Use of a contest based on net economic return to promote conservation tillage[1]

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ABSTRACT

A contest based on economic return related to land area was conducted among farmers from 1982 to 1984 to show soil could be conserved using no-till or till-plant systems while producing corn (*Zea mays* L.) profitably. Contestants were limited to corn producers using no-till or till-plant systems and having soil losses within the USDA–SEA tolerable T level for each soil. County USDA Soil Conservation Service personnel recorded and reported soil loss and other soils information, and participants provided records of actual fertilizer, pesticide, and seed inputs and all field operations. Grain yield and moisture content were measured and recorded under the supervision of county agricultural extension agents. Production costs were calculated using each contestant's variable inputs, calculated grain drying costs and custom rates for field operations, and by charging for land based on estimated corn yield potential for each soil. Placings were based on net economic return per hectare, which was gross economic return per hectare (yield × standard corn price) minus production costs per hectare. In 2 of the 3 yr, best net return per hectare was obtained by a farmer not placing first in yield per hectare, although top-placing contestants generally had higher yields than moderate to low placings. Total production cost per hectare was greatest for top-placing contestants, but this was more than balanced by increased yield. Top-placing contestants tended to farm more expensive land, use more crop rotation, plant earlier, use later-maturity hybrids, and harvest earlier than moderate to low placings. The participants' experience with no-till or till-plant systems ranged from 1 to 20 yr and averaged 5.4 yr. Over two-thirds of the participants' total corn hectares were planted using no-till or till-plant systems. The primary reasons given for entering the contest were for personal education and comparison of one's production practices with those of others. Most believed contest return per hectare (calculated) was similar to their actual return.

Additional index words: **Corn producers, Yield contests, Agricultural education.**

CORN (*Zea mays* L.) yield contests have utilized human competitive natures for many years to promote new crop production practices. A major emphasis of university extension and governmental agencies is on technologies for soil erosion control by reduced or conservation tillage. Conservation tillage divisions have been incorporated into many ongoing yield contests, and educational groups have begun new yield contests in which eligibility depends on use of conservation tillage practices in the contest field. These contests are used with other traditional educational and promotional methods to display successful conservation tillage usage by leading crop producers.

A problem with yield contests is that economic factors are often disregarded in efforts to produce best yields. For example, excess fertilizer beyond profitable levels may be applied, or a high-yielding but late-maturing corn hybrid may be planted, despite high harvest grain moisture and drying costs. Increased yields are important to meet world food needs and increase productivity, but acceptance of new technology by farmers depends primarily on his or her perception of the financial benefits. This is especially true with conservation tillage. Surveys indicate that widespread use of soil conservation techniques will only occur when farmers are convinced that such practices improve their enterprise profitability (National Association of Conservation Districts, 1984; Nowak, 1983; Pioneer Hi-Bred International, Inc., 1982.).

In 1981 the Board of Directors of the Wisconsin Corn Grower's Association (WCGA) approached extension personnel at the University of Wisconsin concerning joint sponsorship of a "Wisconsin No-Till Corn Production Contest." The sponsors of the contest perceived an overemphasis on "maximum yields" in research and educational programs, with relatively little regard for economic factors. This contest would decide placings on the basis of net monetary return per land area, not yield. Financial assistance from seed, chemical, and equipment firms was obtained, the USDA Soil Conservation Service (SCS) agreed to cooperate, and the contest was initiated in 1982 and continued during 1983 and 1984. The objective was to promote

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conservation tillage (specifically no-till or till-plant systems) by demonstrating that soil could be conserved while producing corn profitably.

CONTEST APPROACH

A committee (with representatives from the WCGA, SCS, University of Wisconsin departments of agronomy and agricultural economics, and agricultural industry) formulated the following contest rules:

1. All contestants must be members of the Wisconsin Corn Grower's Association. Membership will be waived for Future Farmers of America chapters.
2. Tillage is not allowed before planting. The contest is limited to no-till and till-plant (ridge-till) systems. Stalk chopping is allowed. Anhydrous ammonia (NH_3) may be applied before planting provided: (i) only one knife is used between previous crop rows, and (ii) no substantial disturbance of residue occurs.
3. The contest field must be at least 4.05 ha in one continuous plot of corn. The exception is for fields that are strip-cropped or terraced. In a strip-crop situation, individual corn strips must be at least 20 rows wide and corn strips must total at least 2.025 ha in one continuous 4.05-ha strip-cropped field. Alternating strips, if not corn, must be a close-growing crop such as forage legumes, small grains, or grass.
   A contestant may select the best 4.05 ha in a corn field larger than 4.05 ha and enter this as the contest field. The field that is originally entered must be the same field that is reported on the harvest report form.
4. All fields with slopes greater than or equal to 6% must be planted on the contour. Soil loss computed on the contest field must not be higher than the tolerable T level (USDA–SEA, 1978) designated for the soil involved. Soil loss will be computed using the Universal Soil Loss Equation by county SCS personnel. Percent residue cover must be recorded within 3 weeks after planting. Other general soil information will also be provided by SCS appraisers.
5. The field should be readily accessible from a farm or public roadway.
6. Accurate crop production record forms must be provided by participants. Forms will be given to all entrants.
7. Yield checks will be conducted by "yield-checkers" (county agents), appointed for each county, using National Corn Grower's Association rules (National Corn Grower's Association, 1984). These require that 0.506 ha must be harvested from the contest area with a multiple row harvester. Harvest report forms and rules will be provided to all entrants.
8. Custom rates will be charged for each contestant's specific field and machine operations and chemical application costs based on Wisconsin custom rates publications (Wisconsin Agriculture Reporting Service, 1984a, 1984b).
9. A standard price list will be used per unit for cash inputs (seed, pesticides, fertilizer).
10. Commercial N and micronutrient costs will be based on a standard price per unit for specific form applied. Phosphorous and K costs will be computed on the basis of nutrient removal (at the grain yield obtained) times a standard price per unit. The only manure cost will be for application.
11. Irrigation costs will be the sum of annual ownership costs plus operating costs per centimeter of water applied.
12. Drying costs will be based on standard propane fuel and electricity prices for on-farm, high-temperature drying from reported harvest grain moisture to 15.5% moisture.
13. Land costs will be computed by multiplying \$0.75 by corn yield potential on the particular soil type according to SCS-SOILS-5 forms (Soil Survey Staff, 1978).
14. Interest will be calculated for 6 months on calculated cash inputs using current interest rates.
15. Net return per hectare will be gross return per hectare (yield × standard corn price/Mg) minus production costs per hectare.

Brochures with contest rules, awards, and entry forms were printed and distributed state-wide during February and March before the contest crop season. Entrants returned entry forms to the Department of Agronomy before planting and were mailed three additional materials: (i) a soil information form, (ii) a crop-production record form, and (iii) a harvest rules and report form.

The soils information form was completed by SCS district conservationists in contestant's counties, within 3 weeks of planting. Information on this form included soil series and texture, percent residue cover at planting, percent field slope, estimated potential corn yield per hectare (Soil Survey Staff, 1978), soil loss calculations (based on the Universal Soil Loss Equation), and an outline of conservation practices (terraces, strip-cropping, etc.) used by the producer. The SCS appraiser also attested to whether contest requirements for residue management and soil loss were met.

Crop production records for production cost calculations were kept by contestants, assuming they were honest and accurate in reporting figures. Records included previous crop; planting rate, date, and depth; row spacing; hybrid; herbicide and insecticide rates; N and micronutrient fertilizer forms and rates; irrigation application times and rates; and all field operations. Grain yield and moisture content were measured and recorded under supervision of county agricultural extension agents.

A standard list of per-unit production costs was developed each year by obtaining current chemical and seed prices from a local supplier and by utilizing cur-

rent custom rate charges from the Wisconsin Agriculture Reporting Service (1984a, 1984b) for field and drying operations. All crop chemical product and application costs were based on levels actually applied by growers in the contest year, except for P and K. Instead, P and K fertilizer costs were based on estimated nutrient removal per unit of grain yield (Kelling et al., 1981) multiplied by a standard nutrient price per unit. Similar prices per unit or operation were charged to all entrants, based on the standard cost list, regardless of prices actually paid. Net return per hectare was gross return per hectare (yield × current corn price) minus production costs per hectare.

All completed forms were returned to the Department of Agronomy and compiled by state extension specialists. Top-placing contestants were recognized at the WCGA annual banquet. A top prize of a new tractor and no-till planter for use during spring planting by the entrant with the highest net return per hectare was awarded. Numerous chemical and seed product awards were presented to other top-placing corn producers by cooperating companies. Plaques were presented to the best three placings, and the top-10 participants received certificates.

CONTEST RESULTS

Contest entrants totaled 40 to 45 farmers for 1982 to 1984; 22 to 25 finished the contest (Table 1). Because entries were due before planting, several contestants with subsequent crop performance below expectations (due to weather or management problems) were reluctant to report final results and withdrew from the contest. Forty to 45 contest entrants seems few in Wisconsin, which has over 1.5 million ha of corn (Wisconsin Agriculture Reporting Service, 1984c). However, less than 4% of those hectares are planted using the required no-till or till-plant systems (Conservation Tillage Information Center, 1984). The somewhat lengthy forms may have also limited participation.

In 1982 and 1984, best net return per hectare was obtained by a farmer with the fourth (1982) and second (1984) highest grain yield (Table 1). In 1983, the participant with the best yield also had the best net return. Total production cost per hectare was greatest for top-placing contestants, but this was more than offset by increased yield (Table 2). Land and drying costs contributed most to increased costs of top-placers compared with lower-placers (Table 2). Herbicide and insecticide costs were lower for the top group. Costs for field operations, fertilizer and seed were relatively similar for all contestants.

Table 1. Number of contestants and net return and yield ranges and averages for participants in the Wisconsin No-Till Corn Production Contest (1982–1984).

Item	Year		
	1982	1983	1984
No. of contestants	25	25	22
Highest net return ($/ha)	470.73†(190.58)‡	781.16 (316.26)	464.41 (188.02)
Yield rank	4	1	2
Lowest net return ($/ha)	−22.28 (−9.02)	38.93 (15.76)	2.05 (0.83)
Yield rank	25	24	22
Average net return ($/ha)	102.43 (41.47)	388.41 (157.25)	246.36 (99.74)
Highest yield (Mg/ha)	12.9 (205.7)§	12.2 (194.5)	12.0 (191.3)
Net return rank	18	1	2
Lowest yield (Mg/ha)	2.8 (44.6)	4.5 (71.7)	6.0 (95.7)
Net return rank	25	21	22
Average yield (Mg/ha)	9.0 (143.5)	8.3 (132.3)	9.1 (145.0)

† Figures used to calculate gross returns and production costs varied each year. For example, a corn price of $98.33/Mg ($2.50/bushel) was used in 1982 and 1984, and $118.00/Mg ($3.00/bushel) was used in 1983.
‡ Figures in parentheses are $ per acre.
§ Figures in parentheses are bushels per acre.

Concerns About Contest Rules

Overall response to the contest was favorable, but several questions about its format generated considerable discussion and sometimes controversy, which heightened interest. Some individuals wondered why the contest was limited to no-till and till-plant systems. It was suggested that the contest would be of greater value if economic comparisons of different tillage systems was allowed. The original intent of the contest was not to compare tillage systems, but instead to display techniques skilled farmers used to grow corn profitably with the most extreme forms of reduced tillage (i.e., no-till, till-plant systems) and to keep soil loss within USDA–SEA tolerable levels. An expanded contest, without the tillage restriction, is being considered for use in subsequent years.

The contest rules specified use of standard per-unit

Table 2. Mean net return, costs, and production factors for the first five placing contestants compared to remaining placings in the Wisconsin No-Till Corn Production Contest (1984).

Item	Return or costs			
	First five placings (avg)		Remaining 17 placings (avg)	
	$/ha	$/acre	%	
Net return	396.92	(160.70)	70†	
Total production cost	684.71	(277.21)	93	
Land	243.79	(98.70)	88	
Cash inputs	247.79	(100.32)	106	
Fertilizer	128.24	(51.92)	101	
Herbicide	39.52	(16.00)	130	
Insecticide	9.34	(3.78)	141	
Seed	56.66	(22.94)	97	
Interest on cash inputs	14.03	(5.68)	83	
Field operations	95.96	(38.85)	108	
Drying	97.17	(39.34)	56	
Other production factors				
Yield (Mg/ha)	11.0	(175.4)‡	8.6	(137.1)
Hybrid relative maturity (days)	107.8		104.1	
Planting date (days after 1 May)	8.4		11.7	
Harvest date (days after 1 Oct.)	29.2		37.1	
Harvest grain moisture (%)	24.5		22.0	

† Expressed as a percentage of the first five placings.
‡ Yield in bushels per acre.

production costs for calculating return per unit area. Some critics suggested these standards "built-in" control of the contest and removed managerial skills as a factor. We were not interested in a contestant's ability to reduce costs by negotiating with landlords or suppliers or by making volume purchases. Many contestants had access to fields with a range of soil types and had the option to enter a contest field on "expensive" land with very high yield potential or to enter "cheaper" land with lower yield potential (see rule no. 13). Contestants had to decide whether the additional yield benefit resulting from an operation or chemical application would cover the extra cost. Planting rates, and form, rates, and timing of pesticide and N fertilizer applications were determined by contestants.

Critics were correct in charging that P and K fertilizer costs were "fixed" instead of "actual" since the basis for these costs was nutrient removal at the yield obtained (see rule no. 10). It was deemed inappropriate to charge directly for actual application of these nutrients in a particular year. It is possible on most soils to buildup soil P and K to very high levels, and then avoid application of these nutrients for several years with no adverse influence on corn yields (Bundy, 1985). Perhaps soil test, rather than yield, should be used as a basis for P and K costs in future contests. However, our current rules do reward the long-term management of those who have established high P and K levels over a period of time and consequently produce high yields under no-tillage systems. Uptake of P and K can be limited under such systems if soil levels of these nutrients are not elevated before switching from conventional tillage (Bundy, 1985).

Examples of Educational Benefits to Contestants

The contestant with highest yield in 1984 placed second in return per hectare (Table 1), with a return only $25/ha behind the winner. The grower was charged for an aerial insecticide application to control European corn borer (*Ostrinia nubilalis* H.), which cost an extra $37/ha for insecticide and aerial application (using standard costs). This farmer indicated that, in hindsight, he was uncertain the application was economically justified, and that he planned to more carefully evaluate insect economic threshold levels before applying insecticides in the future. In the usual yield contest, this re-assessment may not have appeared important to the grower.

Participants had to evaluate tradeoffs between hybrid-maturity, harvest date, harvest losses, and drying costs. For example, in 1982 the farmer with best yield placed 18th of 25 contestants (Table 1) due to planting of a late-maturity hybrid, which caused wet harvest grain moisture content and unprofitably high drying costs. In general, top-placing contestants tended to plant earlier, but slightly later hybrid-maturities were used (Table 2). They harvested earlier, which increased harvest grain moisture content and drying costs, but presumably lowered harvest losses.

Economic benefits of crop rotations in no-till or till-plant systems were apparent. In 1982, 40% of the contestants planted corn into previous-crop residue other than corn, and this percentage increased to 64% in 1983 and 1984. In all years, six or more of the top-10 placing contestants rotated crops, and in 1984 farmers with the first five placings planted corn into soybean [*Glycine max* (L.) Merr.] or alfalfa (*Medicago sativa* L.) residue.

Fertility credits for manure were not charged contestants; only field application costs were assessed. Approximately one-third of contestants applied manure to supplement fertility needs, despite the prohibition on incorporation of surface residue in the contest.

Many superb managers did not place well in the contest due to difficult circumstances (dry weather, hail, herbicide or insecticide failures, etc.), or to inherent soil limitations in corn yield potential. Unfortunately, such circumstances are part of any crop contest and of crop production economics in general.

Survey of Contest Participants

A survey was mailed in 1984 to the 22 contestants to obtain information on types of farmers entering and completing the contest and to evaluate attitudes about participation. Average age of the 17 participants who responded to the survey was 40.4 yr, with seven respondents under 35 yr and only three older than 50 yr. Experience with no-till or till-plant systems ranged from 1 to 20 yr and averaged 5.4 yr. One-third of the respondents had $\leq$ 2 yr experience with these systems. Farms were about equally distributed between cash grain, dairy, other livestock, and combined grain-livestock operations. Average land area planted to corn was 153 ha, with a range of 28 to 486 ha. Over two-thirds of this land was planted using no-till or till-plant systems and one-half the responding farmers planted their entire corn crop using these conservation-tillage systems.

Long-term usage of no-till or till-plant systems was not a prerequisite for a top placing; four of the first five finishers had $\leq$ 2 yr experience with these systems. The bottom five finishers tended to raise less corn than the average; land area planted to corn for these contestants was $<$ 70 ha. There was no relationship between contest placing and a contestant's age or type of farm operation.

Thirty-five percent of the contestants entered primarily to improve their corn production by comparing personal production practices with those of others. Four farmers entered mostly for competitive reasons, while others participated to help promote conservation tillage or because someone (seed dealer, county agent, neighbor) suggested they enter. Sixteen of 17 respondents believed contest net return per hectare was similar to their actual economic return and several commented that a contest on this basis was more beneficial or realistic than one based solely on best yield per land area. One contestant expressed concern about potential misrepresentation of input costs by dishonest par-

ticipants and another believed his contest land charges were unrealistically low.

Methods Used to Inform the Public about Contest Results

The contest received widespread, national publicity in educational publications, meetings, and conferences. All major state farm magazines and newspapers featured articles on the top-placing entrants and their production methods and costs. More than 2000 copies of leaflets containing production details for the top-10 placing farmers were distributed annually by Wisconsin Corn Grower's Association members, county extension agents, and SCS personnel at winter educational meetings. These groups used this information to show on-farm examples of profitable crop production with conservation tillage methods. Articulate farmers who placed well in the contest were speakers at local meetings, explaining to neighbors how contest results compared to their entire corn crop. The 1983 winner was featured in two major national farm magazines and was invited to present a farmer's view of the economic benefits of conservation tillage at a national symposium of leading researchers, educators, agricultural industry representatives, and governmental agency heads (Awe, 1984).

Contest results have also been useful to Wisconsin researchers in the departments of agronomy and soil science to evaluate acceptance of recommended practices and to identify new research problems in conservation-tillage corn production systems.

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