



Developing soil fertility management plans

Five Easy Steps

Richard Simpson
CSIRO Sustainable Agriculture Flagship

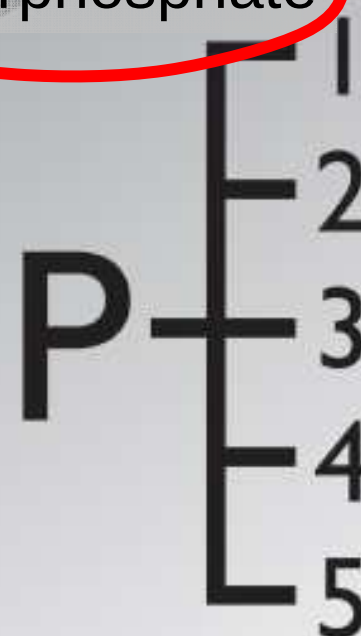
Luke Pope
NSW Industry and Investment

Five easy steps

to ensure you are making money from superphosphate

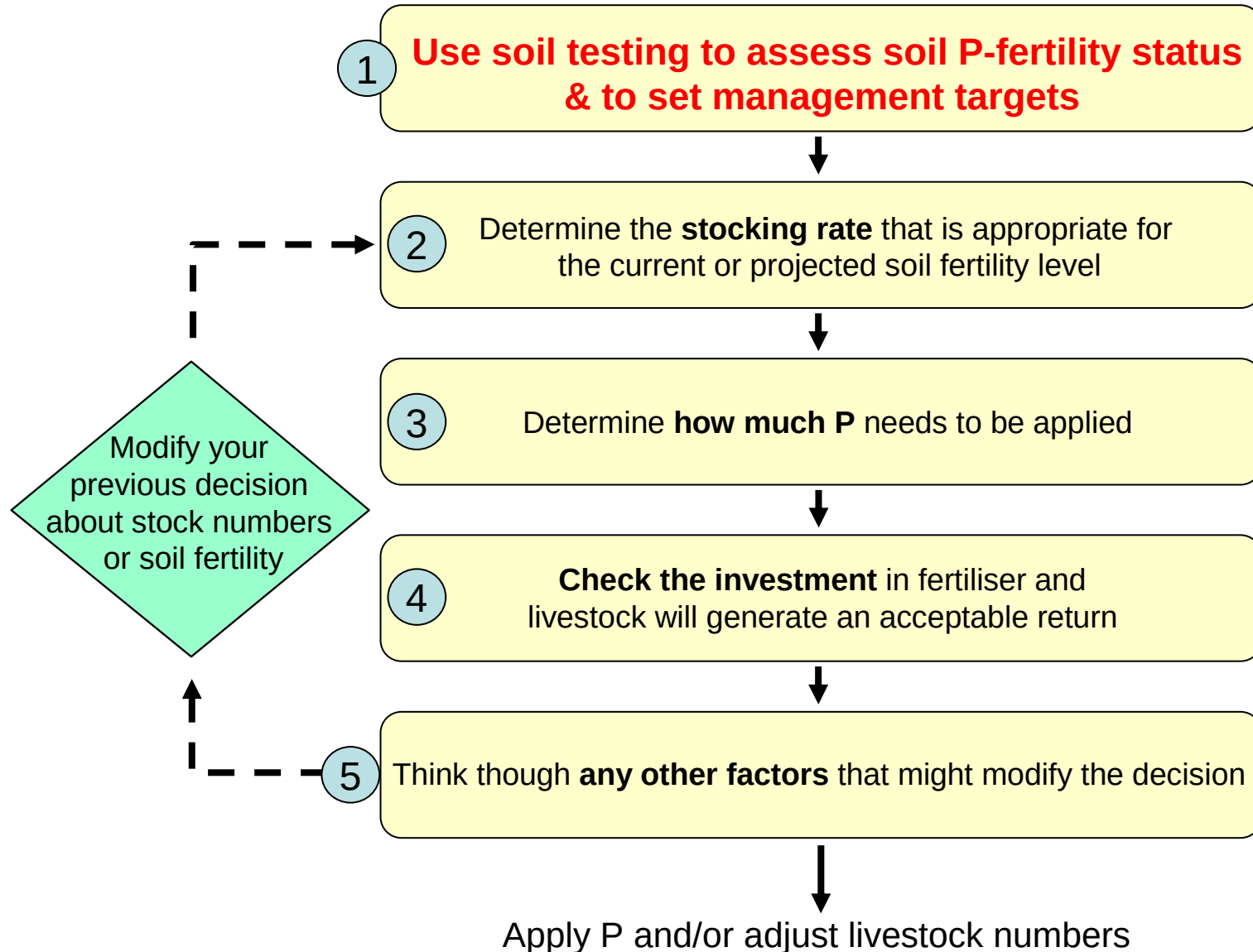
Is the message about P or super ?

- the message is about P and the second decision is about the best product to use to achieve the objective.



Five Easy Steps

What are we doing that is different or better?



Why we use fertiliser

Control

(all nutrients)

-P

-Ca

-K

-Mg

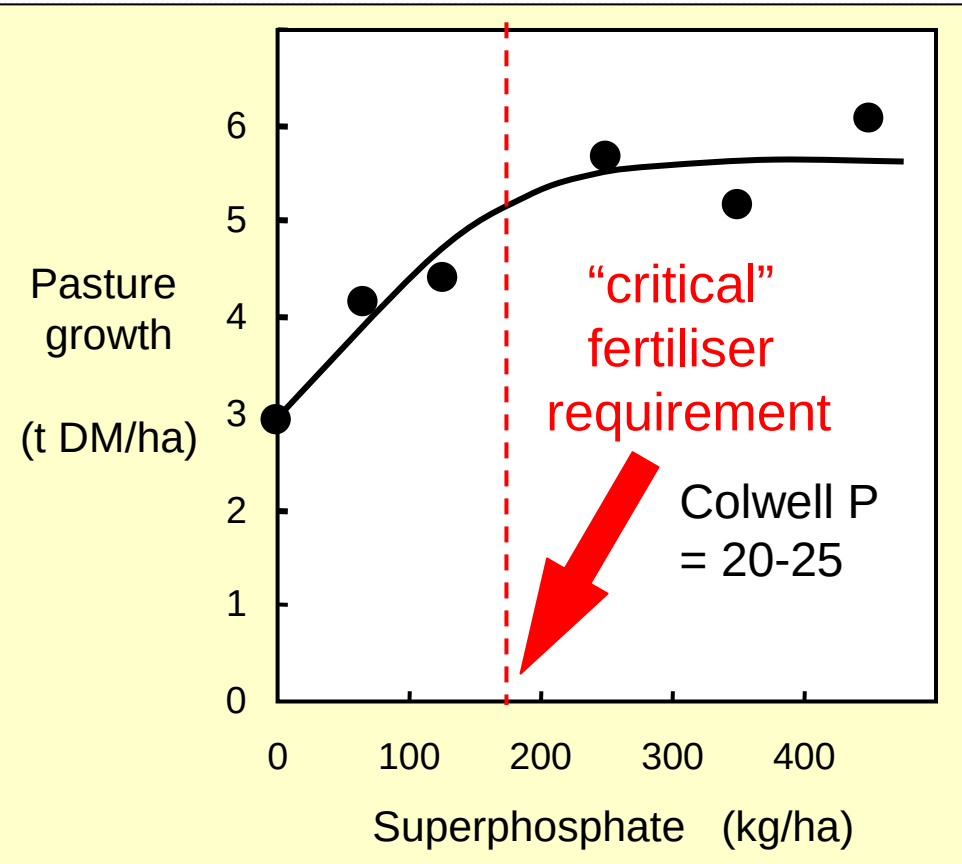
-N



Growth of annual ryegrass in topsoil from “Kia-Ora”, Bookham NSW (1 Sep. 03)

Response to superphosphate

(Ginninderra Experiment Station, Canberra)

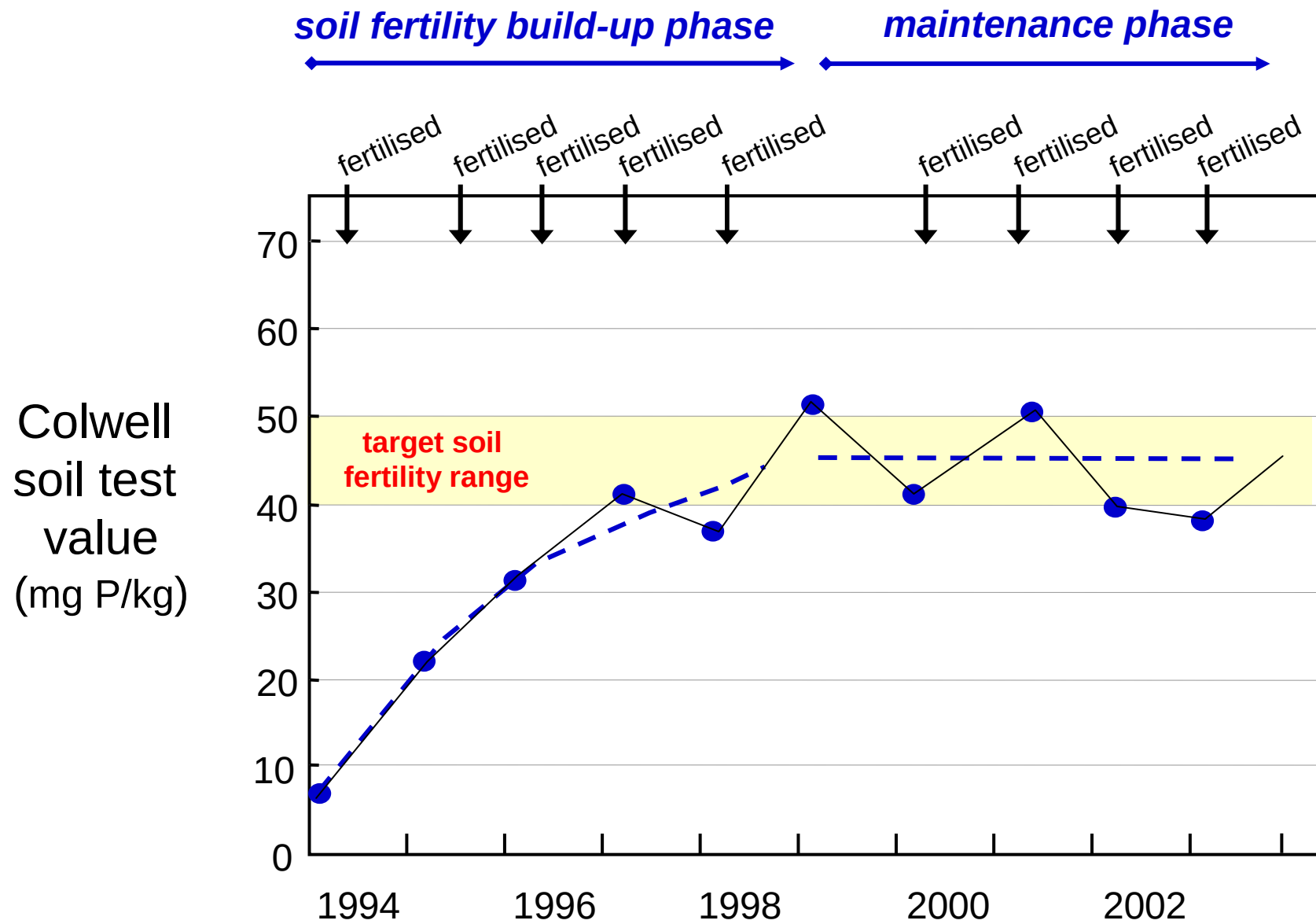


125

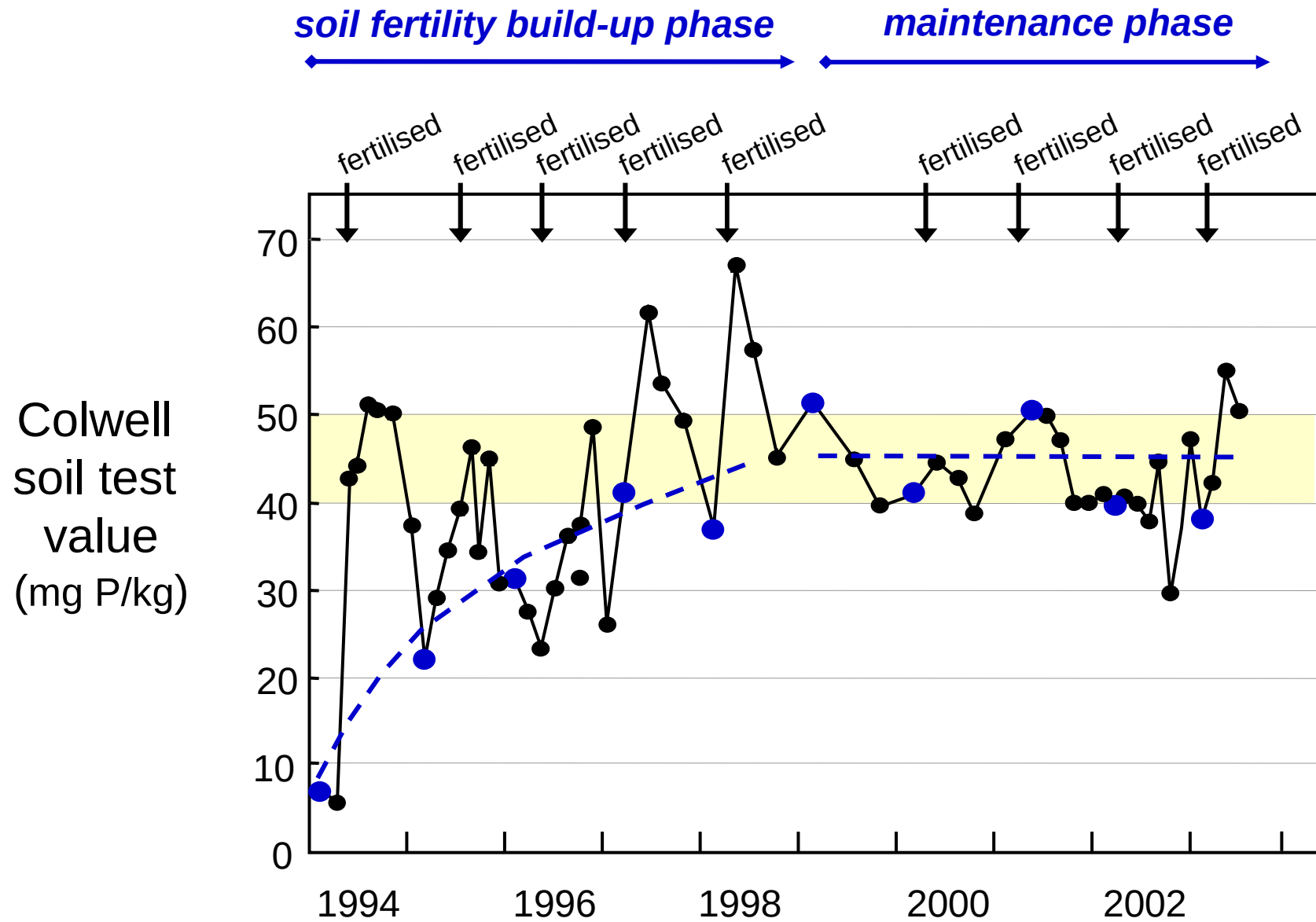
0

63

250 kg superphosphate/ha

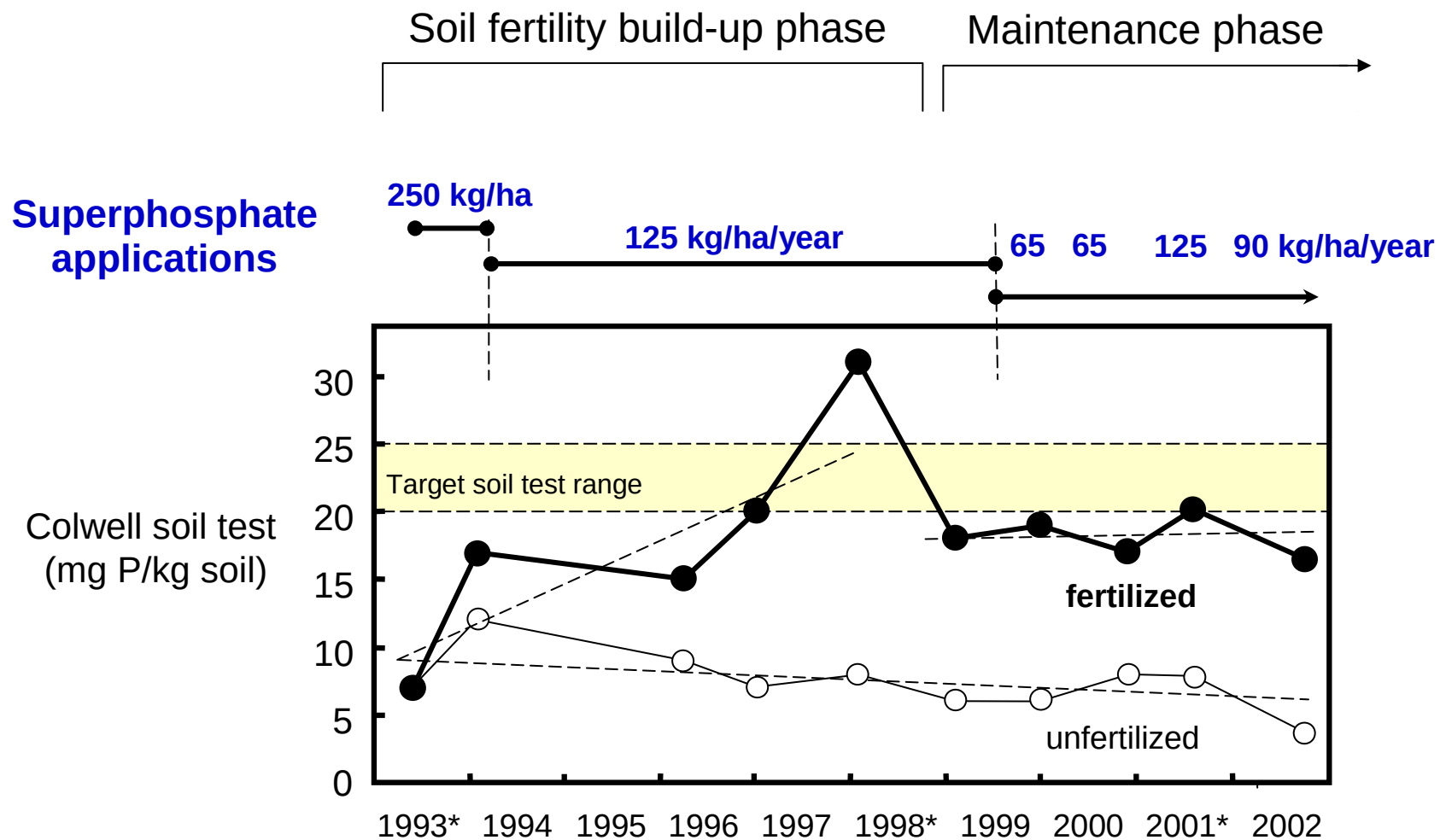


NOTE: importance of regular soil testing



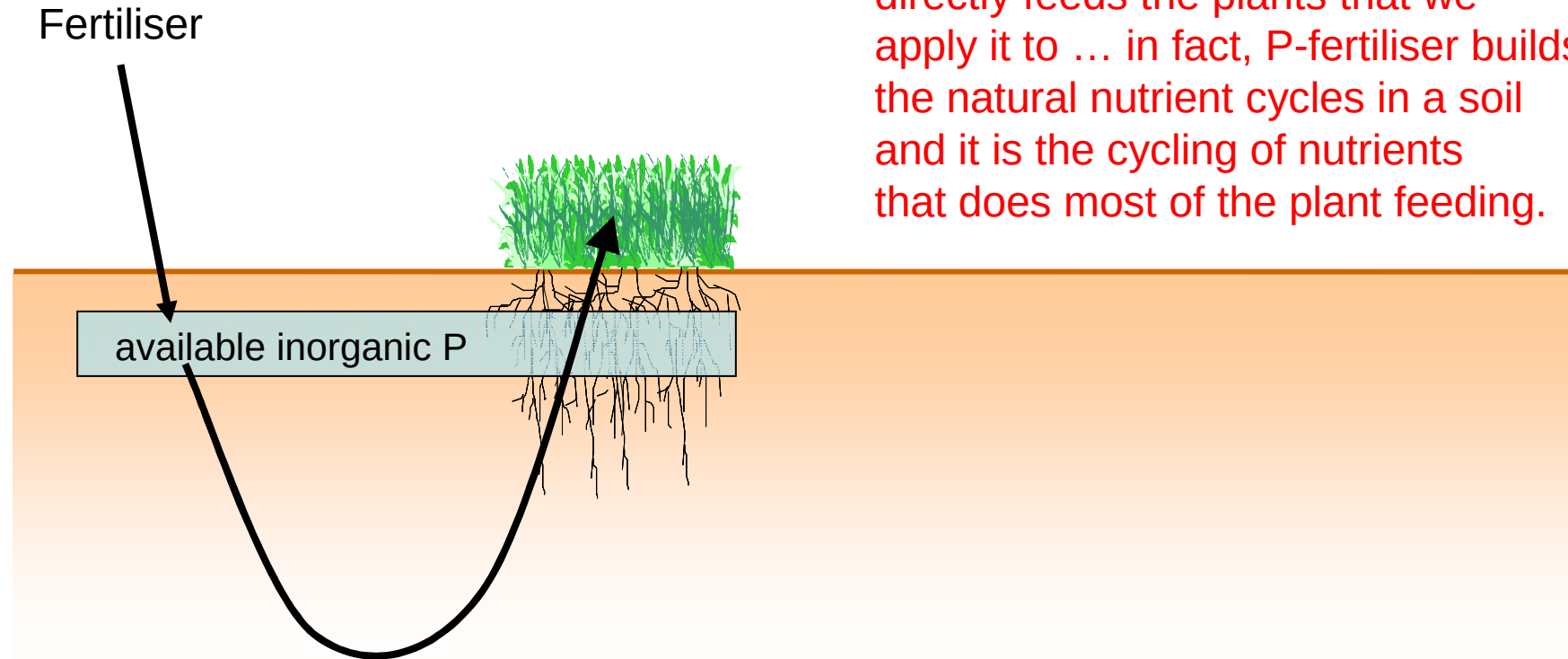
Soil fertility: Bookham Grazing Demonstration

NOTE: importance of regular soil testing



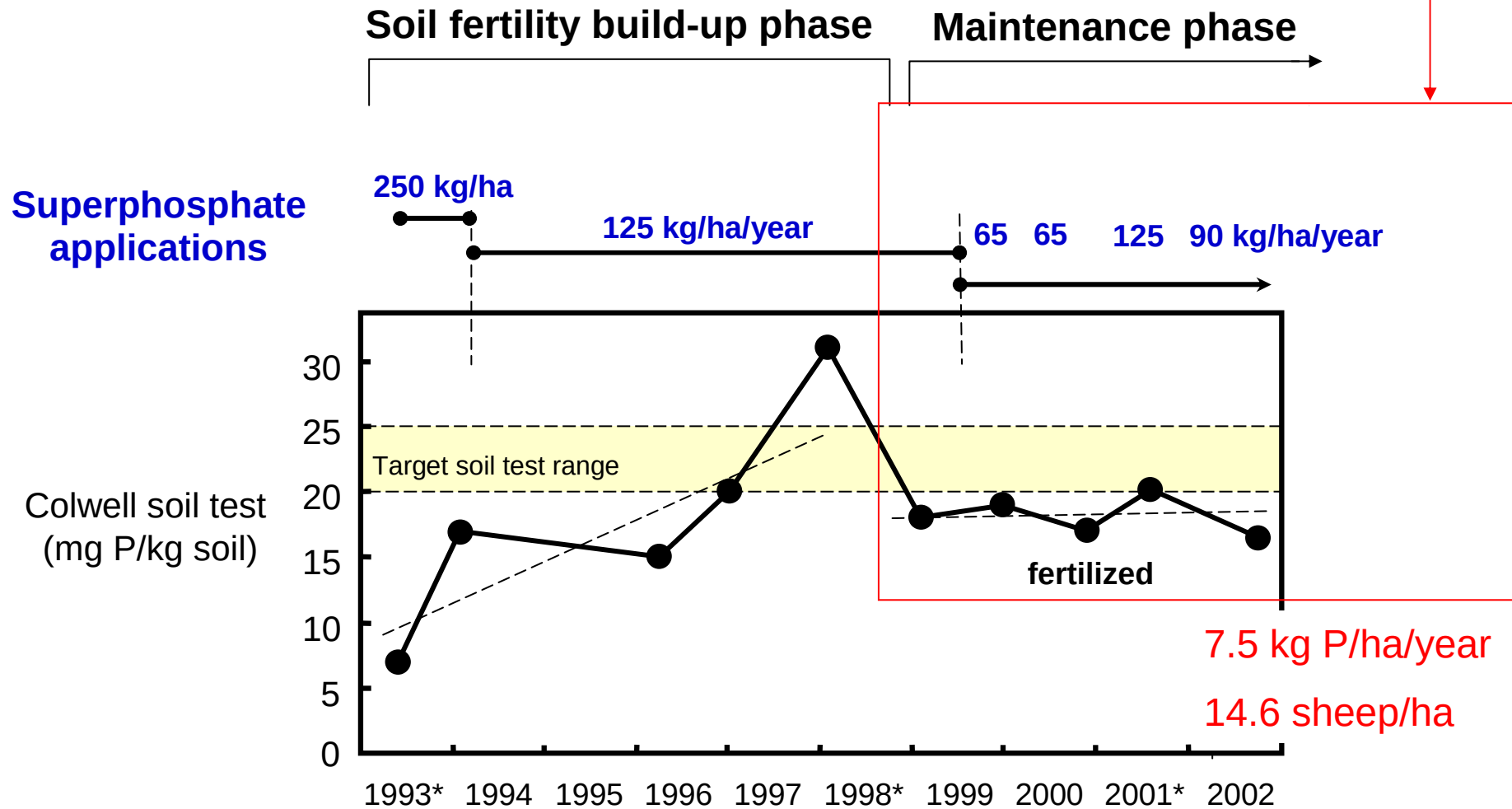
What are we actually doing when we apply P-fertiliser?

Most of us think that P-fertiliser directly feeds the plants that we apply it to ... in fact, P-fertiliser builds the natural nutrient cycles in a soil and it is the cycling of nutrients that does most of the plant feeding.



Soil fertility: Bookham Grazing Demonstration

To illustrate this we will look at the P budget for this period at Bookham



Forms of P in soil

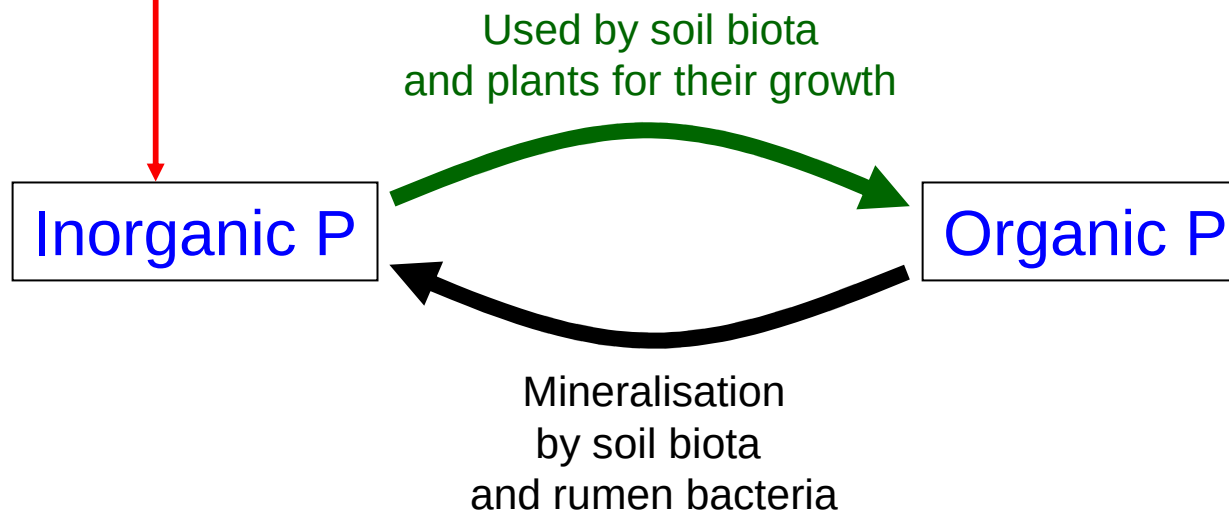
Inorganic P

phosphate (PO_4^{2-})

Organic P

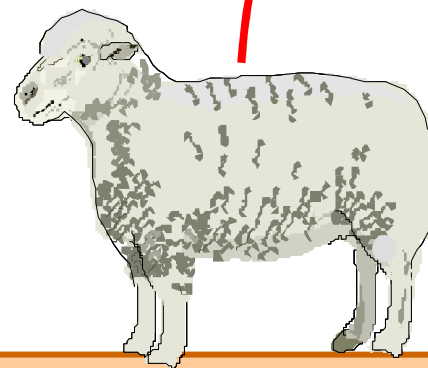
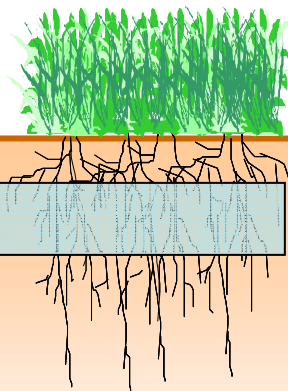
P that is chemically bonded into organic materials

Plants use **Inorganic P**, they cannot take-up or use **Organic P** directly.



Fertiliser
7.5 kg P/ha
per year

available inorganic P



0.4 Sold off farm

<0.04
Erosion
& runoff

0.5
Accumulated
in camp area

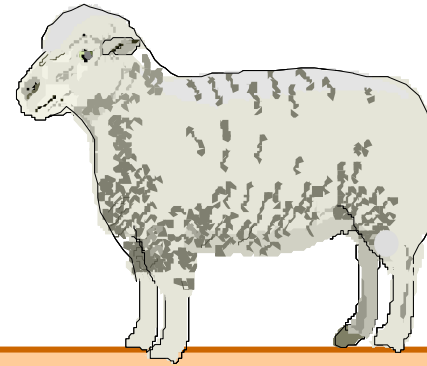
~6.5 kg P/ha
Accumulates
in the soil

Total P removal
or loss **~1 kg P/ha**

Fertiliser
7.5 kg P/ha
per year

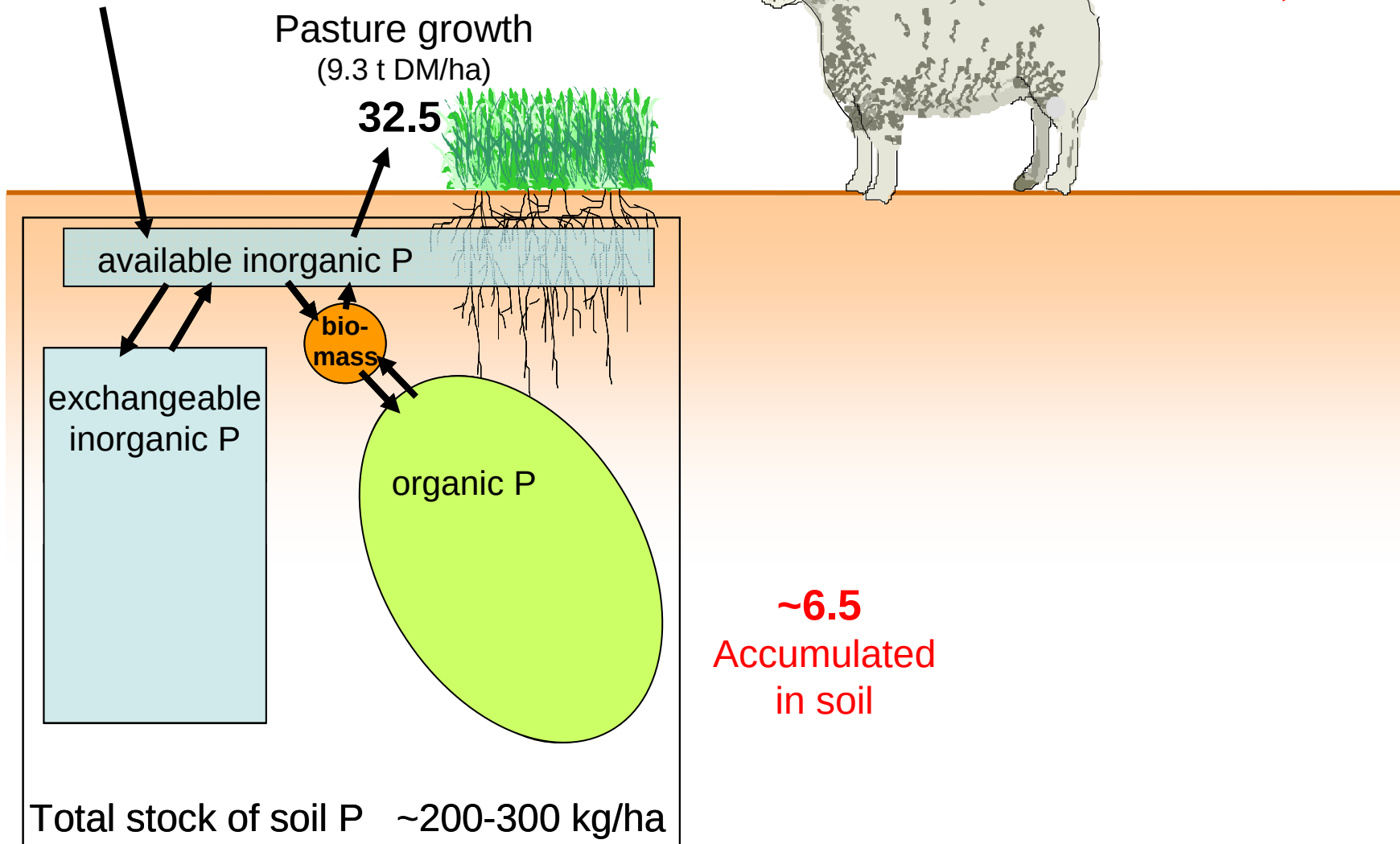
Pasture growth
(9.3 t DM/ha)

32.5



P removal
or loss

→ ~1



~6.5
Accumulated
in soil

Fertiliser
7.5 kg P/ha
per year

P removal
or loss
→ ~1

Pasture growth
(9.3 t DM/ha)

11.9

32.5

20.6

11.5

available inorganic P

bio-
mass

exchangeable
inorganic P

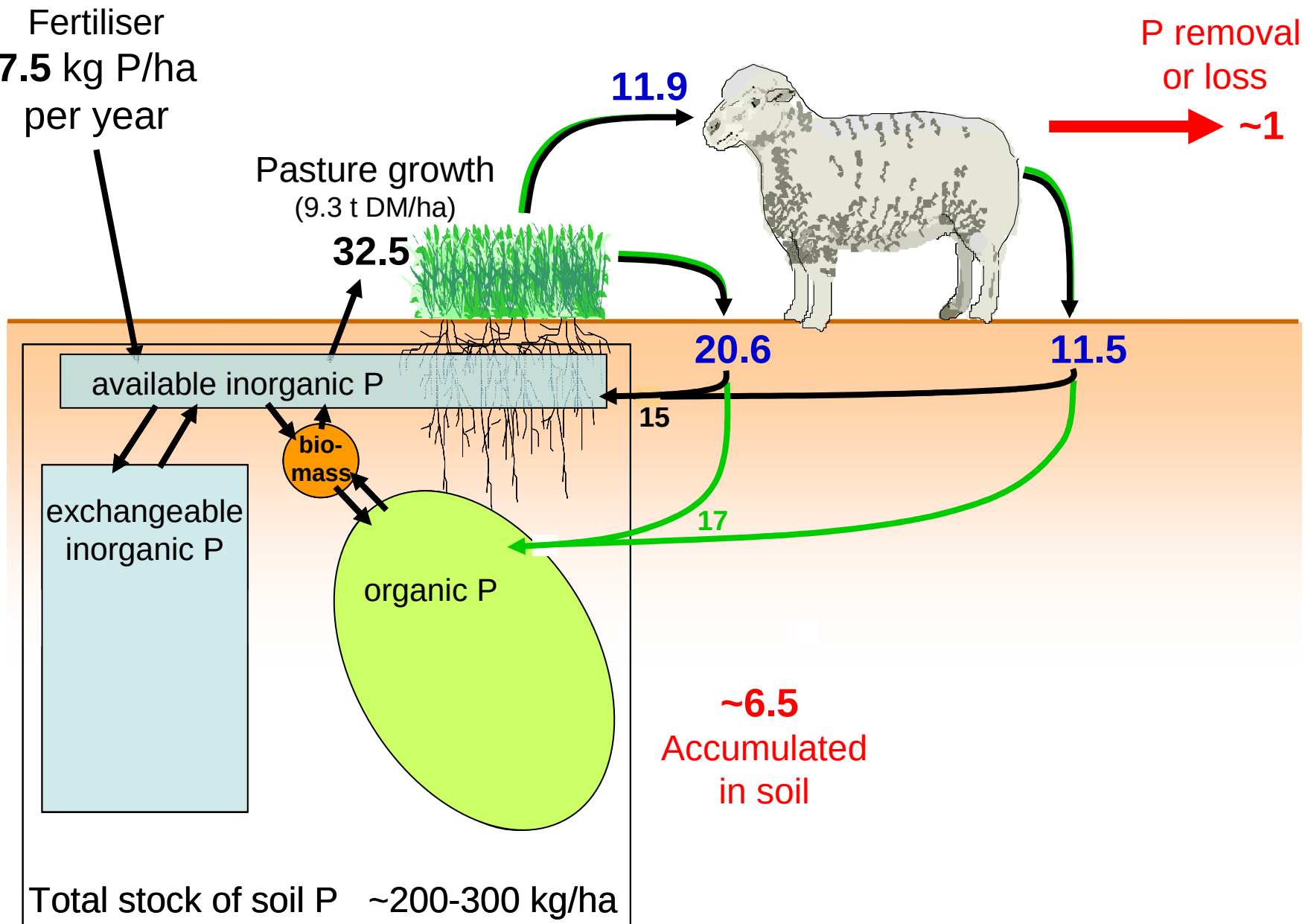
organic P

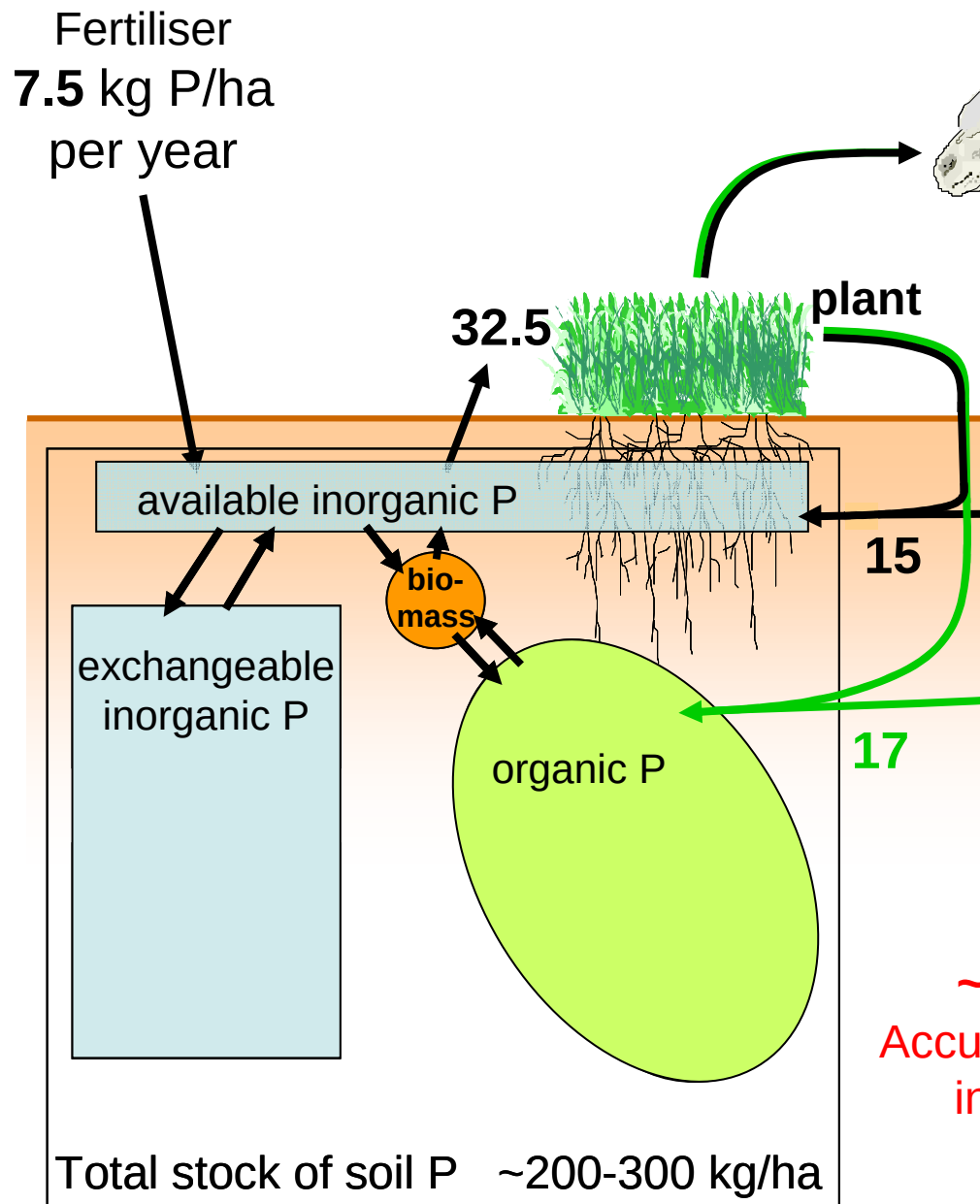
15

17

~6.5
Accumulated
in soil

Total stock of soil P ~200-300 kg/ha



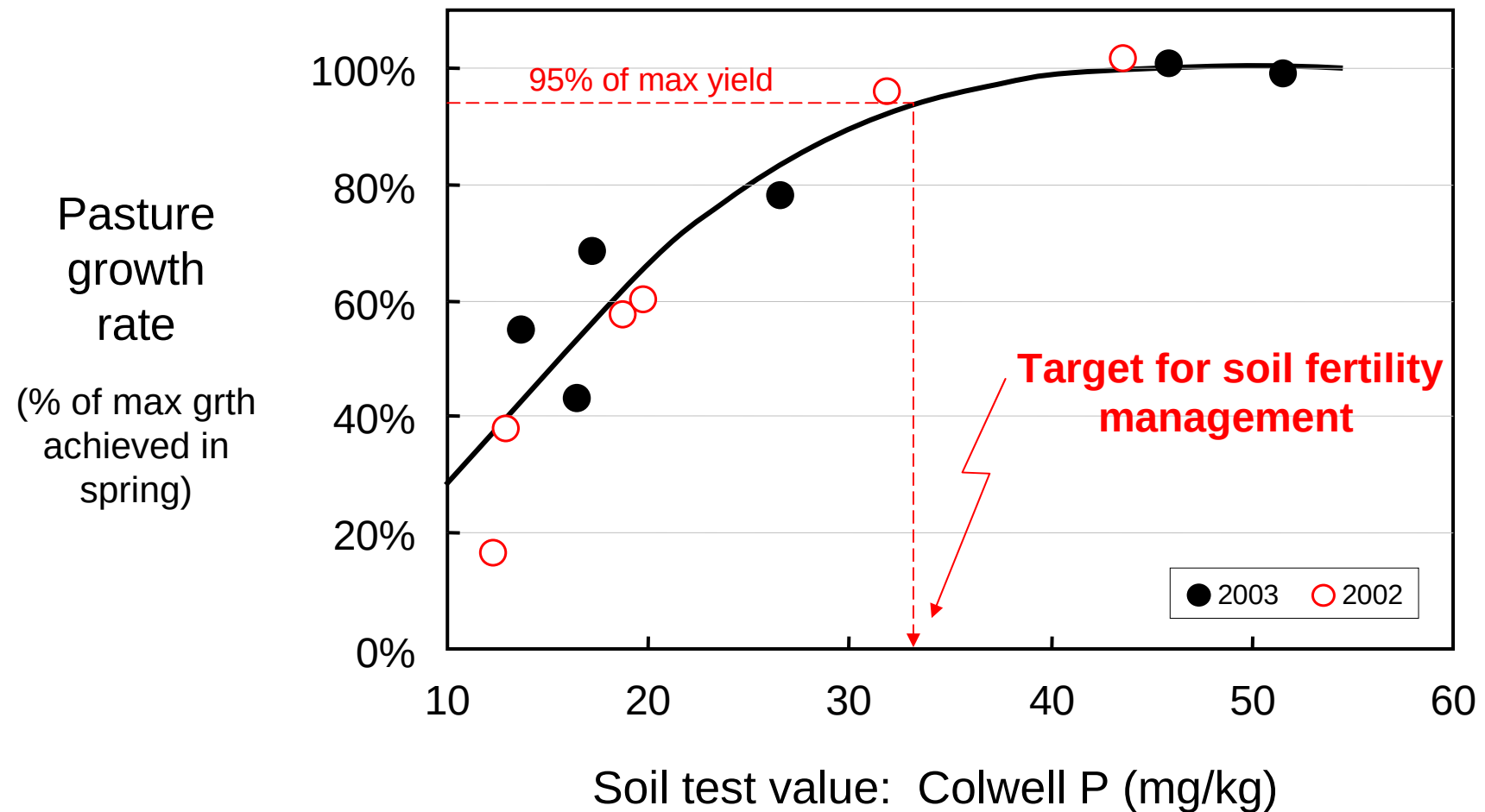


Balance Sheet Summary

1. P uptake by pasture
= 3x amount applied in fertiliser
2. Nutrient cycling is critical for
pasture productivity
3. Soil biology cycles the organic P
= 2x amount applied in fertiliser
4. **Fertiliser "tops up" the
soil's nutrient cycles which
in turn feed the pasture**
5. P-fertiliser use is "inefficient"
(7.5 kg P applied for only 1 kg output)

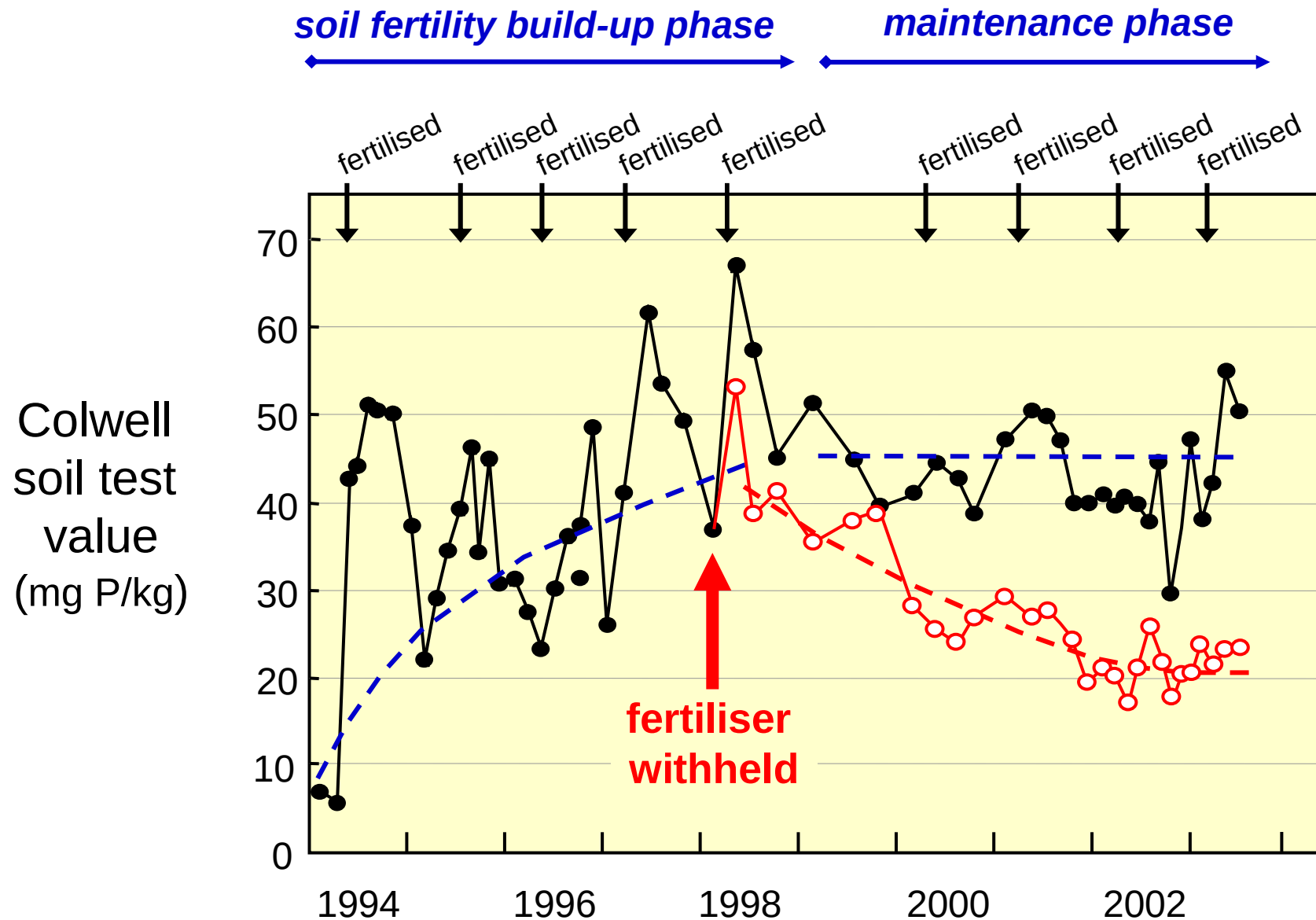
~6.5
Accumulated
in soil

A targeted approach to managing soil P fertility



Response of subclover-rich pasture to superphosphate ("Kia-Ora", Bookham)

Why continue to apply P once the critical level in soil has been reached?

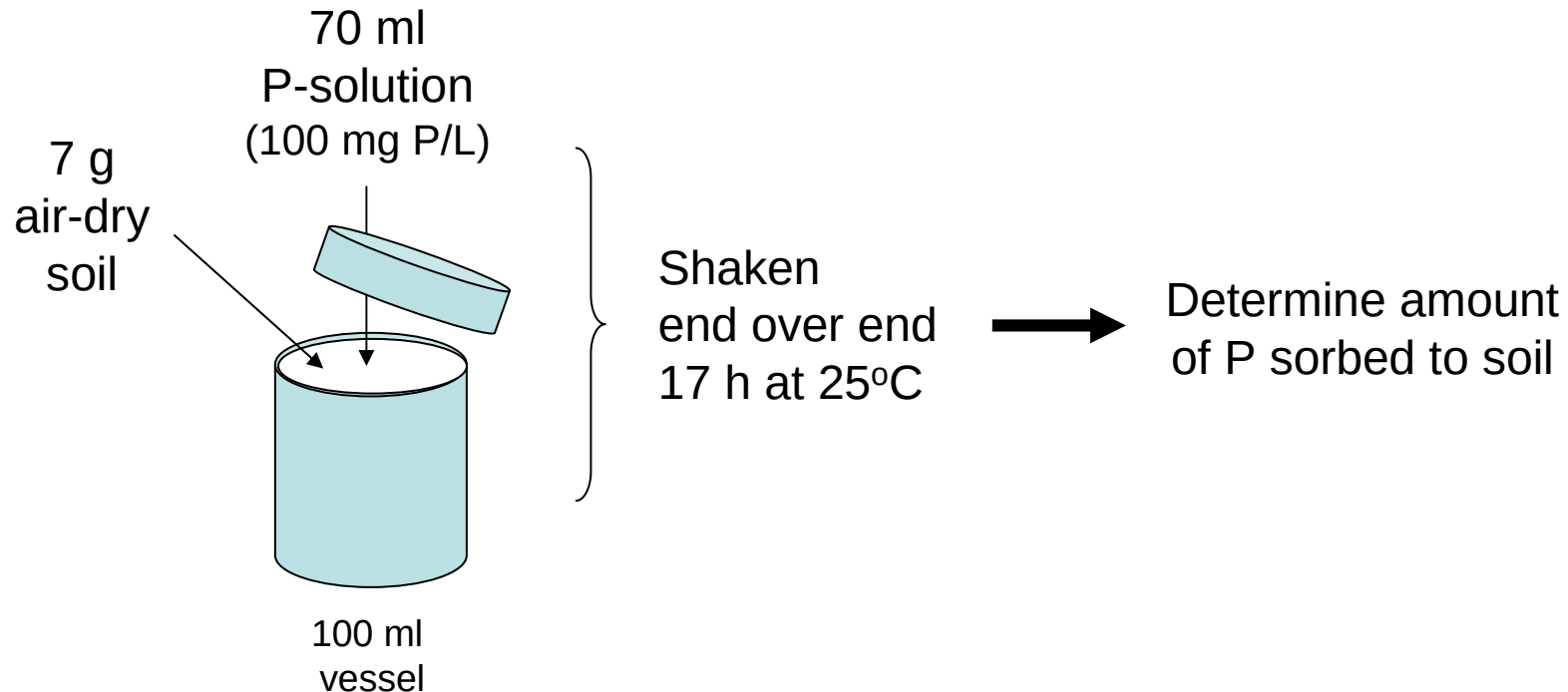


Setting soil P fertility management targets

Phosphorus Buffering Index (a relatively new soil test)

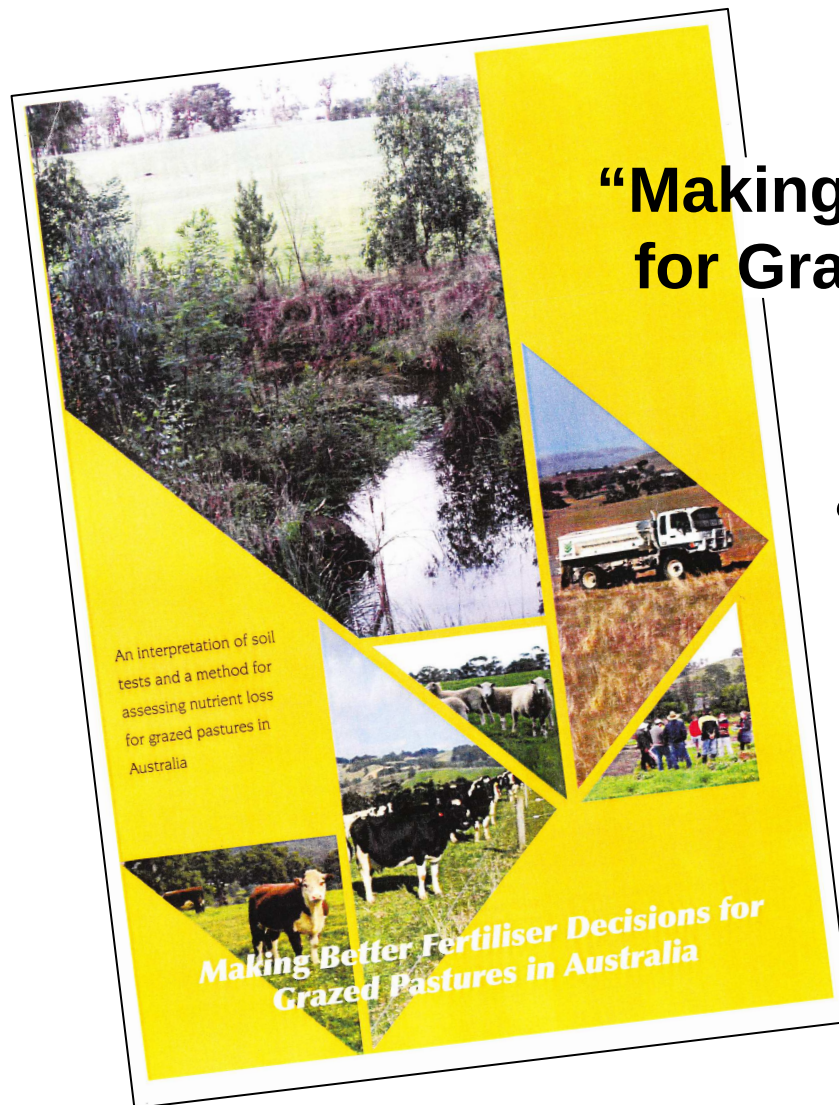


What is Phosphorus Buffering Index (PBI) ?



One-step measure of P sorption capacity of a soil

- This
- enables critical Colwell P of a soil to be predicted
 - allows calculation of the amount of P needed to lift a soil towards the target P concentration
 - can identify potential for leaching of soluble P through soil



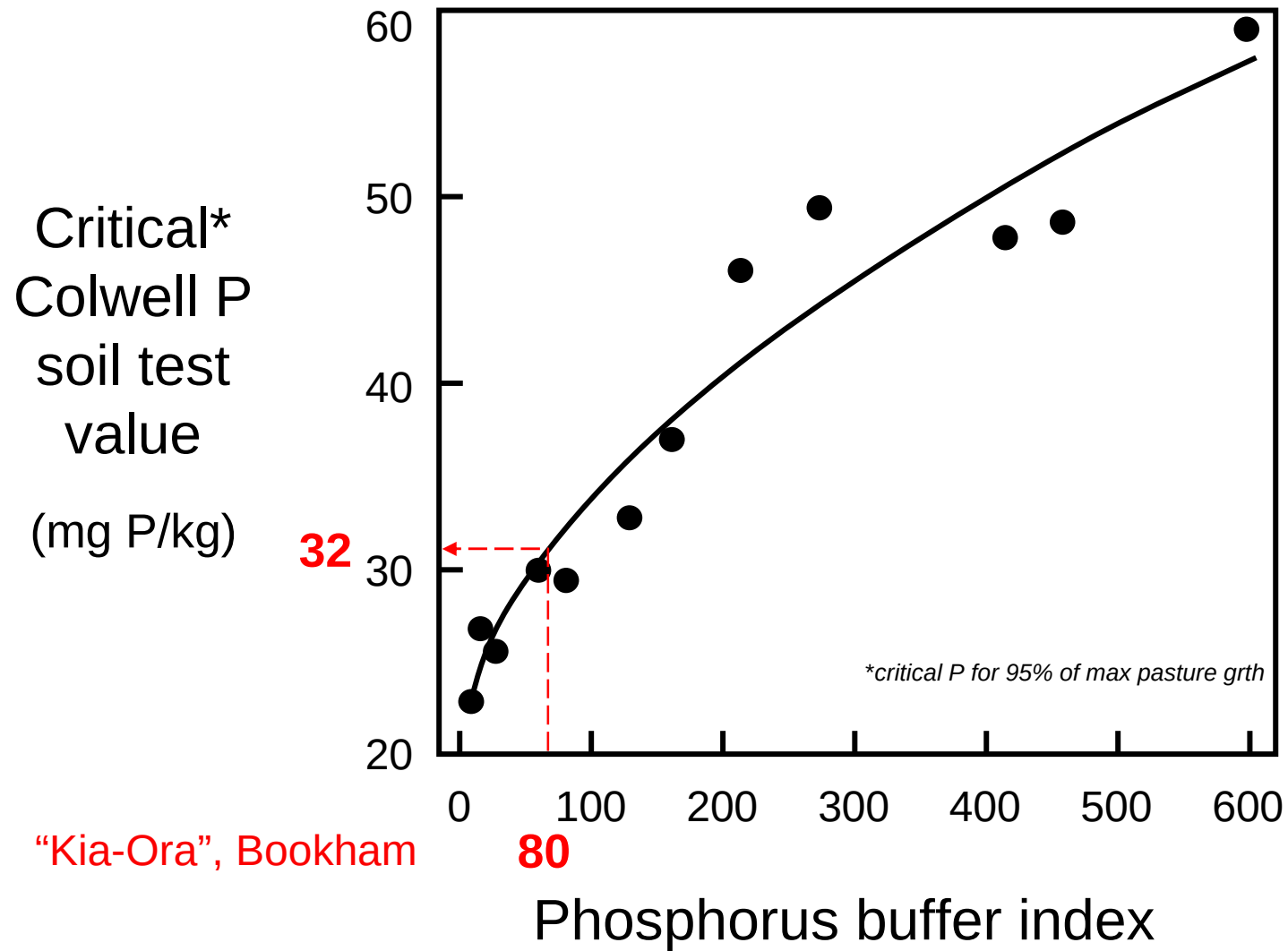
“Making Better Fertiliser Decisions for Grazed Pastures in Australia”

available on the web

<http://www.asris.csiro.au/>

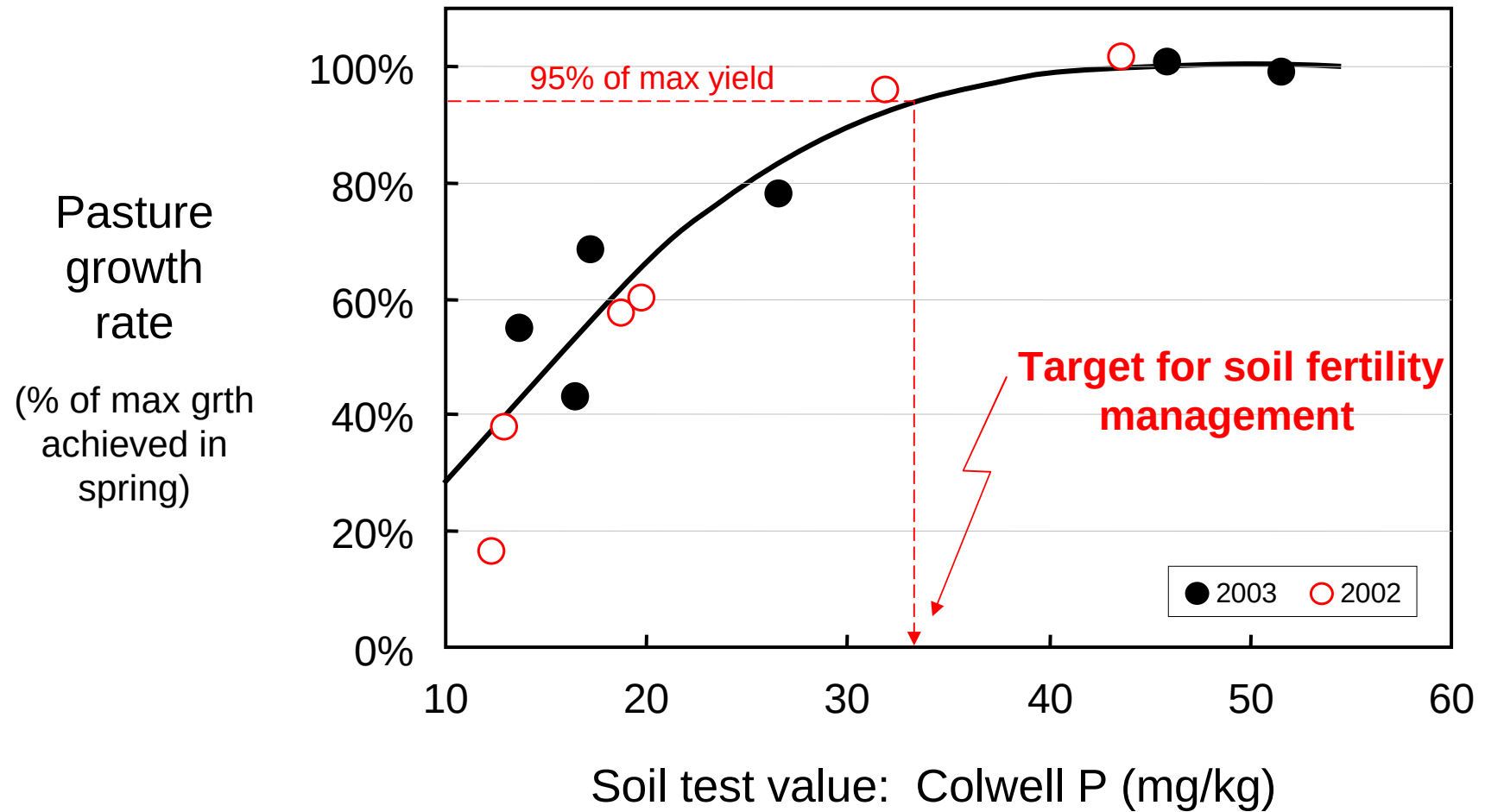
**downloads/BFD/Making%20Better%20Fertiliser%20Decisions
%20for%20Grazed%20Pastures%20in%20Australia.pdf**

The PBI can be used to predict the Colwell soil test value for near-max pasture growth

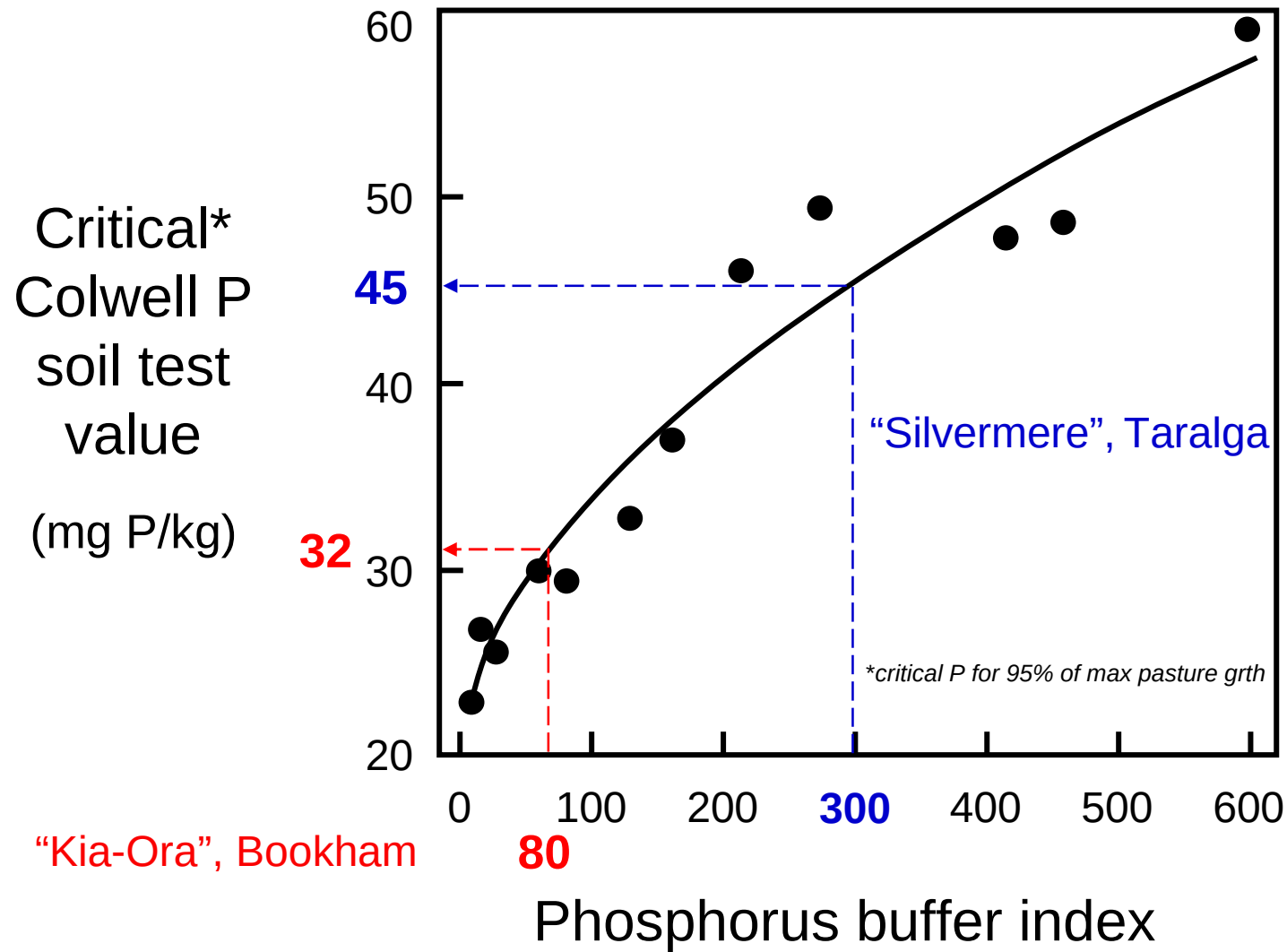


* Relationship from the **Better Fertiliser Decisions Project** Gourlay, Peverill, (Moody), et al.

Response of clover-rich pasture to superphosphate ("Kia-Ora", Bookham)

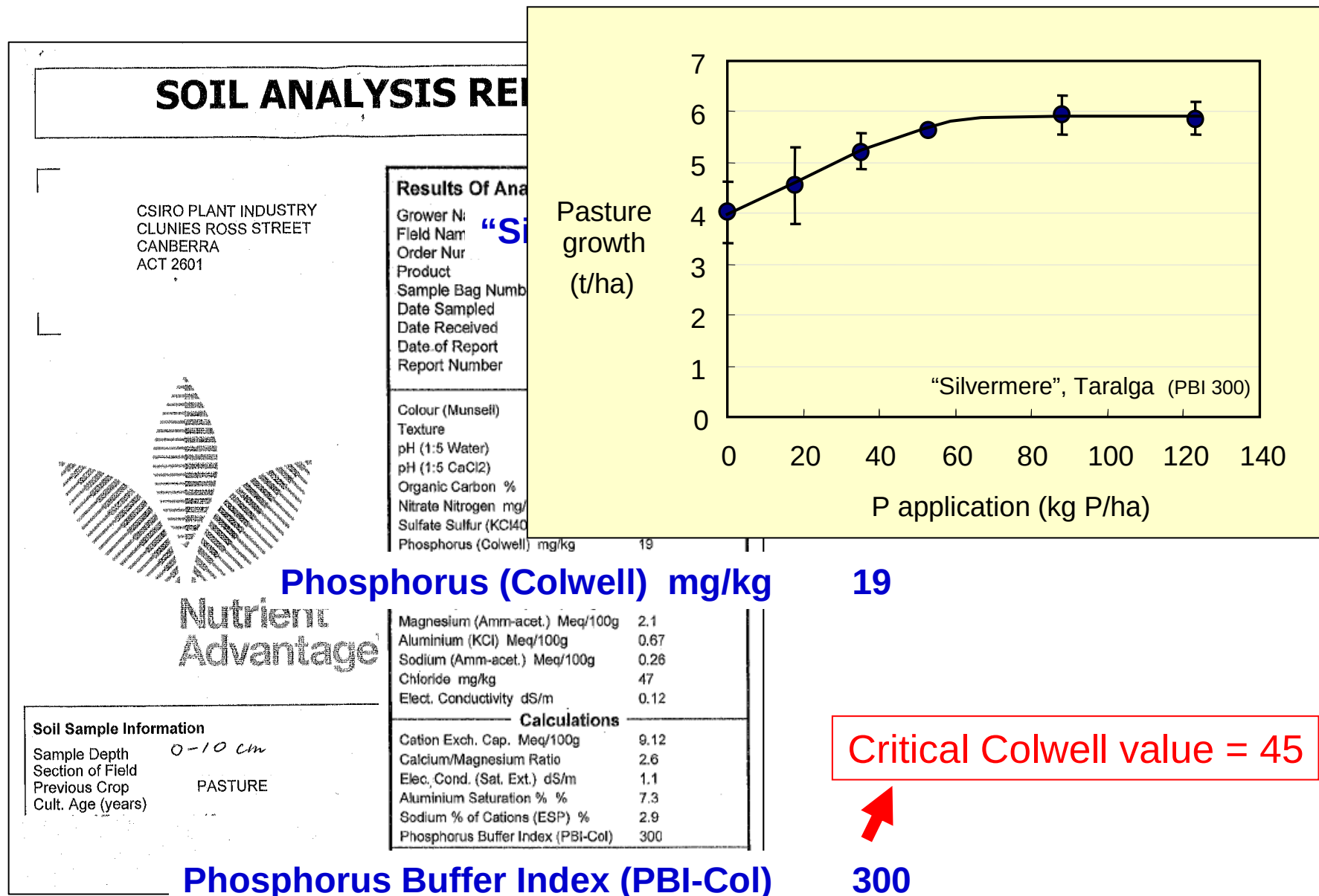


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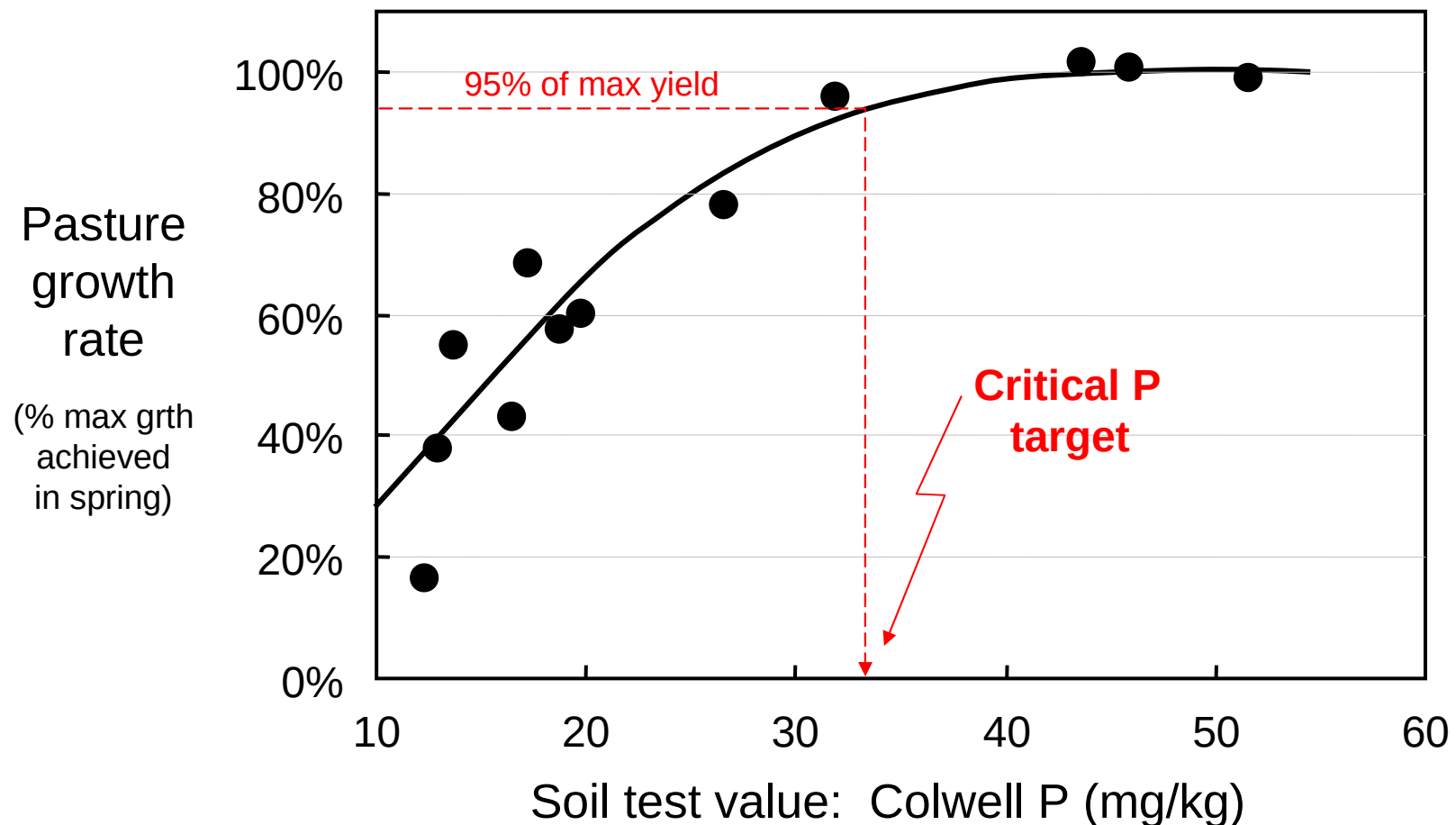
* Relationship from the **Better Fertiliser Decisions Project** Gourlay, Peverill, (Moody), et al.

New soil test information: Phosphorus Buffering Index (PBI)



Three reasons why there is no point exceeding the critical P value of your soil

- (i) no more pasture will be grown
- (ii) it takes more P-fertiliser to maintain high soil P concentrations
- (iii) high P concentrations in soil mean greater losses to the environment



Look at your soil test(s)

Which lab did you use

Visit: www.aspac-australasia.com/index.php?option=com_labproficiency&Itemid=126,
to view the list of ASPAC-certified soil testing labs in Australia

Your soil type?

Types of P test used

PBI and range for the district

P test values relative to targets

Sulphur (S) test results

Potassium (K) test results

FOR MORE INFORMATION

Look at the [Five Easy Steps](#) booklet
or the [Better Fertiliser Decisions](#)

brochure available at:

<http://www.asris.csiro.au/>

downloads/BFD/Making%20Better%
20Fertiliser%20Decisions
%20for%20Grazed%20Pastures%20
in%20Australia.pdf

Soil Location	coarse granite Berridale	intermediate Bungarby	basalt Cooma
pH(CaCl ₂)	4.8	5.1	5.6
Phosphorus (Colwell; mg/kg)	22	56	94
Sulphur (KCl ₄₀ ; mg/kg)	1.7	5.0	3.5
Potassium (amm.acet. Meq/100g)	0.33	1.1	1.1
Phosphorus Buffer Index	25	200	219
Cation Exchge Cap. (Meq/100g)	4	25	38

Source: NSW I&I

How to take soil tests properly

It is important to collect soil samples correctly to ensure a meaningful test result:

- i. **Representative samples** – Establish monitor areas or transects that represent each of the major classes of land (land management units) across the farm. The objective is to adequately represent the differing areas of the farm that are to be fertilised whilst ensuring a reasonable soil testing load and expense. Using a soil corer, sample in the monitor area or along the transect in a systematic way and record the sampling interval and pattern used so that the sampling pattern can be replicated at later times. To ensure samples reflect the paddock as a whole, avoid stock camps, fence lines, water troughs, fertiliser dumps, burnt timber rows, wet gullies, gateways, tracks or dung patches and sample from different soil types separately.
- ii. **Mark the site** – Keep a record of the monitor area or transect for future testing. You may do this by noting where you started and finished and the route taken, by taking a series of GPS readings, etc.
- iii. **Depth** – Extractable P is measured in topsoil samples using a soil sample depth of 10cm. P is typically more concentrated in the top few centimetres of soil so it is very important to obtain the full volume of soil to 10 cm depth to avoid biasing the concentration of P in the soil sample.
- iv. **Sample number and handling** – Take a minimum of 30 soil cores along the transect or monitor area and combine to give a sample that is representative of the paddock. Send the sample to the testing laboratory promptly. Use an ASPAC-accredited laboratory to take advantage of the quality control that this accreditation represents.
- v. **Timing** – Always sample at the same time every year. It is potentially feasible to take annual samples at any time of the year, but soil samples are most commonly taken in late spring. At this time soil is usually moist, but not wet, allowing soil cores to be taken quickly

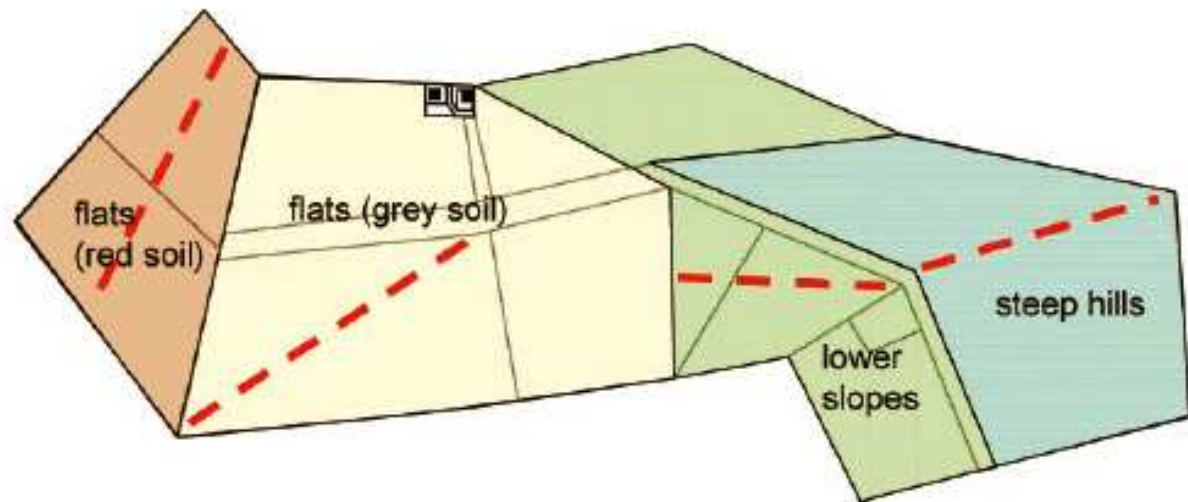
and easily. Moist soil holds together in the corer and this helps to ensure the sample is the full 10 cm depth. Never sample within the first few months after fertiliser application.



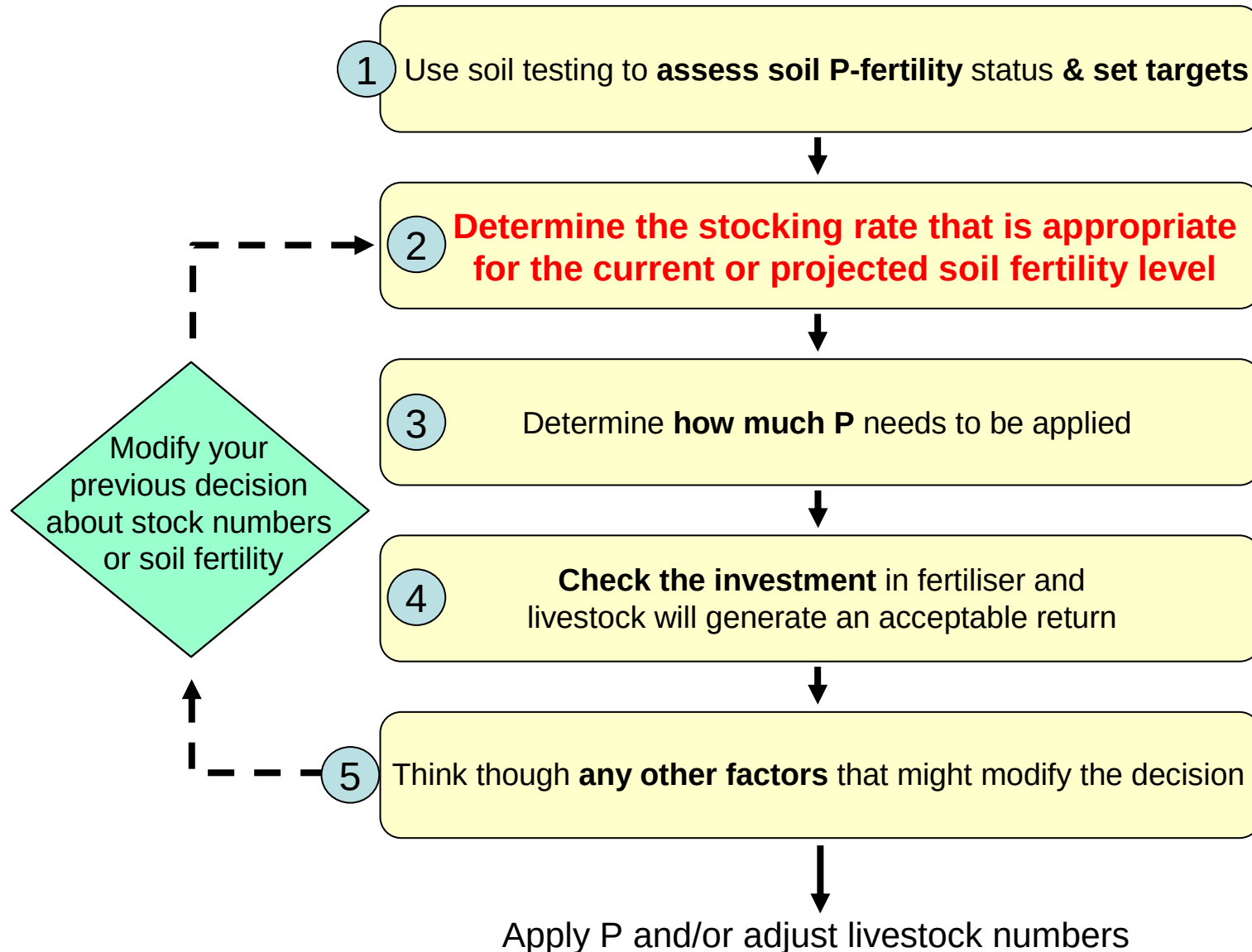
Soil tests that are not taken correctly will not give you an accurate result.

See page 6 of the “Five easy Steps..” booklet

Soil testing: establish monitor paddocks or transects (■■■■) that represent the major classes of land, or land management units of the farm. The objective is to adequately represent the differing areas of the farm that are to be fertilised whilst ensuring a reasonable soil testing load. Retest the monitor areas annually. Over time you will be able to make decisions on the basis of the soil fertility trends that the data will reveal.



Five Easy Steps



Predicting potential stocking rate **at optimal soil P fertility** based on length of typical (average) growing season

Bookham ~7.5 mths green feed (May-mid Nov)

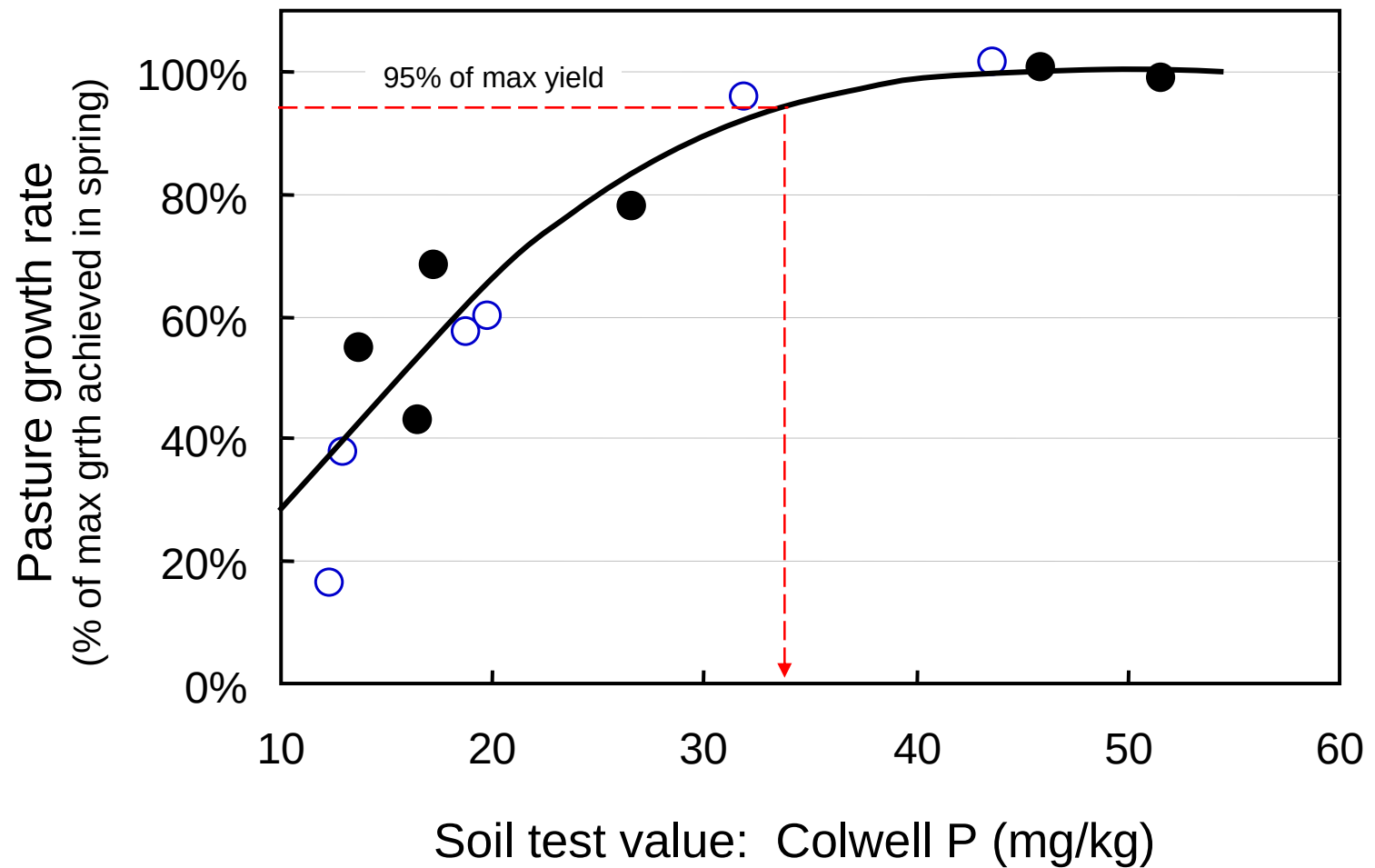


Growing season (mths):	5	6	7	8	9	10	11	12
Paddocks smaller than 20ha								
Stocking rate (dse/ha)	12	16	19	23	26	29	33	36
Paddocks larger than 20ha								
Stocking rate (dse/ha)	10	13	16	20	23	27	30	33

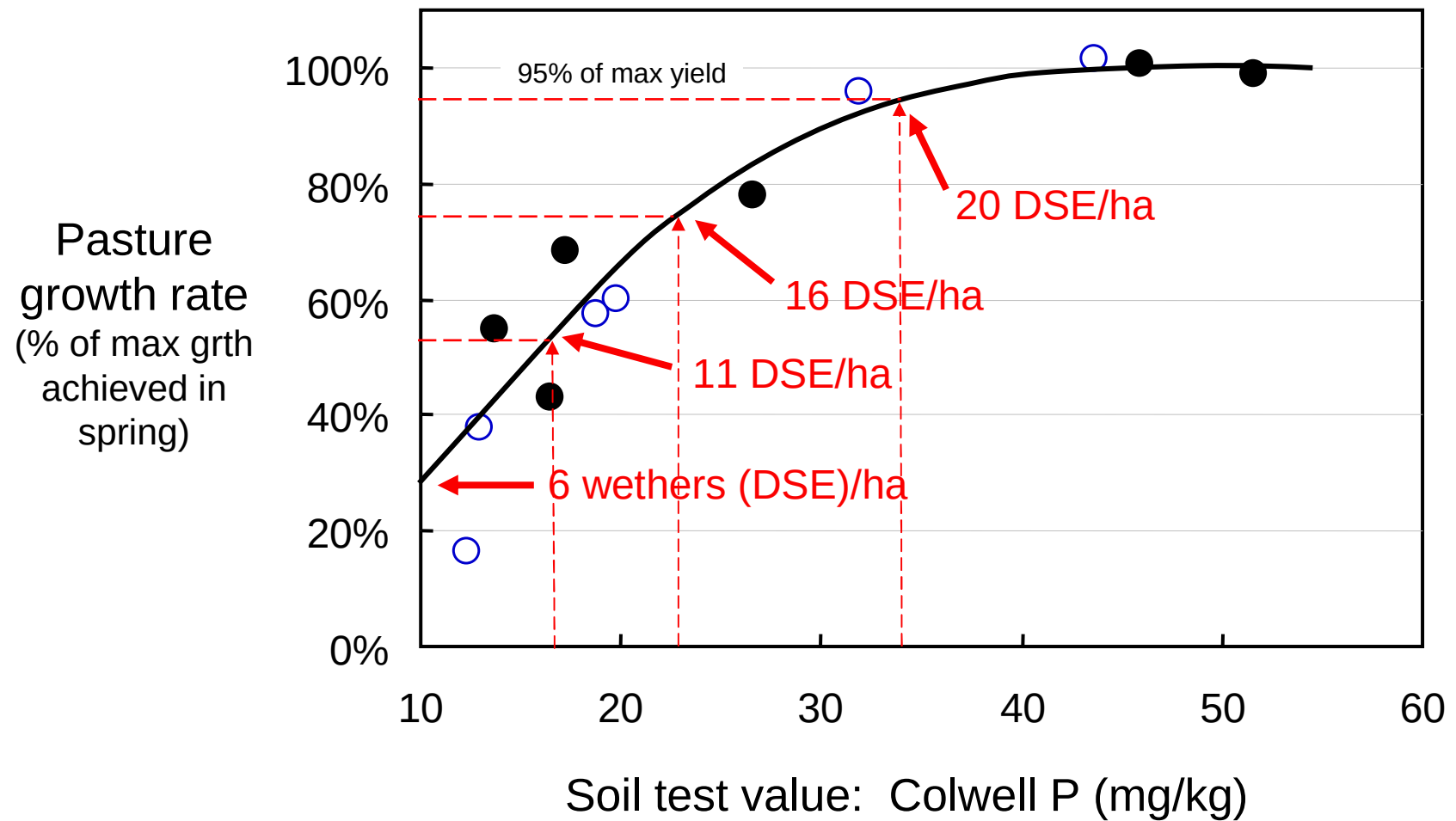
71% of variance in stocking rate accounted for by length of growing season and soil P fertility

Response of subclover-rich pasture to superphosphate

("Kia-Ora" Bookham, PBI = 80)

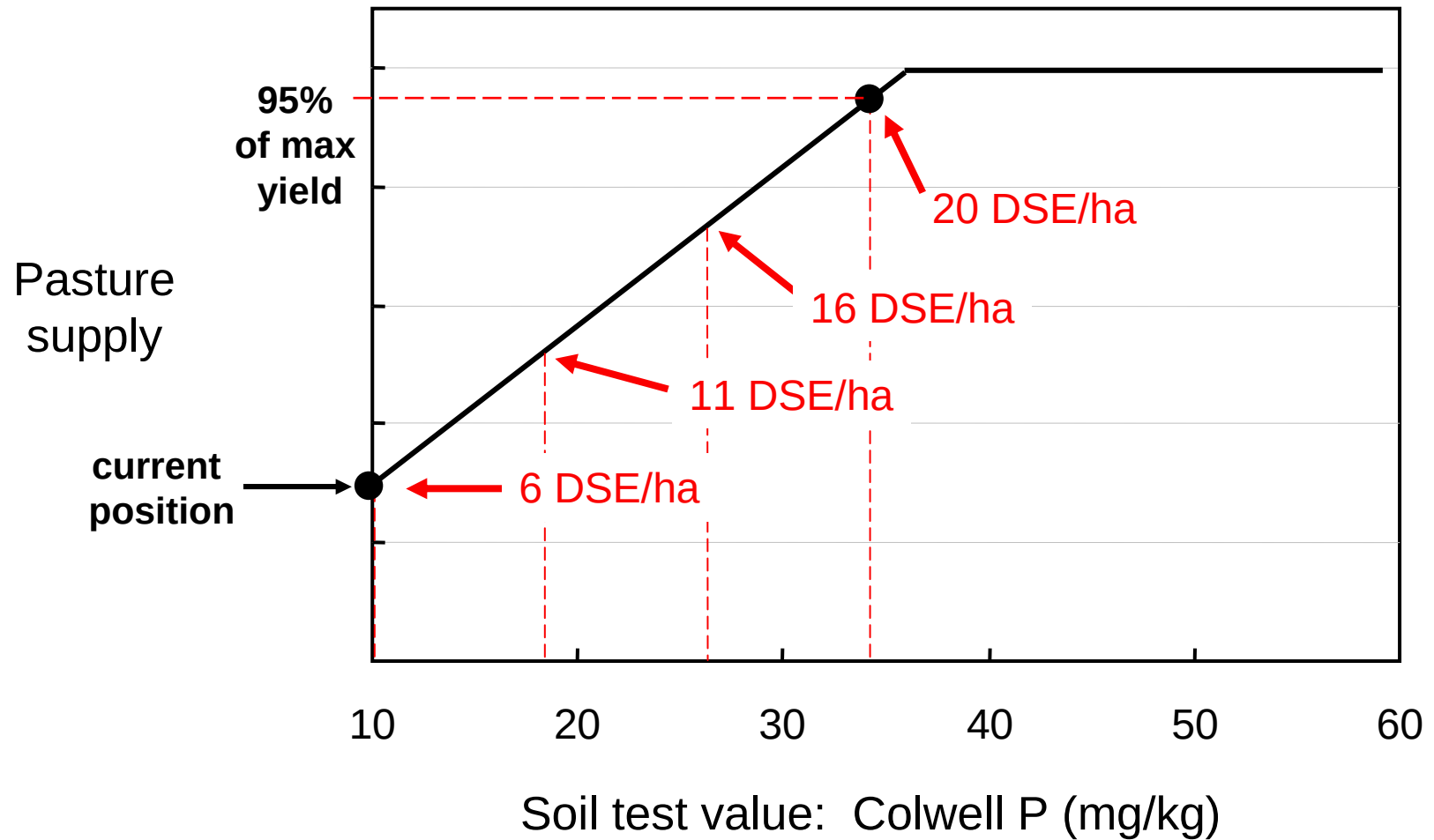


Response to superphosphate (subclover-rich pasture, "Kia-Ora" Bookham, PBI = 80)



Response to superphosphate (subclover-rich pasture, "Kia-Ora" Bookham, PBI = 80)

What if you do not have access to
a local pasture response curve?



Calculating annual DSE's

See Appendix 1 of the “Five Easy Steps...” booklet

Application to Land management Units across the farm

Application to the Monaro

Other ways to do this

Predicting potential stocking rate at optimal soil P fertility
based on length of typical (average) growing season

Bookham ~7.5 mths green feed (May-mid Nov)

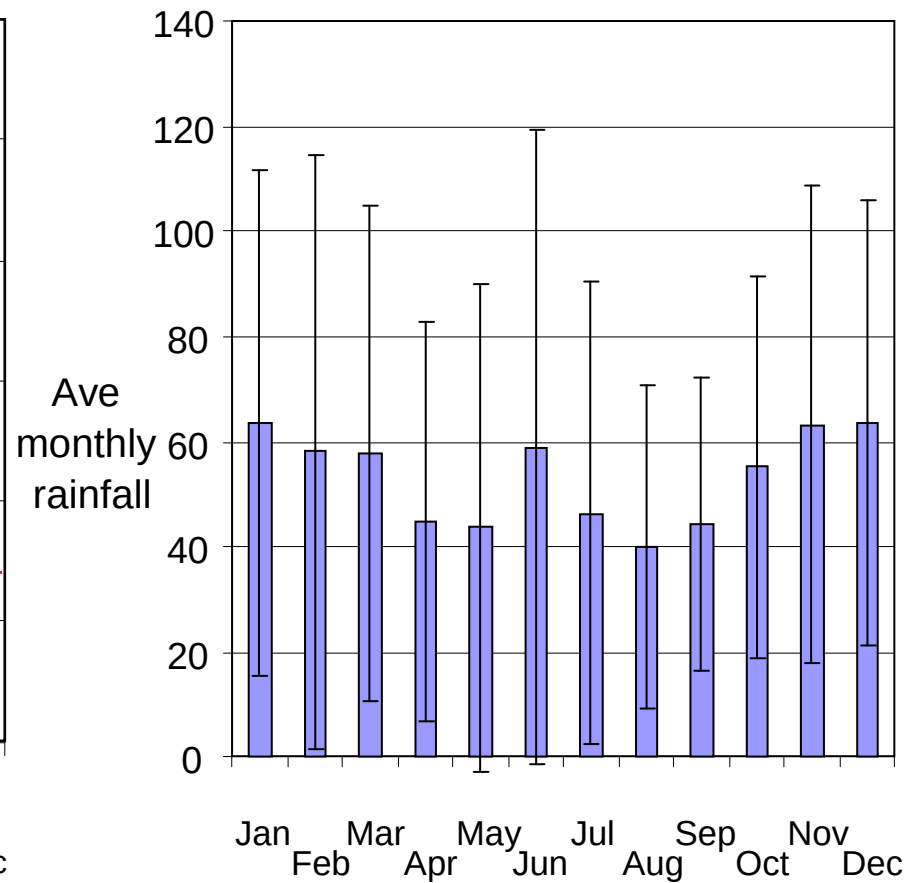
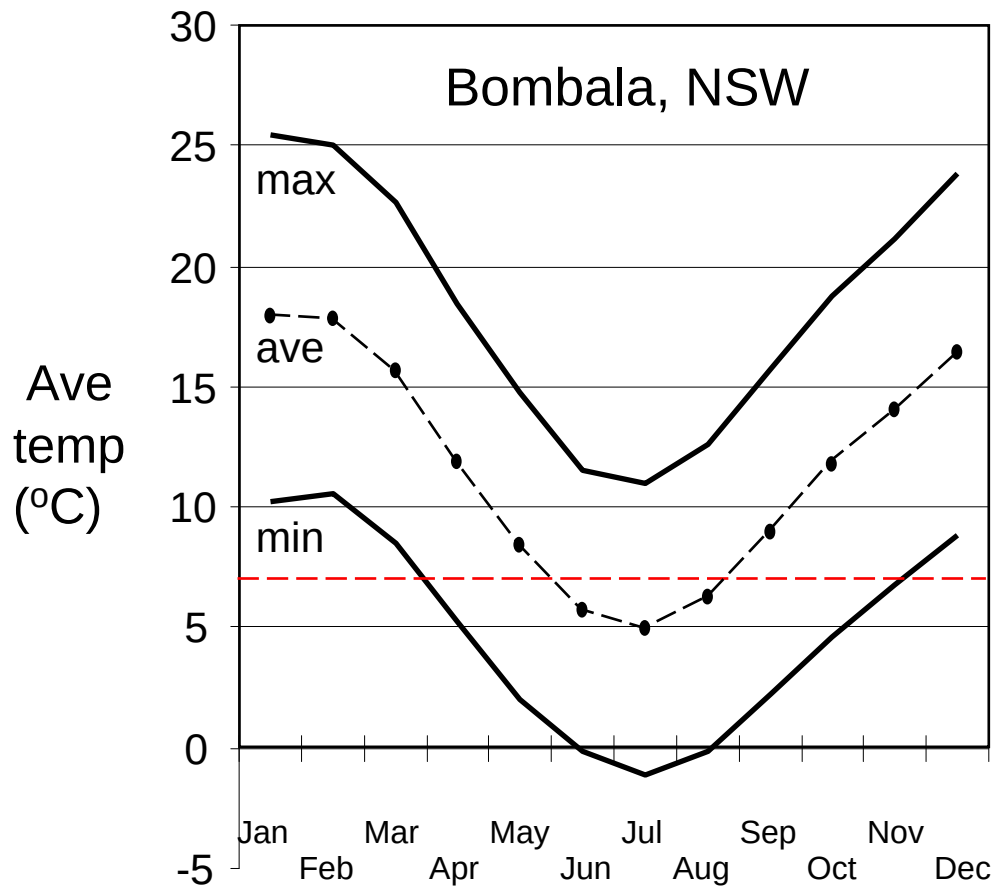


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Application to Land management Units across the farm

Application to the Monaro

Other ways to do this



Appendix 3

Worksheet for planning the P-requirements of paddocks

[illegible]