

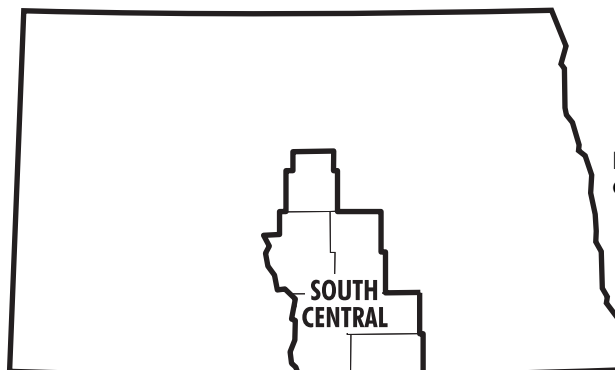
Farm Management Planning Guide



December 2010

Projected 2011 Crop Budgets South Central North Dakota

Andrew Swenson, Farm Management Specialist
Ron Haugen, Farm Management Specialist



Note: This region consists of six counties: Burleigh, Emmons, Kidder, Logan, McIntosh and Sheridan.

The 2011 crop budgets provide an estimate of revenues and costs for selected crops. Each set of budgets are developed for a multi-county region. There is considerable variation in soil type and productivity, weather conditions, as well as management and production practices within each region. Therefore, **THESE BUDGETS ARE ONLY INTENDED TO BE USED AS A GUIDE. EVERY INDIVIDUAL IS HIGHLY ENCOURAGED TO DEVELOP HIS/HER OWN BUDGETS!**

The profitability budget accounts for full economic opportunity costs for land and machinery investment, regardless of farm operator equity position. The bottom line is the return to labor and management. This is the expected "payment" to the producer for the labor and managerial efforts required by the crop

enterprise. Each individual must make the decision whether it is sufficient.

The budget can be changed to conform to the more common definition of accounting profit (return to unpaid labor and management, and owner equity) by replacing the machinery investment and land charge cost items with your per acre interest and rental expense of machinery and land, and real estate tax if land is owned.

The budget can be used for long run decisions if the revenues and costs are realistic for several years. (Crop prices, direct costs, and the land charge are best estimates for only the 2011 crop year, but crop yields are historic averages and machinery ownership costs are an average for the total length of ownership). If the budget shows a high return to labor and management, and is representative for several years, increased acreage and corresponding investment should be considered. However, if long-run returns to labor and management are unsatisfactory the best decision may be to exit the crop enterprise and employ the machinery and land investment, and labor and management, in a different enterprise or investment.

NDSU
Extension Service

North Dakota State University, Fargo, ND 58108

For short-run planning decisions you can omit the indirect costs if the land and machinery required to produce the different enterprises are in place. Simply compare the crop enterprises by calculating return over direct costs. Labor requirements and risk should also be considered. Insurance is not available for some crops.

The budget can be used to estimate cashflow by making a few modifications. Machinery depreciation should be omitted and the machinery investment number replaced with your per acre principal and interest payment on machinery debt. For owned land, the land charge should be replaced with your per acre real estate tax and principal and interest payment on land debt.

Direct and counter-cyclical payments under the Farm Bill are omitted from the budgets because those payments are tied to historic farm program base acres and payment yields, not to current crop selection or production. Direct payments for this region are \$6.50 per acre when averaged over all crop acreage. Counter-cyclical payments, which occur if the national average price of program crops are below a certain level, are not expected with the price levels used in the budgets.

Primary Assumptions:

Crops are planted on dryland recrop ground. Costs of moving crop to local market/storage are included.

The budgets for the South West, North West, South Central and North Central regions typically represent production systems where soil disturbance only occurs at seeding.

Market Price: Best estimates of NDSU extension economists. The greater of projected market price and marketing loan rate is used.

Market Yields: Average yield for the 7 year period 2003-2009, after the low and high yield years are removed. Yields for safflower, yellow mustard, buckwheat, millet, rye and chickpeas are from NDSU extension agronomists and industry sources.

Fertilizer: Cost of fertilizer applied, based on soil test, to meet yield goal of 130% of market yield. N fertilizer can be reduced if previous crop was soybean, dry bean, field peas or lentil.

Soil test - recrop:
 Nitrogen - 35 lb
 Phosphorus - 9 ppm
 Potassium - 328 ppm

Fertilizer prices:

Nitrogen - .48/lb
 Phosphorus - .56/lb
 Potassium - .46/lb

Seed Prices:

Spring Wheat 11.00/bu
 Durum 10.50/bu
 Barley 7.50/bu
 Corn grain RR/Bt 2.55/thou.kern.
 Corn grain RR 2.15/thou.kern.
 Soybean RR .295/thou.kern.
 Dry Beans .78/lb
 Oil Sunflower 1.30/thou.kern.
 Conf. Sunflower 2.20/thou.kern.
 Canola 8.50/lb
 Flax 17.50/bu
 Field Peas 10.50/bu
 Oats 5.75/bu
 Mustard 1.10/lb
 Buckwheat .54/lb
 Millet .26/lb
 Winter Wheat 9.50/bu
 Rye 6.00/bu

Fuel prices:

Diesel 3.00/gal
 Gas 3.00/gal

Lubrication charge: 15% of fuel cost

Crop Insurance: Coverage levels are 70% on all insurable crops. Yield Protection or APH insurance estimates are used, except for Revenue Protection on all wheat, soybeans, canola and sunflowers.

Miscellaneous: soil testing, machinery rent and custom work.

Operating Interest: Direct costs charged 5.00% interest for 6 month period.

Misc. Overhead: Machinery housing and insurance at .5% and .85%, respectively, of average machinery investment. Also, liability insurance and license fees of trucks. In addition, \$3 per acre is assumed for general farm utilities, farm publications, meetings, dues, income tax preparation, legal fees, etc.

Land charge = average cash rent.

Machinery investment: 4.5% real interest rate, over the years of machine ownership, is charged on average machinery investment. The real, or inflation adjusted, rate is the commercial rate minus the inflation rate. Ave. mach. investment = (Purchase price + Disposal price)/2

Depreciation = (Purchase price - disposal price / years ownership)

Spring Wheat

Durum

	Per Acre	Your Figures	Per Acre	Your Figures
Market Yield	35	_____	34	_____
Market Price	7.12	_____	7.43*	_____
MARKET INCOME	249.20	_____	252.62	_____
DIRECT COSTS				
-Seed	16.50	_____	15.75	_____
-Herbicides	20.00	_____	20.00	_____
-Fungicides**	5.50	_____	5.50	_____
-Insecticides***	0.00	_____	0.00	_____
-Fertilizer	49.72	_____	47.82	_____
-Crop Insurance	11.80	_____	12.50	_____
-Fuel & Lubrication	12.17	_____	12.13	_____
-Repairs	13.54	_____	13.52	_____
-Drying	0.00	_____	0.00	_____
-Miscellaneous	6.50	_____	6.50	_____
-Operating Interest	3.39	_____	3.34	_____
SUM OF LISTED DIRECT COSTS	139.13	=====	137.07	=====
INDIRECT (FIXED) COSTS				
-Misc. Overhead	5.96	_____	5.94	_____
-Machinery Depreciation	15.29	_____	15.26	_____
-Machinery Investment	8.80	_____	8.78	_____
-Land Charge	38.10	_____	38.10	_____
SUM OF LISTED INDIRECT COSTS	68.15	=====	68.09	=====
SUM OF ALL LISTED COSTS	207.28	_____	205.15	_____
RETURN TO LABOR & MANAGEMENT	41.92	_____	47.47	_____
LISTED COSTS PER BUDGET UNIT	(bu):		(bu):	
-Direct Costs	3.98	_____	4.03	_____
-Indirect Costs	1.95	_____	2.00	_____
-Total Costs	5.92	_____	6.03	_____

Wheat notes:

*Durum price is for milling quality. There is risk of lower quality and price.

**Includes seed treatment (\$1.50-\$2) and early season foliar fungicide (\$3-\$4.50). Late season fungicide, often not warranted in this region, would cost \$4-\$14, plus application. Trials consistently show yield response of 5-10% with early season fungicide, IF wheat planted into residue, and 15-20% with late application IF weather favors disease development.

***Cereal grain aphid insecticide would cost about \$6 per acre plus application.

Malting Barley

Corn Grain

	Per Acre	Your Figures	Per Acre	Your Figures
Market Yield	57	_____	79	_____
Market Price	4.88*	_____	4.34	_____
MARKET INCOME	278.16	_____	342.86	_____
DIRECT COSTS				
-Seed	11.25	_____	58.05*	_____
-Herbicides	18.50	_____	14.50	_____
-Fungicides	1.50	_____	0.00	_____
-Insecticides	0.00	_____	0.00	_____
-Fertilizer	50.45	_____	59.84	_____
-Crop Insurance	8.50	_____	29.20	_____
-Fuel & Lubrication	14.66	_____	18.21	_____
-Repairs	14.94	_____	15.35	_____
-Drying	0.00	_____	15.80	_____
-Miscellaneous	6.50	_____	6.50	_____
-Operating Interest	3.16	_____	5.44	_____
SUM OF LISTED DIRECT COSTS	129.46	=====	222.88	=====
INDIRECT (FIXED) COSTS				
-Misc. Overhead	6.64	_____	7.50	_____
-Machinery Depreciation	17.69	_____	22.71	_____
-Machinery Investment	10.40	_____	12.76	_____
-Land Charge	38.10	_____	38.10	_____
SUM OF LISTED INDIRECT COSTS	72.83	=====	81.07	=====
SUM OF ALL LISTED COSTS	202.29	_____	303.95	_____
RETURN TO LABOR & MANAGEMENT	75.87	_____	38.91	_____
LISTED COSTS PER BUDGET UNIT	(bu):		(bu):	
-Direct Costs	2.27	_____	2.82	_____
-Indirect Costs	1.28	_____	1.03	_____
-Total Costs	3.55	_____	3.85	_____

Barley notes:

*Use \$3.64 estimate for feed barley price.

Corn notes:

*RR/Bt corn is planted on 80 percent of acres and RR corn without Bt Trait is on 20 percent of acres for corn borer refuge. Cost includes insecticide seed treatment for wireworm, rootworm, white grub and suppression of cutworm.

Soybeans

Drybeans*

	Per Acre	Your Figures	Per Acre	Your Figures
Market Yield	25	_____	1270	_____
Market Price	11.35	_____	0.245	_____
MARKET INCOME	283.75	_____	311.15	_____
DIRECT COSTS				
-Seed	51.63*	_____	39.00	_____
-Herbicides	14.50	_____	36.00**	_____
-Fungicides	0.00	_____	0.00***	_____
-Insecticides	7.00**	_____	0.00	_____
-Fertilizer	5.28	_____	32.75	_____
-Crop Insurance	20.90	_____	21.60	_____
-Fuel & Lubrication	12.09	_____	17.61	_____
-Repairs	13.81	_____	16.30	_____
-Drying	0.00	_____	0.00	_____
-Miscellaneous	6.50	_____	4.50	_____
-Operating Interest	3.29	_____	4.19	_____
SUM OF LISTED DIRECT COSTS	135.00	=====	171.95	=====
INDIRECT (FIXED) COSTS				
-Misc. Overhead	5.91	_____	6.71	_____
-Machinery Depreciation	15.82	_____	20.51	_____
-Machinery Investment	8.96	_____	11.74	_____
-Land Charge	38.10	_____	38.10	_____
SUM OF LISTED INDIRECT COSTS	68.79	=====	77.06	=====
SUM OF ALL LISTED COSTS	203.79	_____	249.01	_____
RETURN TO LABOR & MANAGEMENT	79.96	_____	62.14	_____
LISTED COSTS PER BUDGET UNIT	(bu):		(lb):	
-Direct Costs	5.40	_____	0.14	_____
-Indirect Costs	2.75	_____	0.06	_____
-Total Costs	8.15	_____	0.20	_____

Soybean notes:

*Roundup (glyphosate) resistant soybeans.

**Soybean aphid and/or spider mite insecticide

Drybean notes:

*Acreage limitations exist under the farm bill. The general rule is drybean acres can not be planted on base acres. If farm or producer has drybean history, drybean can be planted on base acres but government payments on those acres will be forfeited.

**Includes dessicant prior to straight cutting.

***Fungicide for white mold would cost about \$18 plus application.

Oil Sunflower

Confectionery Sunflower

	Per Acre	Your Figures	Per Acre	Your Figures
Market Yield	1350		1300	
Market Price	0.197		0.288	
MARKET INCOME	265.95		374.40	
DIRECT COSTS				
-Seed	28.60*		39.60*	
-Herbicides	27.50		27.50	
-Fungicides	0.00**		0.00**	
-Insecticides	6.00***		12.00***	
-Fertilizer	35.05		33.13	
-Crop Insurance	21.80		27.70	
-Fuel & Lubrication	14.10		14.03	
-Repairs	12.75		12.72	
-Drying	2.70		2.60	
-Miscellaneous	13.50		20.50	
-Operating Interest	4.05		4.74	
SUM OF LISTED DIRECT COSTS	166.05		194.53	
INDIRECT (FIXED) COSTS				
-Misc. Overhead	6.32		6.29	
-Machinery Depreciation	16.70		16.65	
-Machinery Investment	9.78		9.75	
-Land Charge	38.10		38.10	
SUM OF LISTED INDIRECT COSTS	70.89		70.79	
SUM OF ALL LISTED COSTS	236.94		265.32	
RETURN TO LABOR & MANAGEMENT	29.01		109.08	
LISTED COSTS PER BUDGET UNIT	(lb):		(lb):	
-Direct Costs	0.12		0.15	
-Indirect Costs	0.05		0.05	
-Total Costs	0.18		0.20	

Oil Sunflower notes:

*Cost includes seed treatment for control of wireworm and flea beetle.

**Fungicide for rust would cost \$4 plus application.

***One spraying for head feeding insects (red seed weevil, lygus bug and banded moths). Custom application cost of \$7 is under "Miscellaneous." Insecticide treatment for cutworms would cost about \$5 plus application (usually tank mixed with herbicide).

Confectionery Sunflower notes:

*Cost includes seed treatment for control of wireworm and flea beetle.

**Fungicide for rust would cost \$4 plus application.

***Two sprayings for head feeding insects (red seed weevil, lygus bug and banded moths) at about \$6 per application. Each custom application cost of \$7 is under "Miscellaneous." Insecticide treatment for cutworms would cost about \$5 plus application (usually tank mixed with herbicide).

Canola

Flax

	Per Acre	Your Figures	Per Acre	Your Figures
Market Yield	1360	_____	17	_____
Market Price	0.221	_____	12.14	_____
MARKET INCOME	300.56	_____	206.38	_____
DIRECT COSTS				
-Seed	42.50*	_____	12.25	_____
-Herbicides	16.00	_____	22.00	_____
-Fungicides	0.00**	_____	0.00	_____
-Insecticides	0.00	_____	0.00	_____
-Fertilizer	60.40	_____	21.37	_____
-Crop Insurance	11.50	_____	7.30	_____
-Fuel & Lubrication	12.64	_____	12.89	_____
-Repairs	13.82	_____	14.24	_____
-Drying	0.00	_____	0.00	_____
-Miscellaneous	6.50	_____	1.50	_____
-Operating Interest	4.08	_____	2.29	_____
	=====	=====	=====	=====
SUM OF LISTED DIRECT COSTS	167.44	_____	93.84	_____
INDIRECT (FIXED) COSTS				
-Misc. Overhead	6.01	_____	6.08	_____
-Machinery Depreciation	16.12	_____	16.36	_____
-Machinery Investment	9.25	_____	9.75	_____
-Land Charge	38.10	_____	38.10	_____
	=====	=====	=====	=====
SUM OF LISTED INDIRECT COSTS	69.48	_____	70.29	_____
SUM OF ALL LISTED COSTS	236.92	_____	164.13	_____
RETURN TO LABOR & MANAGEMENT	63.64	_____	42.25	_____
LISTED COSTS PER BUDGET UNIT	(lb):		(bu):	
-Direct Costs	0.12	_____	5.52	_____
-Indirect Costs	0.05	_____	4.13	_____
-Total Costs	0.17	_____	9.65	_____

Canola notes:

*Cost includes insecticide seed treatment for flea beetles.

**Fungicide for white mold would cost about \$18 plus application.

Field Peas

Oats

	Per Acre	Your Figures	Per Acre	Your Figures
Market Yield	33		60	
Market Price	6.30*		2.75	
MARKET INCOME	207.90		165.00	
DIRECT COSTS				
-Seed	31.50		11.50	
-Herbicides	26.00		7.70	
-Fungicides	1.50		0.00	
-Insecticides	0.00		0.00	
-Fertilizer	10.38		43.88	
-Crop Insurance	5.10		9.20	
-Fuel & Lubrication	13.74		14.79	
-Repairs	15.13		14.99	
-Drying	0.00		0.00	
-Miscellaneous	8.00		6.50	
-Operating Interest	2.78		2.71	
SUM OF LISTED DIRECT COSTS	114.13		111.28	
INDIRECT (FIXED) COSTS				
-Misc. Overhead	6.22		6.68	
-Machinery Depreciation	17.68		17.79	
-Machinery Investment	9.73		10.45	
-Land Charge	38.10		38.10	
SUM OF LISTED INDIRECT COSTS	71.73		73.02	
SUM OF ALL LISTED COSTS	185.86		184.30	
RETURN TO LABOR & MANAGEMENT	22.04		(19.30)	
LISTED COSTS PER BUDGET UNIT	(bu):		(bu):	
-Direct Costs	3.46		1.85	
-Indirect Costs	2.17		1.22	
-Total Costs	5.63		3.07	

Field Pea notes:

*Food quality price. Use \$3.50 price estimate for feed quality peas.

Yellow Mustard

Buckwheat

	Per Acre	Your Figures	Per Acre	Your Figures
Market Yield	900	_____	900	_____
Market Price	0.233	_____	0.233	_____
MARKET INCOME	209.70	_____	209.70	_____
DIRECT COSTS				
-Seed	13.20	_____	27.00	_____
-Herbicides	15.50	_____	14.00	_____
-Fungicides	0.00	_____	0.00	_____
-Insecticides	0.00	_____	0.00	_____
-Fertilizer	30.32	_____	16.76	_____
-Crop Insurance	0.00	_____	12.20	_____
-Fuel & Lubrication	12.84	_____	12.41	_____
-Repairs	14.23	_____	13.72	_____
-Drying	0.00	_____	0.00	_____
-Miscellaneous	6.50	_____	1.50	_____
-Operating Interest	2.31	_____	2.44	_____
SUM OF LISTED DIRECT COSTS	94.90	=====	100.03	=====
INDIRECT (FIXED) COSTS				
-Misc. Overhead	6.07	_____	5.93	_____
-Machinery Depreciation	16.33	_____	15.93	_____
-Machinery Investment	9.73	_____	9.16	_____
-Land Charge	38.10	_____	38.10	_____
SUM OF LISTED INDIRECT COSTS	70.23	=====	69.13	=====
SUM OF ALL LISTED COSTS	165.13	_____	169.16	_____
RETURN TO LABOR & MANAGEMENT	44.57	_____	40.54	_____
LISTED COSTS PER BUDGET UNIT				
(lb):				
-Direct Costs	0.11	_____	0.11	_____
-Indirect Costs	0.08	_____	0.08	_____
-Total Costs	0.18	_____	0.19	_____

notes:

Millet

Winter Wheat

	Per Acre	Your Figures	Per Acre	Your Figures
Market Yield	1500	_____	46*	_____
Market Price	0.075	_____	6.24	_____
MARKET INCOME	112.50	_____	287.04	_____
DIRECT COSTS				
-Seed	6.50	_____	9.50	_____
-Herbicides	6.20	_____	16.50	_____
-Fungicides	0.00	_____	9.00	_____
-Insecticides	0.00	_____	0.00	_____
-Fertilizer	23.82	_____	70.63	_____
-Crop Insurance	0.00	_____	15.20	_____
-Fuel & Lubrication	13.46	_____	12.14	_____
-Repairs	14.47	_____	13.23	_____
-Drying	0.00	_____	0.00	_____
-Miscellaneous	6.50	_____	6.50	_____
-Operating Interest	1.77	_____	3.82	_____
SUM OF LISTED DIRECT COSTS	72.73	=====	156.52	=====
INDIRECT (FIXED) COSTS				
-Misc. Overhead	6.26	_____	5.95	_____
-Machinery Depreciation	16.79	_____	15.04	_____
-Machinery Investment	9.96	_____	8.44	_____
-Land Charge	38.10	_____	38.10	_____
SUM OF LISTED INDIRECT COSTS	71.12	=====	67.53	=====
SUM OF ALL LISTED COSTS	143.84	_____	224.04	_____
RETURN TO LABOR & MANAGEMENT	(31.34)	_____	63.00	_____
LISTED COSTS PER BUDGET UNIT	(lb):		(bu):	
-Direct Costs	0.05	_____	3.40	_____
-Indirect Costs	0.05	_____	1.47	_____
-Total Costs	0.10	_____	4.87	_____

Winter Wheat notes:

*Yield is per harvested acre, 2003-2009 acreage abandonment averaged 9%.

Rye

	Per Acre	Your Figures
Market Yield	41	_____
Market Price	4.24	_____
MARKET INCOME	173.84	_____
DIRECT COSTS		
-Seed	7.20	_____
-Herbicides	3.50	_____
-Fungicides	0.00	_____
-Insecticides	0.00	_____
-Fertilizer	61.13	_____
-Crop Insurance	5.90	_____
-Fuel & Lubrication	12.08	_____
-Repairs	13.07	_____
-Drying	0.00	_____
-Miscellaneous	6.50	_____
-Operating Interest	2.73	_____
	=====	=====
SUM OF LISTED DIRECT COSTS	112.11	_____
INDIRECT (FIXED) COSTS		
-Misc. Overhead	5.94	_____
-Machinery Depreciation	15.03	_____
-Machinery Investment	8.56	_____
-Land Charge	38.10	_____
	=====	=====
SUM OF LISTED INDIRECT COSTS	67.64	_____
SUM OF ALL LISTED COSTS	179.75	_____
RETURN TO LABOR & MANAGEMENT	(5.91)	_____
LISTED COSTS PER BUDGET UNIT	(bu):	
-Direct Costs	2.73	_____
-Indirect Costs	1.65	_____
-Total Costs	4.38	_____

notes:

2011 Machinery List

Machine	Purch. Price	Annual Use	Years to trade	Trade in	Deprec.	Invest.	Repairs	Ac/hr
2WD 100HP Tractor	62100	400hr	20	20032	5.26 /hr	4.62 /hr	6.33 /hr	
2WD 160HP Tractor	105600	500hr	15	31268	9.91 /hr	6.16 /hr	10.76 /hr	
4WD 330HP Tractor	183300	500hr	15	54237	17.21 /hr	10.69 /hr	10.67 /hr	
SP Combine (base unit)	231800	250hr	12	57648	58.05 /hr	26.05 /hr	37.62 /hr	
Tandem Truck (used)	34000	150hr	15	10800	10.31 /hr	6.72 /hr	6.67 /hr	
Semi & Trailer (used)	38100	150hr	10	10900	18.13 /hr	7.35 /hr	8.27 /hr	
Pick-up Truck	25500	300hr	10	5000	6.83 /hr	2.29 /hr	3.03 /hr	
Swather 25 ft	21100	1000ac	20	4997	0.81 /ac	0.59 /ac	0.37 /ac	12.1
Sprayer 90 ft	33500	5000ac	10	15176	0.31 /ac	0.22 /ac	0.43 /ac	42.5
Heavy Harrow 70 ft	26800	2000ac	20	15602	0.28 /ac	0.48 /ac	0.30 /ac	39.7
Air Seeder 40 ft	156000	2400ac	12	73524	2.86 /ac	2.15 /ac	5.40 /ac	17.0
Planter 12-30	49200	800ac	20	16360	2.05 /ac	1.84 /ac	2.72 /ac	10.6
Corn head	42200	600ac	20	3977	3.18 /ac	1.73 /ac	0.98 /ac	6.8
Grain head w/pt	13500	800ac	15	2803	0.89 /ac	0.46 /ac	0.25 /ac	8.5
Grain str. cut 30 ft	22500	2000ac	8	9066	0.84 /ac	0.35 /ac	0.35 /ac	10.2
Head w/sunf pans 30 ft	27000	600ac	20	2758	2.02 /ac	1.11 /ac	0.42 /ac	10.2
Soybeans str. cut 30 ft	33300	1000ac	20	3043	1.51 /ac	0.82 /ac	0.51 /ac	10.2
Rock picker	19300	50hr	20	6139	0.44 /ac	0.38 /ac	0.29 /ac	29.1
Grain auger	8400	50hr	20	610	7.79 /hr	4.05 /hr	4.20 /hr	

Example Sequence of Operations

Field operations sequence for spring wheat and durum.

OP. NO.	DESCRIPTION	(FEET) WIDTH	(MPH) SPEED	(AC/HR) Fld Cap	(\$/AC) FUEL & LUBE	(\$/AC) EST. REPAIRS
1	Pick Rocks				0.52	0.50
2	Spray (burn-down)	90	6.0	42.5	0.36	0.58
3	Plant	40	5.0	17.0	2.95	6.03
4	Spray	90	6.0	42.5	0.36	0.58
5	Combine	30	4.0	10.2	3.88	4.04
6	Heavy Harrow	70	5.5	39.7	0.61	0.57
	Trucks*				1.55	0.61
	Grain auger (pto)				0.21	0.08
	Pickup truck allocation				1.74	0.55
	Total				12.17	13.54

* Truck costs will vary between crops.

For more information on this and other topics, see: www.ag.ndsu.edu