CHEMICAL FERTILIZERS USAGE FOR GRASSLAND AND CROPS IN 2003

by

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INTRODUCTION

The National Farm Survey (NFS) is carried out each year by Teagasc in order to determine and report on the financial situation on Irish farms. It provides a database for agricultural economics and rural development research projects. A subset of the data from the NFS was made available to Johnstown Castle Research Centre in order to conduct a Fertilizer Use Survey (FUS).

The survey data includes the amount and types of chemical fertilizer used by the farmers for grassland and crops, together with data on areas under the crop, livestock numbers, land use class, animal numbers, the location of the farm etc. The aim is to determine the amounts of N, P and K nutrients and types of fertilizer used on grassland and arable crops and to measure the relationships between fertilizer use and such factors as geographic region, farm size, stocking rate and soil use class.

Comparisons are also made between fertilizer use and current Teagasc fertilizer advice for the different crops and the report points to possible explanations for the findings.

SURVEY METHODS

The survey data consists of information from the 1275 farms which took part in the Teagasc National Farm Survey of 2003 (Connolly et al, 2004). These farms represent a random selection of major farm systems and sizes selected using information from the CSO Census of Agriculture 2000. Farms were classified into major farming system according to the standardised EU types used by Eurostat. For the purpose of this report, the 8 EU system types were simplified to 4 main farm types namely: dairying, cattle, sheep and tillage.

The distribution of farms of different sizes using this simplified farm classification is shown in Table 1. The table shows that 27% of farms in the survey are in dairying while over 50% are involved in cattle enterprises. Almost 40% of Irish farms had an area of 20 ha or less.

Table 1 Percentage distribution of Irish farms according to farm system and size

System	Farm Size (ha)						
	< 10	10-20	20-30	30-50	50-100	> 100	Total
Dairying	1.3	3.5	5	8.7	7.3	1.2	27
Cattle	7.8	16.1	10.8	9.9	4.7	0.9	50.2
Sheep	2.5	4	3	3.6	2.4	0.9	16.4
Tillage Systems	0.7	1	0.9	1.4	1.4	0.8	6.2
All Systems	12.3	24.6	19.7	23.6	15.8	3.8	100

Survey Method

The survey database consists of 1275 records, each containing farm management and fertilizer data for one farm. The records contains a numeric farm reference code, fertilizer usage data and codes for the farm system, soil suitability class and for the county in which the farm is situated. The utilized agricultural area (UAA), the area of forage, the area of total feed and the number of livestock units on the farm are also included.

The fertilizer information for each farm includes the type and amount of each fertilizer that is used for grazing, silage and hay and for up to 16 tillage crops. The farm area under each crop is also included.

The data were tabulated using the data management/statistical package from the SAS Institute into two- and three-way tables. These tables related N, P and K fertilizer use to geographic regions and farm management factors such as farm enterprise, farm size, stocking rate, soil use class etc. The procedures used were based on those used by Murphy *et al* (1997) and Coulter *et al* (2002) in the fertilizer use surveys for 1995 and 2000. The mean values quoted for different crops are weighted according to the area of the crop on the farm in question.

In addition to mean fertilizer application rates, standard errors (S.E.) are also obtained. These give a measure of the variability of the mean in question. Statistically speaking, one can be 95% confident that the true value of the mean lies within the band of two standard errors on either side of the mean. Furthermore, if the difference between two means is greater than 2.8 times their S.E. then this is significant at the 5% level.

Validation Procedure

The survey results were validated by comparing the nationally published annual sales of N, P and K (Anon, 2004) with the amount calculated from the survey results for N, P and K usage for different crops together with the published national areas under these crops. It was necessary to use appropriate weightings from the National Farm Survey (NFS) to calculate weighted means. The number of farms with different utilizable agricultural area is shown in Table 2.

Table 2: Farm sample numbers for NFS 2003

	Number of Farms in the Survey[1] with Different Total Area					
Farm Size (ha)	2 – 20	20 - 30	30 - 50	50 -100	> 100	Total
Dairy	25	54	183	205	40	507
Cattle	127	108	125	84	10	454
Sheep	20	26	40	34	17	137
Tillage	5	9	23	34	41	112
Total Sample	177	197	371	357	108	1210

[1] The 1210 farms in the NFS sample represent a farming population of 114,457

The representativeness of the survey results is illustrated by Table 3. This shows the number of farms in the country represented by one farm in the survey. The table shows that large farms are better represented than small ones; for example for dairying and tillage, one participating farm in the survey represents about 40 large (>50 ha) farms from the national population but more than 100 farms in the 2-30 ha size range.

Table 3 Farm sample representation for NFS 2003

	Survey Representation[2] of the National Population of Farms					
Farm Size (ha)	2 – 20	20 - 30	30 - 50	50 -100	> 100	Total
Dairy	196	107	55	42	36	60
Cattle	218	116	91	65	101	96
Sheep	383	136	104	84	60	137
Tillage	241	113	70	49	24	112
Total Sample	235	116	73	52	41	1210

[2] Number of farms in the national population represented by one participating farm

These national CSO estimated areas were obtained from "Irish Agriculture in Figures 2000" (Fingleton, 2002). For each crop, a table was prepared giving the total area of all farms of each given size and farm system. These areas were multiplied by the fertilizer use per hectare of crop, obtained in the survey, to give an estimate of total consumption for each crop, farm size and farm system. Summing all these values weighted by crop area gave a survey estimate of total annual consumption. These are shown in Table 4.

Table 4 Validation of the survey results

	N	P	K
National Sales (kt/year)	388.1	43.8	111.1
Calculated Usage (kt/year)	383.0	44.7	111.3
Discrepancy	-1.3%	2.0%	0.2%

The agreement between the calculated consumption from the survey and the nationally published fertilizer sales for 2003 was excellent with deviations of only -1.3%, 2.0% and 0.2% for the three elements. Some minor errors could have been expected because (i) rough grazing is not included, (ii) the national statistics do not distinguish between malting barley and spring feeding barley and (iii) certain minor crops are omitted. Also, national fertilizer statistics are compiled on the basis of an October 1st to September 30th year but the NFS was compiled on a Jan 1st to December 31st year. Possible errors from this time difference would be expected to be low because farmers are advised

not to apply fertilizers during this winter period. The good agreement between fertilizer use and official national statistics of fertilizer consumption proves that the results of this fertilizer use survey are valid.

Land Use Classes

The categorisation of farms into different classes follows the classification of Gardiner and Radford (1980) who divided the potential uses of soils into six classes varying from wide, moderately wide, somewhat limited, limited, very limited and extremely limited. These were amalgamated into four by combining the bottom three classes into a single range called limited. The extent of land use class is regionally distributed within the country; nationally, 35% of land is in class 1 or 2 (wide and moderately wide); in Leinster, 54% of soils are in classes 1 or 2, in Munster the percentage is 39%, in Ulster it is 12% and in Connacht 17%.

Comparison with Teagasc Advice

Teagasc gives fertilizer advice depending on the crop, the nutrient Index of the soil and other factors relevant to the crop. For example, N advice for grazed grassland depends on the stocking rate. The P and K advice depends on the results of soil analysis and on whether the livestock are cows or cattle (Coulter, 2001). For silage, advice depends on the nutrient indices, the number of cuts and the amount of organic nutrients to be recycled. Advice for hay is similar to that for silage. Advice for tillage crops depends mainly on the soil index but for some crops, the fertilizer advice is modified according to the expected yield, the soil texture or the expected summer rainfall amount.

Taking the appropriate factors into account, a mean fertilizer recommendation was calculated for each crop in this survey from the percentages of soils in each Index point for N, P and K published by Teagasc. These calculated recommendations are compared with the N, P and K usage as determined by this fertilizer use survey.

FERTILIZER USE FOR GRASSLAND

Grazing

The average amount of fertilizer nutrients applied to grazed grassland was estimated from the fertilizer used on 1248 survey farms which contained grassland. The mean overall values were 104, 8 and 18 kg/ha for N, P and K respectively. Table 5 shows the distribution of nutrient use classified by national region. It is clear that the amount of nutrients, particularly N, used in the southeast and south of the country was very much greater than that used in the other regions. The Dublin and west regions were very low. However, Dublin represented less than 1% of the survey area and can be disregarded; this lack of representation and variability is also shown by the very high standard error of estimates for Dublin.

Table 5 Regional distribution of N, P and K application rates for grazing (kg/ha)

REGION	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	120	5.8	9	0.5	21	1.4	36	189
Dublin	66	26.1	3	1	6	2.1	38.9	10
Mid-East	92	7.5	6	0.7	13	1.3	47.5	119
Midlands	92	7.4	8	0.7	19	1.5	36.3	122
Border	84	5.4	7	0.5	14	0.9	28.8	218
South-West	78	6.2	8	0.6	17	1.3	30.6	141
South	167	6.8	11	0.6	25	1.4	32.4	251
West	55	4	7	0.4	15	1	24.6	190
Overall	104	2.6	8	0.2	18	0.5	32.8	1240

The geographic distribution of N and P application rates is shown in Figure 1. The higher usage of N in the south and south-east may be due to the longer grass-growth season in these regions; this is shown in Figure 2.

Figure 1 N and P for grazing

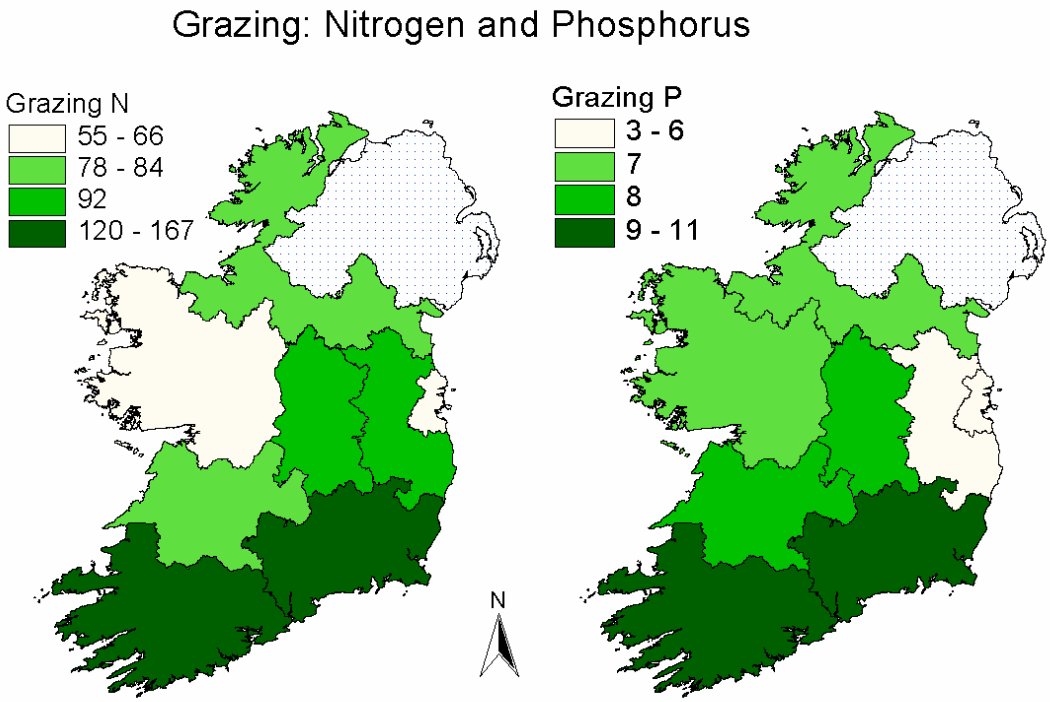
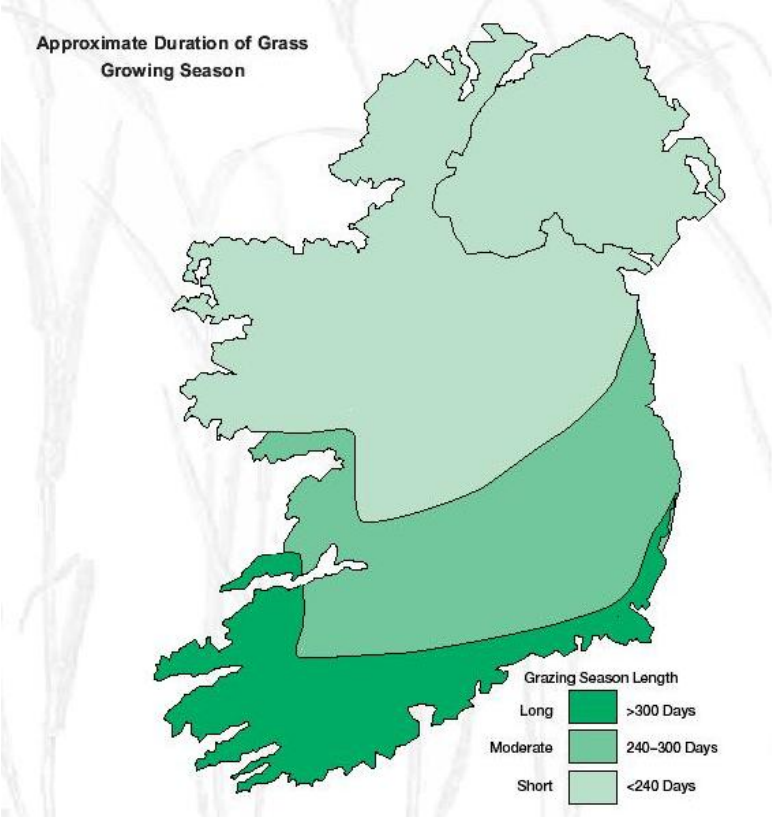


Figure 2 Length of typical grass growing season



The estimated amount of N, P and K applied to grazing land in the different farm systems is given in table 6.

Table 6 Estimated N, P and K fertilizer applied to grazed grassland (kg/ha)

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	159	4	10	0.4	23	0.8	39.0	522
Cattle	44	1.9	6	0.3	13	0.6	25.6	484
Sheep	51	4.1	5	0.5	11	1.2	32.5	142
Tillage	84	6.8	6	0.8	16	2.1	35.5	89
All	104	2.6	8	0.2	18	0.5	32.8	1237

Not surprisingly, the N, P and K application rates are much higher for grazing land on dairy farms than on farms which are mainly cattle sheep or tillage enterprises. The nutrient rates also depend on the size of the farm; Table 7 shows that on dairy farms, the rates appear to be larger of farms of 30 ha or greater but there appears to be no significant different difference between the rates for 30-50 ha farms and for farms larger than this. The errors of estimation are high on the smaller farms indicating marked variability between fertilizer practices.

Table 7 Relationship between farm size and nutrient application rates for dairy grassland

FARM SIZE ha	N	s.e.	P	s.e.	K	s.e.	Mean Area	No of Farms
10 - 20	135	18.9	9	1.2	21	2.8	11.6	22
20 - 30	143	14.5	9	1.1	20	2.5	18.7	56
30 - 50	161	7.6	10	0.6	23	1.4	29.1	187
50 -100	161	6	11	0.6	24	1.2	47.3	209
> 100	155	12.3	11	1.4	24	2.9	82.2	45

The effect of soil quality on nutrient applications to grazed grass is shown in Table 8. The Table shows that the highest rates of N, P and K were applied to the best soils.

Table 8 Effect of soil use class on nutrients for grazing

Class	SOIL Use	N	s.e.	P	s.e.	K	s.e.	Mean Area	No of Farms
1	Wide	137	5.3	9	0.4	20	1	36.8	384
2	Moderately Wide	98	5.7	7	0.5	16	1	34.9	227
3	Somewhat Limited	79	4.8	7	0.4	16	1	31.7	219
4	Limited	85	3.9	8	0.4	18	0.9	28.5	410
	All	104	2.6	8	0.2	18	0.5	32.8	1240

The N application rates for different stocking rates are given in table 9 for farms in which the main enterprise is dairying and cattle. The levels are much higher for dairy systems than for cattle.

The Teagasc N advice is also compared with N usage in Table 9. At stocking rates above 2 LU/ha, the N usage does not differ significantly from Teagasc advice for dairying, but below this stocking rate, N usage is significantly higher than the advised rates, the percentage difference decreasing with stocking rate. The N usage for cattle is considerably below Teagasc advice at all stocking rates.

Table 9 N for grazing cows and cattle at different stocking rates (kg/ha)

Stocking Rate (LU/ha)	N Usage Cows	s.e.	N Usage Cattle	s.e.	Teagasc N Advice
< 1.2	77	12.6	29	2.5	45
1.2 - 1.5	100	7.9	59	3.5	60
1.8	134	5.3	69	5.2	100
2.1	177	6.8	112	12.1	160
2.4	216	10.4	171	32.6	225
2.7	258	20.9	-		300

Table 10 shows the P and K for grazing cows at different stocking rates in comparison with Teagasc advice. The P usage conforms fully with advice but K usage is lower at every stocking rate.

Table 10: P and K usage and Teagasc P & K advice for grazing on mainly dairy farms by stocking rate

STOCKING RATE (LU/ha)	P Usage (kg/ha)	P Advice (kg/ha)	K Usage (kg/ha)	K Advice (kg/ha)
< 1.2	6	6	16	23
1.2 - 1.5	10	9	23	25
1.8	9	10	21	27
2.1	11	12	26	29
2.4	13	15	26	31
2.8	12	14	29	33

The usage of different fertilizer compounds for grazing over all farms is summarised in Table 11. It shows the percentage of the N, P and K applications supplied by the different compounds, the area receiving the compound expressed as a percentage and the number of farms involved. CAN, high N compounds (e.g. 23:2.5:5) and urea supplied over 91% of the N with 18:6:12 supplying the bulk of the remainder. High N compounds, 18:6:12 0:10:20 and 10:10:20 supplied 90% of the P with 0:7:30 supplying much of the remainder. The K distribution mirrored the P distribution almost exactly. There was a 12-14% increase in the use of high N compounds to supply N, P and K for grazing; thus nutrient are increasingly being applied on a “little and often” basis.

Table 11 Main sources of N, P and K for grazing (%)

COMPOUND	N	P	K	Area %	No of Farms
	Percentage for Each Source				
CAN	37.3	-	-	27.3	311
UREA	16	-	-	8.2	87
SUPER 16% P	-	1.9	-	0.4	6
POTASH 50% K	-	-	1.4	0.4	3
0:7:30	-	3.5	6.6	1.3	18
0:10:20	-	5.3	4.8	1.2	13
7:6:17	-	0.1	0.2	0.4	4
10:10:20	1.1	13.6	12.1	6.9	88
14:7:14	0.1	0.4	0.4	0.5	4
18:6:12	5.4	23.3	20.8	16.5	221
High N Compounds	38	48.1	48.5	32.1	357
22:2.5:10	1.2	1.8	3.2	1.4	15
18:2.5:14	0.1	0.1	0.3	0.3	4
20:3:6	0.1	0.3	0.3	0.5	4
Unclassified	0.4	-	-	2.2	22

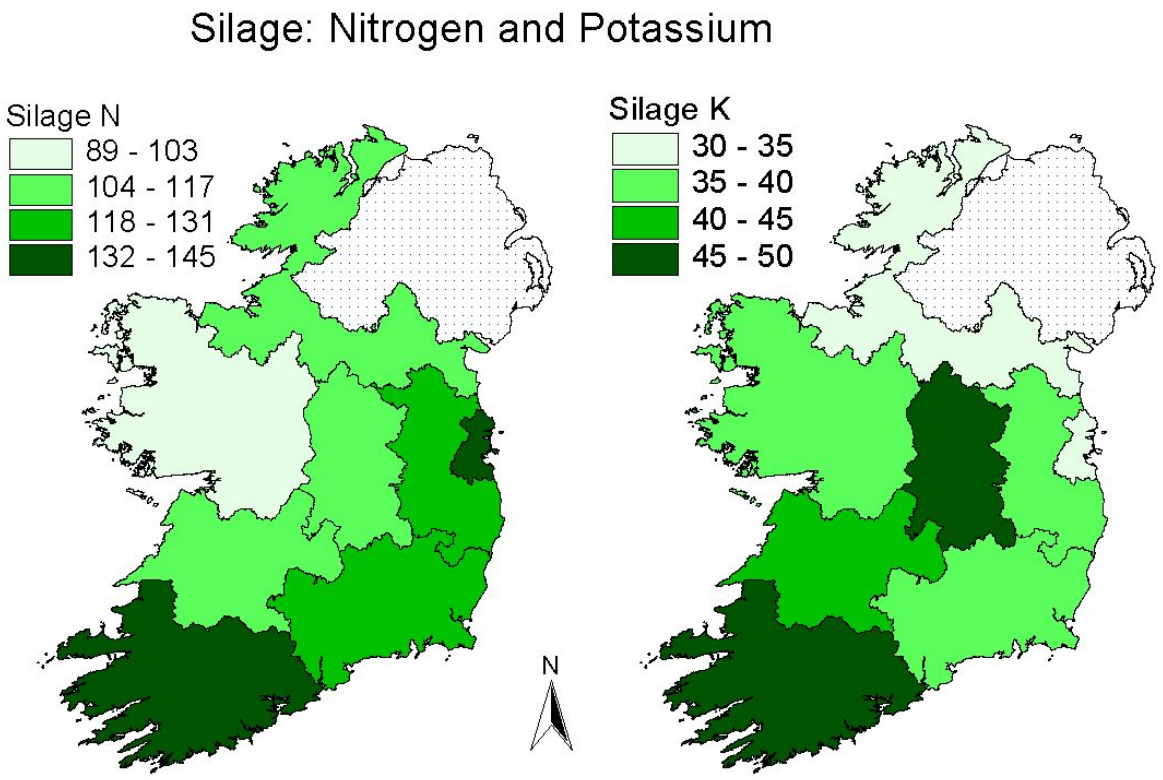
Silage

The nutrients used for silage are given in Table 12 broken down by region. In general, the highest rates of N were found south-east, mid-east and south but the highest P and K rates were found in the midlands and south. The regional distribution of N and K rates is illustrated in Figure 3.

Table 12 N, P and K for silage (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	125	3.4	12	0.8	36	2.6	14.1	174
Dublin	138	20	9	3	35	12.7	12.2	10
Mid-East	125	5.7	12	0.9	38	3	17	110
Midlands	114	4.8	15	0.9	49	2.8	13.1	115
Border	107	4	12	0.6	34	1.5	10.2	203
South-West	104	3.9	18	1.5	44	2.6	10.8	129
South	145	4.3	13	0.6	46	2.3	13.2	236
West	89	3.4	13	0.7	37	2.1	7.6	175
All	120	1.7	13	0.3	41	0.9	12	1152

Figure 3 Nutrient usage for silage in different regions



Teagasc N advice for silage depends on the number of cuts and on whether slurry is distributed on the crop (Coulter, 2001). Nitrogen advice for the survey farms in which 40% of silage farmers took 2 cuts would be 135 kg/ha assuming slurry and 165 kg/ha assuming no slurry. Actual usage was 120 kg/ha (Table 12) which is 13% below Teagasc advice assuming all slurry is applied to the silage crop.

Teagasc P and K advice for silage also assumes that the slurry or manure produced from the silage ground is returned to the soil. Median recommendations, derived by assuming that the survey farms have a typical distribution of P and K values, are shown in Table 13. Comparison between the calculated advice in the table and the mean nutrient applications for the survey farms shows that the N and P usage for silage (Table 12) was about midway between the slurry and no-slurry advice suggesting that economy in chemical fertilizer is possible if more farmers take into account the nutrient value of P and K nutrients in slurry.

Table 13: P and K fertilizer advice for silage (kg/ha)

	P (kg/ha)		K (kg/ha)	
	Slurry	No Slurry	Slurry	No Slurry
Teagasc Advice	5	25	19	136
Nutrient Application (as per table 15)	13		41	

The usage of different fertilizer compounds for silage over all farms is summarised in Table 14. It shows the percentage of the N, P and K applications supplied by the different compounds, the area receiving the compound expressed as a percentage and the number of farms involved. The pattern is similar to that for grazing land; CAN, high N compounds (e.g. 23:2.5:5) and urea supplied over 91% of the N with 18:6:12 supplying the bulk of the remainder. High N compounds, 18:6:12 and 0:7:30 supplied 90% of the P with 0:10:20 and 10:10:20 accounting for the remainder. The K distribution mirrors the P distribution almost exactly. Straight K accounts for only 0.8% of the K use for silage. There was a 16-18% increase since 2000 in the use of high N compounds to supply N, P and K for silage. This trend was already noted for the period between 1995 and 2000. Thus nutrient are increasingly being applied on a "little and often" basis as opposed to the application of P and K once per season.

Table 14 Main sources of N, P and K for silage on all farms

COMPOUND	N	P	K	Area %	No of Farms
	Percentage for Each Source				
CAN	21.3	-	-	18.3	370
UREA	11.8	-	-	5.9	114
Potash 50% K	-	-	0.8	0.4	6
0:7:30	-	15	20.8	4.3	110
0:10:20	-	3.6	2.3	1.2	25
10:10:20	0.5	4.2	2.7	2.2	39
14:7:14	0.1	0.4	0.2	0.1	4
18:6:12	6.5	19.9	12.9	10.3	232
High N Compounds	58.4	55.1	58.2	53.9	819
22:2.5:10	0.5	0.5	0.6	0.6	20
18:2.5:14	0.3	0.3	0.6	0.4	7
Unclassified	0.3	-	-	2.1	30

Hay

The N, P and K fertilizer rates for hay are summarised in Table 15 classified by region. The N rates do not vary as much for hay as they do for grazing and silage. The highest rates are found in the south and mid-east and the lowest in the midlands. Apart from Dublin which represents a small unrepresentative sample, the highest usage of P and K are found in the west and mid-east.

Table 15 N, P and K for hay (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	56	4	9	1.2	20	2.6	4.4	73
Dublin	18	11.9	12	7.8	25	15.6	2.4	6
Mid-East	60	6	14	1.4	33	3.3	5	52
Midlands	42	5.4	9	1	23	2.6	4.5	53
Border	75	15.1	11	2.6	24	5.1	2.5	56
South-West	34	3.9	11	1.3	26	3.3	3.2	53
South	61	6.6	8	1.2	22	2.9	2.6	56
West	46	3.3	12	1.3	31	2.8	3.1	57
All	53	2.5	11	0.5	25	1.2	3.6	406

FERTILIZER USE FOR TILLAGE CROPS

The nutrient usage for the most commonly grown tillage crops are given in this section. Because most tillage is grown in the south, east, south-east and midlands, the coverage of some of the crops is incomplete in the provincial tables.

Winter Barley

This crop was grown on only 34 farms out of the 1275 farms in the survey. The nutrients used for winter barley are given in Table 16 broken down by region. No barley was grown on survey farms in the south-west, south or west and information for the midlands and Dublin regions have been omitted from the regional table as it was found on only one or two farms in each. Standard errors were high making comparisons difficult.

Table 16 N, P and K for winter barley (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	167	17	17	9.3	52	18.5	11	5
Mid-East	161	19	17	4.4	57	12.7	13	12
Border	179	8.9	38	3.6	84	10.5	27	15
All	167	8.8	30	3	71	7.2	19	32

The mean N application rate of 167 kg/ha for survey farms was slightly higher than the calculated mean Teagasc advice of 156 kg/ha. Calculated Teagasc P and K advice levels matched almost exactly the rates used on the survey farms. The mean N usage for winter barley showed a decrease of 8% over the estimate for 2000 compared to the 5% drop in national sales of N over the same period.

Spring Barley

The nutrients used for spring barley are given in Table 17 broken down by region. There was a much wider occurrence of this crop than winter barley although the number of occurrences in the survey for the western counties was small. The N rates for south-east, mid-east and Dublin were the highest, and P rates were high in the south-west and border region.

Table 17 N, P and K for spring barley (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	126	4.3	24	1.7	41	2.6	15	56
Dublin	124	3.8	19	6.5	59	12.4	24	6
Mid-East	126	5.9	23	2.4	52	4.8	15	29
Midlands	113	9.1	26	3.4	77	7.1	14	20
Border	131	5.9	33	3.9	65	5.6	17	35
South	115	6.9	24	1.5	54	4.2	8	27
South-West	70	12.5	34	2.9	67	5.9	9	6
West	67	11.1	22	8.8	56	16.6	4	5
All	123	2.5	26	1.2	55	2.1	14	184

Teagasc N advice for spring barley is 120 kg/ha for Index 2 and 100 kg/ha for Index 3 soils. The mean N application rate for survey farms was 123 kg/ha which is slightly higher than with calculated Teagasc advice of 118 kg/ha. Teagasc P and K advice was calculated as 25 kg/ha and 57 kg/ha for P and K respectively. This matches very closely with rates shown in Table 17.

Winter Wheat

The nutrients used for winter wheat are given in Table 18 broken down by region.

Table 18 N, P and K for winter wheat (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	231	11.9	19	6.3	43	13.5	36	10
Mid-East	198	8.3	23	3.2	60	9.2	38	19
Border	206	7.5	33	2.3	76	7	42	16
South	170	16.9	26	8.9	68	5.1	13	3
All	203	5.6	23	2.2	55	5.7	40	48

Teagasc N advice for winter wheat depends on both the soil N index and the expected yield. The calculated Teagasc N advice for normal grain yields (9 t/ha of dry matter) would be 172 kg/ha and the advice for very high yields (11 t/ha or greater) would be 207 kg/ha.

Crop yields are not available in the survey, however N usage appears to exceed Teagasc advice assuming a normal mixture of low and high yielding crops.

The calculated mean Teagasc P and K advice for winter wheat on the survey farms was 25 and 67 kg/ha respectively. The surveyed farm P usage matched very well the calculated mean Teagasc P advice for winter wheat of 25 kg/ha but the K usage was low. The mean N usage for winter wheat decreased by 2% over that estimated for 2000, more or less in line with a 5% drop in national sales of N. The mean P and K usage dropped by 17% and 31% which are much greater decreases than the national drop in P and K sales of 11 and 9% respectively.

Spring Wheat

The nutrients used for spring wheat are given in Table 19 broken down by region. The standard errors are high making comparisons between the different regions difficult to achieve.

Table 19 N, P and K for spring wheat (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	157	6.3	21	3.5	45	7.2	19	24
Dublin	158	8.1	7	7.6	14	15.3	21	3
Mid-East	159	14.9	22	3.6	39	6.6	10	13
Midlands	159	25.8	13	6.3	26	12.6	11	4
Border	119	13	53	6.2	130	17.7	26	5
South	152	7.4	12	7.2	23	14.4	9	3
All	152	5.1	24	2.7	53	6.5	17	52

The calculated mean Teagasc N recommendations for spring wheat was 112 kg/ha. If one assumes that each farm achieved high yields of grain (9.5 t/ha or greater), the calculated rate would be 148 kg/ha. Thus the N usage of 152 in Table 19 was higher than Teagasc advises. The calculated advice rates for P and K were 26 and 57 kg/ha. Fertilizer usage of P and K for spring wheat is consistent with this advice.

Fertilizer Compounds for Cereals

The fertilizer compounds used for supply of N, P and K to cereals are listed in Tables 20-22. Most of the N was mainly supplied by CAN with some 10:10:20 and 18:6:12 and small amounts of urea used for particular cereals.

Phosphorus and potassium were mainly supplied by 18:6:12 and 10:10:20 for winter and spring barley, winter and spring wheat and some 0:10:20 and 18:8:6 used for winter oats.

Table 20 Main sources of N for cereals (%)

	Cereal Crop						
COMPOUND	W. Wheat	S. Wheat	W. Barley	S. Barley	M. Barley	W. Oats	S. Oats
CAN	72.4	68.6	62.0	52.4	52.2	76.0	48.5
UREA	7.8	0.9	5.8	0.4	3.0	1.0	2.8
8:5:18	-	2.6	-	-	-	-	-
10:3:18	0.7	-	-	-	-	-	-
10:10:20	5.3	6.8	9.8	7.2	4.0	6.3	9.2
14:7:14	0.1	0.4	-	1.6	6.5	-	-
15:3:20	-	-	-	1.8	6.5	-	-
15:10:10	0.9	1.0	-	0.6	2.4	2.1	2.2
16:5:20	0.1	-	1.9	2.1	4.0	-	-
16:7:13.3:NI	-	7.1	0.5	-	-	-	-
18:6:12	5.0	10.6	7.2	26.3	18.3	0.6	34.0
18:8:6	-	-	-	1.5	-	11.6	-
High N Compounds	6.1	1.2	12.1	5.4	2.2	1.7	1.2
Total	98.4	99.2	99.3	99.3	99.1	99.3	97.9

Table 21 Main sources of P for cereals (%)

	Cereal Crop						
COMPOUND	W. Wheat	S. Wheat	W. Barley	S. Barley	M. Barley	W. Oats	S. Oats
0:7:30	10.6	-	6.7	-	-	7.9	-
0:10:20	14.5	0.2	14.2	4.1	0.8	22.0	-
8:5:18	0.3	10.2	-	-	-	-	0.1
10:3:18	1.9	-	-	-	-	-	-
10:10:20	47.0	42.1	55.2	35.9	22.5	33.4	41.7
14:7:14	0.3	1.1	-	3.9	18.2	-	-
15:3:20	-	-	-	1.8	7.2	-	-
15:10:10	5.5	4.2	-	2.0	9.0	7.4	6.7
16:7:13.3:NI	-	19.3	1.3	-	-	-	-
16:5:20	0.2	-	2.6	2.8	7.1	-	-
18:6:12	14.8	21.9	13.5	44.0	34.2	1.1	51.4
18:8:6	-	-	-	3.4	-	27.3	-
High N Compounds	5.1	0.7	6.5	2.2	1.1	0.8	-
Total	100.2	99.7	100.0	100.1	100.1	99.9	99.9

Table 22 Main sources of K for cereals (%)

	Cereal Crop						
COMPOUND	W. Wheat	S. Wheat	W. Barley	S. Barley	M. Barley	W. Oats	S. Oats
Potash 50% K	2.1	2.6	3.1	0.8	10.3	4.5	-
0:7:30	18.9	-	11.9	-	-	18.4	-
0:10:20	12.0	0.2	11.8	3.7	0.6	23.8	-
8:5:18	0.4	17.0	-	-	-	-	0.1
10:3:18	4.8	-	-	-	-	-	-
10:10:20	39.0	38.9	46.0	32.2	16.9	36.2	41.9
14:7:14	0.3	1.0	-	3.5	13.6	-	-
15:3:20	-	-	-	5.3	18.1	-	-
15:10:10	2.3	1.9	-	0.9	3.4	4.0	3.4
16:7:13.3:NI	-	17.0	1.0	-	-	-	-
16:5:20	0.4	-	5.5	4.8	10.6	-	-
18:6:12	12.3	20.2	11.3	39.4	25.7	1.2	51.7
18:8:6	-	-	-	1.1	-	11.1	-
High N Compounds	7.7	0.7	9.3	5.1	0.8	0.9	2.1
All	100.2	99.5	99.9	96.8	100.0	100.1	99.2

Sugar Beet

The nutrients used for sugar beet are shown in Table 23 classified by region. Application rates for N were highest in the midlands but differences were not significant between any of the regions apart from mid-east where usage was low. Phosphorus rates were highest in the midlands and south-east and lowest in the south and mid-east. Potassium rates were much lower in the mid-east and south than elsewhere.

Table 23 N, P and K for sugar beet (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	160	7.5	47	2.9	168	9.3	11	35
Mid-East	107	13.8	21	9.9	76	34.6	10	8
Midlands	183	16.8	51	6.4	221	27.6	6	12
South	180	9.7	35	2.9	126	10.4	9	12
All	159	5.8	43	2.5	157	9.3	10	67

The mean Teagasc N recommendation for sugar beet is 139 kg/ha assuming normal summer rainfall (200 mm from April to June). For sugar beet grown with high summer rainfall (260 mm), the calculated advice would be 149. Thus the N usage on the survey farms of 159 kg/ha is higher than Teagasc advises. The calculated Teagasc recommendations for P and K were 39 and 170 kg/ha. Phosphorus fertilizer use was optimal at 43 but K levels appears to be somewhat low at 157 kg/ha.

Potatoes

The nutrients used for potatoes are shown in Table 24 classified by region. The N, P and K usage for potatoes were 9, 5 and 4% than in the 2000 survey respectively.

Table 24 N, P and K for potatoes (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	107	26.7	93	24.2	258	61.2	5	4
Dublin	163	5.1	161	8.6	332	0.2	19	2
Border	109	11.7	87	11.3	196	25.2	22	9
Mid-East	107	7.6	124	0	247	0.1	23	2
South	46	24.1	39	20.6	111	58.4	1	2
All	115	7.9	102	8.7	225	18.1	15	19

Mean Teagasc N, P and K fertilizer advice for potatoes was 134, 86 and 219 kg/ha. The surveyed N usage was lower, P was higher and K usage was broadly in line with these figures (Table 24). However, standard errors were high so differences were not significant.

Fertilizer Compounds for Root Crops

The fertilizer compounds used for supply of N, P and K to root crops are listed in Tables 25-27.

Table 25 Main sources of N for root crops (%)

	Root Crop			
COMPOUND	**Turnip**	**Potatoes**	**Sugar Beet**	**Fodder Beet**
CAN	12.7	2.8	37.0	29.2
S/A 21% N	-	13.9	-	-
6:10:18	-	-	-	0.9
7:6:17	-	26.7	-	-
8:5:18	25.2	0.9	11.2	30.3
9:4.5:18	-	-	13.9	6.3
9:6:15	-	-	5.4	-
10:3:18	-	-	2.8	4.1
10:5:25	-	-	2.9	3.8
10:10:20	-	50.4	-	4.5
13:4:14	-	-	22.1	10.3
14:7:14	-	-	-	0.8
15:10:10	41.3	-	-	-
18:6:12	-	-	0.8	5.2
22:2.5:10	20.8	-	-	-
High N Compounds	-	-	0.2	2
Total	100.0	94.7	96.3	97.4

Table 26 Main sources of P for root crops (%)

	Root Crop			
COMPOUND	**Turnip**	**Potatoes**	**Sugar Beet**	**Fodder Beet**
0:10:20	12.7	15.0	-	-
6:10:18	-	-	-	4.1
7:6:17	-	26.3	-	-
8:5:18	25.2	0.7	26	51.5
9:4.5:18	-	-	25.8	8.6
9:6:15	-	-	13.5	
10:3:18	-	-	3.1	3.4
10:5:25	-	-	5.3	5.1
10:10:20	0.0	58.0	-	12.3
13:4:14	-	-	25.3	8.6
14:7:14	-	-	-	1.1
15:3:20	-	-	-	-
15:10:10	41.3	-	-	-
16:7:13.3:NI	-	-	-	-
16:5:20	-	-	-	-
18:6:12	-	-	1.0	4.7
22:2.5:10	20.8	-	-	-
High N Compounds	-	-	-	0.5
All	100.0	100.0	100.0	99.9

Table 27 Main sources of K for root crops (%)

	Root Crop			
COMPOUND	**Turnip**	**Potatoes**	**Sugar Beet**	**Fodder Beet**
POTASH 50% K	-	0.7	-	-
0:10:20	-	13.4	-	-
6:10:18	-	-	-	2.2
7:6:17	-	33.2	-	-
8:5:18	60.5	1.1	25.5	54.4
9:4.5:18	-	-	28.1	10.1
9:6:15	-	-	9.2	-
10:3:18	-	-	5.1	5.9
10:5:25	-	-	7.2	7.5
10:10:20	-	51.6	-	7.2
13:4:14	-	-	24.1	8.9
14:7:14	-	-		0.7
15:3:20	-	-	-	-
15:10:10	29.4	-	-	-
18:6:12	-	-	0.5	2.7
22:2.5:10	10.1	-	-	-
High N Compounds	-	-	0.2	0.3
All	100.0	100.0	99.9	99.9

CHANGES IN FERTILIZER USE FROM 1995-2003

A summary of nutrient usage for grassland for the years 1995-2003 is given in Table 28.

Table 28 Mean fertilizer nutrient use for grassland from 1995-2003

YEAR	N	P	K	Mean Farm Area (ha)	No of Farms
	(kg/ha)				
1995	123	16	39	32.9	1207
1999	145	13	34	36.9	1097
2000	136	13	33	39.1	1112
2001	133	11	30	40.7	1207
2002	126	11	28	39.4	1224
2003	123	11	27	39.5	1251

Because grassland is the major crop grown in Ireland, one would expect a strong relationship between usage of N, P and K and national sales of the elements as chemical nutrients. The changes in N usage from 1995 to 2003 (Figure 4) appear to be similar to those for national N sales although the correlation coefficient of 0.45 is not statistically significant. The relationship between P and K usage and national sales of the elements (Figures 5 and 6) are very much stronger, with correlation coefficients of 0.99 and 0.95 respectively.

Figure 4 Relationship between N usage and national sales of N

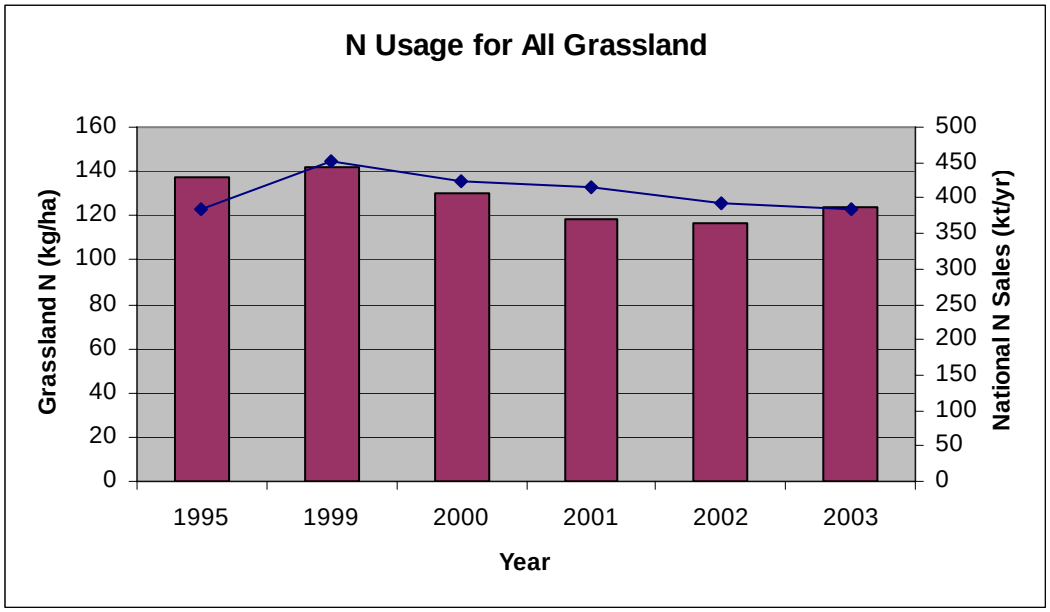


Figure 5 Relationship between P usage and national sales of P

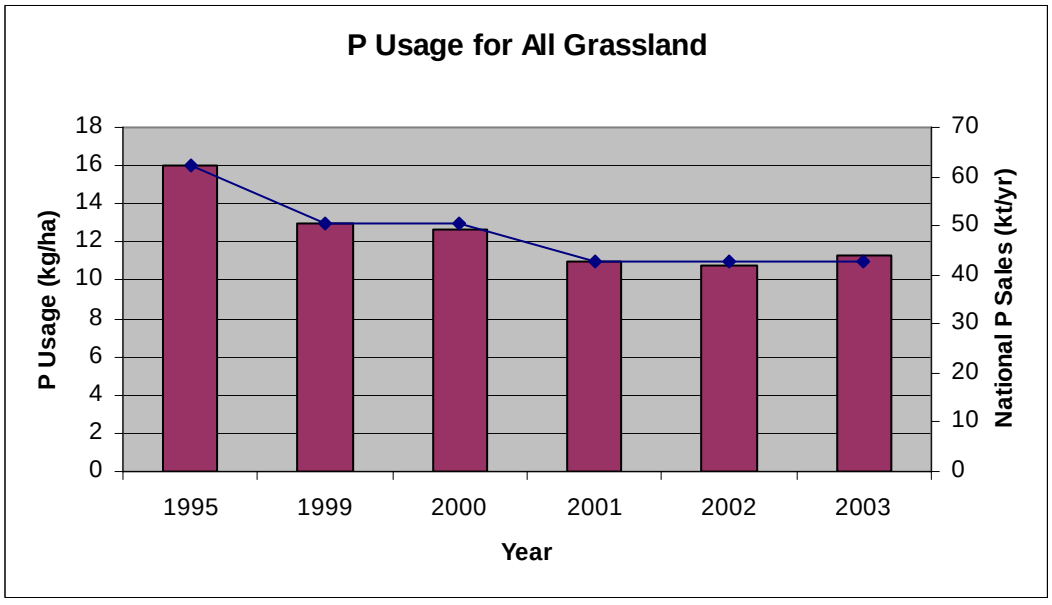
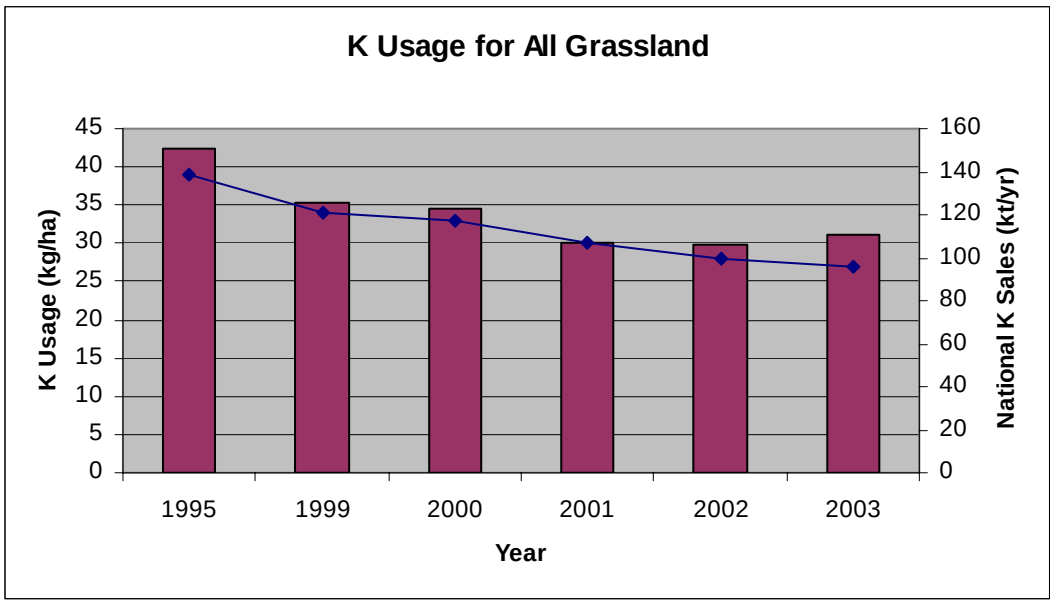


Figure 6 Relationship between K usage and national sales of K



A summary of nutrient usage for cereals and root crops for the years 1995-2003 is shown in Tables 29 – 30. The N usage for cereals shows an increase of about 11% over the period but was quite variable. P use was constant but K use showed a decrease of approximately 19%. For root crops, the usage of all three nutrients decreased markedly; the changes were 14%, 24% and 16% for N, P and K respectively.

Table 29 Mean fertilizer use for cereals from 1995-2003

YEAR	N	P	K	Mean Farm Area (ha)	No of Farms
	(kg/ha)				
1995	137	26	69	18	262
1999	127	25	56	23	210
2000	160	25	60	28	214
2001	147	24	53	27	240
2002	157	25	56	28	255
2003	152	25	56	30	247

Table 30 Mean Fertilizer Use for Root Crops from 1995-2003

YEAR	N	P	K	Mean Farm Area (ha)	No of Farms
	(kg/ha)				
1995	161	76	199	5	211
1999	154	62	190	7	126
2000	146	70	187	8	112
2001	151	74	208	9	120
2002	142	57	169	9	123
2003	139	58	168	9	117

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