Challenge Rose

performance evaluation of autonomous weeding robots

FIRA 2019

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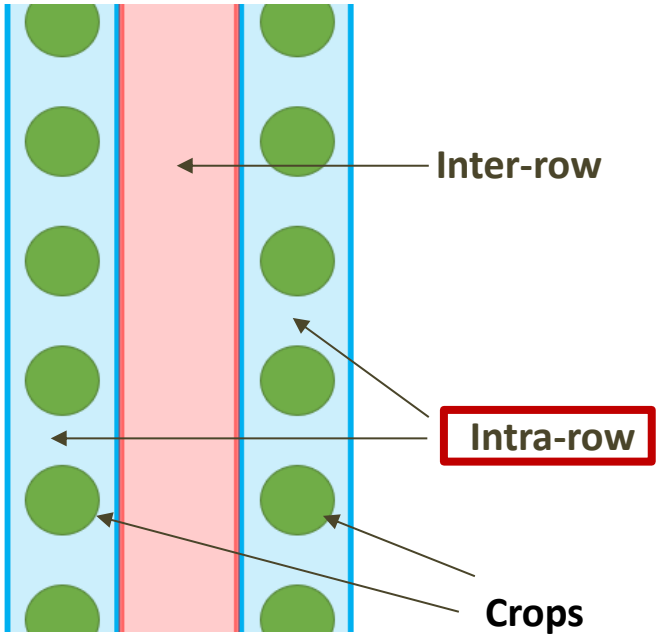
- ✓ Goal : encourage the development of autonomous innovative solutions for **intra-row weed control** in **field crops** with wide spacing and **vegetable crops** in order to reduce by 50% the use of **phytosanitary products**, and thus contribute to the achievement of the objectives of the Ecophyto II plan.



The ROSE challenge goal

Challenge participants

Participants	**Develop solutions** **Contribute to the definition of the scientific and technological objectives of the challenge**	4 projects funded BIPBIP PEAD ROSEAU WeedElec
Operational organizer (trust third party)	**Leads the definition of competition objectives and ensures that they are measurable** **Organizes and leads the challenge** **Ensures fair treatment of participants**	LABORATOIRE NATIONAL DE MÉTROLOGIE ET D'ESSAIS irstea
Funding body	**Finance the challenge** **Statue on the objectives of the challenge**	ANR AGENCE FRANÇAISE POUR LA BIODIVERSITÉ ÉTABLISSEMENT PUBLIC DE L'ÉTAT ÉCOPHYTO

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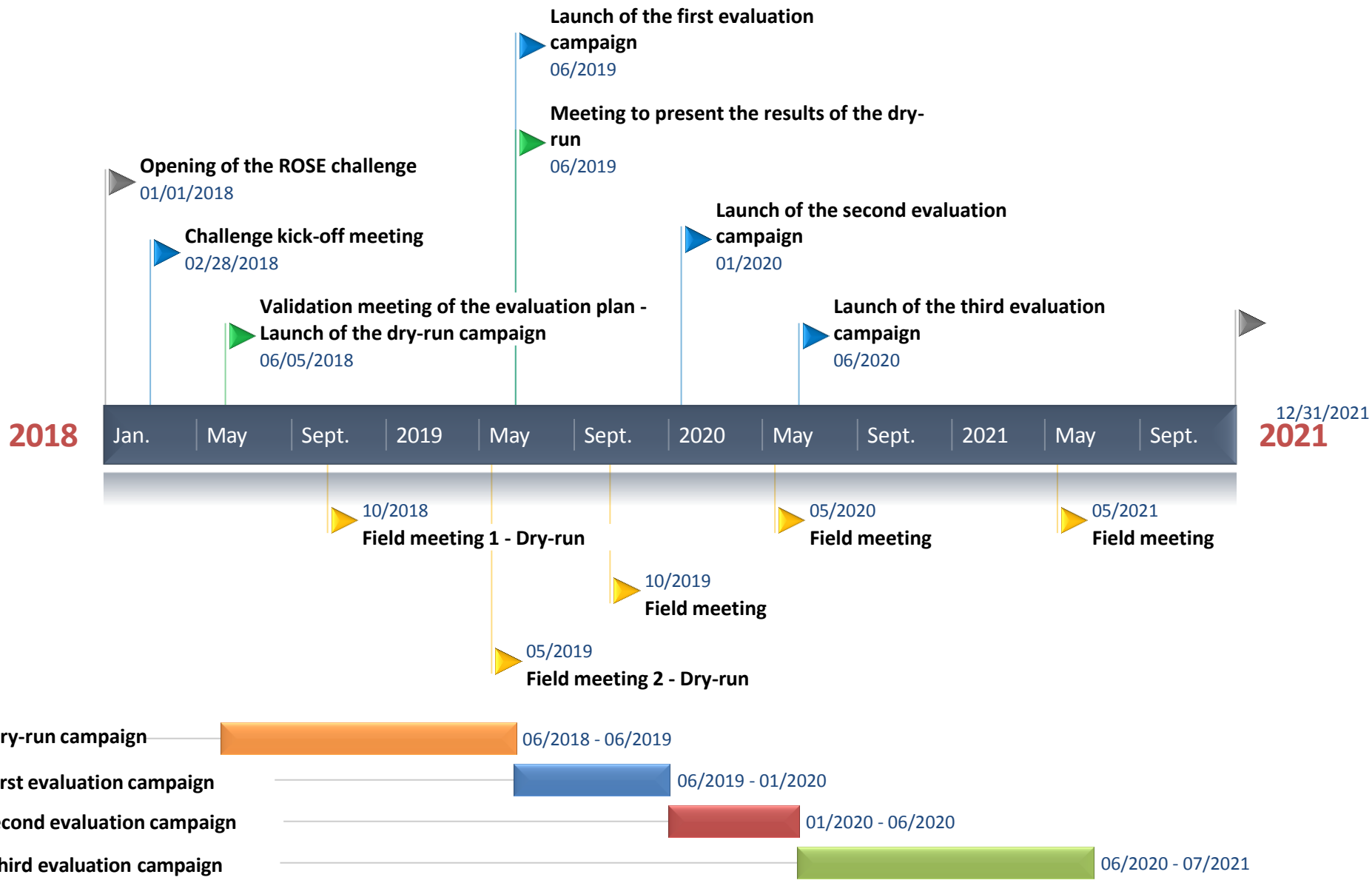


The macro planning of the challenge

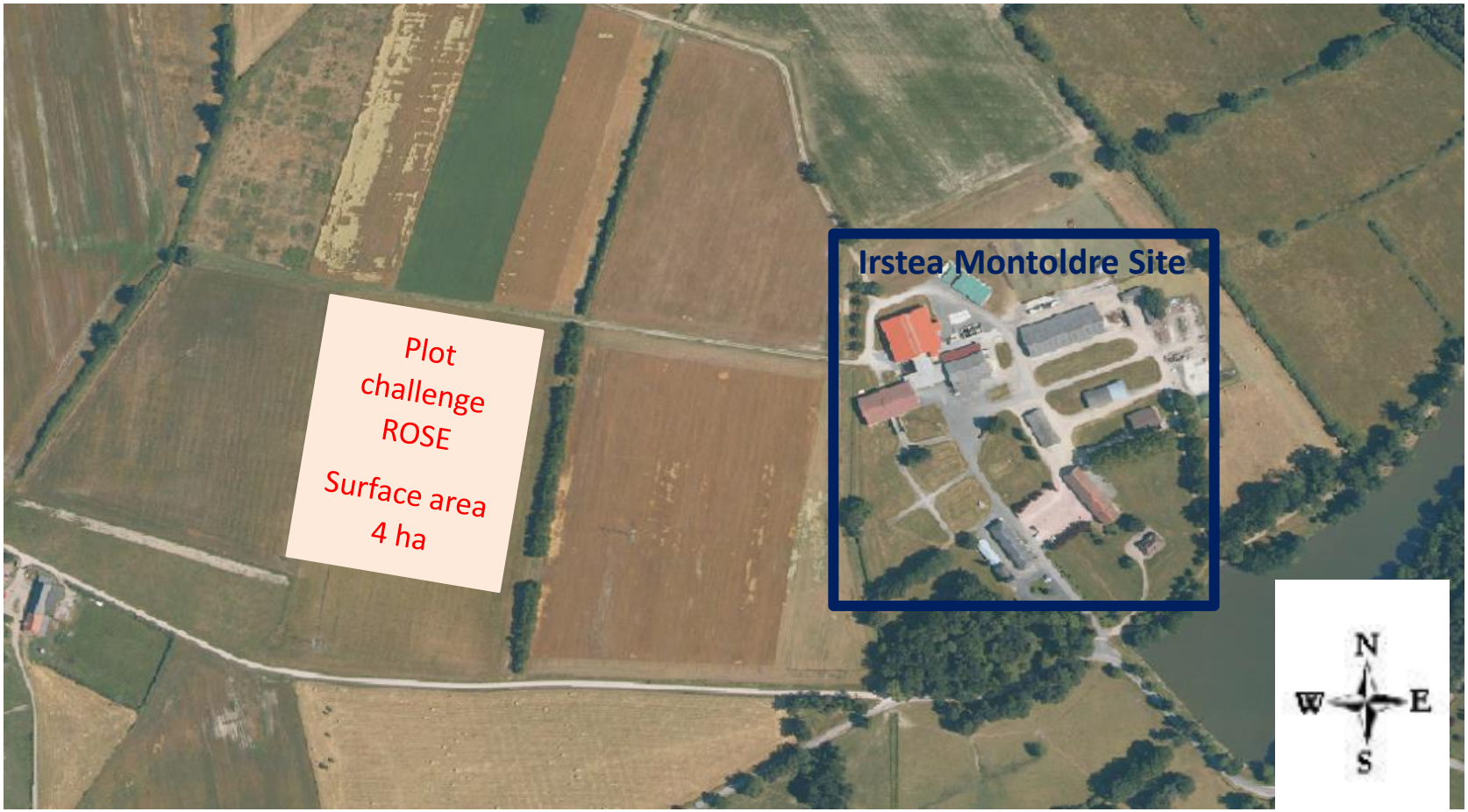
Four evaluation campaigns

Six meetings in the experimental field

An area of four hectares dedicated to experiments

Operational organization

AgroTechnoPôle site : Irstea Montoldre
Plot challenge ROSE



- Detect and identify plants

- Decide on the action to be taken

- Carry out the weeding action

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Three key steps to evaluate

Types of crops planted :

- large crop with wide spacing: maize (row spacing 75 to 80 cm, foot spacing 14 cm)
- field vegetable crops: beans (row spacing 15 to 30 cm, foot spacing 3 to 8 cm)

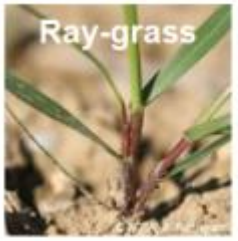
Types of weeds planted: spread out (horizontal):

spread out (horizontal) :

- Model weeds : **mustard**
- Natural weeds : **matricaria**.

with upright (vertical) :

- Model weeds : **ray grass**
- Natural weeds : **goosefoot**.



Crops and weeds

Prototype presented by BIPBIP in September 2019

Prototype presented by Pead in September 2019

Prototype presented by ROSEAU in September 2019

Prototype presented by Weedelec in September 2019

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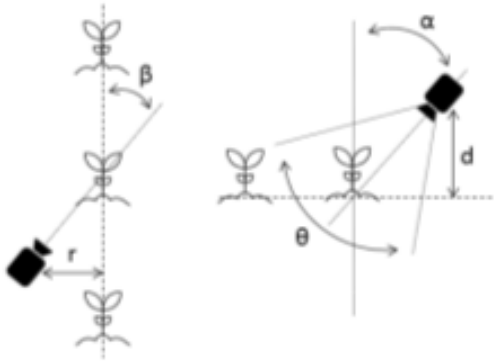
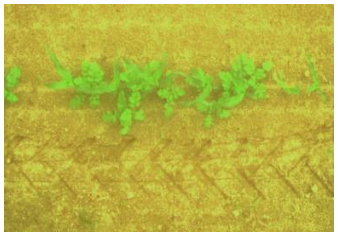
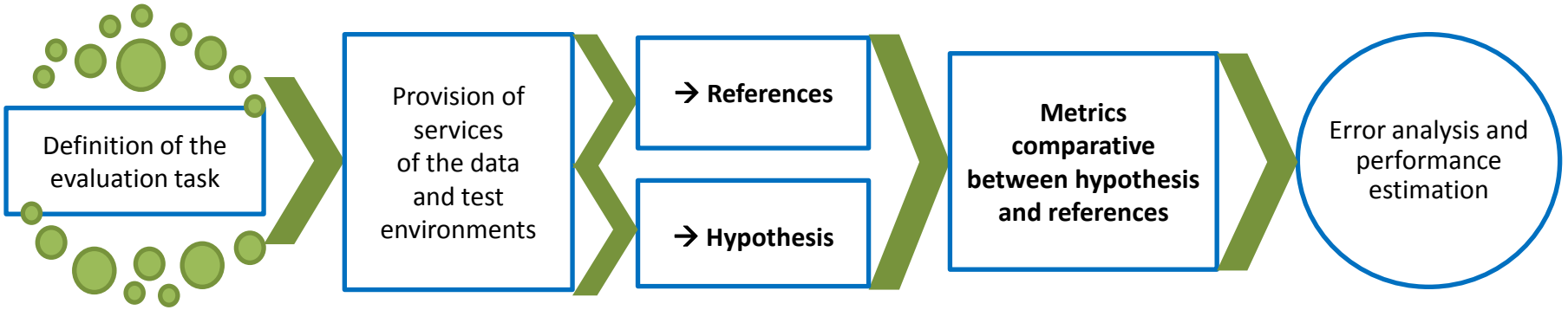
Detection evaluation

Participant	Camera	Light	Resolution	Surface	d	θ	α	β	r
1	RGB	Artificial (DEL)	5 Megapixels (5 pixels/mm)	45cm*5 5 cm	40cm		0°		
2	Visible + hyperspectral (Carbon Bee)	Natural			50 cm	60°	0°	0°	
3	RGB + Infrared	Natural	1024*768 pixels	2m*1.3 m	1.3 m		0°		
4	RGB	Natural (night excluded)	5 Megapixels (1.5mm/pixel)				25°		







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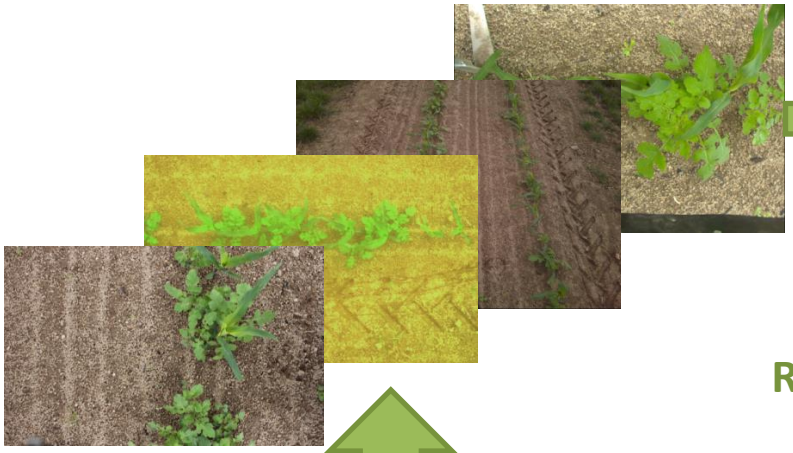
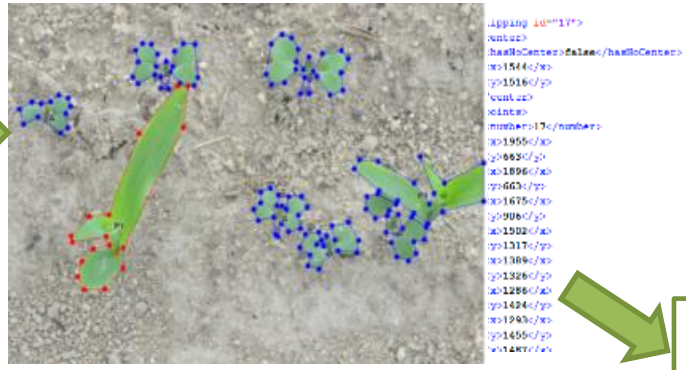
Four technologies for one evaluation



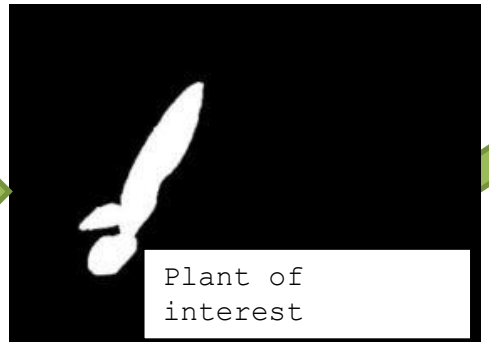


References : manual annotations

Comparaison

1. Mapping
2. Calculation of the error rate

Acquisition of images by the 4 evaluated robots



Hypothesis : outputs from detection systems

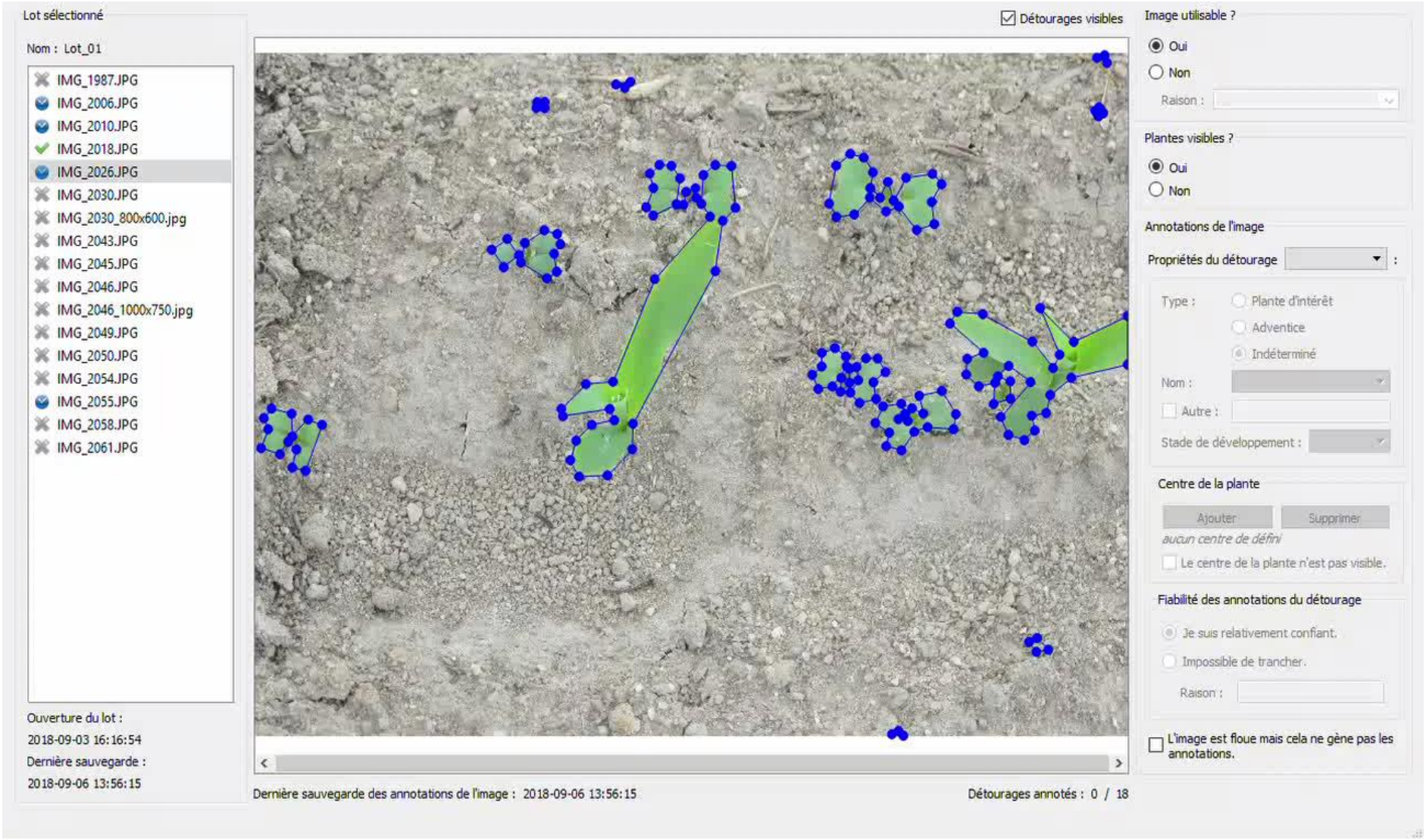
Objective: determine the position of weeds and/or plants of interest on the images

Metric

Evaluation via the EGER metric:

$$EGER = \frac{\sum_{k=1}^{N} C_k + FA_k + O_k}{\sum_{k=1}^{N} NR_k}$$

C_k *:* costs of confusion on the image k
FA_k : false alarm costs on the image k
O_k : costs of forgetting on the image k
NR_k : number of plants detected in the reference (weeds and plants of interest)


Lot sélectionné
Nom : Lot_01
IMG_1987.JPG
IMG_2006.JPG
IMG_2010.JPG
IMG_2018.JPG
IMG_2026.JPG
IMG_2030.JPG
IMG_2030_800x600.jpg
IMG_2043.JPG
IMG_2045.JPG
IMG_2046.JPG
IMG_2046_1000x750.jpg
IMG_2049.JPG
IMG_2050.JPG
IMG_2054.JPG
IMG_2055.JPG
IMG_2058.JPG
IMG_2061.JPG
Ouverture du lot :
2018-09-03 16:16:54
Dernière sauvegarde :
2018-09-06 13:56:15
Détourages visibles
Dernière sauvegarde des annotations de l'image : 2018-09-06 13:56:15
Détourages annotés : 0 / 18
Image utilisable ?
Oui
Non
Raison :
Plantes visibles ?
Oui
Non
Annotations de l'image
Propriétés du détourage :
Type :
Plante d'intérêt
Adventice
Indéterminé
Nom :
Autre :
Stade de développement :
Centre de la plante
Ajouter
Supprimer
aucun centre de défini
Le centre de la plante n'est pas visible.
Fiabilité des annotations du détourage
Je suis relativement confiant.
Impossible de trancher.
Raison :
L'image est floue mais cela ne gène pas les annotations.

Next steps :

- January 2020: presentation of the results of the first campaign
- Presentation of the results of the first campaign
- Availability of the four annotated databases during 2020 (250 images with minimum annotations per technology).
- New evaluation in June 2020

Possibility to use the parcels for image acquisition on request from IRSTEA Montoldre

To follow the progress of the challenge : http://challenge-rose.fr/

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Thank you for your attention

	Influencing factors	Controllability	Robustness test	Measurements made
Agro-pedoclimatic conditions	Weather (rain, wind,...)	No	No	Daily measurements by weather station
	Brightness	No	- During the image-based detection task - During the field detection task	Measurements by luxmeters when participants pass through
	Soil moisture content, temperature, useful water reserve	No	No	Daily measurements by ground probes
	Clay rate measurement	Yes (constant)	No	Measurement before the first meeting
Test mode	Technical itinerary	Yes (constant)	No	Described before the start of the campaigns
	Crop density and distribution	Yes	- During the field detection task - During weeding tasks	Taking pictures before each meeting
	Stage of plant development	No	- When detecting on the image database	Daily image capture

Global influencing factors

Title	Bloc-outil et Imagerie de Précision pour le Binage Intra-rang Précoce	Perception Et binage autonome des cultures en Agriculture Durable	RObotics SEnsorimotor loops to weed AUtonomously	Robot de désherbage localisé par procédé électrique haute tension combiné avec une gestion prédictive par vision hyper-spectrale et post-évaluation par drone
Project acronym	BIPBIP	PEAD	ROSEAU	WeedElec
Coordinating body	Laboratoire de l'Intégration du Matériau au Système (IMS, UMR5218 CNRS, university of Bordeaux, Bordeaux INP) Team MOTIVE	Research institut Xlim (UMR CNRS 7252, multi-sites Limoges, Poitiers, Brive, Angoulême) Team REMIX	SITIA (Engineering company)	UMR Itap Information, Technologies, Analyse environnementale, Procédés agricoles (Irstea, Montpellier SupAgro) Teams COMIC and PEPS
Academic partners	• Bordeaux Sciences Agro • Bordeaux INP • CNRS • Université de Bordeaux (IMS, Labri équipe Rhoban)	• CNRS • Université de Limoges (Xlim)	• INRA (UMR Agroécologie) • IRSEEM	• Irstea • CIRAD (AMAP, UR AIDA) • INRIA (ZENITH, LIRMM) • INRA (UMR EMMAH/UAPV)
Technical and economic partners	• Les Fermes Larrère • Elatec • CTIFL	• CARBON BEE • SABI AGRI	Les chambres régionales d'Agriculture de Pays de la Loire et de Bretagne	• AGRIAL

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Participating consortia to the ROSE challenge