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Optimization of phosphorus availability in soil: impact of Phosphate-Solubilizing Microorganisms on rapeseed growth and nutrient use efficiency

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Context and Hypotheses :

Available Phosphorus (P) is a scarce element in soils for plants and micro-organisms growth due to its quick complexation in soils to organomineral particles such as clay, Iron or Aluminium^[1]. P-Solubilizing Microorganisms (PSM) are able to solubilize complexed P. To face nutrient limitations, plants and micro-organisms interact through rhizodeposition for instance to enhance availability of limiting elements^[2]. Rapeseed (*Brassica napus* L.) is a major oleoproteaginous crop which requires high Nitrogen (N) ^[3] and P inputs and presents a low N and P use efficiencies. Furthermore, little is known concerning rapeseed interactions with soil micro-organisms in relation with P and N availabilities in soils.

Our hypotheses are : i) Optimisation of P nutrition in rapeseed can enhance P and N use efficiency, ii) Rapeseed can recruit PSM through rhizodeposition iii) Changes in P availability in soils can modify N cycle dynamics.

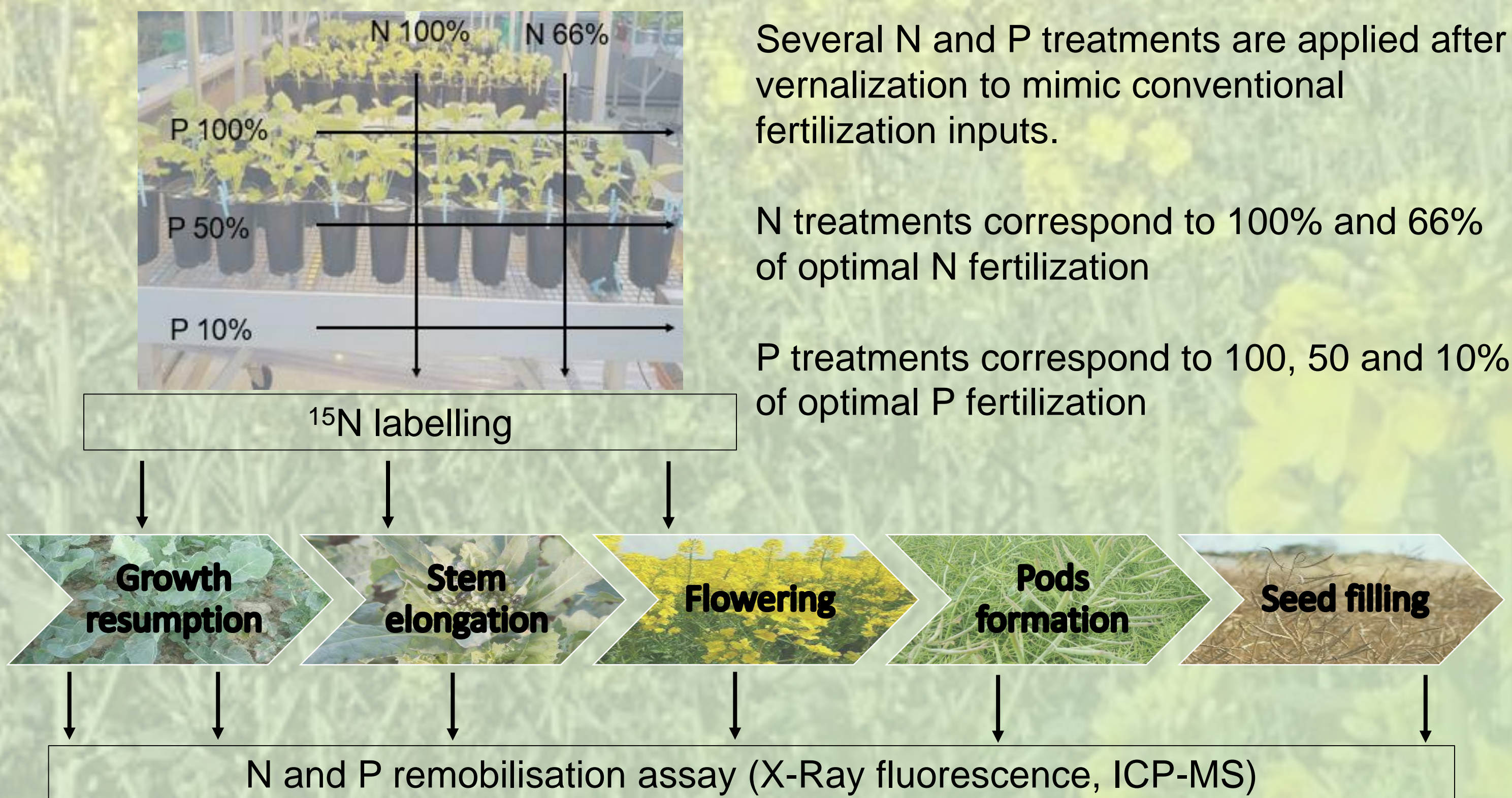
Nutrients required for a yield of 35 q/ha^[4] :

	Exported	Restituted	Total
K ₂ O	35	315	350
N	110	134	244
CaO	17	157	174
MgO	14	73	87
SO ₃	72	143	215
P ₂ O ₅	47	41	88

Unit : kg / ha

Objectives, experimental design and preliminary results

Objective 1: Interactions of N x P nutrition in rapeseed



Preliminary results :

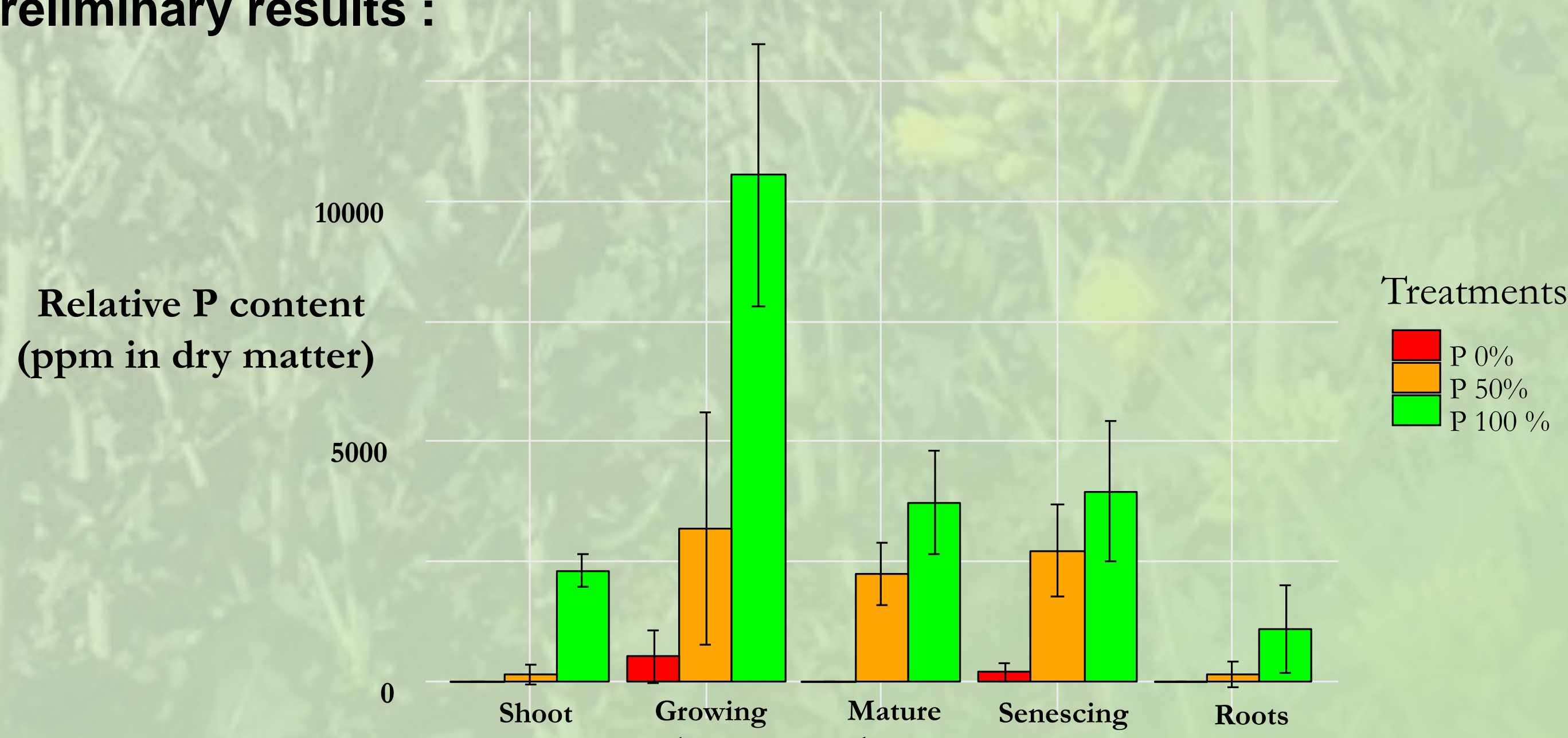
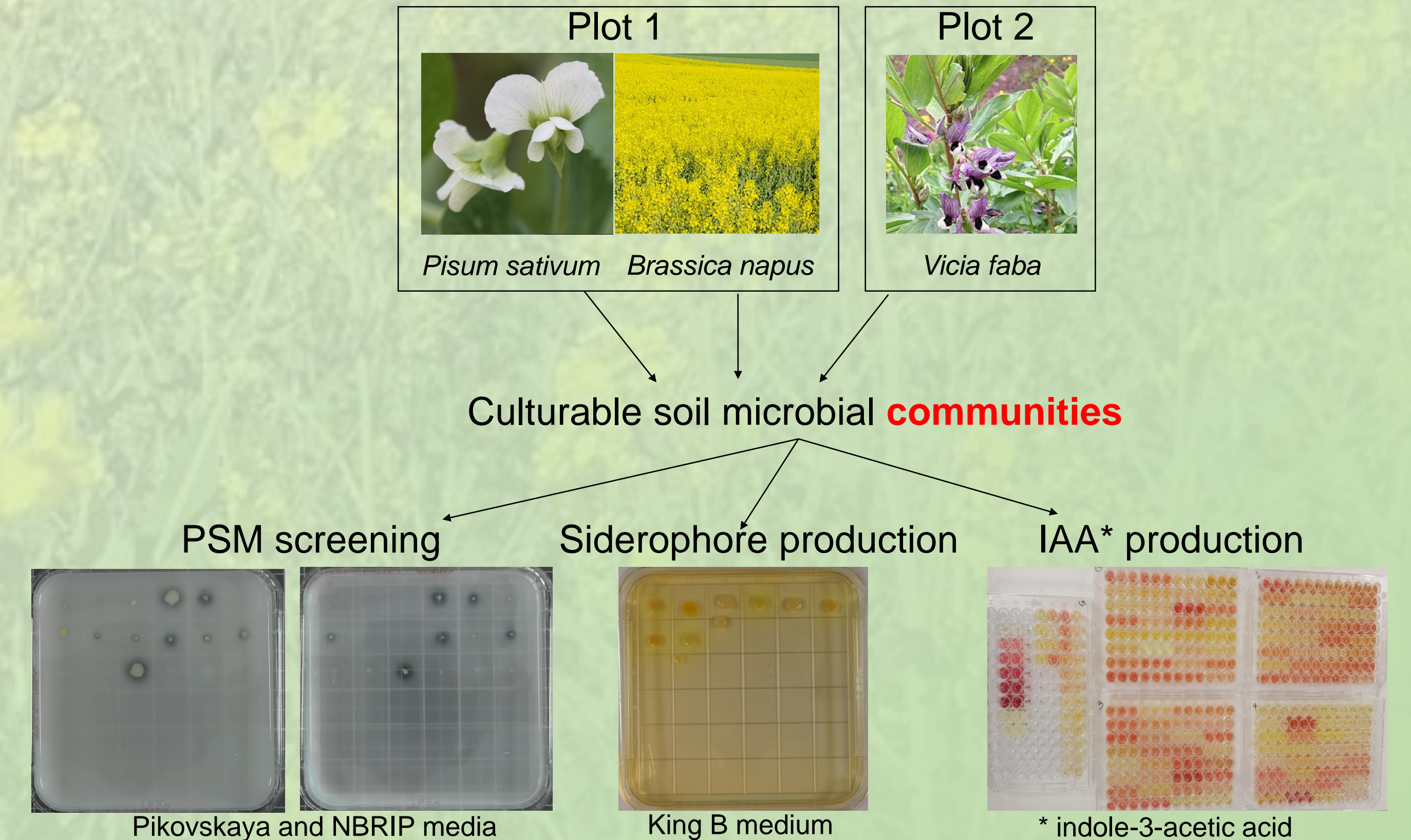


Figure 1 : P content in organs of rapeseed at vegetative stage in response to various P treatments. Plants were grown on Hoagland (3,75mM NO₃) solution. P was measured by X-Ray Fluorescence (XRF)

Objective 2: Crop effect on potential beneficial soil microorganisms



Preliminary results :

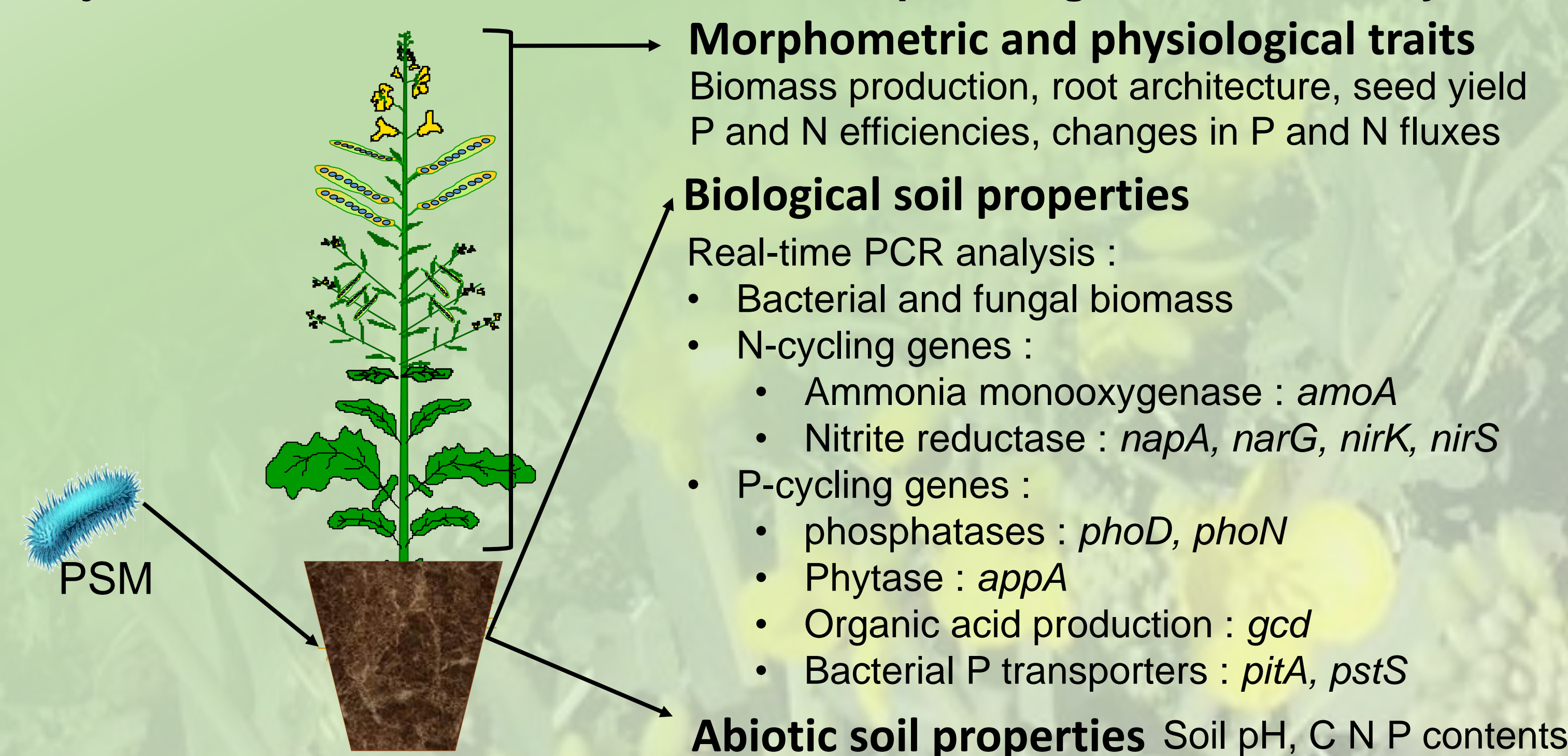
- 299 strains were isolated from soils under winter pea (*Pisum sativum*), rapeseed (*Brassica napus*) and faba bean (*Vicia faba*)
- 166 strains have shown a positive solubilization index
- Positive strains have been tested on (for?) auxin (IAA) production

Table 1 : Isolated strains presenting positive solubilization index and potential other growth promoting properties as IAA or siderophore production.

PVK = Pikovskaya medium, NBRIP = NBRIP medium. Solubilization index = solubilization halo size / colony size

Crop	Strain	PVK solubilization index	NBRIP solubilization index	IAA production (ng/μL)	siderophore production
<i>Pisum sativum</i>	P21	1,176	1,297	208,400	+
	Pc12	1,000	1,698	97,200	+
<i>Vicia faba</i>	F46	3,674	1,600	76,300	+
	Fc30	1,368	1,314	99,700	-
	Fc48	1,210	1,000	147,600	-
<i>Brassica napus</i>	C17	1,000	1,401	297,126	NA
	C32	1,824	2,540	211,600	NA
	Cc15	1,468	1,885	122,900	NA
	Cc21	1,358	2,711	113,700	NA

Objective 3: Effect of PSM inoculum on rapeseed growth and N/P cycles



Perspectives :

- Quantitative P solubilization and organic acids production assays will be carried out in order to better discriminate PSM under each crop
- Other analyses will be done to test other growth promotion properties of the isolated strains : HCN production, ACC deaminase activity, germination test
- Interesting microorganisms will be then identified by DNA sequencing