

The comparison of smartphone and Vis-spectrometer for soil P analysis by Mehlich 3 method

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Aim of research

- To develop an express method, which could be used *in situ* to reliably estimate plant available phosphorous content in soil.
- To find ways to remove disturbing effects caused by environmental lighting and at the same time to improve the measurement accuracy when using digital photography in the analysis of the plant available phosphorous content in soil.



Material and methods

- The soil plant available phosphorus was extracted by Mehlich 3 method
- The content of soil in extracts was determined by two instrumental methods:
 - Spektrometrically by molybdate blue method, $\lambda = 882 \text{ nm}$, Helios Omega (Thermo Scientific).
 - Digital photography was conducted by using Samsung Galaxy S4 I9505, post processing was conducted with Gimp and the data from the photos was collected using ImageJ

Equipment

- Test vials-

Plastic tubes: $h = 130 \text{ mm}$, $\varnothing 16 \text{ mm}$

- Distance from the samples: 18 - 25 cm

- Environment-

In room: 410 – 471 lux

In shadow: 576 lux

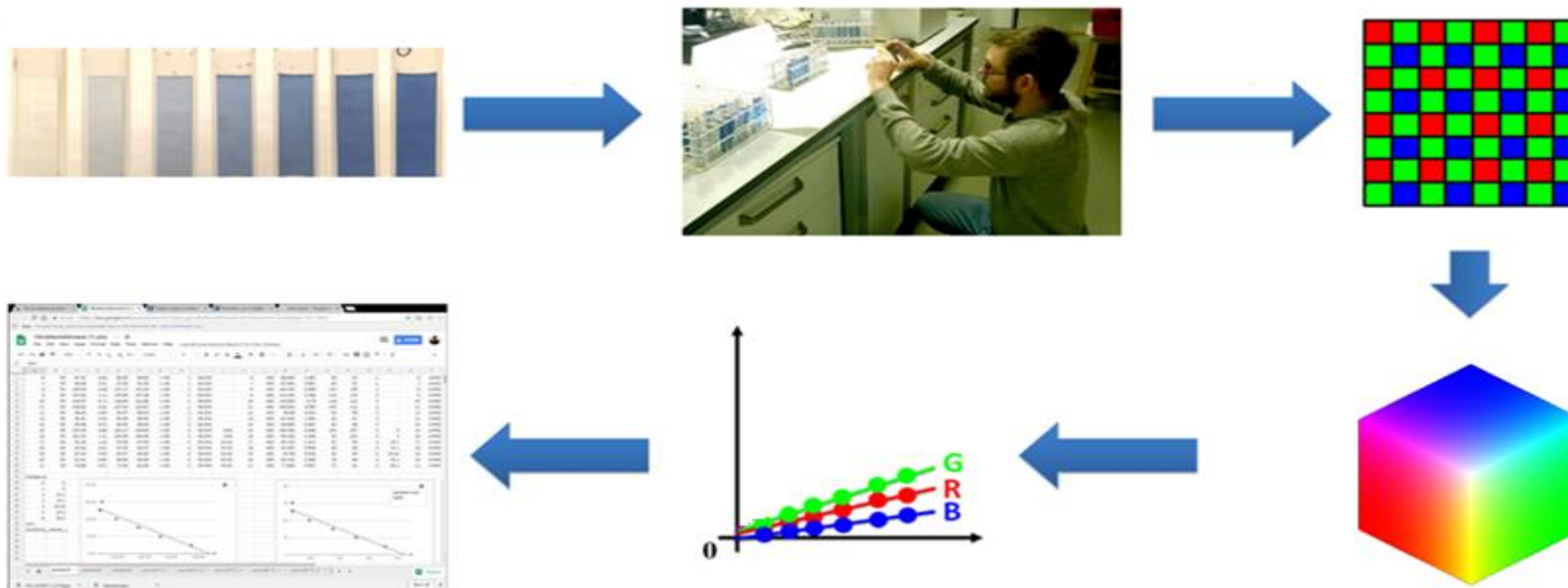
In direct sunlight: 58753 lux



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Graphical scheme of determination



Characterization of soil sample set

	pH _{KCl}	C _{TOT}	N _{TOT}	K _{M3}	P _{M3}
		%	%	ppm	ppm
Average	6,70	3,21	0,31	252,1	117
Min	4,46	0,88	0,08	3,8	1,28
Max	7,61	6,85	0,68	701	361,1



Results

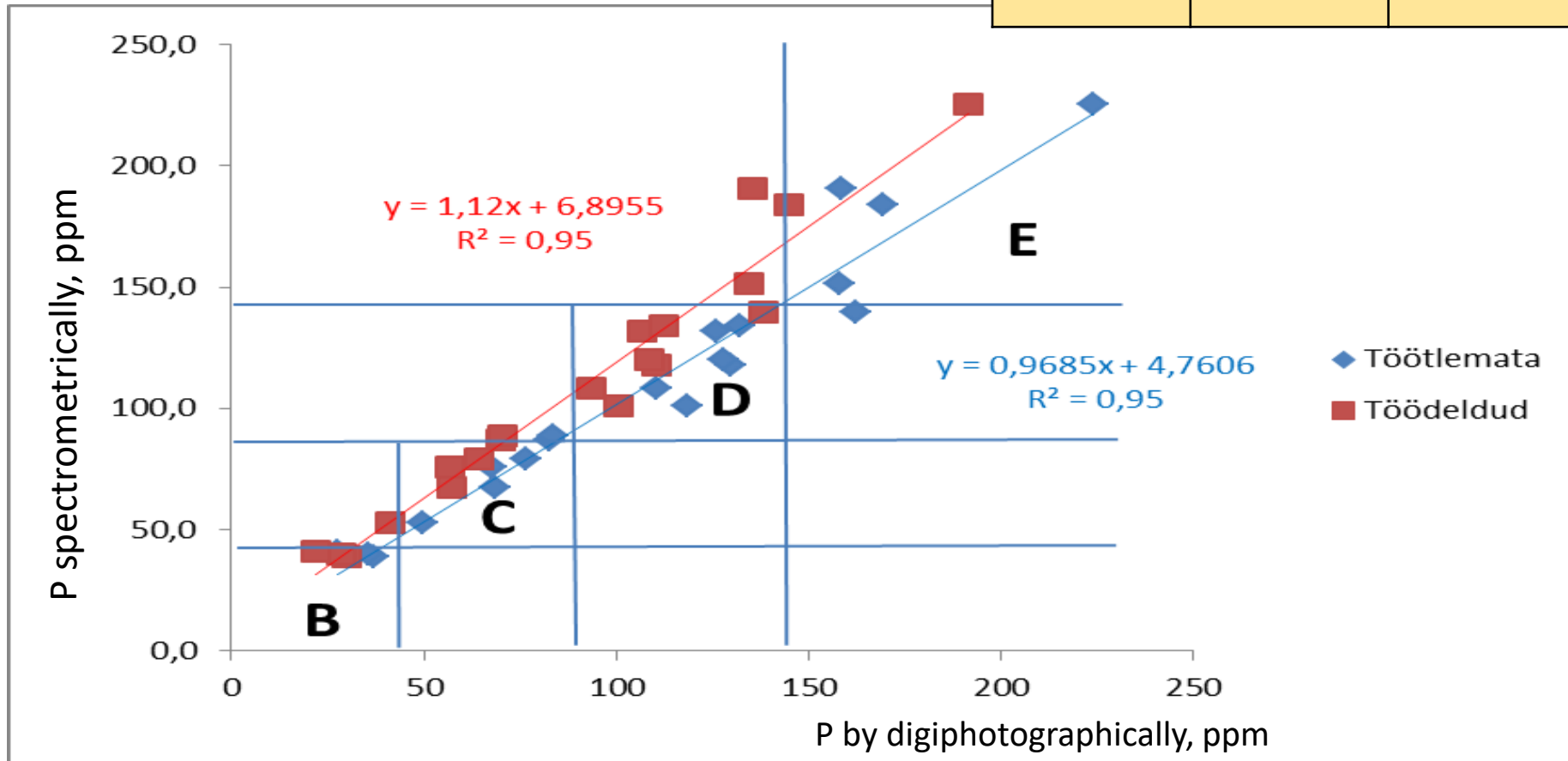


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In room

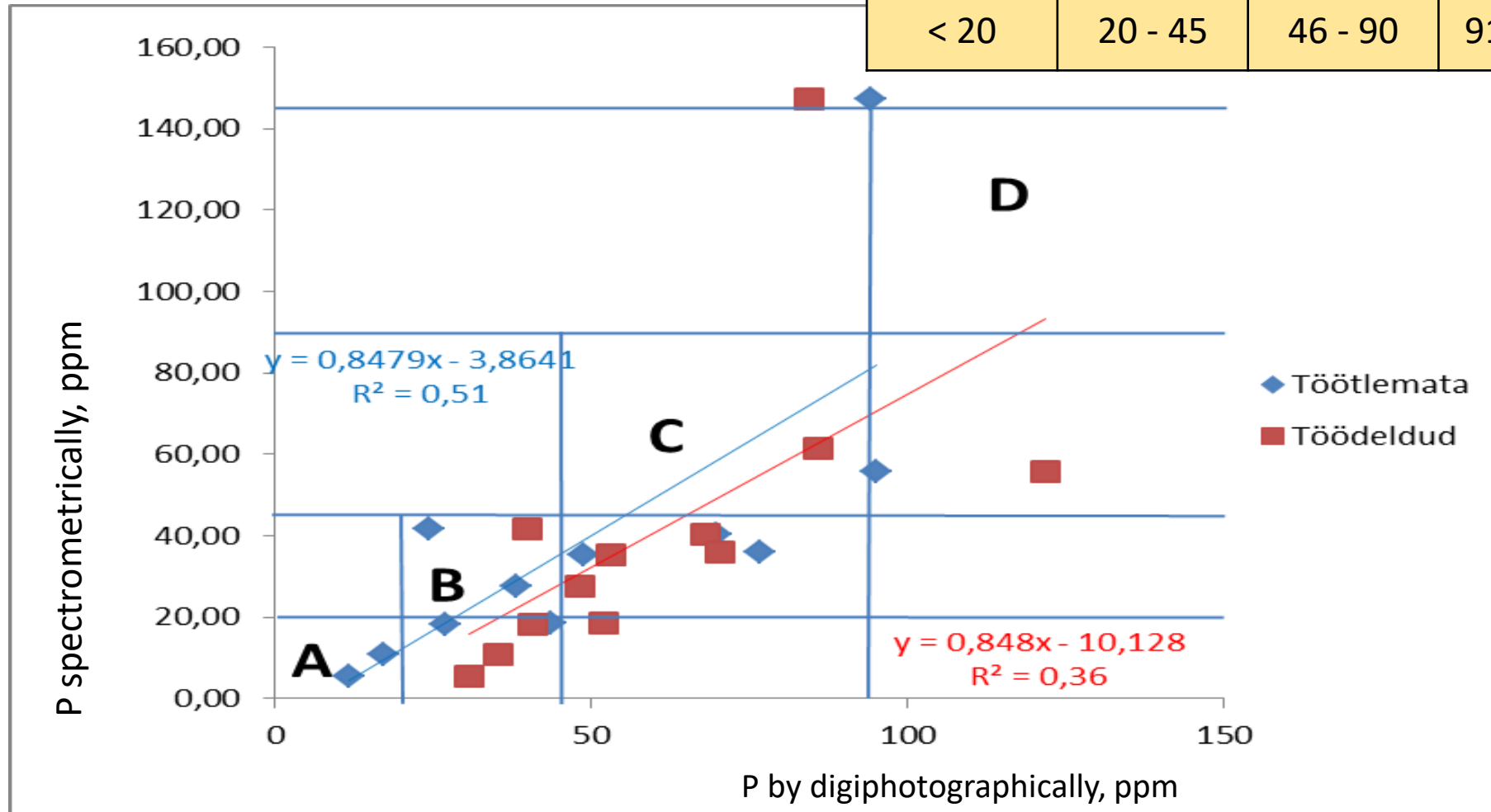
P content class, ppm				
Very low	Low	Medium	High	Very high
A	B	C	D	E
< 20	20 - 45	46 - 90	91 – 145	> 145



The correlation of P content determined by spectrometer and smartphone in room conditions using plastic tubes.

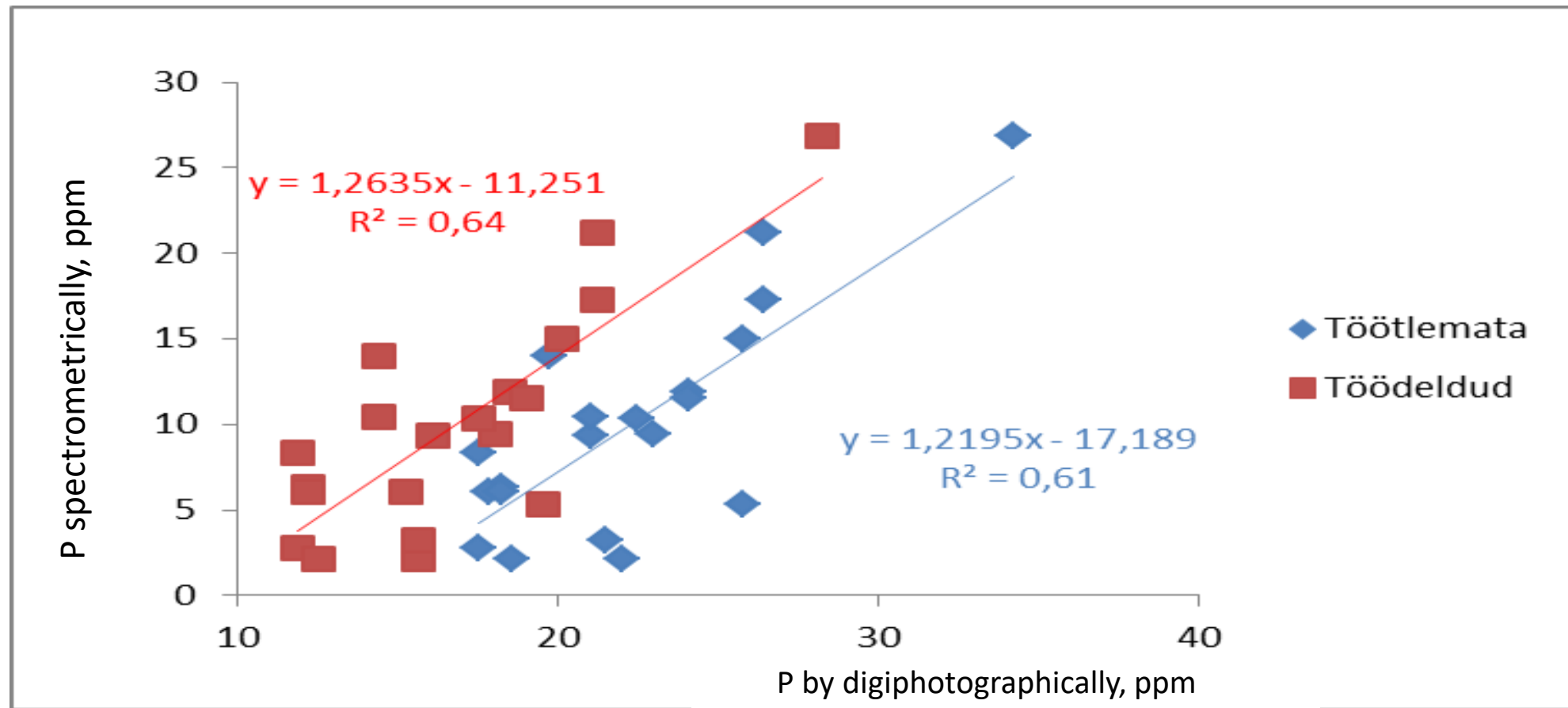
In shadow

P content class, ppm				
Very low	Low	Medium	High	Very high
A	B	C	D	E
< 20	20 - 45	46 - 90	91 – 145	> 145



The correlation of P content determined by spectrometer and smartphone in shadow conditions using plastic tubes.

Low P content samples



The correlation of low P content determined by spectrometer and smartphone in room conditions using plastic tubes.

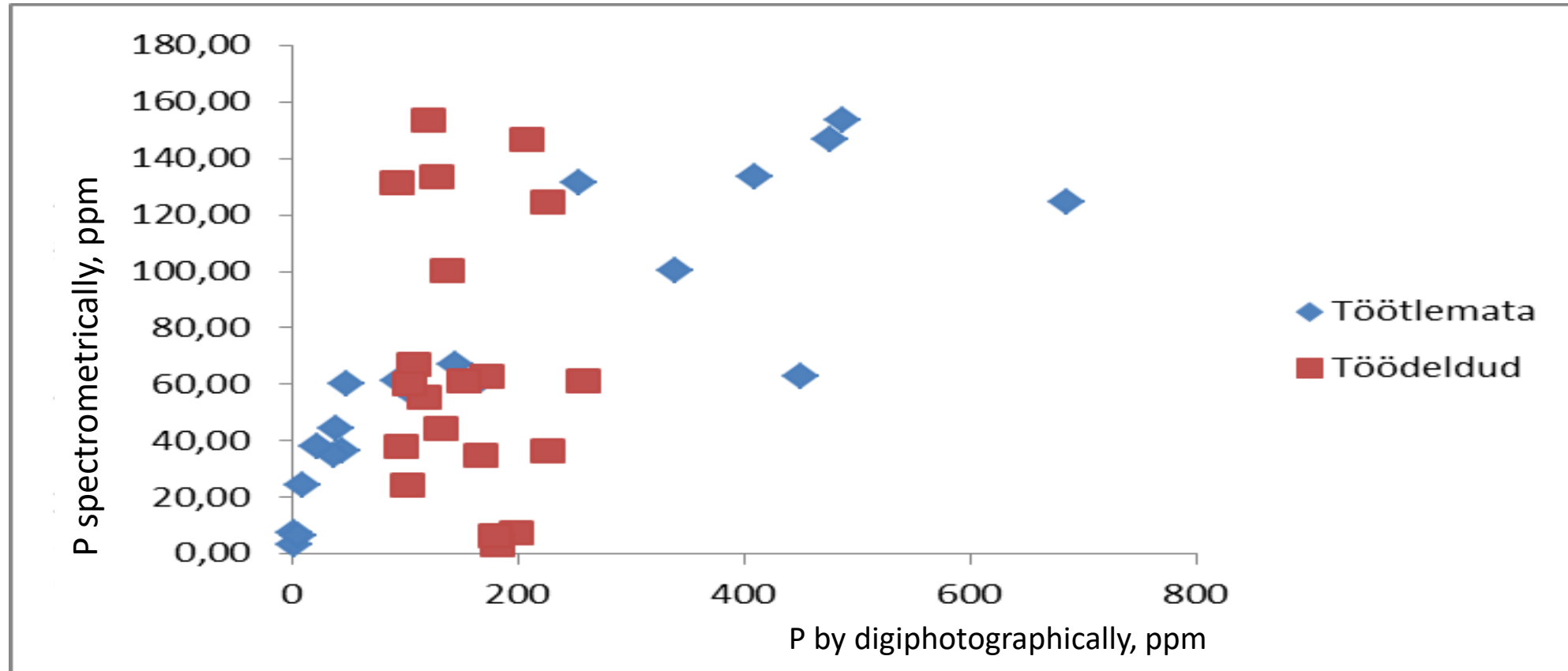


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The correlation of results of soil P content determined in direct sunlight and spectrometrically in plastic tubes



The correlation of P content determined by spectrometer and smartphone in direct sunlight conditions using plastic tubes.

Summary

- Environmental lighting impacts significantly the results. In direct sunlight it is not possible to achieve satisfactory results.
- In 10 – 150 ppm range, it is possible with satisfactory precision to estimate the plant available phosphorous content in room or shadow conditions.
- Using image data the inaccuracy increases when analyzing soil samples where the P content is lower than 10 ppm or over 150 ppm.



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