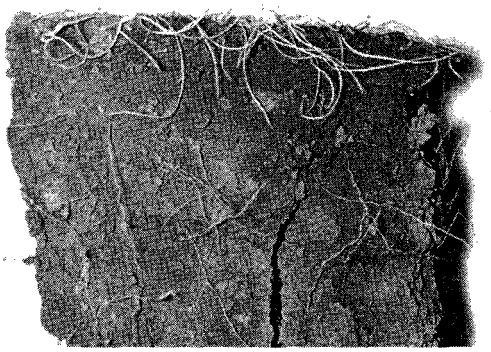
WEST TECHNICAL SERVICE CENTER, PORTLAND, OREGON
CONSERVATION AGRONOMY TECHNICAL NOTE NO. 27

USDA-SCS-PORTLAND, OREG. 1974



Use your soil survey to help determine the condition of your soil. B-790-4





Dig a hole and see what condition your soil is in and what is happening to the roots of the crops that are growing.

Photo at left above shows soil in poor physical condition.
Photo at right above shows good soil structure in well managed irrigated pasture.

Criteria for Evaluating the Quality of California Cropping Systems

California field office Technical Guides provide two sets of criteria for evaluating the adequacy of cropping systems as follows:

1. On cropland with sheet and rill erosion as a problem or potential problem, the Universal Soil Loss Equation guidelines presented in Technical Guide Section II-D-2 will be used.

2. On cropland without significant sheet and rill erosion problems, the procedure outlined in the following guidelines for using Soil Conditioning Ratings will be used to develop acceptable cropping system alternatives.

When using either of the guidelines listed above, wind erosion may also be a significant problem to be considered separately in developing adequate cropping systems, using Crop Residue Management, Field Windbreaks, or other wind erosion control measures to keep soil movement from wind within acceptable limits.

Detailed information needed for applying soil conditioning rating methods to develop adequate cropping systems is contained in "Soil Conditioning Rating Indices for Major Irrigated and Non-Irrigated Crops Grown in the Western United States", West Technical Service Center, Portland, Oregon Conservation Agronomy Technical Note No. 27. The latest reprint of this publication dated March 1974 was issued to all California SCS offices attached to California Agronomy Technical Note No. 5 (Rev. 2) May 1974.

Forms CF-CONS-9 and 10, 8/75, have been developed for applying Soil Conditioning Ratings to conservation planning on California cropland. The back of CF-CONS-9 provides instructions for using the form. CF-CONS-10 is a work sheet for developing soil conditioning ratings for various cropping systems. Example forms follow.

Field office personnel may expedite use of "Soil Conditioning Ratings" by using CF-CONS-10 to consolidate information needed for evaluating crop rotations most commonly used in the area, arranging applicable plus and minus factors for easy reference. Forms developed in this manner could become a part of the field office Technical Guide and serve as tables for developing satisfactory cropping systems, using individual CF-CONS-10's for each crop rotation. Once forms were developed for all commonly used cropping sequences, the basic reference (T.S.C. Agronomy TN No. 27) would be needed only for uncommonly used cropping systems or other unusual circumstances not documented on the forms developed for commonly used sequences.

_____, CA Field Office
Technical Guide Section II-D-3
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
California

CF-CONS-9
8/75

CROPPING SYSTEM EVALUATION

RESOURCE CONSERVATION DISTRICT _____ FIELD OFFICE _____

COOPERATOR _____ COMMUNITY NO. _____

FIELD NO. _____ DATE _____ TECHNICIAN _____

The following rating system is a guide in evaluating a cropping system to determine if it is improving, maintaining or deteriorating the soil. The effect of the cropping system on erosion is not rated.

This system is useful in evaluating suitable alternative crop combinations (rotations) and the management of each crop grown, including the amount of crop residue produced, the manure and fertilizer used, and the tillage operations that are limited to those that are properly timed and essential to produce a crop and prevent soil damage.

The soil conditioning ratings are comparative plus or minus values assigned to crop and soil treatments which gives their relative soil-improving (+) or soil-deteriorating (-) effect for any crop combination.

A conservation cropping system has a soil condition rating of (0.0) or (+).

(1) An evaluation of your present cropping system is as follows:

_____

_____

_____

_____

_____

_____

(2) This cropping system shows a rating of (+) (-)_____.

A plus factor indicates a conservation cropping system which is maintaining or improving the physical, chemical and biological condition of the soil for sustained production and use. A minus factor indicates that the system has an adverse effect and suitable alternatives should be considered.

(3) Comments or Alternatives that can strengthen the cropping system:

_____

_____

_____

INSTRUCTIONS FOR THE CROPPING SYSTEM EVALUATION RECORD
(Form CF-CONS-9)

This Evaluation Record is used in planning to explain the strength or weakness of a cropping system.

(1) AN EVALUATION OF YOUR PRESENT CROPPING SYSTEM: Information that has been developed in the evaluation process is placed in these spaces. It can be presented in several degrees of detail. The following are examples of alternative ways to show the information.

a. Alfalfa hay 3 years, cotton, tomatoes, and barley; with the residue from the cotton, tomatoes and barley incorporated into the soil. Tillage operations are limited to those that are properly timed and essential to produce a crop and prevent soil damage. Fertilizer is applied according to the crop needs. Total rating_____.

b.

Crop and Treatment	Rating
Alfalfa 3 years	_____
Cotton and Crop Residue	_____
Tomatoes and Crop Residue	_____
Barley and Crop Residue	_____
TOTAL	_____

c. ----See the attached Work Sheet on "Soil Conditioning Rating for Conservation Cropping System"----

(Note: Attach the Work Sheet CF-CONS-10 with detailed computations)

(2) Enter on this line the rating value that has been developed for the total cropping system.

(3) COMMENTS OR ALTERNATIVES:

a. These blank spaces can be used for any comments the planner may wish to make about the cropping system, or

b. If the evaluation shows a minus rating then the space should be used to present alternative treatments, that will bring the system to a zero or better rating.

Examples of Alternatives:

Mowing instead of discing to maintain orchard cover crop will add +0.5 to the rating.

Reducing tillage operations to one discing and one harrowing to prepare the seedbed for barley will add +0.1 to the rating.

Incorporating wheat straw into the soil rather than burning it will add +0.6 to the rating for each ton of straw.

CF-CONS-10
8/75

Technical Guide Section II-D-3
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
California

WORK SHEET

SOIL CONDITIONING RATING FOR CONSERVATION CROPPING SYSTEM

RESOURCE CONSERVATION DISTRICT _____ FIELD OFFICE _____

COOPERATOR _____ COMMUNITY NO. _____

FIELD NO. _____ DATE _____ TECHNICIAN _____

(1) ROTATION _____

(2) TREATMENT (Crop, Residue, Fert., Tillage, etc.)	Units x Index = Rating Value			
	Units(3)	Index(4) ±	Plus(+)	Minus(-)
(6) Column Totals				
(7) Total for ___ Year Cropping System				

FOREWORD

This Soil Conditioning Rating Index covers both Irrigated and Non-irrigated crops grown in the Western States. This has been placed in booklet form to make it more readily usable by the field technicians. Also included is some supplemental material which has already been issued as technical notes but has been included in this booklet for the convenience of those who will be using it in the field.

This material supersedes Agronomy (Western States) Technical Note No. 21 and the last revision dated July 1, 1964.

It is hoped that this latest revision will be found useful as a guide to the conservation field technicians in evaluating the strengths or weaknesses of the many crop combinations (rotations) which are in use in the Western States.

An effort has been made to incorporate all of the excellent suggestions which have been received from conservation agronomists and other conservation technicians in the Western States. It is hoped that it will continue to be found helpful to conservationists in discussing conservation cropping systems with farmer-cooperators.

Wayne W. Austin
Regional Agronomist - Western Region
USDA-SCS; July 1964

Revised by J. W. TURELLE
Regional Agronomist, Western Region
USDA-SCS; April, 1967

Reprinted by F. L. BROOKS
Agronomist, WTSC
USDA-SCS; March, 1974

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SOIL CONDITIONING RATING INDICES FOR MAJOR CROPS GROWN IN THE WESTERN STATES

- INTRODUCTION -

It has long been recognized that there is a need for a simple, straightforward way of expressing the complex phenomenon of maintaining and improving physical, chemical and biological condition of the soil for high sustained production of high quality crops under both irrigated and non-irrigated conditions here in the Western States.

Specifically we need to know whether a specific cropping system is improving, maintaining, or deteriorating the soil and to what degree or rate any of these conditions are occurring under a precise system of crop rotation, soil management and water management. Such a system of evaluation would be most useful to conservationists and others in working with farmers in considering suitable alternative crop rotations in the conservation cropping system and to compare the relative effectiveness of each crop combination as related to the effect of growing each crop, amount of crop residue or organic material returned, and the kind of material returned to the soil.

In the Midwestern States, long-time research information and farmer experience are available on which to base numeral values for each cultural practice and for each crop grown as it affects soil condition for specific soils. Here in the Western States where our agriculture is much younger, we do not have as complete research information or farmer experience to draw upon. In setting up such a rating system for the Western States it has been necessary to draw heavily on what limited research information is available and, until more specific data is available, to make field evaluations and to use farmer experience in designing a workable soil conditioning indices for the major crops grown under widely different soils and climatic conditions.

Since this is the case, this can serve only as a general guide and may in many cases need to be further refined to meet local soil, climatic, crop and culture needs in growing a specific crop.

The following are some of the items which are considered in the development of this Soil Conditioning Rating Indices:

I. Items relating to the soil itself:

(a) Physical condition as affecting water intake (Insoak).

(b) Physical condition as affecting plant root development (traffic pans and tillage pans).

(c) Physical condition as affecting desirable soil aeration.

(d) Keeping an adequate supply of active soil organic matter turning over in the soil.

(e) Keeping the soil at a high level of fertility. (Replacement or addition of plant nutrients as needed.)

(f) Maintaining the soil in a condition to resist water and wind erosion.

II. Items which will help promote a desirable soil condition:

(a) Use of grass-legume sod crops which have ability to produce large quantities of fibrous and soil penetrating roots.

(b) Use of green manure crop which return large quantities of carbonaceous materials to the soil, both top and roots.

(c) Return of all crop residues to the soil. Use crops which produce large quantities of high quality residues to compensate for those crops which produce little or no crop residues of low quality.

(d) Apply animal manure as well as other organic materials such as wood chips.

(e) Maintain a proper balance of plant food elements through the addition of needed mineral fertilizers.

(f) Use of soil amendments such as lime and gypsum.

(g) Use of artificial soil conditioners .

III. Items which help destroy favorable soil condition:

(a) Tillage. Necessary in the growing of a crop but all too often improperly carried out.

(b) Traffic by farm equipment. Again necessary in the growing and harvesting of a crop but many times improperly used.

(c) Excessive trampling by livestock, especially when the soil is not at the proper moisture content.

This Soil Conditioning Rating Index, which covers the major crops grown in the Western States under both irrigated and non-irrigated conditions, was arrived at after consultation with a number of Soil Conservation Service technicians and research people who are working in this field. The values are relative one to another and should be adjusted to fit local conditions based on the best available research information, supplemented by local observations and farmer experience. Locally adjusted figures should be entered in the column which is left blank on the right hand side of the table.

Soil conditioning ratings are comparative plus (+) or minus (-) values assigned to crops and soil treatments which will give their relative soil-improving (+) or soil-deteriorating (-) effect for any specific crop combination (rotation) in a specific conservation cropping system. Index ratings assigned plus (+) or minus (-) values should reflect the degree to which each crop and soil treatment used in producing the crop affects soil tilth and organic matter, either favorably or adversely, in a particular conservation cropping system.

In arriving at a rating for any given crop combination (rotation) in a conservation cropping system the algebraic sum of the values assigned to each crop including the residues returned from the crop, along with the animal manure and/or other applied organic material and fertilizer, will give the relative soil-improving (+) or soil-deteriorating (-) effect on a particular soil. The allowable amount of commercial or mineral plant food applied should be calculated separately. (See attached example).

This system <u>does not</u> rate the erosion effectiveness for any crop combination. The allowable soil loss for any alternative conservation cropping system must be determined by other means such as the use of the "Soil Loss Equation" or by actual field evaluations which are made locally.

Also attached are examples of how to evaluate a specific crop combination (rotation) for crops grown under irrigation and without irrigation (dryland).

The system described above is a modification of a similar system developed first by the research work of R. M. Salter and T. C. Green in Ohio (1). From this basic research, Salter, Lewis, and Slipher (2) prepared a "Productivity Index" for the important crops in Ohio. It was published in 1936 and later in 1941. Klemme and Coleman (3), working in Missouri, published a similar productivity rating for individual crops grown in Missouri. The first of these ratings was published in 1939 and revised and published again in 1949. For a brief summary of this work see Agronomy Technical Note No. 13, prepared by Wayne W. Austin, Washington-Field Agronomist (Western), Berkeley, California, April 15, 1960.

REFERENCES

(1) AUSTIN, WAYNE W. SOIL PRODUCTIVITY INDEX. Soil Conservation Service, U. S. Department of Agriculture, Technical Note Agronomy No. 13 (Western States), April 15, 1960.

(2) BEAR, FIRMAN E. SOILS AND FERTILIZERS. 4th Edition, 1953. John Wiley and Sons. New York, N. Y. Pages 192, 193 and 194.

(3) COOK, R. L. SOIL MANAGEMENT FOR CONSERVATION AND PRODUCTION. John Wiley and Sons. New York, N. Y. 1962.

(4) KLEMME, A. E., and COLEMAN, O. T. EVALUATING ANNUAL CHANGES IN SOIL PRODUCTIVITY. Missouri Agricultural Experiment Station Bulletin No. 405, 1939, and Bulletin No. 522, 1949.

(5) SALTER, R. M.; LEWIS, R. D.; and SLIPHER, J. A. OUR HERITAGE - THE SOIL. Ohio State University, Agricultural Extension Service Bulletin No. 175, 1936, 3rd Edition, 1941.

(6) SALTER, R. M. and GREEN, T. C. FACTORS AFFECTING THE ACCUMULATION AND LOSS OF NITROGEN AND ORGANIC CARBON ON CROPPED SOILS. Journal of The American Society of Agronomy 25: 622-630, 1933.

SOIL CONDITIONING RATING INDICES FOR MAJOR IRRIGATED CROPS IN THE WESTERN STATES

A. Crop and Residue Use	Rating*	Adjusted Local Rating*
1. ALFALFA-GRASS (hay, silage or green chop)		
Establishment period 1/		
(a) New seeding without companion crop	0.00	
(b) Grain, new seeding, straw removed	-1.00	
(c) Alfalfa-grass w/companion crop, latter removed	-0.50	
1st year forage production	+1.50 2/	
2nd year forage production	+3.00 2/	
3rd year forage production	+4.00 2/	
4th year forage production	+4.50 2/	
5th year forage production	+4.75 2/	
6th year forage production	+5.00 2/	
7th year forage production	+5.25 2/	
8th year forage production	+5.50 2/	

For additional years in sod, add 0 0.20 for each year. Rating index figure is accumulative.

2. ALFALFA - (alone) (hay, silage or green chop)		
Establishment period 1/		
(a) New seeding without companion crop	0.00	
(b) Grain, new seeding, straw removed	-1.00	
(c) Alfalfa-grass w/companion crop, latter removed	-0.50	
1st year forage production	+1.00 2/	
2nd year forage production	+2.50 2/	
3rd year forage production	+3.00 2/	
4th year forage production	+3.50 2/	
5th year forage production	+3.75 2/	
6th year forage production	+4.00 2/	
7th year forage production	+3.80 2/	
8th year forage production	+3.50 2/	

For each additional year in alfalfa beyond 8 years, subtract 2/10 for each year. Rating index figure is accumulative.

Last crop plowed under.

1/ The value for the Establishment period is in addition to the value for the years in forage production.

2/ These are accumulative to-date values and not including the establishment periods.

*Includes the minimum number of cultural operations required in growing the crop.

A. Crop and Residue Use (continued)

	Rating*	Adjusted Local Rating*
3. PASTURE (perennial grass-legume)		
Establishment period 1/		
(a) New seeding without companion crop	0.00	
(b) Small grain, new seeding, straw removed	-1.00	
(c) Grass-legume w/companion crop, latter removed	-0.50	
1st year forage production	+1.50 2/	
2nd year forage production	+3.00 2/	
3rd year forage production	+4.00 2/	
4th year forage production	+4.75 2/	
5th year forage production	+5.25 2/	
6th year forage production	+5.50 2/	
7th year forage production	+5.75 2/	
8th year forage production	+6.00 2/	

For each additional year, add 1/10 of a point. Rating index figure is accumulative.

1/ The value for the Establishment period is in addition to the value for the years in forage production.

2/ These are accumulative to-date values and not included in the establishment year or years.

4. PASTURE (annual or biennial)	
(a) Grass-legume (rye grass and vetch)	+1.50
(b) Small grain	+0.50
(c) Sudan grass	+0.50
(d) Sweet clover and grass (2 years)	+2.00

5. GRASS FOR SEED PRODUCTION	
1st year of establishment	-1.00
1st seed year, residues removed	+1.00
2nd seed year, residues removed	+2.50
3rd seed year, residues removed	+3.00
4th seed year, residues removed	+3.25

Last seed year, add +0.60 per ton residues returned.

1/ The value for the Establishment period is in addition to the value for the years in forage production.

*Includes the minimum number of cultural operations required in growing the crop.

A. Crop and Residue Use (continued

	Rating*	Adjusted Local Rating*
6. LEGUME (perennial, for seed production), in rows		
Period of establishment 1/	-1.00	
1st year seed production, residue removed	+1.00	
2nd year seed production, residue removed	+2.00	
3rd year seed production, residue removed	+2.50	
4th year seed production, residue removed	+2.75	
5th year seed production, residue removed	+3.00	
7. LEGUME (biennial for seed production), solid seeding		
Period of establishment, with small grain, companion crop, residue removed	-1.00	
1st year seed production, residues removed 2/	+1.00	
2nd year volunteer seed production, residues removed	+1.50	
8. COVER CROP - later used as a green manure crop		
(a) Small grain 2/ seedbed preparation	-1.00	
(b) Legumes 2/ (annual) seedbed preparation	-0.50	
(c) Grass-legume 2/ (annual) seedbed preparation	-0.50	
(d) Grass (annual) 2/ seedbed preparation	-0.50	
(e) Volunteer (annual) 2/ no seedbed preparation.	+0.00	
9. A. FORAGE CROPS (annual) all tops removed		
(a) Small Grain - (cut for hay or silage)	-1.00	
(b) Small Grain and annual legume (cut for hay or silage)	-1.00	
(c) Sudan grass drilled (cut for hay or silage)	-1.00	
(d) Annual grass-legume (cut for hay or silage)	-0.50	
(e) Sorghum, sweet stalk-cultivated rows (silage)	-1.50	
B. FORAGE CROPS (Biennial Legumes)		
Establishment period 1/		
(a) New seeding w/companion crop, latter removed	-1.00	
(b) New seeding without a companion crop	+0.00	
(c) Production year for silage, green chop	+1.00	

1/ The value for the Establishment period is in addition to the value for the years in forage production.

2/ Add +0.60 for each ton of crop residue returned to the soil.

*Includes the minimum number of cultural operations required in growing the crop.

A. Crop and Residue Use (continued)

	Rating*	Adjusted Local Rating*
9. C. FORAGE CROPS (perennial legumes except alfalfa for use as hay, silage or green chop)		
Establishment period 1/		
(a) New seeding without companion crop	+0.00	
(b) New seeding, w/companion crop, latter removed	-0.50	
(c) Preparatory crop only such as small grain and Sudan grass, residue removed	-1.00	
1st year forage production	+0.50 2/	
2nd year forage production	+1.25 2/	
3rd year forage production	+2.25 2/	
4th year forage production	+3.00 2/	
5th year forage production	+3.50 2/	
6th year forage production	+3.25 2/	
7th year forage production	+2.75 2/	
9. D. FORAGE CROPS (Perennial grasses and legumes except alfalfa for use as hay, silage or green chop)		
Establishment period 1/		
(a) New seeding without companion crop	0.00	
(b) New seeding w/companion crop, latter removed	-0.50	
(c) Preparatory crop only such as small grain and Sudan grass, residue removed	-1.00	
1st year forage production	+1.00 2/	
2nd year forage production	+2.25 2/	
3rd year forage production	+3.25 2/	
4th year forage production	+4.00 2/	
5th year forage production	+4.50 2/	
6th year forage production	+4.75 2/	
7th year forage production	+5.00 2/	
10. GREEN MANURE CROP		
(a) Biennial sweetclover (second year crop ret'd) or second year alfalfa 2/	+1.00	
(b) Annual legumes 2/ (such as peas, vetch, Sesbania, horsebeans, hubam sweetclover)	+0.50	
(c) Sorghum or corn 2/	-1.50	
(d) Small grain 2/	-1.00	
(e) Volunteer annuals (all of the plants returned to the soil) 2/	+0.00	
(f) Sudan grass, drilled	-1.00	

1/ The value for the Establishment period is in addition to the value for the years in forage production.

2/ Add + 0.60 for each ton of crop residue returned to the soil.

*Includes the minimum number of cultural operations required in growing the crop.

A. Crop and Residue Use (continued)

	Rating*	Adjusted Local Rating*
11. ARTICHOKES (in rows, cultivated) all residues removed 2/	-1.50	
12. BEANS AND PEAS (dry, planted in rows and cultivated) all tops removed 2/	-1.50	
13. CASTOR BEANS (planted in rows and cultivated) all tops removed 2/	-1.50	
14. CORN (cultivated, in rows)		
(a) Grain (stalks removed) 2/	-1.50	
(b) Grain (stalks grazed) Take 80% of value of residue produced 2/	-1.50	
(c) Silage (all stalks removed)	-1.50	
(d) Sweet corn (all stalks removed)	-1.50	
(e) Sweet corn (stalks grazed) Take 80% of value of residue produced)	-1.50	
15. COTTON (rows cultivated) all residues removed) 2/	-2.00	
16. FLAX (drilled) all residues removed 2/	-1.00	
17. LENTILS - dry, (drilled) all residues removed 2/	-1.25	
18. PEAS - dry, (drilled) all residues removed 2/	-1.25	
19. PEAS - green (drilled) all residues removed 2/	-1.25	
20. POTATOES (rows cultivated) all residues removed 2/	-2.50	
21. SMALL GRAIN FOR GRAIN (drilled) Small grain, all straw removed 2/	-1.00	

2/ Add +0.60 for each ton of crop residue returned to the soil.

*Includes the minimum number of cultural operations required in growing the crop.

A. Crop and Residue Use (continued)

	Rating*	Adjusted Local Rating*
22. SUGAR BEETS (rows cultivated)		
(a) Tops removed 2/	-2.00	
(b) Tops grazed when field is dry (Take 80% of the total residues produced)	-2.25	
(c) Tops grazed when field is wet (Take 80% of the total residues produced)	-2.50	
23. SAFFLOWER		
(a) Planted in rows and cultivated, all residues removed 2/	-1.50	
(b) Solid planted, all residues removed 2/	-1.00	
24. SORGHUM for grain		
(a) Planted in rows, cultivated, all residues removed 2/	-1.50	
(b) Solid seeded, not cultivated, all residues removed 2/	-1.00	
25. VEGETABLE CROPS, cultivated in rows		
(a) Non-root crops such as broccoli, cabbage, lettuce, melons, celery, tomatoes, cauliflower planted in rows, cultivated, (all residues removed) 2/	-1.50	
(b) Root crops such as table beets, radishes, carrots, (all residues removed) 2/	-2.00	
26. ASPARAGUS, planted in rows, cultivated, all tops removed 2/	-1.50	
27. STRAWBERRIES, planted in rows, cultivated 2/		
(a) First year of establishment	-1.50	
(b) Established stand	-1.00	
28. SUGAR BEETS for seed, in rows, cultivated, all residues removed 2/	-1.50	
29. VEGETABLE AND FLOWER SEED PRODUCTION, in rows, cultivated, all residues removed. 2/	-1.50	

2/ Add + 0.60 for each ton of crop residue returned to the soil.

* Includes the minimum number of cultural operations required in growing the crop.

A. Crop and Residue Use (continued)

	Rating*	Adjusted Local Rating*
30. ORCHARD CROPS, clean cultivated, minimum tilled, all prunings removed. 2/ When volunteer annuals are allowed to grow this rating value becomes 0.00	-1.50	
31. ORCHARD CROPS, week free non-tillage (chemical weed control, all prunings removed.) When additional mulch is applied, see C1 for additional credit.	0.00	
32. ORCHARD CROPS, seeded annual green manure crop. Rotary mowed and minimum tilled, all prunings removed. 2/ When volunteer annuals are allowed to grow, this becomes 0.00 When mulch is added, refer to C1 for additional credit.	+0.50	
33. ORCHARD CROPS, well established perennial sod crop, mowed, all prunings removed.	+6.00	
34. VINE AND BERRY CROPS (bramble or cane,) clean cultivated, all prunings removed, minimum tilled. 2/ When volunteer annuals are allowed to grow, this becomes 0.00 When mulch is added, refer to C1 for additional credit.	-1.50	
35. VINE AND BERRY CROPS (bramble or cane,) seeded annual cover-green manure crop. Rotary mowed and minimum tilled, all prunings removed. 2/	+0.50	
36. VINE AND BERRY CROPS (bramble or cane,) all prunings removed. Weed free non-tillage (chemical weed control.) When organic materials are applied as mulch, see C1 for additional credit.	+0.00	
37. VINE AND BERRY CROPS, well established, all prunings removed. Perennial sod mowed.	+6.00	

2/ Add +0.60 for each ton of crop residue returned to the soil.

*Includes the minimum number of cultural operations required in growing the crop.

B. Animal Manures

	Rating*	Adjusted Local Rating*
1. MANURE		
(a) For each 1 ton of air dry cow manure, well cared for	+0.70	
(b) For each 1 ton of air dry sheep manure, well cared for	+0.80	
(c) For each 1 ton of air dry poultry manure, well cared for	+1.00	
Air dry weight calculated at a moisture content of not more than 10%.		

C. Organic Materials

1. MULCH (applied)		
For each ton of air dry organic mulch material applied, such as wood chips, sawdust, straw or other plant residues properly balanced with Nitrogen. (Not to exceed a total of more than +2.00 may be credited annually but can be credited as long as it is effective.) Air dry weight calculated at an average moi ture content of not more than 10%.	+0.60	
Example: 2 tons of wood chips + 40 lbs of actual N=+1.20 (Note the Nitrogen is not creditable in this case.)	+1.20	

D. Plant Food Elements

1. FERTILIZER (commercial) - only needed elements will qualify. Ratings are based on actual pounds of plant food elements applied. Up to 200 pounds of elemental plant nutrients can be credited annually.		
(a) Nitrogen per poun of elemental N.	+0.005	
(b) Phosphorus per pound of elemental P. 5/	+0.005	
(c) Potassium per pound of elemental K. 6/	+0.005	
(d) Sulphur per pound of elemental S.	+0.008	
(e) Other minor elements per pound of each mineral element in pure form, such as Zn, Cu, and mg.	0.010	

5/ Conversion P_2O_5 to P, (P_2O_5 X 0.44 = amount of elemental P)
6/ Conversion K_2 to K, (K_2O X 0.83 = amount of elemental K)

*Includes the minimum number of cultural operations required in growing the crop.

E. Soil Treatments

1. TILLAGE (Fallow or clean cultivation in orchard and vineyards.)
Where irrigated land is not cropped for some reason such as lack of irrigation water or to control undesirable weeds, or insect pests, and is fallowed for a season or crop year, use the table below to calculate the minus (-) rating for each year of fallow as it may occur in the cropping sequence.

(a) Tillage Operations

1.	Moldboard plowing	-0.50
2.	Disc plowing	-0.60
3.	Heavy tandem disc, offset (Goble or Towner)	-0.70
4.	Sweeping (heavy sweep, 8-12 in. deep)	-0.40
5.	Chiseling up to 16 inches deep	-0.45
6.	Light tandem discing	-0.50
7.	Heavy duty springtoothing	-0.33
8.	Duckfoot cultivating 4-8 in. deep	-0.33
9.	Cultivating for weed control, 3-4 in. deep.	-0.25
10.	Spiketooth harrow	-0.25
11.	Packing (land roller, cultipacker or or till and pack)	-0.10
12.	Subsoiling deep - 16 inches and deeper - 3 to 6 ft. apart	-0.75

WORK SHEET FOR ESTIMATING
SOIL CONDITIONING RATINGS ON IRRIGATED LAND

Crop Rotation (Crop combination or Sequence) (Irrigated)	Crop Residues Returned and Fertilizers	Rating Index	Calculations	Rating Value
Alfalfa: 3 years forage production Last crop green manure	2000 lbs.	+0.60	3 yrs. (accumulative) = +3.00 1 X +0.60 = +0.60	+3.60
Cotton: 3 years 2.5 bales each year	4000 lbs. each year	-2.00 +0.60	3 X -2.00 -6.00) = -2.40 3 X +1.2 +3.60)	-2.40
Barley 1 year grain (Straw baled off) Alfalfa drilled in stubble		-1.00	1 X -1.00 = -1.00) = -1.00	-1.00
Fertilizer Applied	Amount of Fertilizer Applied			
1st year alfalfa	90# P_2O_5 X .44 = 39.6	+0.005	39.6 X +0.005 = +0.20	+0.20
1st year cotton	75# N	+0.005	75 X +0.005 = +0.38	+0.38
2nd & 3rd year cotton	115# N X 2 = 230#	+0.005	230 X +0.005 = 1.15	+1.15
Barley	75# N 50# P_2O_5 X .44 = 22	+0.005 +0.005	75 X +0.005 = +0.38) 22 X +0.005 = +0.10) = +0.48	+0.48
			Total for the 7-year rotation	+2.41

WORK SHEET FOR ESTIMATING
SOIL CONDITIONING RATINGS ON IRRIGATED LAND

Crop Rotation (Crop combination or Sequence (Irrigated)	Crop Residues Returned and Fertilizers	Rating Index	Calculations	Rating Value
Alfalfa-grass 4 years (Hay) production	None	+4.50	4 years accumulated = +4.50	+4.50
Corn for grain 1 year (8000 lbs stalks returned)	4 tons	-1.50 +0.60	1 X -1.50 = -1.50) 4 X +0.60 = +2.40) +0.90	+0.90
Potatoes 2 years (1000 lbs tops returned each year)	1 ton for 2 yrs	-2.50 +0.60	2 X -2.50 = -5.00) 6 X +0.60 = +3.60) +4.40	+4.40
Sugar Beets 2 years (6000 lbs of tops returned each year)	6 tons of tops for two years	-2.00 +0.60	2 X -2.00 = -4.00) 6 X +0.60 = +3.60) -0.40	-0.40
Alfalfa-grass 1 year, seeded in spring without companion crop.	None	0.00		0.00
Barnyard Manure (cow)	4 tons air dry	+0.70	4 X +0.70 = +2.80	+2.80
Fertilizer Applied (mineral)	Amount applied			
1st year alfalfa-grass	90# P_2O_5 X .44 = 39.6	+0.005	39.6 X +0.005 = +0.20	+0.20
3rd year alfalfa-grass	90# P_2O_5 X .44 = 39.6	+0.005	39.6 X +0.005 = +0.20	+0.20
Corn 1 year	150 # N	+0.005	150 X +0.005 = +0.75	+0.75
Potatoes 2 years for N 1 year for P	150# X 2 = 300 45# P O X .44 = 19.8	+0.005 +0.005	300 X +0.005 = +1.50) 19.8 X +0.005 = +0.10) +1.60	+1.60
Sugar Beets 2 years for N 1 year for P	150# N X 2 = 300 90# P O X .44 = 39.6	+0.005 +0.005	300 X +0.005 = +1.50) 39.6 X +0.005 = +0.20) +1.70	+1.70
			Total for the 10- year Rotation	+7.85

WORK SHEET FOR ESTIMATING
SOIL CONDITIONING RATINGS ON IRRIGATED LAND

Crop Rotation or Sequence (Crop combination (Irrigated)	Crop Residues Returned and Fertilizers	Rating Index	Calculations	Rating Value
Barley companion crop Red clover drilled with barley. (Straw removed)	None	-1.00	1 X -1.00 = 1.00	-1.00
Red Clover 1st seed year		+1.00	1 X +1.00 = +1.00	+1.00
Red Clover 2nd seed year-volunteer (all residues returned)	2 tons	+1.50 +0.60	1 X +1.50 = +1.50) 2 X +0.60 = +1.20) +2.70	+2.70
Potatoes: 2 years ($\frac{1}{2}$ ton of tops plowed under per year)	1 ton for 2 years	-2.50 +0.60	2 X -2.50 = -5.00) 1 X +0.60 = +0.60) = -2.40	-2.40
Fertilizer Applied	Amount Applied			
Red Clover 1st seed year.	90# P_2O_5 X .44 = 39.6 40# Sulphur	+0.005 +0.008	39.6 x +0.005 = +0.20) 40 x +0.008 = +0.32) =+0.52	+0.52
Potatoes 1st year	150# N 90# P_2O_5 X .44 = 39.6	+0.005 +0.005	150 X +0.005 = +0.75) 39.6 X +0.005 = +0.20) = +0.95	+0.95
Potatoes 2nd year	150#N 45# P_2O_5 X .44 = 19.8	+0.005 +0.005	150 X +0.005 = +0.75) 19.8 X +0.005= +0.10) = +0.85	+0.85
			Total for the 5-year Rotation	+0.62

SOIL CONDITIONING RATING INDICES FOR MAJOR NON-IRRIGATED CROPS IN THE WESTERN STATES

This section which deals with crops grown without the benefit of irrigation considers both the desirable effect of the growing crops and the crop residues which are returned, as well as the deteriorating effect of cultural practices which include tillage, (working of the soil) and traffic of farm equipment necessary in the planting, growing and harvesting of crops. In addition there is the deteriorating effect om soil structure by the trampling of livestock when planted to a pasture crop or when the crop residues and aftermath are grazed.

Because of the tremendous effect that cultural practices have on the maintenance of good physical condition, particularly when crops are grown under dryland conditions here in the Western States, individual tillage and other cultural practices have been given relative values.

In order to arrive at a value for any crop combination grown without the benefit of supplemental water (irrigation) it will not only be necessary to know the amount of crop residues returned as well as animal manure and fertilizer applied, but also the number and kind of tillage and other cultural practices performed in the preparation of the seedbed, planting of the crop, growing of the crop and the harvesting of the crop.

The procedures and the basic principle in arriving at a value for a particular crop combination along with the tillage and other cultural practices necessary in the production of a crop are set forth in the general introduction.

Also attached are examples of how to evaluate a specific crop combination (rotation) along with the tillage and other cultural practices necessary in the production of the crops.

The value arrived at through the use of this system does not rate the erosion effectiveness for any crop combination. The allowable soil loss for any alternative conservation cropping system must be determined by other means such as the use of the "Soil Loss Equation" or by actual field evaluations which are made locally.

<u>The Soil Conditioning Index</u> should numerically reflect the net values of the practices in the cropping system which <u>promote</u> desirable soil condition as compared with those practices which <u>destroy</u> desirable soil condition.

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SOIL CONDITIONING RATING INDEX FOR CROPS AND CROPPING PRACTICES FOR THE NON-IRRIGATED AREA CROPPED EACH YEAR

A. Crop and Residue Use

1. SMALL GRAIN (All residues returned to soil) 1/

Winter Wheat Bu/Ac	Rating	Adj. Loc. Rating	Winter Rye or Barley Lbs/Ac	Rating	Adj. Loc. Rating
25	+1.00		1500	+1.00	
30	+1.25		2000	+1.40	
40	+1.60		2500	+1.80	
50	+2.00		3000	+2.20	
60	+2.40		3500	+2.50	
70	+2.80		4000	+2.90	
80	+3.20				
90	+3.60				

Spring Wheat Bu/Ac	Rating	Adj. Loc. Rating	Spring Barley Lbs/Ac	Rating	Adj. Loc. Rating
25	+ 0.9		1500	+ 0.8	
30	+ 1.1		2000	+ 1.1	
40	+ 1.4		2500	+ 1.3	
50	+ 1.8		3000	+ 1.5	
60	+ 2.2		3500	+ 1.8	

Oats Lbs/Ac	Rating	Adj. Loc. Rating
1500	+0.8	
2000	+1.1	
2500	+1.4	
3000	+1.7	
3500	+2.0	

1/ (a) When residues mechanically removed, reduce values by 90%.
(b) When all residues are burned, reduce to Zero.
(c) When residues and aftermath volunteer growth is grazed, reduce the total air dry tonnage produced above ground by 20%.

A. Crop and Residue Use (continued)

2. DRY PEAS AND LENTILS (All residues returned to soil) 1/

		RATING	ADJ. LOC. RATING
(a) DRY FIELD PEAS	800-1,000 lbs. seed yield	+0.50	
	1,200-1,500 lbs. seed yield	+0.75	
(b) LENTILS or DRY BEANS	400-500 lbs. seed yield	+0.25	
	600-800 lbs. seed yield	+0.50	

1/ (a) When residues are mechanically removed, reduce values by 90%.
(b) When residues are burned, reduce values to Zero (0).

3. GREEN PEAS AND BEANS

(a) GREEN FIELD PEAS - all residues removed 1/	-1.50	
(b) GREEN BEANS - all residues removed 1/	-1.50	

1/ Add +0.60 for each ton of residues, dry weight returned or left in the field.

A. Crop and Residue Use (continued)

4. FORAGE CROPS (Perennial grasses and legumes for hay, silage, green chop or pasture) 1/

	Hay, silage or green chop		Pasture	
	Rating	Adj. Loc. Rating	Rating	Adj. Local Rating
Period of establishment 2/				
Seeded without companion crop	0.00		0.00	
Seeded with approved companion crop (residue removed)	- 1.00		- 1.00	
Seeded in small grain stubble	- 0.50		- 0.50	
1st year forage production 3/	+ 0.75		+ 1.25	
2nd year forage production	+ 1.25		+ 2.00	
3rd year forage production	+ 1.75		+ 2.75	
4th year forage production	+ 2.25		+ 3.50	
5th year forage production				

For each additional year add +0.10 to the 5 year values up to a maximum of 10 years.

1/ When alfalfa alone is used, reduce each value of 1st to 5th forage production year by 0.5 Add +0.3 for each additional ton of alfalfa residue not grazed or removed.

2/ The value for the establishment year is in addition to the value for the years in forage production.

3/ Add +0.60 for each ton of residue returned to soil.

A. Crop and Residue Use (continued)

5. FORAGE CROPS, Annual GRASSES AND LEGUMES
Establishment year seeded in small grain stubble -0.50

	Pasture Use		
	1st year	2nd year	3rd year
Fertilized 1/	+1.50	+1.75	+2.00
Unfertilized 2/	+1.00	+1.25	+1.50

1/ Add +0.20 for each additional year until a miximum of +3.00 is reached.

2/ Add +0.10 for each additional year until a maximum of +2.00 is reached.

6. SEED PRODUCTION (grass or legume)
(a) Grass Seed Production

	Solid Seeded		Intertilled Rows	
	Rating	Adj. Loc. Rating	Rating	Adj. Loc. Rating
Period of establishment 1/				
Seeded without companion crop	0.00		0.00	
Seeded in stubble	-0.50		-0.50	
Seeded with a companion crop	-1.00		-1.00	
1st year seed production 2/	+1.5		+1.0	
2nd year seed production	+2.0		+1.5	
3rd year seed production	+2.5		+1.75	
4th year seed production	+3.0		+2.00	

1/ The value for the establishment period is in addition to the value for years in seed production.

2/ Add +0.60 for each ton of residues returned to the soil.

A. Crop and Residue Use (continued)

6. SEED PRODUCTION (grass or legume)
   (b) Legume Seed Production
   White Dutch Clover, Alsike Clover, Red Clover, Trefoil and Alfalfa.

	White Dutch		Red or Alsike		Alfalfa/Trefoil	
	Rating	Adj. Loc. Rating	Rating	Adj. Loc. Rating	Rating	Adj. Loc. Rating
Period of establishment 1/						
Seeded without companion crop	0.00		0.00		0.00	
Seeded with companion crop	-1.00		-1.00		-1.00	
Seeded in stubble	-0.50		-0.50			
1st year seed production 2/	+1.00		+1.00		+1.00	
2nd year seed production	+1.50		+1.25		+1.50	
3rd year seed production	+2.00		+1.50		+2.00	
4th year seed production	+1.50				+2.50	

7. GREEN MANURE (Two Years)

   (a) Biennial or perennial 1/

	ALFALFA		SWEETCLOVER	
	Rating	Adj. Loc. Rating	Rating	Adj. Loc. Rating
Period of establishment 2/				
Seeded with companion crop	-1.00		-1.00	
Seeded in stubble	-0.50		-0.50	
Seeded without a companion crop	0.00		0.00	

1/ The value for the establishment period is in addition to the value for years in seed production.

2/ Add +0.60 for each ton of residues returned to the soil.

A. Crop and Residue Use (continued)

7. GREEN MANURE (Two Years) (continued)
Biennial or perennial

	ALFALFA		SWEETCLOVER	
	Rating	Adj. Loc. Rating	Rating	Adj. Loc. Rating
Plow out year: 3/				
(1) Plowed at bud stage (good crop)	+1.50		+1.75	
(2) Grazed until soil is dried out, then plowed.	+1.00		+1.25	
Plow out year of long-lived sod: 3/				
Nothing removed year of plowing	+1.25		----	
First cutting removed, or lightly grazed.	+1.00		----	

1/ If adapted grassed are included, add 50% to values for plow out year.
2/ The value for the establishment year is in addition to the value for plow out year.
3/ Values are for good stand and growth. Approx. 2T/A dry weight at plowing time. Vary values accordingly for poor stands and growth.

(b) Annual Grass and/or Legumes, or (1) Small grain regrowth	Rating	Adj. Loc. Rating
(a) Not fertilized add lightly grazed 1/	+0.50	
(b) Fertilized and lightly grazed 1/	+0.75	
(c) Fertilized and not grazed 1/	+1.00	

B. Animal Manures

1. MANURE	Rating	Adj. Loc. Rating
(a) For each 1 ton of air dry cow manure, (well cared for)	+0.70	
(b) For each 1 ton of air dry sheep manure, (well cared for)	+0.80	
(c) For each 1 ton of air dry poultry manure, (well cared for)	+0.90	

Air dry weight calculated at a moisture content of not more than 10%.

C. Organic Materials

1. MULCH (applied)

	Rating	Adj. Loc. Rating
For each ton of organic mulch material applied, such as wood chips, sawdust or other plant residues properly balanced with Nitrogen.	+0.60	

Not to exceed a total of more than +2.00 may be credited annually. Any amount applied which exceeds this value may be spread over as long a period as it is effective.

Example: 2 tons of wood chips + 40 lbs. of Nitrogen = +1.20

Note the Nitrogen is not creditable in this case.

D. Plant Food Elements

1. FERTILIZER (commercial) only needed elements will qualify.

	Rating	Adj. Loc. Rating
(a) Nitrogen per pound of elemental N	+0.01	
(b) Phosphorus per pound of elemental P 4/	+0.01	
(c) Potassium per pound of elemental K 5/	+0.01	
(d) Sulphur per pound of elemental S	+0.01	
(e) Other minor elements per pound of each mineral element in pure form, such as Zn, Cu, or Mg.	+0.05	

Actual pounds of plant food elements applied to be credited, not to exceed a total of 150 pounds annually.

4/ Conversion P_2O_5 to P, (P_2O_5 X 0.44 = amount of elemental P.)

5/ Conversion K_2O to K, (K_2O X 0.83 = amount of elemental K.)

E. Soil Treatment

All tillage breaks down soil structure and therefore is given a minus (-) value.

	Rating	Adj.Loc. Rating
1. PRIMARY OR INITIAL TILLAGE OPERATIONS:		
Moldboard plowing	-0.50	
Disc plowing	-0.60	
Heavy tandem disc off-set (Goble or Towner)	-0.70	
Modified moldboard plowing	-0.25	
Sweeping (heavy sweeps) 8 to 12 inches deep	-0.40	
Chiseling 12 to 16 inches deep	-0.45	
Rotary subsoiling, 8 to 10 inches deep	-0.35	
2. SECONDARY TILLAGE (seedbed preparation) OPERATIONS: 1/		
Light tandem discing	-0.50	
Heavy duty springtoothing	-0.33	
Duckfoot cultivating	-0.33	
Rotary rod weeding	-0.50	
Skew treading	-0.33	
3. LIGHT WEEDING OPERATIONS: 1/		
Spiketooth harrowing	-0.25	
Light drag springtoothing	-0.25	
Rotary hoeing	-0.15	
4. MISCELLANEOUS OPERATIONS:		
(a) Packing, (land roller, cultipacker or till and pack)	-0.10	
(b) Fertilizing (injecting)	-0.20	
(c) Fertilizing (spreader)	-0.05	
(d) Drilling	-0.10	
(e) Subsoiling deep - 16 to 36 inches 3 to 6 feet apart	-0.50	

1/ Above values are for work at time soil moisture content is at optimum level and at "reasonable speed." If performed when soil moisture content is significantly above or below this optimum range or at excessively high speed, add 25% to figures.

WORK SHEET FOR ESTIMATING
SOIL CONDITIONING RATINGS ON NON-IRRIGATED ANNUALLY CROPPED LAND

Crop Rotation - 4 year alfalfa-grass; 1 yr. winter wheat; 1 yr. dry peas; 1 yr. winter wheat; 1 yr dry peas.

Crop Rotation (crop combination and tillage required to produce the crop)	Tillage, Crop Residues Returned and Fertilizers	Rating Index	Calculations	Rating Value
Alfalfa-grass 4 years	-----	+3.50	----	+3.50
Last crop plowed under	1 ton	+0.60	1 X 0.60	+0.60
Winter Wheat 1 year	60 bushels	+2.40	1 X +2.40 = +2.40	+2.40
Dry peas 1 year	1,200 lbs.	+0.75	1 X +0.75 = +0.75	+0.75
Alfalfa-grass seeded w/o companion crop	------	0.00	--------	0.00
Fertilizer	Amount Applied			
(a) Nitrogen) Pasture	240 lbs. N in 4 yrs	+0.01	240 X +0.01 = +2.40)	+3.10
Phosphorus)	160 " P_2O_5 " " (160 X .44 = 70)	+0.01	70 X +0.01 = +0.70)	
(b) Nitrogen - Winter Wheat	60 lbs. N	+0.01	60 X +0.01 = +0.60	+0.60
(c) Dry Peas	100 lbs. Sulphur	+0.01	100 X +0.01 = +1.00	+1.00
Tillage and Cultural Operations Used in Growing the Crops				
Heavy tandem disc after turning sod	Once	-0.70	1 X -0.70 = -0.70	-0.70
Heavy duty springtooth	Twice	-0.33	2 X -0.33 = -0.66	-0.66
Rotary rod weed	Once	-0.50	1 X -0.50 = -0.50	-0.50
Fertilizing, spreader	Once	-0.05	1 X -0.05 = -0.05	-0.05
Drilling Winter Wheat	Once	-0.10	1 X -0.10 = -0.10	-0.10
Rough fall plow	Once	-0.50	1 X -0.50 = -0.50	-0.50
Light tandem disc	Once	-0.50	1 X -0.50 = -0.50	-0.50
Light drag springtooth	Once	-0.25	1 X -0.25 = -0.25	-0.25
Fertilize, spreader	Once	-0.05	1 X -0.05 = -0.05	-0.05
			Total Rating for the Rotation	+8.64

SOIL CONDITIONING RATING INDEX FOR CROPS AND CROPPING PRACTICES, NON-IRRIGATED - SUMMERFALLOW AREAS

A. Crop Residue Use

1. Small Grain — All residues returned 1/

Winter Wheat Bu/ac	Rating	Adj. Loc. Rating	Winter Barley Lbs/Ac	Rating	Adj. Loc. Rating	Spring Barley Lbs/Ac	Rating	Adj. Loc. Rating
15	+0.60		1000	+0.70		1000	+0.5	
20	+0.80		1500	+1.00		1500	+0.8	
25	+1.00		2000	+1.40		2000	+1.1	
30	+1.25		2500	+1.80		2500	+1.3	
40	+1.60		3000	+2.20		3000	+1.5	
50	+2.00							

1/ (a) When residues are mechanically removed, reduce values by 90%.

(b) When all residues are burned, reduce all values to Zero (0).

(c) When residues and aftermath volunteer growth is grazed reduce the total air dry tonnage produced above ground by 20% to obtain the corrected figure for the amount of crop residue returned.

A. Crop and Residue Use (continued)

2. FORAGE CROPS 1/

(a) Alfalfa-grass

	Hay		Pasture	
	Rating	Adj.Loc. Rating	Rating	Adj.Loc. Rating
1st year, grass-legume, seeded alone	0.00		0.00	
1st year, grain, grass-legume, seeded in stubble	-1.00		-1.00	
2nd year, year of establishment	+0.50		+0.50	
1st year of forage production	+0.75		+1.00	
2nd year of forage production	+1.00		+1.50	
3rd year of forage production	+1.50		+2.00	
4th year of forage production	+2.00		+2.50	
5th year of forage production	+2.50		+3.00	
6th year of forage production	+2.75		+3.25	
7th year of forage production	+3.00		+3.50	
8th year of forage production 2/	+3.25		+3.75	

Rating index figure is accumulative.

1/ Straight alfalfa, solid seeded reduce the listed rating -0.5 1st to 8th production year.

2/ For each additional year in grass-legume beyond 8 years, add a +0.10

(b) Annual Reseeding Grass and/or Legume

Pasture	1st year		2nd year		3rd year	
	Rating	Adj. Loc. Rating	Rating	Adj. Loc. Rating	Rating	Adj. Loc. Rating
Fertilized a/	+1.50		+1.75		+2.00	
Unfertilized b/	+1.00		+1.25		+1.50	

a/ Add +0.20 for each additional year until a maximum of +3.00 is reached.

b/ Add +0.10 for each additional year until a maximum of +2.00 is reached.

A. Crop and Residue Use (continued)

3. SEED PRODUCTION (grass or legume)

(a) Grass Seed Production

	Solid Seeded		Intertilled Rows	
	Rating	Adj.Loc. Rating	Rating	Adj.Loc. Rating
Period of Establishment 1/				
Seeded without a companion crop	0.00		0.00	
Seeded in stubble	-0.50		-0.50	
Seeded with a companion crop	-1.00		-1.00	
1st year seed production	+1.50		+1.00	
2nd year seed production	+2.00		+1.50	
3rd year seed production	+2.50		+1.75	
4th year seed production	+3.00		+2.00	
(b) Legume Seed Production				
Period of Establishment				
Seeded without a companion crop	0.00		0.00	
Seeded in stubble	-0.50		-0.50	
Seeded with a companion crop	-1.00		-1.00	
1st year seed production	+1.00		+1.00	
2nd year seed production	+1.50		+1.25	
3rd year seed production	+2.00		+1.50	
4th year seed production	+1.50		+1.00	

1/ The value for the establishment year is in addition to the value for years in seed production.

D. Plant Food Elements

1. FERTILIZER (commercial): Only needed elements will qualify. Ratings are based on actual pounds of plant food elements applied. Up to 150 pounds of elemental plant nutrients can be credited annually.

	Rating	Adj. Loc. Rating
(a) Nitrogen - per pound of elemental N	+0.01	
(b) Phosphorus - per pound of elemental P	+0.01	
(c) Potassium - per pound of elemental K	+0.01	
(d) Sulphur - per pound of elemental S	+0.01	
(e) Other Minor Elements - per pound of each mineral element in pure form, such as Zn, Cu, or Mg.	+0.05	

E. Soil Treatment

All tillage breaks down soil structure and therefore all are given a minus (-) value.

Following is a rating table for common types of Primary and Secondary tillage equipment, as well as for some miscellaneous.

	Rating	Adj. Loc. Rating
a. Primary or Initial Tillage		
(1) Moldboard	-0.50	
(2) Off-set disc (heavy tandem) (Goble or Towner)	-0.70	
(3) Sweep-type tool 6-8 in. deep	-0.40	
(4) One way disc plough	-0.60	
(5) Chisel 12 to 16 inches deep	-0.45	
(6) Rotary subsoiler 8 to 10 inches deep	-0.35	
b. Secondary Tillage		
(1) Light tandem disc	-0.50	
(2) Duckfoot cultivator	-0.33	
(3) Heavy duty springtooth	-0.33	
(4) Rod weeder	-0.50	
(5) Spiketooth harrow	-0.50	
(6) Drag (springtooth)	-0.25	
(7) Cultivator, shovel type	-0.33	
(8) Skew Treader	-0.33	

E. Soil Treatment (continued)

	Rating	Adj.Loc. Rating
c. Miscellaneous		
(1) Cultipacker	-0.10	
(2) Fertilizer, spreader	-0.05	
(3) a. Fertilizer, injecting	-0.20	
b. Fertilizer, spreader	-0.05	
(4) Drilling	-0.10	
(5) Subsoiling deep 16-36 inches, 3 to 6 feet apart	-0.50	

d. When summerfallow operations are made in accordance with minimum tillage specifications, a value of -1.5 may be used for the summerfallow year in lieu of values derived from individual machinery operations shown in sections Ea, b, and c above.

WORK SHEET FOR ESTIMATING
SOIL CONDITIONING RATING ON SUMMERFALLOWED LAND

Crop Rotation: (Alternate Grain-Fallow)

Crop Combination, Fertilization, and Tillage Required to Produce the Crop	Amounts	Rating Index	Calculations	Rating Value
Crop - SMALL GRAIN (Winter Wheat)	30 bu/ac	+1.25	1 year X +1.25 = +1.25	+1.25
Fertilizer	40 lbs N/ac	+0.01	40 X +0.01 = +0.40	+0.40
Summerfallow Year (Minimum Tillage)	----	-1.50	1 X -1.50	-1.50
			Rating for complete rotation	+0.15

WORK SHEET FOR ESTIMATING
SOIL CONDITIONING RATING ON SUMMERFALLOWED LAND

Crop Rotation - 2 yrs. annual reseeding grass-legume, summerfallow, barley, summerfallow, barley

Crop Combination, Fertilization, and Tillage Required to Produce the Crop		Rating Index		Rating Value
Crop - GRASS-LEGUME, Annual Reseeding 1/	2 yrs pasture	+1.75		+1.75
BARLEY (Winter)	2 yrs, 2000 lbs/year	+1.40	2 X 1.40 = +2.80	+2.80
Fertilizer	Amount Applied			
(a) Grass-legume - Nitrogen	64 lbs. N	+0.01	64 X +0.01 = +0.64	+0.64
Phosphorus	80 lbs. .44 = 35.2 lbs P.	+0.02	35.2 X +0.02 = +0.704	+0.70
(b) Nitrogen	40 lbs. N.	+0.01	40 X +0.01 = +0.40	+0.40
Summerfallow (minimum Tillage)	2 years	-1.50	2 X -1.50 = -3.00	-3.00
			Rating for complete rotation	+3.29

1/ Annual reseeding means allowing the annual grasses and legumes to produce sufficient seed to provide a good stand the following year without drilling or broadcasting additional seed the second and succeeding years.
The 80 lbs. of P_2O_5 is split between the two years as follows - 36 lbs. the 1st year, and 44 lbs. the 2nd year. These were lumped together for ease of figuring. The 150 unit maximum is not exceeded in any one year.

WORK SHEET FOR ESTIMATING
SOIL CONDITIONING RATING ON SUMMERFALLOWED LAND

Crop Rotation - 8 yrs. alfalfa-grass, 8 years winter wheat, and 8 years summerfallow.

Crop Combination, Fertilization, and Tillage Required to Produce the Crop	Amounts	Rating Index	Calculations	Rating Value
Alfalfa-grass (New seeding in summerfallow, no companion crop	One year	0.00	---------	0.00
Alfalfa-grass; establishment period continued	One year	+0.50	1 X +0.50 = +0.50	+0.50
Alfalfa-grass for pasture	6 years	+3.25	(Accumulative value)	+3.25
Winter Wheat	30 bu/ac each year - 8 years	+1.25	8 X +1.25	+10.00
Nitrogen fertilizer	40 lbs/ac each year - 8 years	+0.01	40 X +0.01 = +0.40 0.40 X 8 = +3.20	+3.20
Summerfallow (Minimum Tillage)	8 years	-1.50	8 X -1.50 = 12.00	-12.00
			Rating for complete rotation	+4.95

APPENDIX

1. Estimating Crop Residues - Conservation Agronomy Note #23, Western Region, November 1965.

2. Relationships of C to N in Crop Residues - Conservation Agronomy Note #24, Western Region, November 1965.

3. N P K - Simpler Terms for Fertilizer

4. Fertilizer Conversion Scales for Phosphorus and Potassium.

TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE — SOIL CONSERVATION SERVICE
WEST REGIONAL TECHNICAL SERVICE CENTER - PORTLAND, OREGON

CONSERVATION AGRONOMY NOTE NO. 23
J. W. TURELLE, Regional Agronomist November 1965

SUBJECT: I. METHODS OF MEASURING OR ESTIMATING AMOUNTS OF CROP RESIDUES PER ACRE.

II. RESIDUE-GRAIN RATIOS OF CERTAIN CROPS AFTER HARVEST.

III. CROP RESIDUE MAINTENANCE BY VARIOUS TYPES OF FARM MACHINERY.

I. Measuring or Estimating Crop Residues Per Acre After Harvest.

Residue measurements are required for (1) estimating soil losses by erosion; (2) determining the amounts of residue needed to control erosion; and (3) evaluating the effectiveness of crop residues for conservation practices.

An effective field method for measuring amounts of residue on land surfaces is to collect clean, air-dry residues from representative sampling areas and weighing. There are several procedures for measuring amounts of residue that may be used for planning and establishing conservation practices involving crop residues:

A. For harvested small grains

1. Collect 3 one-square-yard random samples of air-dry crop residues. All residues down to the surface are taken and weighed. A one-square-yard frame will facilitate the marking of the plot. Shake out foreign material such as soil and stones. Weigh all 3 samples and record total weight in ounces. Multiply this total weight in ounces by 100. This gives the pounds of residue per acre. If greater accuracy is desired, use 6 one-square-yard random samples and divide the total weight in ounces by 2 before multiplying by 100.

2. Outline a circular plot 9.6 square feet using a radius of 21 inches. Collect clean, air-dry residue, record weight in grams and multiply by 10. This will give the pounds of residue per acre. More accuracy will result if several random samples are taken, weighed, and averaged before multiplying by 10.

3. The same method as item 2 above may be used with a square plot, each side being 3.1 feet.

B. For harvested corn or sorghum

1. Clip the vegetation at the surface for proper row length as shown in table below. Then weigh and multiply by the appropriate constant for the selected weight scale. This will give the pounds of residue per acre.

Row spacing (Inches)	Row Feet Per Acre	POUND SCALE Row Length (Feet)	POUND SCALE Constant	OUNCE SCALE Row Length (Feet)	OUNCE SCALE Constant	GRAM SCALE Row Length (Feet)	GRAM SCALE Constant
22	23,764	23.7	1,000	14.7	100	5.2	10
28	18,695	18.7	1,000	11.7	100	4.1	10
30	17,424	17.4	1,000	10.9	100	3.9	10
32	16,315	16.3	1,000	10.2	100	3.6	10
34	15,392	15.4	1,000	9.6	100	3.4	10
36	14,520	14.5	1,000	9.1	100	3.2	10
38	13,754	13.8	1,000	8.6	100	3.0	10
40	13,081	13.1	1,000	8.2	100	2.9	10
42	12,445	12.5	1,000	7.8	100	2.8	10

2. Using factors below an estimate of pounds of residue per acre may be made for corn and sorghum harvested for silage.

a. Weight of air-dry corn stubble

Estimate 50 lbs. per acre per inch of stalk height left after harvest. This is based on a plant population of 10,000 plants per acre.

b. Weight of air-dry sorghum stubble

Estimate 40 lbs. per acre per inch of stalk height left after harvest. This is based on a plant population of 10,000 plants per acre.

Experience has shown that with a little practice field personnel can make a reliable estimate of pounds of residue per acre by observation. It is desirable, however, to make an occasional check of field observations by actual measurements.

II. Residue-Grain Ratios After Harvest

It is necessary in planning and establishing a residue management program that measurements or dependable estimates be made on amounts of residue after harvest (before any tillage operation or baling). Actual measurements may be made by using any method described in Section I. The estimation of residue amounts (air-dry) after harvest and before the first tillage operation or baling may be made by using the following residue-grain ratios.

(Note: When baling occurs the amount of residue removed must be deducted from the amount of residue estimated before baling. The amount of remaining stubble is the quantity used when planning the tillage program for conserving planned amounts of residue.)

Winter wheat	:	135 lbs. of residue per bushel of grain.
Winter rye	:	120 lbs. of residue " " " " .
Spring wheat	:	120 lbs. of residue " " " " .
Spring barley	:	85 lbs. of residue " " " " .
Oats	:	60 lbs. of residue " " " " .
Flax	:	85 lbs. of residue " " " flaxseed.
Corn	:	90 lbs. of residue " " " grain.
Sorghum	:	100 lbs. of residue " " " " .
Cotton	:	3.5 lbs. of residue per pound of cotton.
Rice	:	1.5 lbs. of residue per pound of rice.

III. Residue Maintenance by Various Types of Farm Machinery

Adequate vegetative protection on land surfaces cannot be overstressed as it is often the only applicable effective erosion control method. Excessive tillage or tillage with improper implements are major causes of vegetative cover reduction. Residue management practices that protect the soil surface at all times are essential for erosion control.

Machinery for tillage can be broadly classed into three types:

(1) those that turn the tilled layer, (2) those that stir the soil, and (3) those that cut beneath the surface without stirring or turning the tilled layer. An example of the first type is the moldboard plow but this machine has little or no place in a residue management program. The second and third types include implements used in the stubble mulch system of farming.

Stirring or mixing equipment includes various disk machines; field and heavy-duty cultivators; rotary hoes and skew treaders.

Subsurface equipment includes straight blade or V-blade machines; straight rodweeders or rodweeders with semi-chisels or shovels.

The following table presents a summary of the averages of residue maintenance using different kinds of tillage equipment. They are reliable for amounts and heights of residue ordinarily encountered in field practice.

Type of Equipment	Average Maintained After Each Tillage Operation
	Percent
Subsurface Implements:	
Blades (36" or wider)	90
Sweeps (24" or wider)	90
Rodweeders - plain rod	90
Rodweeders - with semi-chisels	80
Mixing Implements:	
Heavy-duty cultivator (16" - 22" sweeps)	85
Field or duckfoot cultivator (shovels or narrow sweeps)	80
Heavy-duty cultivator (shovels and chisels)	75
Disk machines (one-way, tandem or offset disks)	50
Deep Furrow Drills:	85

TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE — SOIL CONSERVATION SERVICE
WEST REGIONAL TECHNICAL SERVICE CENTER - PORTLAND, OREGON

CONSERVATION AGRONOMY NOTE NO. 24
J. W. TURELLE, Regional Agronomist November 1965

"RULE OF THUMB ESTIMATES" OF THE RELATIONSHIPS OF CARBON TO NITROGEN IN CROP RESIDUES

1. Carbon and Nitrogen Content of Soil Organic Matter and Crop Residues

	Organic Carbon	Nitrogen
Crop residue	45%	0.1 - 2.5%
Soil organic matter	58%	3.0 - 6.0%

Average ratio of carbon to nitrogen in soil organic matter is 11.6 to 1 or 58% for C and 5% for N.

To convert organic carbon to soil organic matter multiply by 1.7.

To convert nitrogen to soil organic matter multiply by 20.

2. Importance of C:N Ratio in Relation to Crop Residues

a. Conversion of organic carbon in crop residues to soil organic matter is dependent upon the amount of nitrogen present in the residues.

b. Availability of nitrogen is determined by the C:N ratio. When the ratio is narrow (less than 30 or 35:1) nitrogen is released. If the ratio is wide (more than 30 or 35:1) nitrogen becomes temporarily unavailable.

3. Conversion of Crop Residues to Soil Organic Matter (Figures are approximate).

a. Crop residues contain about 45% organic carbon or 900 pounds per ton. Microorganisms use 2/3 of this carbon, or 600 pounds per ton, to change it to CO_2. Three hundred pounds of carbon remains for use as soil organic matter. 300 pounds x 1.7 = 500 lbs. (approx.) of soil organic matter under favorable conditions.

b. Both carbon and nitrogen are necessary to form soil organic matter. Assuming a soil organic matter-nitrogen ratio of 20:1, 500 lbs. of soil organic matter will contain 25 lbs. of nitrogen. Therefore, 25 lbs. of nitrogen is required for the conversion of a ton of crop residue to about 500 lbs. of soil organic matter when other conditions are favorable.

M-1776 USDA-SCS-PORTLAND OREG. 1965

c. Assume a N content in a ton of wheat straw at 0.25%. This is equal to 5 lbs. of N. Since there is also 45% (900 lbs.) of organic carbon in this ton of straw the C:N ratio is 180 to 1. A nitrogen "tie-up" will occur as the amount of nitrogen needed for decomposing the residue is less than the approximate 25 lbs./ton required for this purpose. (Refer to Para. 3b). Twenty pounds of commercial N must be added in this case to make the conversion to soil organic matter.

d. Assume a N content in a ton of alfalfa at 2.25%. This is equivalent to 45 lbs. of N. The organic carbon content is 45% or 900 lbs. per ton alfalfa. The C:N ratio is 20:1. There is ample N (more than 25 lbs.) to help convert a ton of alfalfa residue to soil organic matter. The nitrogen not needed for decomposing residues will be available for the next growing crop.

4. Carbon and Nitrogen Content in Crops

Crops	Carbon (%)	Nitrogen (%)	C:N ratio
Peas in bloom	45.3	2.69	17:1
Alfalfa hay	43.1	2.34	18:1
Austrian peas (green manure)	45.0	2.53	18:1
Pea vines (mature)	44.0	1.50	29:1
Austrian pea straw	37.5	0.64	59:1
Wheat straw (Tetonia, Idaho)	43.6	0.49	88:1
Wheat straw (Moscow, Idaho)	43.6	0.26	168:1
Wheat straw (Oregon)	44.7	0.12	373:1

5. Data for Making Estimates

a. About 2% of total N in the soil becomes available for plant use with fallow or irrigation.

b. About 1% of total N in the soil becomes available for plant use under continuous cropping in non-irrigated areas.

c. Crop residues require a minimum of 1.25-1.5% nitrogen to avoid a temporary depressing effect on amount of nitrogen in the soil.

d. Approximately 500 lbs. of soil organic matter (humus) is the maximum that can be developed in the soil from one ton of crop residue - assuming all conditions are favorable for soil organic matter formation.

N P K

Simpler Terms for Fertilizer

Nutrients in soil, plant and fertilizer analyses will be expressed on the elemental basis in all publications of the American Society of Agronomy after January 1963.

This report gives reasons why this change is desirable and the conversions necessary to change from the oxide to the elemental basis . . .

THE ELEMENTAL expressions of phosphorus and potassium—chemically identified as P and K—will soon become familiar terms in CROPS & SOILS. This change, to be fully effective by January of 1963, was approved by the American Society of Agronomy at its 1961 meeting in St. Louis.

The new policy directs that the values for plant nutrients in soil, plant and fertilizer analyses will be expressed on the elemental basis in all Society publications.* Other groups and societies are currently investigating this change for use in their reports and journals.

Basically, this change means that the nutrient or "plant food" content of fertilizers, as well as soil and plant tests, will be shown in the form of the chemical element (phosphorus—P, potassium—K, boron—B, etc.) instead of oxides or compounds such as phosphorus pentoxide (P_2O_5), potassium oxide (K_2O), or borax ($Na_2B_4O_7 \cdot 10H_2O$). Of course, the oxide form also may be included for awhile when needed to help readers in making this change in terminology.

Why make the change? Briefly, the answer is to *(1)* provide accuracy, simplicity, and uniformity in expressing plant nutrients, and *(2)* avoid the great confusion in terminology that has arisen from the use of out-of-date and meaningless expressions.†

Much of the present confusion is centered on two of the major plant nutrients, phosphorus and potassium, and how they should be expressed and listed in the fertilizer grade. Other plant nutrients, such as nitrogen—N, zinc—Zn, sulfur—S, iron—Fe, manganese—Mn, and copper—Cu, are now expressed as the element.

A good example of the confusion of terms is seen in the expression of the phosphorus content of fertilizers as P_2O_5, which is phosphorus pentoxide. In various publications, however, this term is also called "phosphoric acid," "available phosphoric acid," "phosphate," "phosphoric pentoxide," "phosphoric oxide" and even "phosphorus" is used occasionally.

Some of these terms are merely vague and misleading; others are inaccurate. For example, the term "phosphoric acid" to designate P_2O_5 is easily confused with the liquid fertilizer, H_3PO_4. This liquid material is correctly called "phosphoric acid."

The continuing development of new high-analysis fertilizers provides another sound reason for changing to the elemental basis. There is a definite possibility that within a few years some fertilizers will contain over 100 percent "plant food" if the P_2O_5 and K_2O method of expression is continued! In fact, preliminary research on such fertilizer is already under way.

Is this a new idea? The idea of expressing nutrients or minerals on the elemental basis is not new. It has been discussed and endorsed by many organizations, including the fertilizer control officials, professional societies, and some fertilizer industry groups.

One of the major objections voiced against making this change has been that our scientific publications and books are not consistent, as expressions of oxides and other forms have been employed. For this reason, the Soil Science Society of America in 1960 took the lead in recommending the change to the elemental basis. Since then, several other societies (including the publisher of CROPS & SOILS) have followed this lead and will express plant nutrients on the elemental basis.

We also should point out here that the method of elemental expression for mineral elements, such as calcium—Ca is firmly established in the animal nutrition and biochemical fields.

Has a change been made before? Yes! The method of expressing nitrogen in fertilizer was changed to the element (N) beginning in 1916. Until that time, nitrogen in fertilizer had been expressed as ammonia (NH_3). This was a logical move because common fertilizers of that day, such as sodium nitrate, contained no ammonia.

By the same logic, there is little reason to express potassium as K_2O and phosphorus as P_2O_5, because these compounds do not occur as oxides in fertilizers.

Many years were required to make the change with nitrogen, and it was not until 1939 that the law became effective in *all* states. We now have the experience behind us of changing to N and realize the advantages. Also, we live in a fast changing world and

* Publications of the American Society of Agronomy include the *Agronomy Journal, Agronomy Abstracts, Agronomy Monographs* and *Crops & Soils*. The same policy will be followed in the *SSSA Proceedings*, published by the Soil Science Society of America; and in *Crop Science*, published by the Crop Science Society of America.

† For detailed discussion see "Pros and Cons of Changing Fertilizer Guarantees from the Oxide to the Elemental Basis", *SSSA Proceedings*, Vol. 19, pp. 247-249, 1955; and *Agronomy Journal*, Vol. 47, pp. 191-193, 1955. (Write us for a free reprint.)

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understand more quickly the needs and advantages of changes. For these reasons, it is hoped that the use of elemental expressions for P and K will be adopted by all related professional groups.

In recent years a number of other countries, including Norway, Ireland, New Zealand, and the state of South Australia, have changed to the elemental basis of expression. Scientists from these countries indicate that the change was made with a minimum of confusion for dealers and farmers.

How do we convert nutrient values? Plant nutrient values may be converted from the oxide expression to the elemental expression by using a little arithmetic. Merely multiply the percent or pounds of the oxide by a conversion factor and this will give the percent or pounds of the element.

You will always find that the percent or pounds expressed as the oxide is greater than the percent or pounds of the element. This is true because the value for the oxide includes the weight of the oxygen. The calculations described remove the weight of the oxygen. Calculations for phosphorus and potassium are shown in Table 1.

Table 2 shows examples of conversions for seven leading fertilizer materials and mixtures being used in the U. S. today. You will note that since nitrogen is already expressed on the elemental basis, no change is required for this nutrient.

What steps are needed? To gain national acceptance for changing from the oxide to the elemental form of expression, two basic steps are needed: *(1)* educational, and *(2)* legislative. We firmly believe that the educational approach to this problem is the logical way to begin.

The recent action by several scientific societies has triggered a renewed interest in this whole subject from an *educational standpoint*. For example, a large number of states, on a regional basis, are now reporting results of soil and plant tissue tests in terms of the element.

Several states are in the process of unifying their methods of nutrient expression in their own research publications. As more states continue this trend toward uniformity and clarity, all will benefit from a better understanding of nutrient expressions.

This educational approach is being given further aid by fertilizer companies which are using a system of *dual labeling*. That is, the elemental content is listed on the fertilizer bag along with the oxide content.

Fertilizer labeling is controlled by state laws and many state laws would need to be changed before fertilizer could be sold on an elemental basis. Thus, any educational effort must be followed by *legislative action*. Legislative change is being aided by the Association of American Fertilizer Control Officials who, in 1956, included in their Model Fertilizer Bill a provision for switching to the elemental basis for phosphorus and potassium.

To date about 30 states have adopted major portions of the Model Bill; however, only a few have made provisions for including guarantees on the elemental basis for P and K. Only Minnesota has adopted the basic wording of the Model Bill. This provision allows a state to change to the elemental basis if and when a sufficient number of surrounding states are ready to change and after a public hearing. The provision also allows for dual labeling for a period of 2 years after the change.

In another recent move, a group representing the fertilizer industry, fertilizer control officials, as well as university and USDA scientists met in August of 1961 to develop a policy for registration and guarantee of secondary and micronutrients (minor elements) in fertilizers. This group was in unanimous agreement that these plant nutrients, when guaranteed in a fertilizer, should be shown on the elemental basis.

It is recognized that an extensive educational effort is needed to explain this change. Education must be followed by effective, though tolerant, legislation. But the desirability and simplicity of elemental expression seem to outweigh any difficulties involved in this change. ★

Statement prepared by the Committee on Elemental Guarantees of the Soil Science Society of America. B. A. Krantz, Chairman, S. R. Aldrich, P. Onstot, H. T. Rogers, D. P. Satchell, and W. C. White.

TABLE 1—OXIDE-ELEMENTAL CONVERSION METHODS

Percent or pounds	Multiply by factor		Converted to percent or pounds
Conversion to element			
P_2O_5	× 0.44	=	P
K_2O	× 0.83	=	K
Conversion to oxide			
P	× 2.29	=	P_2O_5
K	× 1.20	=	K_2O

TABLE 2—CONVERSION FROM THE OXIDE TO ELEMENTAL VALUES

Fertilizer materials or mixtures	Present system for fertilizer grade			Nearest equivalent on elemental basis		
	% N	% P_2O_5	% K_2O	% N	% P	% K
Fertilizer Materials						
Ammonium nitrate	33	0	0	33	0	0
Triple superphosphate	0	46	0	0	20	0
Muriate of potash*	0	0	60	0	0	50
Fertilizer Mixtures						
6-12-12	6	12	12	6	5	10
12-12-12	12	12	12	12	5	10
5-20-20	5	20	20	5	9	17
4-12-12	4	12	12	4	5	10

*Muriate of potash is chemically known as potassium chloride (KCl).

N P K

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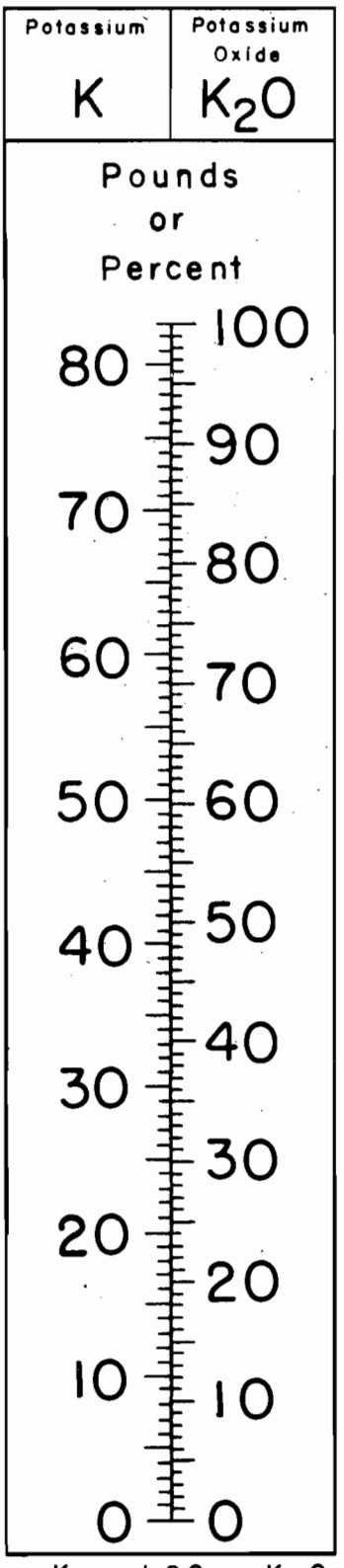
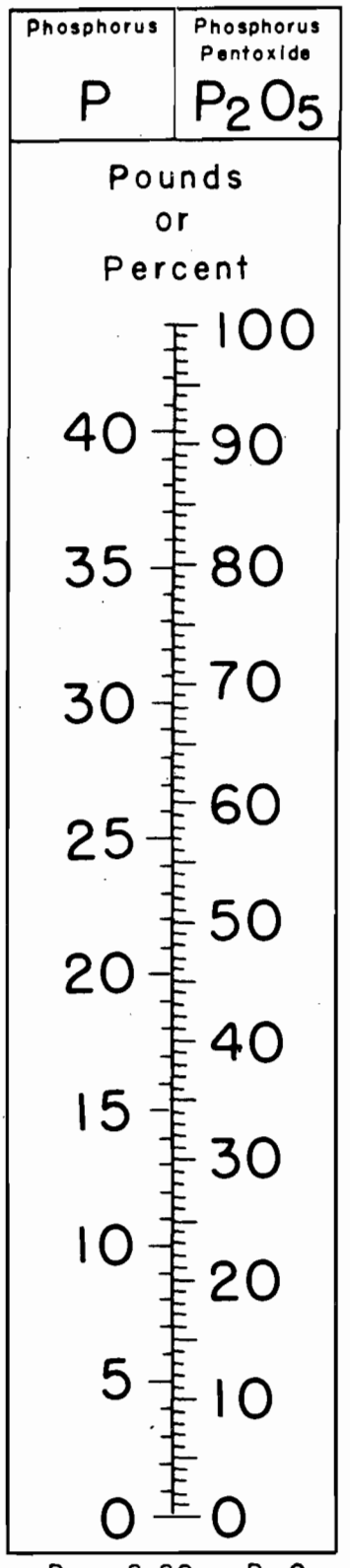
FERTILIZER CONVERSION SCALES FOR PHOSPHORUS AND POTASSIUM



$K \times 1.20 = K_2O$

$K_2O \times 0.83 = K$



$P \times 2.29 = P_2O_5$

$P_2O_5 \times 0.44 = P$

Attachment to TN - Soils - 10

CROP RESIDUE MANAGEMENT (continued)

All crop residues can be returned to the soil unless they contain insects or diseases which would damage the crops which follow.

Many of our intensively cultivated crops produce large quantities of highly valuable organic materials which when returned to the soil help keep it in top condition.

2-407

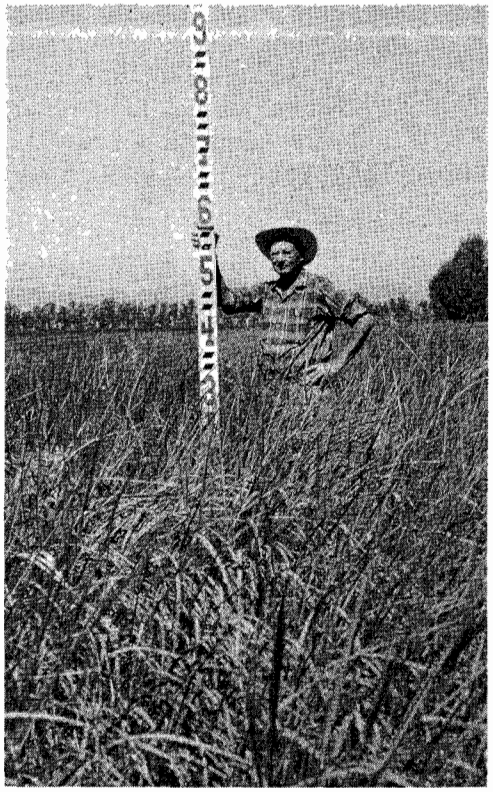
5-170

2-408

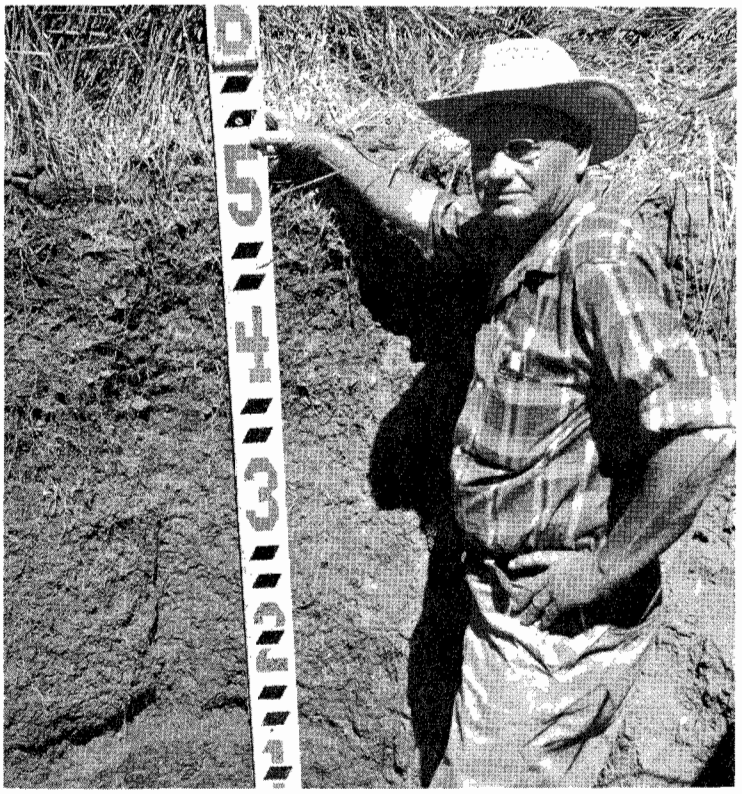
7-719-8

9-1271-7

COVER and GREEN MANURE CROPS



2-145-3

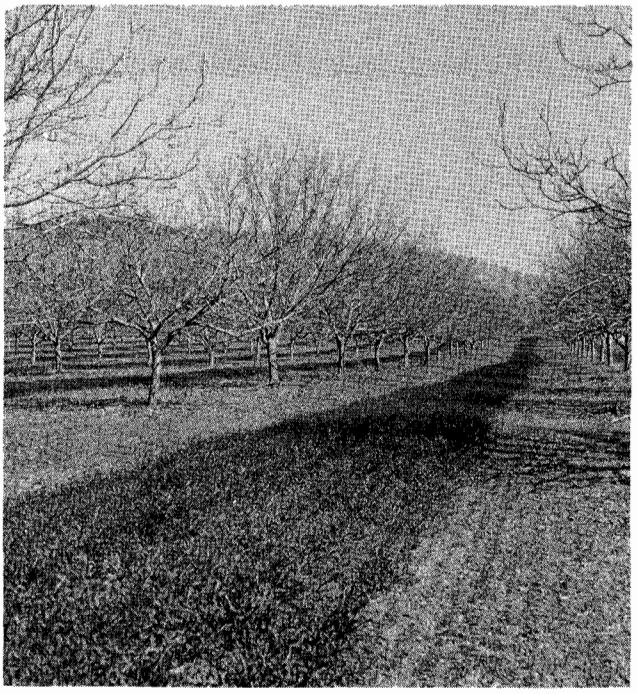


2-145-6

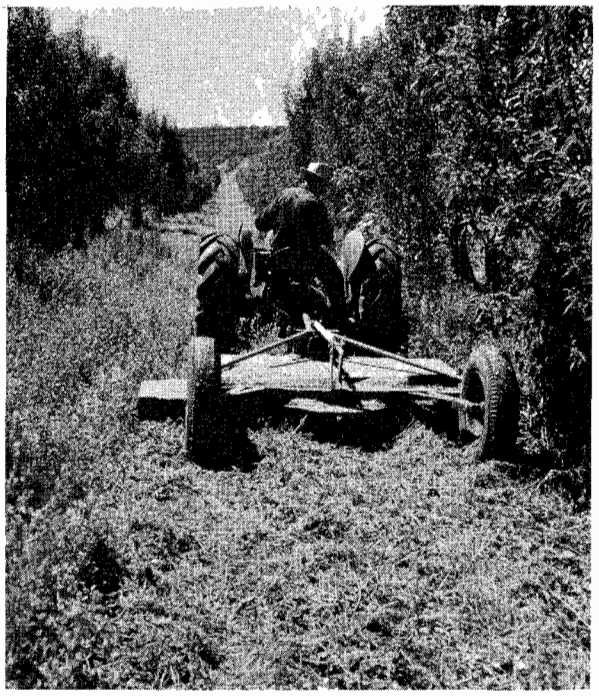
The above two photos show Tall Wheatgrass being grown in the Salt River Valley of Arizona as a winter green manure crop under irrigation.

The two photos below show small grain seeded as a winter cover crop in a walnut orchard and a fertilized annual reseeding orchard cover crop being reduced with a rotary mower.

3-2210-11



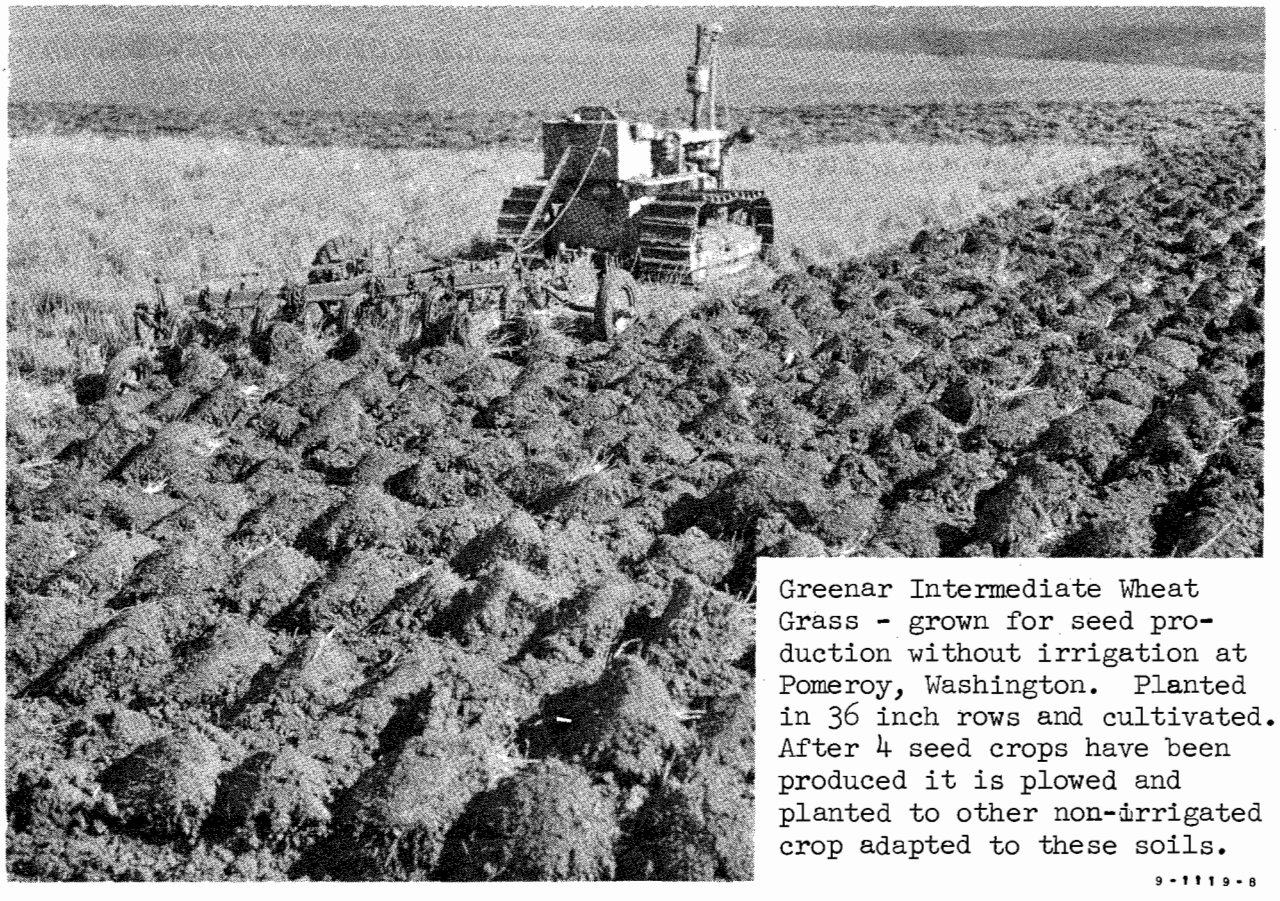
9-1630-8



GRASS - LEGUME SOD CROPS

Soils which are in poor physical condition can be greatly improved by including adapted grass-legume sod crops in the cropping system. 6-221-3

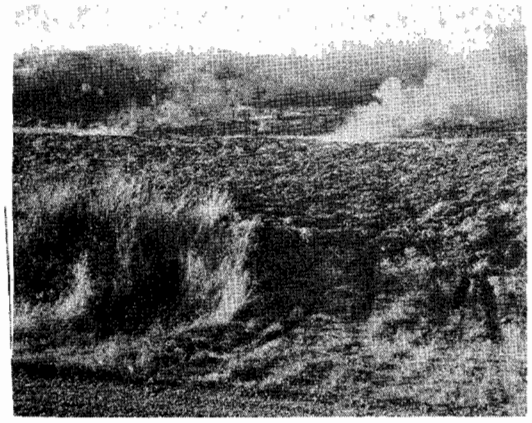
Grass-legume sod crops produce excellent forage for livestock. They also are excellent soil conditioners. Large amounts of fine fibrous roots produced by grasses and legumes help keep soil in good physical condition. Irrigated alfalfa used for pasture and hay in rotation with cotton in Arizona. 2-136-3

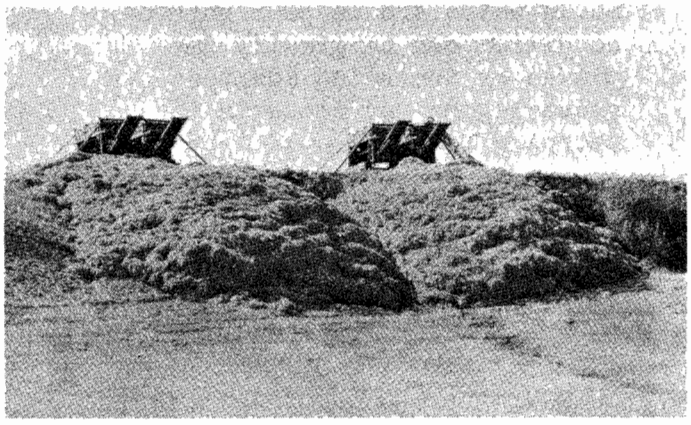


Greenar Intermediate Wheat Grass - grown for seed production without irrigation at Pomeroy, Washington. Planted in 36 inch rows and cultivated. After 4 seed crops have been produced it is plowed and planted to other non-irrigated crop adapted to these soils.

9-1119-8

CROP RESIDUE MANAGEMENT





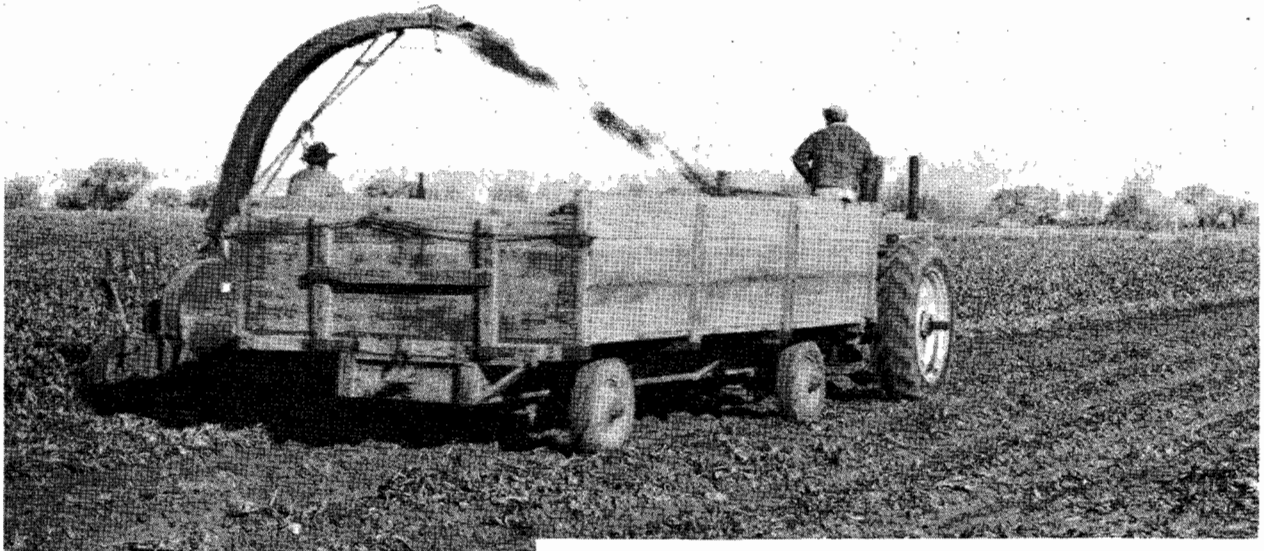
9-2877-2

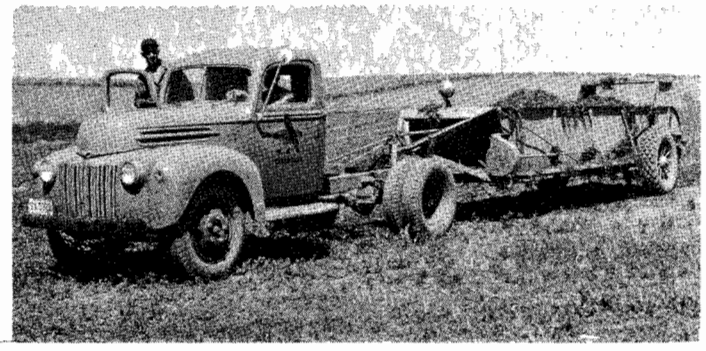
AGR-570

Crop residues should never be destroyed by burning or dumping in gullies as shown in the above two photos. Crop residues when properly conditioned and returned to the soil will help keep the soil alive. The soil needs a continuous supply of organic material returned to keep it in good physical condition.

When crop residues are removed as shown below with sugar beet tops, then manure should be returned to the land.

6-285-7



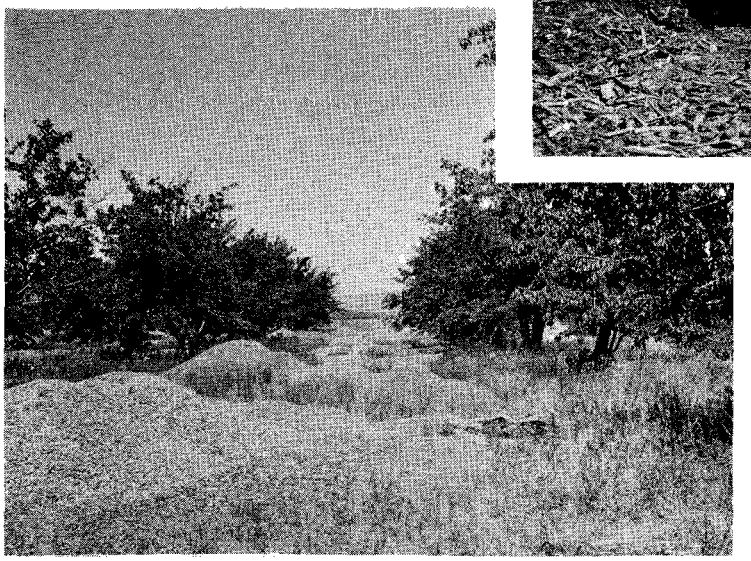


RO-304-1.0

ORGANIC MULCHES

Wood chips applied as a surface mulch and properly balanced with Nitrogen effectively controls soil and water loss and improves soil condition.

3-2084-5



Sawdust and wood shavings being applied as a surface in orchard to add needed organic material and conserve soil and water.

7-567-1

8-388-1

Straw and hay mulch being applied in a citrus grove to add needed organic material and conserve soil and water.