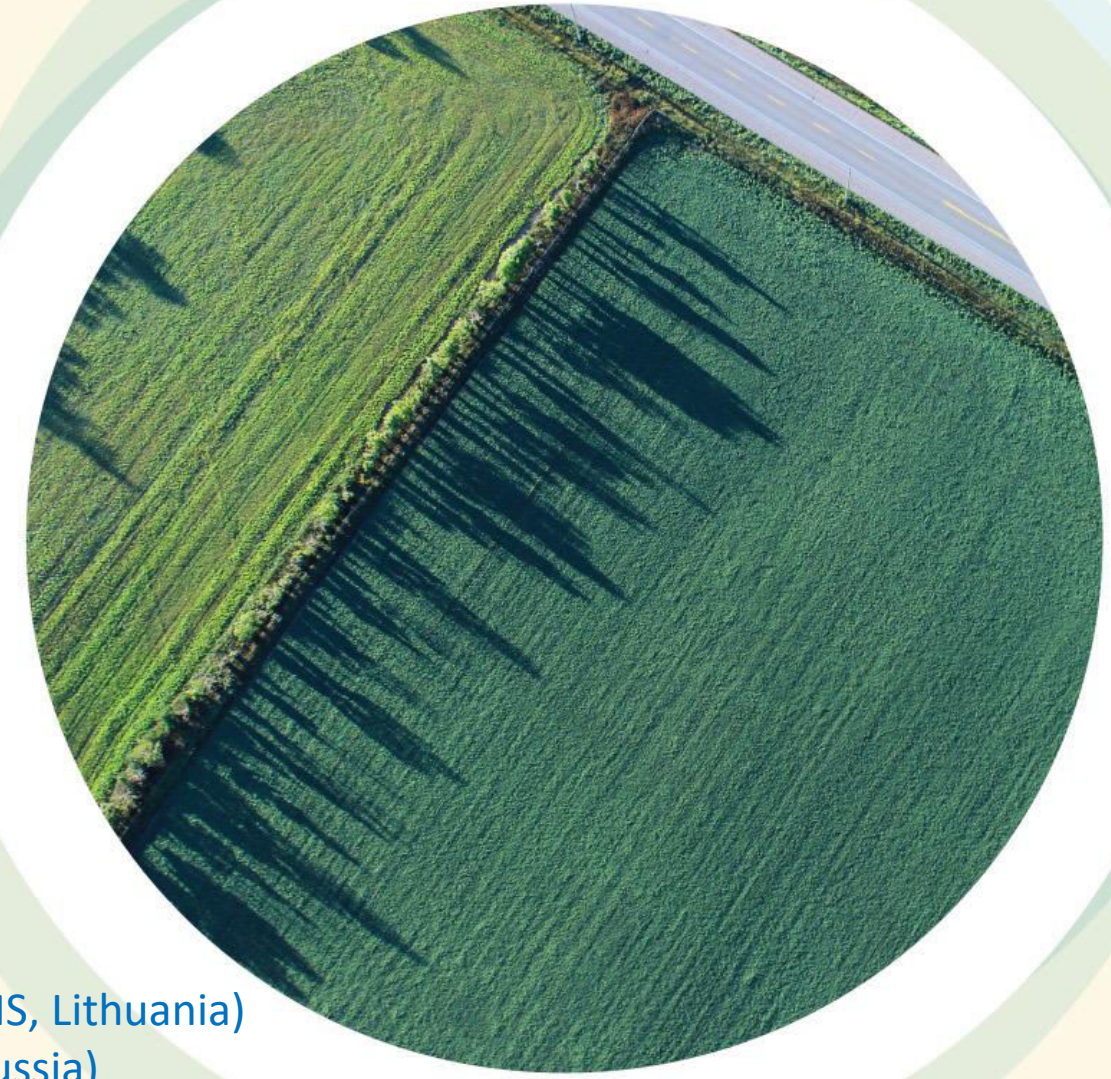
Sustainable crop production: decreasing phosphorus rates or splitting phosphorus application?



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ESPP webinar on* Impacts of reducing "legacy phosphorus" in agricultural soils, *2nd February 2022

Field experiments in Lithuania: Location & soil fertility

LOCATION: Voke Branch, Lithuanian Research Centre for Agriculture and Forestry (LAMMS), Vilnius.

Soddy-podzolic soil (Umbric Albeluvisols Abruptic according to WRB, 2014):

- loamy sand texture,
- low content of organic matter,
- close to neutral soil pH,
- good level of available P in the soil (due to the history of P fertilizer application).

Season	pH_{KCl}	OM, %	Available* P_2O_5	Available * K_2O
			ppm	
2020	6.2	1.86	225	165
2021	6.0	2.00	210	174

** Egner-Riem-Domingo method (AL-method)*

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Experimental design

No	Treatment	Fertilizer	Physical weight, kg/ha	Method & time of application
1	$N_{135}P_{57}S_{60}$	**Apaviva® NP 12-52**	110	Broadcasted before preplant cultivation
		Ammonium Sulphate	250	Topdressed at BBCH 20
		Ammonium Nitrate	200	
2	$N_{135}P_{46}S_{60}$	**Apaliqua® NP 11-37 (APP)**	125	Sprayed before preplant cultivation
		Ammonium Sulphate	250	Topdressed at BBCH 20
		Ammonium Nitrate	200	
3	$N_{135}P_{46+10}S_{60}$	**Apaliqua® NP 11-37 (APP)**	125	Sprayed before preplant cultivation
			28	Foliar applied at BBCH 20
		Ammonium Sulphate	250	Topdressed at BBCH 20
		Ammonium Nitrate	190	

Note: *winter rye was a preceding crop for winter rapeseed (var. Hasting)*

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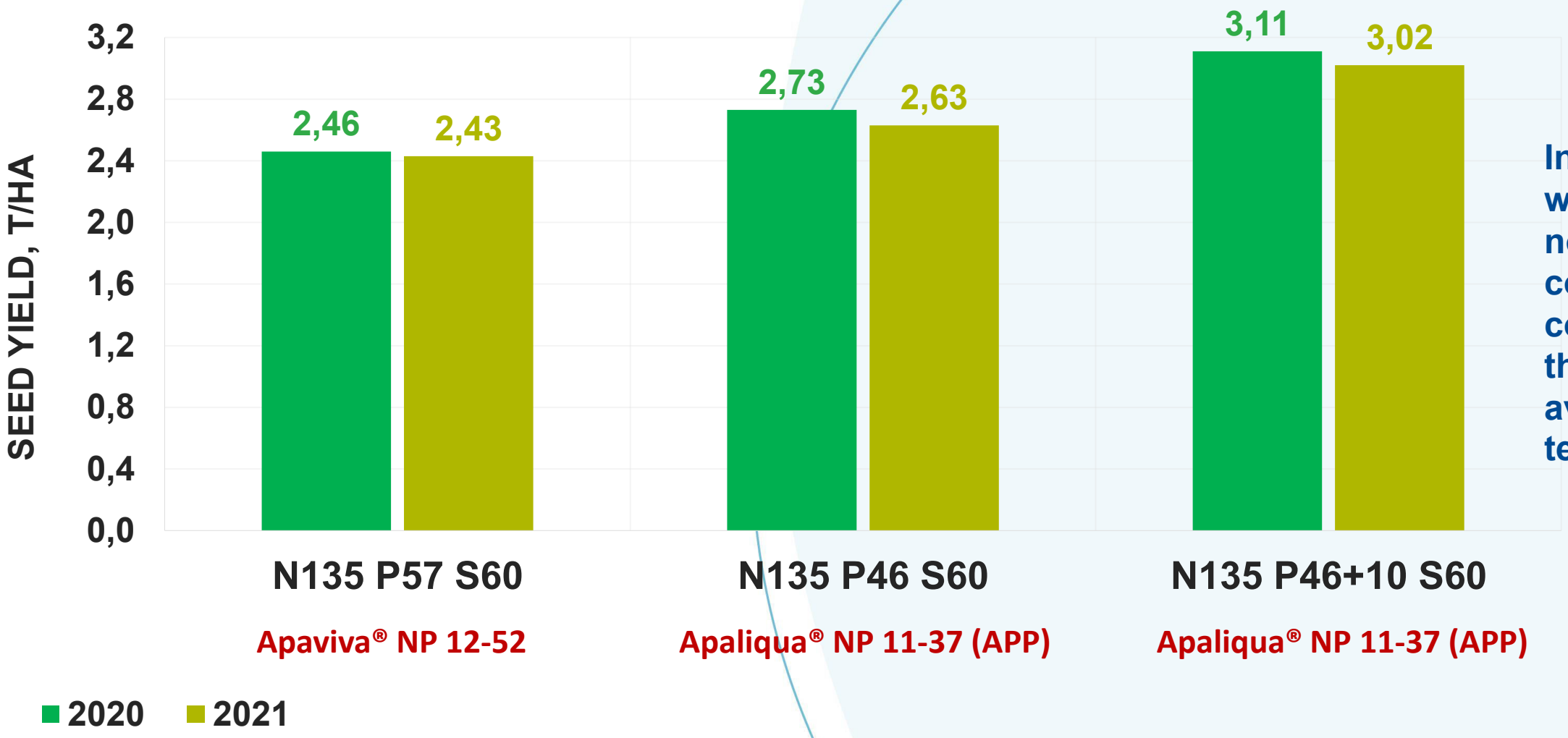
Seed yield of winter rapeseed



In 2020, May was noticeably cooler compared to the long-term average temperature.

***Note**: $LSD_{0.05}$ = 0.11 (both seasons)*

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Economics of nutrient management

No	Treatment	Seed yield, t/ha	Yield value	Fertilizer cost including application	Additional income
			EUR/ha		
2020					
1	$N_{135}P_{57}S_{60}$	2.46	1107.00	122.25	-
2	$N_{135}P_{46}S_{60}$	2.73	1228.50	116.85	127.90
3	$N_{135}P_{46+10}S_{60}$	3.11	1399.50	122.05	292.70
2021					
1	$N_{135}P_{57}S_{60}$	2.43	1664.55	191.85	-
2	$N_{135}P_{46}S_{60}$	2.63	1801.55	168.55	160.30
3	$N_{135}P_{46+10}S_{60}$	3.02	2068.70	180.15	415.85

Note: Seed price (EUR/t): 450 in 2020 and 685 in 2021.

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Conclusions

Decreasing P rate by 18% when using liquid Ammonium Polyphosphate fertilizer resulted to yield increase by 8-10% compared to a higher P rate coming from a dry fertilizer.

Maintaining P rate when using liquid Ammonium Polyphosphate fertilizer and splitting P between broadcasting before planting and foliar application in the 3rd decade of May (P_{46+10}) resulted to yield increase by 24-26% compared to dry P fertilizer.

Liquid Ammonium Polyphosphate fertilizer probably helped to decrease P fixation by the soil having a close to neutral pH thus increasing soil P availability to rapeseed plants.

Soil P uptake by plant roots decreases under low temperatures in spring that may be a case for Northern Europe, especially on podzolic soils. Split P application (soil + foliar) seems to be a reasonable approach for sustainable crop production.

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Thank you!


1
Autumn $N_{13}P_{57}$ (MAP 110 kg/ha)
Spring N_{52+68} (AS 250 kg/ha + AN 200 kg/ha)
2
Autumn $N_{13}P_{46}$ (NP 11-37 125 kg/ha)
Spring N_{52+68} (AS 250 kg/ha + AN 200 kg/ha)
3
Autumn $N_{14}P_{46}$ (NP 11-37 125 kg/ha)
Spring $N_{3+52+65}$ (NP 11-37 28 kg/ha, AS 250 kg/ha + AN 190 kg/ha)


1
2
3