An Economic and Agronomic Evaluation of Selected Wheat Planting Methods in Arkansas

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ABSTRACT

The four most commonly used methods of seeding wheat *(Triticum aestivum)* in the lower Mississippi River Valley are conventionally drilled into prepared seedbed (DP), broadcast incorporated (BI), drilled no-till (DN), and broadcast unincorporated (BU). The objective of this study was to determine the effects of the above wheat seeding methods on net returns, yields, yield components, and stand establishment. Experiments were conducted at four locations over a period from 1992 to 1995. Grain yields were adjusted to a constant 13 % moisture content. Yield components of culms per plant, kernels per spike, and kernel weight were analyzed. Percent residue measurements were taken to characterize the effects of residue on stand. An enterprise budget technique was used to estimate expenses associated with each production strategy. BI and DP yields were rather similar and were higher to those of the other two alternatives. No-till and broadcast unincorporated resulted in about a 17% and 24% reduction in yield compared to BI, respectively. DN, while yielding slightly less than DP and BI, also had more stable yields than DP or BU. Thus, BU displays characteristics of a high-risk planting method. Net returns ranged from -$31.31 to $84.18/a. BI had the highest average net returns followed by DP. Moreover, results were mixed with DP, BI, and BU, each being the most profitable in two of six experiments. DP was consistently the most profitable at one site while BI was otherwise most profitable in 1993-1994 and BU in1994-1995. The economics of production indicates that total expenses are similar for DP, DN, and BI except for varied seeding rates. Therefore, yield is directly proportional to net returns in those cases.

INTRODUCTION

In 1994, there were 880,000 a of wheat *(Triticum aestivum* L.) harvested in Arkansas with a value of over $129.5 million at the farm level (Anon., 1994a). Wheat accounted for about 11% of the 1994 harvested acreage in Arkansas. Its importance as a field crop is evidenced by its fifth rank in terms of harvested acreage and value of production. Management is an important factor in wheat production (Beurlin et al., 1991(. Arkansas farmers are constantly searching for more efficient and profitable wheat production practices.

The four most commonly used methods of seeding wheat in the lower Mississippi River Valley are conventionally drilled into prepared seedbed (DP), broadcast incorporated (BI), drilled no-till (DN), and broadcast unincorporated (BU). Wheat is typically conventionally drilled into a prepared seedbed (DP). This method is the most time-consuming because of the number and nature of required field operations. BI has recently increased in popularity as a planting method because it requires less time than DP since seed is usually mixed and spread with fertilizer. Another planting method that is gaining popularity is DN. This practice is thought to be relatively fast because no mechanical seedbed preparation is involved. BU is the least popular wheat planting method. This method is typically implemented through the use of an airplane. BU requires the least time and equipment of the four methods. Although farmers have sporadically used BU for many years, they have usually discontinued the practice after only one or two crops because of inconsistent stand establishment and yields.

The planting method with the greatest expected net returns or yield is not always the method a farmer uses. Each planting method may have certain advantages in various situations. For example, if the window for planting wheat is narrowing, a producer may choose to finish planting the wheat by BU because of the speed at which the method is performed in terms of acres planted per day. Generally, Arkansas farmers will choose between DP and BI. DP is also the most precise method of planting because of accurate seed placement and metering. BI wheat is widely used because of reduced labor, number of field trips, planting speed, and timeliness of completing the planting operation.

Previous research has demonstrated the benefits of BI seeding including improved labor distribution, timeliness and reduced labor requirements (Collins and

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Fowler, 1992). Nonetheless, poor stand establishment has been the primary problem associated with BI seeding of wheat in research studies in Canada (Collins and Fowler, 1992; Barnett and Comeau, 1980) and in Germany (Heymann and Bemhardt, 1973). While Shah et al. (1994) examined the effects of many alternative production practices on wheat yield and yield components, the tillage and planting methods have focused on factors influencing morphological development and anatomical features of wheat (e.g - Huang and Taylor, 1993) and the impact of management on soft red winter wheat production (e.g. - Beuerlein et al., 1991) while soil science studies have investigated infiltration characteristics of different tillage methods (Christensen et al., 1994). Economic analysis of alternative tillage techniques on wheat production has provided mixed results. A 10-yr Oklahoma study of six tillage methods indicated a disk system had the greatest net returns while no-till was the least economical method (Epplin et al., 1994). Comparison across planting dates for two Oklahoma counties also provides evidence of the economic desirability of conventional tillage over no-till (Epplin et al., 1991). Reduced tillage has been shown to outperform either conventional tillage or no-till methods on Colorado winter wheat (Halvorson et al., 1994). Whole farm analysis for Texas High Plains wheat, corn *(Zea mays* L) and grain sorghum *(Sorghum bicolor* [L.] Moench) production did indicate some no-till wheat production would maximize profits, especially under irrigated conditions; sensitivity analysis results display a greater proportion of conventional tillage to no-till for the dryland wheat acreage (Harman et al., 1985).

The objective of this study was to determine the effects of the above alternative wheat seeding methods on net returns, yields, yield components, and stand establishment. The ultimate purpose of this study is to provide information useful for wheat production management decisions.

MATERIALS AND METHODS

This research study entails both an agronomic and an economic component. A discussion of agronomic materials and methods including general factors, planting, harvesting, yield components and crop stand issues is followed by a discussion of the economic analytical techniques employed.

Agronomic

General

Experiments were conducted at four locations in Arkansas over a period from the fall of 1992 to the summer of 1995 (Table 1) on planting methods for soft red winter wheat. Agronomic factors such as planting date, seeding rate, stand sampling date, wheat seed variety, fertilization rate, fertilization, and harvest information are included in Table 2. Soybeans *(Glycine max* [L.] Merr.) were the crop grown prior to wheat for all experiments.

Planting

The four methods of planting employed were: 1) broadcast incorporated (BI), 2) drilled into a prepared seedbed (DP), 3) drilled into a no-till seedbed (DN), and 4) broadcast unincorporated over undisturbed soil (BU). The various seeding applications are outlined in Table 2. Specific techniques for implementing each treatment are given in Table 3. Preparation of seedbeds consisted of disking followed by a do-all operation to smooth the seedbed and to incorporate seeds in the broadcast incorporated treatment. Where the disk was used a tandem disk was operated at a depth of three to five in. at five to six miles p a hr. This disk was equipped with disk blades on 9-in. spacing. The following do-all operation pulverized clods, and in the same motion, mixed the soil in the top 2-in. of the seedbed while smoothing it out. The drill mechanically placed seeds one to two in. deep and pressed the soil firmly around the seeds. Two large scale farm experiments were done to check the validity of plot simulations for commercial equipment. In these experiments, commercial fertilizer applicators were used to broadcast the seed (Table 1). A ground-driven, twin spinner, fertilizer distributor, commonly called a "fertilizer buggy" and loaned by fertilizer dealers to growers, was used in one test. The other test used a truck equipped with ground radar and a pneumatic delivery system through individual, evenly spaced tubes, commonly called an "air flow" truck, for BI and an airplane for BU.

Weed Control

Herbicide treatments followed Arkansas Cooperative Extension Service recommendations. Weed pressures tended to be the same across wheat planting methods at a given location and year. As a result, the herbicide applied was the same for all planting methods at a location and year. Consequently, Harmony was applied at 0.5 oz at the Marianna CBES in both 1993 and 1994. At the Keiser NEREC (1994 and 1995) and the Keiser farm field, 1.5 pt of 2,4-D was applied. The Marianna farm field required no herbicide.

Harvesting

A swath from the center of each plot was harvested. The swath width is indicated in Table 2. A commercial combine was used on the farm fields. The Cotton Branch Experiment Station (CBES) and Northeast Research and Extension Center (NEREC) tests were harvested using a plot combine.

The wheat grain moisture contents were determined either by an individual plot sample or by composites from each treatment. Grain yields were adjusted to a constant 13% moisture content. Dockage from foreign material was determined from the experiment harvested by a commercial combine.

Yield Components

Yield components of culms per plan< kernels per spike, and kemel weight were determined. Plants for analysis were selected by randomly locating a site in each plot A straight line was then made from the site, and the first 10 plants (20 plants for NEREC 1994-95) intersected by the line were subsequently analyzed. Culms were determined by visual inspection. Grain from all plants was combined and weighed. A 10-g (0.35 oz) subsample was counted to determine seed weight and for calculating seed per culm. Other details are shown in Table 3.

Crop Stand Versus Percent Residue Cover

During the course of the study, the stand was noted to be critical in determining yield. Percent residue measurements were taken to characterize the effects of residue on stand. Measurements were made to determine the percent cover of residue on broadcast unincorporated treatments at the Keiser farm field. The percent residue cover was determined with the standard Soil Conservation Service method using a 25-ft rope (Soil Survey Staff, 1992). The associated stand of wheat was determined at each residue check point using a one inch by two inch rectangle centered on the residue check point The long axis was perpendicular to the row. The 25 measurements so obtained were summed and then converted to plants per acre. Data was summarized by averaging all data within 2.5% residue cover intervals. Both percent ground cover and stand were averaged to give a single data point for the above intervals.

Economic

An enterprise budget method was used to estimate expenses associated with each production strategy. Managers of farm businesses frequently must estimate costs and returns. In some cases, it may be necessary to estimate costs and returns for one part of the business (Boehlje and Eidman, 1984). An enterprise budget was used rather than a whole farm budget because the study consisted only of wheat production. The Mississippi State Budget Generator (MSBG) computer program (Spurlock, 1992) was used to compile economic information from the four different planting strategies. Gross income was calculated by multiplying total yield by the 1985-1994 seasonal price average of $3.12/bu (Anon., 1994a). Total costs are a sum of the direct and fixed costs. Direct costs included seed, fertilizer, fuel, and herbicides. Also included in direct costs are custom work, labor, repairs, and maintenance, and interest on operating capital. Diesel fuel, operator labor, and repairs and maintenance requirements are presented in Table 5. Custom work included, as relevant, charges for applications of herbicide and fertilizer as well as custom hauling. Input prices are from Arkansas enterprise budgets (Anon., 1994b). Fixed costs included cost of depreciation, taxes, insurance, and interest on capital investment for equipment. Expenses were generated by MSBG and reflect the actual cost for each of the individual treatments.

RESULTS AND DISCUSSION

Yield

Yield results are presented in Table 5. The analysis of variance indicated a complex relation between seedbed and location as well as seedbed and year (both at the 5% level). The year effect can be observed from the Marianna data (CBES, experiments 1 and 2) and Keiser data (NEREC, experiments 3 and 4) noting that the relative order of treatment effect does not remain the same from year to year. Yields resulting from planting methods, year and locale were aggregated over the composite data, and the overall mean was analyzed to provide insights to yield level expectations. The broadcast incorporated and conventionally drilled yields were equivalent and were superior to those of the other two tests. No-till and broadcast unincorporated resulted in about a 17% and 24% reduction in yield, respectively.

Yield Components

Selected yield component results are shown in Tables 4 and 5. Yield components such as plants/a, culms/plant, kernels/culm and kernel weight are included in these tables. Stand varied dramatically according to the different planting methods employed and varied more so than any other yield component analyzed. In most instances where there was a significant stand reduction, yield was directly affected. The culms per plant at harvest were the same across a given year throughout the different planting methods except for two experiments. Kernels/culm and weight/kernel observations are consistent across all planting methods in a given year at a given location strengthening the observation that the primary yield component to affect yield is stand. In the BU, increasing surface residue from the previous crop resulted in increased stands (Figure 1). The seeds that were lodged against surface residue survived whereas the unprotected seeds either had erratic emergence and were subsequently desiccated or eaten by pests. As a result, it can be hypothesized that increasing crop residue to 25% ground cover may be more important than increasing seeding rate for improving stand under the BU method. Increasing the seeding rate of the DN would probably improve the stand, but there was also a yield loss resulting from fewer kernels per culm that still would not be overcome. It has been observed (Cartwright, 1996a; 1996b) that wheat is more susceptible to freeze damage in no-till situations due to planting the wheat too shallow or planting in a seedbed with excessively thick (1 in. to 2 in.) residue.

Economic Analysis

Results for estimated expenses are shown in Table 7. Direct expenses varied from one planting strategy to another due to different levels of custom application work, field operations and seeding rates. Average direct expenses per acre across experiments ranged from a high of $76.81 for BI to a low of $72.33 for DN. The labor required at planting time for each planting method is given in hr/a as follows: BI, 0.15 hr/a; DP, 0.30 hr/a DN, 0.37 hr/a and BU, 0 hr/a. BU requires no labor at planting because the procedure is custom hired DN had the highest labor requirements because of the use of a narrow width drill whose operating speed is required to be 4.1 mph or less. DP required about 20% less labor than DN while BI required about 60% less labor than DN.

Fixed costs will be greater on the enterprise which requires the higher capital expenditures and are therefore a function of the machinery complement required. This machinery complement included a 25-ft combine for all systems, 200 HP tractor (DP, BI, DN), 32-ft light cut disk (DP, BI), triple K (DP, BI), conventional grain drill (DP) and no-till drill (DN), depending on the wheat planting method. As for the fixed costs associated with all the planting methods, DP and DN fixed costs were about the same at about $14.40/a. BI was the third highest at $11.78/a followed by BU at $7.1/a. Fixed expense reduction was due to the reduction in use of equipment at planting time; BU takes the fewest hips across the field with the farmer's personal equipment.

Expected total expenses per acre for all methods varied from a low of $80.43 to a high of $88.36, a range of only $7.93. Total expenses for BU are the lowest of all four planting methods except when seeding rate is altered (the fifth experiment).

Gross income is a direct function of yield. The total income varied from a high of $179.09 to a low of $60.53 (Table 8). On average, total income results from highest to lowest strategies are BI, DP, DN, and BU for all locations and years with total income paralleling mean yield results.

Net returns to land, risk, overhead labor and management ranged from -$31.31 to $84.18/a. BI had the highest average net returns followed by DP. Moreover, results were mixed with DP, BI, and BU each being the most profitable in two of six experiments DP was most profitable at CBES while BI was otherwise profitable in 1993-1994 and BU in 1994-1995. DN had about half the net returns of BI on average. BU experienced a loss two out of six times and had net returns about 35% of those for BI.

CONCLUSIONS

Agronomically, the yield of wheat grown with DN or BU methods varies considerably across years. There is a stand loss with both systems. The stand loss from BU is related to crop residue on the soil surface and probably cannot be improved by increasing the seeding rate. The DN stand probably could be improved by increasing seed rate; however, the smaller number of kernels per culm would still reduce yields of both DN and BU. The economics of production indicates that total expenses are similar for DP, DN, and BI except for varied seeding rates. Therefore, yield is directly proportional to net returns in those cases. DP and BI yields seemed similar and were consistently the highest. DN, while yielding slightly less than DP and BI, also had more stable yields than DP or BU. Yields for BU were erratic. The yields ranged from being equivalent to the best for some locations and years, to being as low as 44% of the best. Thus, BU displays characteristics of a high-risk planting method.

From a whole farm management standpoint, a farmer will choose the method which best utilizes available labor and equipment for maximizing net returns. Typically during the window for planting wheat, labor and equipment are primarily being utilized for harvest of other crops. During this time, a shortage of labor and equipment often exists. Consequently, a farmer may choose BI because of the speed at which the crop can be planted Without sacrificing net returns. If time and equipment are not a constraining factor, a farmer may choose DP and still expect the same net return as if choosing BI. However, the competition for labor during this wheat planting window suggests that further analysis under a whole farm framework would be appropriate.

If conditions become worse (usually due to prolonged rains) and the planting window narrows, a farmer may be forced to use the more risky BU and chance sacrificing yield to get crops planted. The farmer may also choose this method if there is no equipment available to plant the crop.

For crop production in row crops, labor savings as well as speed of operation are usually considered benefits of no-till. The results of this study show that no-till drilling of wheat requires more labor, money, and time than any other planting method. The reasons for this are the equipment size and cost combined with operating speed. BU, the other no-till planting method, had the highest direct cost mainly because of the money spent for custom planting. Thus, BU displays some tendency of greater risk than other planting methods.

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Table 1 . Experimental Loeation and Soil Series for Each Site

Experiment'	Year	Location: Nearest Town	Location: Field Description	Soil Series
1	1992-93	Marianna'	CBES'	Calloway-Loring-Hemy silt loam
2	1993-94	Marianna'	CBES	Calloway-Loring-Hemy silt loam
3	1993-94	Keiser'	NEREC[§]	Sharkey silty clay
4	1994-95	Keiser'	NEREC	Sharkey silty clay
5	1993-94	Marianna	Farm field	Newellton silty clay
6	1994-95	Keiser	Farm field	Sharkey silty clay and Steel loamy sand

'The above experiments were performed in the following locations: 1) 1992-93 CBES; 2) 1993-94 CBES; 3) 1993-94 NEREC; 4) 1994-95 NEREC; 5) 1993-94 Oxner Farm; and 6) 1994-95 Goble Farm. Wheat followed soybeans in all cases

'Plots were at the same location in consecutive years.

[§]CBES refers to the Cotton Branch Experiment Station and NEREC refers to the Northeast Research and Extension Center.

Table 2. Agronomic Factors for All Experiments

	Planting			Fertilizer		Plot		Stand
Experiment[†]	Date	Variety[‡]	Rate (lb/a)	Date	Amount (lb/a)	L. x W. (ft. x ft.)	Harvest Swath (ft.)	Date Counted
1	11/16/92	Cardinal	90	2/23/93	100-0-0[§]	12.7*100	5	---
2	11/9/93	Cardinal	90	2/28/94	100-0-0	12.7*100	5	3/11/94
3	10/7/93	Madison	90	2/28/94	60-0-0	12.7*100	5	3/16/94
				3/22/94	60-0-0			
4	11/5/94	Madison	90	4/17/95	75-0-0	12.7*100	5	---
5	10/7/93	Cardinal	90 to 180[¶]	2/25/95	46-0-0	60*420	26	6/18/94
				3/10/95	46-0-0			
6	11/16/94	Madison	90	2/25/95	46-0-0	38*1142	20.42	11/21/94
				3/10/95	46-0-0			

[†]The above experiments were performed in the following locations: 1) 1992-93 Cotton Branch Experiment Station; 2) 1993-94 Cotton Branch Experiment Station; 3) 1993-94 Northeast Research and Extension Center; 4) 1994-95 Northeast Research and Extension Center; 5) 1993-94 Oxner Farm; and 6) 1994-95 Goble Farm.

[‡]Soft red winter wheat.

[§]N-P_2O_5-K_2O.

[#]Dates not recorded, estimates used are given.

[¶]Varied according to the recommendations of the Delta Agricultural Digest (1994). Drilled seeded in a prepared seedbed was at 90 lbs./a, drilled into a no-till seedbed was at 90 lbs./a, and broadcast incorporated and broadcast unincorporated was at 180 lb/a.

Table 3. Methods of Seeding and How Accomplished in Each Experiment

	Seeding Methods			
Methods of planting	Marianna (CBES)	Marianna (farm field)	Keiser (farm field)	Keiser (NEREC)
DP (i.e. drilled into prepared seedbed)	conventional grain drill	JD750 no-till drill	JD750 no-till drill	JD750 no-till drill
DN (i.e. drilled into no-till seedbed)	conventional grain drill	JD750 no-till drill	JD750 no-till drill	JD750 no-till drill
BI (i.e. broadcast incorporated)	simulated' airflow	fertilizer buggy	airflow	simulated' airflow
BU (i.e. broadcast unincorporated)	simulated' airplane	simulated' airplane	airplane	simulated' airplane

'Simulated by driving across the plots with grain drill raised sufficiently to meter seeds without the openers touching the soil.

[‡]Simulated by driving across the plots with a fertilizer buggy.

Note: These treatments were simulated either because it was impractical to have plots large enough to accomodate the swath width of fertilizer buggies (25 ft.), air flow trucks (60 ft.) or air planes (60 ft.) or the characteristics related to their operation. These implements have characteristic application patterns that have been document many times and usually if set and operated proplery have a coefficient of uniformity greater than 85%. The manner in which we simulated these implements placed the *seed* on the soil surface with a uniformity coefficient that would exceed 90%. This same procedure or similiar simulations has been used for decades in soil testing 7 research. The authors feel that these procedures were close enough to mimicking the implements actually used that methods would give the same results.

Table 4. Diesel, Operator Labor and Repairs and Maintenance Requirements

	Drilled		Broadcast	
Input	Prepared Seedbed	No-till Seedbed	Incorporated	Unincorporated
Diesel (gal/a)	4.1757	3.8193	3.3177	1.7469
Operator Labor (hrs/a)	0.4352	0.5040	0.2857	0.1429
Repairs and Maintenance (%/a)	5.49	5.47	4.01	2.18

Table 5. Yield and Plant Density for Selected Experiments

	Drilled		Broadcast	
Exp No.†	Prepared Seedbed	No-till Seedbed	Incorporated	Unincorporated
		------------------------------ Yield (bu/a) ------------------------------		
1	37 6a‡	24.9b	34.5a	19.4c
2	54 9a	43.4ab	44.8ab	37.1b
3	18 2a	18.9a	22.8a	10.0b
4	26 2a	26.8a	37.5a	37.7a
5	46 9a	31.5b	42.2a	29.8b
6	32 7a	34.6a	33.0a	35.6a
Mean	34.8a	29.0b	35.1a	26.8b
		---------------- Relative percent of maximum yield ----------------		
Mean	99	83	100	76
		------------------ Plant density (plants/a * 0.001) ------------------		
1	---	---	---	---
2	232a	211a	200a	127b
3'	334b	345b	526a	171c
4	784a	632c	697b	610c
5§	1071a	1059a	1061a	747b
6¶	76a	72a	81a	80a

Note: Numbers in same row followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test. †The above experiments were performed in the following locations: 1) 1992-93 CBES; 2) 1993-94 CBES; 3) 1993-94 NEREC; 4) 1994-95 NEREC; 5) 1993-94 Oxner Farm; and 6) 1994-95 Goble Farm. ‡Plants may have had culms at counting time. §Heads per a, not individual plants. 'Stand was taken prior to culming negating comparisons to other experiments.

Table 6. Yield Components (Culms and Kernels) From all Locations and All Years

	Drilled		Broadcast	
Exp. No.†	Prepared seedbed	No-till Seedbed	Incorporated	Unincorporated
	------------------------- Culms/plant at harvest -------------------------			
1	---	---	---	---
2	3.7a	4.6a	4.3a	3.7a
3	4.5b	6.7a	4.9ab	5.5ab
4	6.9a	7.5a	6.5a	6.7a
5	3.6a	2.1a	2.3a	2.3a
6	4.1a	3.2b	3.9a	4.1a
Mean	5.1a	5.9a	5.3a	4.9a
	------------------------------ Kernels/culm ------------------------------			
	---	---	---	---
2	31.9a	28.8a	35.9a	29.5a
3	18.0a	22.8a	25.1a	21.7a
4	15.7a	13.7a	13.1a	15.5a
5	21.9a	14.5a	19.5a	20.2a
6	21.3a	13.8b	20.0a	18.2ab
Mean	24.9ab	20.3c	25.3a	21.9c

Note: Numbers in same row followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range **test.**

†The above experiments were performed in the following locations: 1) 1992-93 CBES; 2) 1993-94 CBES; 3) 1993-94 NEREC; **4)** 1994-95 NEREC; 5) 1993-94 Oxner Farm; and ***6)*** 1994-95 Goble Farm.

Table 7. Total Expenses (TEXP), Fixed Expenses (FEXP), and Direct Expenses (DEXP) in Dollars per Acre for Various Wheat Planting Methods

	Drill						Broadcast					
	Prepared seedbed			No-till seedbed			Incorporated			Unincorporated		
Exp. No.'	TEXP	FEXP	DEXP‡	TEXP	FEXP	DEXP	TEXP	FEXP	DEXP	TEXP	FEXP	DEXP
1	97.18	14.39	77.39	89.91	14.41	75.50	90.41	11.28	79.12	79.29	7.61	71.68
2	94.90	14.39	80.51	92.93	14.41	78.52	90.85	11.28	79.56	82.20	7.61	74.58
3	96.94	14.39	82.55	97.32	14.41	82.91	96.24	11.28	84.95	94.65	7.61	87.04
4	77.48	14.39	63.09	77.70	14.41	63.29	77.04	11.28	65.76	69.64	7.61	62.03
5	78.24	14.39	63.85	76.70	14.41	62.29	90.69	11.28	79.40	80.52	7.61	72.91
6	85.44	14.39	71.05	85.88	14.41	71.47	83.32	11.28	72.04	76.26	7.61	68.65
Mean	88.36	14.39	73.07	86.74	14.41	72.33	88.09	11.28	76.81	80.43	7.61	72.82

'The above experiments were performed in the following locations: 1) 1992-93 Cotton Branch Experiment Station; 2) 1993-94 Cotton Branch Experiment Station; 3) 1993-94 Northeast Research and Extension Center; 4) 1994-95 Northeast Research and Extension Center; 5) 1993-94 Oxner Farm; and 6) 1994-95 Goble Farm.

‡Direct expense includes labor charges of $2.72, $3.11, $1.85, and $1.03 for drilled into a prepared seedbed, no-till drilled, Broadcast incorporated, and broadcast unincorporated, respectively.

Table 8. Total Income (TINC) and Net Returns (NRET)[†] for Various Wheat Planting Methods in Dollars per Acre

	Drill				Broadcast			
	Prepared seedbed		No-till seedbed		Incorporated		Unincorporated	
Exp. No.[†]	TINC	NRET	TINC	NRET	TINC	NRET	TINC	NRET
1	117.31	25.53	77.69	-12.22	107.64	17.23	60.53	-18.77
2	179.09	84.18	137.59	44.66	141.96	51.11	117.94	35.74
3	115.13	18.19	120.12	22.80	144.46	48.22	63.34	-31.31
4	82.06	4.58	83.93	6.23	116.69	39.64	117.62	47.99
5	131.66	53.42	98.59	21.89	146.64	55.95	92.98	12.45
6	101.71	16.27	107.95	22.07	102.96	19.64	110.76	34.50
Mean	121.16	33.70	104.31	17.57	126.73	38.63	93.86	13.43

[†]Net returns are calculated as total income less total specified expenses and represent net returns to land, **risk,** overhead labor and management.
'The above experiments were performed in the following locations: 1) 1992-93 Cotton Branch Experiment Station; 2) 1993-94 Cotton Branch Experiment Station; 3) 1993-94 Northeast Research and Extension Center; 4) 1994-95 Northeast Research and Extension Center; 5) 1993-94 Oxner Farm; and 6) 1994-95 Goble Farm.

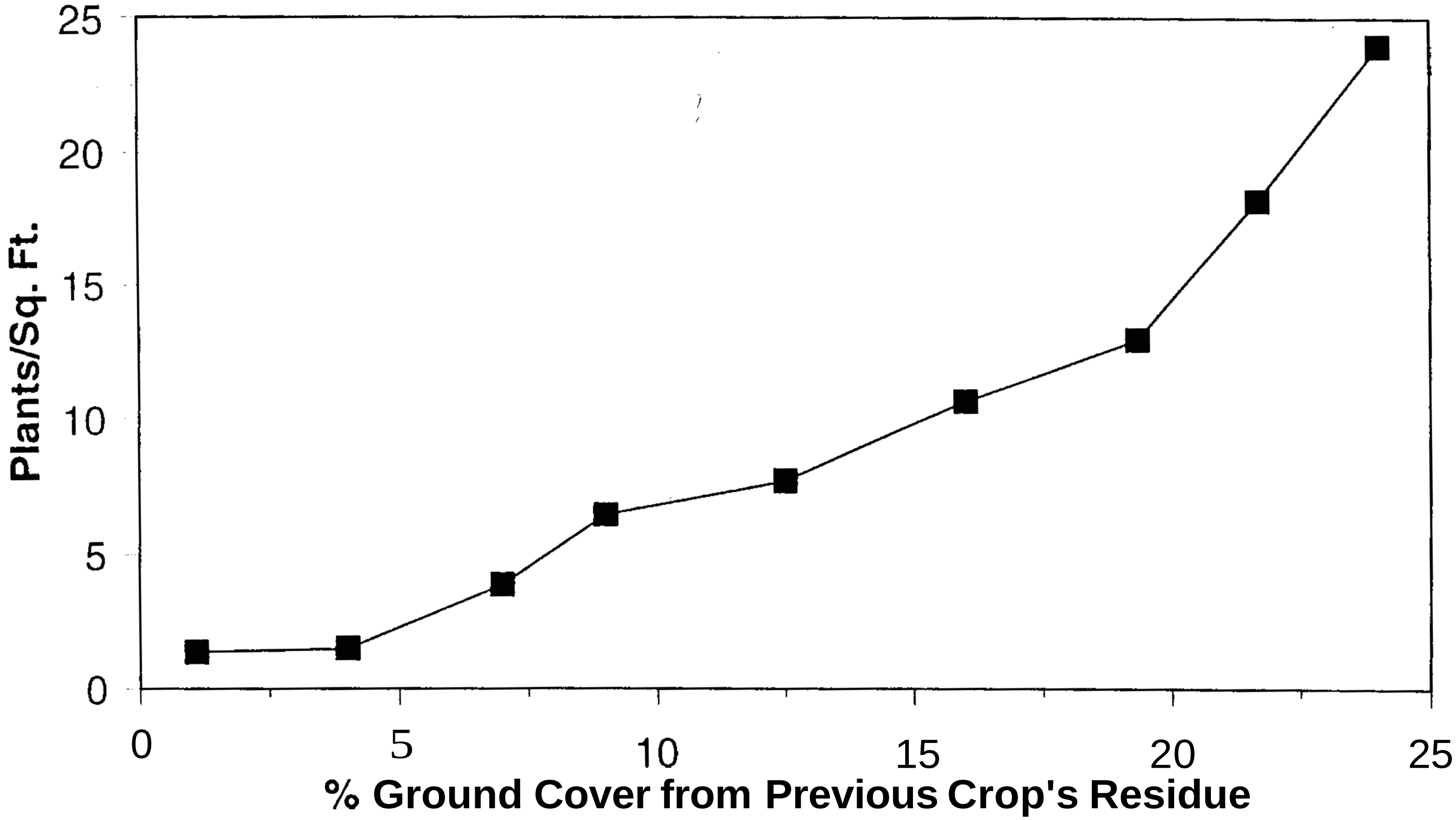

Fig. 1. Plant establishment as related to percent of cover from the previously grown crops.