Soil Test Values to Nutrient Applied Values **Name:** _____

Answer the following using both ND Soil Fertility Packets – old and new (charts included) and the soil test below each problem. Problems 1-2 will be done as examples. Complete problems 3-5 as homework to bring to class Tuesday. Grades of fertilizer (the 46-0-0) are given on last page

1. Find how much N, P, K, and potentially S are needed given:
   a. Using the NDSU soil guide, how much nitrogen would you have to apply for malting grade barley in warmer drier climates if you have done no-till for greater than 10 years?

   b. Using the NDSU soil guide, how much P2O5 would you have to apply for malting grade barley in warmer drier climates if you have done no-till for greater than 10 years?

   c. Using the NDSU soil guide, how much K2O would you have to apply for malting grade barley in warmer drier climates if you have done no-till for greater than 10 years?

   d. Create a blend from answers a-c using urea, DAP, and potash.

Table 4b. Barley, malting grade, in warmer, drier climates within North Dakota*.

Yield potential	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm VL 0-5 0-3	L 6-10 4-7	M 11-15 8-11	H 16-20 12-15	VH 21+ 16+	Soil Test Potassium, ppm VL 0-40	L 41-80	M 81-120	H 121-160	VH 161+
bu/a	lb/acre-2'		lb P_2O_5/acre					lb K_2O/acre				
40	48		28	20	12	4	0	45	31	17	3	0
60	72		43	31	19	7	0	67	47	26	5	0
80	96		57	41	25	9	0	89	62	35	7	0
100	120		71	51	31	11	0	112	78	44	8	0

Nitrogen recommendation = 1.2 YP-STN-PCC
Bray-1 P recommendation = (0.785-0.039 STP)YP
Olsen P recommendation = (0.785-0.050 STP)YP
Potassium recommendation = (1.2860-0.0085 STK)YP

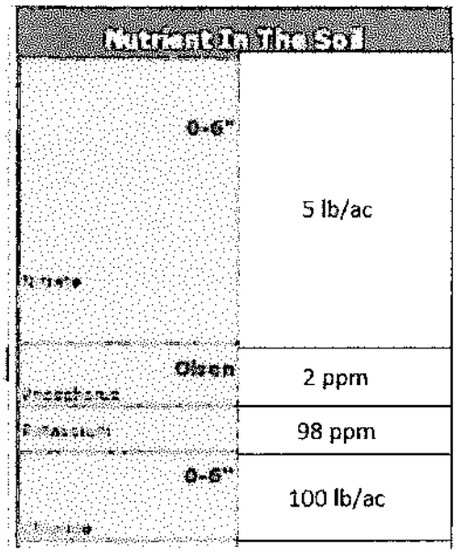
Early planting is critical for greatest success.
Planting later than May 15 will require lower N rates.
Applying potassium chloride (0-0-60) at 15-20 lb K_2O/acre can increase kernel plumpness on well-drained soils if a chloride test is not available.

* This recommendation is most useful for the North Dakota region from north of Williston south and everything west of the Missouri River. In years with low soil moisture, growers further east may benefit from this formula (see Figure 1).

Table 4-2. Barley, malting grade, in warmer, drier climates in North Dakota.*

Total available N**, pounds per acre	Soil Test P, ppm VL 0-3	L 4-7	M 8-11	H 12-15	VH 16+	Soil Test K, ppm VL 0-40	L 41-80	M 81-120	H 121-150	VH 151+
	Pounds P_2O_5 per acre					Pounds K_2O per acre				
100	78	60	52	26	0	90	60	45	30	0

* Generally west and south of the Missouri River, see Figure 1.
**Total available N includes residual soil nitrate-N to a 2-foot depth, previous crop N credit, and supplemental N from fertilizers, manures or other sources. In long-term (six years or more continuous no-till) systems, N rate is 70 pounds of N/acre.



2. Find how much N, P, K, and potentially S are needed:
   a. Using the NDSU soil guide, how much nitrogen would you have to apply for canola in a cooler and moister environment?

YP
2200

   b. Using the NDSU soil guide, how much P2O5 would you have to apply for canola in a cooler and moister environment?

   c. Using the NDSU soil guide, how much K2O would you have to apply for canola in a cooler and moister environment?

   d. Using the NDSU soil guide, how much sulfur would you have to apply for canola in a cooler and moister environment?

   e. Create a blend from answers a-c using urea, DAP, AMS, and potash.

Table 6. Canola.

			Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
Yield potential	Soil N plus fertilizer N required	Bray-1 Olsen	VL 0-5 0-3	L 6-10 4-7	M 11-15 8-11	H 16-20 12-15	VH 21+ 16+	VL 0-40	L 41-80	M 81-120	H 121-160	VH 161+
lb/a	lb/acre-2*		lb P_2O_5/acre					lb K_2O/acre				
1000	65		33	24	15	6	0	47	34	20	6	0
1500	100		49	36	23	9	0	71	50	30	10	0
2000	130*		65	48	30	13	0	94	67	40	13	0
2300	150		75	55	35	18	0	108	77	46	15	0
2500	150		82	60	38	16	0	118	84	50	16	0
3000	150		98	72	46	18	0	142	100	60	20	0

Nitrogen recommendation = 0.065 YP-STN-PCC with a 150 lb max limit
Bray-1 P recommendation = (0.036-0.0017 STP)YP
Olsen P recommendation = (0.036-0.0022 STP)YP
Potassium recommendation = (0.054-0.00034 STK)YP

Note: Canola has a high requirement for sulfur. Application of 20 to 30 lb/a S is recommended regardless of soil test results for this crop. Apply S as sulfate or thiosulfate form.

* Growers in warmer, drier areas should cap N rates at 120 lb N/a. (Fig.1).

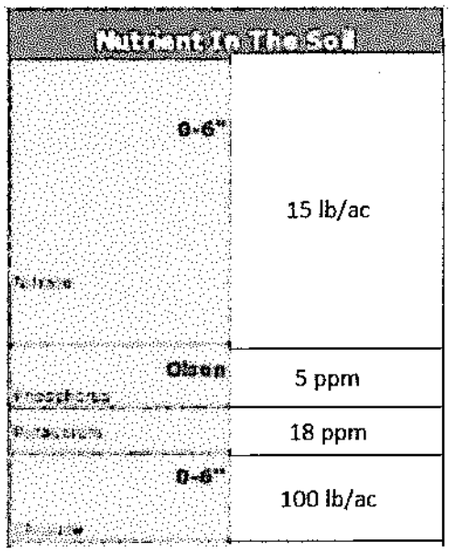
Table 6. Canola.

Soil N plus fertilizer N required	Olsen Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
	VL	L	M	H	VH	VL	L	M	H	VH
	0-3	4-7	8-11	12-15	16+	0-40	41-80	81-120	121-160	161+
	lb P_2O_5/acre					lb K_2O/acre				
120*	60	44	28	12	0	90	60	40	20	0
150**	60	44	28	12	0	90	60	40	20	0

* Indicates N rate for warmer and drier areas in North Dakota (Figure 1).

** Indicates N rate for cooler and moister areas in North Dakota (Figure 1).

A sulfate or thiosulfate form of S always should be used when growing canola at a rate of about 20 pounds of S per acre. See SF1122 for more details.



3. Find how much N, P, K, and potentially S are needed given soil test below values:
   a. Using the NDSU soil guide, how much nitrogen would you have to apply for tilled ground planted in silage corn?

   b. Using the NDSU soil guide, how much P2O5 would you have to apply for tilled ground planted in silage corn?

   c. Using the NDSU soil guide, how much K2O would you have to apply for tilled ground planted in silage corn?

   d. Create a blend from answers a-c using urea, DAP, and potash.

YP
16 tons

Table 9. Corn, silage.

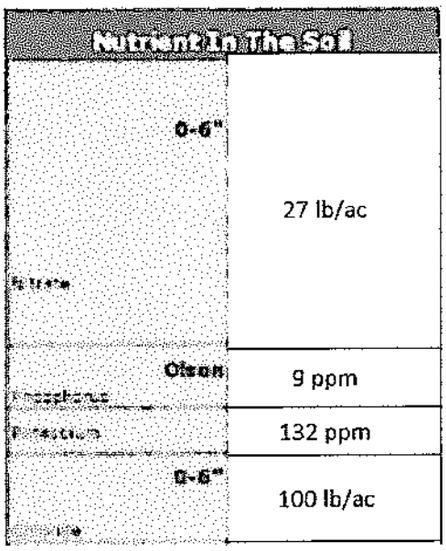
Yield potential	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm VL	L	M	H	VH	Soil Test Potassium, ppm VL	L	M	H	VH
			0-5	6-10	11-15	16-20	21+	0-40	41-80	81-120	121-160	161+
ton/a	lb/acre-2'		lb P_2O_5/acre					lb K_2O/acre				
10	105		51	37	23	9	0	83	59	35	11	0
14	145		71	52	32	13	0	116	83	49	15	0
18	185		92	67	41	16	0	149	106	63	20	0
22	230		112	81	50	20	0	183	130	77	24	0

Nitrogen recommendation = 10.4 YP-STN-PCC
Bray-1 P recommendation = (5.62-0.28 STP)YP
Olsen P recommendation = (5.62-0.35 STP)YP
Potassium recommendation = (9.50-0.06 STK)YP

Table 8. Corn for silage.

N* recommended	Olsen Soil Test Phosphorus, ppm 0-3	4-7	8-11	12-15	16+	Soil Test Potassium, ppm 0-40	41-80	81-120	121-150	151+
	lb/acre P_2O_5					lb/acre K_2O				
180	90	70	40	20	0	120	120	90	60	0

* Recommended N includes soil test nitrate-N to 2 feet in depth, previous crop N credits and 50 pounds of N credit for long-term (six years or more continuous no-till) systems.



4. Find how much N, P, K, and potentially S are needed given:
   a. Using the NDSU soil guide, how much nitrogen would you have to apply for no-till safflower?

   b. Using the NDSU soil guide, how much P2O5 would you have to apply for no-till safflower?

   c. Using the NDSU soil guide, how much K2O would you have to apply for no-till safflower?

   d. Create a blend from answers a-c using urea, DAP, and potash.

YP
1400

Table 21. Safflower.

Yield potential	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm VL 0-5 0-3	L 6-10 4-7	M 11-15 8-11	H 16-20 12-15	VH 21+ 16+	Soil Test Potassium, ppm VL 0-40	L 41-80	M 81-120	H 121-160	VH 161+
lb/a	lb/acre-2		lb P_2O_5/acre					lb K_2O/acre				
800	40		20	14	9	3	0	34	24	14	5	0
1,200	60		29	21	13	5	0	50	36	22	7	0
1,600	80		39	28	17	6	0	67	48	29	10	0
2,000	100		49	35	22	8	0	84	60	36	12	0

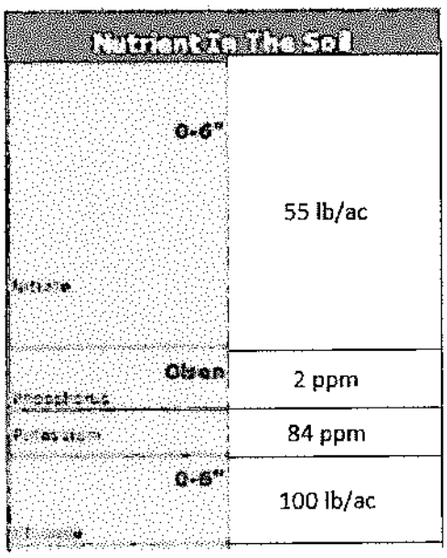
Nitrogen recommendation = 0.05 YP-STN-PCC
Bray-1 P recommendation = (0.027-0.0014 STP)YP
Olsen P recommendation = (0.027-0.0017 STP)YP
Potassium recommendation = (0.048-0.0003 STK)YP

Safflower will extract N from depths of more than 4 feet.
Excessive N will delay maturity and lower oil content.

Table 20. Safflower.

Total N* Recommended	Olsen Soil Test Phosphorus, ppm VL 0-3	L 4-7	M 8-11	H 12-15	VH 16+	Soil Test Potassium, ppm VL 0-40	L 41-80	M 81-120	H 121-150	VH 150+
80	40	30	20	20	0	60	60	30	30	0

* Total N includes soil test N to 2 feet in depth, previous crop N credits and supplemental fertilizer N, and a 30-pound N/acre N credit for fields in six years or more continuous no-till systems.



40
~~35~~ 60
336

5. Find how much N, P, K, and potentially S are needed given below soil test values:
   a. Using the NDSU soil guide, how much nitrogen would you have to apply for tilled ground planted in buckwheat?

   b. Using the NDSU soil guide, how much P2O5 would you have to apply for tilled ground planted in buckwheat?

   c. Using the NDSU soil guide, how much K2O would you have to apply for tilled ground planted in buckwheat?

   d. Create a blend from answers a-c using urea, DAP, and potash.

Table 5. Buckwheat.

			Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
Yield potential	Soil N plus fertilizer N required	Bray-1 Olsen	VL 0-5 0-3	L 6-10 4-7	M 11-15 8-11	H 16-20 12-15	VH 21+ 16+	VL 0-40	L 41-80	M 81-120	H 121-160	VH 161+
bu/a	lb/acre-2'		lb P_2O_5/acre					lb K_2O/acre				
25	55		30	22	13	5	0	41	29	18	6	0
30	65*		36	26	16	6	0	49	35	21	7	0
35	75*		42	30	19	7	0	57	41	25	8	0
40	90*		48	35	21	8	0	65	47	28	9	0

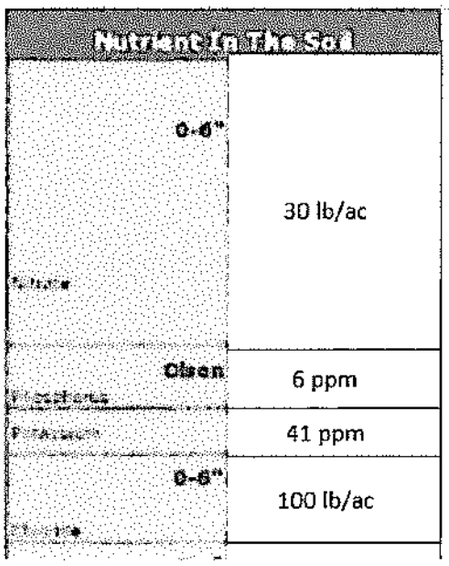
Nitrogen recommendation = 2.2 YP - STN - PCC
Bray-1 P recommendation = (1.320-0.066 STP)YP
Olsen P recommendation = (1.320-0.063 STP)YP
Potassium recommendation = (1.8600-0.0116 STK)YP

* N fertilizer rates greater than 50 lb/acre can cause lodging in wet years.

Table 5. Buckwheat.

	Olsen Soil Test Phosphorus, ppm					Soil Test Potassium, ppm			
Recommended N	VL 0-3	L 4-7	M 8-11	H 12-15	VH 16+	VL 0-40	L 41-80	M 81-120	H 121+
lb/acre-2'	lb P_2O_5/acre					lb K_2O/acre			
80*	40	30	20	10	0	60	40	30	0

*N rate includes soil test nitrate-N to 2 feet in depth, previous crop N credit, and a 30-pound N credit for long-term (six years or more continuous no-till) no-till systems.



Fertilizer Grade	Fertilizer Name
46-0-0	Urea (dry or liquid)
82-0-0	Anhydrous Ammonia
11-52-0	MAP – Mono-Ammonium Phosphate (Dry)
10-34-0	Liquid Ammonium Polyphosphate
18-46-0	DAP – Di-Ammonium Phosphate (Dry)
0-0-60	Potash (Dry or liquid)
21-0-0-24 (S)	AMS – Ammonium Sulfate

1. A. i Old

Nitrogen = 1.2 (100) - 5 - 0

115 lbs N/acre

A ii New

70 - 5 = 65 lbs N/acre

B i Olsen 2ppm

Old

(0.785 - .050 * 2) 100

68.5 lbs/acre P

B ii

New

78 lbs lbs P/acre

C i

Old

(1.286 - .0085 · 98²) 100

45.3 lbs K/1acre

C ii

New

45 lbs K/1acre

Di old

N	P	K
115 lbs	68.5 lbs	45 lbs

urea
46-0-0

DAP
18-46-0

Potash
0-0-60

K

$$\frac{45 \text{ lbs k}}{1 \text{ acre}} \cdot \frac{100 \text{ lbs pot}}{60 \text{ lbs k}} = \boxed{\frac{75 \text{ lbs Potash}}{1 \text{ acre}}}$$

P

$$\frac{68.5 \text{ lbs P}}{1 \text{ acre}} \times \frac{100 \text{ lbs DAP}}{46 \text{ lbs P}} = \boxed{\frac{148 \text{ or } 149 \text{ lbs DAP}}{1 \text{ acre}}}$$

N in DAP

$$\frac{149 \text{ lbs DAP}}{1 \text{ acre}} \cdot \frac{18 \text{ lbs N}}{100 \text{ lbs DAP}} = \underline{\qquad \sim 27 \frac{\text{lbs N}}{\text{acre}} \qquad}$$

N 115 lbs − 27 lbs = 88 lbs N

$$\frac{88 \text{ lbs N}}{1 \text{ acre}} \times \frac{100 \text{ lbs urea}}{46 \text{ lbs N}} = \boxed{\frac{191 \text{ lbs urea}}{1 \text{ acre}}}$$

New

Dii N P K

95 lbs N 78 lbs 45 - same as Di

Urea 46-0-0

DAP 18-46-0

Potash 0-0-60

K - See Di K - same # = 75 lbs Potash

P $\frac{78 \text{ lbs P}}{1 \text{ acre}} \times \frac{100 \text{ lbs DAP}}{46 \text{ lbs P}} = \boxed{\frac{170 \text{ lbs DAP}}{1 \text{ acre}}}$

N in DAP

$\frac{170 \text{ lbs DAP}}{1 \text{ acre}} \times \frac{18 \text{ lbs N}}{100 \text{ lbs DAP}} = \frac{30.6 \text{ lbs N}}{1 \text{ acre}}$

N Adjustment $65 - 30.6 = 34.4 \text{ lbs N}$

N $\frac{34.4 \text{ lbs N}}{1 \text{ acre}} \times \frac{100 \text{ lbs urea}}{46 \text{ lbs N}} = \boxed{\frac{75 \text{ lbs urea}}{1 \text{ acre}}}$

2 Ai Old

$0.065(2200) - 15 - 0$

128 lbs N/acre

Aii New

$150 - 15 =$ 135 lbs N/acre

Bi Old

$(0.036 - .0022 \cdot 5) \cdot 2200$

55 lbs P_2O_5/acre

Bii New

44 lbs P_2O_5/acre

Ci Old $(0.054 - .00034 \cdot 18) \cdot 2200$

105 lbs K2O/acre

Cii New - 90 lbs K2O/acre

2 D. Old	lbs/acre	N	P	K	Urea
		128 lbs N / 1 acre	55	105	46-0-0

DAP 18-46-0

Potash 0-0-60

K: $\frac{105 \text{ lbs } K_2O}{1 \text{ acre}} \cdot \frac{100 \text{ lbs Potash}}{60 \text{ lbs } K_2O} = \boxed{\frac{175 \text{ lbs Potash}}{1 \text{ acre}}}$

P: $\frac{55 \text{ lbs } P_2O_5}{1 \text{ acre}} \cdot \frac{100 \text{ lbs DAP}}{46 \text{ lbs } P_2O_5} = \boxed{\frac{\sim 120 \text{ lbs DAP}}{1 \text{ acre}}}$

N in DAP

$\frac{120 \text{ lbs DAP}}{1 \text{ acre}} \cdot \frac{18 \text{ lbs N}}{100 \text{ lbs DAP}} = \frac{\sim 22 \text{ lbs N}}{1 \text{ acre}} \rightarrow$ in DAP

Adjst top N $- \frac{128 \text{ lbs N}}{1 \text{ acre}} - \frac{22 \text{ lbs N}}{1 \text{ acre}} = \frac{106 \text{ lbs N}}{1 \text{ acre}}$

N: $\frac{106 \text{ lbs N}}{1 \text{ acre}} \cdot \frac{100 \text{ lbs Urea}}{46 \text{ lbs N}} = \boxed{\frac{217 \text{ lbs Urea}}{1 \text{ acre}}}$

3. Dii New N P K → lbs/acre

135 44 90

46-0-0-ur
18-46-0-DA
0-0-60-M

K $\frac{90 \text{ lbs } K_2O}{1 \text{ acre}} \cdot \frac{100 \text{ lbs Potash}}{60 \text{ lbs } K_2O} = \boxed{\frac{150 \text{ lbs Potash}}{1 \text{ acre}}}$

P $\frac{44 \text{ lbs } P_2O_5}{1 \text{ acre}} \cdot \frac{100 \text{ lbs DAP}}{48 \text{ lbs } P_2O_5} = \boxed{\frac{96 \text{ lbs DAP}}{1 \text{ acre}}}$

N in DAP $\frac{96 \text{ lbs DAP}}{1 \text{ acre}} \cdot \frac{18 \text{ lbs N}}{100 \text{ lbs DAP}} = \sim \frac{17\text{-}18 \text{ lbs N}}{1 \text{ acre}}$

$135 \text{ lbs N} - 17 \text{ lbs N} = \frac{118 \text{ lbs N}}{1 \text{ acre}}$

$\frac{118 \text{ lbs N}}{1 \text{ acre}} \cdot \frac{100 \text{ lbs Urea}}{46 \text{ lbs N}} = \boxed{\frac{257 \text{ lbs Urea}}{1 \text{ acre}}}$

3ai Old $10.4 \times 16 - 27 - 0 = \frac{139.416 \text{ lbs N}}{1 \text{ acre}}$

aii New $180 - 27 = \frac{153 \text{ lbs N}}{1 \text{ acre}}$

bi Old $(5.62 - 0.35 \cdot 9)\,16 = \frac{39.52 \text{ lbs } P_2O_5}{1 \text{ acre}}$

bii New $\frac{40 \text{ lbs } P_2O_5}{1 \text{ acre}}$ — Same

Ci Old $(9.5 - 0.06 \cdot 132)\,16 = \frac{25.28 \text{ lbs } K_2O}{1 \text{ acre}}$ ← Little high for old rec but we will use

Cii New $\frac{60 \text{ lbs } K_2O}{1 \text{ acre}}$

30:0:0 N P K

Rounded → ~140 lbs ~40 lbs ~25 lbs

139.4

46-0-0 Urea

18-46-0 DAP

0-0-60 Potash

K $\frac{25 \text{ lbs } K_2O}{1 \text{ acre}} \cdot \frac{100 \text{ lbs Pot}}{60 \text{ lbs } K_2O} = \boxed{\frac{\sim 42 \text{ lbs Potash}}{1 \text{ acre}}}$

P $\frac{40 \text{ lbs } P_2O_5}{1 \text{ acre}} \times \frac{100 \text{ lbs DAP}}{46 \text{ lbs } P_2O_5} = \boxed{\frac{87 \text{ lbs DAP}}{1 \text{ acre}}}$

N in DAP

$\frac{87 \text{ lbs DAP}}{1 \text{ acre}} \cdot \frac{18 \text{ lbs N}}{100 \text{ lbs DAP}} = \frac{15.6 \text{ lbs N}}{1 \text{ acre}}$

N — Adjusted $139.4 - 15.6 = \frac{\sim 123.7 \text{ lbs N}}{1 \text{ acre}}$

N $\frac{123.7 \text{ lbs N}}{1 \text{ acre}} \cdot \frac{100 \text{ lbs Urea}}{46 \text{ lbs N}} = \boxed{\frac{268.9 \text{ or } 269 \text{ lbs N}}{1 \text{ acre}}}$

30ii New

N	P	K
153 lbs N / 1 acre	SAME AS 30i	60 lbs K_2O / 1 acre

46-0-0
18-46-0
0-0-60

K $\frac{60 \text{ lbs K}}{1 \text{ acre}} \cdot \frac{100 \text{ lbs Potash}}{60 \text{ lbs K}} = \frac{100 \text{ lbs Potash}}{1 \text{ acre}}$

P From 30i

87 lbs DAP / 1 acre

15.6 lbs N in DAP

153 lbs N − 15.6 lbs N = 137.4 lbs N

$\frac{137.4 \text{ lbs N}}{1 \text{ acre}} \cdot \frac{100 \text{ lbs Urea}}{46 \text{ lbs N}} = \frac{\sim 299 \text{ lbs Urea}}{1 \text{ acre}}$

4a i old $0.05 \times 1400 - 55 - 0 =$ 15 lbs N / acre

Chart → 80 - 30 - 55 = 0 lbs N

a ii New — 30 → no till; 55 → in soil

4b i old $(0.027 - 0.017 \times 2)\ 1400 =$ ~33 lbs P_2O_5 / acre

6 ii new 40 lbs P_2O_5 / acre

4c i old $(0.048 - .003 \times 84)\ 1400 =$ ~32 lbs K_2O / acre

4c ii ~30 lbs K_2O / acre

very close say the same

4 Di - Solution - Old

K - Potash	P - DAP	N - Urea	Nitrogen in DAP
30 lbs K / acre	33 lbs P$_2$O$_5$ / acre	151 lbs N / acre	↓
Solution: 50 lbs Potash / acre	72 lbs DAP / acre	~5 lbs Urea / acre	~12.9 N / acre from DAP

4 Dii Solution New

K - Potash	P - DAP	N - Urea	Nitrogen in DAP
same as 4 Di → 30 lbs K / acre	40 lbs P$_2$O$_5$ / acre	0 lbs N / acre	↓
Solution: 50 lbs Potash / acre	87 lbs DAP / acre	0 lbs Urea / acre	15.6 lbs N / acre. ↑ N in DAP

5 Di Old

	N	P	K
lbs N / acre	~42.6	~27	~46

Solution
- ~70 lbs Urea / 1 acre
- ~59 lbs DAP / 1 acre
- ~77 lbs Potash / 1 acre
- 10.56 lbs N in DAP

5 Di New

	N	P	K
lbs / acre	50 lbs N / 1 acre	30 lbs P_2O_5 / 1 acre	40 lbs K_2O / 1 acre

Solution
- ~83 lbs Urea / 1 acre
- ~65 lbs DAP / 1 acre
- ~67 lbs Potash / 1 acre
- 11.74 lbs N in DAP

5Ai Old $2.2 \times 33 - 30 - 0 =$ **42.6 lbs N / acre**

Aii New $80 - 30 =$ **50 lbs N / acre**

Bi Old $(1.320 - 0.083 \times 6) \times 33 =$ **27.126 lbs P_2O_5 / acre**

Bii New **30 lbs P_2O_5 / acre**

Ci Old $(1.86 - 0.0116 \times 41) \times 33 =$ **45.6852 lbs K_2O / acre**

Cii New **40 lbs K_2O / acre**