Colorado State University

Cooperative Extension
Colorado State University
Fort Collins, Colorado 80523

AGRON-GRAM

August, 1986

We have several subjects in this newsletter. We have been getting some questions on hail injury to corn. Bob Croissant has put together some information on this subject that should provide information on how to assess hail losses to corn. Since the Soil Testing Laboratory offers a plant analysis service, Hunter Follett and Steve Workman put together an article on plant analysis.

The interdisciplinary Wheat Research/Extension Team of CSU has conducted many fertility experiments for dryland winter wheat in eastern Colorado. Dwayne Westfall, Hunter Follett and Jim Echols have summarized this information in a paper titled "Fertilization of Dryland Winter Wheat -- the Paying Proposition."

Bob Croissant was asked to summarize the annual precipitation for several selected cities in Colorado. This is an interesting table, so we have included it in the newsletter. We have also included a letter from Gary McIntyre and Joe Hill regarding phytosanitary certificates.

We have been trying to write papers and summarize information based on the telephone calls and requests that come into the office. If there is some topic that we should put into the next newsletter, please let us know.

Sincerely,

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R. Hunter Follett
Extension Specialist
Soils

Bob Croissant
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Extension Agronomist
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James W. Echols
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FILE: HAIL DAMAGE CORN
July 1986

HAIL INJURY TO CORN

BY

BOB CROISSANT[1]

In many regions of Colorado, hailstorms can severely reduce corn yields during the growing season. Proper assessment of hail losses will help a producer decide if the field should be replanted or abandoned. If the field is not abandoned, operational and production costs will continue to be incurred with the possibility of drastically reduced yields.

To determine the advisability of replanting, yields expected from the hail-damaged crop should be compared with estimated yields from replanted corn. If late planting occurs, a shorter season variety should be selected, which unfortunately may have less yield potential than full season varieties . Additional costs of seed and equipment must be considered when making your decision.

Critical Periods When Corn Is Susceptible to Hail

Hail occurring prior to emergence causes very little damage. Severe crusting of the soil may occur, preventing adequate stands unless the crust is broken with tillage or softened with water. Occasionally, these methods fail to improve emergence.

At the time of emergence, the growing point is below the surface and remains there for about 3 weeks. (Table 1). From this period until tasseling (about 5-7 weeks), as the plant matures, plant growth is rapid, and sensitivity to hail damage increases with stage of growth. Once tasseling and pollination have occurred, yield losses as a result of hail damage decrease with stage of growth.

[1]Extension Agronomist and Associate Professor, Department of Agronomy

Table 1. Average plant height and growing point locations as a function of days after emergence on Dekalb XL43 and XL64 grown at Dekalb, IL, 1973.

Days after emergence	Plant height (inches)	Average growing point location above ground level (inches)
12	6	0
14	9	0
16	12	0.5
21	20	1
26	30	6
30	36	8-14

Adapted from: Dekalb Crop Management Manual, 1973.

Losses From Stand Reduction

Early in the season, severe hail storms may cause significant stand reductions. An assessment of stand losses should be done about one week after the storm. During the seedling stage, split the plants lengthwise to determine the health of the growing point. If it is whitish-yellow, the plant will survive but if it is discolored and softened, the plant is dying. Hail damage to stalks during the summer months may increase the incidence of plant disease such as stalk rot and smut. If soil fertility is adequate, additional foliar fertilizer applications have not proven beneficial (Hooker et al., 1984). Information is not available to justify application of other products claiming to improve or protect plant health and vigor.

Prior to the 11th leaf stage, field losses because of stand reduction can be estimated by referring to Table 2. To determine the number of plants in the sample area, count the number of plants in 1/100 acre. The sample area needed for 1/100 acre for various row widths can be determined be referring to Table 3. To determine the stage of growth of the plants, the leaves are counted, beginning with the first leaf that is formed (round tipped), up to the indicator leaf. The indicator leaf is the topmost leaf exposed from the whorl whose tip points below a horizontal line. Figure 1 shows a corn plant in the 8-leaf stage. Beginning with the 11th leaf stage, stand reduction and yield are on a one-to-one ratio. (Example: 80% stand = 80% yield potential).

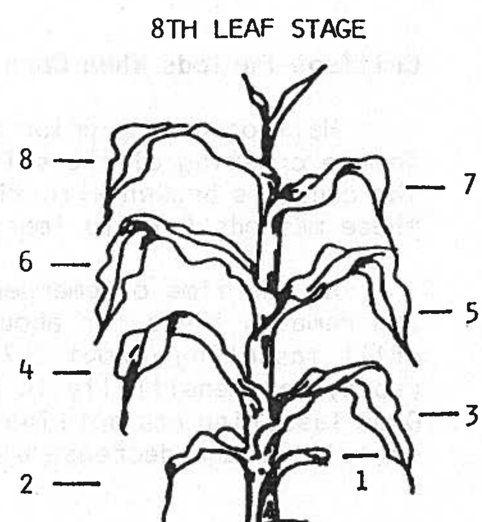

Figure 1. LEAF STAGES ON A CORN PLANT

Yield Reduction due to Defoliation

Yield reduction on corn varies considerably depending on the stage of growth and amount of leaf loss (Table 4). When leaf area is removed, the plant loses its capability to produce dry matter through photosynthesis, resulting in reduced grain yields. The severity of the loss depends on the growth stage and the amount of leaf area removed. Growth stages that must be recognized for defoliation losses include the leaf numbers per plant and subsequent stages as described in Table 5.

Estimating Total Yield Loss of Corn

Total yield loss from hail is estimated by adding the expected yield loss caused by stand reduction and the expected yield loss caused by defoliation. For example, 17% loss by stand reduction plus 9% loss by defoliation = 26% yield loss. The 26% yield loss would equal a 74% potential yield. If the average farm yield is 150 bushels per acre, then yield after hail damage would be 150 x .74 = 111 bushels per acre (See sample worksheet). The estimated yield should be based on four or more samples averaged together depending on the field size and uniformity.

As with undamaged corn, extremely favorable weather during the rest of the growing season can cause actual yields to be higher than expected. Likewise unfavorable weather can cause greater than anticipated yield reductions. Tie or buggy whips may occur, causing the growing point to be bound in the whorl. Other deviations such as lack of pollination due to drought or insects, early freeze, ear damage and insect damage may also change expected yields.

Table 2. Hail stand reduction loss chart - corn.

	Remaining Plants - 1/100 Acre										
	300	280	260	240	220	200	180	160	140	120	100
	% Damage										
300	0	2	4	6	9	12	17	23	29	34	41
280		0	2	5	7	10	14	19	24	30	37
260			0	3	5	7	10	14	19	25	33
240				0	2	4	6	10	15	22	29
220					0	2	4	8	13	20	28
200						0	3	6	11	19	27
180							0	4	9	15	23
160								0	5	11	19
140									0	6	14
120										0	7

To interpolate for 132 remaining plants and 240 original plants:
132 is .6 of difference between 120 and 140 (12 ÷ 20 = .6)
.6 x (chart dif) = % damage
.6 + (22-15) = 4.2
22 - 4.2 = 17.8% (round to 18%) - projected yield loss because of stand reduction

Adopted from: Corn Handbook - Federal Crop Insurance Corp. 1985.

Table 3. Feet of row required for 1/100 acre at various row widths.

ROW WIDTH	ROW LENGTH	ROW WIDTH	ROW LENGTH	ROW WIDTH	ROW LENGTH
20 in.	261 ft.	32 in.	163 ft.	38 in.	138 ft.
28 in	187 ft.	34 in.	154 ft.	40 in.	131 ft.
30 in.	174 ft.	36 in.	145 ft.	42 in.	124 ft.

Table 4. Estimated corn yield reduction due to various amounts of leaf removal at several stages of plant development.

	PERCENT LEAF AREA DESTROYED									
Stage of Growth	10	20	30	40	50	60	70	80	90	100
	---------------- % yield reduction ----------------									
7 Leaf				1	2	4	5	6	8	9
8 Leaf				1	3	5	6	7	9	11
9 Leaf			1	2	4	6	7	9	11	13
10 Leaf			2	4	6	8	9	11	14	16
11 Leaf		1	2	5	7	9	11	14	18	22
12 Leaf		1	3	5	9	11	15	18	23	28
13 Leaf		1	3	6	10	13	17	22	28	34
14 Leaf		2	4	8	13	17	22	28	36	44
15 Leaf	1	2	5	9	15	20	26	34	42	51
16 Leaf	1	2	6	11	18	23	31	40	49	61
17 Leaf	2	4	7	12	20	27	35	45	56	69
18-21 Leaf	3	5	10	17	26	34	44	56	69	84
Tasseled	3	7	13	21	31	42	55	68	83	100
Silked	2	6	11	19	28	38	50	63	78	95
Silks Brown	2	6	11	18	26	36	47	58	71	88
Pre-Blister	2	5	10	16	24	32	43	54	66	81
Blister	2	5	10	16	22	30	39	50	60	73
Early Milk	2	4	8	14	20	28	36	45	55	66
Milk	1	3	7	12	18	24	32	41	49	59
Late Milk	1	3	6	10	15	21	28	35	42	50
Soft Dough	1	2	4	8	12	17	23	29	35	41
Early Dent		1	2	5	9	13	18	23	27	32
Dented			2	3	7	10	14	17	20	24
Nearly Mature				2	5	7	9	12	14	16

Adopted from The National Crop Insurance Association (Rev. 1975)

Table 5. Descriptions of selected growth stages for corn.

Stage	
Tasseled	Tassel fully extended but not shedding pollen.
Silked	Silks have emerged and pollen is being shed.
Silks brown	Pollination almost complete. 75% of silks show purple to brown color.
Pre-Blister	Silks are brown but not dry. Kernel has appearance of a pimple.
Blister	Kernels appear as watery blisters. Kernel fluid is colorless.
Early Milk	Beginning of roasting ear stage. Kernels changing from white to yellow. Thin milky substance in kernels.
Milk	Prime roasting ear stage. Milky fluid in kernels.
Late Milk	Milky fluid thickens and solids begin to form.
Soft Dough	Kernel contents pasty. First few dents show near butt end of ear.
Early Dent	Kernels along entire ear show dent. Kernels will squirt milk when smashed.
Dent	Most kernels dented and can be cut with fingernail. Most kernels will not squirt milk when squeezed.
Late Dent	All kernels dented and drying down from the top. Starch layer begins to form.
Nearly Mature	Hull on opposite side of embryo has a shiny hardened appearance nearly halfway to cob.
Mature	Physiological maturity has been reached and moisture level is below 40%. Dry matter accumulation has ceased.

Adopted from Corn Handbook Federal Crop Insurance Corp. 1985

Literature cited.

Hooker, M.L., M.D. Witt and G.M. Herron. 1984. Response of hail damaged corn to application of nutrients through simulated fertilization. Journal of Fertilizer Issues 1:130-135.

SAMPLE WORKSHEET

		EXAMPLE	YOUR FIELD
1.	STAGE OF PLANT GROWTH.	8th leaf	
2.	ORIGINAL NUMBER OF PLANTS PER 1/100 ACRE.	300	
3.	REMAINING LIVE PLANTS PER 1/100 ACRE.	180	
4.	PERCENT DAMAGE FROM STAND REDUCTION (CHART)*	17	
5.	POTENTIAL REMAINING YIELD [100% - (4)]	83	
6.	PERCENT LEAF AREA DESTROYED	90	
7.	PERCENT DAMAGE FROM LEAF DESTRUCTION (CHART)*	9	
8.	TOTAL PERCENT DAMAGE FROM HAIL (4 + 7)	26	
9.	PERCENT POTENTIAL REMAINING [100% - (8)]	74	
10.	YIELD HISTORY	150	
11.	ESTIMATED REMAINING YIELD (9 x 10) IN BUSHELS PER ACRE	111	

Note: Numbers in parentheses refer to values from the respective step in worksheet.

*BEGINNING WITH THE 11th LEAF STAGE, STAND REDUCTION AND YIELD ARE ON A 1:1 BASIS, e.g., 80% STAND = 80% YIELD POTENTIAL.

PLANT ANALYSIS

BY

R. H. FOLLETT AND S. M. WORKMAN[1]

Plant analysis can be a valuable tool in determining the general nutritional status of crops. It can be particularly helpful in diagnosing nutritional deficiency symptoms because various elements have similar visual symptoms of deficiencies. In some cases symptoms which appear to be caused by nutrient deficiencies may actually be caused by other factors such as disease, herbicide residues, insects, high temperature or low temperature, too much or too little moisture.

Plant analysis should not be confused with tissue testing. In the latter, a special kit is used in the field for quick tests for plant nutrients in the cell sap of certain plant parts. Tissue tests are quick, but largely qualitative in nature. These tests can reveal which elements are present in excessive or deficient quantities, but cannot measure the magnitude of the excess or deficiency. For plant analysis, the whole plant or particular plant parts are analyzed. In addition, the results of plant analysis are reported as precise numerical concentrations which can be compared to previously established critical levels and sufficiency ranges.

Collecting and Handling Plant Tissue Samples

Plant sampling is frequently the most limiting factor in a successful plant analysis program. Extreme care should be exercised in selecting the plant part to be sampled because of large variations in nutrient concentrations among different parts on the same plant. Proper sampling requires that a definite plant part be taken such as a particular leaf, group of leaves, or portion of a plant at a specified time in the plant growth cycle. When no specific sampling instructions are given for a particular crop, the general rule of thumb is to sample the most recently matured leaves. Young emerging leaves, older mature leaves, and seed are not considered suitable plant tissues for analysis since they do not ordinarily reflect the general current nutrient element status of the whole plant. The recommended time to sample many plants usually occurs just prior to the beginning of the reproductive stage.

Accurate plant analysis requires that plant tissue samples be carefully collected and handled prior to shipment to the laboratory. Elemental compostion of plants varies with age, the portion of the plant sampled and numerous other factors. Therefore, it is essential to follow standard sampling procedures (See Table 1).

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[1]R.H. Follett, Professor and Extension Specialist (Soils), and S. M. Workman, Research Associate, Department of Agronomy.

Once the plant has been sampled, proper handling of the sample becomes of utmost importance. If the plant to be sampled is dusty, dust off with a light brush. Washing may be employed to remove contaminants, but caution should be practiced as some nutrients can be leached out or the sample contaminated by water. Use distilled water if possible. In order to prevent spoilage of the plant material, it is important that the sample be thoroughly air-dried prior to mailing to a laboratory for analysis. Fresh plant tissue will decompose rapidly when placed in polyethylene bags or tightly sealed containers unless kept under refrigeration. Place samples in a clean paper or cloth container. Close and seal shipping container to avoid contamination.

Table 1 Plant sampling instructions

Plant	Stage of Growth	Plant Part to Sample	Number of Plants to Sample
Corn	Less than 12" tall	Whole plant	20-25
	12" to pre-tassel	Uppermost fully developed leaf	25-30
	Tasseling to silk initiation	Leaf below and opposite ear leaf	25-30
Small Grain and forage grasses	Seeding to heading	Whole plant	80-100
	Early heading	Top 4 leaves	80-100
Alfalfa or clover	1/10 bloom	Top 6" of plants	40-50
Soybeans	Initial flowering to pod set	Uppermost fully developed trifoliate	40-50
Sunflowers	Prior to or at early flowering	Uppermost fully developed leaf	25-30
Grain sorghum	Prior to head emergence	2nd fully developed leaf	25-30

Interpreting Plant Analysis

The success of plant analysis as a diagnostic technique depends on the interpretation of the test results. The procedure used by many plant analysis laboratories is to compare the elemental concentration found in the plant tissue against a sufficiency range found in normal plants as established by research. Plant analysis has not been conducted to establish "sufficiency ranges" for crops grown in Colorado. However, plant analysis is very useful in identifying plant growth problems resulting from nutrient stress if paired plant samples can be taken from both good and poor areas in the field where the same variety, soil moisture and environmental conditions exist.

Notes About Plant Sampling and Analysis

1. It is often easier to diagnose nutritional disorders if a plant sample is taken from both good and poor areas within a field.

2. Soil samples taken from both the good and poor areas within a field along with plant samples can increase the chances of correctly determining the problem.

3. Severely nutrient deficient plants can have very erratic nutrient concentrations in the tissue due to growth under severe stress. In fields with severely deficient plants, it can be helpful to sample some plants which are normal or nearly normal but near severely deficient plants.

4. In some cases, extreme plant stress such as drought, heat, cold, insects or disease can cause excessive variation in the nutrient concentrations of plant tissue

5. When sending plant samples to a lab for problem diagnosis, also send a note listing conditions under which the plants were growing such as soil type, moisture, position on the landscape, cropping history, fertilizer and chemicals applied this year and in recent years and a description of the problem.

6. Even though it is often too late to fertilize after deficiencies are discovered through plant analysis, it is important to recognize a problem exists so corrective fertilizer applications can be made for the next crop.

7. Yield losses due to a nutrient deficiency usually occur before the deficiency is severe enough to cause visual symptoms.

The CSU Soil Testing Laboratory provides a plant analysis service. The routine analysis for plants costs $15.00 and includes N, P, K, Zn, Fe, Cu, Mn, Ca, Mg, Na, and B. Plant Sulfur costs an additional $2.50.

Samples should be sent to:
Soil Testing Laboratory
Colorado State University
Ft. Collins, CO 80523

FERTILIZATION OF DRYLAND WINTER WHEAT - THE PAYING PROPOSITION

by

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Dryland winter wheat producers in the western Great Plains have gained a new interest in fertilizing their crops. Estimates in 1978 show less than 5% of the acreage was fertilized with any form of fertilizer. Currently, over 65% of the acreage receives N. Phosphorus fertilization is still in its infancy in the western Great Plains Region. It is estimated that less than 15% of the total acreage receives P fertilizer.

The question arises, "Which fields will respond to N and/or P fertilizer?" Use of calibrated soil tests is the best way to answer the question. The application of N or P fertilizer to fields that have adequate nutrient availability results in no return to fertilizer dollar input. Conversely, proper fertilization of fields that are deficient in N or P will result in large returns to fertilizer dollar input. Soil testing, in conjunction with a proper fertilizer management program, is the key to obtaining maximum economic yields of dryland winter wheat.

Since 1981, the Interdisciplinary Wheat Research/Extension team of CSU has conducted many fertility experiments in the dryland winter wheat area of eastern Colorado (Westfall et al., 1984; Follett et al., 1984; Goos et al., 1982 and Russell et al., 1986). Annual precipitation in this area varies from 12 to 18 in/year. The following information is a summary of our findings plus related results from studies conducted in adjoining states.

N FERTILIZATION

Nitrogen fertilizer experiments have been conducted at 66 locations since 1981. Sixty-four per cent (Table 1) of these sites responded to N fertilizer with yield increases ranging from 5 to 28 bu/A. Average grain yield response at the 64 sites was 12 bu/A, as a result of N application. The magnitude of response to each increment of N fertilizer is shown in Figure 1. Yield response did not maximize until the 60 lb N/A rate was exceeded. Application of the first 30 lb N/A resulted in a 9 bu/A increase in yield. An increase of 0.4% in protein content also occurred with the 30 lb N/A application (Figure 2). The increase in protein as a function of N fertilizer application was linear. High-protein wheat often brings a premium price in the market place.

Protein content has also been shown to be a post-harvest indicator of N sufficiency of winter wheat (Goos et al., 1982). This relationship is shown in Table 2. If the protein content is less than 11.1%, it is likely that yields were limited by an N deficiency. Application of N fertilizer would probably increase yields and protein content. In the range of 11.1 to

12.0% protein, the probability of N limiting grain yield is much smaller. Applying N fertilizer may not increase yield, but it is likely that it would increase protein content. When the protein content is greater than 12%, N availability is probably not limiting yield but would still increase protein content. Grain protein as a post-harvest indicator of N sufficiency is an educational tool. Farmers usually know if a field produces "high" or "low" protein content grain. Thus, the criteria presented in Table 2 can be used to show the farmers their probable need to alter their N fertilizer management program. A proper N management program is vital if growers are to achieve maximum economic yields and produce wheat of good milling and baking quality.

P FERTILIZATION

Winter wheat growers have not adopted good P fertilizer management practices as rapidly as N fertilization. Phosphorus fertility studies have been conducted at 64 sites since 1981 (Table 3). The actual application rates used in these studies were 60 and 120 lb P_2O_5/A broadcast on the soil surface before planting with no additional incorporation. Other research we have conducted has shown that the relationship between broadcast and incorporated P is 3:1. Therefore, 60 and 120 lb broadcast is equivalent to 20 and 40 lb P_2O_5 incorporated. Incorporation equivalents are used throughout this discussion. Thirty-three per cent of these sites responded to P fertilizer, ranging in yield response from 2.4 to 16.3 bu/A. The average yield response to P has been 5.2 bu/A; much smaller than the 12 bu/A average yield increase observed with N fertilization. The maximum yield response usually occurs with the application of about 40 lb P_2O_5/A broadcast-incorporated applied on low soil testing P fields. When soil-test P is at the high end of the medium range or greater, the probability of a yield increase is small.

Proper placement of P is very important and the effectiveness of different placements is dependent upon soil-test P level. On low P soil testing fields, the advantage of row application to broadcast-incorporated application may be as great as 3:1 (Peterson et al., 1981). This means that three times as much P applied broadcast-incorporated is required to produce the same yield response as a given amount of P row-applied with the seed. On medium soil test level soils, this advantage decreases markedly and there may be no advantage to applying P fertilizer in the row as compared to broadcast. McConnell et al. (1986) concluded that knifing P prior to planting, application with the seed, and dribbling the P directly over the row were all equal in terms of yield response. Dual N-P application is a good method of application and under certain conditions may result in higher P uptake and yield than other methods (Hanson, 1984; Leikham et al., 1983; Maxwell et al., 1984; and Kissel, 1984). Phosphorus fertilizer applied on the surface and left unincorporated is a very inefficient method of application. Three or four times as much P may be needed to get the same yield response as incorporated P. As can be seen from the results cited above, proper P placement is critical to efficient fertilizer use.

N AND P FERTILIZER INTERACTIONS

The interaction between N and P availability on plant growth has been documented. This interaction is often highly visible on dryland winter wheat. Yield response to N fertilizer will be limited if the P requirement of the crop is not satisfied. This interaction is shown in Figure 3, which is the average of data from 9 experiments conducted on P-deficient soils in 1985. The application of 60 lb N and no P_2O_5 resulted in no significant increase in yield as compared to no N fertilizer. However, when 20 or 40 lb P_2O_5/A was applied with the N, a yield increase of about 4 bu/A was obtained. This graphic representation of the interaction of N and P fertilizer on dryland winter wheat yields demonstrates the need for proper use of P fertilizer and the interdependence of N response on P availability, if P is a yield-limiting nutrient.

SUMMARY

Proper use of N and P fertilizer is necessary to maximize profits in the production of dryland winter wheat. Soil testing is a key step in determining which fields should be fertilized and which fields will not give an economic return to fertilizer dollar input. Approximately 65% of the fields in eastern Colorado are deficient in N and should receive N fertilizer. Approximately 33% of the fields are deficient in P. Grain yield responses to P average about 5.2 bu/A, while responses to N have averaged 12 bu/A. If P is limiting growth, the maximum response to N fertilizer will not occur. The proper rates of both N and P are necessary for maximum economic yields and good milling and baking quality of dryland winter wheat in the western Great Plains Region.

REFERENCES

Follett, R. H., D. G. Westfall, J. W. Echols, J. S. Quick, V. J. Labhsetwar, and P. N. Soltanpour. 1984. Phosphorus fertilization of dryland winter wheat in eastern Colorado. Colorado State Univ. Exp. Sta. PR. 14.

Goos, R. J., D. G. Westfall and A. E. Ludwick. 1982. Nitrogen fertilization of dryland winter wheat in eastern Colorado. Colorado State Univ. Ext. Serv. SIA No. 554.

Goos, R. J., D. G. Westfall, A. E. Ludwick and J. E. Goris. 1982. Grain protein content as an indicator of N sufficiency for winter wheat. Agron. J. 74:130-133.

Hanson, R. L. 1984. Phosphorus transformations of dual nitrogen and phosphorus application. M.S. Thesis, Colorado State University, Fort Collins, CO.

Kissel, D. E. 1984. Effects of P source and method of N-P application on phosphorus availability of winter wheat. J. Fert. Issues 1:125-129.

Leikham, D. F., L. S. Murphy, D. E. Kissel, D. A. Whitney and H. C. Moser. 1983. Effects of nitrogen and phosphorus application method and nitrogen source on winter wheat grain yield and leaf tissue phosphorus. Soil Sci. Soc. Am. J. 47:530-535.

Maxwell, T. M., D. E. Kissel, M. G. Wagger, D. A. Whitney, M. L. Cabrera and H. C. Moser. 1984. Optimum spacing of preplant bands of N and P fertilizer for winter wheat. Agron. J. 76:243-247.

McConnell, S. G., D. H. Sander, and G. A. Peterson. 1986. Effect of fertilizer phosphorus placement depth on winter wheat yield. Soil Sci. Soc. Am. J. 50:148-153.

Peterson, G. A., D. H. Sander, P. H. Grabouski, and M. L. Hooker. 1981. A new look at row and broadcast phosphorus recommendations for winter wheat. Agron. J. 73:13-17.

Russell, R. E., D. G. Westfall and K. A. Barbarick. 1986. Fall and spring nitrogen fertilization of dryland winter wheat. Colorado State Univ. Agr. Exp. Sta. TR86-8.

Westfall, D. G., R. H. Follett, J. W. Echols, J. S. Quick and R. L. Croissant. 1984. Nitrogen fertilization of dryland winter wheat in eastern Colorado. Colorado State Univ. Exp. Sta. PR.14.

Table 1. Response of dryland winter wheat to N fertilizer.

Year	Total Sites	Site Response to N No.	Site Response to N %	Yield Increase Range (bu/A)	Yield Increase Average (bu/A)
81-82	17	12	71	5-28	14
82-83	19	10	53	6-19	12
83-84	-	-	-	-	-
84-85	18	12	67	6-21	12
85-86	12	8	67	5-12	10
SUMMARY	66	42	64	6-20	12

Table 2. Guidelines for interpreting dryland winter wheat grain protein-nitrogen nutrition levels.

Protein level	Interpretation
Less than 11.1%	Yields may be significantly limited by nitrogen deficiency. More nitrogen fertilizer would probably increase yields and protein content.
11.1-12%	Yields may have been limited by nitrogen deficiency. Applying more nitrogen fertilizer may not increase yield but will increase protein content.
Greater than 12.0%	Yields were probably not limited by nitrogen deficiency. Application of more nitrogen probably will not increase yield but will increase protein content.

Table 3. Response of dryland winter wheat to P fertilizer

Year	Total Sites	Site Response to P		Yield Increase	
		No.	%	Range	Average
				--------(bu/A)--------	
81-82	3	2	-	4.7-6.1	5.4
82-83	19	6	32	2.4-8.5	4.7
83-84	17	2	12	2.7-3.6	3.2
84-85	18	7	39	2.8-16.3	4.8
85-86	7	4	57	5.0-12.3	7.8
SUMMARY	64	21	33	3.5-9.4	5.2

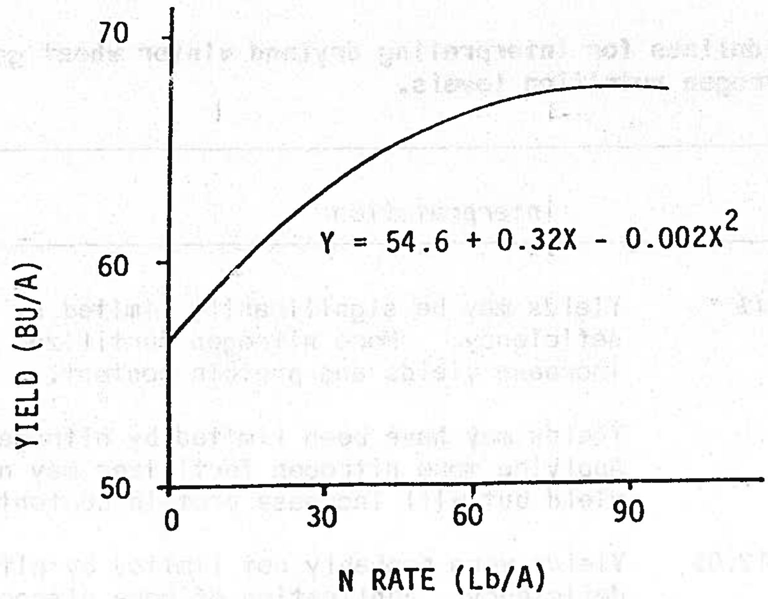

Figure 1. Yield response of dryland winter wheat to N fertilizer.

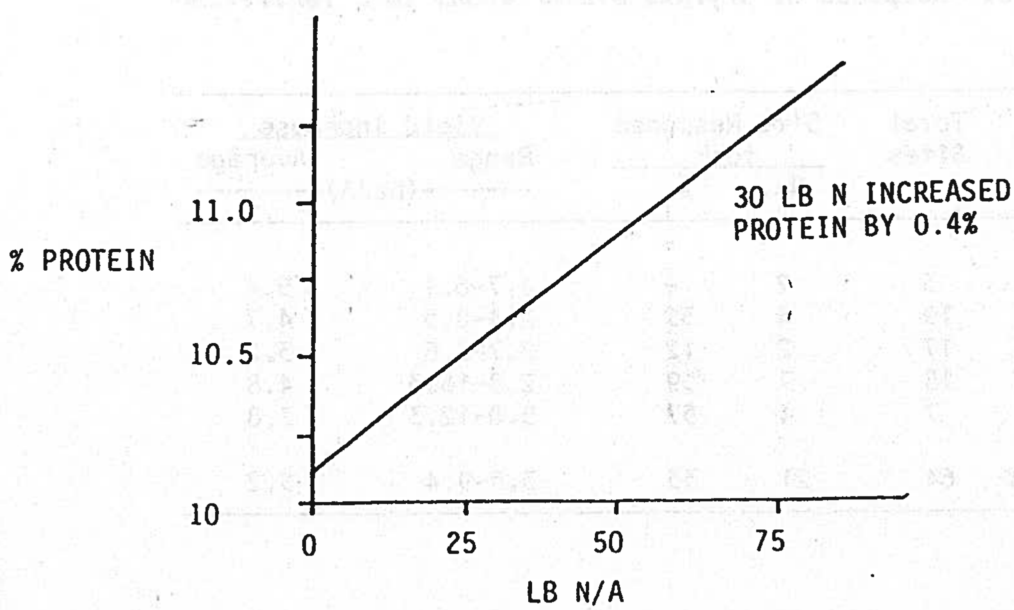

Figure 2. The relationship between N rate and protein content.

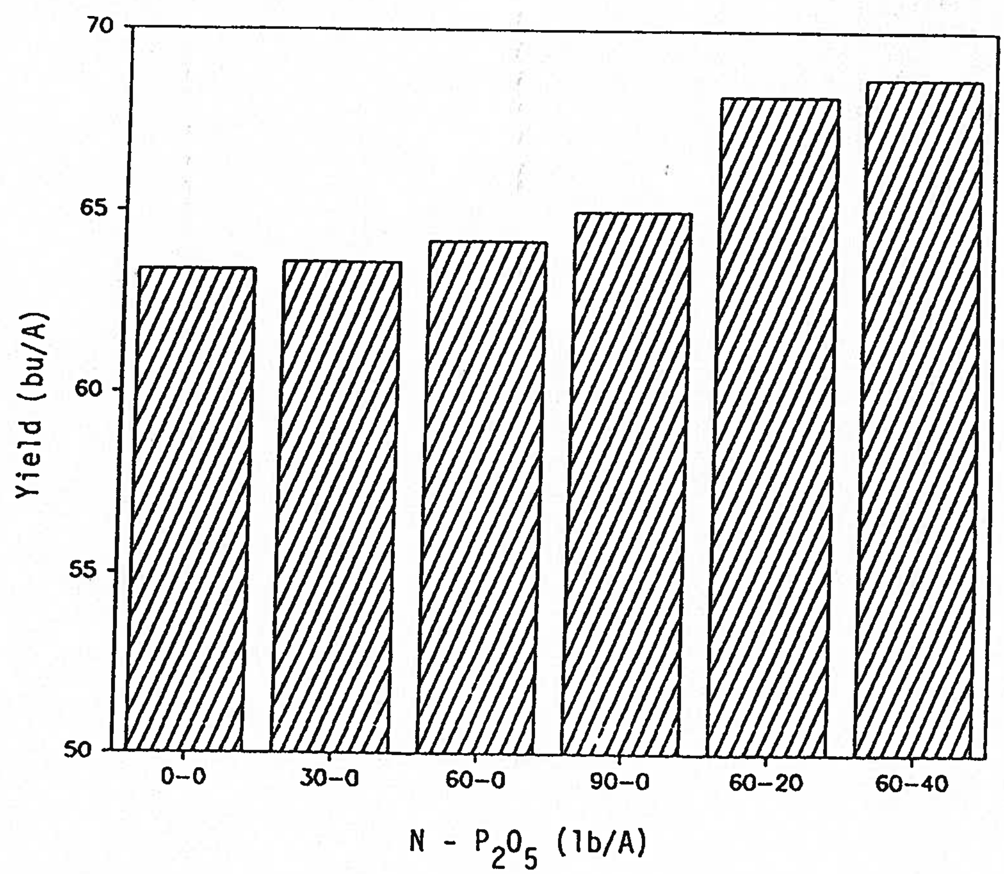

Figure 3. The interaction of N and P fertilization on yield.

File: PHYTOSANITARY CERTIFICATES
JULY 1986

PHYTOSANITARY CERTIFICATES

by

Gary A. McIntyre, Professor and Head, and Joseph P. Hill, Associate Professor, Department of Plant Pathology and Weed Science
Colorado State University

Phytosanitary certificates may be required by other countries to assure that certain pests are not found in crops or crop products that are to be exported. The crops must be inspected in the field while green tissue remains on the plants and sometimes a second field inspection is necessary, depending upon the crop and pests listed for a particular country. Requests for phytosanitary certifications must be made early enough to schedule field inspections.

Certificates are issued by the State Department of Agriculture, and requests for phytosanitary inspections should not be directed to individuals at Colorado State University. Inspection requests should be addressed to Les Aermeuhlen, Colorado Department of Agriculture, 1525 Sherman Street, Denver, Colorado 80203.

File: ANNUAL PRECIPITATION SUMMARY
AUGUST, 1986

ANNUAL PRECIPITATION FOR SELECTED CITIES IN COLORADO DURING 1951-1980

	AKRON	BURLINGTON	FT. COLLINS	FT. MORGAN	FRUITA	GREELEY	HOLYOKE	LA JUNTA	LAMAR	LAS ANIMAS	LONGMONT	ROCKY FORD	STERLING	WALSENBURG		TOTAL	MONTHLY MEAN
JAN	.33	.33	.42	.24	.67	.36	.36	.31	.45	.32	.39	.28	.31	.58	JAN	5.35	.38
FEB	.30	.33	.40	.21	.53	.28	.37	.26	.33	.30	.41	.24	.21	.80	FEB	4.97	.35
MAR	.93	.90	1.07	.56	.75	.82	1.06	.63	.88	.61	.91	.59	.70	1.27	MAR	11.68	.83
APR	1.27	1.37	1.75	1.20	.69	1.47	1.55	1.06	1.24	1.09	1.70	1.14	1.27	1.72	APR	18.52	1.32
MAY	3.08	2.72	2.79	2.53	.74	2.50	3.28	1.80	2.54	2.04	2.58	1.64	3.03	1.89	MAY	33.16	2.37
JUN	2.44	2.27	1.75	1.92	.43	1.76	3.39	1.10	2.15	1.49	1.61	1.27	2.59	1.09	JUN	25.26	1.80
JUL	2.75	2.22	1.56	1.91	.58	1.26	2.62	2.12	2.19	2.27	1.09	1.90	2.52	2.11	JUL	27.10	1.94
AUG	1.79	2.07	1.52	1.44	.97	1.24	1.97	1.42	2.01	1.58	1.17	1.47	1.74	1.84	AUG	22.23	1.59
SEP	1.03	1.30	1.09	1.14	.68	1.20	1.31	.84	1.05	.93	1.23	1.02	1.02	.96	SEP	14.80	1.06
OCT	.78	.86	1.05	.63	.84	.86	.85	.71	.74	.79	.92	.75	.84	1.07	OCT	11.69	.84
NOV	.59	.54	.62	.40	.67	.56	.51	.50	.60	.53	.58	.48	.46	.89	NOV	7.93	.57
DEC	.37	.41	.45	.25	.65	.37	.36	.27	.35	.26	.41	.25	.33	.70	DEC	5.43	.39
TOTAL:	15.66	15.32	14.47	12.43	8.20	12.68	17.63	11.02	14.53	12.21	13.00	11.03	15.02	14.92		188.12	1.12

Source: National Oceanic and Atmospheric Administration. Asheville, NC. 28801-2696