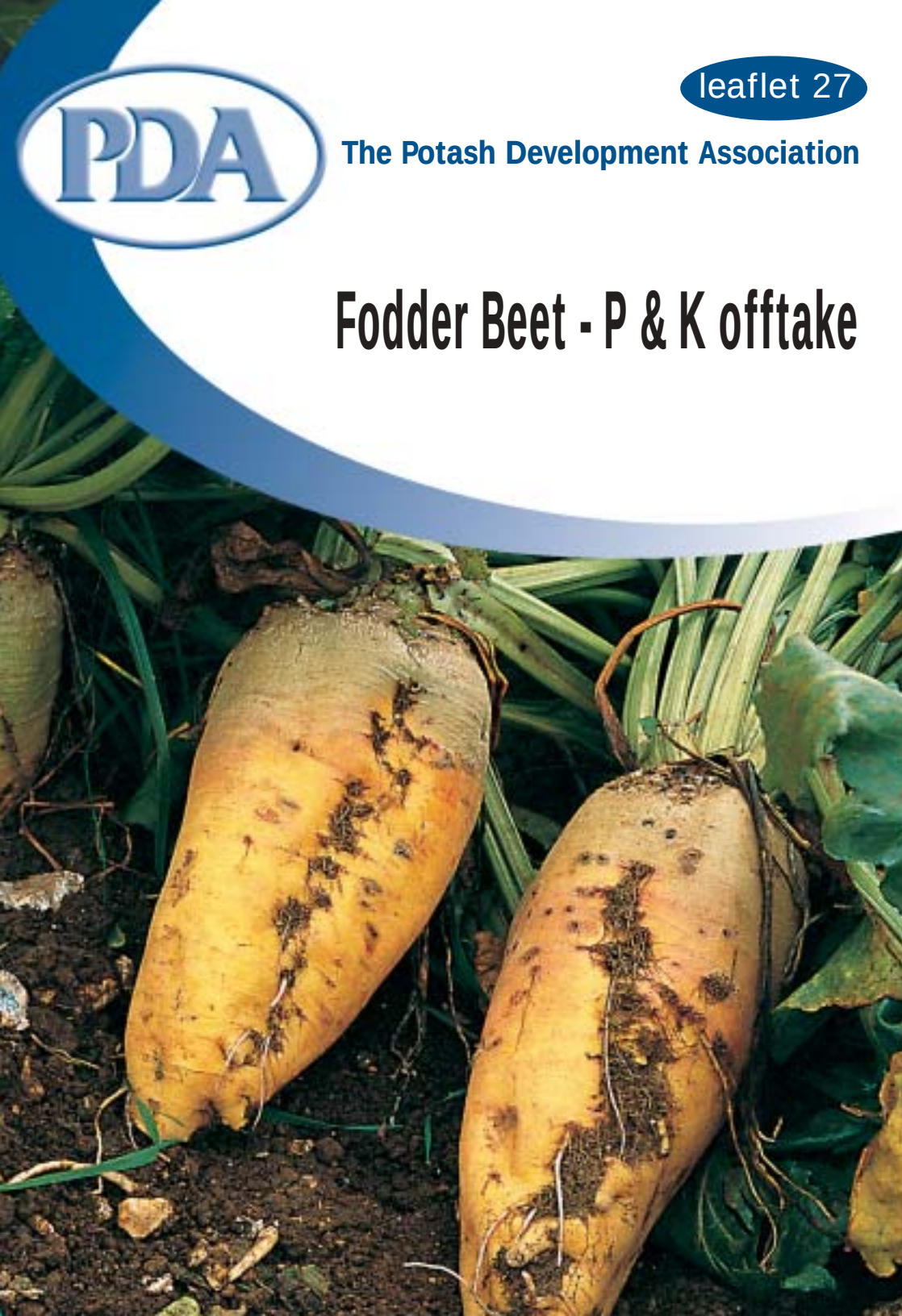
leaflet 27

The Potash Development Association

Fodder Beet - P & K offtake



Background

A three year trial, carried out by Kingshay Farming Trust & Duchy College with support from the PDA, examined the nutrient requirement of different fodder crops, (see PDA leaflet 26). The results indicated a major difference between the removal of potash in fodder beet compared to accepted typical values – Table 1. This is important because nutrient recommendations for optimum economic and environmental performance are based on crop removal.

Table 1. Phosphate and potash removed

	kg per t of root yield			
	Kingshay/Duchy study [1]		Standard figures [2]	
	P_2O_5	K_2O	P_2O_5	K_2O
Whole crop wheat	1.8	5.4	na	na
IRG	1.4	6.3	1.7	6.0
PRG/white clover	1.3	6.8	1.7	6.0
Fodder beet	**0.7**	**4.0**	**0.8**	**1.7**
Kale	0.9	5.0	1.2	5.0
Maize	1.7	6.5	1.4	4.4

[1] PDA leaflet 26 Nutrient requirements of fodder crops

[2] Phosphate and potash removal in crops PDA October 1997

It was subsequently established that the UK typical values for phosphate and potash removal for this crop were largely, if not entirely, based on data for sugar beet. Whilst these two crops are closely related, different varieties are used for the two separate purposes and have distinct characteristics such as root dry matter, sugar % and growth habit. It has been postulated that sugar in the roots of sugar beet replaces potassium as the preferred osmoticum and it is logical to presume that with lower sugar levels this substitution may not be as extensive in fodder varieties. It is also relevant that potassium is regarded as an "impurity" in the sugar extraction process with sugar beet. Breeding programmes have included this parameter in varietal selection and development over many years. This has resulted in declining levels of potassium in sugar varieties. A study of sugar beet crops in Germany, indicates a reduction from around 2.7kg K_2O/t roots to 2.1 kg K_2O/t between 1969 and 1988 - much of this being attributable to breeding.

Data from other Countries where fodder and sugar varieties are separately identified also confirms a distinct difference in potash content between the two crop types.

Survey of commercial fodder beet crops

In order to establish the typical values for potassium and phosphorus content of fodder beet, a survey was carried out to collect representative root samples from 30 commercial fodder beet crops across the UK during the harvest of 2000. The tops were not harvested and included in the survey because it is now very rare for these to be taken from the field. A very wide range of locations was involved from The Lizard in Cornwall, West Pembrokeshire in Wales through the Midlands to North Yorkshire. Soil type ranged from light sand to heavy loam with generally satisfactory pH and phosphate levels, but soil K levels ranging from low Index 1 to high Index 3. The surveyed crops included a range of modern varieties and received varying manurial treatment. Three quarters of the 30 crops received FYM or slurry usually in conjunction with mineral fertilisers. Salt was only used on approximately 25% of the crops.

Methods

Around 50kg of roots per crop were collected, 80% from clamps, the others were hand-harvested in the field. Clamp sampling provides the most accurate reflection of actual crop removal from the field for this forage crop which is not topped to a specified factory standard but to the individual farmer's own ability or requirements. As the aim of the survey was to establish what nutrients are removed from the field in practice, the variation in top tare and crown content of samples was accepted as representing the normal range of commercial practice. The total root samples were processed to a "brei" sample (homogeneous fresh sample of roots produced by chopping roots and sub-sampling as undertaken for commercial sampling of sugar beet crops) following normal procedures in a mobile tarehouse by IACR Brooms Barn who also prepared a dry matter sample. Dry matter samples were analysed by NRM Ltd using normal acid extraction to assess total phosphorus and total potassium.

Measurements

The % dry matter of fresh roots was measured together with total P & total K.
Yields were not measured but were subjectively assessed by co-operating farmers on a "trailer loads/experience" basis. Most crops were estimated to be yielding in the range 60-80 t/ha range (25-32 t/acre) with a few poorer crops around 45-50 t/ha (18-20t/acre) and one or two excellent crops over 80t/ha.

Results

The sample size was not large enough to identify relationships between "site factors" and "measured factors" *e.g. variety versus dry matter : soil fertility versus root P or K content : etc.* The "site factors" (soil type, manuring treatment, variety, etc.) were only recorded in order to exclude any crops which could not be regarded as normal. Whilst there was a range in dry matter and P & K content values, this was expected and none were felt to be so extreme as to warrant exclusion - see Tables 3a and 3b.

Dry matter ranged from 12.3 to 19.4% with an average of 15.2%. These results are on the low end of the expected DM range for the varieties involved and this is likely to be a direct consequence of the extreme wet conditions prevailing over the harvest period.
Phosphorus (P) and potassium (K) were measured in the dry matter but are expressed here as P_2O_5 and K_2O in the fresh roots (kg nutrient per tonne of roots) as this is the normal basis for expressing nutrient removal.

Table 2 **Phosphate & potash content of roots** (kg/t fresh roots)

	P_2O_5	K_2O
Lowest	0.4	2.6
Highest	0.8	5.9
Mean	0.6	4.0

Table 3a Distribution of root P values
(number of crops)

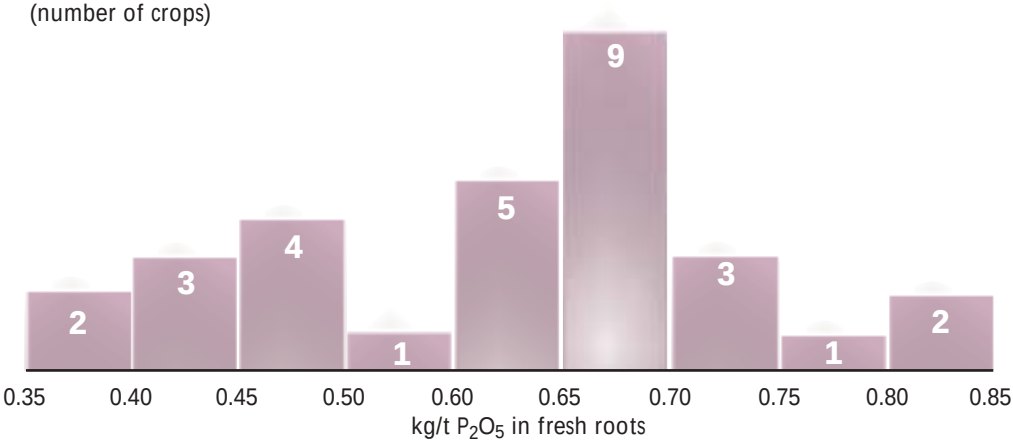
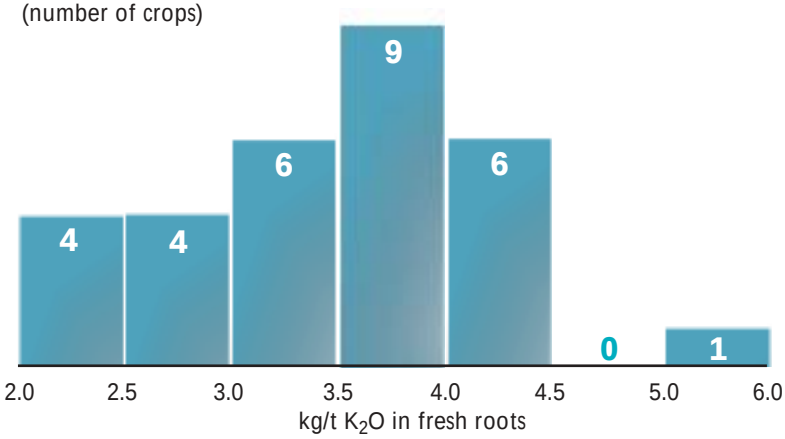


Table 3b Distribution of root K values
(number of crops)



The root K content was not influenced by manure use or sodium application, nor by the rate of potash applied in this survey.

The survey results are very similar to those from the earlier forage crop study (see table 1) and are also endorsed by removal data from other countries which quote specific fodder beet figures.

Removal data from other Countries

A literature search produced some data specifically on fodder beet from other countries which endorse the survey finding that P content of roots is similar in fodder and sugar beet but that K content is considerably higher in fodder roots. The actual levels are similar to those found in the survey.

kg/t fresh roots	P_2O_5 in roots		K_2O in roots	
	Fodder beet	Sugar beet	Fodder beet	Sugar beet
Latvia [1]	0.7	0.7	4.2	2.5
Slovak [1]	0.9	0.9	3.8	2.4
Poland [1]	0.9	0.9	4.6	2.2
Germany [2]	0.9 [a] 0.7 [b]	1.0	5.0 [a] 4.5 [b]	2.5
Denmark [3]	0.7	0.7-1.0	3.2	2.3-3.5
UK [4]	0.8.	0.8	1.7	1.7

[1] *Source : M Shepherd ADAS, data from the EU funded "MAINTAINE" project (CT-98-0108)*
[2] *Source : K Orlovius Kali und Salz. German standards*
[3] *Source : IFA World Fertilizer Use Manual. Carl Pederson LIK data.*
[4] *Source : PDA leaflet Phosphate & Potash removal by crops. UK standards*
[a] *Vars with higher dry matter*
[b] *Vars with lower dry matter*

Practical consequences

Phosphate and potash recommendations should be calculated to maintain available soil nutrient reserves at a level at which crop growth and yield will not be adversely affected by that nutrient. This is a **maintenance** policy which therefore requires the replacement of the amount of nutrient in the crop which is removed from the field. Where tops are grazed in situ with livestock, nutrient maybe re-distributed across the area but it is virtually all returned and therefore need not be included in the replacement calculation.

These studies indicate a greater removal of potash by fodder beet in practice than existing standards allow for. For a typical 60t/ha crop (25t/ac) the maintenance recommendation using existing standards would be 100 kg/ha potash whereas this study indicates that it should be 240kg/ha. If not recognised, this under-replacement would result in an erosion of soil fertility. In practice this shortfall may be hidden because of the use of generous applications of FYM/slurry but the use of manures should be monitored to make best use of this valuable resource rather than used to excess on a limited crop area.

New typical values

Following this study new typical values for phosphate and potash content of fodder beet should be adopted as follows.

	Phosphate kg/t roots	Potash kg/t roots
Roots only	0.6	4.0
Roots & tops	1.7	7.5

New recommendations

Total nutrient requirements should be based on the replacement of nutrient removed (maintenance levels) adjusted according to the field soil P and K Index. Fertiliser recommendations are calculated after deducting nutrient contribution from any FYM/slurry applied.

Maintenance requirements (kg/ha)	
Phosphate	Root yield (t/ha) x 0.6 (kg/t)
Potash	Root yield (t/ha) x 4.0 (kg/t)

Soil fertility adjustments (kg/ha)							
	soil index						
	0	1	2-	2	2+	3	4
Phosphate	M+50	M+25		M		M-50	Nil
Potash	M+50	M+25	M		M-25	M-70	Nil

Example: Typical 60t/ha crop on soil P index 2 and K index 1 requires 60 x 0.6 = 36kg/ha P_2O_5 and 60 x 4.0 + 25 = 265 kg/ha K_2O

Further information

More details on the fertilisation of fodder beet can be found in :-

PDA leaflet 16 "Fodder Beet – Fertiliser Requirements" by Dr A P Draycott & J. D. Hollies

MAFF Fertiliser Recommendations RB209 7th edition 2000.

*NB. The recommendations in this edition are **not** updated to the new typical values now agreed.*

Other PDA leaflets

1 Role of Potash (out of print)
2 Potash - Maintaining the Balance (out of print)
3 Potash for Quality (out of print)
4 Potash manuring for Arable Crops
5a Results from Cereal Demonstration Plots
5b Results from Grass Demonstration Plots
6 Potash, Magnesium & Sodium Fertilisers for Grass
7 P & K Balance for Cereals
8 Principles of Potash Use
9 Potash for Silage
10 Potash & Cereal Straw
11 Cereals and Potash
12 Potash for Sugar Beet
13 Oilseed Rape and Potash
14 Potash for Grassland
15 Potash for Potatoes
16 Fodder Beet -Fertiliser Requirements
17 Forage Maize - Fertiliser Requirements
18 Grain Legumes need Potash
19 Potash for Heavy Soils
20 Potash & Biosolids
21 Cutting Fertiliser Costs (out of print)
23 Potash for Organic Growers
24 Effective use of Soil Analysis
25 What you should know about fertilisers
26 Nutrient requirements of forage crops
27 Fodder Beet - P & K offtake
28 Why Maintain Soil Potash Reserves?

Grassland Kalculator
Arable Kalculator
P&K Offtake Standards
Nutrient Content of Manures

Thanks

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The Potash Development Association
is an independent technical organisation formed to support the efficient use of potash fertiliser in the UK

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