Research Trends in Evidence-Based Agro-Healing

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SOCIAL CONTEXT

Complex global health crises require new healthcare approaches




Mental Health Crisis

Rising depression, anxiety, and burnout

Approximately 15% of the global population affected

Population Aging

Population aged 65+ expected to exceed 16% by 2050

Rapid increase in elderly care demands

Increase in Chronic Diseases

Growing prevalence of diabetes, cardiovascular disease, and obesity

Lifestyle-related chronic diseases account for over 70% of healthcare costs

Social Isolation

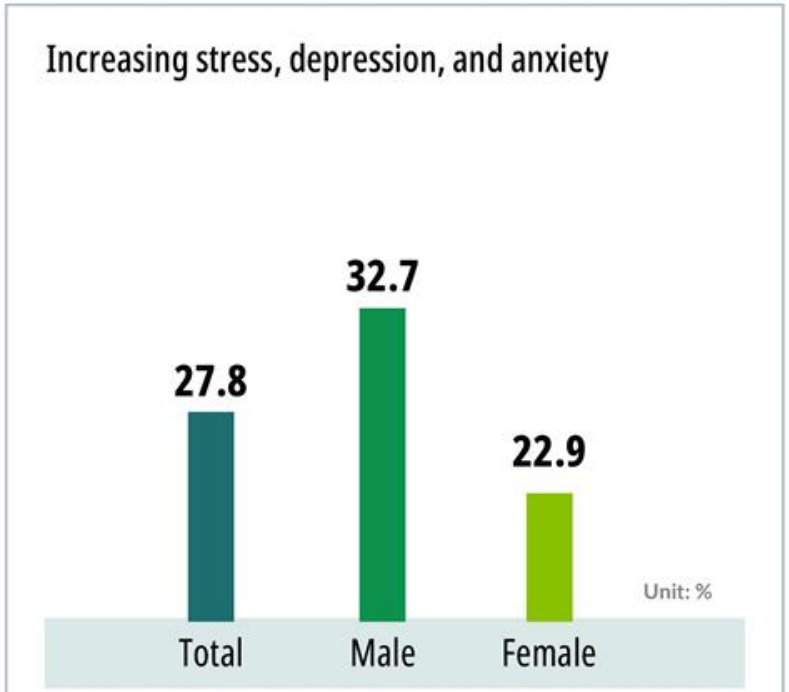
Increase in single-person households and digitalization

Weakening community connections and social support systems

WHO and UN reports (2022–2023)

THE GROWING MENTAL HEALTH CRISIS

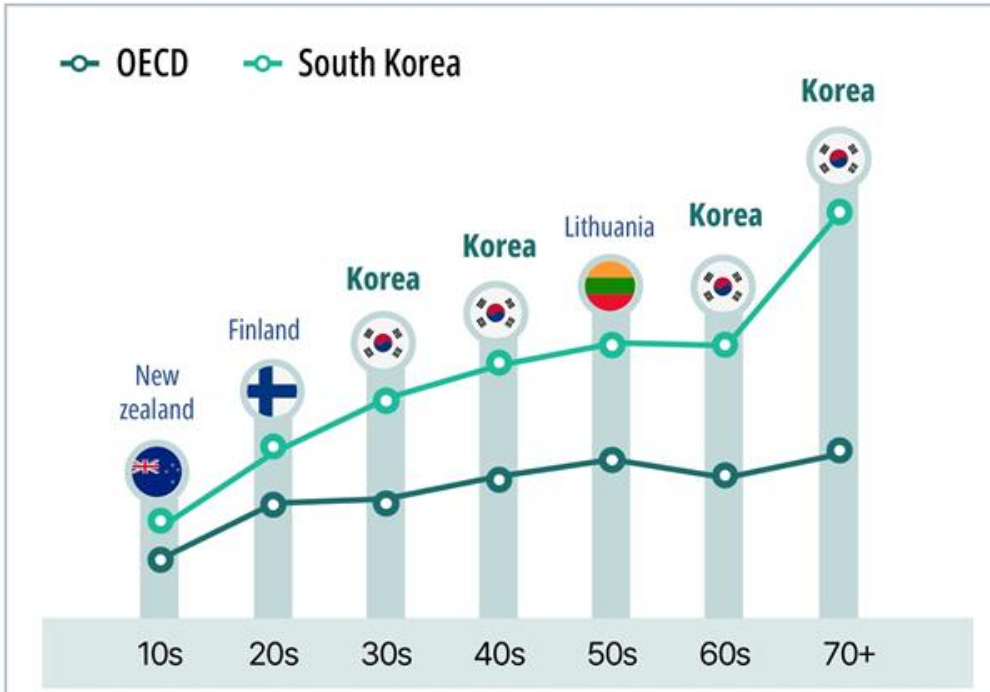
Mental Health Disorders on the Rise



Approximately 1 in 4 people experience mental health disorders

Ministry of Health and Welfare Report (2023)

High Suicide Rates



Korea ranks among the highest in suicide rates among OECD countries

WHO database (2021)

LIMITATIONS OF MENTAL HEALTH SERVICES

Internalized Stigma

Limited Treatment Utilization

Only 25% receive early diagnosis and treatment

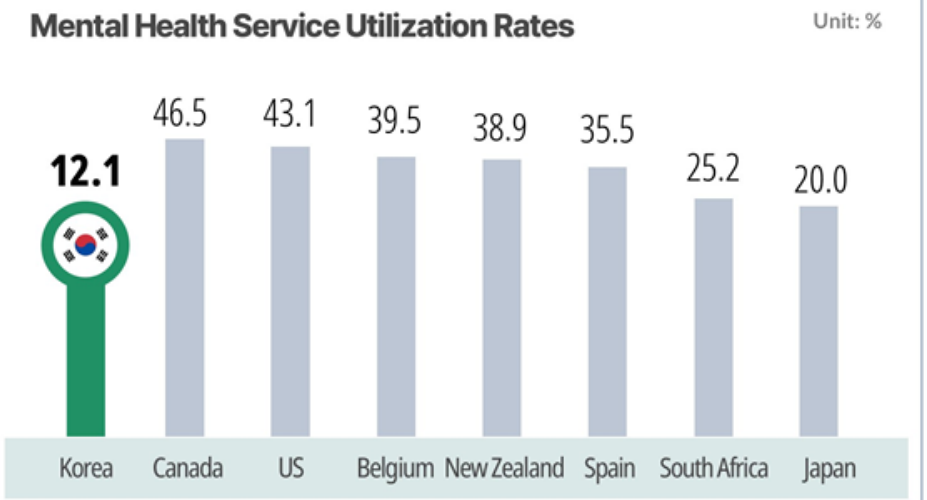
Society discriminates against people with mental health struggles.	77.0%
Living with mental illness in Korea is difficult.	54.8%
Psychiatric treatment records carry strong social stigma.	75.1%
Mental illness should be addressed collectively as a social issue.	82.4%
Admitting emotional pain requires courage.	88.4%
Many people hide their struggles behind a positive appearance.	60.9%

N: 1,000

Limited Accessibility to Mental Health Services

Barriers to Treatment Access

Psychological and physical barriers limit service utilization



Ministry of Health and Welfare Report (2021)

Community- and Government-level Support Systems are needed to improve treatment accessibility and continuity Of care

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DEFINITION OF HEALTH

Health is not merely the absence of disease or infirmity, but a state of complete physical, mental, and social well-being

WHO, 1948

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HEALTHCARE PARADIGM SHIFT

PHASE 01

Conventional Medicine

1. Disease- and symptom-centered treatment
2. Passive treatment approach
3. Short-term intervention

Focused on biological abnormalities and linear processes of diagnosis and prescription

PHASE 02

Complementary and Alternative Medicine

1. Nature-based healing and prevention
2. Mind–body integration
3. Holistic approach

Includes aromatherapy, meditation, and traditional Korean medicine as complementary healing approaches

PHASE 03

Integrative Medicine

1. Patient-centered care
2. Whole-person health and evidence-based approach
3. Integration of conventional and complementary medicine

Nature-based healing environments emerge as key therapeutic resources

WHO (2014-2023), NCCIH (2021-2025)

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A NEW HEALTHCARE PARADIGM, AGRO-HEALING

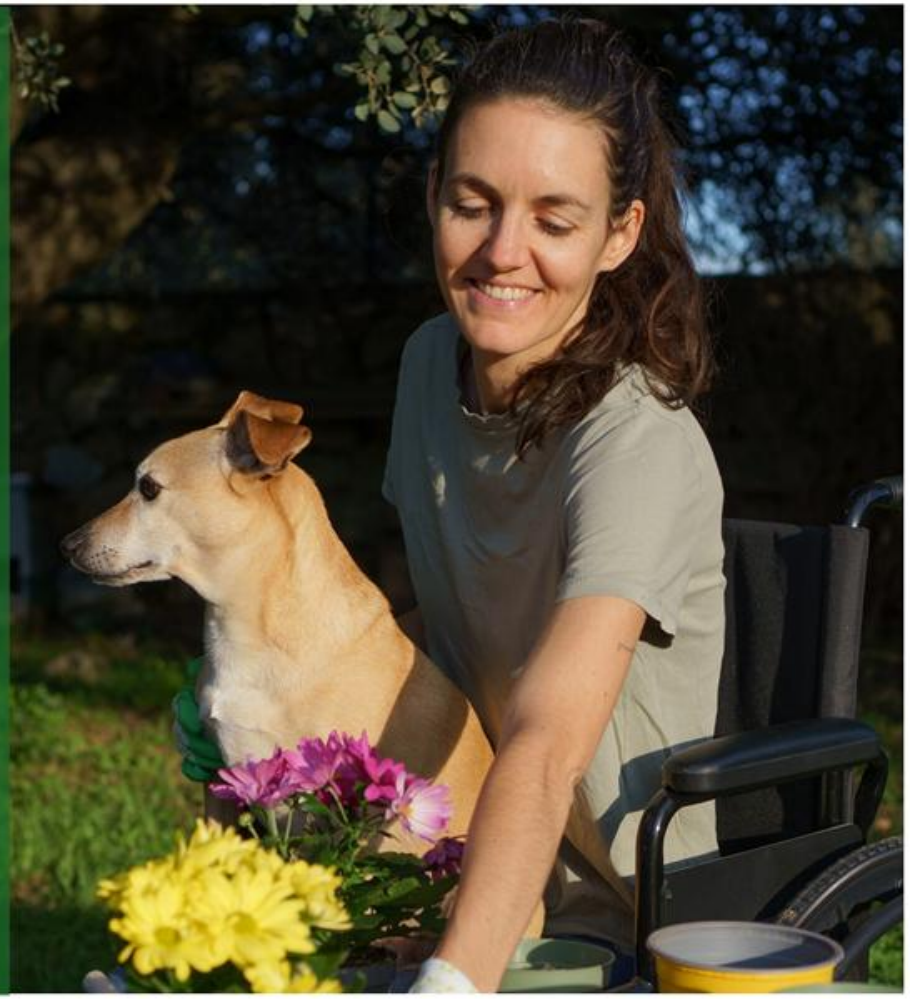
Productive
Agriculture

→

HEALING
AGRICULTURE

Industries and activities that promote the physical and mental health of the public through the utilization of agricultural and rural resources and related activities.

Act on Research, Development and Promotion of Agro-Healing, 2020



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PLANT-MEDIATED THERAPY

An Integrative Approach to Nature-Based Healthcare

THEORETICAL FRAMEWORKS FOR PLANT-MEDIATED THERAPY

Biophilia Hypothesis

"Nature holds the key to our aesthetic, intellectual, cognitive and even spiritual satisfaction."

Edward Wilson, 1984

Attention Restoration Theory

"Attention is restored through experiences of being away, soft fascination, extent, and compatibility."

Kaplan & Kaplan, 1989

Stress Recovery Theory

"Exposure to natural environments after stress promotes rapid physiological recovery and relaxation."

Roger Ulrich, 1983

Hortophilia Hypothesis

"The desire to interact with, manage and tend nature."

Oliver Sacks, 2009

Plant-Mediated Experience Theory

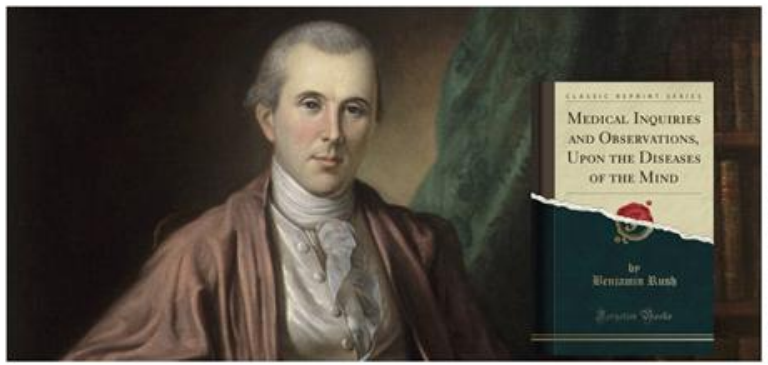
"Plant-related experiences, ranging from passive exposure to active interaction and cultivation, promote restorative emotional, cognitive, physiological, and behavioral outcomes."

Sin-Ae Park, 2024

HISTORICAL DEVELOPMENT AND MEDICAL APPLICATIONS OF HORTICULTURAL THERAPY

Nature-based healing concepts, which originated in 18th-century psychiatry, began to be widely applied in medical settings during the mid-20th century

Dr. Benjamin Rush 1746~1813



Gardening and farm work could benefit individuals with mental illness

Medical Inquiries and Observations upon Diseases of the Mind (1812)

Mid 1940s. Expansion of Clinical Applications of Horticultural Therapy

The Menninger Clinic, Psychiatric treatment center, Topeka, KS, US

Early application of horticultural activities in psychiatric treatment

The Rusk Institute of Rehabilitation Medicine, NYU School of Medicine, Manhattan, NY, US

Early application of horticultural activities in rehabilitation therapy

NATURE-BASED HEALING CULTURE IN TRADITIONAL KOREAN SOCIETY

Late Joseon Dynasty Korea

Diverse sensory experiences with nature: plant appreciation, listening to the sound of rain falling on leaves, writing on leaves, and garden walking
Promotion of positive emotions, emotional stability, and psychological restoration

Jeong Seon
Dokseoyeogado (Reading Leisure)

Kim Hong-do
Literati Landscape Scene

Lee Jae-Gwan
Pacho-do (Banana Tree Painting)

Jeong Seon
Ingokjeongsa

Examples of Traditional Nature-Based Activities Interpreted from a Modern Agro-healing Perspective

Gwon and Park, 2025, J. People Plants Environ.

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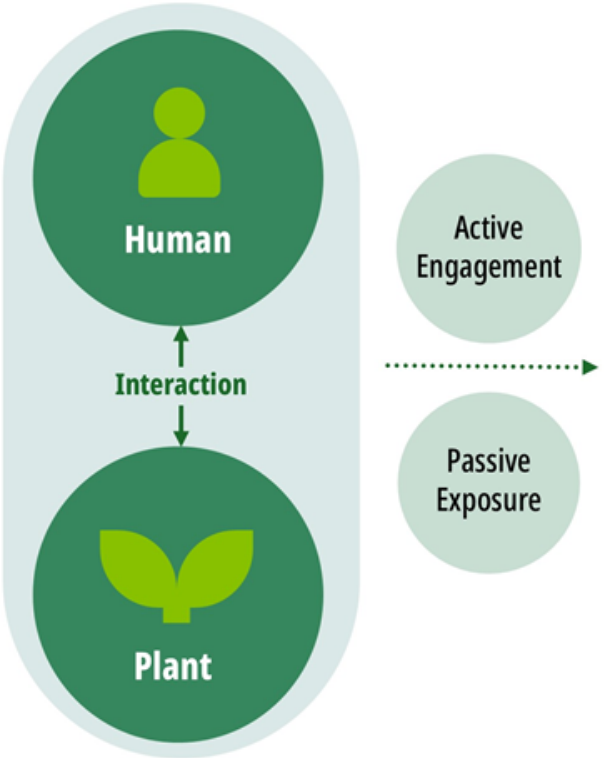
PLANT-MEDIATED HEALING MECHANISM

Core Healing Mechanism



Multidimensional Healing Responses

Emotional Affective connection	Emotional bonding
	Positive affect
Cognitive Attentional restoration	Immersion
	Attention restoration
	Cognitive engagement
Sensory Multisensory stimulation	Tactile stimulation
	Olfactory stimulation
	Visual stimulation
	Auditory stimulation
Physical Physiological regulation	Physical activation
	Physiological relaxation

Multidimensional Health Outcomes

Cognitive Effects

Attention enhancement, Memory improvement, Cognitive restoration

Psychological Effects

motional stability, Stress reduction, Relief of depression and anxiety

Physical Effects

Improved physical function, Increased vitality, Better sleep quality

Social Effects

Enhanced sociality, Improved interpersonal relationships, Cooperative experiences

Multimodal Stimuli Drive Complex Human Responses

PARADIGM SHIFT IN AGRO-HEALING RESEARCH

From Therapeutic Effect Verification to Data-driven Precision Agro-healing

2000s

OUTCOME

Outcome-based Research

2005 ~

MECHANISM

Mechanism-focused Research

2019 ~

BIOMARKERS

Biomarker Discovery

2023 ~

SOLUTION

AI-driven Precision Agro-healing

Validation of effects	Identification of healing mechanisms	Discovery of indicators	AI-driven precision intervention
Systematic evaluation of physical, psychological, cognitive, and social outcomes	Quantification and analysis of human responses during agro-healing activities	Omics-based analysis and biological response profiling	Multimodal data integration and predictive optimization

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FROM EXPERIENCE-BASED TO EVIDENCE-BASED APPROACHES

AI-BASED MULTIMODAL ANALYSIS OF HEALING RESPONSES

Agro-healing Data

- Psychological & Emotional Responses
- Behavioral Responses
- Physiological Responses
- Biochemical Responses
- Cognitive Responses

Multimodal Measurement Data

AI-driven Precision Analysis

- Multimodal data integration
- Individual response profiling
- Prediction of therapeutic outcomes
- Personalized agro-healing intervention optimization

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RESEARCH AREAS IN AGRO-HEALING

Healing Mechanism Research	Psycho-physiological	Emotional	Cognitive	Physical
Target-specific Intervention Research	Children	Adolescents	Adults	Elderly
	Individuals with Disabilities	Vulnerable Populations	Patients	Underserved Populations

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NEUROPHYSIOLOGICAL EVIDENCE OF PLANT-MEDIATED THERAPY

How do plant exposure and horticultural activities influence human neurophysiological responses?

Plant exposure/ Horticultural activity


Visual stimulation


Tactile stimulation


Olfactory stimulation


Auditory stimulation


Physical engagement

EEG & fNIRS assessment of neurophysiological responses

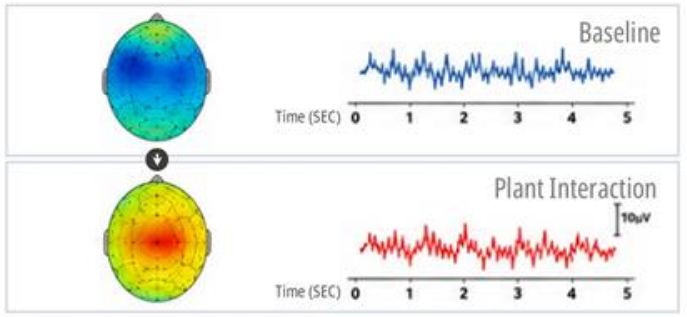
EEG

Relaxation-related neural activity

fNIRS

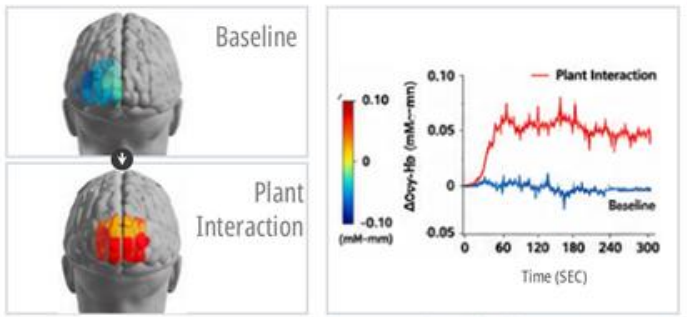
Prefrontal hemodynamic responses

EEG



EEG Waveform (Alpha)

fNIRS



Oxy-Hb Changes

Key Neurophysiological Findings

1. Enhanced attention and cognitive restoration
2. Increased relaxation-related neural activity
3. Reduced stress responses
4. Improved emotional stabilization
5. Modulation of prefrontal cortical activity

Plant-mediated therapy induces measurable neurophysiological responses associated with cognitive restoration and emotional well-being

Representative studies: Kim et al., 2024, HortScience; Son et al., 2024, HortScience; Kim and Park, 2025, Plos One; Jeong et al., 2026, HortScience and related studies

HORTICULTURAL ACTIVITY METHODS DIFFERENTIALLY MODULATE COGNITIVE DEMAND AND NEUROPHYSIOLOGICAL RESPONSES

Different task methods within the same horticultural activity induce distinct neural states

LOW COGNITIVE DEMAND
Rise Fast Alpha
Relaxation
Stress Reduction

HIGH COGNITIVE DEMAND
Rise Gamma
Rise Low Beta
Cognitive Engagement

EEG Responses

LOW COGNITIVE DEMAND
Repetitive
Guided
Simple Sequence

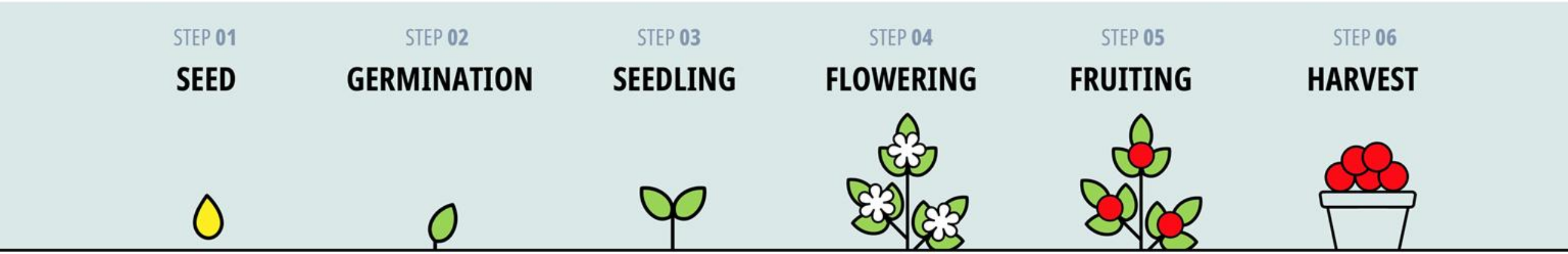
HIGH COGNITIVE DEMAND
Decision-making
Planning
Multi-step Processing

Cognitive Demand Can Be Strategically Modulated Through Horticultural Activity Design

Representative studies: Kim et al., 2021, HortScience; Kim et al., 2022, Sustainability; Kim and Park, 2023, HortScience and related studies

GROWTH STAGE-SPECIFIC HUMAN RESPONSES AND AI-BASED TEXT ANALYTICS

GROWTH STAGE-SPECIFIC HEALING PATTERN MODELING



Multimodal Human Response Data

EEG / fNIRS /HRV / GSR / Behavioral responses / Emotional responses

AI-based Text Analytics

Narrative-based emotional analysis / AI-driven semantic analysis / Emotion-aware text mining / Language-based healing response analysis

Personalized Agro-healing Interventions Based On Growth Stage-specific Human Responses And AI-driven Text Analytics

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BIDIRECTIONAL ANALYSIS OF HUMAN–PLANT INTERACTIONS

MULTIMODAL ASSESSMENT OF HUMAN–PLANT INTERACTIONS

Simultaneous assessment of human and plant biosignals

Human

- Neurophysiological responses
- Emotional responses
- Behavioral responses

↕ Interaction

Plant

- Physiological responses
- Electrophysiological signals
- Bioelectrical activity

AI-driven Integrated Analysis

Integrated analysis of human–plant response data

↓

AI-driven modeling of human–plant interaction patterns

↓

Personalized agro-healing intervention strategies

Toward Personalized Agro-healing Interventions Through Bidirectional Human–Plant Interaction Analysis

PHYSICAL AND BIOMECHANICAL RESPONSES TO HORTICULTURAL ACTIVITIES

Horticultural Activities

Digging

Seeding

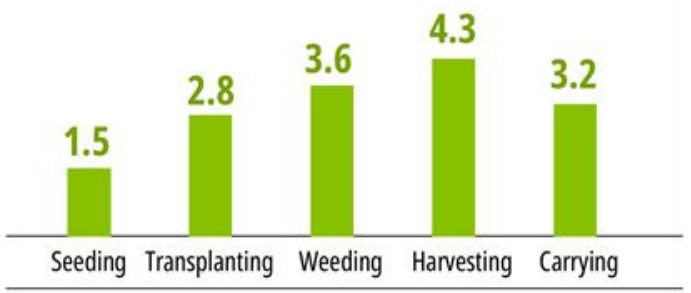
Transplanting

Harvesting

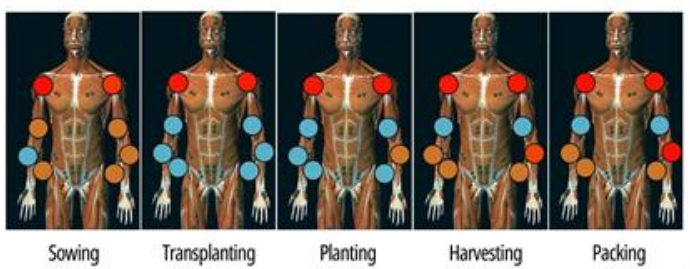
Carrying/ Transport

Exercise intensity (METs)

Low-Moderate-intensity physical activity



Muscle Activation (% MVC)



Key Biomechanical Findings

1. Moderate-intensity physical activity
2. Task-specific muscle engagement
3. Functional upper-limb activation
4. Rehabilitation-related movement patterns
5. Potential for therapeutic physical intervention

Horticultural activities induce measurable biomechanical responses associated with functional rehabilitation and health promotion

Representative studies: Park et al., 2014, Intl. J. Gerontology; Lee et al., 2018, HortScience; Lee et al., 2025, HortTechnology and related studies

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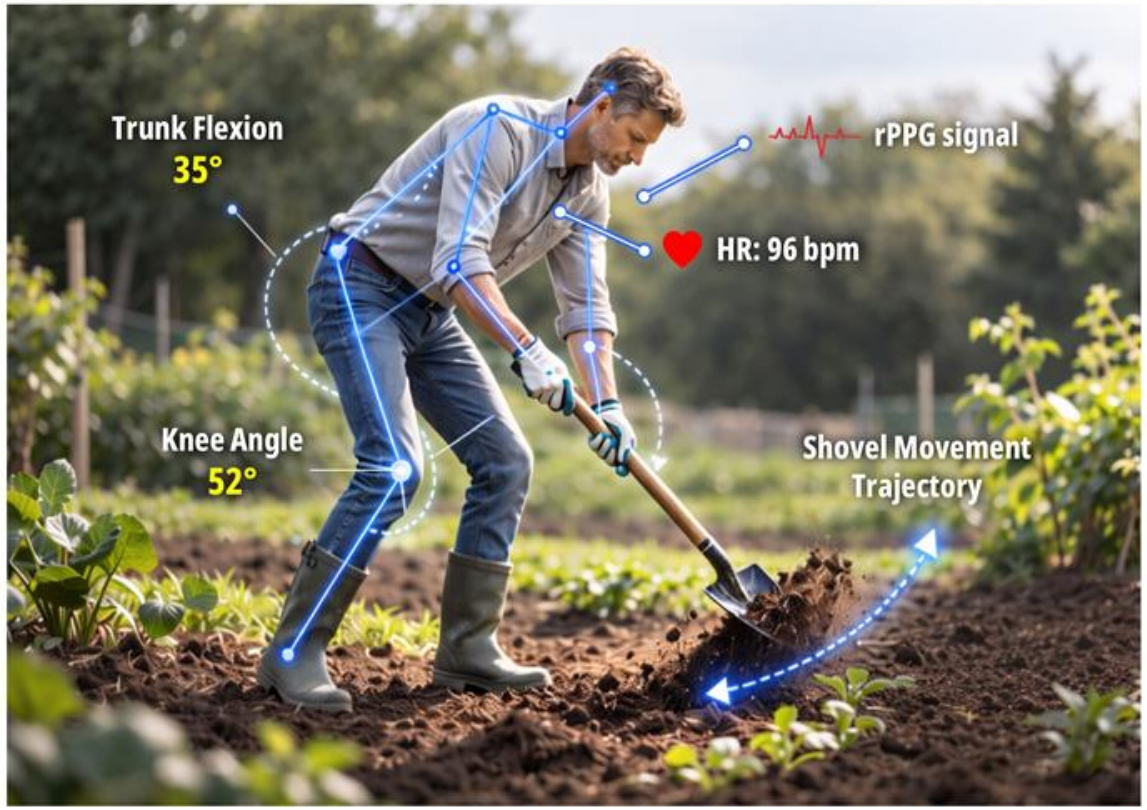
AI-BASED ANALYSIS OF HORTICULTURAL TASK PERFORMANCE AND HUMAN RESPONSES

Example: Digging | **From subjective healing experiences to objective data-driven assessment**



STEP A	**Postural Characteristics**	Joint position tracking Trunk/knee angle analysis Trunk inclination
STEP B	**Task Performance Characteristics**	Activity classification Movement repetition Movement speed
STEP C	**Physiological Response Measures**	rPPG/PPG-based heart rate Cardiovascular responses Physiological arousal
STEP D	**Workload Assessment**	Musculoskeletal load and fatigue prediction Task safety evaluation

AI-driven digital biomarkers facilitate precise assessment of horticultural activities and personalized intervention strategies

AI-BASED PREDICTION OF MENTAL HEALTH RESPONSES IN AGRO-HEALING

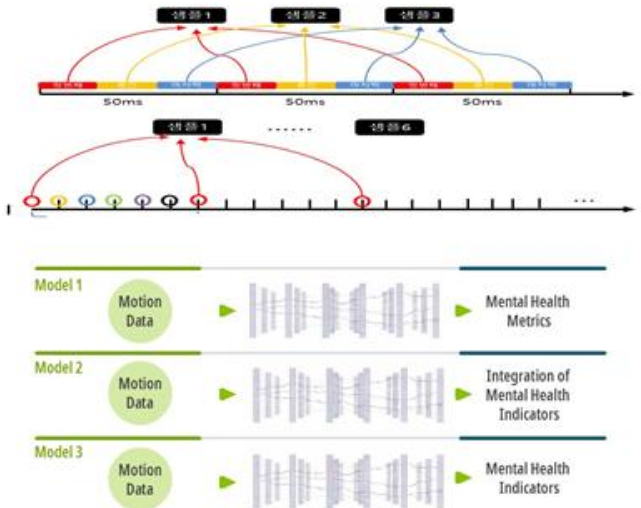
Multimodal Physiological & Behavioral Data Acquisition

Real-time behavioral and physiological sensing during horticultural activities

- Motion and posture features
- Heart rate and HRV
- Horticultural task performance data

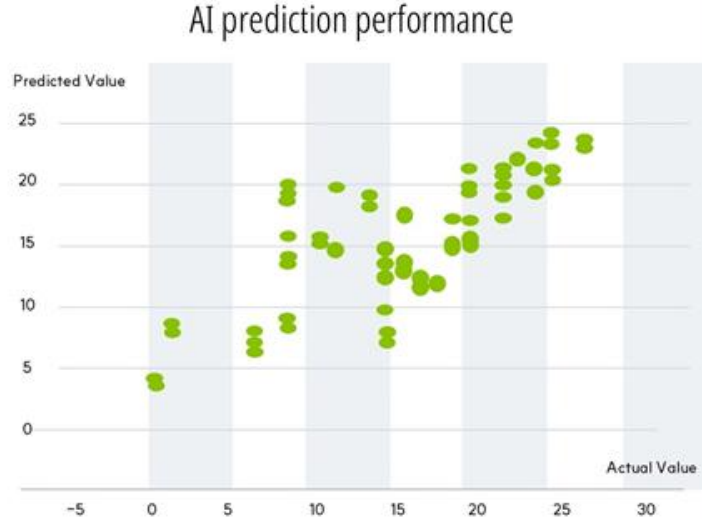
Multimodal AI-based Mental Health Modeling

Prediction of mental health responses using multimodal biosignals



Quantification and Prediction of Therapeutic Outcomes

AI-driven Prediction of Mental Health Changes for Personalized Agro-healing Interventions



Accumulated Multimodal Activity–response Data Enable AI-based Prediction Of Individualized Mental Health Outcomes

Lee et al, 2025, Seneors

TARGET-SPECIFIC PLANT-MEDIATED INTERVENTION

Children

Aggression, sociality, emotional intelligence, etc.

Adolescents

Stress, anxiety, depression, concentration, career experience, etc.

Adults

Stress, depression, anxiety, burnout, healthy behaviors, etc.

Elderly

Depression, anxiety, cognitive function, chronic diseases, immunity, physical function, life satisfaction, etc.

Individuals with Disabilities

Self-Esteem, resilience, vocational rehabilitation, etc.

Vulnerable Populations

Self-esteem, emotional stability, resilience, physical function, life satisfaction, etc.

Patients

Depression, anxiety, emotional stability, physical rehabilitation, etc.

Data-driven Personalization Of Plant-mediated Interventions Across Diverse Populations

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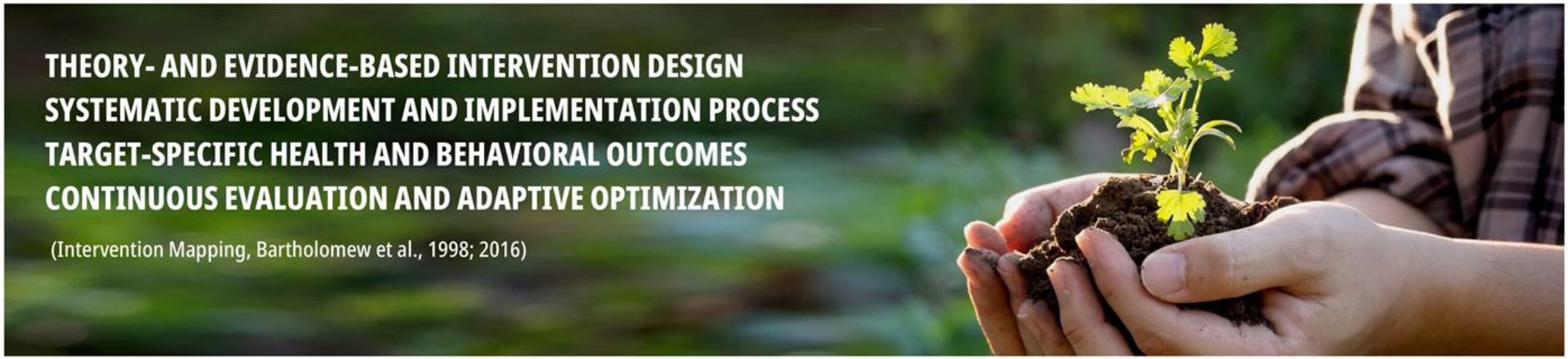
EVIDENCE-BASED FRAMEWORK FOR AGRO-HEALING INTERVENTION DEVELOPMENT

Needs Assessment → Defining Objectives → Selecting Method & Strategies → Developing the Intervention → Implementation Planning → Evaluation & Adaptive Optimization



From Experience-based Activities to Data-driven Agro-healing (Park, 2025)

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ACTIVITY VS. THERAPY

	HORTICULTURAL ACTIVITY	HORTICULTURAL THERAPY
		
Purpose	Recreation and leisure participation	Therapeutic intervention and rehabilitation
Professionals	Horticultural instructor	Certified horticultural therapist
Professional Role	Skill development and enjoyment	Physical, psychological, cognitive, and social health outcomes

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OMICS-BASED BIOMARKER DISCOVERY IN PRECISION AGRO-HEALING

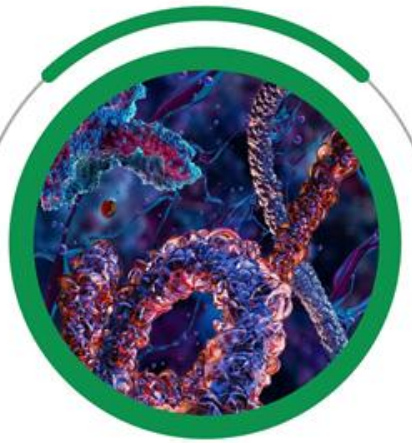
Multi-omics Analysis for Therapeutic Responses

GENOMICS

Stable genetic information and predisposition

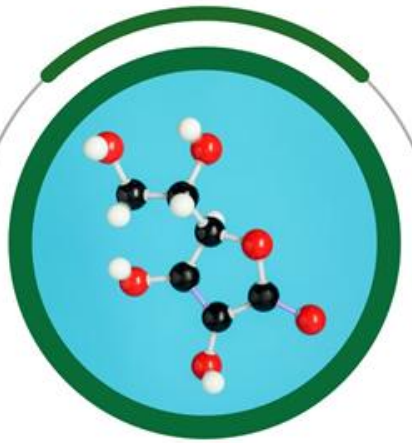
TRANSCRIPTOMICS

Dynamic gene expression changes in response to environmental exposure



PROTEOMICS

Protein expression and functional biological responses



METABOLOMIC

Final metabolic phenotype reflecting physiological and therapeutic responses

THERAPEUTIC PHENOTYPE

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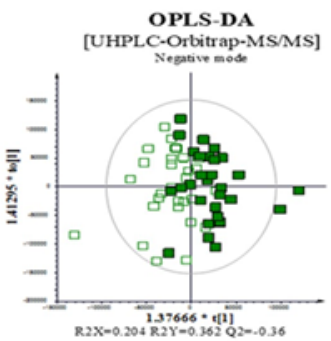
OMICS-DRIVEN PRECISION AGRO-HEALING

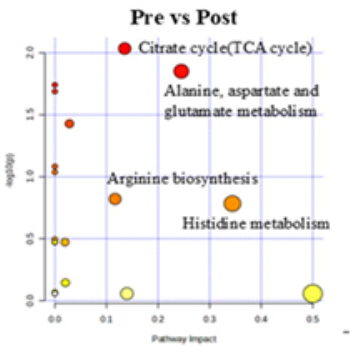
STUDY WORKFLOW

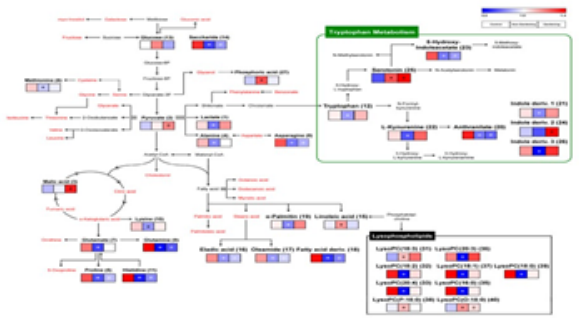
Agro-healing Intervention → Sample Collection → Metabolomics Analysis → Biological Interpretation

Untargeted metabolomics analysis of biofluids from participants before and after intervention

METABOLOMICS RESULTS







Stress-related pathways
Cortisol metabolism
Inflammatory signaling
Oxidative stress regulation

Neuroactive metabolites
Serotonin-related pathways
Dopaminergic modulation
GABA-associated metabolism

Energy metabolism
Mitochondrial function
TCA cycle activation
AMPK signaling

Antioxidant responses
Glutathione metabolism
Polyphenol-associated pathways
NRF2-related signaling

Key Omics Findings

- Modulation of stress-related metabolic pathways
- Regulation of neuroactive metabolites
- Enhancement of antioxidant and anti-inflammatory responses
- Optimization of energy metabolism

Potential biomarkers for personalized agro-healing interventions

Representative studies: Kim et al., 2022, J. Am. Soc. Hort. Sci.; Yang et al., 2025, Computational and Structural Biotech. J.; Kim et al., 2025, Scientific Reports; Kim et al., 2025, HortScience; Park et al., 2026, HortScience and related studies

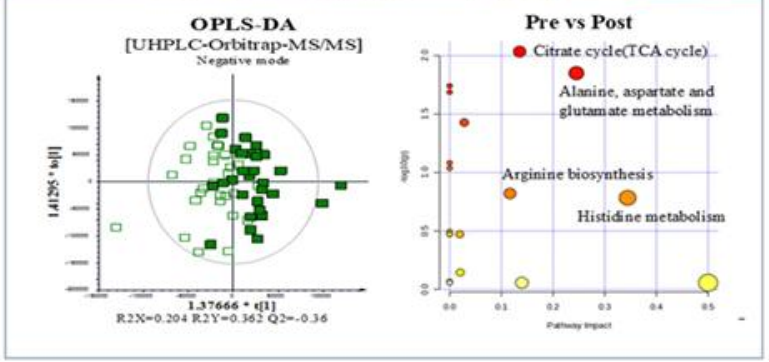
LIFE STAGE–SPECIFIC PLANT-MEDIATED PROGRAMS

Validation of Biofluid-Centered Omics Effects

CHILDREN

Reduced aggression

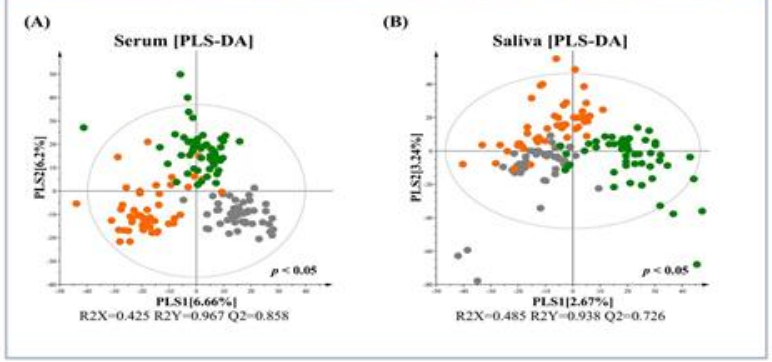
Succinate metabolism changes



ADULTS

Reduced stress and anxiety

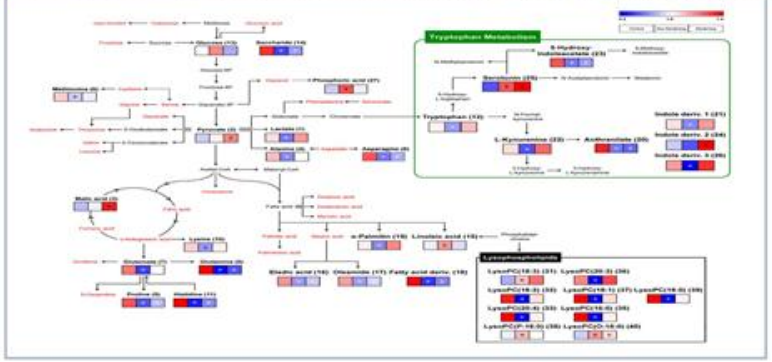
Sphingosine pathway activation



ELDERLY

Increased BDNF/PDGF pathways

Serotonin & melatonin metabolism changes



Omics-based evidence supports personalized precision agro-healing across life stages

Representative studies: Kim et al., 2025, HortScience; Park et al., 2026, HortScience; Park et al., 2019, IJERPH and related studies

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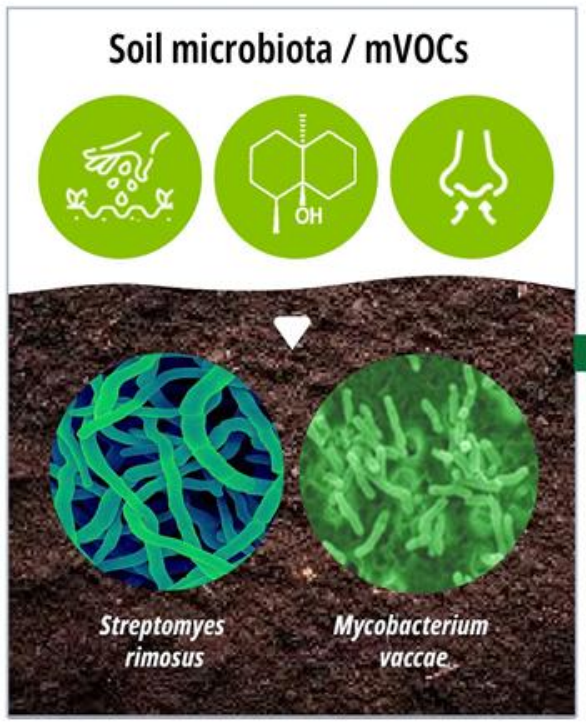
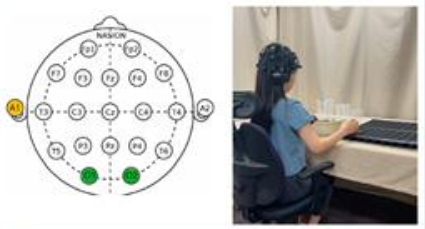
SOIL MICROBIOME–DRIVEN NEUROPHYSIOLOGICAL MECHANISMS

How do soil microorganisms influence human mental well-being through neurophysiological and metabolic regulation?



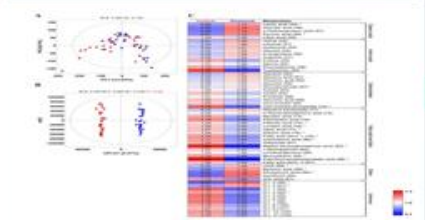
EEG

Human neurophysiological responses
alpha activity
relaxation
stress reduction



Metabolomics

Neuro-metabolic modulation
amino acid metabolism
lipid metabolism
stress biomarkers



Animal Model Validation

ABA/glutamate modulation
reduced anxiety-like behavior
recovery of glutamate biomarkers

Key Neurophysiological & Metabolic Findings

1. Relaxation-related neural activity
2. Stress reduction
3. Emotional resilience
4. Neuro-metabolic regulation

Soil microorganisms may modulate neurophysiological and metabolic pathways associated with stress reduction and emotional regulation

Neuro-Metabolic Interaction

Representative studies: Kim et al., 2022, J. Am. Soc. Hort. Sci.; Yang et al., 2025, Computational and Structural Biotech. J.; Kim et al., 2025, Scientific Reports and related studies

MULTI-OMICS-BASED BIOMARKER DISCOVERY IN AGRO-HEALING

(Ongoing Progress)

Agro-healing

Agricultural Activities

Various farming-related activities

Agricultural Resources

Plant resources and soil microbiota

Omics Analysis

- Metabolic Pathways
- Transcriptomics / Proteomics
- Metabolomics

Organic acids, amino acids		Energy metabolism
Succinate		Citric acid cycle
Fatty acids, lipids		Stress & inflammation regulation
Glycolate / Glycerate		Carbon / organic acid metabolism
Palmitate		Fatty acid metabolism
Tryptophan	BDNF	Serotonin
		Sphingosine
	PDGF	

Psychological and Emotional Outcomes

- Emotional stabilization
- Depression relief
- Anxiety reduction
- Stress reduction
- Cognitive function improvement

FIELD VALIDATION OF AGRO-HEALING FOR INDIVIDUALS WITH PHYSICAL DISABILITIES

CORE COMPONENTS

1. Personalized Task Design
2. Evidence-based Monitoring
3. Job-oriented And Task-driven Framework
4. Smart Farming Integration
5. Scalable Rehabilitation Model
6. Scalability Through Integration With Institutional And Public Service Programs

From Smart Farming to Vocational Rehabilitation

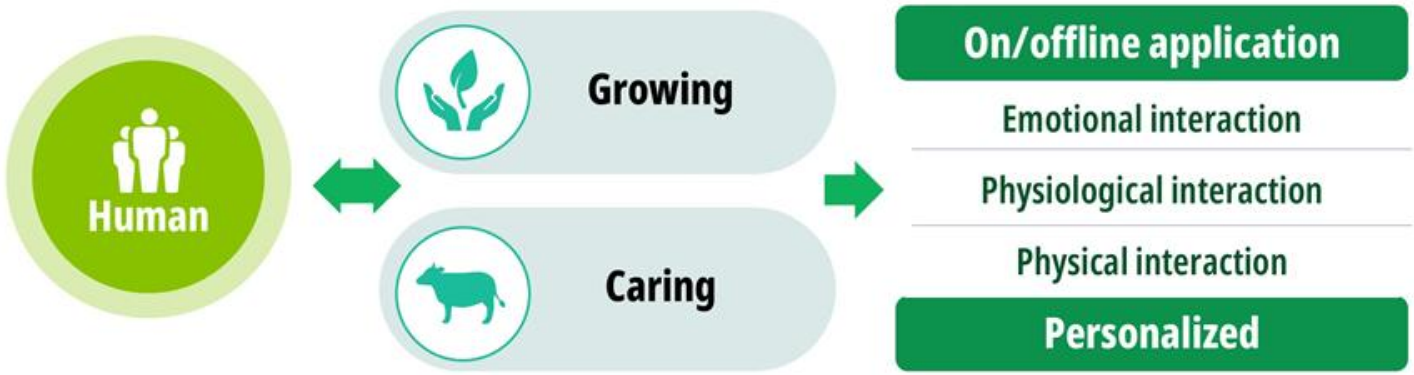
DIGITAL HUMANITIES AGRO-HEALING CONVERGENCE RESEARCH CENTER (CRC), KONKUK UNIVERSITY

1. A Pioneering Research Initiative Addressing National Mental Health Challenges Through Precision Agro-healing
2. Transdisciplinary Convergence Research Program
3. Supported By The National Research Foundation Of Korea: KRW 10 Billion (Approx. USD 7 Million), 2023–2030

Digital Agro-healing

Plant-mediated Therapy + Animal-assisted Therapy + Humanities + Biotechnology + Counseling psychology + Education + Engineering + Medicine

Interspecies Interaction



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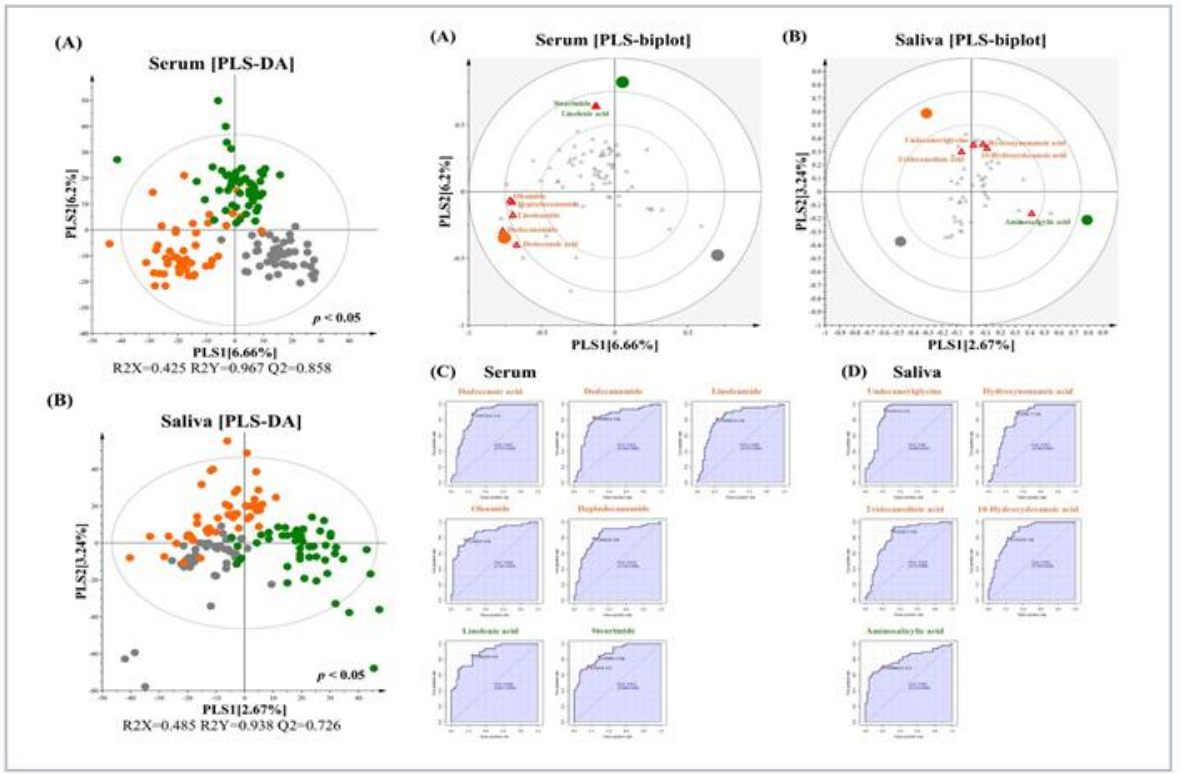
Ministry of Science and ICT

NRF National Research Foundation of Korea

METAVERSE-BASED AGRO-HEALING

Evaluation of emotional and metabolomic responses to virtual agro-healing interventions



Lavender cultivation enhanced emotional stability, whereas calf care produced stronger stress-reduction effects

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AI-BASED DIGITAL AGRO-HEALING

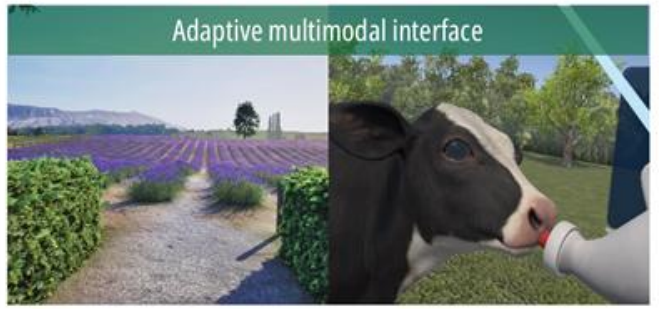
Personal Condition Analysis

- Health condition
- Sociality & openness
- Time constraints
- Availability for outdoor activities

Identifying personalized conditions based on individual status and lifestyle

Personalized Program Recommendation and Effect Prediction/Validation

HEALTH CONDITION	PROGRAM RECOMMENDATION	RECOMMENDED CONTENT	
Office worker	Immersive VR Program	Lavender Herb Garden VR	Calf Care VR

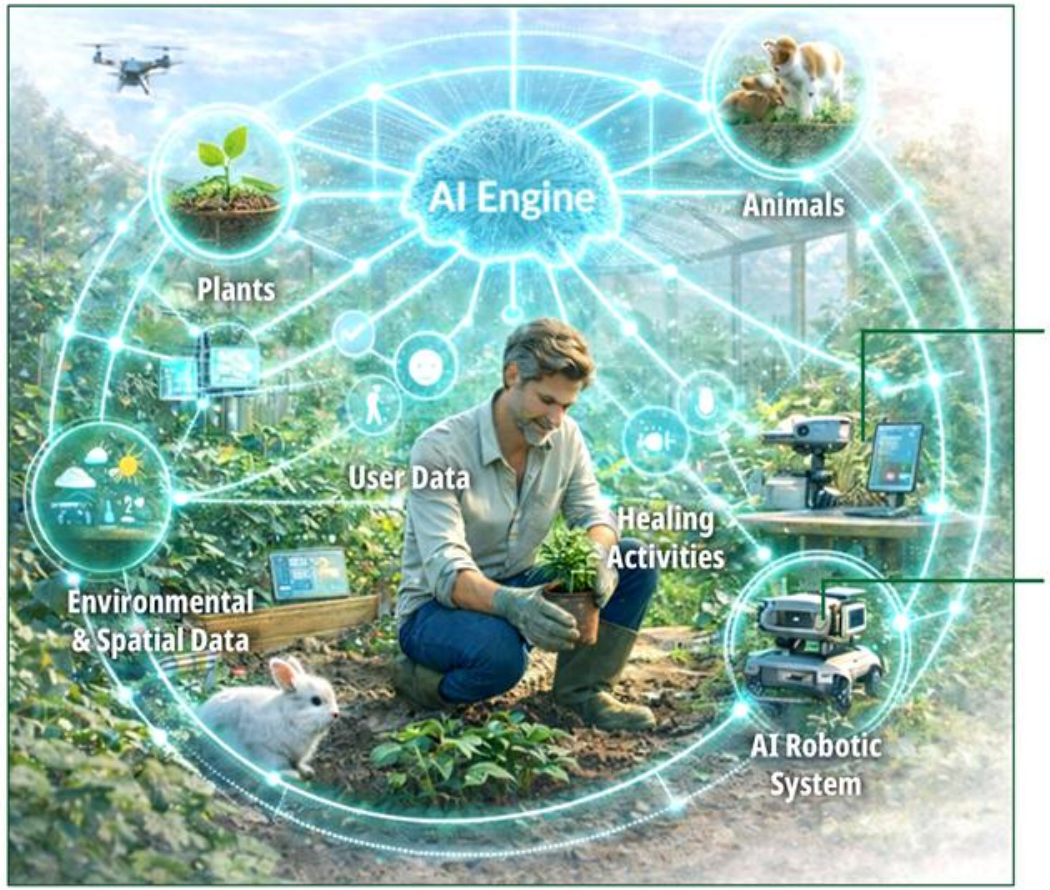


Prediction	Stress reduction / Attention recovery
Validation	20% reduction in stress / 50% increase in attention

Prediction and validation of health effects from recommended programs

AI-BASED HUMAN-CENTERED INTEGRATED AGRO-HEALING SYSTEM

A next-generation agro-healing model that integrates plants, animals, environmental resources, AI, and physical AI technologies to provide personalized nature-based healing



STEP 1	**Sensing**	Integrated collection of behavioral, emotional, physiological, and environmental data
STEP 2	**AI Analysis & Decision-Making**	State interpretation and derivation of optimal intervention strategies
STEP 3	**Acting & Feedback**	Personalized healing interventions, environmental adjustment, effect validation, and continuous updates

A data-driven cyclical healing system integrating measurement, analysis, intervention, and validation

CONTENTS

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TOWARD AI-DRIVEN PRECISION AGRO-HEALING

Precision Agro-healing

Personalized agro-healing interventions driven by multimodal human response data

PREVENTION	TREATMENT	MANAGEMENT
Nature-based Preventive Healthcare	Personalized Therapeutic Support	Long-term Health Management
1 Stress reduction 2 Immune support 3 Healthy lifestyle promotion	1 Emotional recovery 2 Cognitive improvement 3 Rehabilitation support	1 Chronic disease management 2 Social participation 3 Quality of life improvement

From experience-based care to evidence-based, AI-driven precision agro-healing

A new paradigm for integrated, personalized, and preventive healthcare

TOWARD SOCIETAL APPLICATIONS OF PRECISION AGRO-HEALING

AI-driven Precision Agro-healing

Multimodal Biomarkers	AI-driven Analytics	Personalized Intervention	Evidence-based Healthcare

1. Stress prevention
2. Mental health promotion
3. Community health support

1. Recovery support
2. Healthcare–welfare integration
3. Support for vulnerable populations

1. Personalized healing services
2. AI-based digital therapeutics
3. Data-driven healthcare platforms

Agro-Healing for Addressing Societal Challenges

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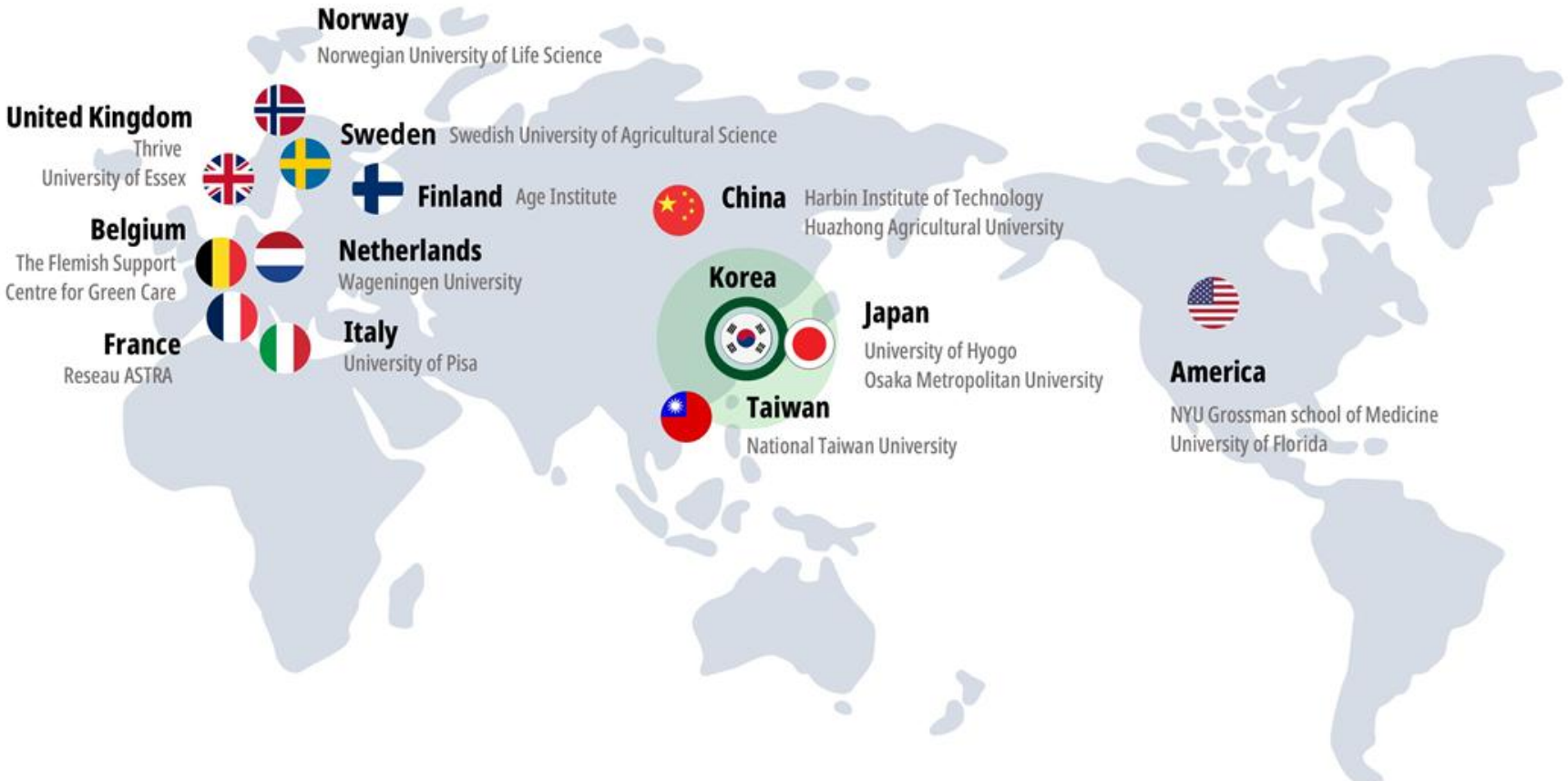
INTERNATIONAL NETWORKING



Sin-Ae Park, Chair

IPPC

International People Plant Council (IPPC)

ISHS

International Society for Horticultural Sciences (ISHS) Working Group Horticultural Therapy

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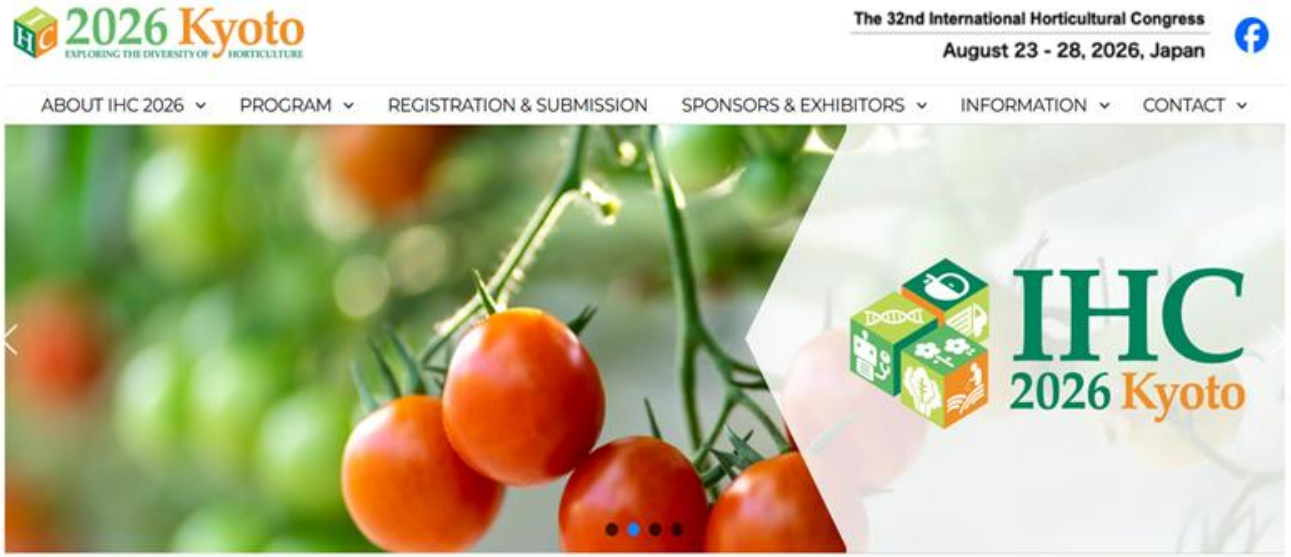
XVII INTERNATIONAL PEOPLE PLANT SYMPOSIUM & IV INTERNATIONAL SYMPOSIUM ON HORTICULTURAL THERAPIES (AUG. 2026)

Theme: Exploring the Interaction Between Humans and Nature: Research and Practices for Improving Health and Quality of Life



https://www.ihc2026.org/symposia/s11/

Understanding the Role of Horticulture in Horticultural Therapy

Diane Relf Professor Emeritus,
Virginia Polytechnic Institute and State University, USA

Insights into Nature-Based Healing: Current Practices and Future Perspectives from Field Experiences

Matthew Wichrowski Clinical Associate Professor,
Horticultural Therapist, Rusk Rehabilitation, NYU Grossman School of Medicine, NY, U.S.A

Human–Plant Interactions: Scientific Evidence and Practical Solutions for Health and Well-Being

Sin-Ae Park Professor,
Department of Bio & Healing Convergence,
Graduate School, Konkuk University, Seoul, South Korea

THANK YOU!

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