PRO AGRO LECTORIUM

Optimised plant nutrition with phosphorus

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How to optimise mineral nutrition of plants?

RIGHT TYPE AND FORMULA

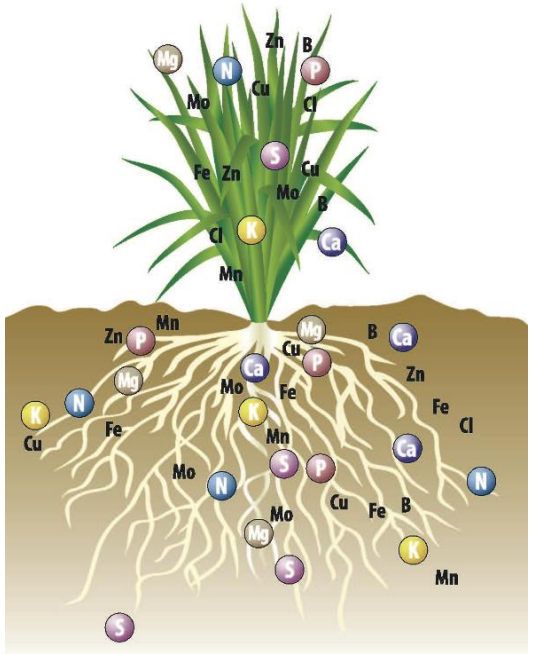
RIGHT DOSAGE

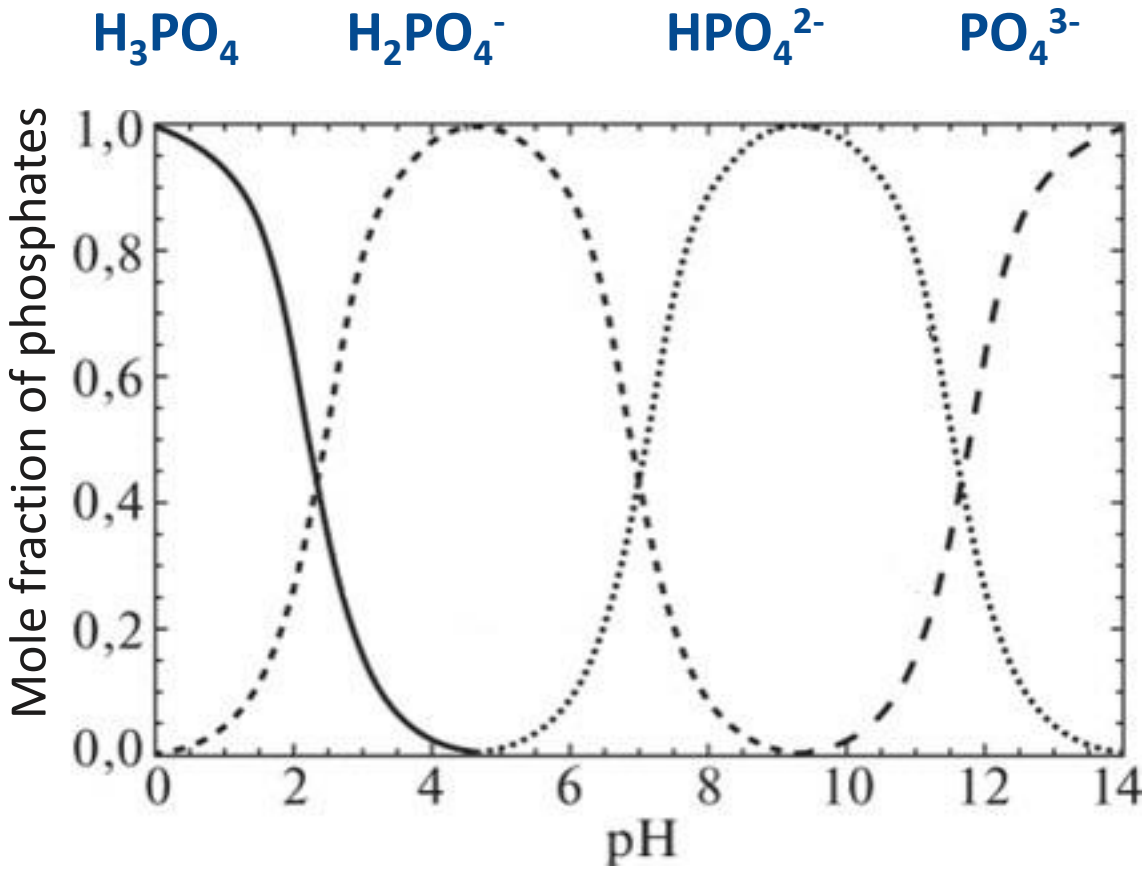
RIGHT APPLICATION TIME

RIGHT APPLICATION METHOD

Absorption of phosphorus by plants

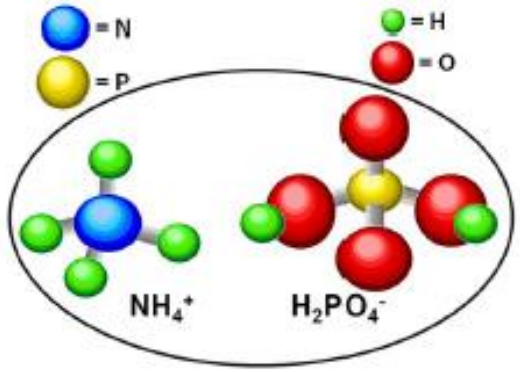
- Absorbed primarily in the form of phosphate anions **$H_2PO_4^-$ and HPO_4^{2-}.**



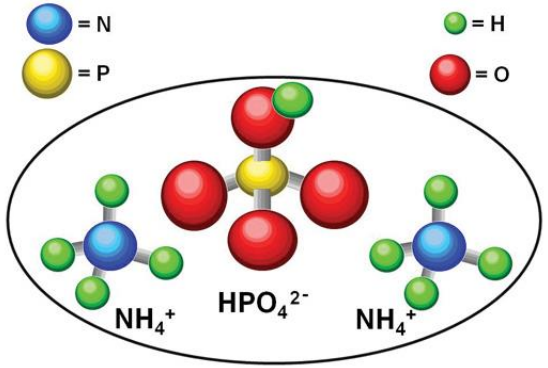


Monoammonium phosphate (MAP) and diammonium phosphate (DAP)

MAP $NH_4H_2PO_4$



DAP $(NH_4)_2HPO_4$



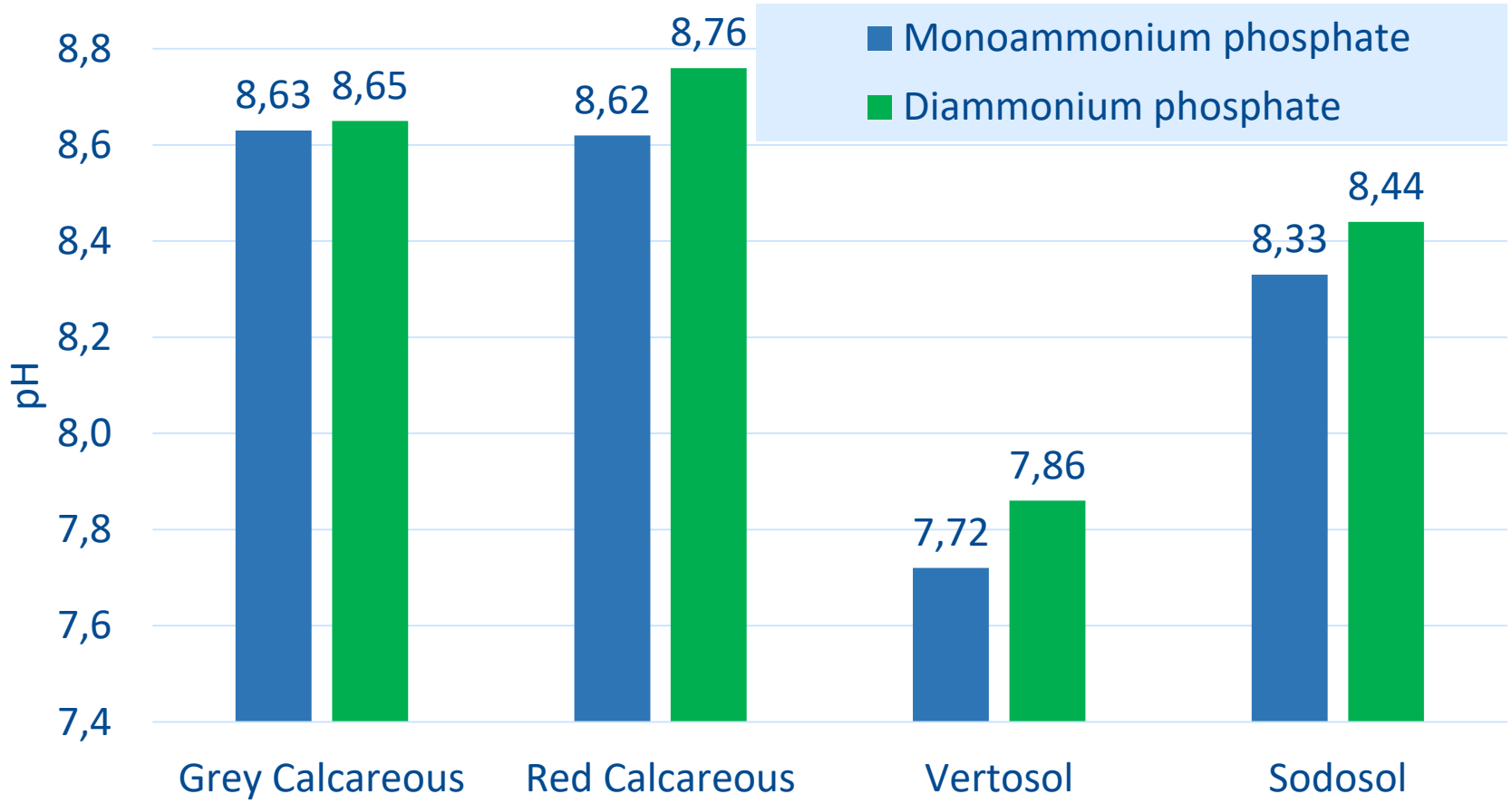
N:P ratio as the key differentiator:

- MAP has one NH_4^+ ion per each phosphate ion;
- DAP has two NH_4^+ ions per each phosphate ion.

MAP and DAP properties

	MAP	DAP
Composition:	12% N **52% P_2O_5** 2% S	18% N **46% P_2O_5** 2.5% S
Water soluble phosphorus:	**90%**	**90%**
	Strong solubility and quick dissociation in soil into phosphate ions and ammonium ion readily available to plants.	
Solution pH:	**4.0–4.5**	**7.5–8.0**
	Acidic pH around the granule, i.e. the fertilizer offers certain benefits for **neutral and alkali soils.** The effect on soil pH is temporary. The fertilizer helps reduce losses of gaseous nitrogen released in the form of NH_3 into the atmosphere.	Alcaline pH around the granule, i.e. the fertilizer offers certain benefits for **acid soils.** The effect on soil pH is temporary.

Alkali soils: pH effect in seven days after the application of MAP and DAP



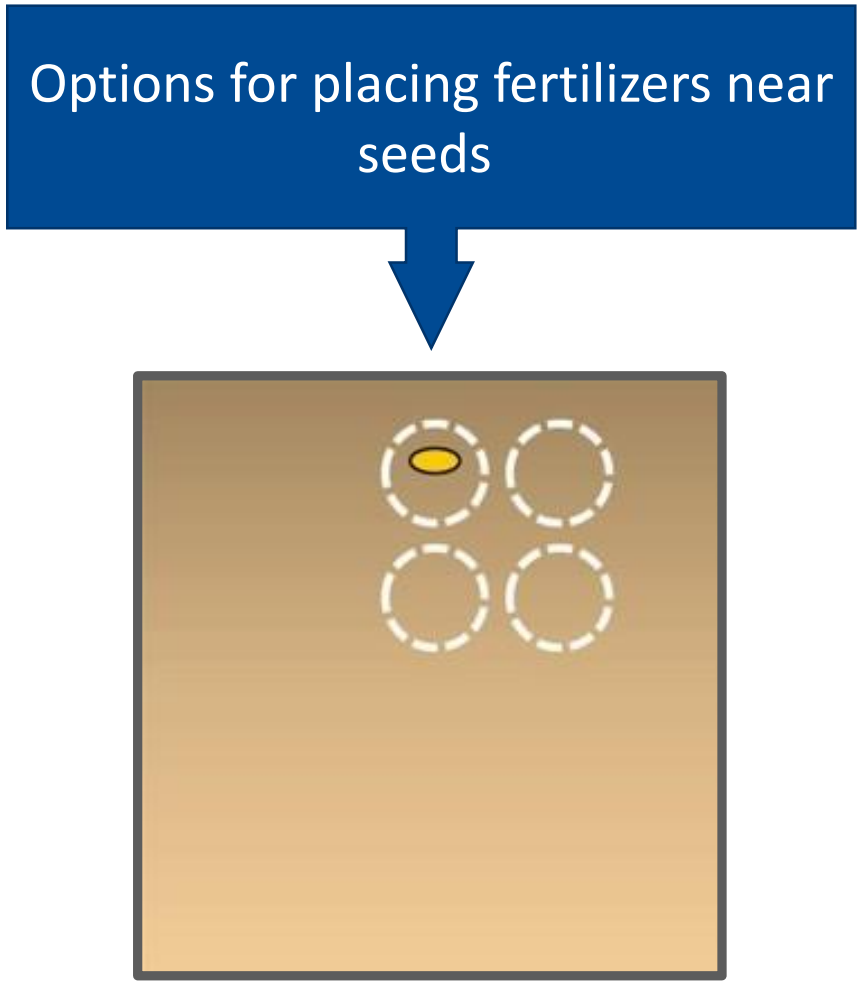
I. Bertrand et al, 2006

Incubation leveraging fertilizers for South Australia soils

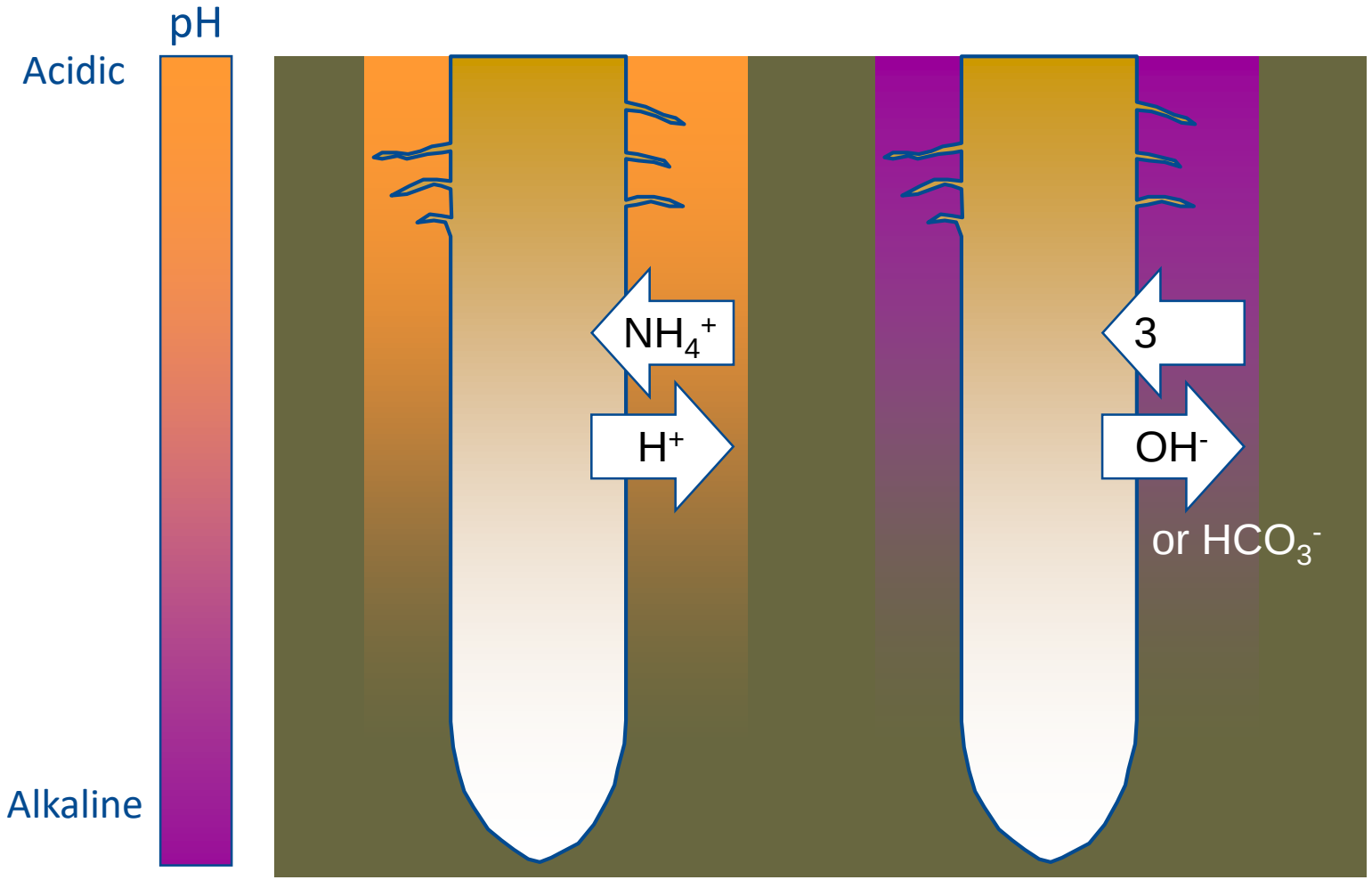
MAP: pH of the soil decreased
(three out of four samples)

Placement of P fertilizers next to seeds

- **MAP** can be placed in immediate proximity to the seeds (however, there are maximum nitrogen dosage restrictions for some plants).
- As **DAP** granules dissolve, they release a large amount of NH_4^+ ions into the soil solution; the resulting gaseous NH_3 affects seedlings and roots (especially in alkali soils) if they are situated too close (the initial pH of the surrounding soil solution is >7.5).
- High concentrations of DAP in immediate proximity to the seeds should be avoided.



Stronger phosphorus absorption thanks to NH_4^+



The ammonium form of nitrogen has a more beneficial effect on absorption of phosphorus by roots as compared the nitrate form.

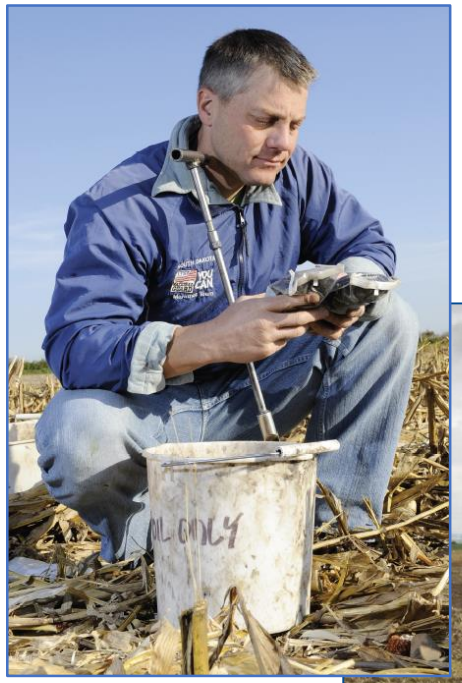
One of the key reasons is lower pH in the rhizosphere.

Mobilisation of soil phosphates improves phosphorus absorption.

Hoffmann et al., 1994; Marschner, 2002; Prochnow, 2018

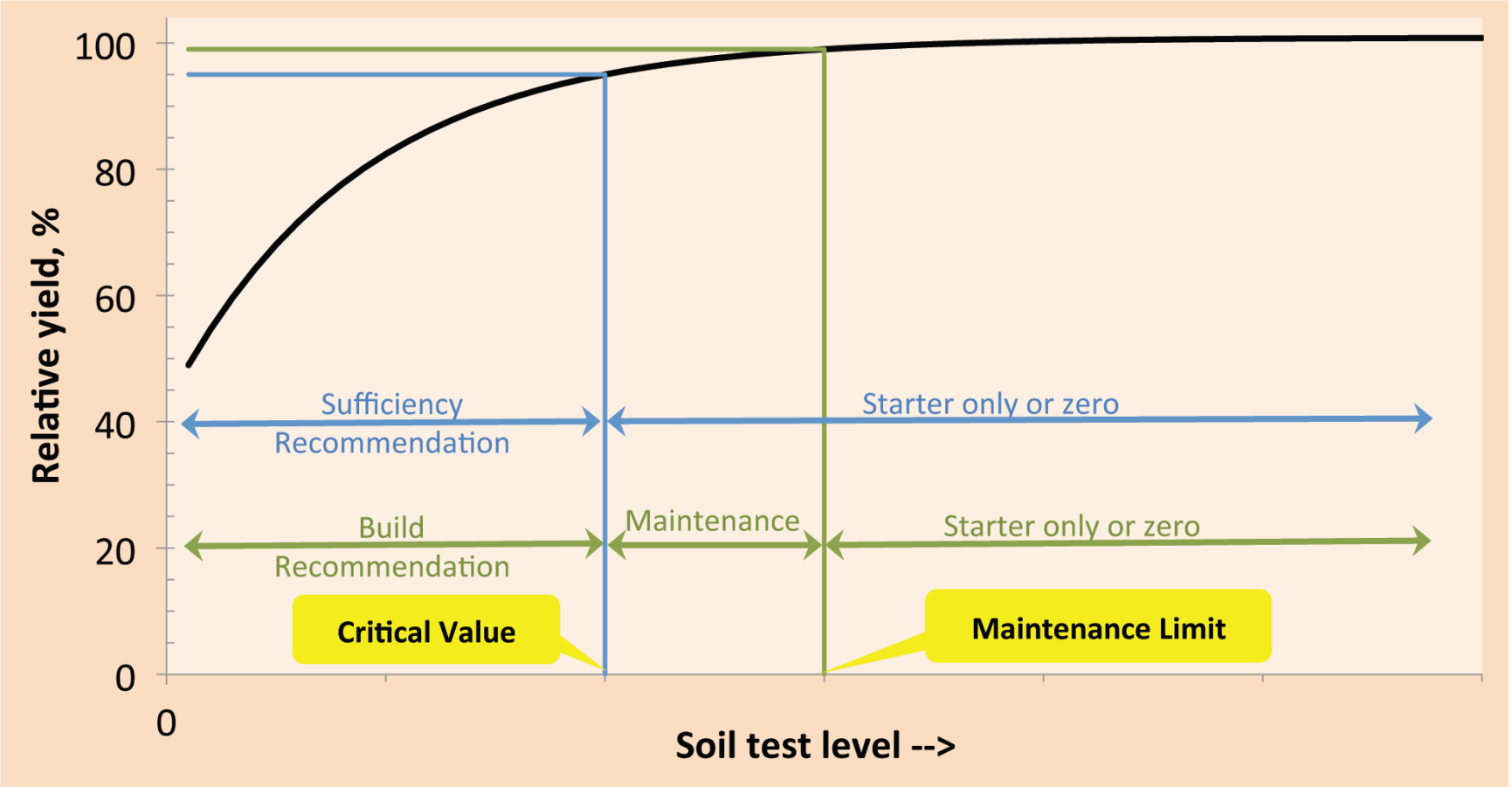
Probability of crop response to fertilizers

Sufficiency of nutrients in soils	Probability of extra yields and return on investment
Very low	Cost effective in the majority of cases
Low	Cost effective in the majority of years
Medium	Cost effective on average
High	Cost effective in certain years
Very high	Return on investment in the year of application is highly unlikely



https://gapp.ggau.by/

P fertilizers application strategies



Economic benefits available only in the year of application

Improvement and maintenance of soil fertility

Adapted from Leikam et al, 2003

Nutrient removal per tonne of harvested crops (kg/t)

Crop	N	P_2O_5	K_2O	S
Spring rapeseed	32	16	8	5
Flax	45	13	11	3.4
Soybeans	55	12	20	3
Sunflower	27	9.7	9	2.5
Spring wheat	25	9.5	5.5	
Barley	21	8.3	6.7	1.9
Winter wheat	19	8	4.8	1.7
Maize (grain)	12	6.3	4.5	1.4
Alfalfa (DM)	26	6	25	2.7
Maize silage (67% water)	4.9	1.6	3.7	0.6
Potatoes	3	1.5	6.5	0.3
Sugar beet	1.9	1.1	3.7	0.2

IPNI, 2016

Nutrient balance

BALANCE = UPTAKE – REMOVAL

PRACTICAL ASPECT:

What happens to soil fertility with regard to phosphorus?

Input data:

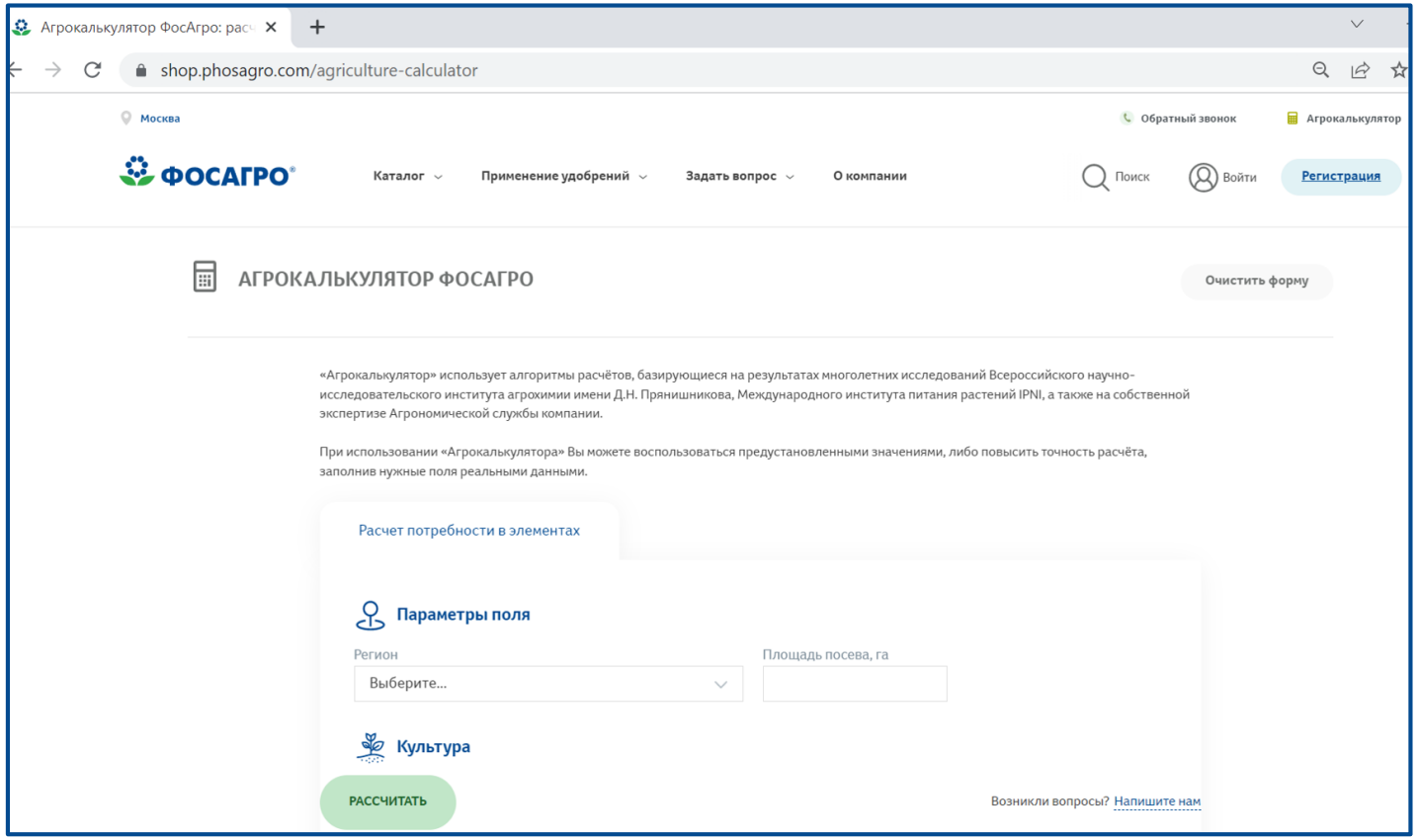
- uptake of phosphorus from the applied fertilizer is approximately **55 kg of P_2O_5 per ha**;
- winter wheat grain yield is **7 t/ha;**
- phosphorus removal from soil at crop harvest is **8 kg of P_2O_5 per tonne**.

a) it increases;

b) it decreases;

c) it remains practically unchanged.

NPK dosage calculation tools



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Thank you!