Essais à la ferme assistés par l'agriculture de précision

4 février 2026

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MAPAQ, Direction régionale de la Mauricie

Votre gouvernement

Québec

Plan de présentation

- Notions géomatiques sur les équipements agricoles
- Courbe de réponse 101
- Essai réalisé avec la plateforme DIFM

exemple_polygone.cpg

exemple_polygone.dbf

exemple_polygone.prj

exemple_polygone.qix

exemple_polygone.shp

exemple_polygone.shx

Notions géomatiques

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Fichier de polygones

Table d'attribut

	id	Nom	Culture	Superficie
1	1	Champ_Jean-Guy	Blé	59,534215
2	2	Champ_Jean_Paul	Soya	32,462750

Fichier de lignes

Table d'attribut

	id	Nom	Longueur
1	1	Haie_brise_vent_feuillus	1193,533785
2	2	Haie_arbustes	497,403928
3	3	Haie arbustes #2	302,445322

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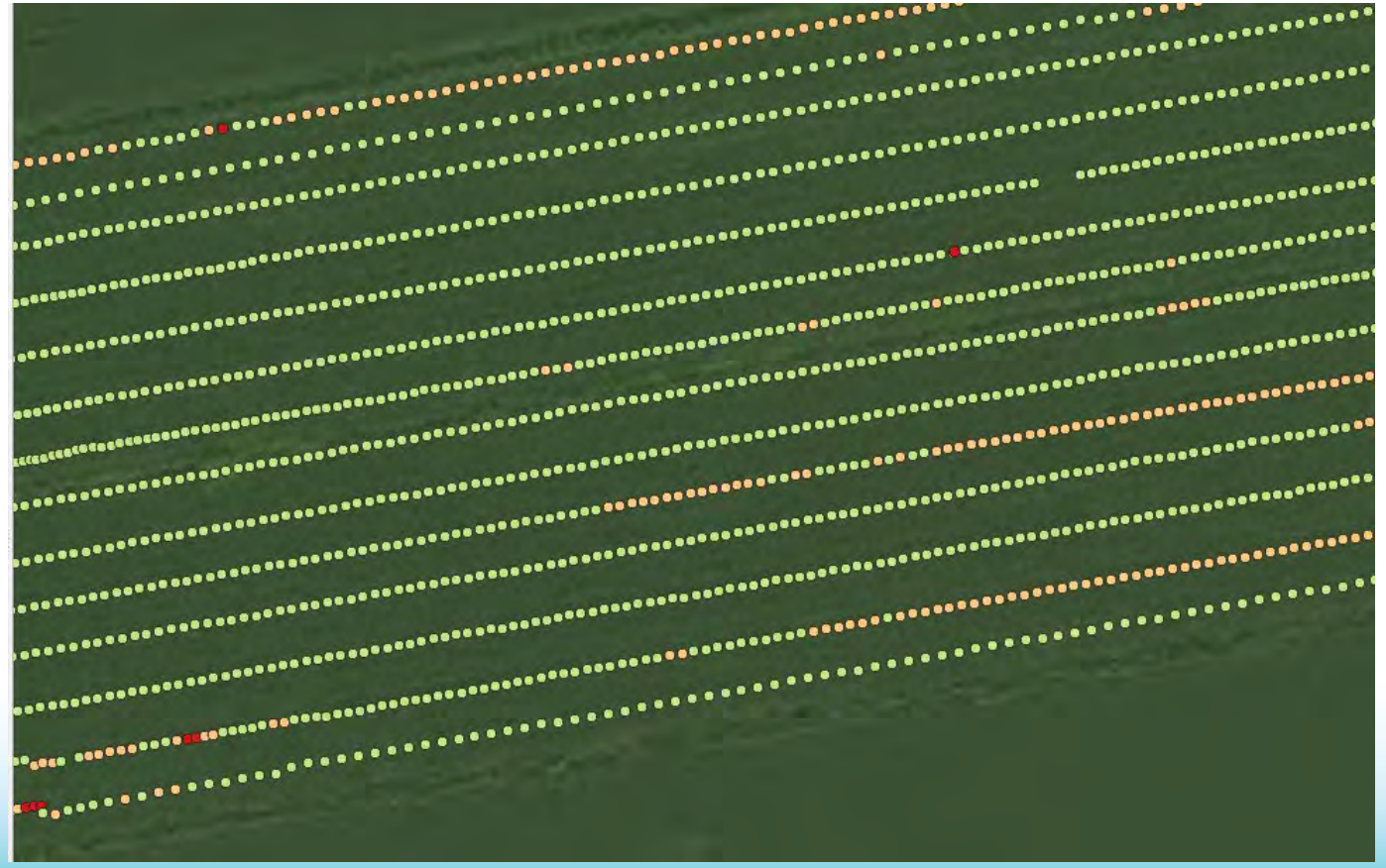
Capteur de rendements : 1 point par seconde

	DISTANCE	SWATHWIDTH	VRYIELDMAS	SECTIONID	Crop	WetMass	Moisture	Time	Heading	VARIETY	Elevation	IsoTime	lachin	FUEL	VEHICLSPEED	DRYMATTER
8	0,693	9,14400000	3,01682618	2050	173	3,01682618	10,400000...	11/16/2023 3:15:44 PM	78,792354...	P8294AM	36,306234...	2023-11-16T15:...	1	0,02019677	2,12188250	89,60000000
9	0,783	9,14400000	2,35178537	2050	173	2,35178537	10,400000...	11/16/2023 3:15:45 PM	78,574602...	P8294AM	36,365234...	2023-11-16T15:...	1	0,02000139	2,56468250	89,60000000
10	0,829	9,14400000	2,15823067	2050	173	2,15823067	10,400000...	11/16/2023 3:15:46 PM	77,756725...	P8294AM	36,454234...	2023-11-16T15:...	1	0,0198625	2,57332250	89,60000000
11	0,703	9,14400000	2,48229995	2050	173	2,48229995	10,400000...	11/16/2023 3:15:47 PM	78,379461...	P8294AM	36,419234...	2023-11-16T15:...	1	0,01924234	2,74900250	89,60000000
12	0,584	9,14400000	3,73334112	2050	173	3,73334112	10,400000...	11/16/2023 3:15:48 PM	77,764041...	P8294AM	36,388234...	2023-11-16T15:...	1	0,0198859	2,44948250	89,60000000
13	0,66751275	9,14400000	4,42705868	2050	173	4,42705868	10,400000...	11/16/2023 3:15:49 PM	78,231927...	P8294AM	36,351578...	2023-11-16T15:...	1	0,02099896	2,37477250	89,60000000
14	0,63878187	9,14400000	6,09780334	2050	173	6,09780334	10,400000...	11/16/2023 3:15:50 PM	78,481381...	P8294AM	36,343578...	2023-11-16T15:...	1	0,01976481	2,64106750	89,60000000
15	0,77878187	9,14400000	6,16535337	2050	173	6,16535337	10,400000...	11/16/2023 3:15:51 PM	78,940520...	P8294AM	36,305578...	2023-11-16T15:...	1	0,02101667	2,67130750	89,60000000



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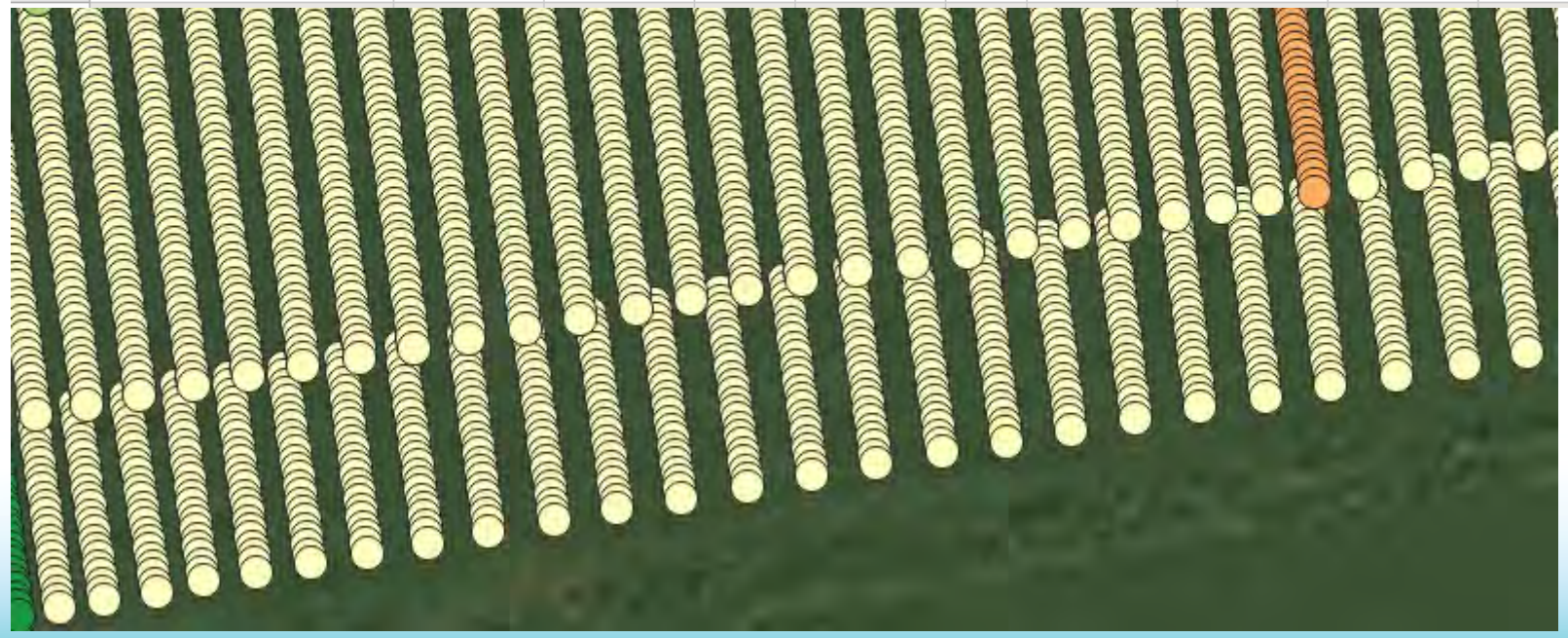
Applicateur de 32-0-0

	Time	Heading	DISTANCE	ATHWID	Product	CTION	AppliedRate	ControlRate	TargetRate	Elevation	IsoTime	Machine	FUEL	VEHICLSPEED	difference
52	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1566	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
53	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1567	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
54	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1568	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
55	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1569	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
56	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1570	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
57	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1571	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
58	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1572	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
59	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1573	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
60	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1574	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
61	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1575	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
62	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1576	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580
63	6/23/2023 10:50:11 PM	77,857672...	1,88000000	0,508	32-0-0	1577	348,58000...	235,00000...	235,00000...	35,502844...	2023-06-23T22...	1	0,00022568	6,80184000	113,580



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Fichier de prescription lu par un applicateur (semoir, épandeur, pulvérisateur)
Type: polygones

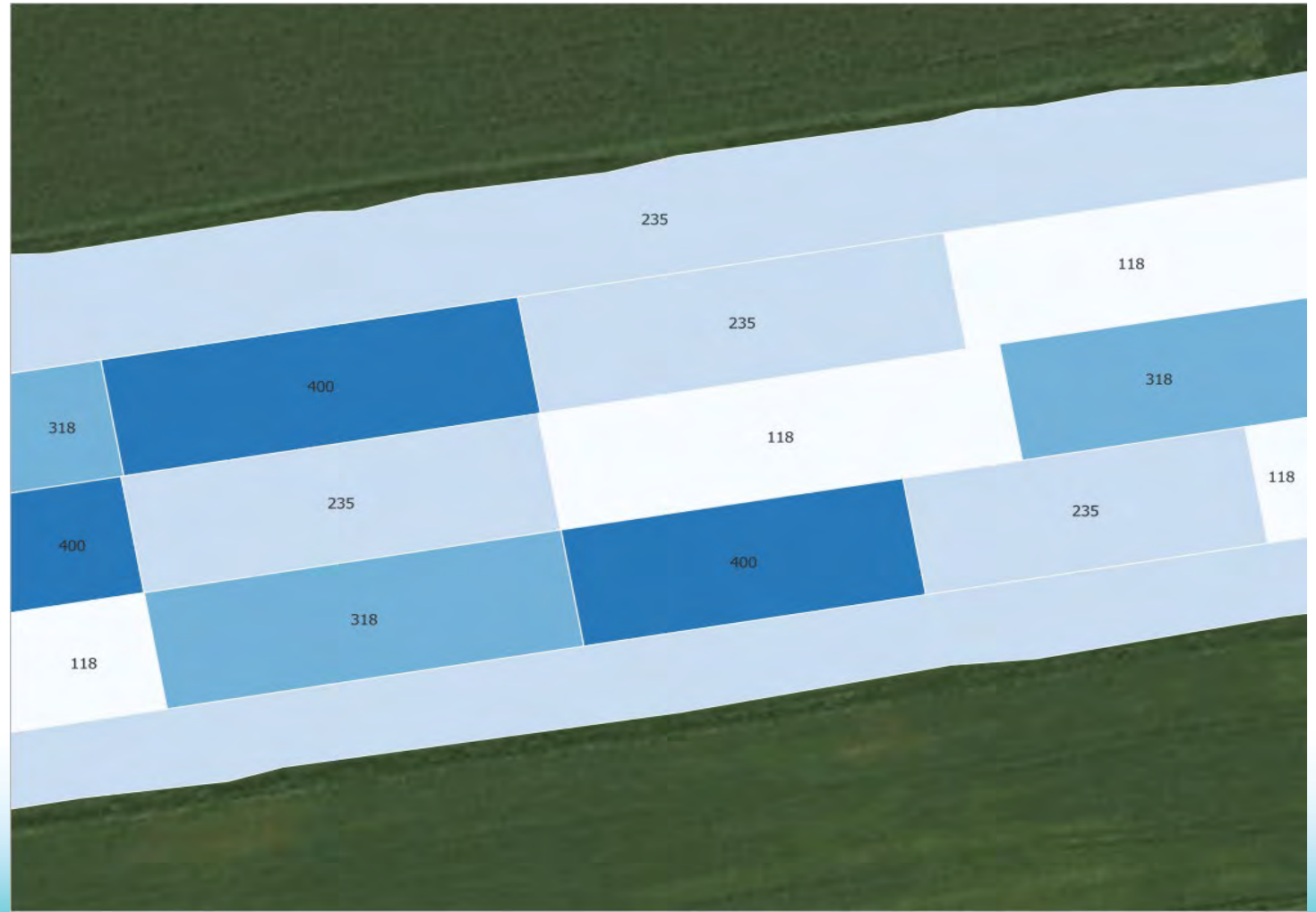
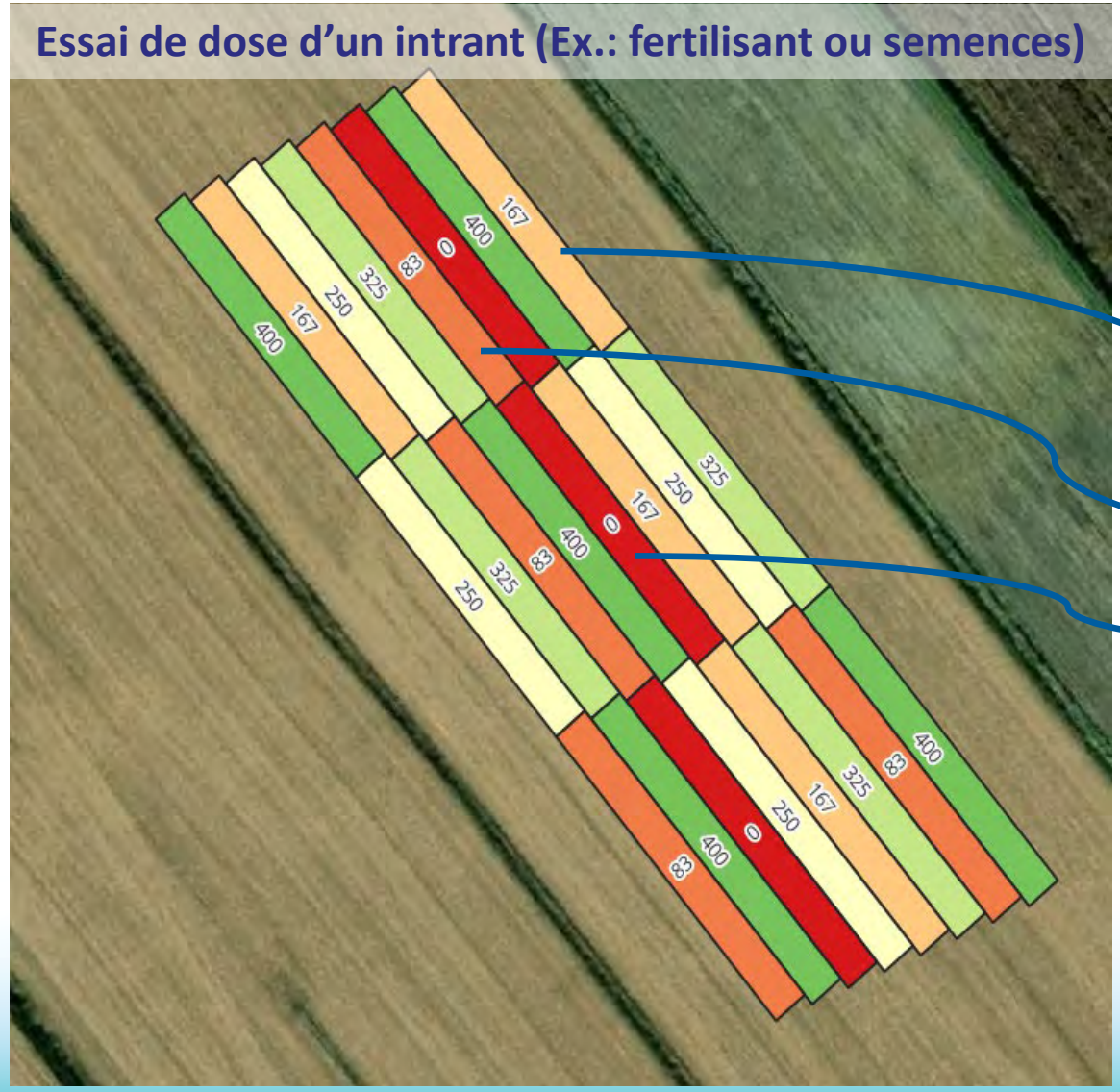


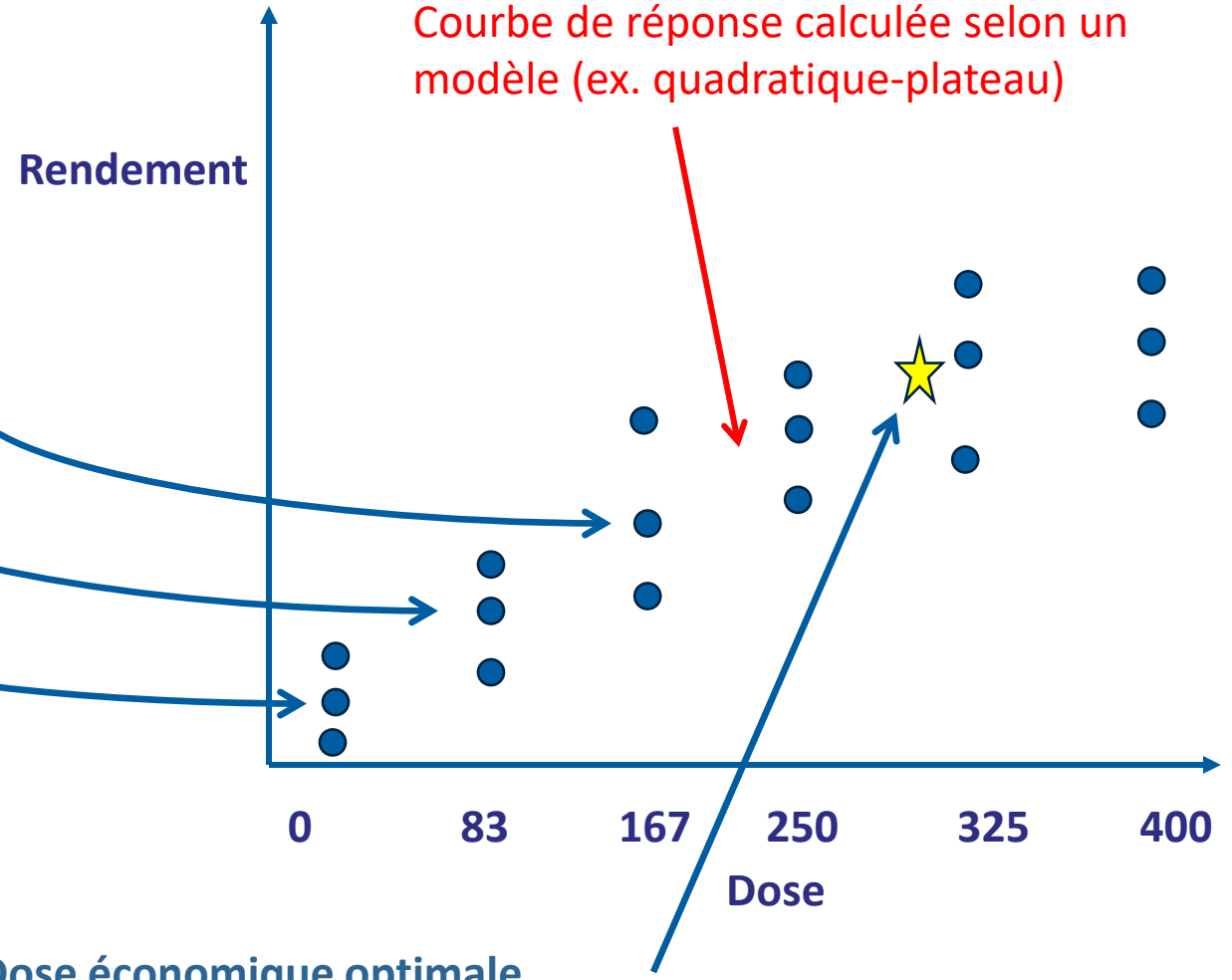
Table d'attribut : 1 colonne utile par intrant

	tgtn
1	235,00000...
2	118,00000...
3	318,00000...
4	400,00000...
5	235,00000...
6	118,00000...
7	318,00000...
8	400,00000...
9	235,00000...
10	118,00000...

Québec

Courbe de réponse 101

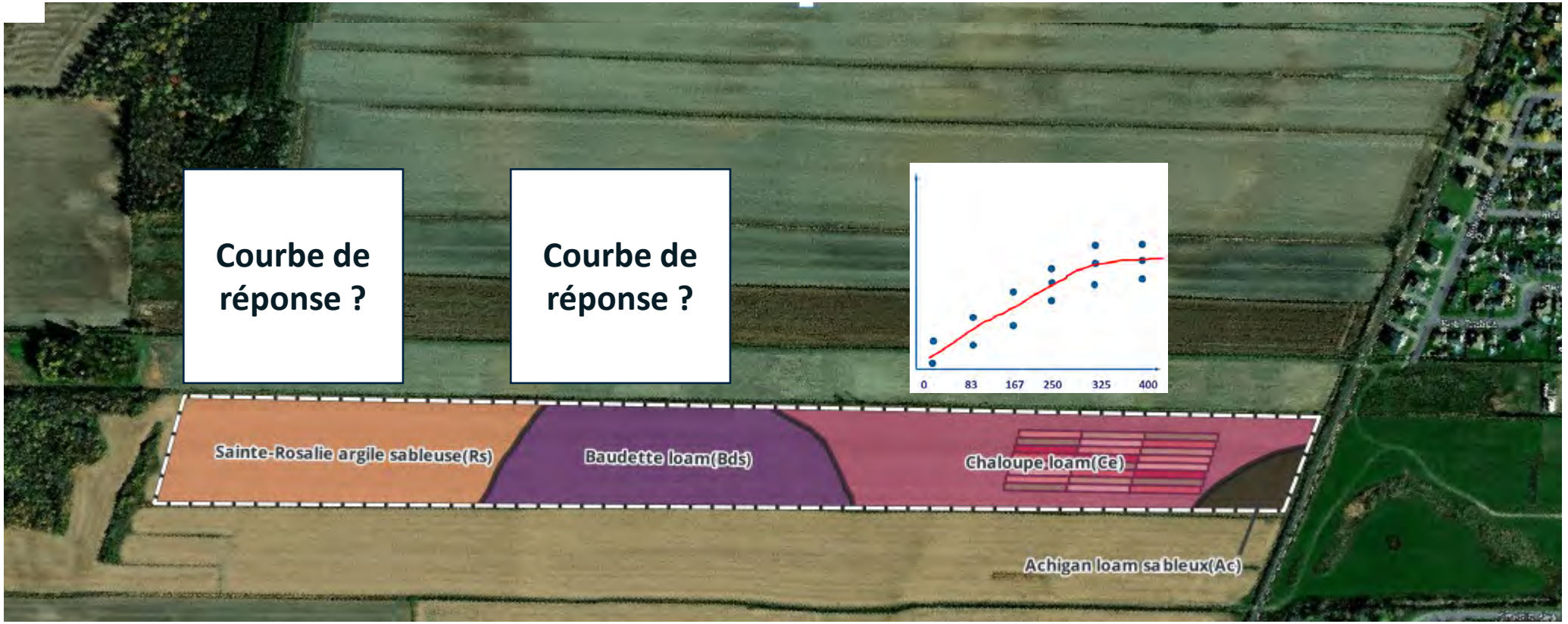




Dose économique optimale

La dose à laquelle le dernier apport d'intrant a la même valeur que l'augmentation de rendement qu'il procure.

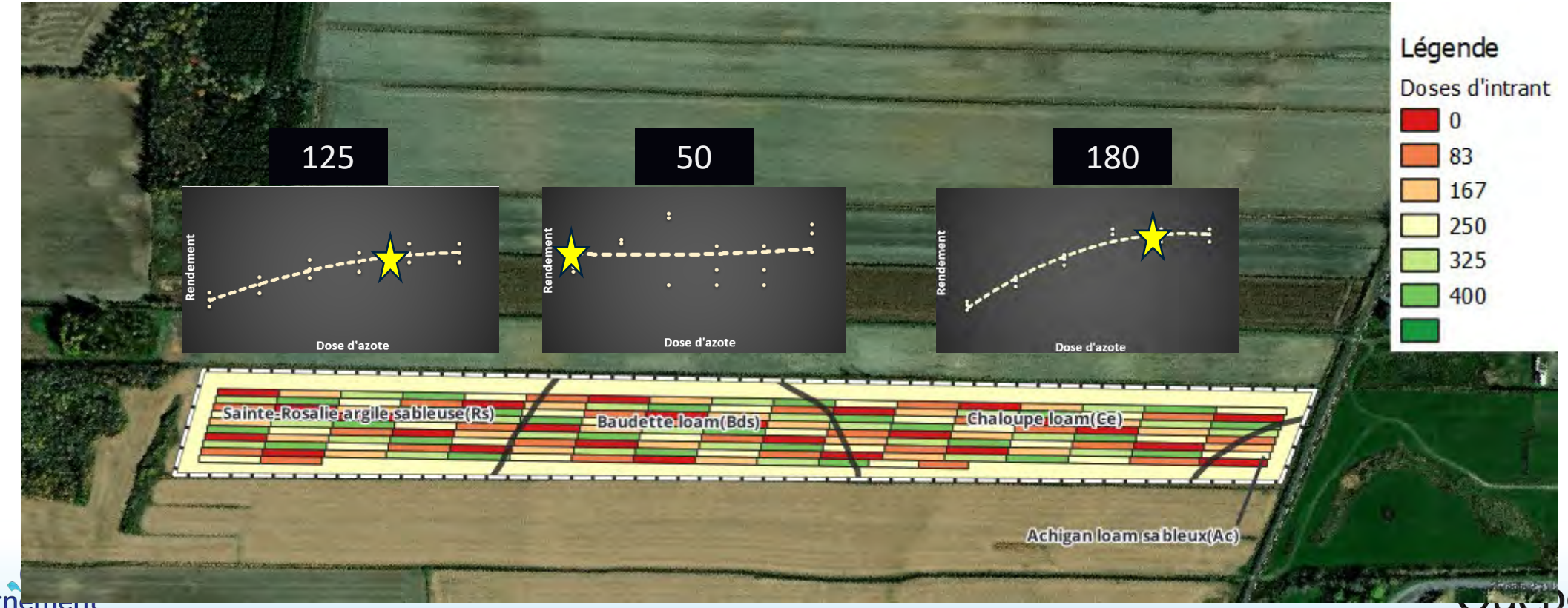
Petit essai = espace d'inférence limité



Solution :

Essai assisté par l'agriculture de précision

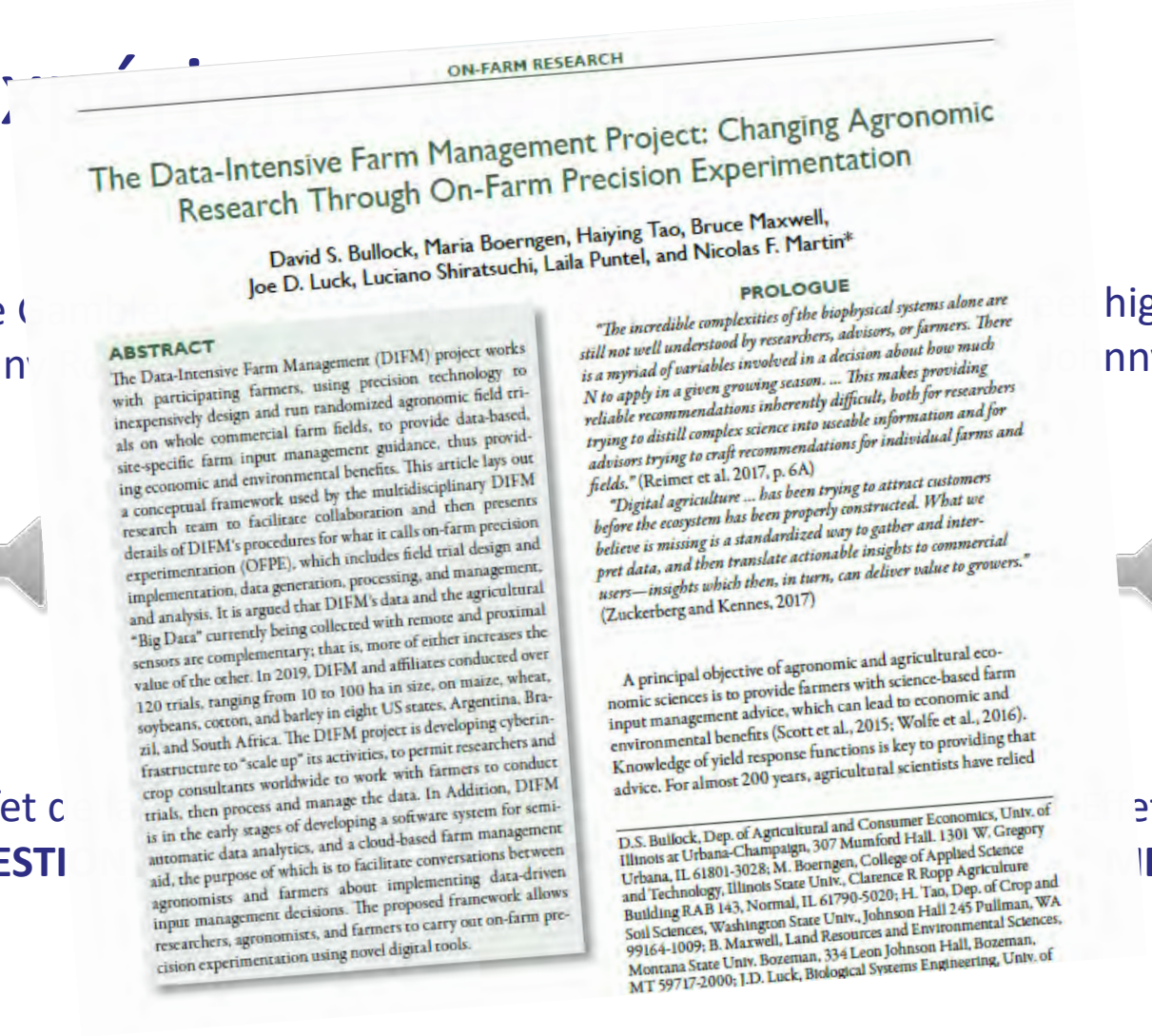
- Intrants appliqués selon carte de prescription
- Récolte avec capteur de rendement géoréférencé
- Plus rapide et permet de générer courbes distinctes



Une petite e

The (high and rising
Kenn nny Cash

Rendement = Effet d et de la
GESTI **ÉTÉO**



ON-FARM RESEARCH

The Data-Intensive Farm Management Project: Changing Agronomic Research Through On-Farm Precision Experimentation

David S. Bullock, Maria Boerngen, Haiying Tao, Bruce Maxwell,
Joe D. Luck, Luciano Shiratsuchi, Laila Puntel, and Nicolas F. Martin*

ABSTRACT

The Data-Intensive Farm Management (DIFM) project works with participating farmers, using precision technology to inexpensively design and run randomized agronomic field trials on whole commercial farm fields, to provide data-based, site-specific farm input management guidance, thus providing economic and environmental benefits. This article lays out a conceptual framework used by the multidisciplinary DIFM research team to facilitate collaboration and then presents details of DIFM's procedures for what it calls on-farm precision experimentation (OFPE), which includes field trial design and implementation, data generation, processing, and management, and analysis. It is argued that DIFM's data and the agricultural "Big Data" currently being collected with remote and proximal sensors are complementary; that is, more of either increases the value of the other. In 2019, DIFM and affiliates conducted over 120 trials, ranging from 10 to 100 ha in size, on maize, wheat, soybeans, cotton, and barley in eight US states, Argentina, Brazil, and South Africa. The DIFM project is developing cyberinfrastructure to "scale up" its activities, to permit researchers and crop consultants worldwide to work with farmers to conduct trials, then process and manage the data. In Addition, DIFM is in the early stages of developing a software system for semi-automatic data analytics, and a cloud-based farm management aid, the purpose of which is to facilitate conversations between agronomists and farmers about implementing data-driven input management decisions. The proposed framework allows researchers, agronomists, and farmers to carry out on-farm precision experimentation using novel digital tools.

PROLOGUE

"The incredible complexities of the biophysical systems alone are still not well understood by researchers, advisors, or farmers. There is a myriad of variables involved in a decision about how much N to apply in a given growing season. ... This makes providing reliable recommendations inherently difficult, both for researchers trying to distill complex science into useable information and for advisors trying to craft recommendations for individual farms and fields." (Reimer et al. 2017, p. 6A)

"Digital agriculture ... has been trying to attract customers before the ecosystem has been properly constructed. What we believe is missing is a standardized way to gather and interpret data, and then translate actionable insights to commercial users—insights which then, in turn, can deliver value to growers." (Zuckerberg and Kennes, 2017)

A principal objective of agronomic and agricultural economic sciences is to provide farmers with science-based farm input management advice, which can lead to economic and environmental benefits (Scott et al., 2015; Wolfe et al., 2016). Knowledge of yield response functions is key to providing that advice. For almost 200 years, agricultural scientists have relied

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$$y = f(x, c, z)$$

Votre gouvernement

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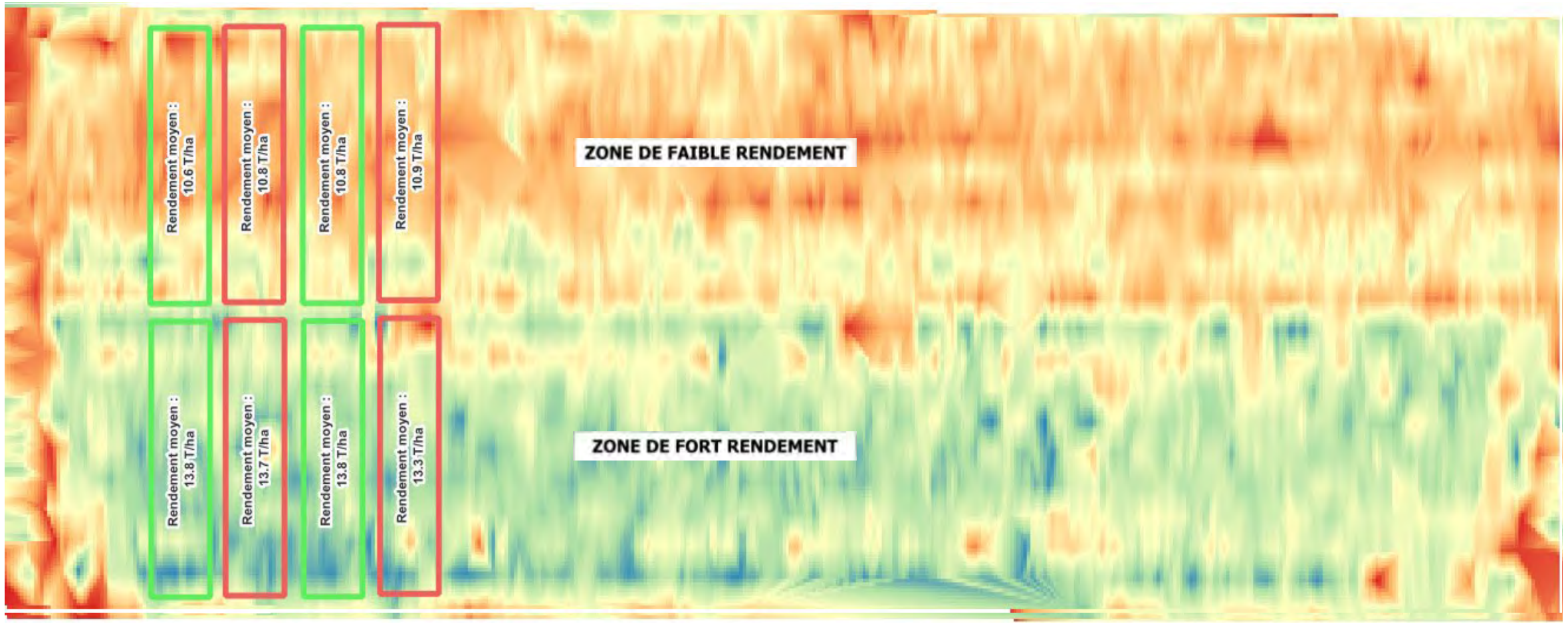
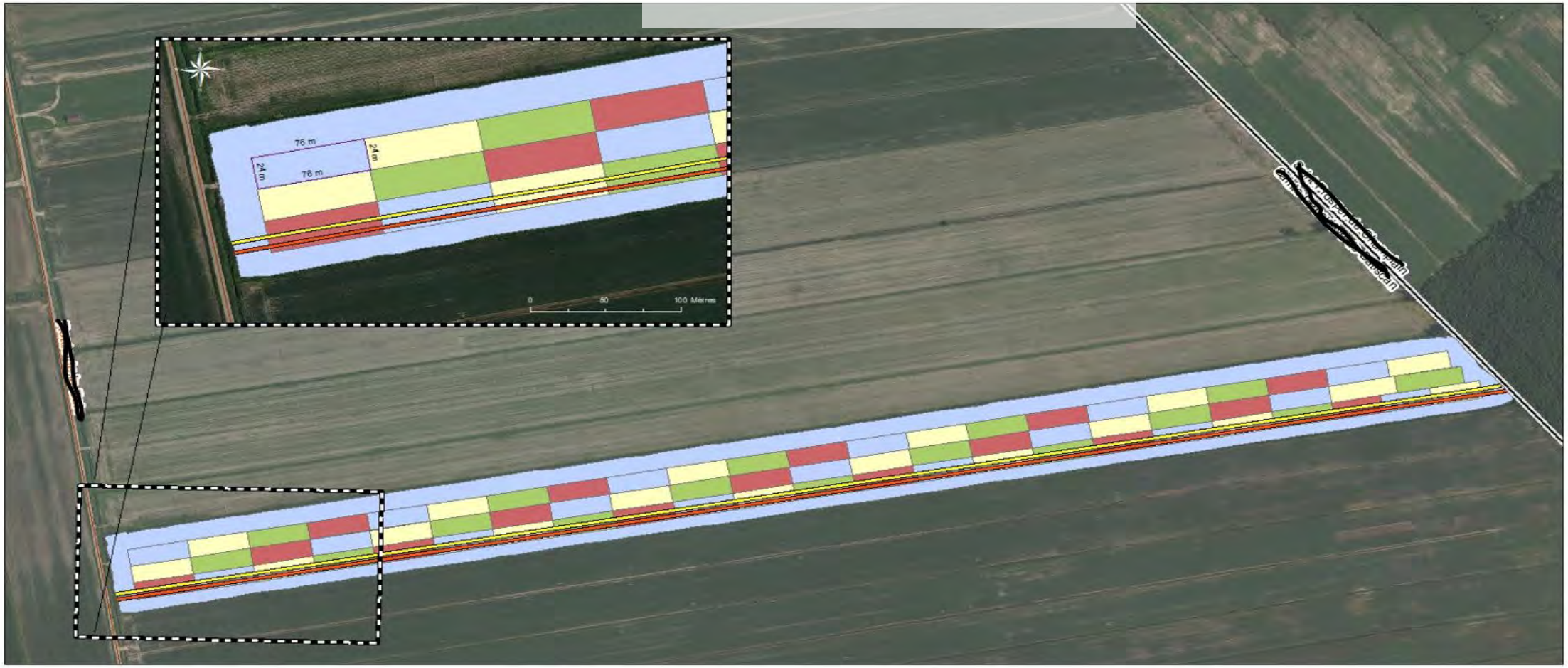
Séparer l’effet terrain de l’effet traitement



Essai au champ réalisé en 2023 en Mauricie



Essai de doses d'azote

Doses d'azote

Litres/ha de 32-0-0

- 118
- 235
- 318
- 400

- AB-Batteuse
- AB-Applicateur d'azote
- Route
- Municipalité

Projection cartographique

Conique conforme de Lambert

0 50 100 200 Mètres

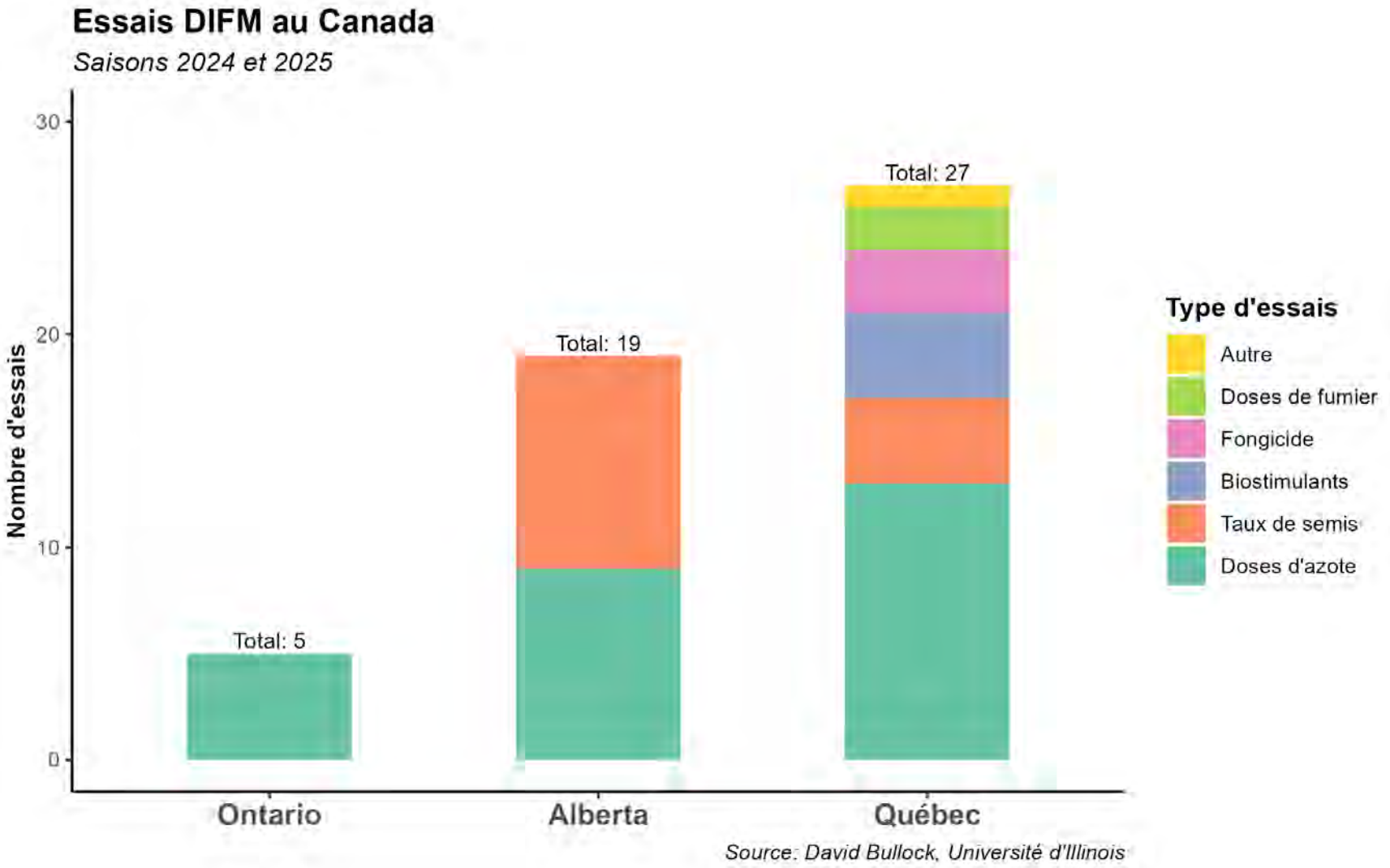
Sources

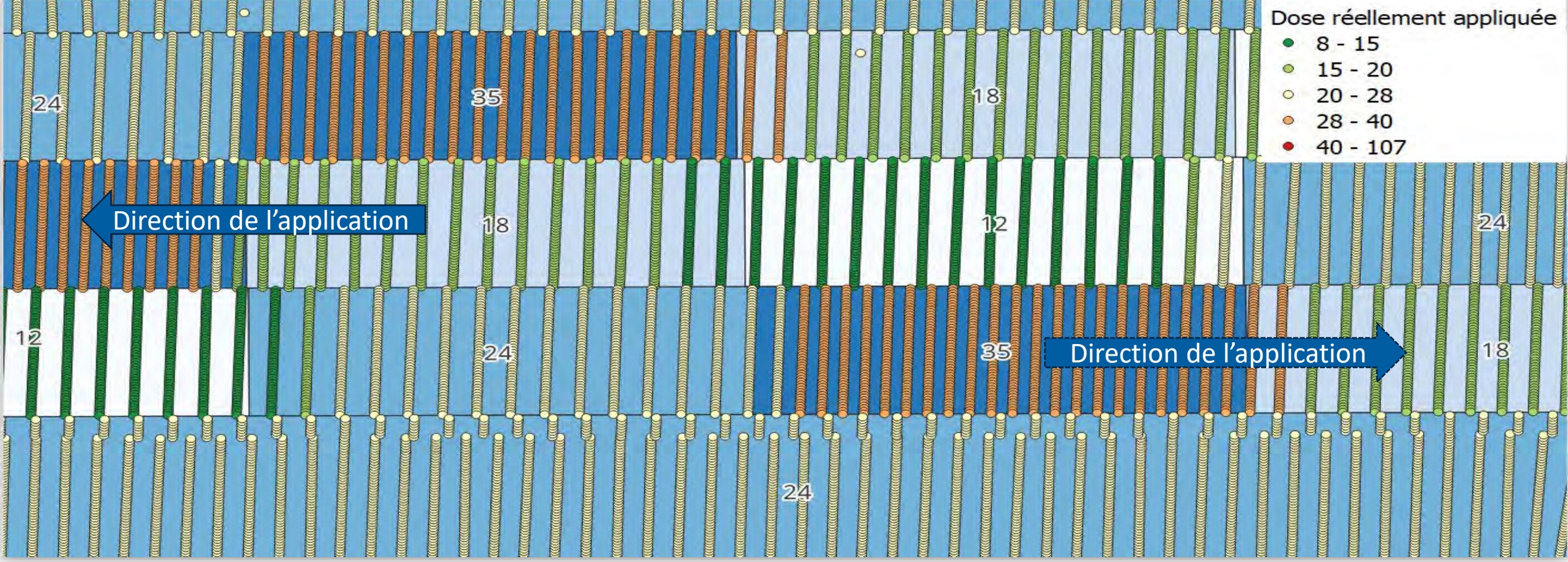
Doses d'azote	Université d'Illinois	2023
Fond de carte	GouvQc.	2022
Limite administrative		2023
Réseau routier		

Réalisation

Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec

Québec


Essais DIFM au Canada
Saisons 2024 et 2025
Nombre d'essais
30
20
10
0
Total: 5
Total: 19
Total: 27
Ontario
Alberta
Québec
Source: David Bullock, Université d'Illinois
Type d'essais
Autre
Doses de fumier
Fongicide
Biostimulants
Taux de semis
Doses d'azote



Les résultats bruts

Votre gouvernement

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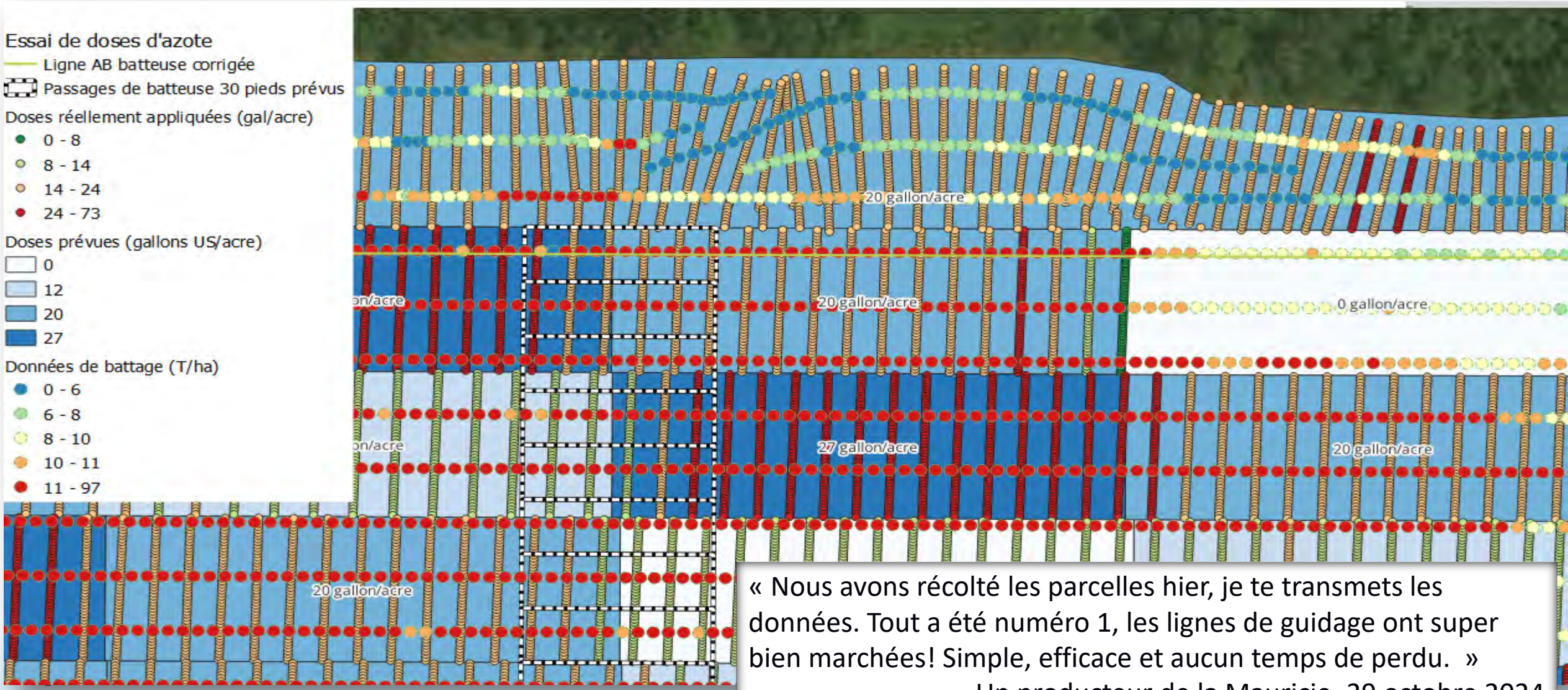
Qualité des données brutes: importance de l'alignement



« Nous avons récolté les parcelles hier, je te transmets les données. Tout a été numéro 1, les lignes de guidage ont super bien marchées! Simple, efficace et aucun temps de perdu. »

Un producteur de la Mauricie, 29 octobre 2024

Une fois les données dans la plateforme…

Nettoyage automatique des données

- Données aberrantes
- Données mal alignées
- Données de transition entre parcelles

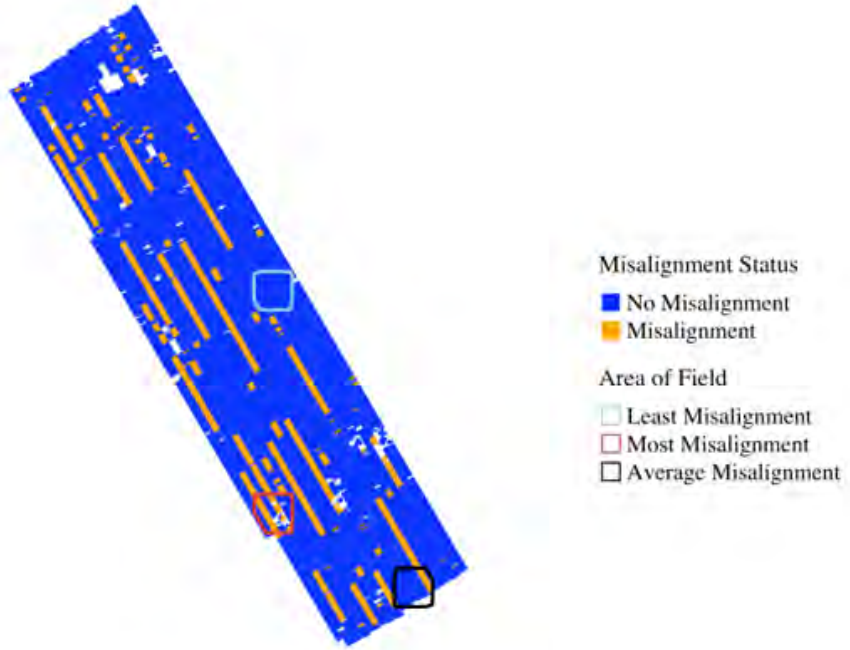
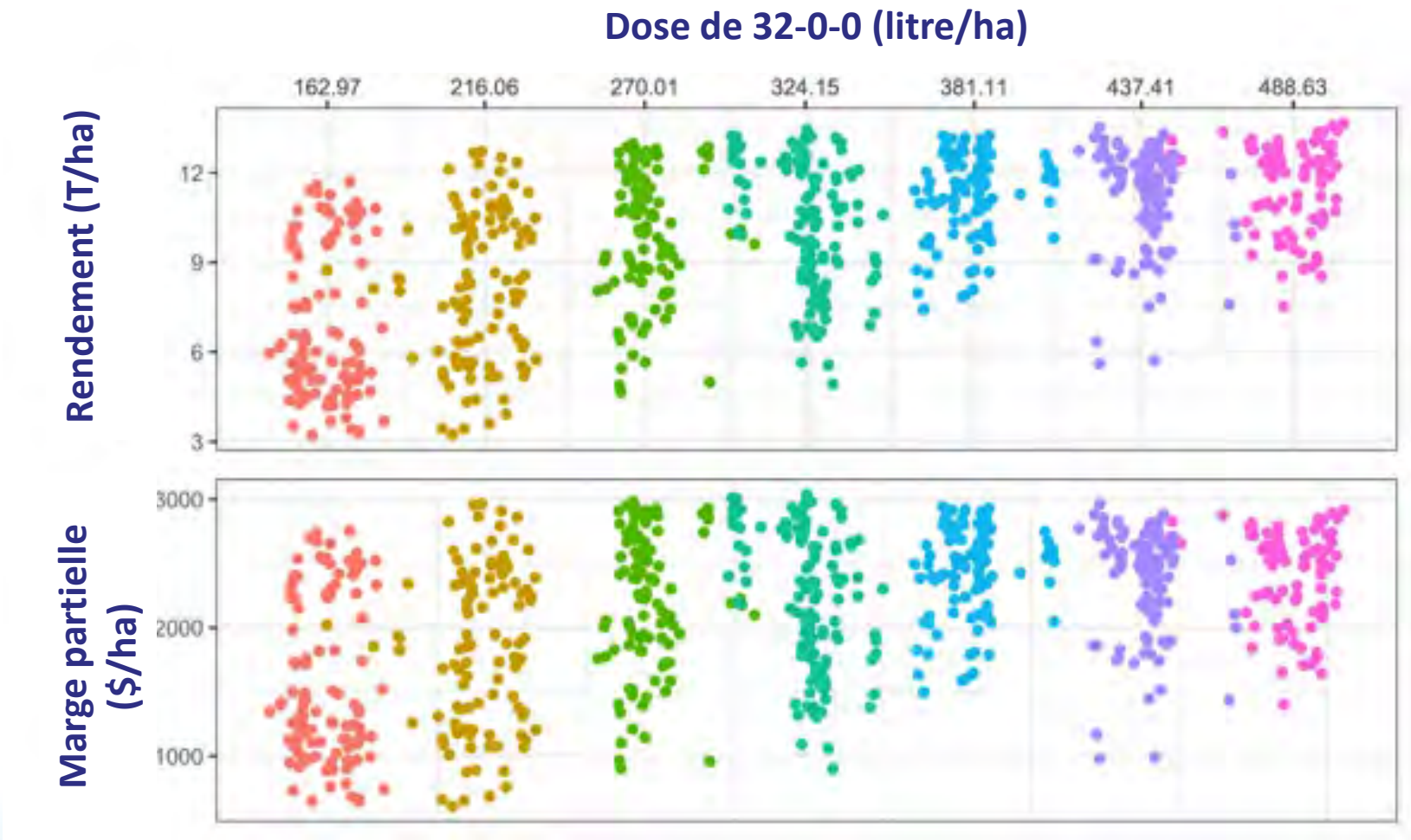


Figure 2: Map of misalignment status across the field and the areas of focus for implementation figures

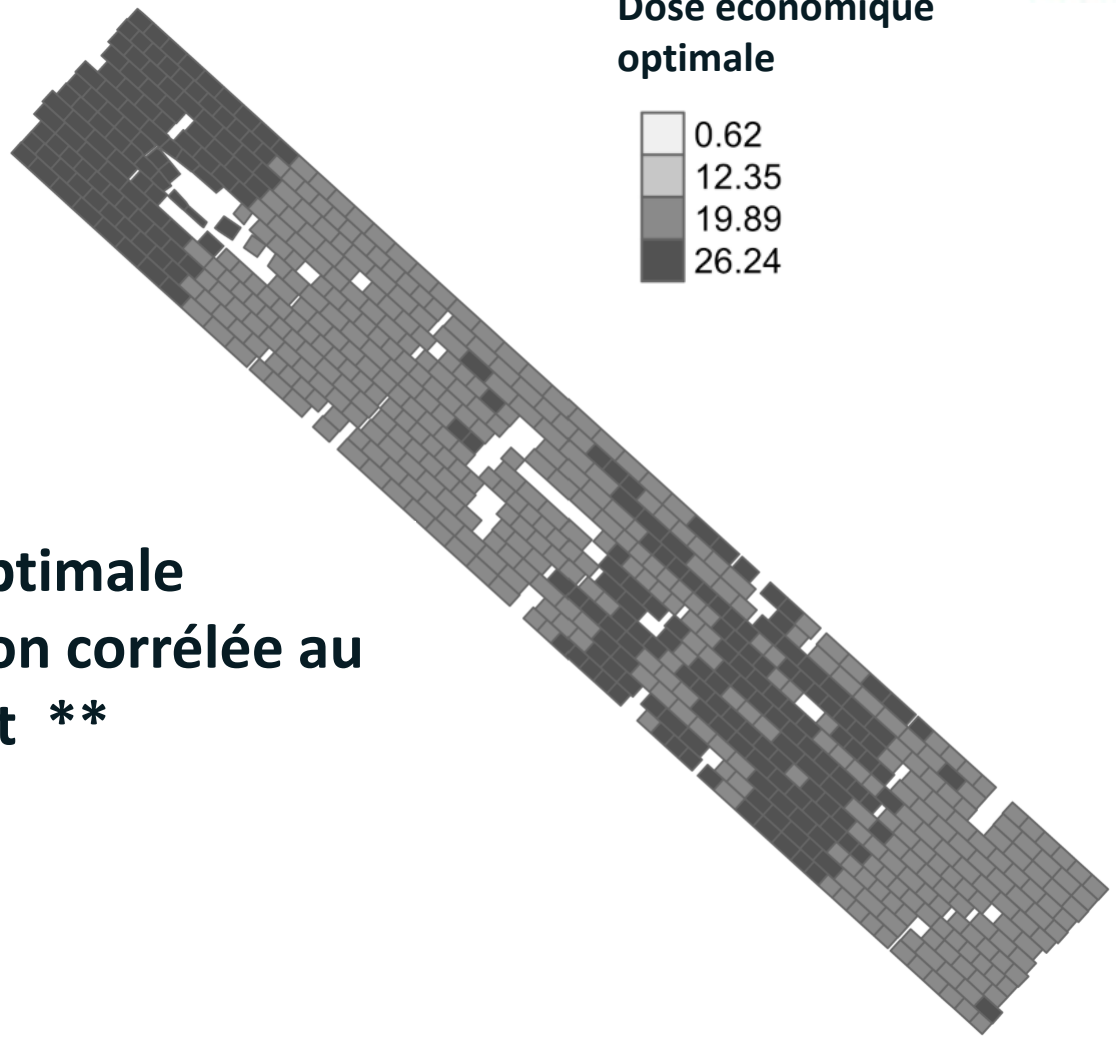
Nuage de points pour tout le champ



Analyse des données par la plateforme DIFM

- Dose variable optimale
- Dose uniforme optimale

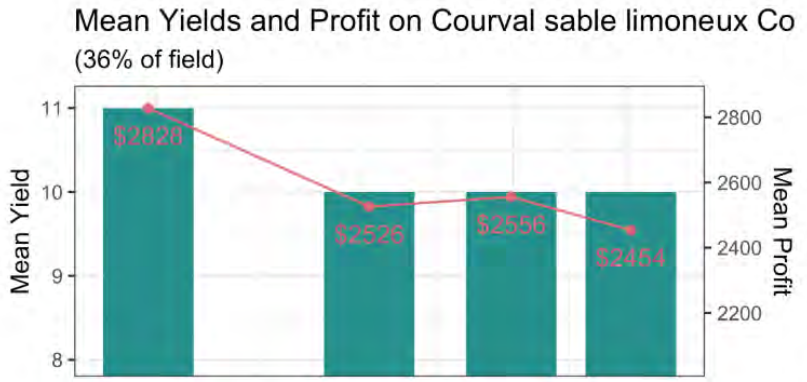
Rendement (T/ha)

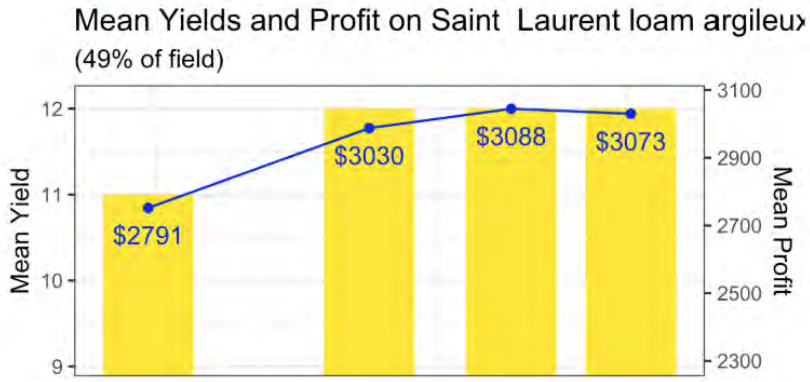


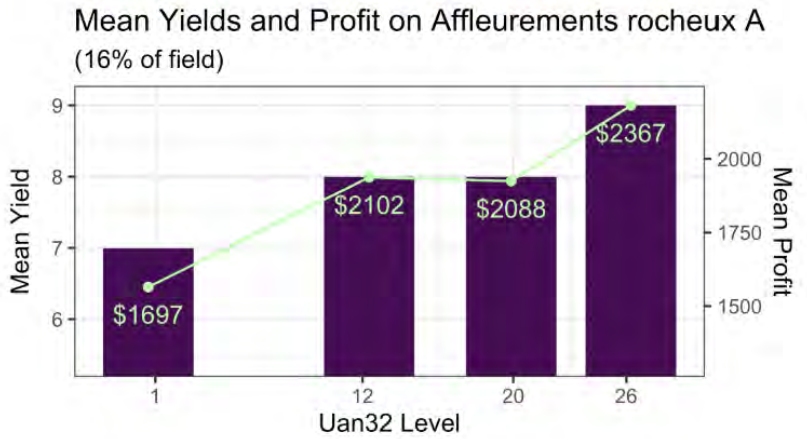
**** Dose optimale souvent non corrélée au rendement ****

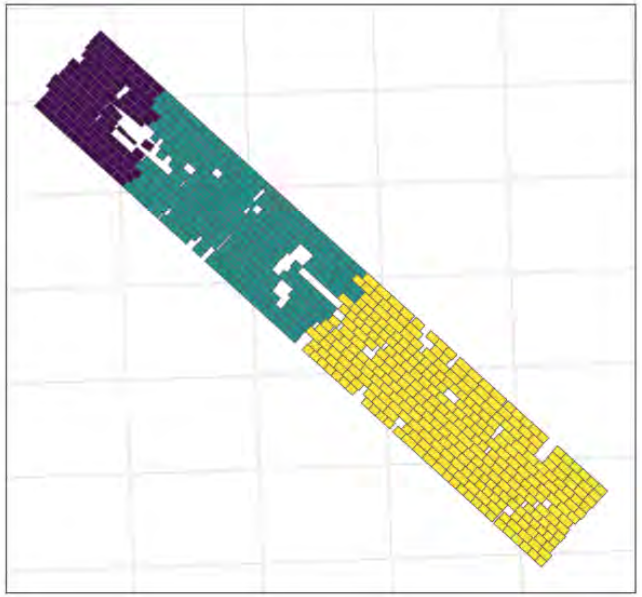
Analyse des données

Par série de sol



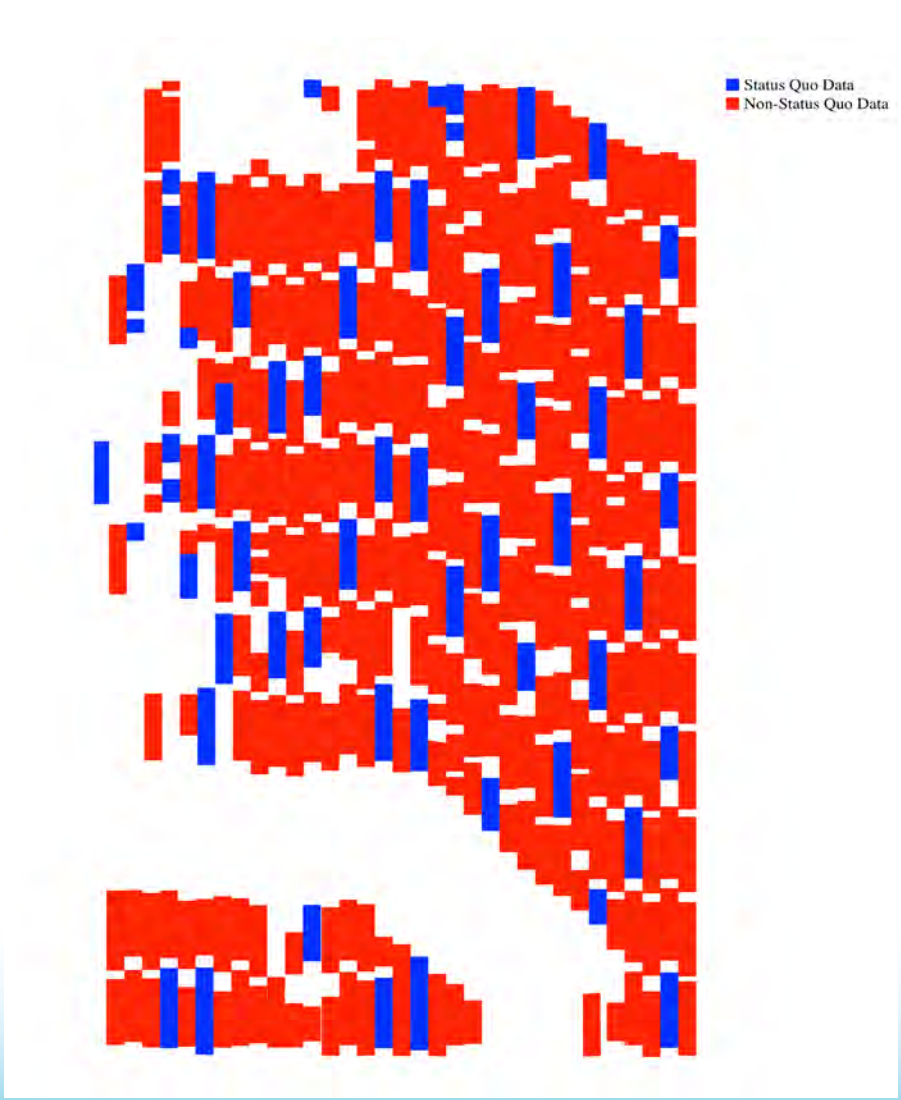


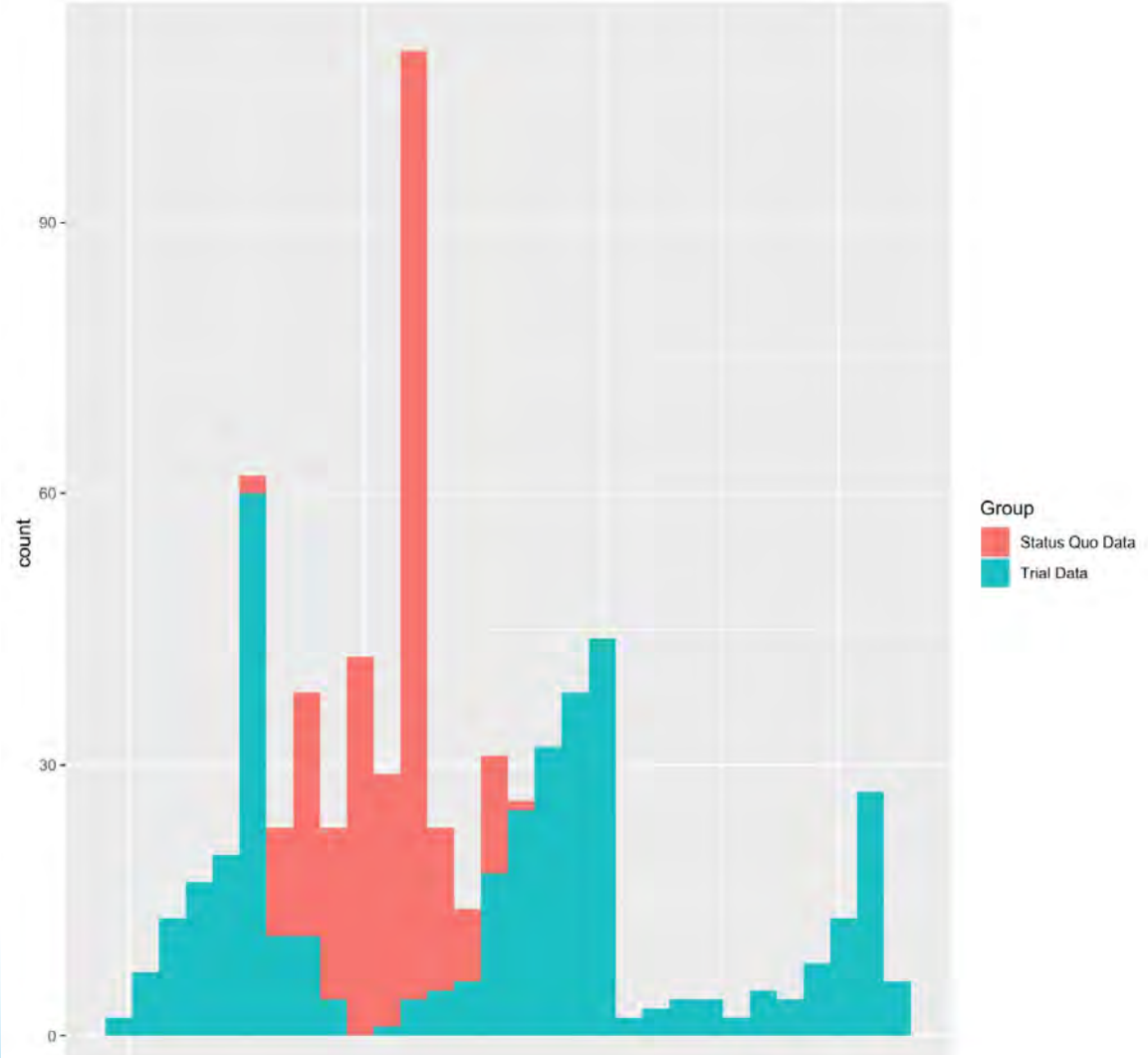




Combien a coûté l'essai ?

Marge parcelles témoin – Marge parcelles expérimentales = Coût de l'essai

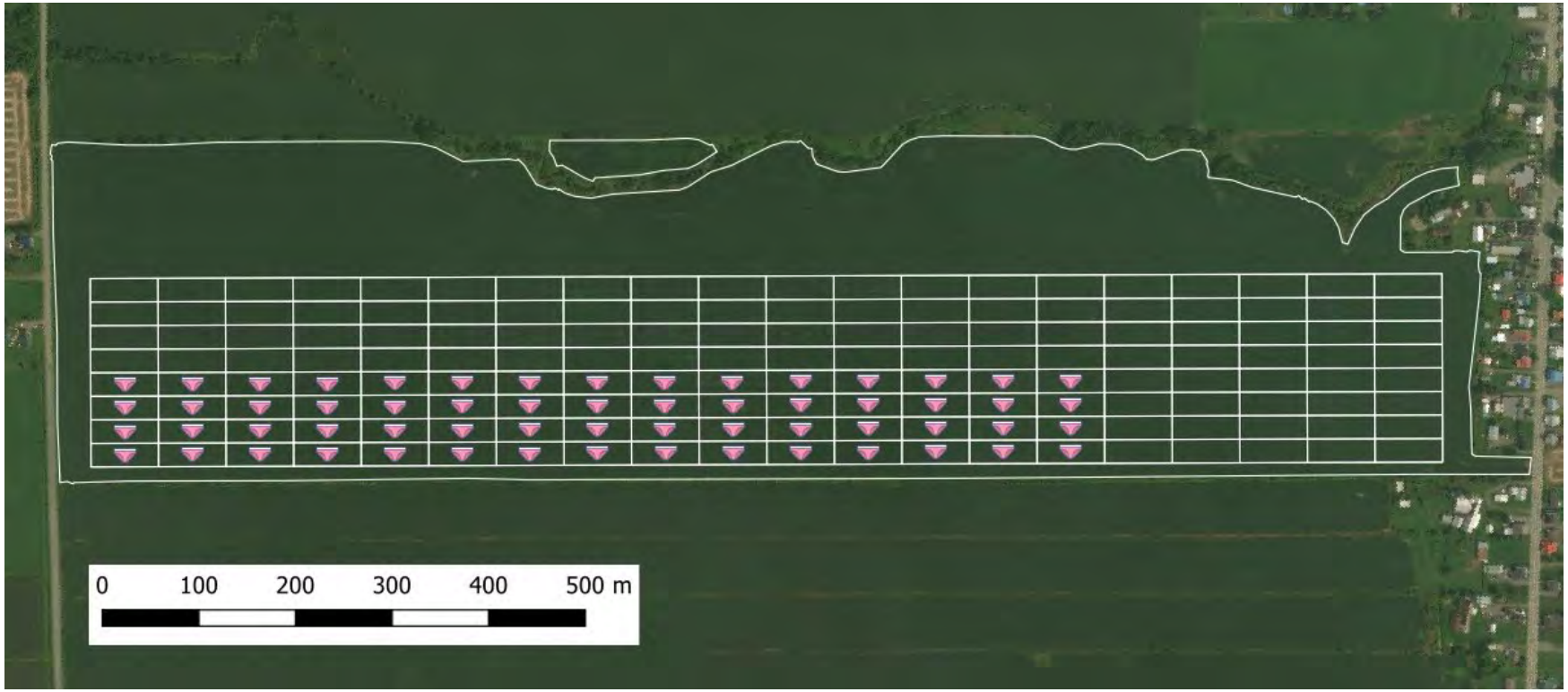




Marge partielle (rendement – coût de l'intrant)

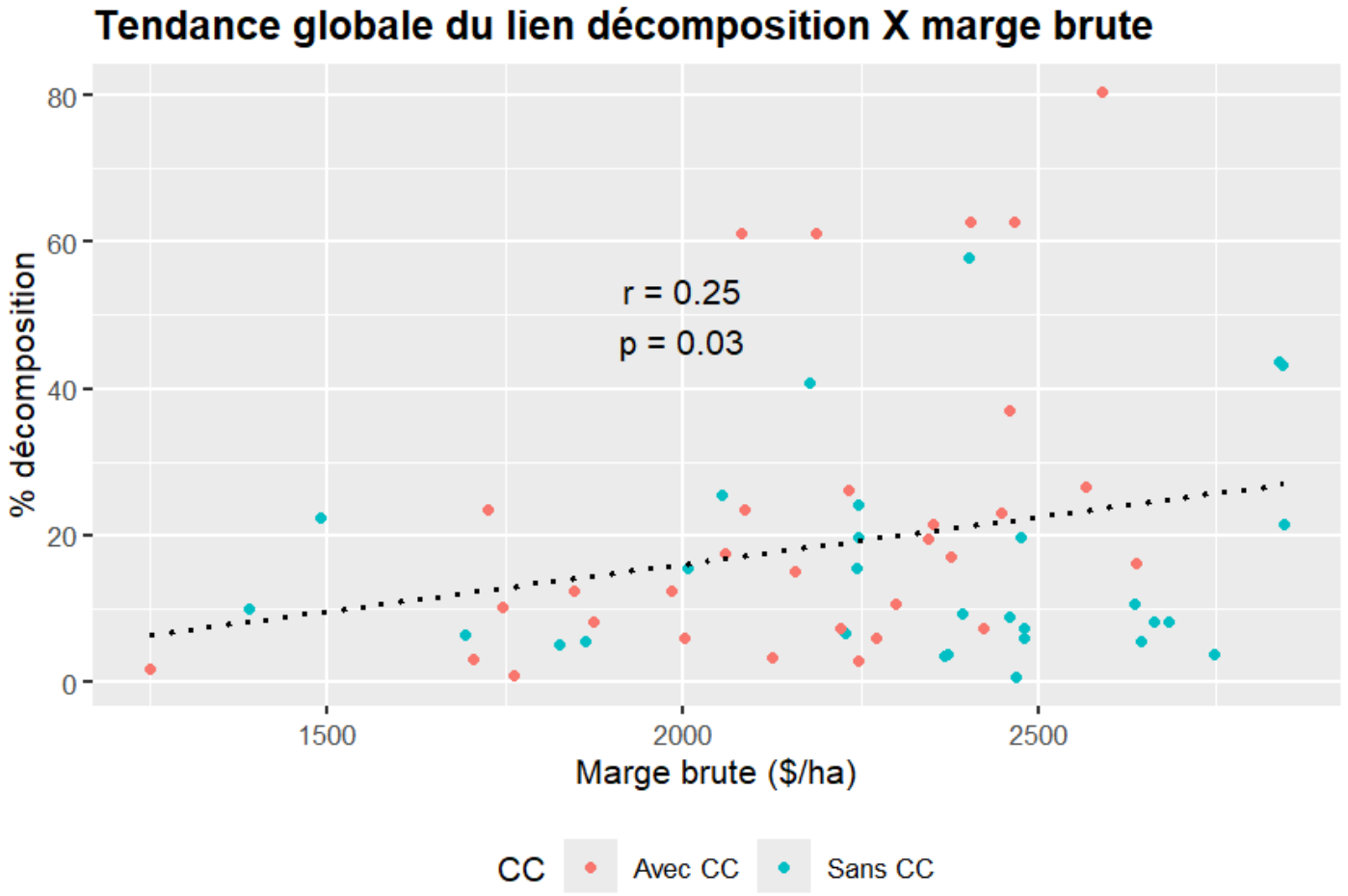
Mesurer la santé des sols avec l’indice bobette

60X



Québec

Les bobettes en dentelle: un indicateur de rentabilité ?



Conclusion

- Les essais à la ferme aident à devenir de meilleurs joueurs !
- L’agriculture de précision facilite les essais à la ferme
- La plateforme difm.farm facilitent l’élaboration et le traitement des données d’essais à la ferme

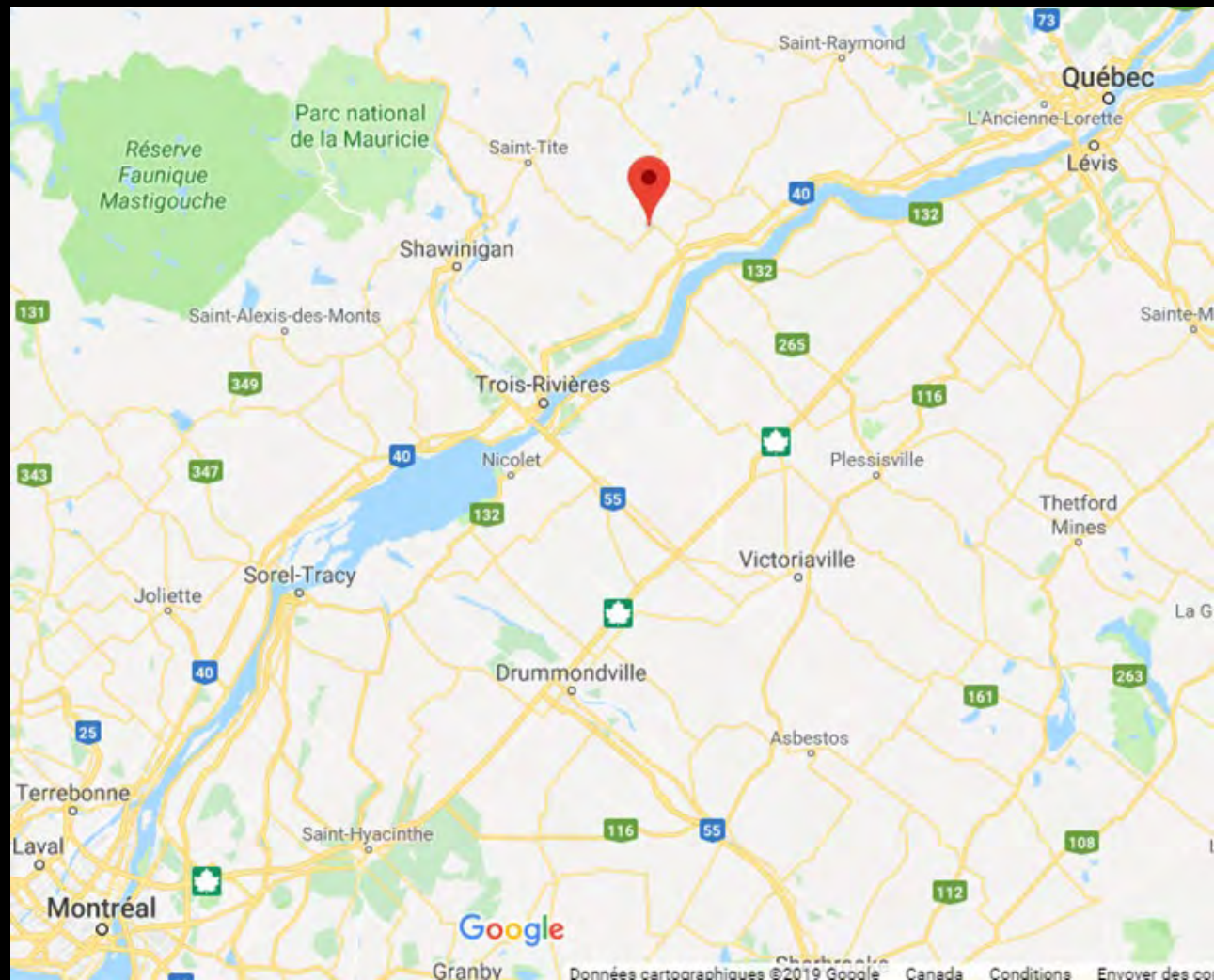
Ferme Jean-Pierre Gagnon

Par: Maxime Gagnon

4 février 2026

Ferme Jean-Pierre Gagnon/ Transport Prosper

- 5e génération
- Située en Mauricie
- Région de 2450 UTM
- Type de sol argileux
- Peu de dénivelé
- Ferme de Grande culture



Ferme Jean-Pierre Gagnon/ Transport Prosper

- 4000 acres (1600Ha) en culture

  céréales (20%)

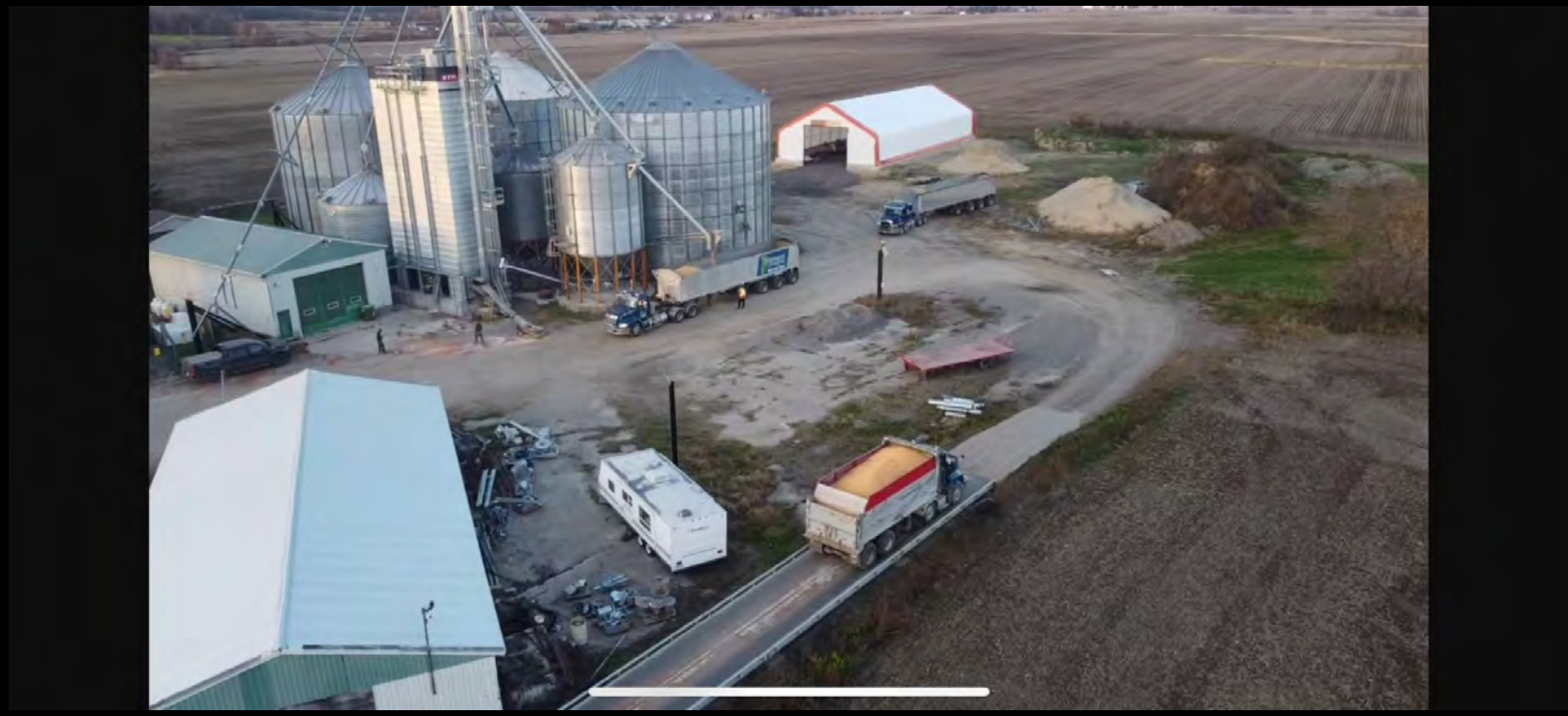
  Soya (45%)

  Maïs grain (35%)

-À travers 4 municipalités

Ferme Jean-Pierre Gagnon/ Transport Prosper

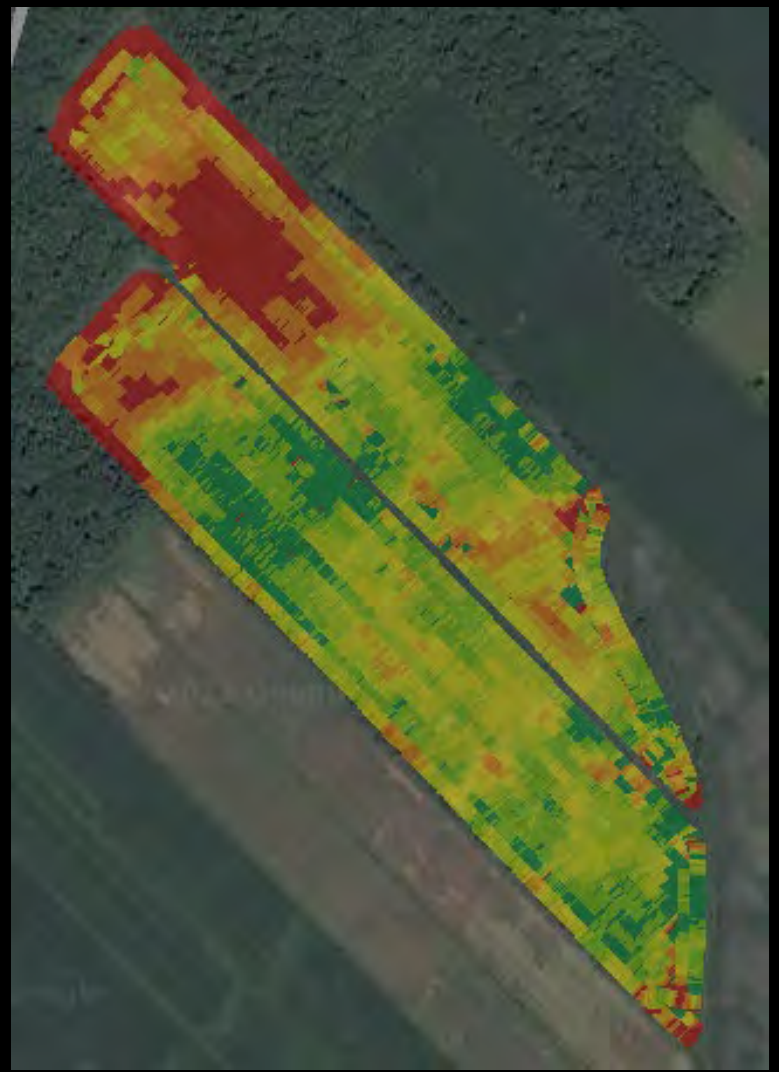
- 2 centres de grains
- Entreposage: 1500t et 7500t
- Séchage: 8T/h et 25t/h
- Transport en vrac
- Séchage à forfait

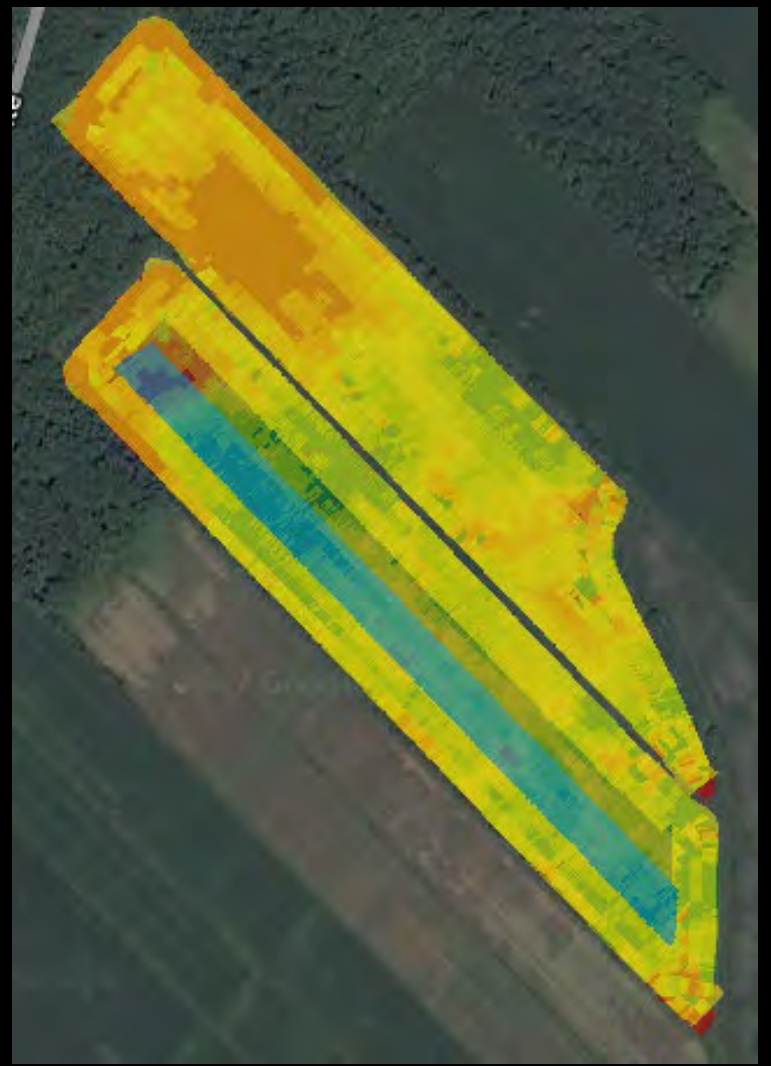


Culture de couverture

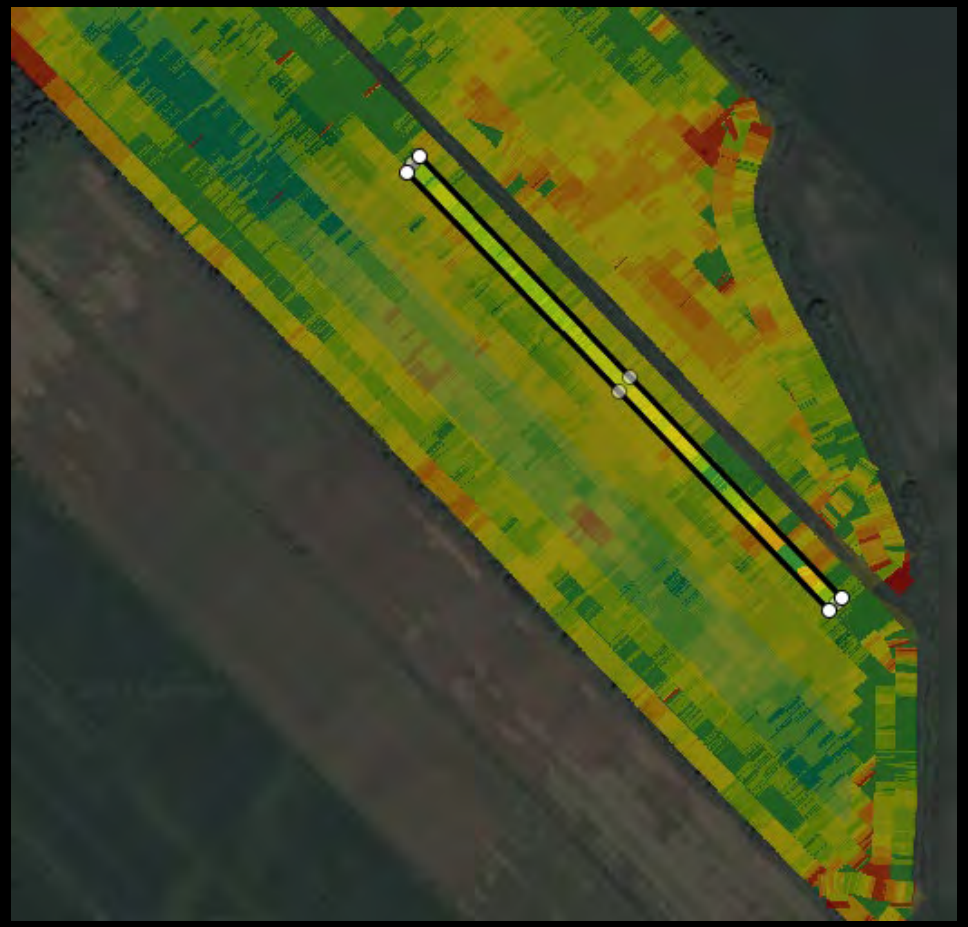
- Depuis 2016 en dérobé (Moutarde, Radis, pois, seigle)
  - 2016: 60 acres (25ha)
  - 2025: 500 acres (200 ha)
  - Depuis 2017 en intercalaire (Ray Grass)
  - 2017: 70 acres (28ha)
  - 2025: 500 acres (200ha)

Test réduction d’azote en 2022





Réduction d’azote



	azote	rendement
bande 1	180 u	9,6 T/ha
bande 2	160 u	9,5 T/ha
bande 3	140 u	9,4 T/ha
bande 4	180 u	8,6 t/ha
bande 5	160 u	8,5 t/ha
bande 6	140 u	8,6 t/ha

55 $/ha

unités	type engrais	coût
40u	46-0-0	90 $/ha
40u	32-0-0	113 $/ha
40u	36-0-0	114 $/ha

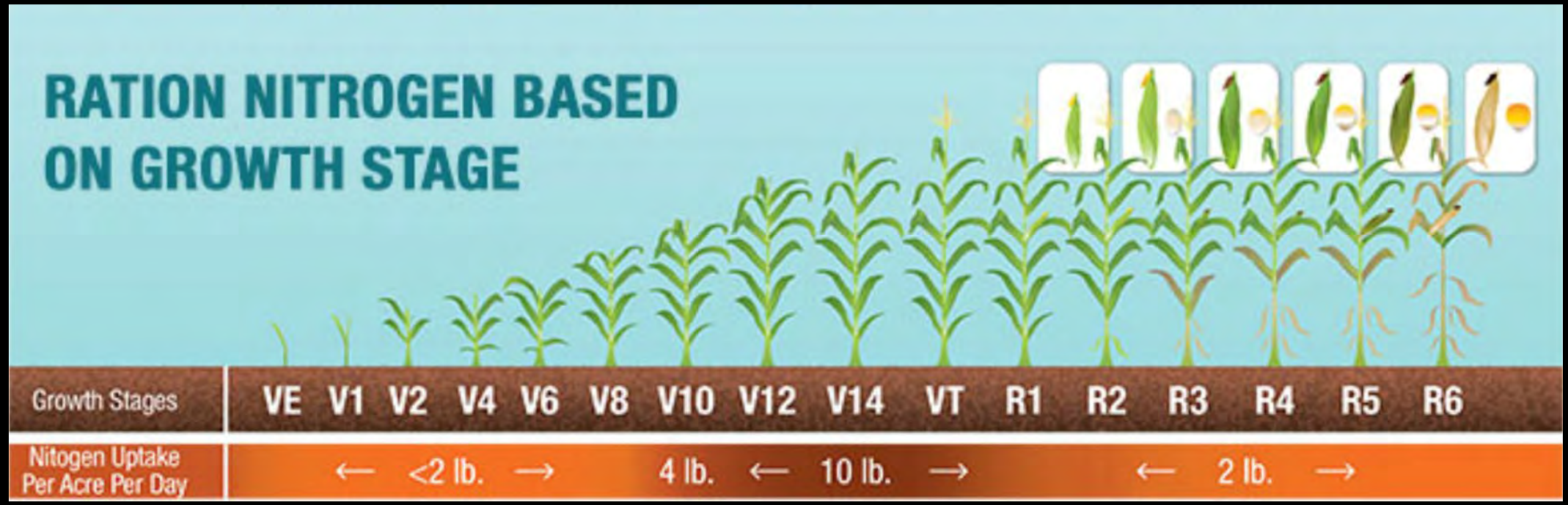
Tests d’azote

-Ez-drop vs applicateur

-1 passage VS 2 passages

-Quantité d’azote apportée

-Type d’azote apporté



https://andersonsplantnutrient.com/agriculture/market-feed/604

2023, achat qui amène des opportunités

2023, achat qui amène des opportunités

2023, achat qui amène des opportunités

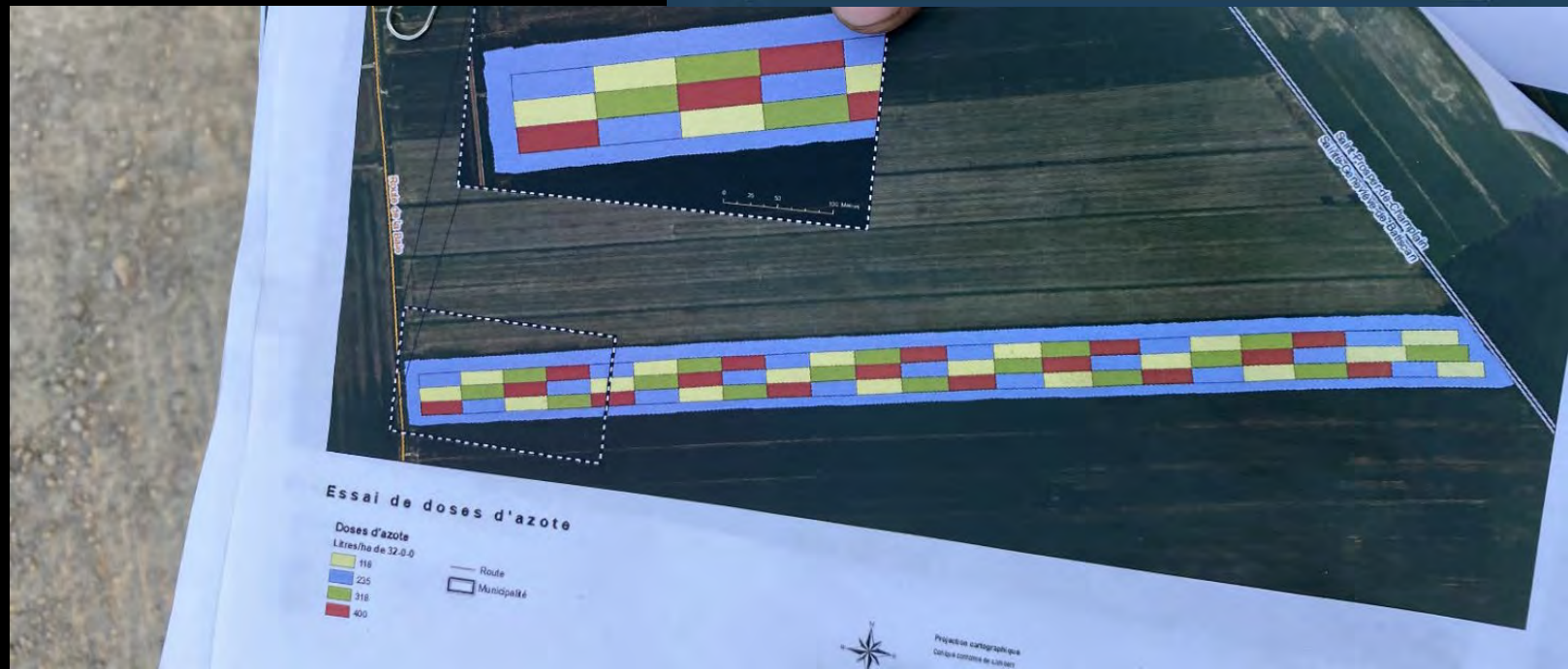
Premier test en 2023

-Baisse de la dose d’azote au planteur
-1er passage de 46-0-0 à 3 feuilles
-2e passage de 32-0-0 à 6 feuilles

-Doses
12 gal/ac (120u)
25 gal/ac (170u)
34 gal/ac (207u)
42 gal/ac (240u)

24 HR	3.8 mm
MOIS TOTAL	213.4 mm
PLUIE DE L'ANNÉE	635.6 mm
TAUX ACTUEL	0 mm/hr
RAIN STORM	63.2 mm

Heure de début: 24-08-13 @ 8:00 p.m.
Durée de la tempête: 7 days



Pendillards, 32-0-0 avec excellis

Retour des tests en 2024

Table 2: AB-line for uan32

	Lat	Long
Point A	46.62677	-72.32052
Point B	46.61570	-72.30431

Table 3: AB-line for harvest

	Lat	Long
Point A	46.62682	-72.32045
Point B	46.61575	-72.30424

Essai de doses d'azote

0 100 200 m

Réalisé pour Groupe Lavi-Eau-Champ inc.
projet à la ferme Jean-Pierre Gagnon

Légende

Champ 52A

Ligne AB applicateur
Ligne AB batteuse

Dose (gal/acre) de 32-0-0
12
18
24
35

Échantillonnage nitrates
Saint- Laurent loam argileux
Sainte-Rosalie argile

Sources

Doses d'azote: créé par Bruce Gélinas à l'aide de la plate-forme difm.farm
Fond de carte: HereWeGo

Réalisation

Bruce Gélinas, agr., MAPAQ
Note: le présent document n'a aucune portée légale.

Table 2: AB-line for uan32

	Lat	Long
Point A	46.62191	-72.30329
Point B	46.62968	-72.31488

Table 3: AB-line for harvest

	Lat	Long
Point A	46.62186	-72.30336
Point B	46.62963	-72.31495

Essai de doses d'azote
Champ 58

0 100 200 m

Réalisé pour Groupe Lavi-Eau-Champ inc.
projet à la ferme Jean-Pierre Gagnon

Légende

Doses de 32-0-0 (gal/acre)
0
12
20
27

Ligne AB applicateur
Ligne AB Batteuse

Sources

Doses d'azote: créé par Bruce Gélinas à l'aide de la plate-forme difm.farm
Fond de carte: HereWeGo

Réalisation

Bruce Gélinas, agr., MAPAQ
Note: le présent document n'a aucune portée légale.

Rapport champ 52

2 Trial Design and Implementation

Figure 2.1 displays the uan32 rate trial design and the trial's raw as-applied data. The farmer's "status quo" uan32 application strategy (that is, the one that the farmer would have used had there been no field trial conducted) was to target the uan32 application rate uniformly across the field at 24 gal/ac. The status quo target rate was assigned to a buffer zone around the perimeter of the trial, but observations from the buffer zone were not included as part of the trial in later analysis. The trial design's targeted uan32 rates were 12, 18, 24, 35 gal/ ac.

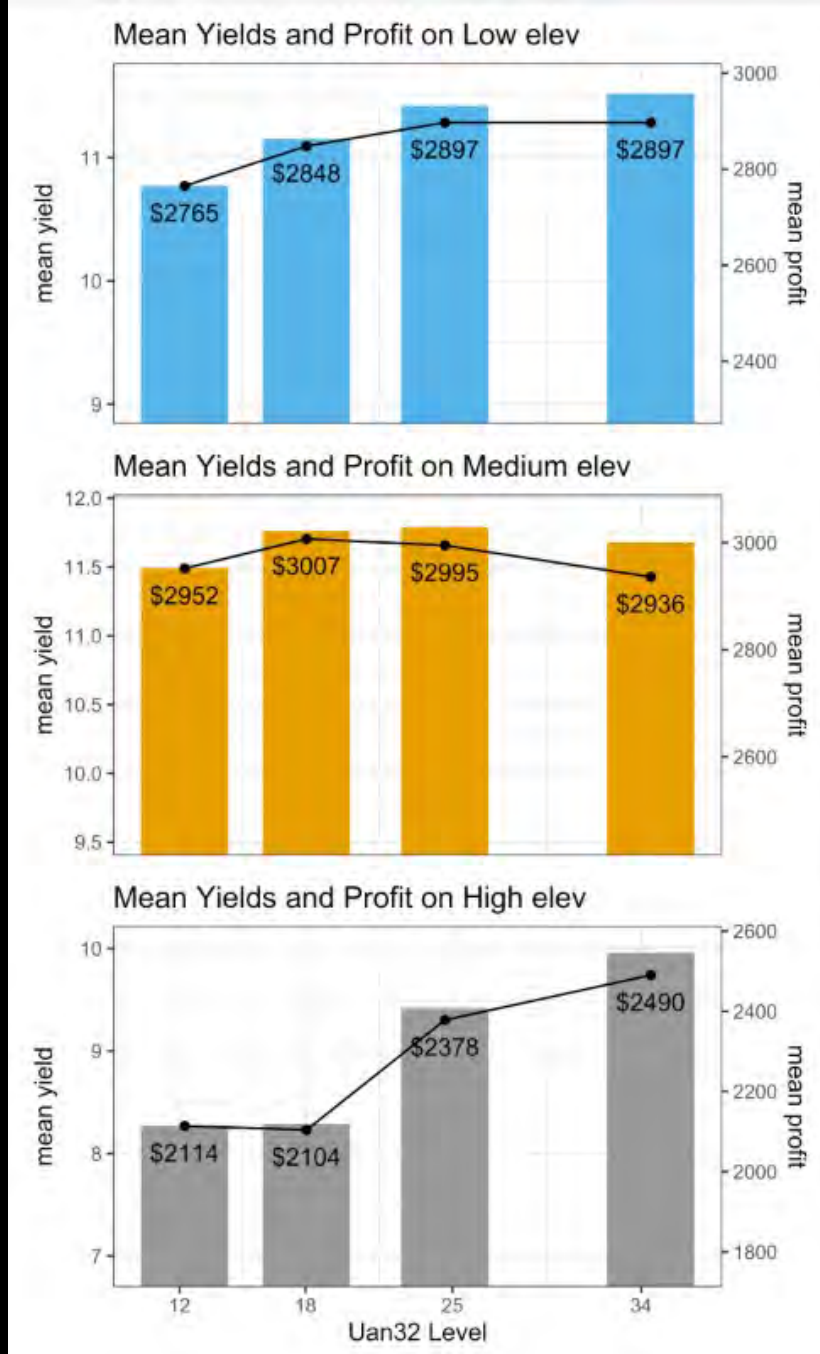
Targeted Uan32 Rate (gal)

12 18 24 35

As-applied Uan32 Rate (gal)

0 10 20 30 40 50

Rapport champ 52

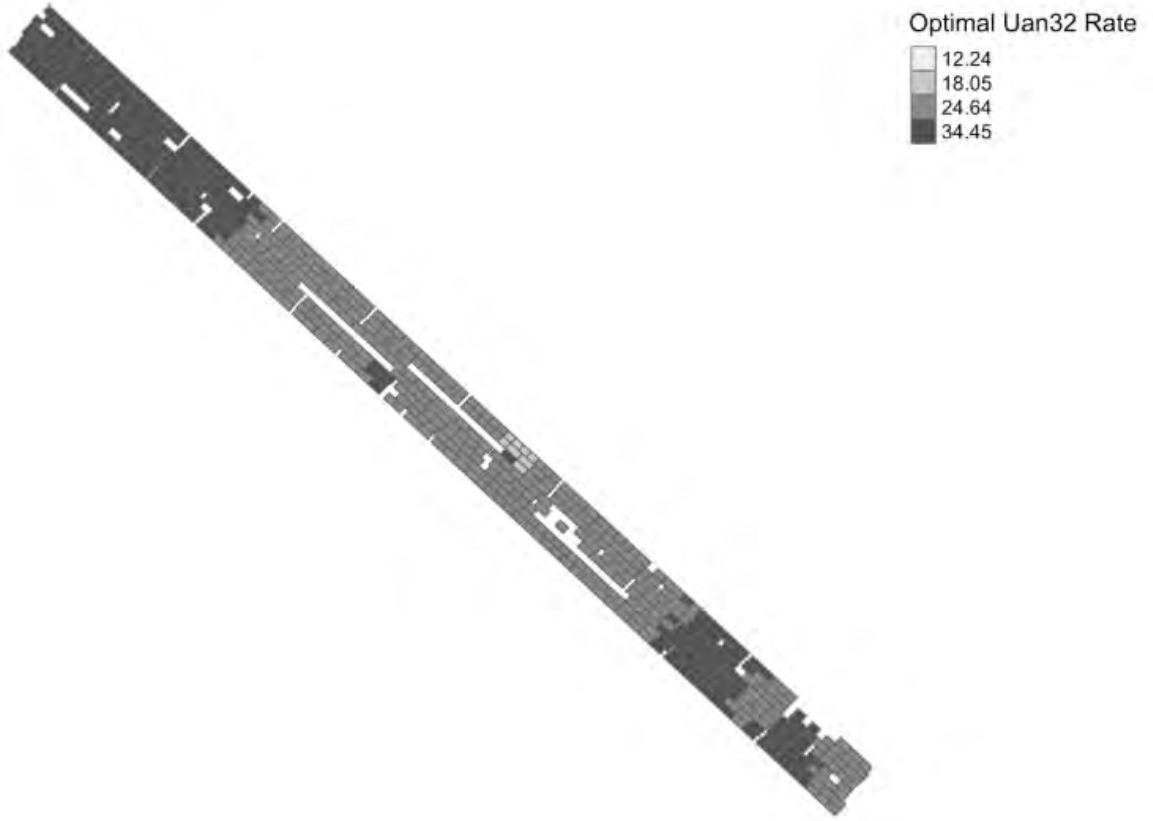


elev level Low elev Medium elev High elev

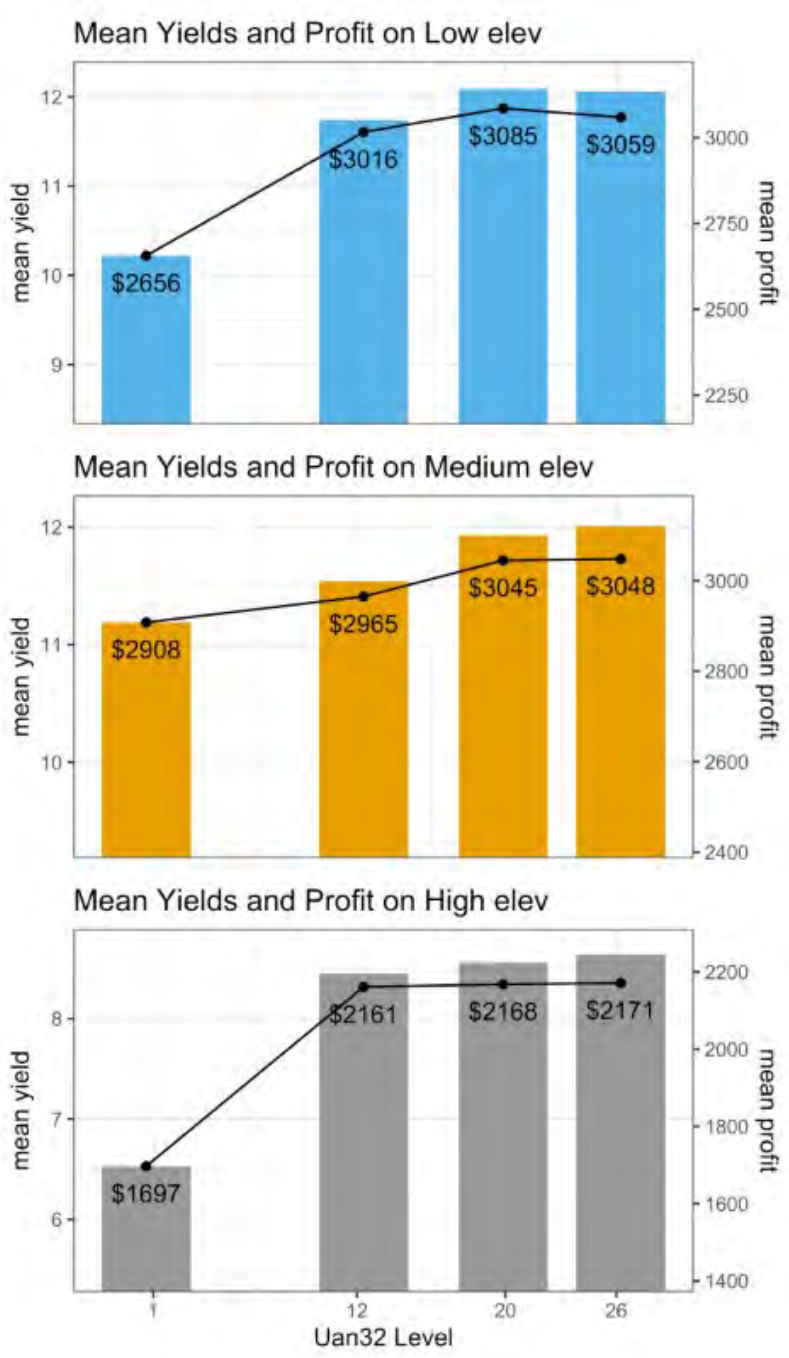
Rapport champ 52

6 Economic Results and Implications

It is estimated that implementing this strategy under the same growing season weather as in 2024 would have raised profits over $29.97/ac relative to status quo profit. Approximately $15.00/ac of those increased profit would come from changing to the optimal uniform rate of 34gal/ac from the status quo rate of 24gal/ac. An additional $15.00 in profit gain would come from using the optimal site-specific strategy in place of the optimal uniform strategy. See table 6.1.



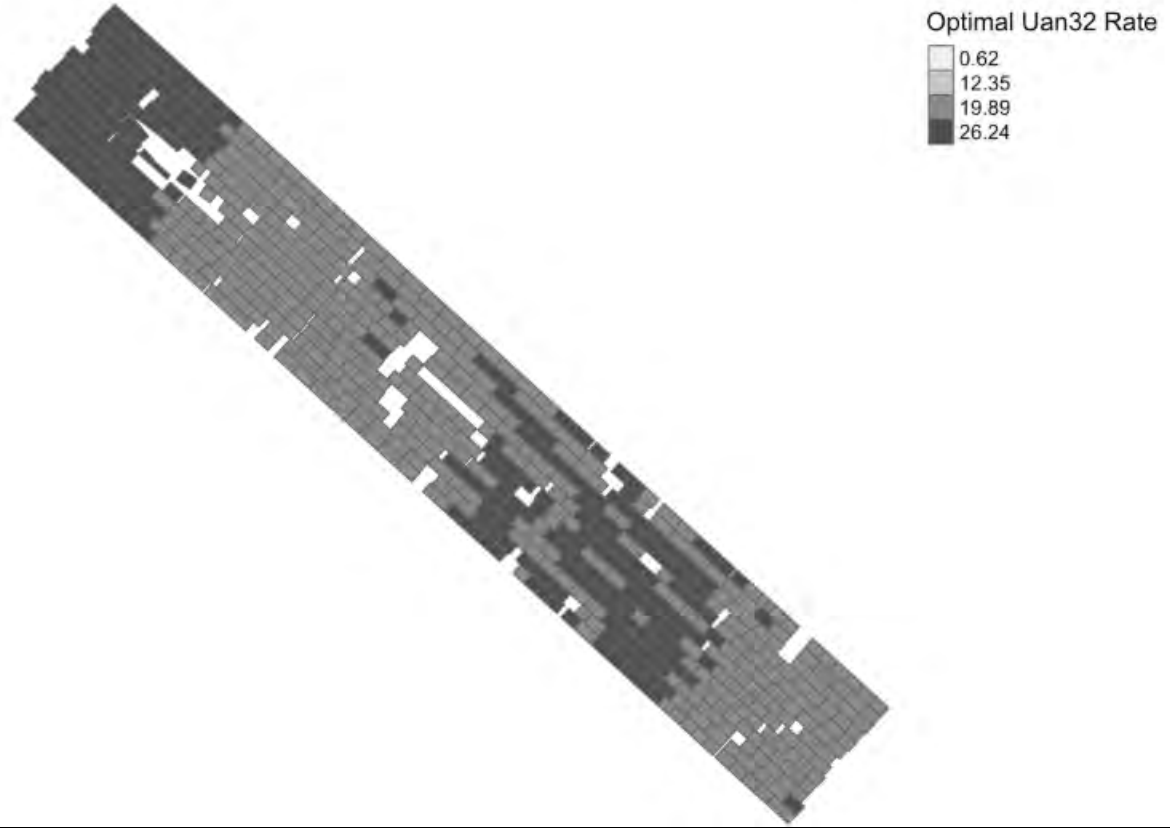
Rapport champ 58



Rapport champ 58

6 Economic Results and Implications

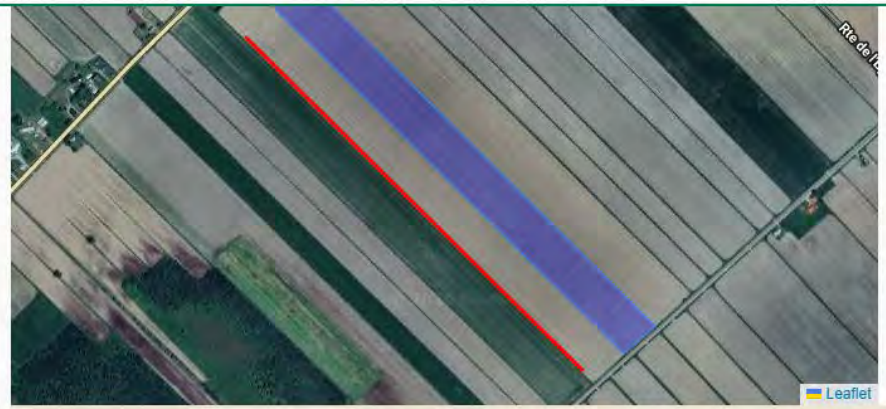
It is estimated that implementing this strategy under the same growing season weather as in 2024 would have raised profits over $21.51/ac relative to status quo profit. Approximately $0.00/ac of those increased profit would come from changing to the optimal uniform rate of 20gal/ac from the status quo rate of 20gal/ac. An additional $22.00 in profit gain would come from using the optimal site-specific strategy in place of the optimal uniform strategy. See table 6.1.



DIFM 2025

DIFM

News Farmers & Advisors Team Publications



Add AB-Line

Trial Configuration

Trial configuration for **45-2-2, 45-2-2 pop-up+nutricharge**
Add info about the harvester and the headland distance for this trial.

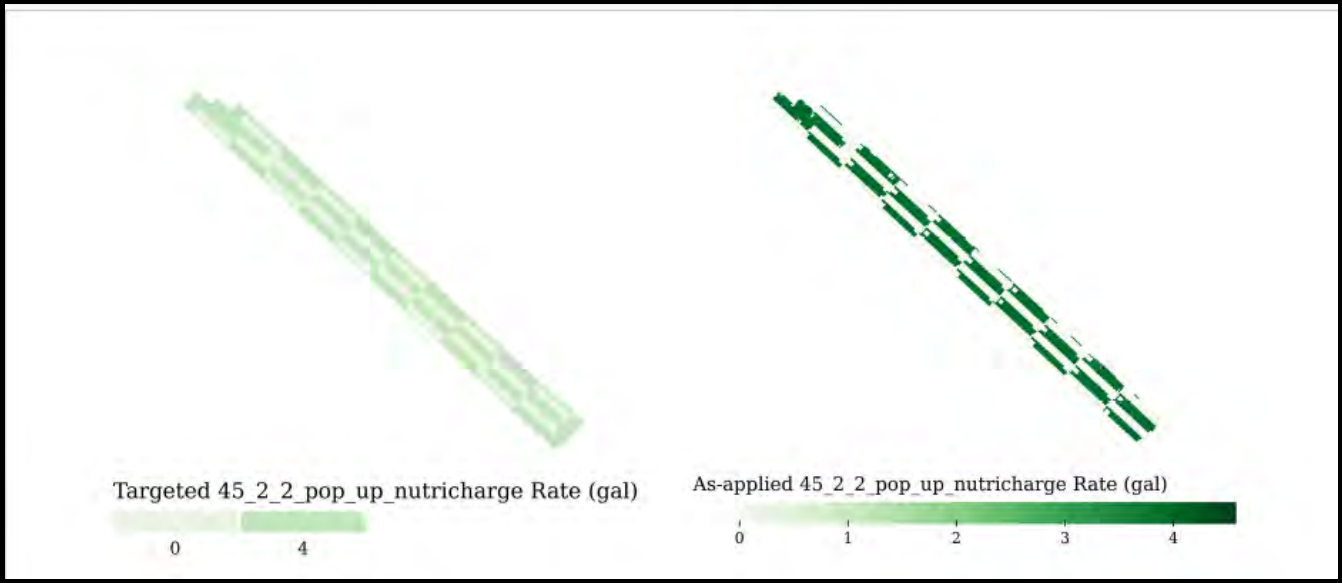
Harvester Width	Headland Distance	Sideland Distance	Min Plot Length	Max Plot Length	Action
30.00 ft	120.00 ft	0.01 ft	400.00 ft	500.00 ft	Add/Edit

Trial Input Specifications

Trial inputs for **45-2-2, 45-2-2 pop-up+nutricharge**

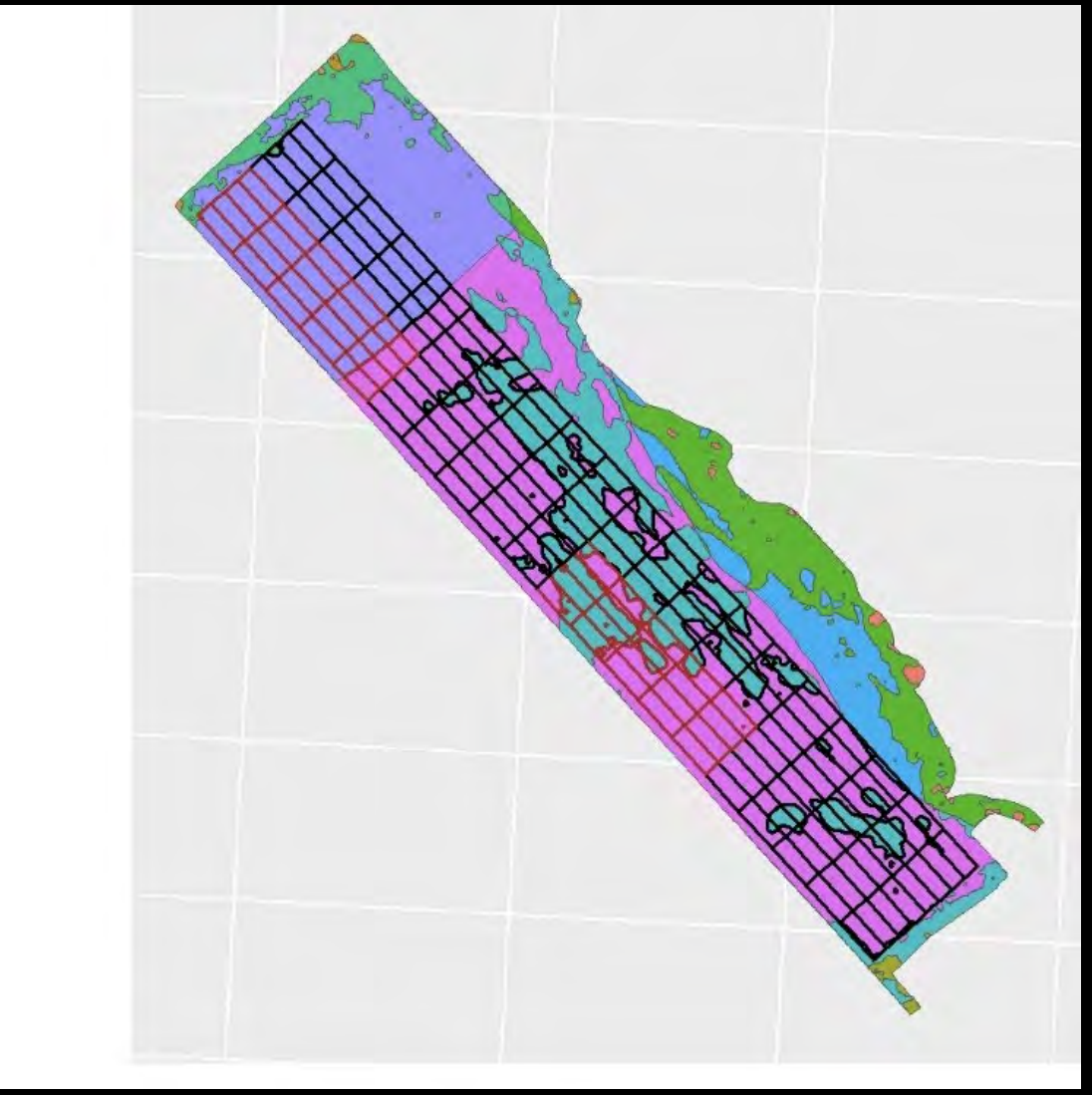
	AB-Line	Design Type	Input Name	Machine Name	Machine Width	Sections	Plot Width	Unit	Sq. Rate	Min Rate	Max Rate	Levels	Action
☐	droite	checkerboard	45-2-2 pop-up+nutricharge	1775nt	40.00 ft	1	80.00 ft	gal	4	0	4	2	Edit

Test pop-up en 2025



Targeted Rates (gal/acre)	Average As-applied Rate (gal/acre)	Mean Yield (acre)	Mean Profit ($/acre)
0	0.33	4.08	1098.51
4	3.60	4.17	1089.20

Test en 2025 (160 parcelles)



	13	25	37.5	50	62.5	75	87.5	100	112.5	138	150	162.5	175	187.5	200
1425															
1325															
1225															
1125															
1025	T5		T1		T1		T1		T1	T1		T1		T1	
925	T4		T2		T2		T2		T2	T2		T2		T2	
825	T3		T3		T3		T3		T3	T3		T3		T3	
725	T2		T4		T4		T4		T4	T4		T4		T4	
625	T1		T5		T5		T5		T5	T5		T5		T5	
525	T5		T1		T1		T1		T1	T1		T1		T1	
425	T4		T2		T2		T2		T2	T2		T2		T2	
325	T3		T3		T3		T3		T3	T3		T3		T3	
225	T2		T4		T4		T4		T4	T4		T4		T4	
125	T1		T5		T5		T5		T5	T5		T5		T5	
25															

Fumier et cc	cc seule

Test en 2025

Cérom: dose:
0 gal/acre
12,2 gal/acre (48U à 88U)
24,8 gal/acre (150U à 190U)
37,5 gal/acre (190U à 230U)
50,1 gal/acre (250U à 290U)

Maxime: dose:
Selon la zone.
150U – 170U – 190U – 210U - 230U

Test 2026

- Densité du sol vs application d’azote
- Strip-till

Questions!