Information Bulletin No. 5 March 1972

The International Wheat and Maize Nurseries

HANDBOOK FOR FERTILIZER CONVERSIONS TO BASIC UNITS

D. R. MacKenzie
and
John Cadavid

CENTRO INTERNACIONAL DE MEJORAMIENTO DE MAIZ Y TRIGO
INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER
Londres 40 Apartado Postal 6-641 México 6, D. F., México

RETURN THE RESULTS OF YOUR INTERNATIONAL NURSERY AS SOON AS POSSIBLE AFTER HARVEST.

Late returns cause delays and depreciate the value of the results to other scientists.

HANDBOOK FOR FERTILIZER CONVERSIONS

TO BASIC UNITS FOR USE WITH

CIMMYT INTERNATIONAL WHEAT AND MAIZE NURSERIES

Introduction

Responsiveness to high soil fertility has been a major cornerstone in the development of the new high yielding crop varieties. The detection of the capacity to utilize high soil fertility can only be made in the presence of high levels of N, P and K. Presently, it is common to receive data reports with units of measure not readily comparable with other units. Such nonuniformity can lead to misinterpretation of results - especially yield levels among locations.

We at CIMMYT have developed a set of tables for the conversion of the more common units of measure based on our experiences in processing the hundreds of returns we get each year. Several individuals have expressed an interest in these tables for personal use. We are most willing to assist cooperators in whatever way we are able. Those cooperators wishing to make fertilizer rate conversions for an International Nursery return are invited to do so. Such extra effort on their part will reduce the work load for us and eliminate a source of error over which we now have little control.

Method of Conversion

The primary objective of these tables is to allow for the conversion of a variety of fertilizer rates to kilograms per hectare (Kg/Ha) in elemental forms of Nitrogen (N), Phosphorus (P) and Potassium (K). We have selected these units of measure for international use to minimize confusion (i.e. is it the reduced form (P_2O_5)? or is it in non-metric units?).

The first step is to calculate the amount applied per large unit of area if the quantity was applied in weight per plot. This step would, of course be omitted if recorded in say pounds/acre, etc. The simplest method to convert plot rates to larger units is to express the amount per plot as the

amount per hectare. To do this divide the plot area in square meters into 10,000 and multiply the result by the number of kilograms of material applied. This is the kilogram quantity applied per hectare.

Example 1:

Plot size: 3 m^2
Amount applied: 300 gms superphosphate
300 gms = 0.30 kg
10,000/3m^2 = 3,333.3
0.30 kg x 3,333.3 =
1000 kg/ha superphosphate

Turning now to Table 2 we find that in the column of units measured kg/ha is the first listed. Reading across the formulation of materials, superphosphate is third. The coefficient for superphosphate applied in kg/ha is 0.08. Multiplication of this coefficient times the amount of superphosphate applied per hectare gives 80 kg/ha of actual phosphorus applied per hectare.

Example 2:

Rate of application: 100 lbs/acre Di-Ammonium Phosphate
From table 1 we see the coefficient for these units of measure and the material is 0.235.

100 lbs/acre x 0.235 =
23.5 kg/ha N

Also, note the numeral 2 at the top of the column. This indicates that Table 2 should be checked for the amount of P contained in an application of 100 lbs/acre of Di-Ammonium phosphate. The coefficient here is 0.263. This times 100 gives 26.3 kg/ha P.

Example 3:

Rate of application: 50 kg/decar of 20-10-0

Tables 1, 2 and 3 give the following coefficients for kg/decar and a fertilizer with percentages 20, 10 and 0 for N, P and K, respectively.

Table 1	N	=	2.00
Table 2	P	=	0.45[1]
Table 3	K	=	0.00

The rates of application are calculated as before.

2.00 x 50 kg/decar = 100.0 kg/ha N
0.45 x 50 kg/decar = 22.5 kg/ha P
0.00 x 50 kg/decar = 0.00 kg/ha K

All tabular coefficients are rounded to numbers considered significantly useful. Table 4 gives the amount in per cent of elemental fertilizer used in developing these coefficients. Any large deviation from these common values should be considered before employing these tables.

Fertilizer formulations which sum greater than 50 (i.e. N, P & K) are usually not percentages, but rates of application. Also, low values of fertilizer formulations (i.e. 1-2-1) are not percentages, but ratios of N to P to K. Neither designation can be converted without more descriptive information.

We hope that these tables are of use to your project. Please take care in their application. Comments, criticizm and/or additions are requested.

Added Note: The use of these tables can be reversed to calculate the amount of commercial fertilizer needed per unit area to give a desired application of elemental fertilizer by simply selecting the desired quantity of elemental chemical and dividing by the appropriate coefficient.

Example 4:

A desired application 100 kg/ha N to be applied as lbs/acre of mono-ammonium phosphate.

100.0 ÷ 0.123 = 833.3 lbs/acre of mono-ammonium phosphate = 100.0 kg/ha N

Also applied would be:

833.3 x 0.235 = 191.7 kg/ha P

This example well demonstrates the imbalance of many fertilizers if caution is not exercised.

---

[1] Note: Interpolation is necessary for 10% since only 12% and 8% are listed. These tables are based on the commonly reported fertilizer formulations. Tabular interpolation is possible since all relationships are linear.

Table 1. Coefficients for the conversion of nitrogen containing fertilizers applied in units/area to kilograms/hectare of actual elemental nitrogen (N).

UNITS OF MEASURE	FORMULATION OF MATERIALS: ACTUAL NITROGEN	AMMONIA OR ANHYDROUS AMMONIA	UREA	AMMONIUM NITRATE	CA. AMMO. NITRATE AND AMMONIUM SULFATE	CALCIUM NITRATE	SODIUM NITRATE	POTASSIUM NITRATE	MONO-AMMO.-PHOSPHATE	DI-AMMO-PHOSPHATE	NO_3	SUM X-Y-Z GREATER THAN 50
CHECK TABLE								3	2	2		
KG./HA.	1.00	0.82	0.45	0.33	0.21	0.18	0.16	0.13	0.11	0.21	0.23	VALUE PROBABLY REFERS TO THE QUANTITY APPLIED - TABLE IS NOT APPLICABLE
METRIC TON/HA.	1000.0	820.0	450.0	330.0	205.0	180.0	160.0	130.0	111.0	210.0	235.0	
QUINTALS/HA. (1Quintal=100 Kg.)	100.0	82.0	45.0	33.0	20.5	18.0	16.0	13.0	11.0	21.0	23.5	
KG./10 ACRES	0.045	0.037	0.020	0.015	0.009	0.008	0.007	0.006	0.005	0.008	0.010	
KG./DU. (Dunum=0.25 Ha.)	4.00	3.28	1.80	1.32	0.82	0.72	0.64	0.52	0.44	0.84	0.92	
KG./DE. (Decar=1000 m^2)	10.00	8.20	4.50	3.30	2.05	18.00	16.00	13.00	11.00	2.10	2.25	
KG./FED. (1 Feddan=0.42 Ha.)	2.40	1.97	1.08	0.79	0.49	0.43	0.38	0.31	0.26	0.51	0.55	
LBS./ACRE	1.120	0.918	0.504	0.370	0.230	0.202	0.179	0.146	0.123	0.235	0.258	
CWT./ACRE (CWT.=100 Lbs.)	112.0	91.8	50.4	37.0	23.0	20.2	17.9	14.6	12.3	23.5	25.8	

Symbols X, Y and Z are used below to designate position in formula of N, P and K, respectively.

FERTILIZER FORMULATIONS														
25 - Y - Z	20 - Y - Z	18 - Y - Z	15 - Y - Z	14 - Y - Z	13 - Y - Z	12 - Y - Z	11 - Y - Z	10 - Y - Z	8 - Y - Z	5 - Y - Z	4 - Y - Z	2 - Y - Z	0 - Y - Z
												LOW VALUE PROBABLY REFERS TO A RATIO - TABLE IS NOT APPLICABLE	
.25	.20	.18	.15	.14	.13	.12	.11	.10	.08	.05	.04		0.00
250.0	200.0	180.0	150.0	140.0	130.0	120.0	110.0	100.0	80.0	50.0	40.0		0.00
25.0	20.0	18.0	15.0	14.0	13.0	12.0	11.0	10.0	8.0	5.0	4.0		0.00
0.011	0.009	0.008	0.007	0.006	0.006	0.005	0.005	0.005	0.004	0.002	0.002		0.00
1.0	0.80	0.720	0.600	0.56	0.52	0.48	0.44	0.40	0.32	0.20	0.16		0.00
2.50	2.00	1.80	1.50	1.40	1.30	1.20	1.10	1.00	0.80	0.50	0.40		0.00
0.60	0.48	0.43	0.36	0.34	0.31	0.29	0.26	0.24	0.19	0.12	0.10		0.00
0.280	0.224	0.202	0.168	0.157	0.146	0.134	0.123	0.112	0.090	0.056	0.045		0.00
28.0	22.4	20.2	16.8	15.7	14.6	13.4	12.3	11.2	9.0	5.6	4.5		0.00

Table 2. Coefficients for the conversion of phosphorus containing fertilizers applied in units/area to kilograms/hectare of actual elemental phosphorus (P).

	FORMULATION OF MATERIALS																						
									Symbols X, Y and Z are used below to designate position in formula of N, P and K, respectively.														
									FERTILIZER FORMULATIONS														
UNITS OF MEASURE	ACTUAL PHOSPHORUS	P_2O_5	SUPERPHOSPHATE	DOUBLE SUPERPHOSPHATE	TRIPLE SUPERPHOSPHATE	MONO-AMMO.-PHOSPHATE	DI-AMMO.-PHOSPHATE	SUM X-Y-Z GREATER THAN 50	X - 25 - Z	X - 24 - Z	X - 20 - Z	X - 17 - Z	X - 16 - Z	X - 15 - Z	X - 14 - Z	X - 13 - Z	X - 12 - Z	X - 8 - Z	X - 7 - Z	X - 2 - Z	X - 0 - Z
CHECK TABLE						1	1	VALUE PROBABLY REFERS TO THE QUANTITY APPLIED – TABLE IS NOT APPLICABLE												LOW VALUE PROBABLY REFERS TO A RATIO – TABLE IS NOT APPLICABLE	
KG./HA.	1.00	0.44	0.08	0.12	0.20	0.21	0.24		0.11	0.10	0.09	0.08	0.07	0.06	0.06	0.06	0.05	0.04	0.03		0.00
METRIC TON/HA.	1000.0	436.0	78.0	123.0	200.0	210.0	235.0		110.0	100.0	90.0	80.0	70.0	60.0	60.0	60.0	50.0	40.0	30.0		0.00
QUINTALS/HA. (1 Quintal = 100 Kg.)	100.0	43.6	7.8	12.3	20.0	21.0	23.5		11.0	10.0	9.0	8.0	7.0	6.0	6.0	6.0	5.0	4.0	3.0		0.00
KG./10 ACRES	0.045	0.020	0.004	0.006	0.009	0.010	0.011		0.005	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.002	0.002	0.001		0.00
KG./DU. (Dunam=0.25 Ha.)	4.00	1.74	0.31	0.49	0.80	0.84	0.94		0.44	0.40	0.36	0.32	0.28	0.24	0.24	0.24	0.20	0.16	0.12		0.00
KG./DE. (Decar=1000 m^2)	10.00	4.36	0.78	1.23	2.00	2.10	2.35		1.10	1.00	0.90	0.80	0.70	0.60	0.60	0.60	0.50	0.40	0.30		0.00
KG./FED. (1 Feddan=0.42 Ha.)	2.40	1.05	0.19	0.30	0.48	0.51	0.56		0.26	0.24	0.22	0.19	0.17	0.14	0.14	0.14	0.12	0.10	0.07		0.00
LBS./ACRE	1.120	0.488	0.087	0.138	0.224	0.235	0.263		0.123	0.112	0.101	0.090	0.078	0.067	0.067	0.067	0.056	0.045	0.034		0.00
CWT/ACRE (CWT=100 Lbs.)	112.0	48.8	8.74	13.78	22.4	23.5	26.3		12.3	11.2	10.1	9.0	7.8	6.7	6.7	6.7	5.6	4.5	3.4		0.00

Table 3. Coefficients for the conversion of potassium containing fertilizers applied in units/area to kilograms/hectare of actual elemental potassium (K).

	FORMULATION OF MATERIAL																	
UNITS OF MEASURE	ACTUAL POTASSIUM	K_2O	MURIATE OF POTASH (SAME AS POTASSIUM CHLORIDE)	POTASSIUM SULFATE	POTASSIUM NITRATE	POTASH SALT (SAME AS POTASIC SALITRE)	SUM X-Y-Z GREATER THAN 50	Symbols X, Y and Z are used below to designate position in formula of N, P and K, respectively. FERTILIZER FORMULATIONS X - Y - 21	X - Y - 20	X - Y - 17	X - Y - 16	X - Y - 15	X - Y - 12	X - Y - 10	X - Y - 8	X - Y - 4	X - Y - 2	X - Y - 0
CHECK TABLE					1		VALUE PROBABLY REFERS TO THE QUANTITY APPLIED - TABLE IS NOT APPLICABLE										LOW VALUE PROBABLY REFERS TO A RATIO - TABLE IS NOT APPLICABLE	
KG./HA.	1.00	0.83	0.51	0.41	0.37	0.17		0.18	0.17	0.14	0.13	0.12	0.10	0.08	0.07	0.03		0.00
METRIC TON/HA.	1000.0	833.0	508.0	408.0	367.0	166.0		180.0	170.0	140.0	130.0	120.0	100.0	80.0	70.0	30.0		0.00
QUINTALS/HA. (1 Quintal = 100 Kg.)	100.0	83.3	50.8	40.8	36.7	16.6		18.0	17.0	14.0	13.0	12.0	10.0	8.0	7.0	3.0		0.00
KG./10 ACRES	0.045	0.038	0.023	0.018	0.016	0.008		0.008	0.008	0.006	0.006	0.005	0.004	0.004	0.003	0.001		0.00
KG./DU. (Dunam = 0.25 Ha.)	4.00	3.33	2.03	1.63	1.47	0.66		0.72	0.68	0.56	0.52	0.48	0.40	0.32	0.28	0.12		0.00
KG./DE. (Decar = 1000 m^2)	10.00	8.33	5.08	4.08	3.67	1.66		1.80	1.70	1.40	1.30	1.20	1.00	0.80	0.07	0.30		0.00
KG./FED. (1 Feddan=0.42 Ha.)	2.40	2.00	1.22	0.98	0.88	0.40		0.43	0.41	0.34	0.31	0.29	0.24	0.19	0.17	0.07		0.00
LBS./ACRE	1.120	0.933	0.569	0.457	0.411	0.186		0.202	0.190	0.157	0.146	0.134	0.112	0.090	0.078	0.034		0.00
CWT/ACRE (CWT=100 Lbs.)	112.0	93.3	56.9	45.7	41.1	18.6		20.1	19.0	15.7	14.6	13.4	11.2	9.0	7.8	3.4		0.00

TABLE 4. Per cent elemental Nitrogen, Phosphorus and Potassium assumed to be contained in the most common sources of fertilizers for purposes of preparing the previous tables.

	Per Cent N	Per Cent P	Per Cent K
AMMONIA OR ANHYDROUS AMMONIA	82.0		
UREA	45.0		
AMMONIUM NITRATE	33.0		
CA. AMMO. NITRATE	20.5		
AMMONIUM SULFATE	20.5		
CALCIUM NITRATE	18.5		
SODIUM NITRATE	16.0		
POTASSIUM NITRATE	13.0		37.0
MONO-AMMO. PHOSPHATE	11.0	21.0	
DI-AMMO. PHOSPHATE	21.0	23.5	
NO_3	23.0		
P_2O_5		43.6	
SUPERPHOSPHATE		7.8	
DOUBLE SUPERPHOSPHATE		12.3	
TRIPLE SUPERPHOSPHATE		20.0	
K_2O			83.3
MURIATE OF POTASH OR POTASSIUM CHLORIDE			51.0
POTASSIUM SULFATE			41.0
POTASH SALT OR POTASIC SALITRE			16.6