Dalla talea alla piantina da trapianto: effetti dell'applicazione di prodotti ad attività biostimolante in specie ornamentali

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MUR
Ministero dell'Università e della Ricerca

UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

DIPARTIMENTO DI SCIENZE DEL SUOLO DELLA PIANTA E DEGLI ALIMENTI– Di.S.S.P.A.
Dipartimento Eccellenza 2023-2027
MAR.V.E.L.
CUP H97G23000110001

Casi studio

Introduzione sul Vivaismo ornamentale

Prodotto: Talea radicata
Biostimolanti, perché?
Ipotesi e metodologia della literature review

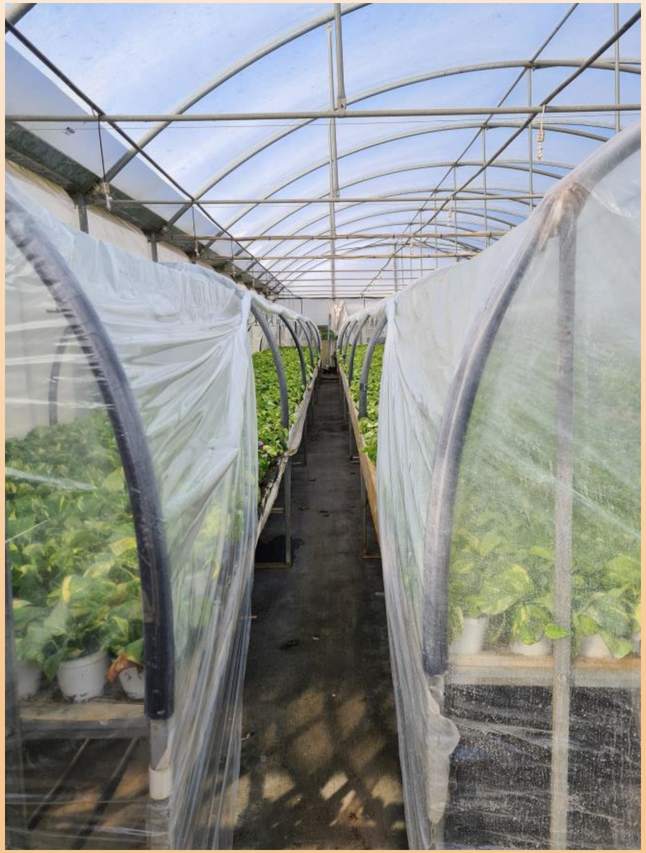
Protocolli con prodotti commerciali a base di
estratti d'alghe
Amminoacidi ed estratti d'alga

Efficacia sulla qualità globale

Conclusioni

Materiale per l'impianto: 1° step: Ornamental **cutting propagation , formazione di radici avventizie**

Point of strength: The technical innovations for propagation by cuttings (automatic mist propagation unit, basal heating) provide optimal **environmental conditions** to improve rooting efficiency.

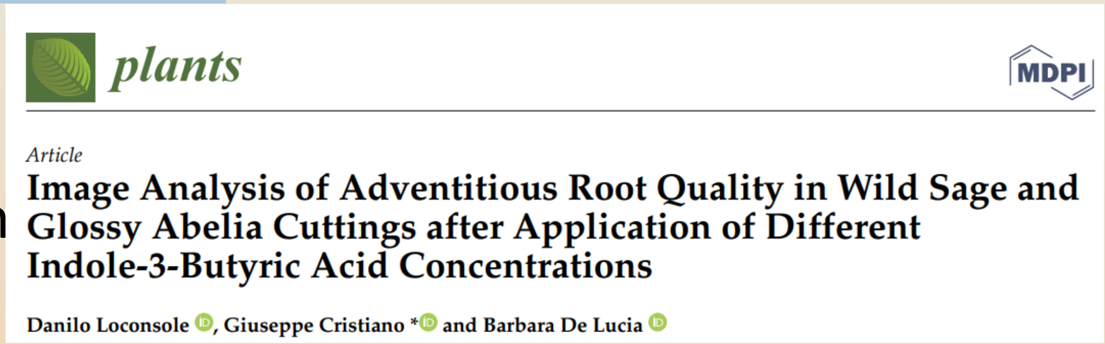


Fote concesse dal dott. agr. Davide Paparella, Terlizzi Bari

Ornamental cutting propagation: **Point of weakness:** insufficient rooting efficiency remains an economic burden

*Application of **auxin** plant growth regulators at different doses.*

IBA, when applied exogenously, play a critical role in generanting adventitious root


plants MDPI

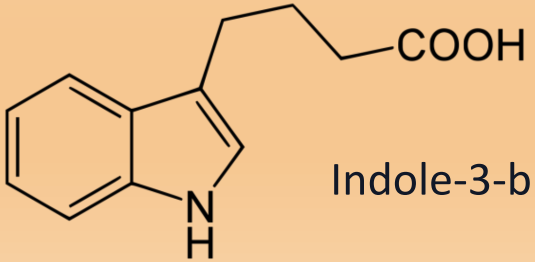
Article

Image Analysis of Adventitious Root Quality in Wild Sage and Glossy Abelia Cuttings after Application of Different Indole-3-Butyric Acid Concentrations

Danilo Loconsole, Giuseppe Cristiano * and Barbara De Lucia

PERICOLOSO

Acute toxic   Irritant



Indole-3-butyric acid IBA

Globally armonized system of classification and labelling of Chemicals (GHS) Hazard Statements

H301 (97.92%): Toxic if swallowed
H315 (96.88%): Causes skin irritation [Warning]
H319 (67.71%): Causes serious eye irritation [Warning]
H335 (71.88%): May cause respiratory irritation [Warning]

Cutting propagation

Agenda 2030

Promossa da ONU e condivisa da svariate nazioni

Obiettivo sostenibilità

Riduzione sostanze di sintesi

Biostimolanti, perché? CONTRIBUTO

Biostimulants are generally considered to be biological, non-toxic, non-polluting, biodegradable, and non-hazardous.

SE-based biostimulants because they have been proven to have an extremely low carbon footprint; moreover, they are expected to account for more than 33% of the global market for biostimulants

Biostimulants are frequently used in horticulture, but rarely in plant propagation.

Ipotesi: Se i prodotti commerciali a base di estratti d’alghe, applicati alle talee di specie ornamentali possono:

1) migliorare l’efficienza della radicazione e la qualità generale dell’intera talea radicata;

2) sostituire, nei protocolli, i prodotti a base di auxine di sintesi

Inquadramento generale della literature review

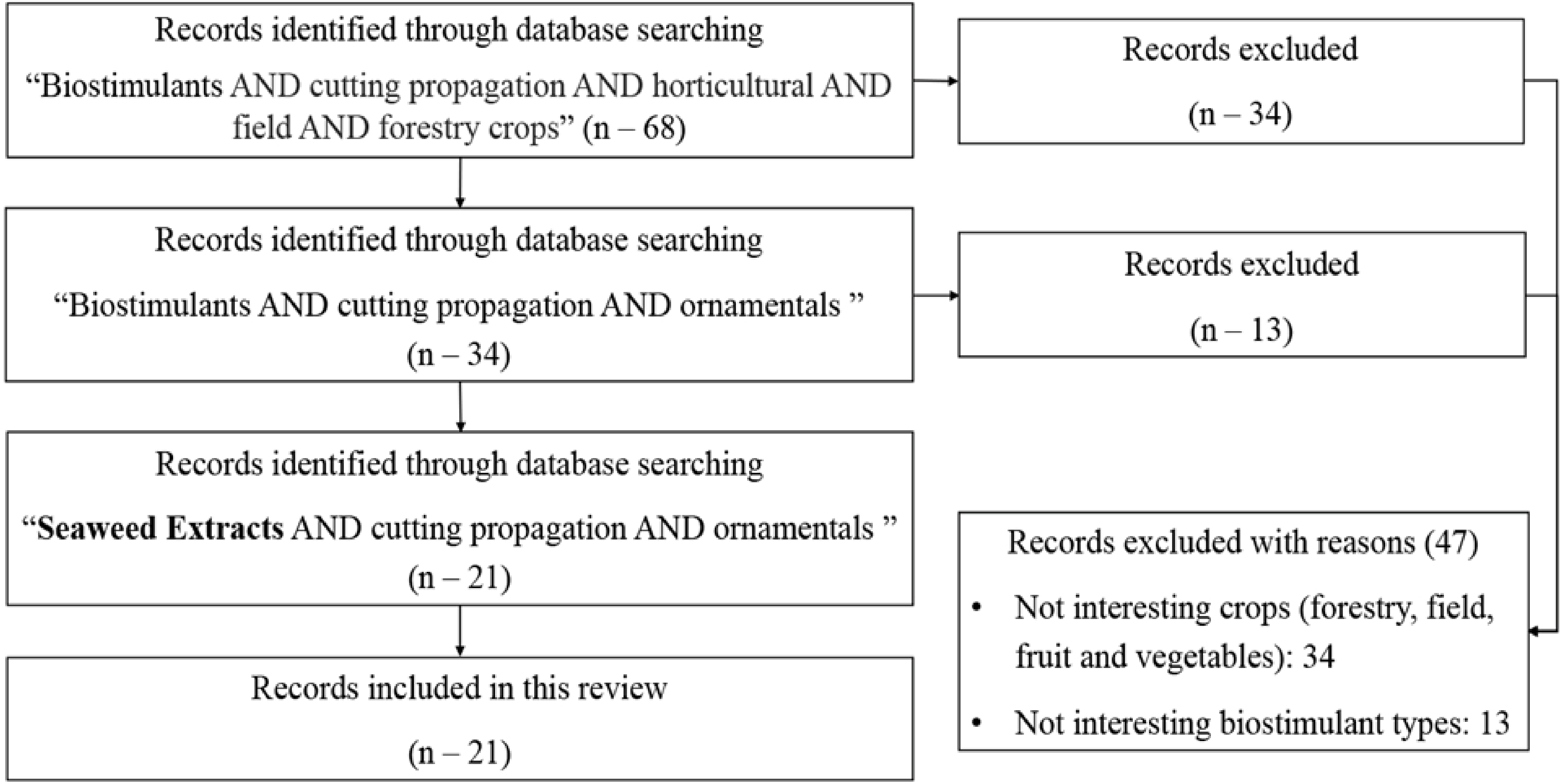
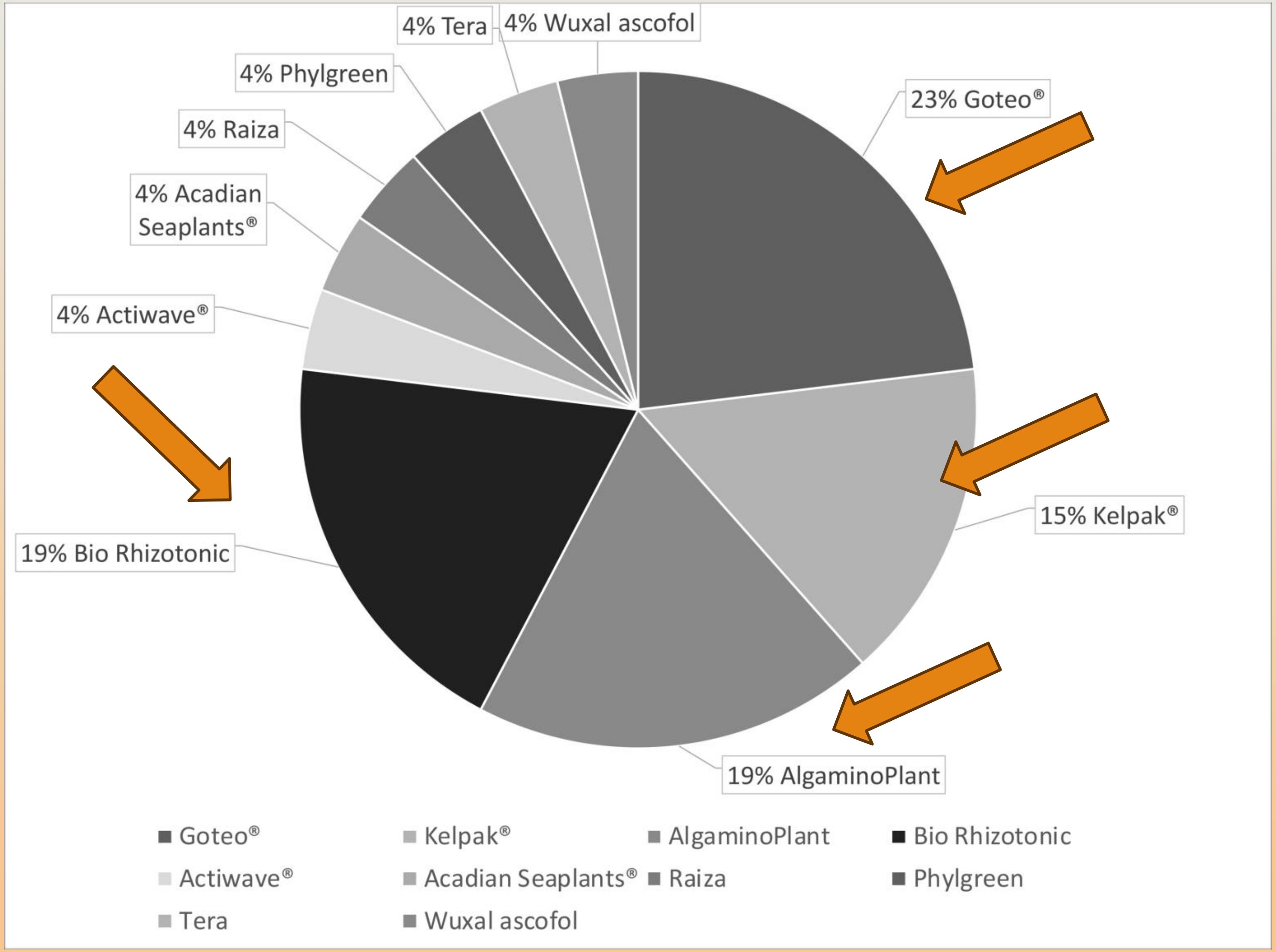


Figure 1 - Systematic review flowchart

Ornamental crops - Scientific Name	SE(*)/PhR(**)	Reference (n=21)
Photinia x fraseri 'Red Robin'	SE+PhR	Loconsole et al. (2023)
Rose 'Duchesse d'Angoulême', 'Hurdals', 'Maiden's Blush' e altre	SE+PhR	Monder and Pacholczak (2023)
Abelia x grandiflora and Lantana camara	SE+PhR	Loconsole et al. (2022b)
Crassula ovata	SE-PhR	Toța et al. (2022)
R. 'Cosmos®' and 'Michelangelo®'	SE+PhR	Traversari et al. (2022)
R. 'Hurdal'	SE+PhR	Monder et al. (2021)
Conocarpus erectus	SE+PhR	Abdel-Rahman et al. (2020)
Pennisetum 'Vertigo'	SE-PhR	Kapczyńska et al. (2020)
R. 'Duchesse d'Angoulême'	SE+PhR	Monder ,Pacholczak (2020)
R. 'Elfrid' and 'Weisse Immensee'	SE+PhR	Pacholczak, Nowakowska (2020)
Passiflora actinia	SE-PhR	Gomes et al. (2018)
R.'Hurdals', 'Maiden's Blush', 'Mousseuse Rouge', beggeriana e altre	SE+PhR	Monder and Pacholczak (2017)
Cornus alba /Physocarpus opulifolius	SE+PhR	Pacholczak et al. (2016a; 2017)
Cotinus coggygria	SE+PhR	Pacholczak et al. (2015)
R. 'Duchesse d'Angoulême'	SE+PhR	Monder et al. (2014)
Ornithogalum umbellatum	SE-PhR	Salachna et al. (2014)
Camellia japonica L.	*SE-PhR*	Ferrante et al. (2012)
Pelargonium peltatum 'Ville de Paris Red'	*SE-PhR*	Krajnc et al. (2012)
Prunus 'Marianna'	*SE-PhR*	Szabó et al. (2011)

N° di lavori che confrontano SE e fitormoni di sintesi = 15/21



Goteo ® liquido, GA142, *A. nodosum* + Phytormones + organo-mineral fertilizers

Algaminoplant: liquido, *Sargassum* sp + *Laminaria* sp + *A. nodosum* + Fucus sp; C=18%.
Phytormones like activities

Biorizotonic: liquido, algae-based, vit. B1 and B2 and NPK

Kelpak ®: liquido, *E. maxima C: 34%*
4.9 mgL^{-1} poliammine
2.8 mg^{-1}florotannini
1.1 μg^{-1} brassinosteroidi
0,8% acido alginico

Figure 3 - Relative frequency (%) of SE commercial products used in ornamental cutting propagation protocols

Metodologia

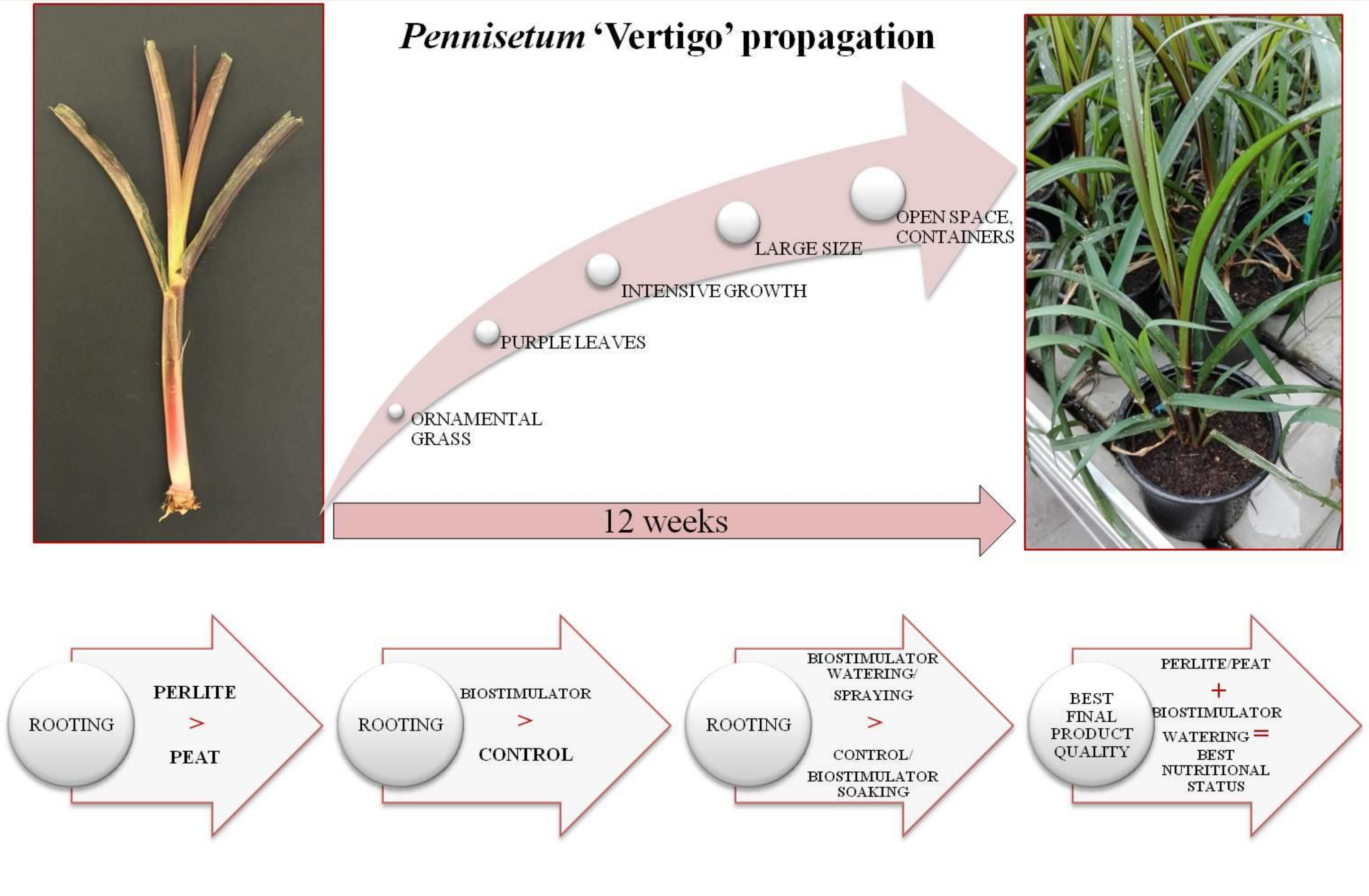
Caso studio

agriculture MDPI

Article

Rooting Media and Biostimulator Goteo Treatment Effect the Adventitious Root Formation of *Pennisetum* 'Vertigo' Cuttings and the Quality of the Final Product

Anna Kapczyńska [1,*], Iwona Kowalska [2], Barbara Prokopiuk [1] and Bożena Pawłowska [1]



Goteo® Dose: = 0.1% **vs control**

Modalità di applicazione

- ✓ Immersione di 2 cm della base della talea per 20 minuti
- ✓ Irrigazione del substrato per 5 volte ogni 5 giorni
- ✓ Spray fogliare: 5 volte ogni 5 giorni

Risultati: non c'è stato un chiaro effetto del Goteo® sul N content

Caso studio

Metodologia

horticulturae

Article

Improving Aerial and Root Quality Traits of Two Landscaping Shrubs Stem Cuttings by Applying a Commercial Brown Seaweed Extract

Danilo Loconsole *, Giuseppe Cristiano and Barbara De Lucia

Trattamenti

- Controllo: acqua distillata
- IBA: 1250 mg L $^{-1}$
- GC1: 1 mL L $^{-1}$
- GC2: 2 mL L $^{-1}$
- GC3: 3 mL L $^{-1}$

GOTEO

A BASE GoActiv®

Filtrato d'alga c processo produttivo unico e brevettato

COMPOSIZIONE GoActiv®
Anidride fosforica (P_2O_5) solubile in acqua 13%
Ossido di potassio (K_2O) solubile in acqua 5%

PESO SPECIFICO 1,16 (kg/L)

FORMULAZIONE Liquido solubile

CONFEZIONE L 5

Applicazione fogliare — Applicazione in fertirrigazione

COLTURE	DOSE Fogliare (L/ha)	DOSE Fertirrigazione (L/ha)	MODALITÀ APPLICATIVE
Actinidia, Drupacee, Pomacee	3 - 5	15 - 30	Da ripresa vegetativa
Agrumi	3 - 5	15 - 30	Da prefioritura
Carciofo	3 - 5	5 - 15	Dal trapianto
Cucurbitacee	3 - 5 3 - 5	5 - 15 10 - 30	Dal trapianto Durante il ciclo della coltura
Frutta a guscio	3 - 5	5 - 15	Da ripresa vegetativa
Solanacee	3 - 5	5 - 15	Dal trapianto
Vite	3 - 5	10 - 20	Ad inizio del risveglio vegetativo e dopo l'allegagione, ripetere se necessario

Dose di 2 - 3 L/ha per applicazione alla concentrazione in acqua di 0,1% - Colture sotto serra

Goteo®: Tre applicazioni spray a distanza di 10 gg

Lantana ed Abelia

Tabella 1. Radicazione (%) e radici per talea (n) in *L. camara* e *A.* x *grandiflora* trattate con diverse concentrazioni di promotori della radicazione.

TMTS	Radicazione (%)			Radici per talea (n.)	
Dose (mL L $^{-1}$)	*L. camara*		*A. x grandiflora*	*L. camara*	*A. x grandiflora*
Controllo	81 ±2,9 b		93 ±2.1a	9,2 ±0,6 c	6,9 ±0,2 c
IBA	92 ±0,9 a	+14%	94 ±2.1a	10,4 ±0,3 bc	9,8 ±0,3 a
GC1	90 ±0,7 a	+11%	92 ± 1,5 a	10,8 ±0,4 bc	10,7 ±0,4 a
GC2	87 ±3,4 ab		91 ± 1,8 a	12,3 ±0,5 b	9,3 ±0,4 a
GC3	87 ±1,7 ab		90 ± 3,8 a	15,7 ±0,9 a +51%	7,3 ±0,5 bc

All'interno di ciascuna specie, i dati seguiti dalla stessa lettera non sono significativamente diversi per p≤0,05 secondo il test Student Newman-Keuls (SNK). I dati mostrati sono medie di tre repliche ± ES. I dati percentuali sono stati sottoposti alla trasformazione della radice quadrata dell'arcoseno prima dell'analisi ANOVA.

Tabella 4. Lunghezza totale delle radici (mm) ed area della superficie radicale (mm^2) in talee radicate di *L. camara* e *A.* x *grandiflora* trattate con diverse concentrazioni di promotori della radicazione.

TMTS	*Lunghezza (mm)*			*Area della superficie (mm^2)*	
Dose ($mL\ L^{-1}$)		***L. camara***	***A. x grandiflora***	***L. camara***	***A. x grandiflora***
Controllo		370c	166 b	60c	25 c
IBA		649b	**391 a**	96 b	67 a
GC1		**794a**	**396 a**	125a	70 a
GC2	+27%	810a	336 a	148a	61 a
GC3		874a	244 b	+47% 150a	42 b

All'interno di ciascuna specie, i dati seguiti dalla stessa lettera non sono significativamente diversi per p≤0,05 secondo il test Student Newman-Keuls (SNK). I dati mostrati sono medie di tre repliche ± ES.

agriculture

Tempo di radicazione

MDPI

Article

Different Responses to Adventitious Rhizogenesis under Indole-3-Butyric Acid and Seaweed Extracts in Ornamental's Cuttings: First Results in *Photinia x fraseri* 'Red Robin'

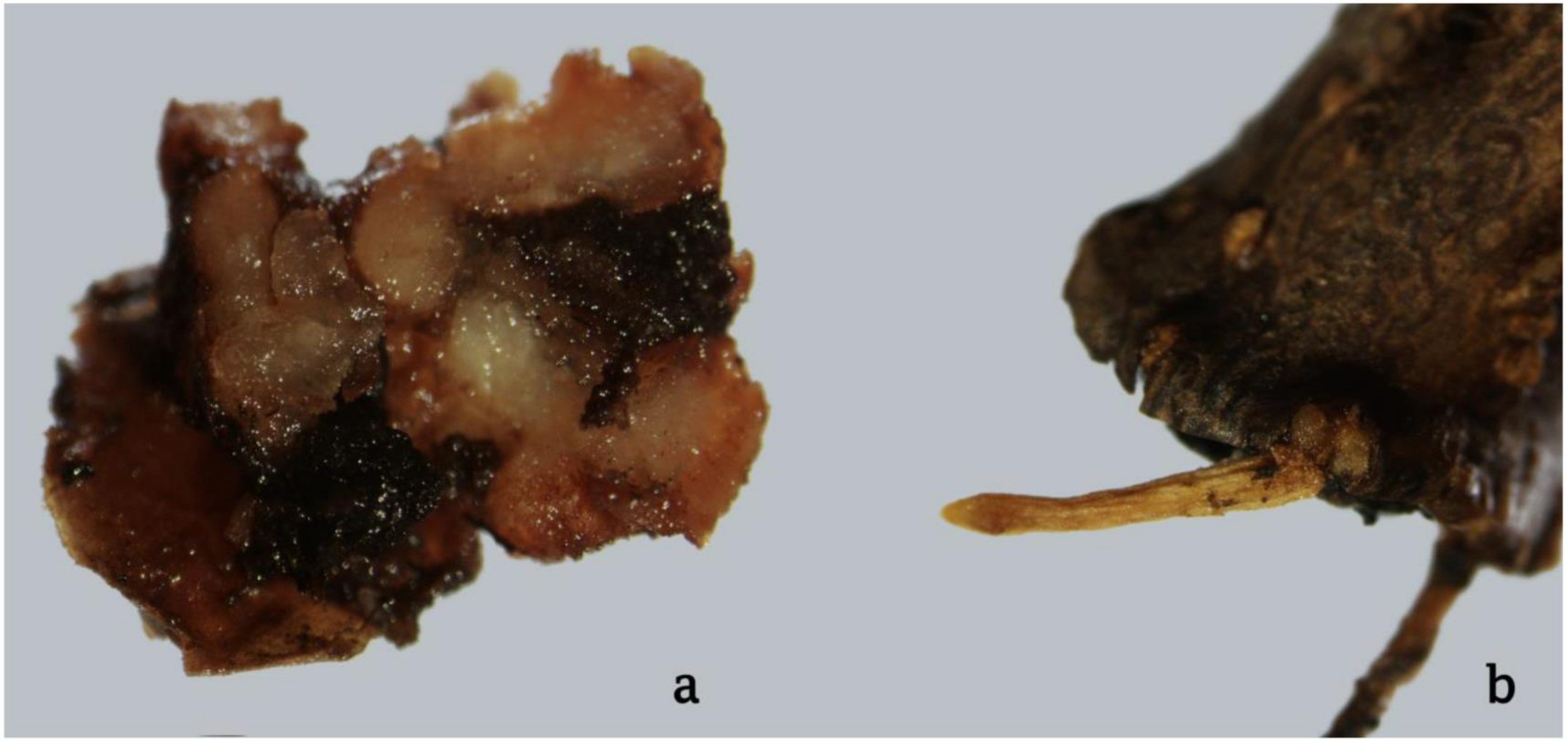
Danilo Loconsole *, Anna Elisa Sdao, Giuseppe Cristiano and Barbara De Lucia

Caso studio

Metodologia

Trattamenti
C0: distilled water;
Rhizopon AA: 1% IBA (R1);
Kelpak®: 2 mL L^{-1} (K2);
Kelpak®: 3 mL L^{-1} (K3);
Goteo®: 2 mL L^{-1} (G2);
Goteo®: 3 mL L^{-1} (G3).

K2-3 e G2-3: 4 applicazioni fogliari ogni due settimane dal taleaggio



On the left (**a**) the production of callous tissue in G2 treated cutting; on the right (**b**) the adventitious root in R1 treated cutting

Rootrd cuttings (%)

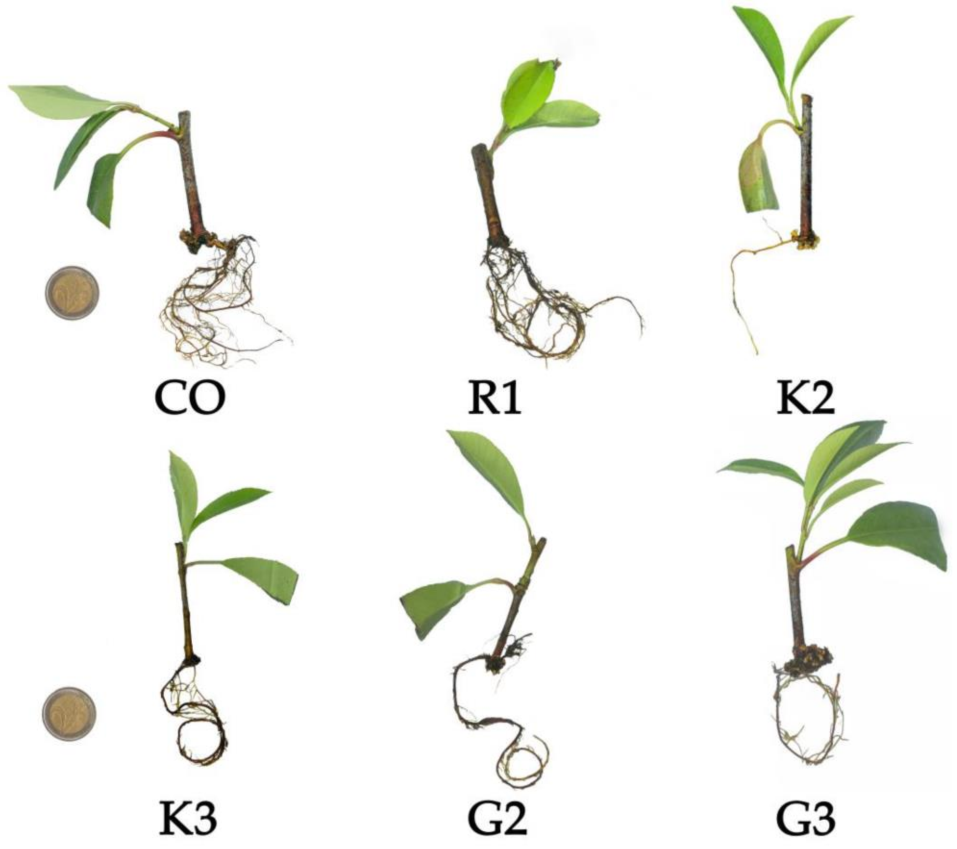
	100 DAC	240 DAC
C0	7.7 ± 0.7 d	29.7 ± 1.4 b
R1	25.0 ± 1.0 a	34.3 ± 0.9 a
K2	12.0 ± 1.0 bc	25.0 ± 0.6 c
K3	13.3 ± 1.3 b	21.3 ± 0.7 d
G2	14.3 ± 1.3 b	27.0 ± 1.0 bc
G3	9.0 ± 1.6 cd	20.7 ± 0.9 d

Traversari et al. (2022) on rose rhyzogenesis: cuttings treated with Phylgreen (*A. nodosum*), had low values of both survival rate and root biometric parameters. The biostimulating effects are clearly species-specific and product-specific

Table 3. Cuttings (no.) with 1, 2, 3, 4, 5 and 6 roots at 240 DAC in *P. x fraseri* 'Red Robin' influenced by rooting promoters concentration (RPC).

RPC	Rooted Cuttings (No.)					
	1 Root	2 Roots	3 Roots	4 Roots	5 Roots	6 Roots
C0	13.7 ± 0.7 a	7.0 ± 0.6 a	4.3 ± 0.3 b	3.7 ± 0.3 a	1.0 ± 0.0 b	0.0 ± 0.0 c
R1	7.0 ± 0.6 c	7.0 ± 1.0 a	8.7 ± 0.3 a	4.3 ± 0.3 a	3.0 ± 0.6 a	4.3 ± 0.3 a
K2	10.3 ± 0.7 b	7.3 ± 0.3 a	4.3 ± 0.3 b	1.7 ± 0.3 b	1.0 ± 0.0 b	0.4 ± 0.3 bc
K3	9.7 ± 0.3 b	5.3 ± 0.3 a	2.7 ± 0.3 c	2.0 ± 0.0 b	1.0 ± 0.0 b	0.7 ± 0.3 bc
G2	14.0 ± 0.6 a	6.3 ± 0.3 a	2.0 ± 0.6 c	4.0 ± 0.6 a	0.7 ± 0.3 b	0.0 ± 0.0 c
G3	10.4 ± 0.7 b	5.7 ± 0.7 a	2.3 ± 0.3 c	1.3 ± 0.3 b	0.0 ± 0.0 b	1.3 ± 0.3 b

In columns, different letters indicate significant differences within parameters (S.N.K. test, $p \leq 0.05$; mean ± SD, $n = 3$) C0: untreated control; R1: Rhizopon AA (1% IBA); K: Kelpak®; G: Goteo®; K2: 2 mL L^{-1}; K3: 3 mL L^{-1}; G2: 2 mL L^{-1}; G3: 3 mL L^{-1}.



Rose coprisuolo:

cv1 Weiss Immensee cv2 Elfrid

ORIGINAL RESEARCH PAPER in HORTICULTURAL PLANTS

The Effect of Biostimulators and Indole-3-Butyric Acid on Rooting of Stem Cuttings of Two Ground Cover Roses

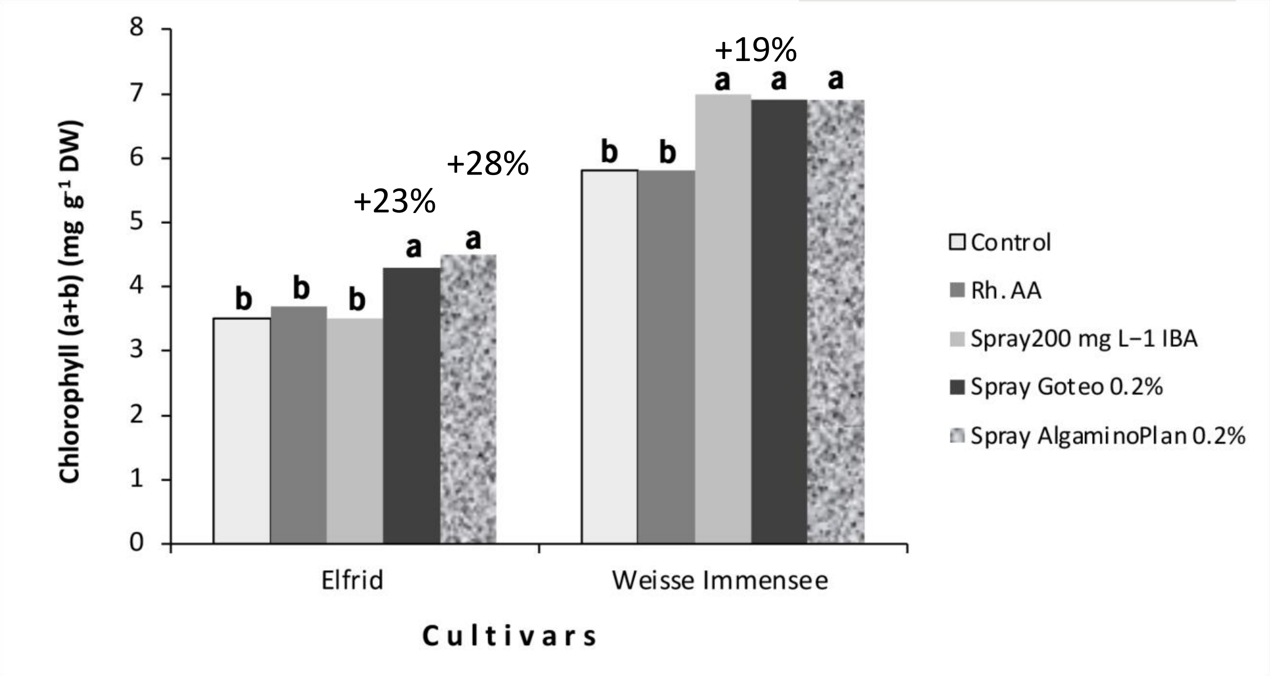
Andrzej Pacholczak*, Karolina Nowakowska

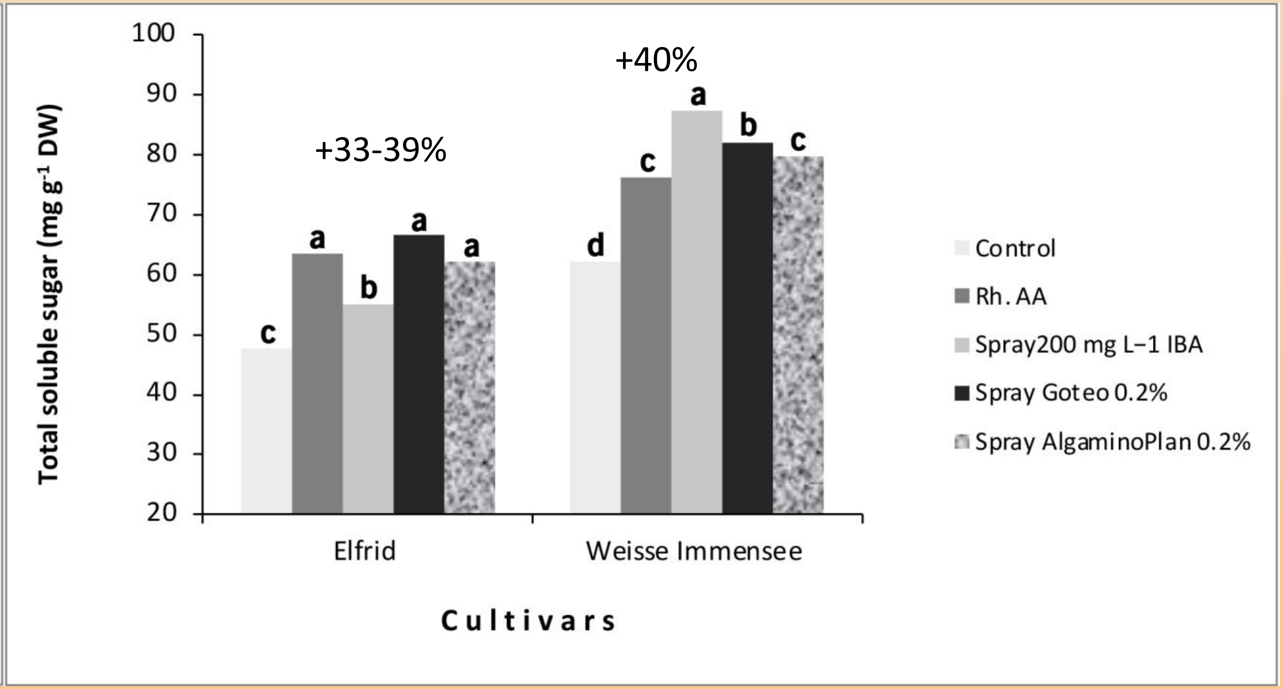
Table 1 List of treatments in the experiment.

No. of treatment	Methods of cuttings' treatment
1	Control 0: single spraying with distilled water
2	Rhizopon AA (1% IBA) powder
3	Single spraying with IBA 200 mg L^{-1}
4	Single spraying with Goteo 0.2%
5	Single spraying with AlgaminoPlant 0.2%

Caso studio

AlgaminoPlant and Goteo® treated cuttings, compared to the control, led to an increase in chlorophyll content by 28% and 23% in Elfrid and by 19% in Weisse Immensee, respectively. Compared to that of the untreated cuttings, all of the rooting enhancers increased the total soluble sugar content in cuttings.

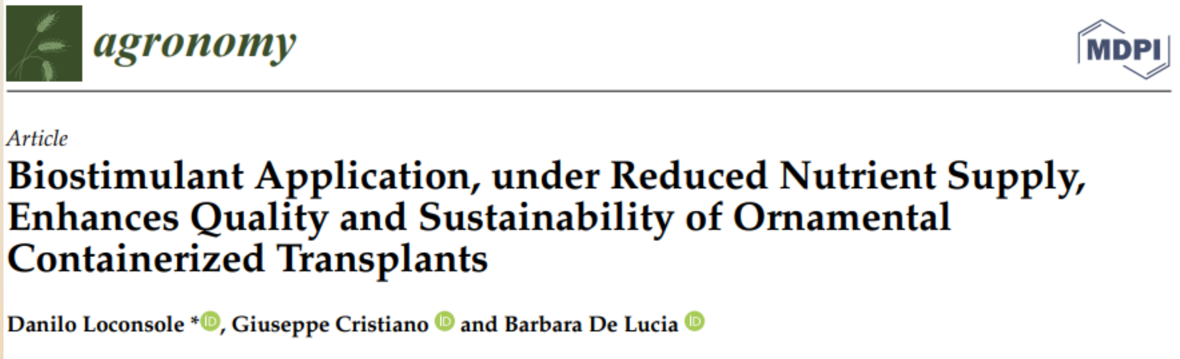




The effects of IBA, Goteo, and AlgaminoPlant on the **chlorophyll (a+b)** and **total soluble sugar contents** in cuttings of Rosa Elfrid and Weiss Immensee

Ornamental containerized transplant production needs high doses of mineral fertilizers, but there is an environmental risk caused by inadequate fertilization management. Therefore, it is essential to apply sustainable techniques to promote plant growth and improve quality features.

BIOSTIMULANTS IN ORNAMENTAL TRANSPLANTS


agronomy

MDPI

Article

Biostimulant Application, under Reduced Nutrient Supply, Enhances Quality and Sustainability of Ornamental Containerized Transplants

Danilo Loconsole *, Giuseppe Cristiano and Barbara De Lucia

Megafol® + 50% CRF

AaB

Best Result

Protocollo in Abelia e Lantana

CRF =Osmocote Exact Mini N:P:K = 15 + 9 + 11 + 2.5 MgO + microelements

MC-Extra® (B1) SEB *A. nodosum*

organic C (20%), organic N (1%), K_2O (20%), mannitol (4%), betaines (0.2%), and cytokinins.

Doses (D)= D1: 0.5 gL^{-1}; D2: 1.0 gL^{-1}.

Megafol® (B2) AaB

proline and tryptophan, sugars (glycosides and polysaccharides), vitamins, and betaines.

total N: 3%, organic N: 1%, ureic N: 2%, K_2O: 8%, and organic C (by fluid vinasse): 9%.

Doses (D)= D1: 1.5 mLL^{-1}; D2: 2.5 mLL^{-1}.

Treatments

T1 = conventional full CRF dose: 4 gL^{-1} GM;

- T2 = limited CRF dose: 50% of T1: 2 gL^{-1} GM;
- T3 = T2 + B1D1 (0.5 gL^{-1});
- T4 = T2 + B1D2 (1.0 gL^{-1});
- T5 = T2 + B2D1 (1.5 mLL^{-1});
- T6 = T2 + B2D2 (2.5 mLL^{-1}).

The biostimulant treatment, started on 10 February 2022, was applied four times as a foliar spray on the leaves of plants at the dose of 30 mL/plant.
540 pots; crops cycle: 90 days

Table 1. Transplant root morphological traits: root length (mm), root surface area (mm^2), and volume (mm^3) in *A. x grandiflora* (S1) and *L. camara* (S2), are influenced by different nutrient supplies.

	TMTS	Root					
		Length (mm)		Surface Area (mm^2)		Volume (mm^3)	
		A. x grandiflora	*L. camara*	*A. x grandiflora*	*L. camara*	*A. x grandiflora*	*L. camara*
Full CRF	T1	5527 b	6144 d	1138 d	1891 b	1299 f	5482 b
Half CRF	T2	6050 b	7599 c	1513 b	2129 b	2824 d	5333 b
T2+SE 0.5 gL^{-1}	T3	6019 b	8252 b	1572 b	2408 a	3196 c	5757 b
T2+SE 1gL^{-1}	T4	5650 b	8356 b	1593 b	2421 a	4154 b	5650 b
T2+Aa 1.5 gL^{-1}	T5	+15% 6382 a	6617 d	+55% 1766 a	2197 b	+236% 4375 a	5302 b
T2+Aa 2.5 gL^{-1}	T6	-17% 5448 b	+54% 9478 a	1266 c -39%	2421 a	2113 e -107%	6217 a

In columns, numbers followed by different letters are statistically different within parameters (S.N.K. test, $p \leq 0.05$; T1 = conventional dose of CRF [4 gL^{-1} GM]; T2 = 50% T1; T3 = T2 + MC-Extra® [0.5 gL^{-1}]; T4 = T2 + MC-Extra® [1.0 gL^{-1}]; T5 = T2 + Megafol® [1.5 mLL^{-1}]; T6 = T2 + Megafol® [2.5 mLL^{-1}].

Table 2. Transplant ground and above-ground dry weight (g) in *A. x grandiflora* (S1) and *L. camara* (S2), influenced by different nutrient supplies.

Dry Weight per Plant (g)

	TMTS	Ground		Above-Ground	
		A. x grandiflora	*L. camara*	*A. x grandiflora*	*L. camara*
Full CRF	T1	0.26 cd	1.05 b	1.53 b	1.86 b
Half CRF	T2	0.24 d	0.98 b	1.40 c	1.40 d
T2+SE 0.5 gL^{-1}	T3	0.29 b	1.00 b	1.60 b	1.63 c
T2+SE 1gL^{-1}	T4	0.27 c	1.06 b	1.36 c	1.73 c
T2+Aa 1.5 gL^{-1}	T5	0.33 a	1.13 ab	1.77 a	1.90 b
T2+Aa 2.5 gL^{-1}	T6	0.24 d	1.27 a	1.57 b	2.20 a

In columns, numbers followed by different letters are statistically different within parameters (S.N.K. test, $p \leq 0.05$; T1 = conventional dose of CRF [4 gL^{-1} GM]; T2 = 50% T1; T3 = T2 + MC-Extra® [0.5 gL^{-1}]; T4 = T2 + MC-Extra® [1.0 gL^{-1}]; T5 = T2 + Megafol® [1.5 mLL^{-1}]; T6 = T2 + Megafol® [2.5 mLL^{-1}].

Table 3 - Transplant Agronomical (Agr.) Nitrogen Use Efficiency (NUE) in *A. x grandiflora* (S1) and *L. camara* (S2), influenced by different nutrient supplies.

	NUE (gg^{-1})		
	TMTS	*A. x grandiflora*	*L. camara*
Full CRF	T1	90 b	163 c
Half CRF	T2	162 ab	251 b
T2+ SE 0.5 gL^{-1}	T3	192 a	279 b
T2+ SE 1gL^{-1}	T4	162 ab	294 ab
T2+ Aa 1.5 gL^{-1}	T5	217 a	323 ab
T2+ Aa 2.5 gL^{-1}	T6	182 a	368 a

In columns, numbers followed by different letters are statistically different within parameters (S.N.K. test, $p \leq 0.05$; T1 = conventional dose of CRF [4 gL^{-1} GM]; T2 = 50% T1; T3 = T2 + MC-Extra® [0.5 gL^{-1}]; T4 = T2 + MC-Extra® [1.0 gL^{-1}]; T5 = T2 + Megafol® [1.5 mLL^{-1}]; T6 = T2 + Megafol® [2.5 mLL^{-1}].

Conclusions

In sustainable agriculture, the substitution of chemical inputs, with alternative natural eco-friendly products presents a key challenge. Biostimulants, renewable sources, can form part of a solution to mitigate such risks deriving from the use of agrochemicals.

Findings show the positive effects of the main commercial SE-based products on AR formation and quality of **rooted cutting**, highlighting their effectiveness on rooting percentage, root number and architecture. Moreover, they increase the overall quality of a rooted cutting as dry biomass and organic compound content. The findings show that the effects, unfortunately, are species-specific and product-specific, depending on the type of seaweed resource, quality, and composition of the extract, and on the method, concentration, and frequency of application.

The showed findings offer valuable insights for optimizing ornamental rooted cuttings by harnessing the SE potential as viable alternative to synthetic compound.

The co-application of mineral N fertilizer and a plant biostimulant is suitable for implementation in current agronomic practice and is aligned with best agricultural practices. Therefore, it is vital for plant nutrition based on sustainable agronomical strategies to reduce the consumption and adverse effects of chemical fertilizers.

The results reported highlighted that, under limited mineral nutrient supply (50% CRF), Megafol® (AaB) was more efficient than Mc Extra® (SEB), increasing the quality performance of Abelia and Lantana transplants compared to those produced without biostimulants.

Nevertheless, additional studies are needed to validate these preliminary findings and to investigate the mechanism/mode of action.

Grazie per la cortese attenzione

P.S.R. Puglia 2014/2020 - Misura 16 — Cooperazione, Sottomisura 16.2 "Sostegno a progetti pilota e allo sviluppo di nuovi prodotti, pratiche, processi e tecnologie"

Progetto " Trasferimento di protocolli per organismi da quarantena e nocivi e per la selezione di materiali sanitariamente migliorati per il vivaismo pugliese" - Gruppo Operativo (ProDiQuaVi)" - D.d.S. n. 94250039990 PSR Puglia 2014-2020, sottomisura 16.2 CUP: B79J20000140009.

Task 3.4: Validazione e trasferimento di protocolli di moltiplicazione e produzione ecosostenibili di specie “mediterranee”.

La task 3.4 ha come obiettivo la validazione ed il trasferimento di protocolli di moltiplicazione e produzione ecosostenibili di specie “mediterranee”. L’attività vivaistica ornamentale è da sempre ritenuta ad elevata intensità di coltivazione: i moderni vivai fanno ampio uso di risorse chimiche per mantenere alti gli standard (quantitativi e qualitativi) di prodotto. Con tali premesse risulta evidente l’importanza di diminuire l’impatto ambientale del processo nell’ottica di una progressiva ottimizzazione degli input, che indirizzi questo settore dell’agricoltura verso una maggiore sostenibilità.

PSR PUGLIA 2014-2020 REGIONE PUGLIA

MISURA 16 - COOPERAZIONE SOTTOMISURA 16.2
Sostegno a progetti pilota e allo sviluppo di nuovi prodotti, pratiche, processi e tecnologie

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