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CEDRIC

BEST PRACTICE 5

Engaging stakeholders and transferring rhizosphere knowledge

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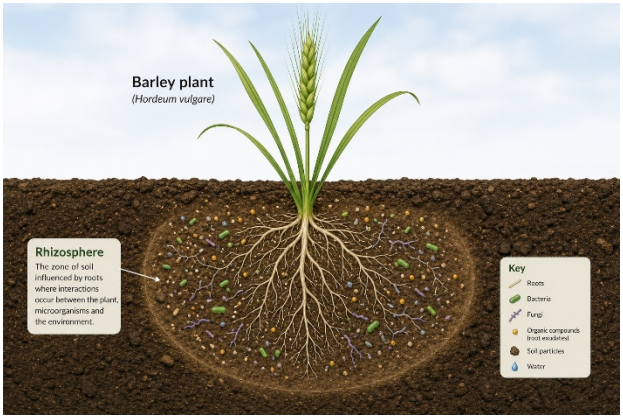
The rhizosphere is the narrow zone of soil influenced by plant roots and their interactions with microorganisms. It is a dynamic interface in which **plants, bacteria, fungi** and other **soil organisms** interact, shaping nutrient mobilization, plant health, stress responses and overall soil functioning. In previous CEDRIC best practices, root-associated microbiomes, rhizosphere sampling, root exudates and the communication of soil science were recognised as strategic knowledge areas because they link basic research with agricultural practice and public awareness. In this context, CEDRIC has worked to generate knowledge, disseminate information and support outreach activities that improve understanding of the rhizosphere, promote biodiversity protection and encourage more sustainable agricultural practices.



Despite the growing scientific relevance of rhizosphere processes, knowledge transfer remains difficult. The topic is scientifically complex, often invisible to non-specialists, and easily fragmented across disciplines. Effective stakeholder engagement therefore requires more than dissemination. It requires translation of evidence into understandable messages, adaptation to different audiences, opportunities for interaction, and practical formats that support uptake and reuse. CEDRIC Best Practice 3 explicitly stresses the need to tailor messages to specific target groups, combine scientific accuracy with accessibility, use storytelling and hands-on formats, and evaluate learning outcomes.

This best practice provides a practical framework for engaging stakeholders and transferring rhizosphere knowledge in research, advisory, educational and demonstration contexts.

Why stakeholder engagement matters in rhizosphere research

Rhizosphere knowledge has direct implications for sustainable agriculture, soil health, nutrient efficiency, resilience to environmental stress and the development of microbiome-based solutions. CEDRIC materials show that root-associated microorganisms can promote plant growth, improve nutrient uptake and influence the physical and biological functioning of soils. They also show that root exudates are central in shaping plant–microorganism interactions, but that these processes are highly context-dependent and require careful interpretation and standardized methods.

For this reason, stakeholder engagement should not be treated as a final communication step. It should be integrated from the beginning of the knowledge-production process, so that research questions, data formats, demonstration activities and outputs are aligned with the needs of farmers, advisors, educators, students, policy actors and innovation intermediaries. The communication-focused CEDRIC best practice also underlines that public understanding improves when soil life is connected to everyday concerns such as food production, ecosystem resilience and climate-related challenges.

Before producing any transfer material, prepare a **stakeholder mapping table** with:

- target group,
- expected prior knowledge,
- practical interest,
- key message,
- preferred format,
- desired action or outcome.

This avoids generic dissemination and helps transform scientific content into audience-specific outputs.

Define a small set of transferable core messages

CEDRIC's communication material shows that effective outreach depends on a limited number of robust concepts repeated across formats. For rhizosphere knowledge, transfer should focus on a small set of messages that remain scientifically accurate while being understandable.

Recommended core messages

The rhizosphere should be understood as a biologically active environment rather than as inert soil. Plants do not grow in isolation, because their roots are continuously engaged in interactions with microorganisms that can influence nutrient cycling, plant nutrition and resilience. Within this dynamic zone, root exudates play a central role as mediators of belowground interactions.

Plants release a wide range of compounds, including sugars, amino acids, organic acids and signaling molecules, which shape microbial communities and affect biological processes in the root zone. At the same time, rhizosphere processes are strongly context-dependent. They vary according to plant species, developmental stage, nutritional status, environmental conditions and management practices, which means that findings should not be generalized too broadly. This is why methodological standardization and control of variability are essential.

Credible knowledge transfer depends on robust methods, since factors such as sampling depth, sample handling, contamination control, replicate design, storage conditions and timing all affect the reliability of rhizosphere data. For this reason, communication with stakeholders should not only present findings, but also explain the level of confidence associated with them and the main methodological limitations.

Overall, rhizosphere knowledge is highly relevant for sustainable agriculture, as it can support soil stewardship, more informed management decisions and a better understanding of plant-soil-microbe interactions. However, its practical application should always remain evidence-based and adapted to local conditions.

Box 1. Identify stakeholder groups and define their knowledge needs

It is mandatory to distinguish stakeholder categories clearly. CEDRIC's communication guidance recommends differentiated approaches for school students, university learners, educators, researchers and the general public. The same logic should be extended to rhizosphere knowledge transfer.

Main stakeholder groups:

- **Farmers and growers:** They need usable information on soil fertility, plant performance, management implications, risk reduction, and compatibility with existing practices.
- **Advisors, extension services and agronomists:**They need interpretable evidence, decision-support messages, practical thresholds, and examples from field or demonstration settings.
- **Researchers and laboratory staff:** They need methodological clarity, reproducibility, metadata standards, and explicit statements on limitations and trade-offs.
- **Policy actors and local authorities:** They need concise evidence on relevance, impact, feasibility, and links to sustainability, soil protection and regional development.
- **Educators, students and the general public:** They need simple narratives, visual explanations and concrete examples that make the "hidden" biology of the rhizosphere understandable.

A recurring lesson from CEDRIC best practices is that communication is more effective when it is interactive, modular and linked to real examples. Passive one-way dissemination is rarely sufficient.

Recommended transfer formats

Field demonstrations and living labs are particularly useful for farmers, advisors and local actors because they allow stakeholders to connect rhizosphere concepts with visible crop performance, soil handling, root traits and management practices. Hands-on activities and guided observation are especially effective for students and the general public, as practical formats such as guided experiments and interactive modules tend to improve engagement and retention. Short technical factsheets are more suitable for advisors, project partners and practitioners, provided that they clearly summarise the objective, the method used, the main observations, their meaning, the remaining uncertainties and the possible implications for practice. Training modules for intermediaries also play an important role, since advisors, teachers and facilitators act as multipliers, and training them increases both the durability and the scale of rhizosphere knowledge transfer. Visual communication tools are equally valuable, because root systems, exudate pathways, microbiome interactions and sampling workflows are often easier to understand through diagrams, photographs and simplified process schemes. This is consistent with CEDRIC's use of exhibit design and visual storytelling. Finally, digital repositories and reusable materials such as protocols, glossaries, slide decks, short videos and FAQs should be archived in accessible formats so that project knowledge remains available and usable beyond the project lifetime.

Box 2. Co-create messages with stakeholders

A stronger transfer model is based on dialogue rather than one-directional dissemination. Stakeholders should be involved in framing problems, selecting examples, testing materials and validating whether messages are understandable and useful.

Practical co-creation steps

Listen first:
Use interviews, short surveys or workshop discussions to identify stakeholder concerns: soil fertility, input costs, crop stress, biodiversity, or practical feasibility.

Translate scientific content into user questions:
For example:
"What does the rhizosphere do for crop performance?"
"How can we observe whether root-associated processes are changing?"
"What can current evidence support in practice, and what still remains experimental?"

Test materials with representative users:
Draft factsheets, posters, field scripts or presentations should be reviewed by at least one representative from the intended audience.

Revise iteratively:
CEDRIC Best Practice 3 recommends pre/post feedback mechanisms and iterative improvement of modules based on participant responses. The same principle should apply here.

An effective workflow for transferring rhizosphere knowledge should begin with a clear definition of the transfer objective. At the outset, it is necessary to establish whether the activity is intended to raise awareness, support training, inform practice, contribute to policy dialogue, or stimulate further experimentation. Once the objective is defined, the next step is to identify the relevant target groups and select a limited number of priority messages tailored to their needs and background knowledge. In most cases, each communication or training output should focus on no more than two or three core messages in order to remain clear and effective. These messages should then be matched with the most appropriate format. For example, detailed protocols may be more suitable for researchers, technical factsheets for advisors, demonstration activities for farmers, and visual or narrative-based materials for students and public audiences. Before delivery, all content should be checked for scientific robustness, ensuring that methods, assumptions and limitations are transparent and traceable. Whenever possible, knowledge transfer should take place in interactive settings, such as workshops, field days, school activities, science events or regional stakeholder forums, because participation generally improves understanding and retention. Finally, the process should include feedback collection and evaluation, using questionnaires, interviews, follow-up exchanges or observations of material reuse. The outputs should then be revised where necessary and archived in accessible formats so that validated rhizosphere knowledge remains available and reusable beyond the immediate activity or project duration.

Box 3. Monitoring success

Evaluation should be built in from the outset. CEDRIC communication guidance explicitly recommends pre/post surveys, participant feedback and iterative refinement of educational modules.

Suggested indicators:

- Number and diversity of stakeholders reached;
- Level of understanding before and after the activity;
- Perceived relevance of the information;
- Intention to reuse or apply the knowledge;
- Requests for follow-up materials or collaboration;
- Evidence that materials were reused by advisors, teachers or partner organisations.

Where possible, combine quantitative indicators with qualitative feedback. In complex topics such as the rhizosphere, improvement in understanding and trust may be a more realistic short-term outcome than immediate behavioural change.

Engaging stakeholders and transferring rhizosphere knowledge requires a structured, transparent and audience-specific approach. In line with the CEDRIC best-practice model, the most effective strategy combines scientific robustness with accessible communication, stakeholder mapping, interactive formats, methodological transparency, and continuous evaluation. CEDRIC materials show that both rhizosphere sampling and root exudate analysis depend on careful standardization, while communication success depends on tailoring content, connecting science to real-life concerns, and building participation rather than one-way dissemination.