

# Field Robot Event 2026 – Task Descriptions

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## 0. Introduction

The Field Robot Event (FRE) continues its tradition of fostering innovation in agricultural robotics through fair, challenging, and spectator-friendly competition. As in previous years, the event adheres to an "Olympic manner," prioritizing fairness, transparency, and mutual support among participating teams.

### Key Changes for 2026

While the core spirit of the competition remains unchanged, the 2026 edition introduces specific structural adjustments to enhance the pace and engagement of the event:

- **Parallel Operation:** Two robots will now run directly after each other on two parallel tracks (Field A and Field B) to maintain a high pace and maximize audience engagement.
- **Dual Attempts with Best Score:** To ensure fairness and account for variability in field conditions, each team will be granted two chances: one run on Field A and one on Field B. The **best performance** will count toward the final score.
- **Single Chance Per Field:** While teams have two total attempts, there is **no second chance for a robot on the same field**. If a robot fails to start or encounters a critical issue on Field A, the team must rely on their performance on Field B to recover.

### Administrative Notes & Registration

- **Communication:** Important and real-time information will be disseminated via the official **Discord server**. Teams are strongly encouraged to join to receive updates on task rule adjustments.
- **Registration:** Registration is **now closed**.
- **Virtual Participation:** There are currently no plans to offer virtual participation or a competition in a virtual environment. All tasks must be performed physically in the field.
- **Rule Modifications:** The organizing team strives to describe tasks as clearly as possible. However, teams should be aware that rules may need to be modified before or even during the contest to clarify ambiguities or resolve unforeseen issues. Any such changes will be decided by the jury and communicated to all teams immediately.

### Team & Robot Eligibility

- **Team-Based Scoring:** Results are attributed to the **team**, not an individual field robot. Teams may utilize different robots for different tasks, but only one robot may perform a specific task instance.

- **Start Protocols:** Each team is allocated exactly two attempts: one on Field A and one on Field B. Robots must start within one minute of the acoustic signal for **each** attempt. If a robot fails to start within this one-minute window on a specific field, that attempt is recorded as a failure for that field. No third attempt is permitted.
- **Performance Assessment:** Performance is assessed by an independent jury committee based on measured or counted parameters for Tasks 1–4, as well as creativity and originality specifically for the Freestyle task (Task 5).
- **Prizes:** Prizes will be awarded for the top three ranks in each task. An overall competition winner will be determined based on the cumulative results of Tasks 1–4. Task 5 (Freestyle) is scored separately as a dedicated creativity and sustainability prize.
- **Participation Points:** Participating teams earn at least one point, while non-participating teams earn zero. In the event of a tie in the overall ranking, the team with better placements across all tasks will be ranked higher.

Ranking	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	not participating
Points	18	16	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

### Operational Procedures

To ensure a smooth and fair competition, teams are expected to follow these standard operational guidelines:

- **Autonomous Operation:** The primary goal is for robots to navigate and perform tasks independently. While remote control for steering or motion is not permitted during the run, teams are encouraged to design robust autonomous systems. The Start/Stop controller is intended solely for pausing the robot to facilitate safe manual corrections if needed.
- **Start & Stop Controller:**
  - Teams should equip their robots with a wireless START/STOP controller featuring clearly marked buttons (e.g., Green/Red or labeled START/STOP).
  - Please present the controller to the jury before the run and place it on the designated table at the field edge.
  - Runs should be initiated using the remote controller's START input to ensure a standardized start for all competitors.
  - A jury member will observe the controller usage to ensure compliance with the autonomous nature of the event.
- **Manual Intervention:**
  - If a robot requires adjustment, the team member operating the remote must press the **STOP** button and wait for the robot to come to a complete halt.
  - **Entry Protocol:** The same team member who pressed the STOP button is the one authorized to enter the field and approach the robot for adjustments.
  - **Assistance for Heavy Robots:** For larger or heavier robots where physical manipulation is difficult, a second team member is permitted to enter the field specifically to assist with moving or stabilizing the robot.
  - **Guidelines:** You are welcome to rotate the robot to improve its heading. Moving the robot is generally discouraged, but you may gently reposition wheels or tracks if they are stuck in crops to prevent further damage. In cases of significant

- navigation errors, carrying the robot back to the last known correct position and orientation is acceptable.
- Please note that the competition timer continues to run during any manual intervention.
- The robot can resume its task once all team members have safely exited the field.
- **Parc Fermé:** When not actively running, robots should remain in the *parc fermé* area. To maintain a level playing field, we recommend disconnecting PC connections (wired or wireless) and enabling battery-saving modes while waiting, ensuring no team gains an advantage based on battery levels or network connectivity.

### General Rules Overview

The following general rules apply to all tasks unless explicitly stated otherwise in the specific task descriptions:

- **GNSS Restrictions:** The use of GNSS receivers is **prohibited** for all tasks except the Freestyle task. For Tasks 1–4, the focus should be on relative positioning and sensor-based behaviors.
- **Crop Conditions:** The crop plants for the tasks are maize (*Zea mays*), with heights approximately 20–40 cm depending on local growing conditions.
- **Plant Damage:** A maize plant is considered damaged if it is permanently bent, broken, or uprooted. The jury or their assistants will determine if a plant has been damaged by a robot. Damaged plants will be replaced with spares to ensure consistent conditions for subsequent runs.
- **Navigation:** Robots should aim to drive **between** the crop rows and not above them for Tasks 1 and 2.

Teams are encouraged to review the detailed task descriptions below and prepare their robots accordingly. Good luck to all participants!

## Task 1: Navigation in a Maize Field

### General Description

Robots navigate autonomously through a maize field (fig. 1) with parallel straight rows (0.75 m apart). The difficulty increases gradually:

- Plant rows 1–4: no gaps, straight driving, adjacent turns.
- Plant rows 5–6: introduce single gaps (missing plants).
- Plant rows 6–n: follow a given turning pattern (e.g., 1L – 1R – 2L – 3R).
- Final plant rows: more gaps and irregularities.

Planting distance within the row: 15–25 cm. Multiple gaps can occur within a single row. The only constraint is that each individual gap (the space between two consecutive existing plants) will not exceed 1 meter in length. Gaps may also occur in adjacent rows at the same position along the row.

The size of the field roughly corresponds to the distance a robot travels in 3 minutes at a speed of 1 m/s (180 m), taking into account the turning pattern (each turn takes approximately 1.2 m). Row length app. 10-12 m.

### Rules for Robots

- Start within 1 minute after the acoustic signal.
- Maximum time: 3 minutes.
- Must stay between rows; damaging maize plants leads to penalties.
- Robot starts at a clearly marked start line.

### Scoring

- Distance travelled correctly along the defined path.
- Bonus:  $1.0 \text{ m} \times t$ , where  $t$  is the seconds finished faster than 3 minutes.
- Penalty: 5 m per damaged plant.

### Formula:

$$P_{\text{Task1}} = P_{\text{Distance}} - P_{\text{Penalty}} + P_{\text{Bonus}(t)}$$



### Scoring

- +2 points per correctly detected diseased plant.
- -2 points per false positive (healthy plant marked as diseased).
- -1 point per missed diseased plant.
- -5 points per damaged maize plant.

Bonus for speed: 1 point  $\times$   $t$ , where  $t$  is the seconds finished faster than 3 minutes.

Bonus upon submission of the log file:

- +2 per correct position of identified diseased plant,
- 2 point per false positive and
- 1 for missed plant.

The bonus cannot be negative.

Formula:

$$P_{\text{Task2}} = P_{\text{Scoring}} + 0.5P_{\text{Bonus speed}(t)} + 0.5P_{\text{Bonus digital}}$$

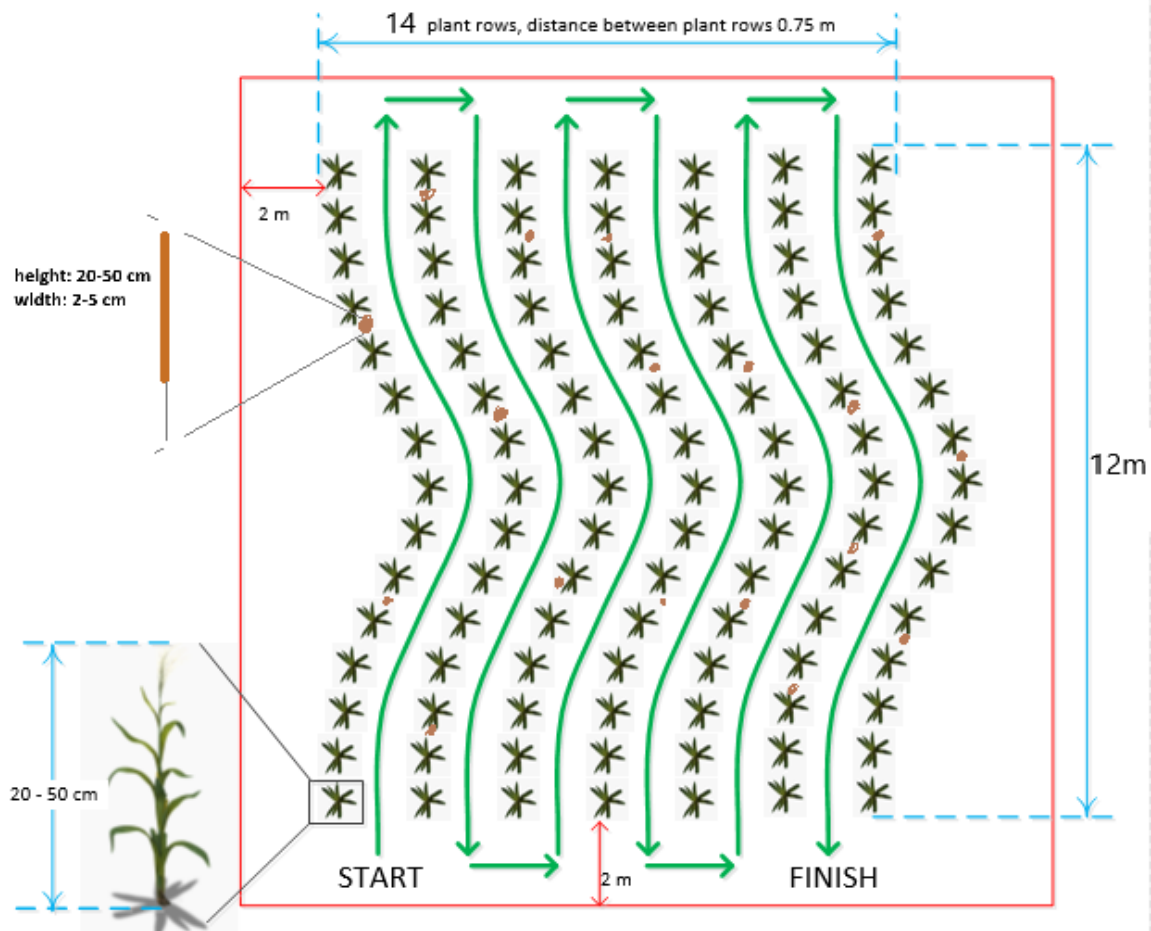


Figure 2 Example of task 2 (illustrative)



**Figure 3 Marker with jute stripe**



**Figure 4 Marker with yellow paper**

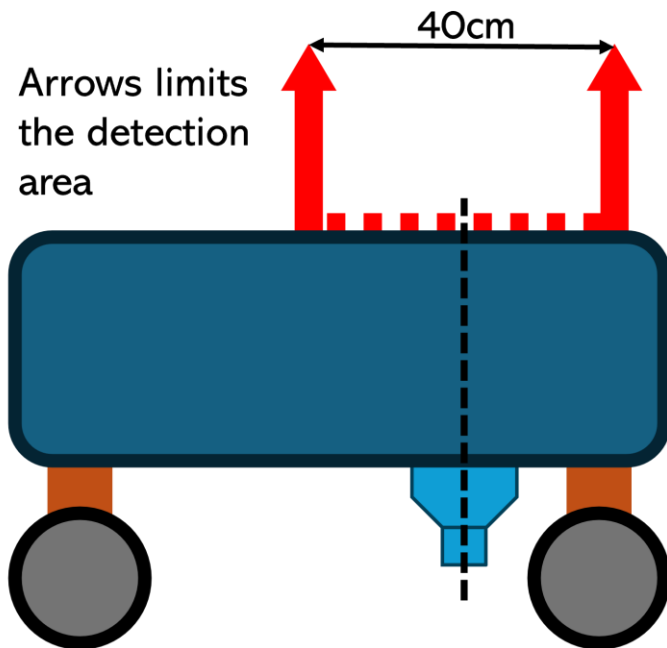


Figure 5: Schematic of detection area. Two markers (e.g. red arrow) mounted to the robot indicate detection area.

### Task 3: Biodiversity Monitoring

#### General Description

Robots encounter images or models of insects placed along the (straight) rows (same field as task 1):

- Bee (beneficial)
- Beetle/aphid (pest) (Lady birds indicate the presence of aphids: TBD)
- Butterfly (neutral)



Figure 6 6 Example of a bee (illustrative)



Figure 7 7 Example of Ladybirds indicate the presence of aphids (illustrative)



Figure8 8 Example of a butterfly (illustrative)

Each insect is attached to a green stick at the height of the leaves. The insects are (plastic) imitations and resemble those in figures 6 to 8. (Where these can be ordered will be announced later.)

To make it clear to the audience which insect needs to be detected, the stick extends above the crop and is decorated with an image, text or soft toy of the insect.

Robots must correctly classify the insect type. To involve the audience, robots must visibly or audibly react:

- Green light or “bee – good!” for bees.
- Red light or “pest detected!” for beetles/aphids.
- Yellow light or “neutral” for butterflies.

#### Rules for Robots

- Robots must start within 1 min.
- Task duration: 3 min.
- Robots pass 10 insect stations. (Max 3 per row)
- Each station must be classified within 40 cm. The robots are equipped with two clearly visible markers for the jury and the public, indicating the start and end of this 40 cm detection area. (fig. 5)
- One signal per station (light, sound, or display). First classification counts.

#### Scoring

- Correct classification: +3 points.
- Incorrect classification: –3 points.
- Missed station: -1 points.
- –5 points per damaged maize plant.

## Task 4: Soil Spot Treatment

### General Description

Robots operate in a test strip where soil spots (marked by colored pads) indicate areas needing treatment. To make this attractive to the audience and agronomically relevant, robots must perform a visible and application-oriented action at each spot, for example:

- Spraying a small jet of water (visible in sunlight).
- Dropping a biodegradable marker pellet.
- Weeding with a (rotary)hoe, harrow.

Treatments have to remain visible after finishing task.

### Bonus for soil engaged treatment

#### Test strip:

Bare ground or stubble. Field measuring 60 to 70 m<sup>2</sup>. (Large enough to be prepared in 3 minutes at a speed of 0.5 m/s, with a working width of 0.75 m.) Unknown shape, without right angles. Marked out with corner flags, for example.

Teams are given the opportunity to measure the corner flags themselves in advance.

If the robot goes outside the field, it must be stopped using the emergency stop and returned to the field by hand.

#### Markers:

Markers consist of red round discs, approx. 5 cm in diameter, with a hole in the middle, which are secured in the ground with a nail or tent peg. Touching the marker is allowed, but pulling it out is a fault (damage).

The distance between markers is at least 0.5 m. There are no markers along the edges (minimum 0.5 m from the edge).

#### Rules for Robots

- Robots must start within 1 min.
- Task duration: 3 min.
- Spots are randomly distributed, not more than 2 m apart.
- Robots must not damage markers. (Any action that changes the colour of the ring, e.g. spray painting, flame thrower ;) is considered damage.)

#### Scoring

To determine the correct distances for scoring, a set of concentric rings with the correct diameters is placed over the marker.

- Correct action within 15 cm of spot: +2 points.
- Correct action within 30 cm of spot: +1 point.
- Missed spot: -1 point.
- Wrong action, > 45 cm of spot: -2 points.
- Damaged marker: -5 points.
- Bonus for soil engaged action within 15 cm of spot: +1 point.

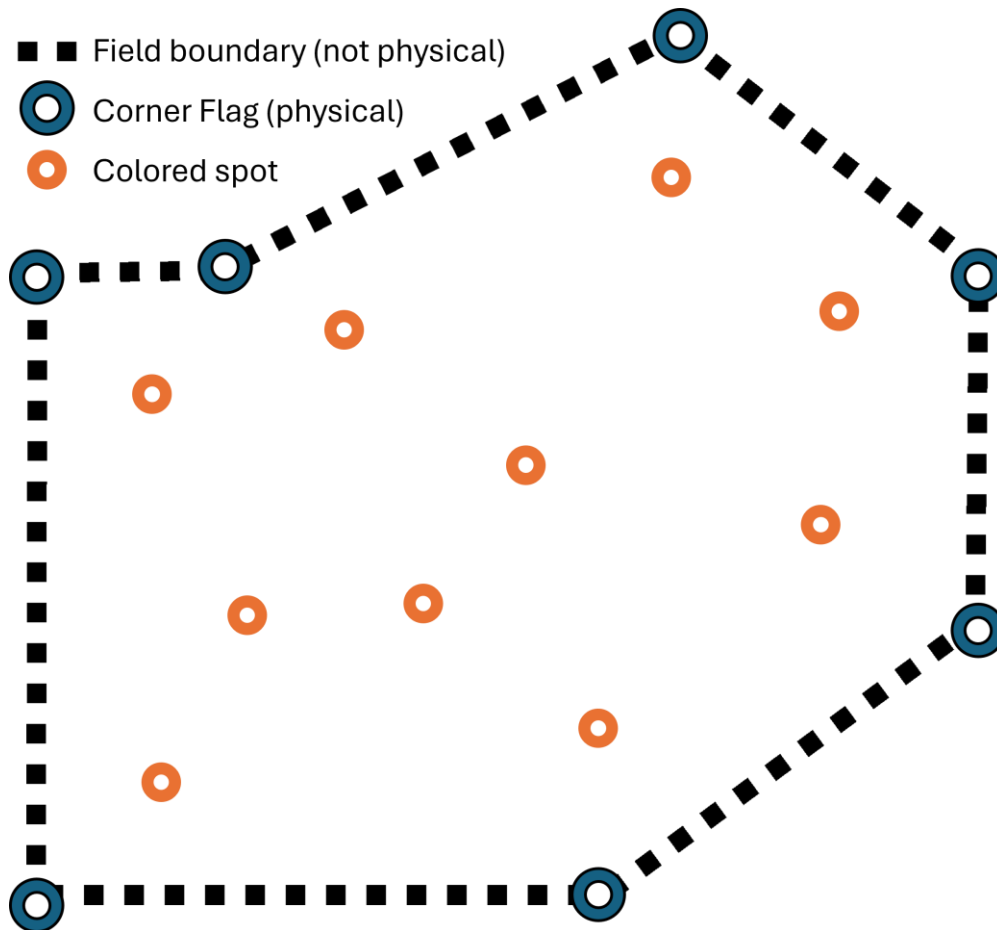


Figure 9: Example of task 4 (illustrative)

## Task 5: Freestyle

### General Description

Teams demonstrate their creativity with an agricultural application of their choice. In 2026, the emphasis is on sustainability – water saving, energy efficiency, biodiversity support, or reduced chemical input. Teams are encouraged to make this focus explicit in their performance.

### Rules for Robots

- Max. 5 minutes including explanation.
- Robot performance must be safe and visible to jury and spectators.

### Scoring

- Hand out balls to the audience (not to team members!) and place a bucket next to each team where they can put their balls.
- Also give the team captains balls to distribute. They are not allowed to give balls to their own team! (Give them balls with their team number on them).

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- Each judge receives balls to award to the best agronomic idea, the most complex technique and the best execution.