TECHNICAL NOTE TN 774 2026 • ELEC

Phosphate and potash management for crops grown in Scotland

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Summary

- **Nutrient Management Planning Tool (NMPT-GB), a new software tool designed for routine use by Scottish farmers and advisers to plan and manage nutrient use on individual fields.**
- **Regular soil analysis with accompanying field information is essential to manage soil PK inputs for optimum yields, profitability and minimising pollution.**
- **Soil P management considers the relationship between differing soils capacity to regulate P availability for plant uptake.**
- **Soils of Scotland have been designated and mapped as index 1, 2 and 3 to reflect inherent soil phosphorus sorption capacity (PSC) which impacts how soils must be managed.**
- **A map produced at farm level with PSC Indices derived from soil associations is shown.**
- **For cereal-based arable rotations the target soil P Status is M- on PSC 1 and 2 soils and M+ on PSC 3 soils. The target soil P Status is M+ for rotations including potatoes and responsive vegetable crops.**
- **Adjustments to P and K fertiliser recommendations are made to build up or run down to target soil PK Status.**

Introduction

Soils should be sampled every 4 to 5 years and analysed for soil pH, extractable P, K, Mg and LOI. Fields cropped with potatoes should be sampled before planting as potatoes often give a yield response to PK fertiliser in the year of application. Cereals and oilseed rape do not generally respond on moderate PK Status soil, and therefore sampling time is not so crucial, but the application of fertilisers and manures may influence results for up to 12 weeks after application. Results may be lower than expected if fields are sampled during periods of maximum nutrient uptake, particularly for K after cuts of silage, but higher (or more variable) than expected in spring due to decomposition of crop residues. Care should be taken to avoid building extractable soil P above the target Status. Much of phosphate transfer from soil to surface is overland transport of particulates with bound P.

Regional differences in soil extractable P concentrations exist primarily in response to variations in land use, particularly the greater role of livestock in the west compared to arable cropping in the east. No obvious or consistent temporal trend in extractable P is apparent, but a very wide range of soil properties and extractable P on concentrations is evident. In this technical note an attempt is made to link advisory P and K data with information from the National Soil Database of Scotland; and to explore the value of introducing 'soil type' into the fertiliser recommendation system, updated in TN766 (2024) (www.fas.scot/technical-notes/).

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Classification of extractable soil PK into PK Status

SAC Consultancy classifies soil PK test values extracted by the Modified Morgan's method into 6 categories in Table A(a).

Table A(a). Classification of extractable soil PK (mg/l) into PK Status.

PK Status	Very Low (VL)	Low (L)	Moderate (M-)	Moderate (M+)	High (H)	Very High (VH)
Range (mg P/l)	<1.8	1.8-4.4	4.5-9.4	9.5-13.4	13.5-30	>30
Range (mg K/l)	<40	40-75	76-140	141-200	201-400	>400

In recent years, about 30% of samples require more than maintenance of P applications i.e. VL and L samples, and 8% of samples require less than maintenance P applications i.e. H and VH samples.

The distribution of samples across K Status remained very similar over many years, with about 20% of samples requiring more than maintenance K applications i.e. VL and L samples, and under 20% requiring less than maintenance K applications i.e. H and VH samples.

More than half of samples have additional information recorded such as previous and next crop. This provides a mechanism for assessing the possible influence of different fertiliser strategies for individual crops. The range in soil P and K Status reflects a wide range in the intensity of farming. These differences are clear with P Status where about 40% of samples in grass and fodder crops have VL or L Status compared with only 8% having VL or L Status going into vegetables and nearly 30% of samples with H or VH Status. In comparison, K, about 30% of samples going into in grass and fodder crops with VL and L K Status, compared with 9% going into winter arable and 18% into vegetables in VL and L K Status. Winter arable has about 25% of samples with H or VH K Status.

Large responses in yields to P and K in the year of fertiliser application are only expected where the soil P and K Status is very low, although some vegetable crops respond to fresh additions of P and K at low soil Status. Low PK Status soils do not necessarily have a low yield potential given adequate fertiliser P and K, but site/season and other aspects of husbandry are the major determinant of yield potential. Seasonal factors are not predictable, so soil PK Status is the main variable for determining fertiliser requirements. Where samples have P and K Status of VL or L and pH below pH of 5.5, if soil pH is not corrected by liming in these soils yield potential is expected to be lower by up to 50% in spring barley; 30% in winter wheat; and 20% in grass even with adequate PK fertiliser. In the Highlands and Islands, about 14% of samples have P and K Status of VL or L and pH below pH of 5.5; in SW Scotland about 12%; NE and Tayside about 5% and SE Scotland about 5% in these categories.

Phosphate (P_2O_5) helps root development, early growth, and the ripening of seeds. Loss of yield is generally more common in the wetter, poorer drained upland areas than in drier, better drained lowland areas, partly because the availability of P is low in acid soils especially with pH values below 5.5. Soil P availability is reduced at low temperatures, such as when growth begins in spring. Soil P supply to the plant is dependent on soil reserves, which must be converted to a soluble form before being absorbed by plant roots. Early grass growth often occurs before land can be accessed to spread fertiliser so maintaining P status is required for maximum spring yields. Soil P levels may decline over the rotation in some soils, due to gradual sorption, when only maintenance applications are made. Soil specific approach to P management considers the relationship between differing soils capacity to regulate P availability for plant uptake. This soil information has been made available at the farm level jointly by SRUC and The James Hutton Institute as Technical Note TN668 (2015) Managing soil phosphorus (www.fas.scot/technical-notes/).

Potash (K_2O) promotes root development and gives strength and stiffness to the whole plant. Cereals inadequately supplied with K are more prone to lodging at high rates of N than those with an adequate supply; and have lower resistance to drought. Maintaining an adequate level of soil K over the long term is important because, on K deficient soils, it is difficult to distribute fresh K fertiliser sufficiently throughout the rooting zone in the season it is applied. Adequate levels of soil K are also imperative so that the roots to access it so that the crop can respond to all the applied N fertiliser and produce optimal yields.

Application of fertiliser serves 3 purposes:

- To replace PK offtake by the crop over the long-term maintaining a balanced soil fertility and helping to optimise nutrient use efficiency.
- To increase the status of Very Low and Low soils on the assumption that Moderate Status results in high yield potential; and
- To maximise profits.

Effective use of PK fertiliser requires 3 key steps:

1. Based on a recent soil test develop a liming program to bring the soil to its pH target (www.fas.scot/technical-notes/). If target pH is not achieved, yields will be lower, which should be recognised when calculating fertiliser requirements.
2. Calculate the amount of PK that will be removed from the soil based on expected yield.
3. Based on soil test results for PK Status, adjust if required to reduce or increase rates to bring soils on target.

RB209 classifies soil P test values extracted by the Olsen method and soil K & Mg measured in ammonium nitrate extract in Table A(b).

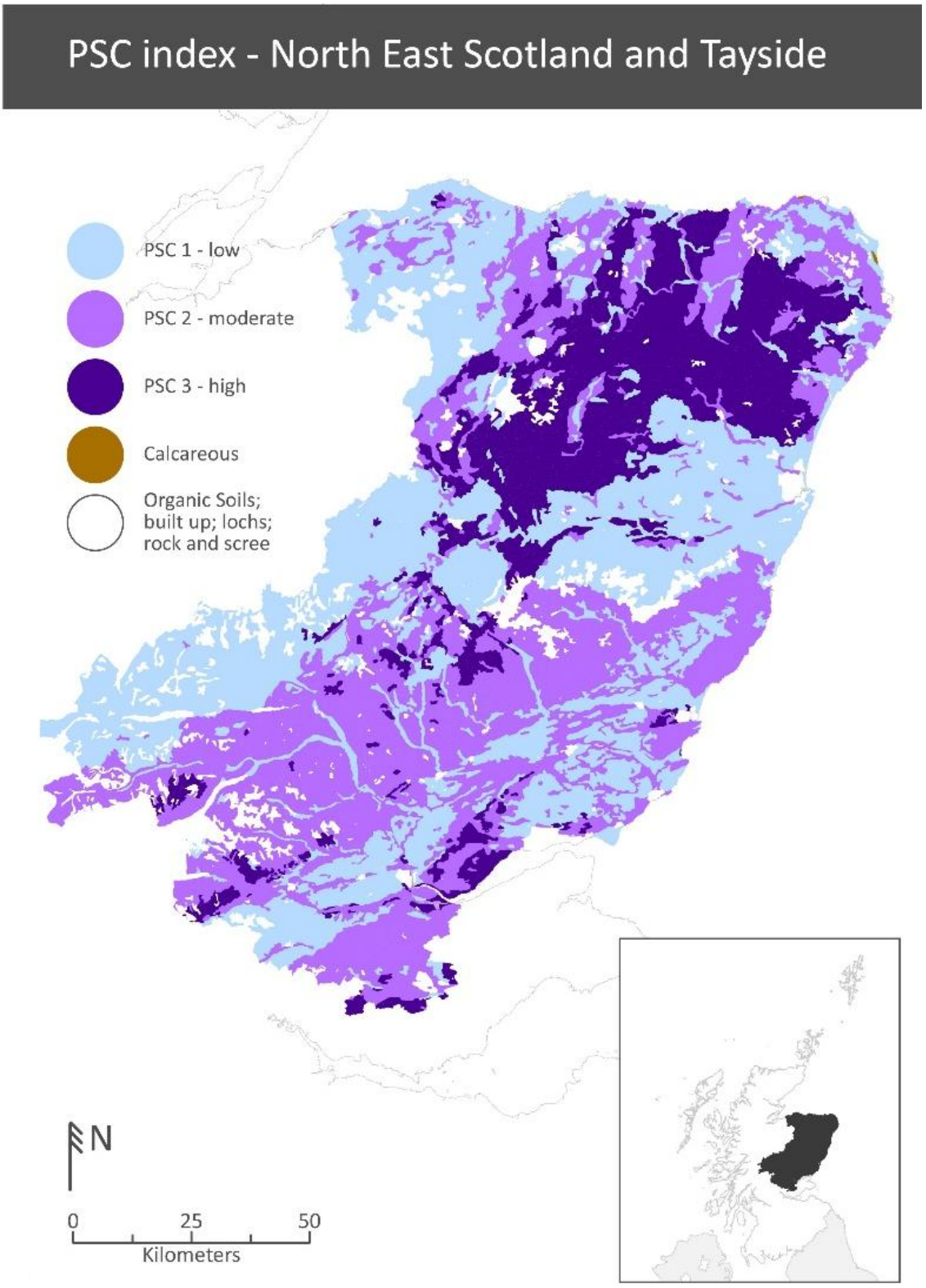
Table A(b). Classification of extractable soil PKMg (mg/l) in RB209 Index has 10 categories but values 4 or above maps to SAC Status VH.

SAC Status	RB209 Index	P		K		Mg	
		SAC	RB209	SAC	RB209	SAC	RB209
VL	0	0-1.7	0-9	0-39	0-60	0-19	0-25
L	1	1.8-4.4	10-15	40-75	61-120	20-60	26-50
M-	2	4.5-9.4	16-20	76-140	121-180 (2-)	61-100	51-65
M+		9.5-13.4	21-25	141-200	181-240 (2+)	101-200	66-100
H	3	13.5-30.0	26-45	201-400	241-400	201-1000	101-175
VH	4 or above	>30.0	>45	>400	>400	>1000	>175

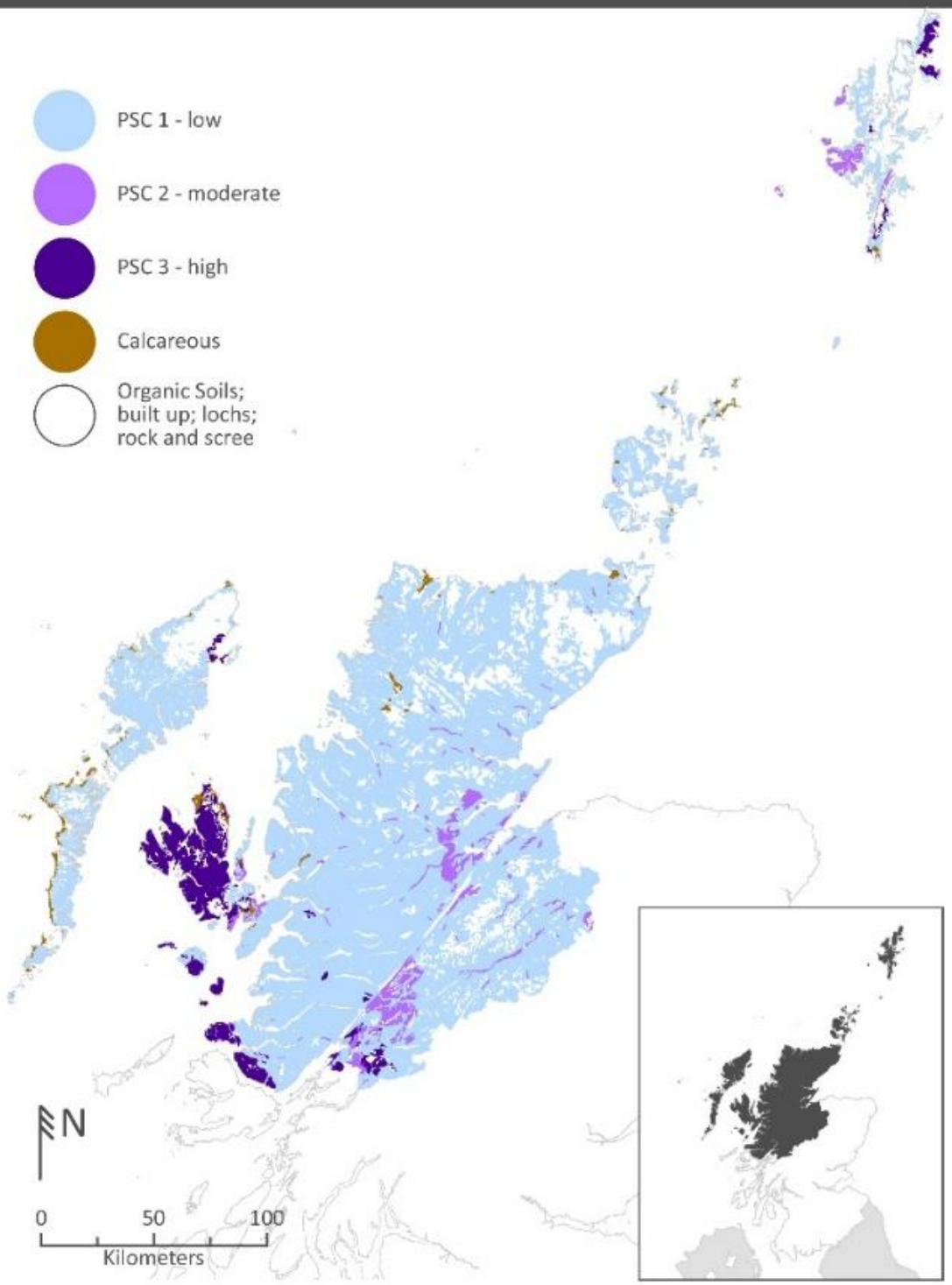
Adjustments to PK fertiliser recommendations taking account of soil P sorption capacity and soil PK Status

Soil P sorption capacity (PSC)

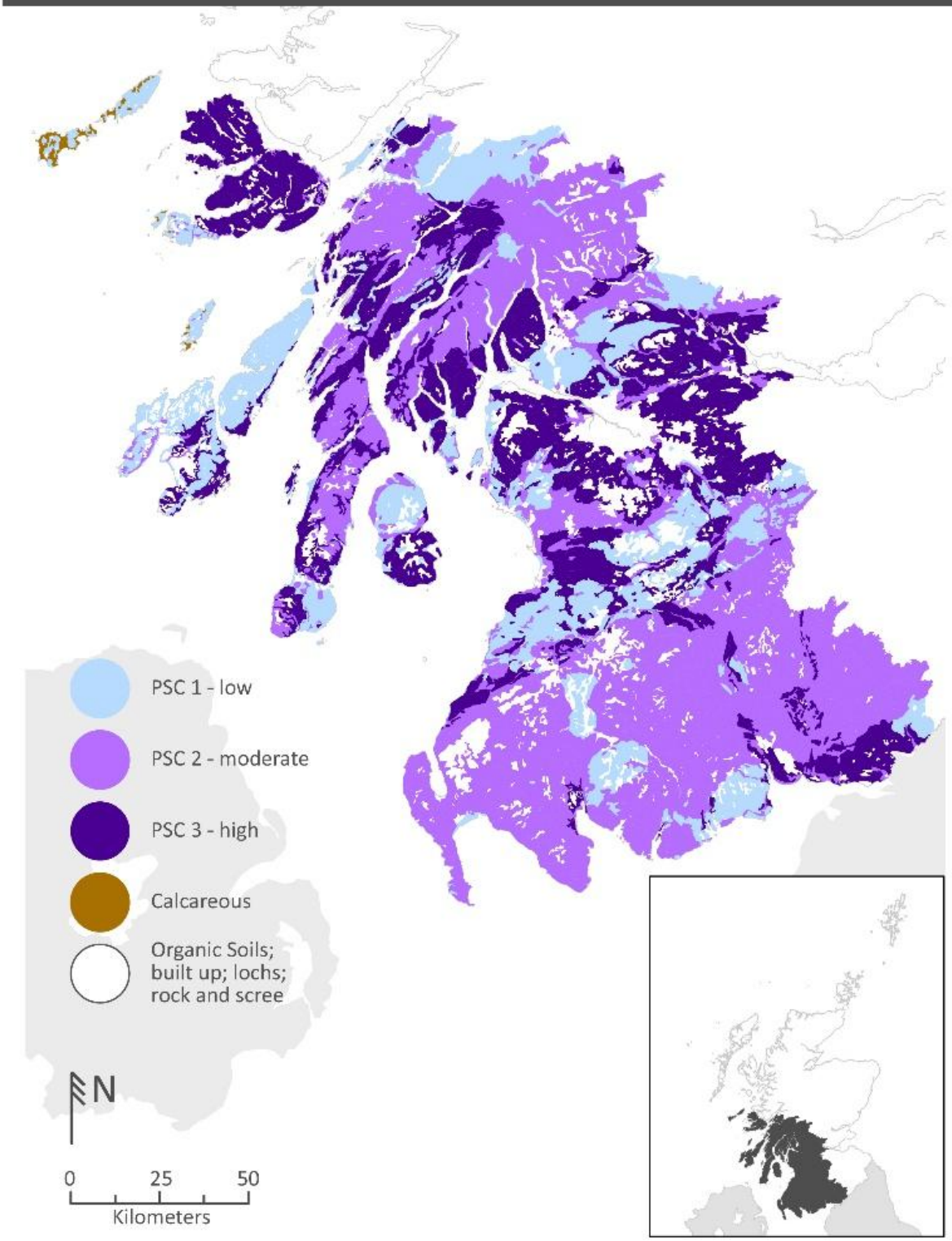
The PSC of a soil refers to the differing capacity of soils to bind applied P making it temporarily unavailable for plant uptake. Experience has shown that this soil binding effect can be controlled by the slow build-up of P in the soil to a point where sufficient P is being released to meet crop demand on an annual basis. The PSC varies depending on soil chemistry, texture, pH and organic content of your soil. Data from the National Soil Database of Scotland for each soil association has been used to create a map ranking PSC Index for non-calcareous soils from low (PSC 1) to high (PSC 3) in Scotland (Figure 1). Blank areas cover built-up areas, open water, rock and scree and organic soils. Calcareous soils from the Fraserburgh Association should be tested using the Olsen method (see TN710, 2018) (www.fas.scot/technical-notes/). Soil associations are listed in Table B for each PSC Index in descending order of soil association areas. The percentage areas mapped in PSC 1, 2 and 3 are 50.3, 31.0 and 18.7 % respectively. On organic soils initially applied P is less firmly sorbed than on mineral soils and P uptake by crops may be higher from organic soils than mineral soils. In the absence of further trials on organic soils, the advice is to treat organic soils similarly to the PSC 1 mineral soils. PSC Indices and soil association maps can be used to aid zone selection as part of GPS soil testing.



PSC index - Highland and Islands



PSC index - South West Scotland



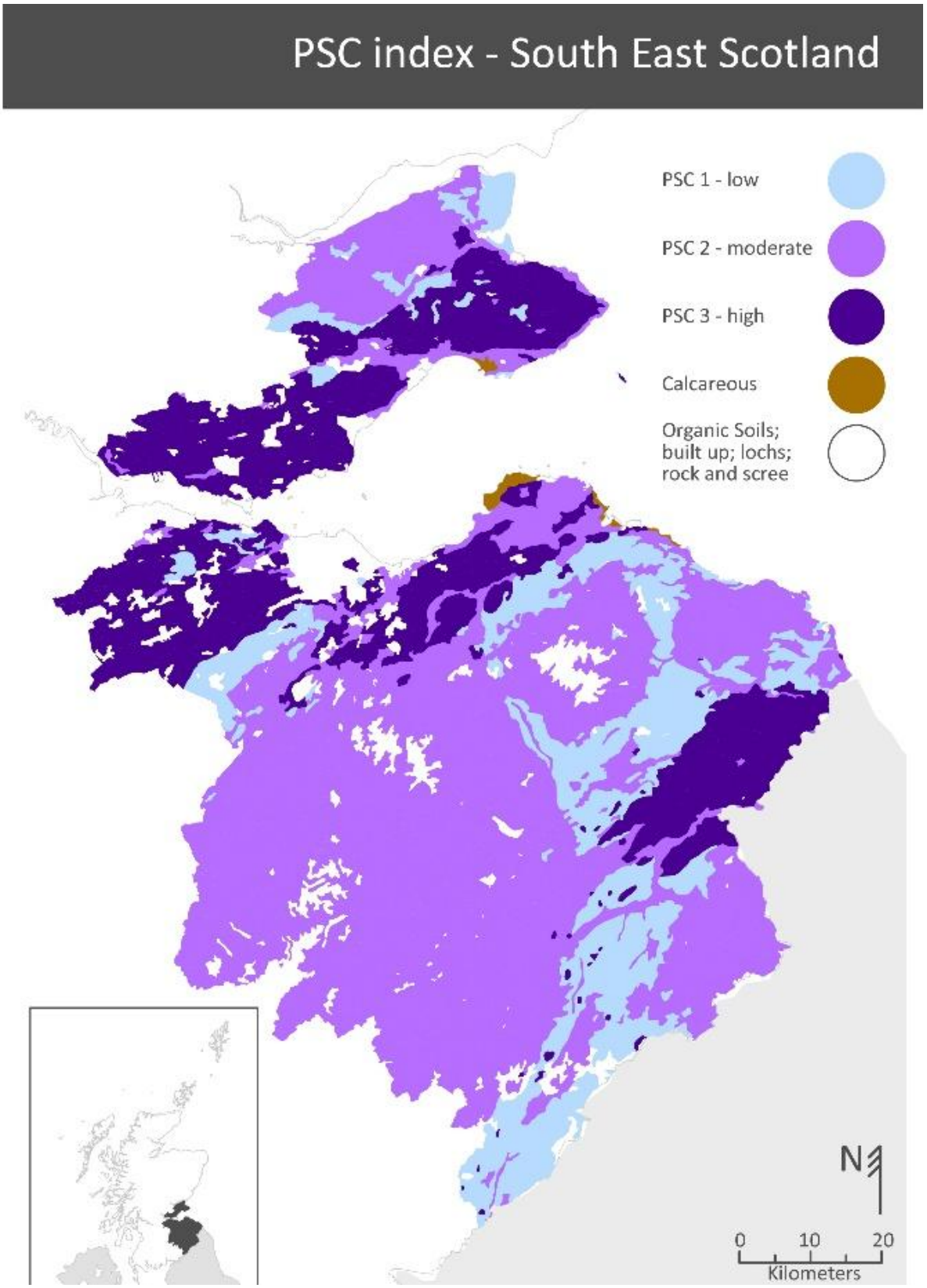


Figure 1. Maps of P sorption capacity (PSC) for soils in Scotland.

Table B. Soil associations with P sorption capacity (PSC) in Scotland.

PSC 1	PSC 2	PSC 3
Arkaig	Ettrick	Darleith
Countesswells	Strichen	Rowanhill
Lochinver	Alluvial Soils	Foudland
Corby	Sourhope	Tarves
Torridon	Yarrow	Torosay
Balrownie	Rhins	Insch
Durnhill	Forfar	Kintyre
Thurso	Darvel	Stirling
Hobkirk	Gourdie	Whitsome
Sorn	Kilmarnock	Canonbie
Canisbay	Eckford	Holywood
Carter	Mountboy	Bargour
Berriedale	Stonehaven	Lanfine
Kippen	Hatton	Arran
Glenalmond	North Mormond	Mauchline
Aberlour	Dreghorn	Leslie
Cromarty	Carpow	Benan
Links	Ordley	Corriebreck
Sabhail	Peterhead	Smailholm
Millbuie	Inchkenneth	Lethans
Dulsie	Walls	Durisdeer
Nigg	Minto	Nochty
Hindsward	Tipperty	
Lauder	Blair	
Gleneagles	Tynehead	
Ashgrove	Tynet	
Reppoch	Kirkwood	
Deecastle	Gruline	
Laurencekirk	Symington	
Knockskae	Ethie	
Dunnet	Craigellachie	
Skelberry	Kirkcolm	
Elgin	Craigdale	
Drongan	Lynedardy	
Bemersyde	Linfern	
Braemore	Barncorkrie	
Ardvanie	Shawhill	
Roy		
Doune		
Creetown		
Cairncross		
Hayfield		
Brightmony		
Skelmuir		
Bogtown		
Arbigland		
Rackwick		

Target soil P and K

For established grass/clover swards and cereal and oilseed rape arable rotations, the target soil P Status is M- on PSC 1 and 2 soils but M+ on PSC 3 soils. Adjustments to P fertiliser recommendations may be made taking account of PSC Indices to build up or run down to the new target soil P tests (Table C). If the PK Status is VL or L, then the adjustment should be to defoliation 1 for grass silage, hay, and grazing. The target soil P Status is Moderate (M+) for rotations including potatoes and some vegetable crops that respond to fresh additions of P and K at Low soil Status. Those soils with a higher PSC that are maintained on target for P represent the greatest erosion risk to water quality as they will contain a higher level of adsorbed P from fertilising.

Soil at target P levels is only justified if the land is actively managed for maximum yields. This requires that other good soil management targets such as pH, nutrient planning, and adequate drainage status are also considered. Soils of PSC 3 will maintain the lowest P concentrations in soil pore water. This relationship explains the observation that despite equivalent soil P Status, high P sorption soils often require additional fertiliser to maintain target plant available P. Regular soil analysis detects this, allowing adjustments to be made.

Table C. Effect of PSC on annual fertiliser adjustments (kg P_2O_5/ha):

a) Grass, cereals, oilseed rape and fodder crops.

P sorption capacity	Soil P status				
	Very low (VL)	Low (L)	Mod (M-)	Mod (M+)	High (H)
PSC 1	+40	+20	0	-10	-20
PSC 2	+60	+30	+10	-20	-30
PSC 3	+80	+40	+20	0	-40

b) Vegetable crops respond to fresh additions of P at low soil Status.

P sorption capacity	Soil P Status				
	Very low (VL)	Low (L)	Mod (M-)	Mod (M+)	High (H)
PSC 1	+60	+30	+15	0	-25
PSC 2	+90	+45	+20	0	-35
PSC 3	+120	+60	+30	0	-50

c) Potatoes.

P sorption capacity	Soil P Status				
	Very low (VL)	Low(L)	Mod (M-)	Mod (M+)	High (H)
PSC 1	+80	+60	+40	0	-30
PSC 2	+120	+90	+60	0	-45
PSC 3	+160	+120	+80	0	-60

Effects of K Status on annual fertiliser adjustments (kg K_2O/ha) are shown in Table D.

Table D. Effects of K Status on annual fertiliser adjustments (kg K_2O/ha)

Crop	Soil K Status				
	Very low (VL)	Low (L)	Mod (M-)	Mod (M+)	High (H)
Grass, cereals, oilseed rape & fodder crops	+60	+30	0	0	K offtake x 0.5
Potatoes & responsive vegetable crops	+90	+60	+30	0	-50

Effect of PSC on adjustments to build-up soil P Status more quickly.

The changes are increments of extractable soil P from 1 to 6 mg/l i.e. from VL to lower end of M-; and 6 to 11 mg/l i.e. lower end of M- to M+ (Table E). Change in P on an area basis (kg P_2O_5/ha) are estimates using an estimated amount of soil in 1ha to 20cm depth as 2400 t. The estimated amount to change soil P test will be closer to the total P required when P is applied as inorganic, soluble P at a small surplus to build-up soil P slowly over several years, compared with single, large applications of P in organic fertilisers. The table shows that more than twice the amount of P is required moving from 1 to 6 mg/l P i.e. from VL to M- than moving from 6 to 11 mg/l P i.e. from M- to M+ P Status; and about twice the amount of P is required in PSC 3 soils than PSC 1 soils to move to M- and M+ P Status.

Table E. The effect of PSC Index on kg P_2O_5/ha required to change soil P test.

PSC Index	Change in P on an area basis from 1 to 6 mg/l (kg P_2O_5/ha) *	Change in P on an area basis from 6 to 11 mg/l (kg P_2O_5/ha) *
PSC 1	241	109
PSC 2	346	147
PSC 3	550	222

*Using an estimated amount of soil in 1ha to 20cm depth as 2400t.

Effect of K on adjustments to build-up soil K Status more quickly.

Offtakes of K in conserved grass can be considerable from 180 – 330kg K_2O /ha from 2 or 3 cuts totaling 10t DM/ha; and soil K reserves can quickly become depleted especially on light sandy soils decreasing from 100 to 75 mg/l e.g. from M+ to L Status in one season. Heavy clay soil generally has higher K reserves and maintains K Status for longer.

If maximum benefits are to be realised from nutrient application to grassland, then it is important to balance the use of nitrogenous fertilisers with potash. Typical application rates for 1st cut silage should be in the order of 60-90 kg K_2O/ha and 50-60 kg for 2nd cut. Exact rates will vary with soil K Status, N application rates and anticipated grass yields but a useful rule of thumb is to apply 2/3rds kg K_2O/ha for every 1 kg of N applied. Where grass offtakes suggest application rates should be more than 90 kg K_2O/ha for 1st cut, any surplus over and above 90kg K_2O/ha should be applied later in the season otherwise luxury uptake can occur.

Soil K tests in M+ at sowing or planting can decrease to L at the peak of K uptake and recover to M+ after senescence when K is leaked back into the soil, or when straw is ploughed back. It is possible in arable crops to maintain K soil tests in the M+ even though M- Status is adequate for cereal, oilseed rape and grass. The target soil K Status is M+ for rotations including potatoes and vegetable crops that respond to fresh additions of P and K at Low soil Status.

An application of 150 - 250 kg/ha K_2O more than crop removal should increase soil K concentration by 50 mg/l, the lower rate in light soils and higher rate in heavy soils. Luxury offtake is always a risk particularly in light soil, and K should not be applied to young grass in spring for fear of inducing hypomagnesaemia (grass staggers) in freshly turned-out stock. The estimated amount to change soil K test will be closer to the total K required when K is applied at a small surplus to build-up soil K slowly over several years, compared with single, large applications of K in inorganic or organic fertilisers.

Farm level maps of PSC Indices derived from soil associations

Field boundaries can be used in tandem with the PSC map of Scotland (https://soils.environment.gov.scot/maps/thematic-maps/map-of-soil-phosphorus-sorption-capacity/) to identify which soil associations are present in each field, and their PSC Index; these are listed on each map (associations covering less than 0.25 ha are not shown). On some farms figures may be split into separate sections for clarity where there are discrete groups of fields too far apart to show on a single map. There are 3 soil associations in the farm map in Figure 2. The soil associations are Corby, Aberlour, and Craigellachie. Corby and Aberlour have PSC Index 1, and Craigellachie have Index 2.

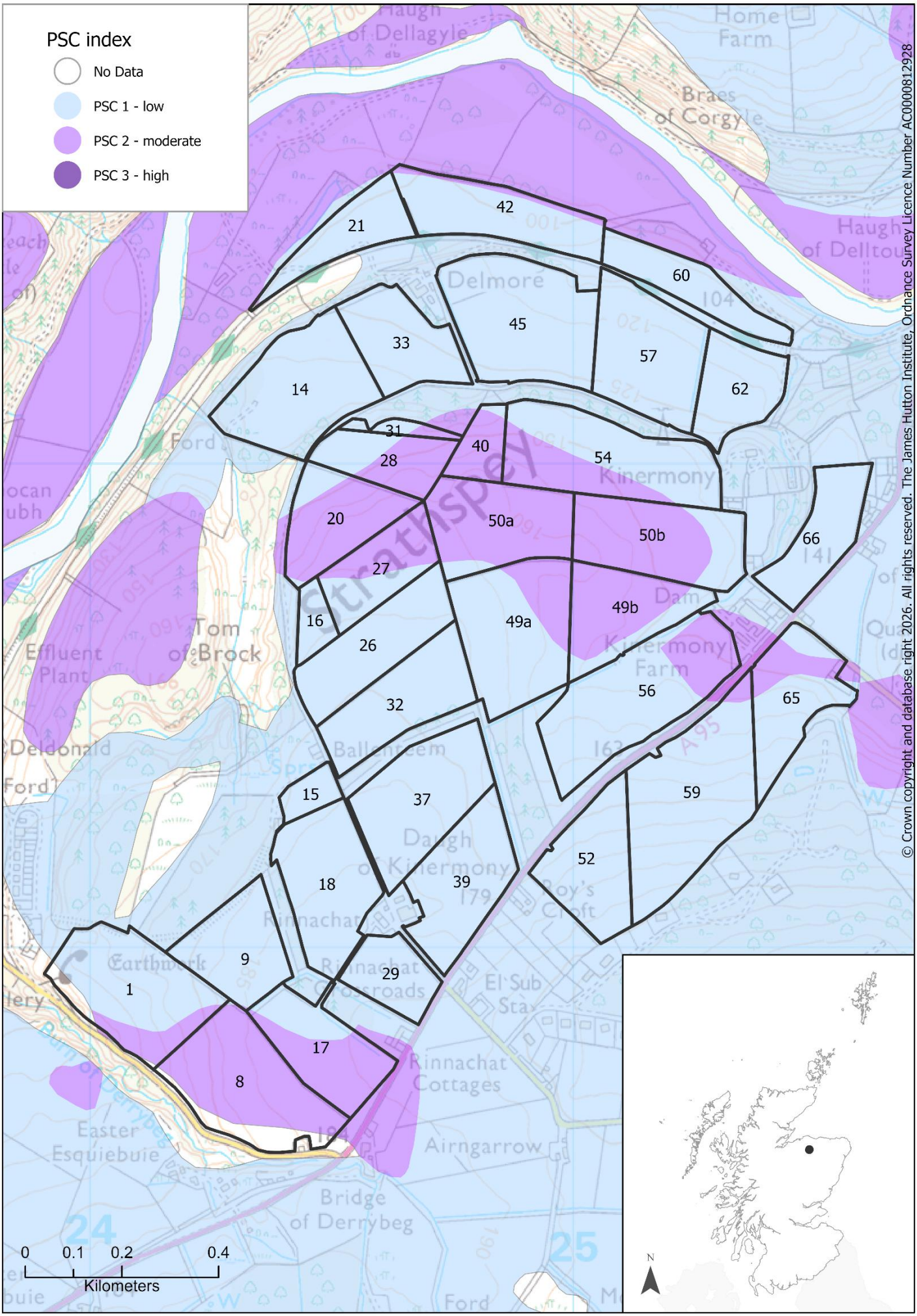


Figure 2: Example map for farm with 3 soil associations and 2 PSC Indices.

PK offtake in crops and fertiliser recommendations

Grass

Phosphate and potash recommendations for target M- PK Status for newly sown grass, autumn or spring sown, are 50 kg/ha for both P and K; and add a further 20 kg/ha for grass with high clover/red clover.

For established grass, grown in soils that are on target M- for PK, apply 'maintenance' PK fertiliser applications to balance the offtake in cut or grazed grass but test soil PK status every 4 – 5 years. PK offtake can be calculated by multiplying grass yield by PK content as given in Table F. To calculate PK requirements, yields in Table F should be replaced by estimated or actual yields where possible. Drought can impair growth and reduce PK offtake and should be considered when assessing PK requirement. The balance between PK offtake and PK applied in organic manures and manufactured fertiliser can then be made at the end of the season. Allowance should be made for any surplus or deficit in PK when planning the following season's fertiliser.

Table F. Established grass default yields (fresh weight) and standard PK content (fresh weight).

Utilisation	Defoliation position	Yield (t/ha)	P content (kg P_2O_5/t)	P offtake (kg P_2O_5/ha)	K content (kg K_2O/t)	K offtake (kg K_2O/ha)
Silage*	1st occurrence	23	1.7	39	6.0	138
Silage*	2nd occurrence	12	1.7	20	6.0	72
Silage*	3rd occurrence	9	1.7	15	6.0	54
Hay**	Any defoliation	7	5.9	41	18.0	126
Grazing***	Any defoliation	10	1.4	3***	4.8	2***

*Silage at 25%DM
**Hay at 86%DM
***Under Grazing this calculation assumes approximately 80% of the P_2O_5 and 95% of the K_2O is recycled in the field by the animal through its dung and urine.

Cereals, oilseed rape and fodder crops

The balance between PK offtake and PK applied in organic and manufactured fertilisers can be made at the end of the season when actual yield is known. Allowance should be made for any surplus or deficit in PK in planning for the following season's fertiliser. The Nutrient Management Planning Tool (NMPT-GB) can be used for field-level nutrient planning and record keeping.

There is information on PK removal in straw separately to that in grain, which will help in assessing the financial value of straw when the weight is known. However, K content of straw can vary substantially – higher than average rainfall between crop maturities and baling straw will reduce straw K content. As a result, less K will be removed from the soil by removing the straw when the harvest period is wet.

On M- PK Status soils and M+ on PSC 3 soils; apply 'maintenance' PK fertiliser applications to balance the offtake in cereals, oilseed rape and fodder crops. PK offtake can be calculated by multiplying typical or expected yield by PK content as given in Table G. This should maintain soil test P and K levels ready for the next crop or rotation. Regular soil analysis detects this, allowing adjustments to be made.

Grain P and K analyses can provide more accurate estimates of crop phosphate and potash offtakes than the typical values in Table G. This information also complements soil analyses for P and K. AHDB-funded research on P nutrition has shown that the critical level of grain P in winter wheat is 0.32%. Grain P contents repeatedly below this level indicate crop P uptake was deficient enough to reduce grain yield. If soil conditions are satisfactory but a field repeatedly shows grain P deficiency, available soil P should be increased for future crops. Grain samples must be representative of fields or areas from where routine soil analyses are taken.

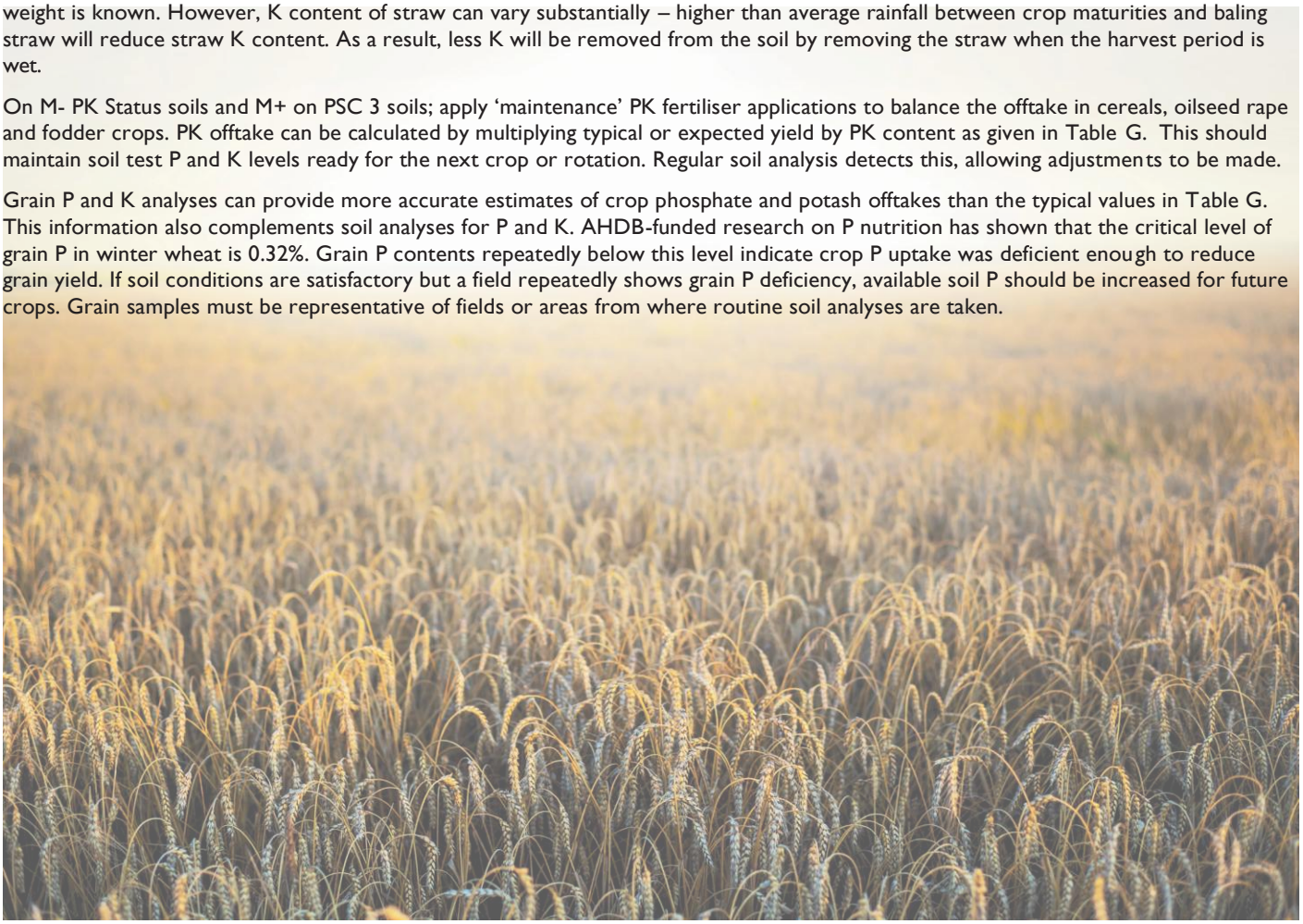


Table G shows the crops split into those with straw to be incorporated and straw to be baled. The table gives an offtake figure for both phosphate and potash per tonne of grain removed. This is multiplied by the standard yield to give an offtake figure per hectare. Standard yields can be altered to tailor the recommendation.

Table G. Typical yields of crops (fresh weight) * and standard PK content in grain/seed, straw and roots (fresh weight).

Crop type	Straw usage	Yield (t/ha)	P content (kg P_2O_5/t)	P offtake (kg P_2O_5/ha)	K content (kg K_2O/t)	K offtake (kg K_2O/ha)
Wheat, winter	Straw to be incorporated	8.0	6.5	52	5.5	44
Wheat, spring	Straw to be incorporated	7.0	8.0	56	5.5	39
Barley, winter	Straw to be incorporated	6.5	8.0	52	5.5	36
Barley, spring	Straw to be incorporated	5.5	8.0	44	5.5	30
Oats, winter	Straw to be incorporated	6.0	8.0	48	5.5	33
Oats, spring	Straw to be incorporated	5.0	8.0	40	5.5	28
Rye, winter	Straw to be incorporated	6.5	8.0	52	5.5	36
Rye, spring	Straw to be incorporated	6.0	8.0	48	5.5	33
Triticale, winter	Straw to be incorporated	8.0	8.0	64	5.5	44
Triticale, spring	Straw to be incorporated	6.0	8.0	48	5.5	33
Wheat, winter	Straw to be baled **	8.0	7.0	56	10.5	84
Wheat, spring	Straw to be baled **	7.0	8.5	60	12.0	84
Barley, winter	Straw to be baled **	6.5	8.5	55	10.5	68
Barley, spring	Straw to be baled **	5.5	8.5	47	12.0	66
Oats, winter	Straw to be baled **	6.0	9.0	54	16.5	99
Oats, spring	Straw to be baled **	5.0	9.0	45	16.5	83
Rye, winter	Straw to be baled **	6.5	8.5	55	10.5	68
Rye, spring	Straw to be baled **	6.0	8.5	51	10.5	63
Triticale, winter	Straw to be baled **	8.0	8.5	68	10.5	84
Triticale, spring	Straw to be baled **	6.0	9.0	54	16.5	99
Oilseed rape, spring	Straw to be incorporated	2.0	14	28	11.0	22
Oilseed rape, winter	Straw to be incorporated	4.0	14	56	11.0	44
Oilseed rape, spring	Straw to be baled**	2.0	15	30	17.5	35
Oilseed rape, winter	Straw to be baled**	4.0	15	60	17.5	70
Spring cereals	Whole crop	25	1.8	45	5.4	135
Winter cereals	Whole crop	30	1.8	54	5.4	162
Hybrid winter rye	Whole crop	35	1.8	63	5.4	189
Forage Maize	Silage	40	1.4	56	4.4	176
Kale	Cut	40	1.2	50	5.0	200
Potatoes	Roots only	50	1.0	50	5.8	290
Forage Swedes/turnips	Roots only	65	0.7	46	2.4	156
Fodder beet	Roots only	85	0.7	60	4.0	340

*Cereals at 15% moisture; oilseed rape at 9% moisture; whole crop 35% DM; maize silage 30% DM; and forage roots lifted.

**Offtake values are per tonne of grain or seed removed but include PK in straw when this is removed without weighing. Where the amount of cereal or oilseed rape straw removed is known, offtakes can be calculated using typical values of 1.2 kg P_2O_5/t and 9.5 kg K_2O/t straw for winter wheat/barley; 1.5 kg P_2O_5/t and 12.5 kg K_2O/t for spring wheat/barley; and 2.2 kg P_2O_5/t and 13.0 kg K_2O/t for oilseed rape.

Potatoes

Phosphate increases the rate of early development of the crop, improving the rate of haulm growth and tuber initiation and early bulking. Except for cases of extreme deficiency, fertiliser P does not increase growth rate or haulm persistence later in the season. A further effect of P is to increase tuber number more than tuber yield, increasing the proportion of seed in the crop. This reinforces the justification for higher rates of fertiliser P on seed crops, but high rates of P should not be regarded as a major means of attaining a high tuber number (Table H).

Potash is required for the establishment and persistence of vigorous haulm and for improved bulking rate and persistence of late season growth. Fertiliser K increases tuber size and the proportion of ware in the crop. At the levels of K required for optimum yield of ware potatoes, the yield of seed will be reduced. The dry matter content of tubers is reduced by K, particularly if muriate (chloride) is applied rather than sulphate of potash. Recommended rates of K in Table H may have to be reduced to achieve dry matter targets for crisping or processed chips. Alternatively, only K fertiliser containing sulphate of potash should be used or, if muriate is used, it should be applied at least 2 months prior to planting to provide time for some chloride to be washed below plough depth. Fertiliser K

increases the susceptibility of potatoes to cracking, splitting and scuffing. The recommended rates should only be exceeded if internal bruising is a more persistent problem than external damage. Higher dry matter tubers are more prone to internal bruising. Soft roots are more prevalent in low dry matter and/or damaged tubers. Therefore, K rates above those recommended should be avoided.

The PK offtake can be estimated using typical values of 1.0 kg P_2O_5 and 5.8 kg K_2O per tonne fresh tubers. There will often be a surplus of P remaining in the soil after potatoes, which will help to maintain the soil at the target P Moderate Status for an arable crop rotation and should be allowed for when assessing fertiliser P for one or more following crops. In many fields there will be a deficit of K remaining in the soil after potatoes, and allowance should be made for any deficit in planning K fertiliser use elsewhere in the rotation.

Table H. Potatoes: Phosphate and potash recommendations (kg/ha) at M+ Status.

Anticipated length of growing season* and intended market	Soil P Status	Soil K Status
	M+	M+
< 60 days (seed and punnets) and 60-90 days (seed and punnets)	100	110
60-90 days (ware) and > 90 days	75	150

*The length of growing season is the number of days from 50% emergence to haulm death.

Vegetable crops that respond to fresh additions of P and K at Low soil Status

The recommendations provided in Table I will ensure sufficient supply of P and K for average yields grown in M+ Status soils.

Table I. P and K recommendations (kg/ha) for responsive vegetables grown in M+ PK Status.

Crop		P_2O_5 (kg/ha) Soil P Status M+	K_2O (kg/ha) Soil K Status M+
Brussels sprouts		100	200
Cabbage, all types		100	200
Calabrese (broccoli)		100	75
Cauliflowers		100	175
Courgette		75	125
Lettuce – whole head		150	175
Leeks		100	175
Onions (bulb & salad)		100	125
Asparagus	Establishment year	125	200
	Second or later years	50	50
Beans, broad		100	100
Beans, dwarf/runner		100	75
Carrots		125	125
Parsnip		100	150
Swedes, shopping		100	150
Turnips (human consumption)		100	125
Beetroot, all types		100	200
Radish		75	100

Worked examples adjusting P applications for P offtake, soil status and PSC Index

Grass

The worked examples of Table J show fertiliser recommendations applied to first cut silage with an expected yield of 20 t/ha (fresh weight) grown in soils from each of the three PSC Indices of PSC 1, 2 and 3. PK offtake values are used by Table F. The soil P Status was Low (2 mg/l P). The decision of the farmer was to build up crop available levels of P over several years by 5 mg/l P from 1 to 6 mg/l P i.e. up to the lower end of M-; but checking progress by soil analysis after 4 years. Raising P Status over the shorter period of 4 to 5 years minimises the period of potential yield loss, but in the short term will increase the annual cost and risk of water pollution. Data from Table C (a) is used for annual P applications for slow change and data from Table E for the change of 4 to 5 years.

Table J. Adjusting P applications for P first cut silage offtake, soil status and PSC Index.

PSC Index	Crop offtake kg P_2O_5/ha	Added kg P_2O_5/ha for slow change in status	Added kg P_2O_5/ha for 4 to 5 years to change status
1	35	20	50
2	35	30	70
3	35	40	110

Arable rotation includes vegetables

The worked examples in Table K show fertiliser recommendations applied to spring barley crop with a crop offtake of 60 kg P_2O_5/ha grown in soils from each of the three PSC Indices of PSC 1, 2 and 3. The soil P was 6 mg/l, i.e. lower end of M-, but the decision of the farmer was to build up crop available levels of P to lower end of M+ to 11 mg/l as the crop rotation includes vegetables. Raising P Status over a shorter period minimises the period of potential yield loss, but in the short term will increase the annual cost and risk of water pollution. The straw was removed and P analytical values used were from Table G. Data from Table C (b) are used for annual P applications for slow change in Status and Table E for faster P change over 3 years.

Table K. Adjusting P applications for P barley offtake, soil status and PSC Index.

PSC Index	Crop offtake kg P_2O_5/ha	Added kg P_2O_5/ha for slow change in status	Added kg P_2O_5/ ha for 3 years to change status
1	60	15	35
2	60	20	50
3	60	30	75

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