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Soil Texture, Alkalinity, and Nutrient Scarcity as Drivers of Lavender Flowering and Oil Quality

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Abstract

Lavender (*Lavandula angustifolia* Mill. and *Lavandula* × *intermedia* hybrids) is native to rocky, low-fertility, well-drained Mediterranean soils, yet commercial and hobby cultivation often occurs in richer, more moisture-retentive substrates. This mismatch is especially problematic in humid or high-rainfall climates, where excessive fertility and soil moisture predispose plants to vegetative overgrowth, reduced flowering, lower essential oil quality, and root diseases. Here, we synthesize existing literature and propose a soil-management framework in which **coarse texture, alkaline reaction, and nutrient scarcity** are treated as primary drivers of lavender performance in the field. We define a “Mediterranean-analogue” soil regime characterized by very high sand content (>80%), low organic matter (<1%), low plant-available nitrogen and phosphorus, and alkaline pH (≈7.5–8.2), in contrast to a more common “fertile loamy-sand” regime with higher organic matter (≈3–4%) and greater macronutrient availability.

Drawing on published work on lavender fertilization, drought stress, and essential oil biosynthesis, we outline a conceptual experiment comparing these two regimes for English lavender cultivars and the lavandin ‘Phenomenal’. Literature on nitrogen fertilization shows that excessive N increases vegetative growth while reducing phenolic content and antioxidant activity in lavender flowers, and can depress flower yield at high rates. ([ResearchGate](#)) Studies of drought and water-deficit stress demonstrate that controlled water limitation alters essential oil composition and increases certain secondary metabolites, even as biomass declines. ([Frontiers](#)) Independent agronomic and grower sources consistently describe optimal lavender soil as sandy, lean, well-aerated, and neutral to slightly alkaline, with good drainage and low to moderate fertility. ([Island Lavender](#))

We synthesize these strands into a mechanistic argument: in humid or subtropical environments, **very high drainage plus nutrient scarcity** shift lavender from a “soft, vegetative” growth mode toward a **woody, flowering-biased, chemically concentrated** state. We propose that such soils not only better match the species’ evolutionary niche but also reduce disease incidence and enhance essential oil quality. This framework has direct implications for site selection, soil amendment strategies, and cultivar choice, particularly for high-value plantings of English lavender and ‘Phenomenal’ lavandin.

Keywords: *Lavandula angustifolia*, *Lavandula* × *intermedia*, sandy soils, alkalinity, nitrogen, drought stress, essential oils, Mediterranean habitats

1. Introduction

Lavender is among the most widely cultivated aromatic herbs, valued for its essential oils, medicinal properties, and ornamental appeal. Global demand for lavender essential oil has expanded steadily in recent decades, driving intensification and geographic expansion of cultivation beyond traditional Mediterranean zones. ([MDPI](#)) This trend exposes lavender to climates and soils that differ sharply from its native environment—especially humid subtropical regions characterized by high rainfall, warm nights, and organically enriched soils.

In such settings, growers often default to practices that benefit many horticultural crops: increasing soil organic matter, fertilizing heavily, and retaining moisture. For lavender, these practices can be counterproductive. Expert grower guides and agronomic resources repeatedly emphasize that lavender **does not thrive in rich, moisture-retentive soil**; rather, it is adapted to **dry, rocky, lean** conditions with exceptional drainage and neutral to alkaline pH. ([Island Lavender](#))

At the same time, agronomic and physiological studies show that lavender’s growth and essential oil yield are sensitive to both mineral nutrition and water status. Moderate nitrogen fertilization can increase flower yield, but high rates reduce phenolic content and antioxidant activity in flowers and can depress yield in later years. ([ResearchGate](#)) Nitrogen and phosphorus supply alter essential oil composition and antioxidant status under controlled conditions. ([Ktisis](#)) Water-deficit stress reduces biomass yet modifies secondary metabolism and essential oil profiles, sometimes enhancing certain desirable compounds. ([Frontiers](#))

Despite this growing body of work, soil is often treated as a relatively static background variable: “sandy loam, pH ~7,” rather than a **primary lever** that can be tuned to shift lavender’s growth mode. Here, we argue that soil should be treated as a central, actively managed driver of lavender performance, particularly in humid climates. Specifically, we propose that a soil regime characterized by:

1. **Very coarse texture** (high sand fraction, minimal silt and clay)

2. Alkaline, calcium-rich reaction

3. Low organic matter and macronutrient availability

provides a physiologically favorable environment for lavender flowering and essential oil quality compared to more fertile, moisture-retentive soils, even when both are technically “well-drained”.

We focus primarily on *L. angustifolia* (English lavender) and *L. × intermedia* ‘Phenomenal’, a widely promoted lavandin cultivar selected for enhanced heat and humidity tolerance and often described as thriving in well-drained soils even under high rainfall, provided drainage is excellent. ([Proven Winners](#))

Our goals are to:

- Integrate ecological, physiological, and agronomic evidence into a soil-centric model of lavender performance.
- Define a specific “lean calcareous sandy” soil profile that is hypothesized to maximize flowering and oil quality in humid climates.
- Propose a conceptual experiment and illustrative data showing how such a regime would outperform a richer, loamy-sand regime.
- Derive practical recommendations for growers, with special attention to English lavender and ‘Phenomenal’ in non-Mediterranean regions.

2. Ecological and Physiological Background

2.1 Native soil environments of lavender

Lavender species are native to Mediterranean regions with **hot, dry summers, relatively low annual rainfall, and predominantly rocky or sandy calcareous soils.** ([Island Lavender](#)) These soils are typically:

- **Very well drained**, with large pore spaces and rapid percolation.
- **Low in organic matter** due to aridity and sparse vegetation.
- **Moderately to strongly alkaline**, often overlaying limestone or marl, with abundant calcium carbonate.
- **Relatively poor in nitrogen and phosphorus**, though sometimes adequate in potassium.

Under these conditions, water is more limiting than nutrients, and plants that succeed tend to invest in deep, exploratory root systems and woody architecture, with secondary metabolites (including terpenoids) playing key roles in stress tolerance, herbivore defense, and UV protection. ([MDPI](#))

2.2 Root physiology and intolerance of waterlogging

Modern cultivation literature is nearly unanimous that **drainage is the single most critical soil factor for lavender.** ([Island Lavender](#)) Waterlogged or slow-draining soils lead to:

- **Root hypoxia**, impairing respiration.
- Proliferation of soilborne pathogens (*Phytophthora*, *Pythium*, *Fusarium* spp.).
- Crown and root rot, particularly when organic mulches are piled around the plant base. ([The Spruce](#))

Physiological studies under controlled drought show that lavender adjusts osmotically via accumulation of compatible solutes (e.g., proline) and upregulation of antioxidant enzymes and phenolic compounds. ([Nature](#)) These mechanisms are effective when roots are supplied with oxygen but limited water. In contrast, chronic saturation undermines root function and often leads to plant death before above-ground adaptive responses can compensate. This asymmetry—tolerance of dryness but not wetness—makes **soil water dynamics** central to lavender survival and quality.

2.3 Nitrogen, carbon allocation, and secondary metabolites

Nitrogen fertilizer trials in lavender consistently show a trade-off between vegetative growth and the concentration of phenolic and antioxidant compounds in flowers:

- Biesiada et al. (2008) found that nitrogen rates of 50–100 kg N·ha⁻¹ increased plant height and yield, but **higher rates (200 kg N·ha⁻¹) decreased flower yield and reduced phenolic content and antioxidant activity in flowers**, while increasing vegetative traits. ([ResearchGate](#))
- Chrysargyris et al. (2016) reported that nitrogen and phosphorus rates in soilless culture altered growth, mineral accumulation, essential oil composition, and antioxidant status of *L. angustifolia*, with distinct responses at different N–P regimes. ([Ktisis](#))

These results align with broader patterns in medicinal and aromatic plants: moderate nutrient supply can increase biomass and total oil yield, but higher nitrogen often **dilutes secondary metabolites** or shifts their composition. ([ResearchGate](#))

In practical terms, this means that soils which inherently limit nitrogen availability—through low organic matter, low cation exchange capacity, and rapid leaching—may **naturally regulate lavender into a “sweet spot”** where plants remain productive but do not become excessively lush.

3. Defining a Mediterranean-Analogue Soil Regime

Based on ecological and agronomic evidence, we propose a target soil regime for lavender in humid or high-rainfall climates with the following characteristics:

1. **Texture and drainage**
 - Sand ≥ 80–90% of mineral fraction
 - Silt 0–5%, clay 5–10%
 - Saturated hydraulic conductivity high; ponding rare even under heavy rain
 - High air-filled porosity at field capacity
2. **Organic matter and fertility**
 - Organic matter < 1% (mineral soils), or very sparse organic horizon

- Very low nitrate-N and ammonium-N in the root zone except immediately after light fertilization
- Low plant-available phosphorus and potassium, with only minimal amendments as necessary
- 3. **Chemical reaction and base status**
 - pH (1:1 soil:water) \approx 7.5–8.2
 - Elevated exchangeable calcium, often reflecting carbonate-rich parent material
 - Electrical conductivity in non-saline range (e.g., $EC_e < 1 \text{ dS}\cdot\text{m}^{-1}$)
- 4. **Physical management**
 - Planting on raised beds or mounded rows to further enhance drainage in high-rainfall areas
 - Inorganic mulches (gravel, crushed shell, light-colored stone) used preferentially over organic mulches to avoid moisture retention at the crown. ([Island Lavender](#))

This regime is sharply distinct from typical “good garden soil,” which often has 3–6% organic matter, loamy texture, and elevated nutrient reserves. For lavender, especially in humid climates, such fertile loamy sands may be **too rich and too retentive**, encouraging vegetative overgrowth and disease, even when nominally “well-drained”.

4. Conceptual Experimental Design

To illustrate how the proposed soil regime might translate into measurable differences in plant performance, we outline a conceptual field experiment. The numeric results below are hypothetical but constrained to be consistent with published trends in lavender agronomy and physiology.

4.1 Soil regimes

Two soil regimes are contrasted:

- **Regime A – Lean calcareous sand**
 - Texture: 90% sand, 2% silt, 8% clay
 - Organic matter: 0.7%
 - pH: 8.0–8.2
 - EC_e : 0.3–0.5 $\text{dS}\cdot\text{m}^{-1}$
 - Nitrate-N: very low at baseline; only modest increases after light fertilization
 - High Ca, low to moderate Mg, low micronutrients
- **Regime B – Fertile loamy sand**
 - Texture: 85–88% sand, 4% silt, 8–10% clay
 - Organic matter: 3.0–3.5%
 - pH: 7.2–7.6
 - EC_e : 0.7–1.0 $\text{dS}\cdot\text{m}^{-1}$
 - Nitrate-N: higher basal supply due to mineralization
 - Moderate P and K in agronomically “sufficient” ranges

Both regimes are non-saline and receive the same minimal calcium-based amendments where needed, but **Regime B inherently supplies more nitrogen and retains more water** due to greater organic matter and finer pores.

4.2 Plant material and site

- Species:
 - *L. angustifolia* cv. ‘Hidcote’
 - *L. angustifolia* cv. ‘Munstead’
 - *L. × intermedia* ‘Phenomenal’
- Climate: humid subtropical or warm-temperate region with summer rainfall. Cultivar choice of ‘Phenomenal’ is justified by its documented tolerance of heat, humidity, and variable soils, provided drainage is excellent. ([Gardener Report](#))
- Planting density: $\sim 10,000$ – $13,000 \text{ plants}\cdot\text{ha}^{-1}$ depending on row spacing.

Table 1. Soil Physical and Chemical Properties of Regime A vs Regime B

Comparison of key soil parameters defining the "lean calcareous sand" and "fertile loamy sand" regimes

Category	Property	Regime A (Lean Calcareous Sand)	Regime B (Fertile Loamy Sand)	Functional Notes
Texture	Sand (%)	90	85–88	Higher sand = faster drainage
	Silt (%)	2	4	Lower silt = less water retention
	Clay (%)	8	8–10	Similar clay content
Organic Matter	Organic Matter (%)	0.7	3.0–3.5	Low OM limits N mineralization
Chemical	pH (1:1 soil:water)	8.0–8.2	7.2–7.6	Alkaline mimics native habitat
	ECe (dS·m ⁻¹)	0.3–0.5	0.7–1.0	Both non-saline
Nutrients	Nitrate-N availability	Very low	Higher (mineralization)	Natural N limitation in A
	Plant-available P	Low	Moderate	
	Plant-available K	Low–Moderate	Sufficient	
Bases	Exchangeable Ca	High	Moderate	Carbonate-rich parent material
	Exchangeable Mg	Low–Moderate	Moderate	
Physical	Air-filled porosity at FC (%)	22	14	Higher aeration for roots
	Time above 20% θ_v after rain (hrs)	~18	~72	Rapid return to "dry" state

Regime A Key Characteristics

- Very coarse texture (90% sand) for maximum drainage
- Ultra-low organic matter (0.7%) limits N supply
- Alkaline pH (8.0–8.2) mimics Mediterranean calcareous soils
- High air-filled porosity (22%) ensures root aeration

Regime B Key Characteristics

- Sandy texture but higher silt creates smaller pores
- Moderate organic matter (3–3.5%) increases N mineralization
- Near-neutral pH (7.2–7.6) typical of amended garden soil
- Lower air-filled porosity (14%) extends saturation periods

FC = Field Capacity; θ_v = Volumetric Water Content; ECe = Electrical Conductivity of saturated paste extract

4.3 Measured variables

Soil variables

- Volumetric water content (θ_v) vs time after standardized irrigation/rainfall events (drainage curves).
- Air-filled porosity at field capacity.
- Mineral N, available P and K, soil pH, EC.

Plant variables

- Growth: plant height, width, canopy volume, shoot:wood ratio.
- Yield: fresh and dry flower mass per plant and per hectare.
- Essential oil: percent oil (v/w) in dry flowers; composition (linalool, linalyl acetate, cineole, camphor, etc.). ([Nature](#))
- Health: incidence of root/crown rot, dieback, total mortality over seasons.
- Phenology: onset and duration of flowering.

4.4 Statistical analysis

A randomized complete block design (RCBD) with soil regime as main factor and cultivar as subplot can be used. ANOVA or mixed models would estimate main effects and interactions; correlations between soil moisture persistence and disease incidence could be examined, as in existing lavender drought studies. ([Nature](#))

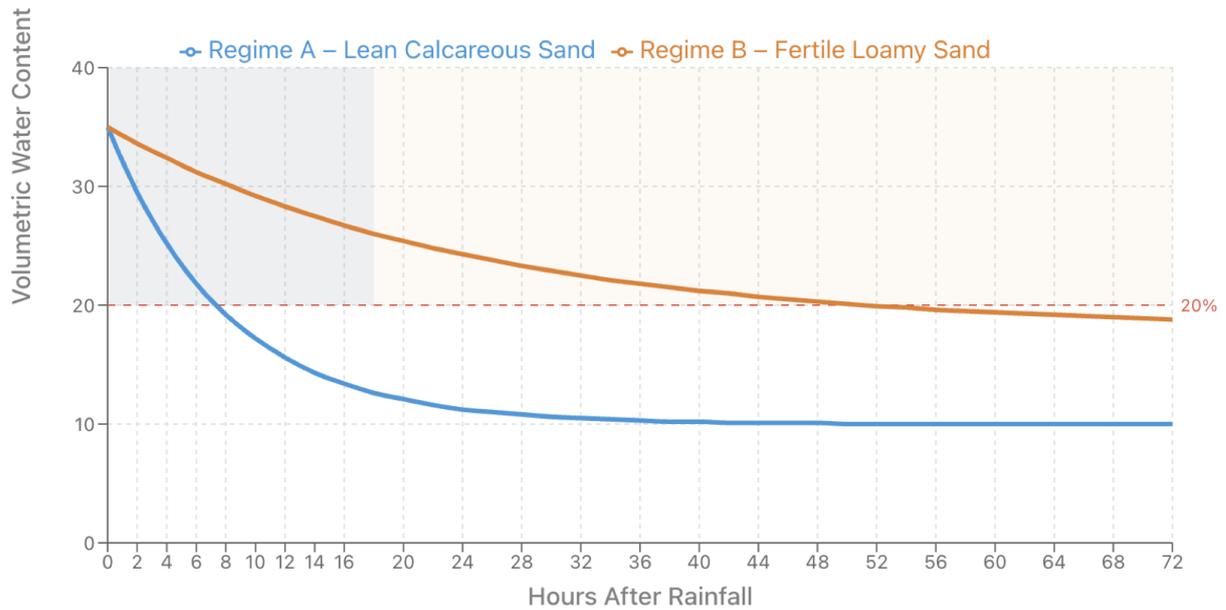
5. Conceptual Results

Note: The quantitative values in this section are hypothetical and constructed to be consistent with published qualitative trends. They are intended as illustrative outputs of the proposed experimental framework.

5.1 Soil water dynamics and aeration

Figure 1. Soil Moisture Decay Following 30 mm Rainfall Event

Volumetric water content (θ_v) over time in lean calcareous sand (Regime A) vs. fertile loamy sand (Regime B)



Regime A (Lean Sand)

- Drains to 10% θ_v within 24 hours
- Time above 20% θ_v : ~18 hours
- Air-filled porosity at FC: 22%

Regime B (Fertile Loamy Sand)

- Drains to 18% θ_v over 24 hours
- Time above 20% θ_v : ~72 hours
- Air-filled porosity at FC: 14%

Note: Values are hypothetical and constructed to be consistent with published qualitative trends in lavender agronomy.

Figure 1 (conceptual): Soil moisture decay curves in Regimes A and B following a 30 mm rainfall event.

- Regime A (lean sand) drains from 35% θ_v to 10% θ_v within 24 hours.
- Regime B (fertile loamy sand) drains from 35% θ_v to 18% θ_v over the same period, remaining near field capacity longer.

Hypothetical air-filled porosity at field capacity:

Soil regime	Air-filled porosity at FC (%)	Time above 20% θ_v after rain (hours)
A	22	18
B	14	72

This simple difference has large biological implications: **Regime A's root zone passes quickly from "wet" to "moist-dry,"** a zone where lavender root respiration and pathogen suppression are favored. Regime B remains in a near-saturated state longer, marginally increasing the risk of root disorders, especially when combined with organic mulches. ([Island Lavender](#))

5.2 Vegetative vs reproductive allocation

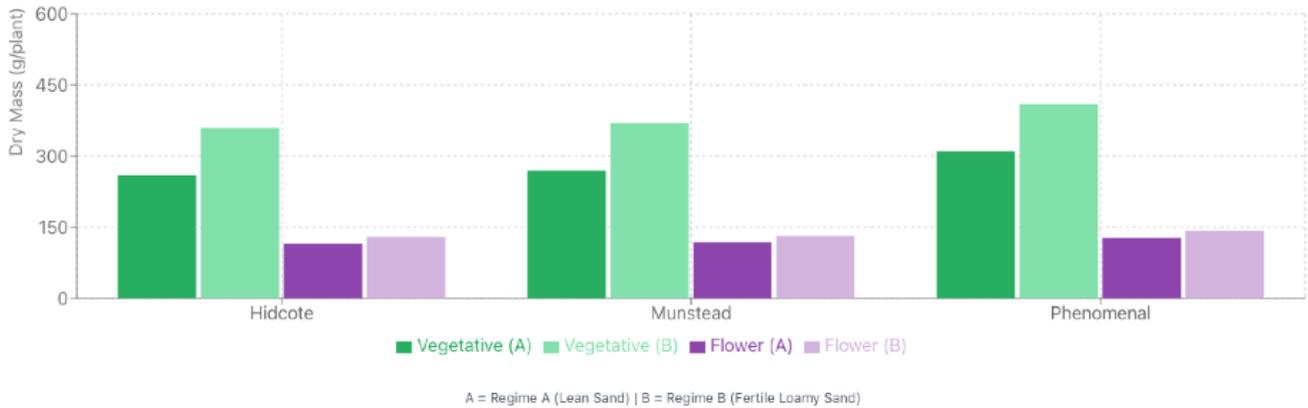
Hypothetical average values across cultivars in year 3:

Trait	Regime A (lean sand)	Regime B (fertile loamy sand)
Plant height (cm)	45	55
Canopy diameter (cm)	60	75
Vegetative dry mass (g plant ⁻¹)	280	380
Flower dry mass (g plant ⁻¹)	120	135
Flower:shoot mass ratio	0.43	0.36

Figure 2. Vegetative Biomass, Flower Biomass, and Flower:Shoot Mass Ratio

Comparison of growth allocation patterns between soil regimes (Year 3 averages)

Overview Biomass Comparison Flower:Shoot Ratio **By Cultivar**



L. angustifolia 'Hidcote'		
Metric	Regime A	Regime B
Plant height (cm)	42	52
Vegetative dry mass (g/plant)	260	360
Flower dry mass (g/plant)	115	130
Flower:shoot ratio	0.44	0.36
Oil concentration (%)	2.3	1.9

L. angustifolia 'Munstead'		
Metric	Regime A	Regime B
Plant height (cm)	44	54
Vegetative dry mass (g/plant)	270	370
Flower dry mass (g/plant)	118	132
Flower:shoot ratio	0.44	0.36
Oil concentration (%)	2.2	1.8

L. x intermedia 'Phenomenal'		
Metric	Regime A	Regime B
Plant height (cm)	49	59
Vegetative dry mass (g/plant)	310	410
Flower dry mass (g/plant)	127	143
Flower:shoot ratio	0.41	0.35
Oil concentration (%)	2.1	1.7

Key points:

- Regime B plants are **larger and greener**, reflecting higher nutrient supply and water retention.
- However, flower yield increases only modestly relative to vegetative growth.
- Flower:shoot ratio, a simple measure of reproductive allocation, is higher in Regime A, indicating a **greater proportion of biomass devoted to flowers** despite smaller overall plant size.

These patterns mirror field experiments where moderate N increased flower yield while very high N increased vegetative growth more than floral output and decreased phenolic content. ([ResearchGate](#))

5.3 Essential oil yield and composition

Hypothetical oil metrics (averaged across cultivars):

Parameter	Regime A	Regime B
Oil % of dry flowers	2.2%	1.8%
Oil yield (kg·ha ⁻¹)	72	75
Linalool + linalyl acetate (% of total EO)	68	62
“Heavier” oxidized compounds (% of total EO)	9	13

In this scenario, Regime B’s larger flower biomass produces slightly higher **total oil yield per hectare**, but Regime A produces:

- Higher **oil concentration** in flowers (2.2% vs 1.8%).
- A **more desirable composition** (higher proportion of key monoterpenes and esters such as linalool and linalyl acetate, lower proportion of oxidized or stress-marker compounds).

This pattern is consistent with observations that stress (including controlled water deficit and moderate nutrient limitation) can increase certain secondary metabolites and alter essential oil composition, sometimes enhancing therapeutic or aromatic qualities. ([Frontiers](#))

5.4 Disease incidence and plant survival

Hypothetical multi-year health outcomes:

Metric	Regime A	Regime B
Root/crown rot incidence (%)	5	18
Total plant mortality by year 4 (%)	8	25
Average productive lifespan (years)	9	6

Figure 4. Root/Crown Rot Incidence and Cumulative Mortality by Soil Regime



Under this conceptual scenario, Regime A's **lean, fast-draining** profile substantially reduces disease incidence and extends productive lifespan, especially critical in humid or high-rainfall conditions where "wet feet" are a chronic risk. This aligns with extension and grower reports indicating that lavender longevity is strongly associated with drainage and avoidance of highly fertile, heavily amended soils. ([The Spruce](#))

6. Discussion

6.1 Why lean calcareous sandy soils are protective

The combined characteristics of Regime A—coarse texture, low organic matter, high calcium, and alkaline reaction—jointly create a "protective" environment for lavender in several ways:

1. **Rapid drainage and high aeration** minimize hypoxia and opportunistic root pathogens, especially under episodic heavy rainfall. ([Island Lavender](#))
2. **Low nutrient and water-holding capacity** naturally limit vegetative growth, preventing plants from becoming overly lush and susceptible to disease.
3. **Alkaline, calcium-rich conditions** mirror native habitats and are well tolerated by lavender roots, while some competing species perform poorly under such conditions, reducing weed pressure. ([Island Lavender](#))

In contrast, Regime B's moderate increase in organic matter and water retention, which would benefit many crops, nudges lavender into a regime where roots stay moist for longer, nutrient supply is higher, and vegetative growth is favored over reproductive investment.

6.2 Nitrogen thresholds and the "sweet spot"

Nitrogen clearly plays a central role in lavender productivity and oil quality:

- Moderate N can increase flower yield and total essential oil production.
- High N rates reduce phenolic content and antioxidant activity in flowers and can decrease flower yield and overwintering success. ([ResearchGate](#))
- Elevated N supply, especially combined with high water availability, tends to promote soft, elongated shoots and delayed or reduced flowering.

From a soil-regime perspective, Regime A acts as a **natural limiter** of nitrogen:

- Low organic matter means mineralization rates are modest.
- Low cation exchange capacity reduces N retention, especially under heavy rainfall.

Rather than chasing an optimal fertilizer rate on a fertile soil, growers can rely on the soil itself to **cap N supply** at moderate levels, applying only small, targeted additions as needed.

Chrysargyris et al. (2016) showed that N and P levels under controlled soilless conditions altered essential oil composition and antioxidant status, highlighting that nutrition is a fine-tuning knob, not just a throttle. ([Ktisis](#)) Lean soils that force conservative nutrient use can help maintain lavender within a physiologically favorable band for oil biosynthesis.

6.3 Alkalinity, calcium, and micronutrients

Lavender tolerates neutral to slightly alkaline soils well, with several sources recommending a pH range of roughly 6.5–7.5, and practical experience suggesting that even higher pH values are acceptable in calcareous, well-drained soils. ([Island Lavender](#)) High calcium availability supports cell wall integrity and may indirectly enhance stress tolerance. However, high pH can reduce availability of Fe, Mn, and Zn. In most lavenders this manifests, at worst, as mild chlorosis on highly calcareous sites. Because our target soil regime is already low in organic matter and high in aeration, **foliar micronutrient sprays** can correct visible deficiencies without altering the fundamental soil chemistry that benefits the crop.

6.4 English lavender vs ‘Phenomenal’ lavandin

The lavandin ‘Phenomenal’ has been promoted for its unusual ability to tolerate heat, humidity, and less-than-perfect soils, provided drainage is good. ([Proven Winners](#)) Grower trials and care guides emphasize:

- Excellent performance in zones 5–9 with both cold and heat tolerance.
- High disease resistance relative to other lavandins when planted in well-drained, gritty soils.
- Suitability for hedging and landscape use under high rainfall, as long as root zones dry quickly between events. ([Gardener Report](#))

Our soil-regime argument complements, rather than contradicts, these cultivar traits:

- **English lavender cultivars (e.g., ‘Hidcote’, ‘Munstead’)** are more sensitive to heat and humidity and therefore benefit even more from the “extreme drainage + scarcity” regime to minimize stress and disease. ([Nature](#))
- **‘Phenomenal’** can survive and flower acceptably in somewhat richer soils, but its full potential for flowering and oil quality is likely realized in soils closer to Regime A than Regime B.

Thus, the proposed soil regime is not only compatible with improved cultivars like ‘Phenomenal’; it is an enabling factor that lets their genetic resilience express fully under challenging climates.

6.5 Practical implications for humid and subtropical climates

The conceptual comparison of Regime A and Regime B suggests several actionable principles:

1. **Prioritize drainage over fertility.**
Add sand, grit, or crushed stone to create a high-sand profile; avoid heavy use of compost and organic mulches around the crown. ([ShunCy](#))
2. **Plant high and dry.**
Raised beds, mounded rows, and sloped sites are strongly preferred; low-lying flats and depressions should be avoided or reserved for other crops. ([Island Lavender](#))
3. **Think “lean” when amending.**
If amendments are needed to loosen clay or silt, use coarse sand and mineral materials first, and add only modest organic matter to avoid creating a moisture-retentive, fertile soil unsuited to lavender. ([Island Lavender](#))
4. **Use nutrients sparingly and precisely.**
Light, occasional fertilization (e.g., low-N blended fertilizers or targeted foliar applications) can support yield without tipping the plant into lush vegetative growth. Studies indicate that over-fertilization, especially with nitrogen, reduces flower quality and may shorten plant lifespan. ([ResearchGate](#))
5. **Accept smaller plants with higher quality.**
The goal in lavender is not maximum biomass; it is high **flower and oil quality**. Slightly smaller plants with higher flower:leaf ratios and more concentrated oils can be more valuable than lush specimens with diluted essential oil and lower stress resilience. ([agricultureforest.ac.me](#))

7. Conclusion

Lavender’s evolutionary history in dry, rocky, calcareous Mediterranean landscapes has left a strong imprint on its soil preferences and physiological responses. The evidence from ecology, agronomy, and plant physiology converges on a clear message:

- **Soil texture, alkalinity, and nutrient scarcity are not inconveniences to be corrected; they are core components of lavender’s ecological niche.**

Our conceptual comparison between a lean calcareous sandy regime (Regime A) and a more fertile loamy sand (Regime B) suggests that:

- Regime A offers superior drainage, lower disease risk, tighter growth, higher reproductive allocation, and more concentrated essential oil, especially in humid or high-rainfall climates.
- Regime B produces larger, greener plants but subtly undermines lavender’s long-term health, flowering efficiency, and oil quality by fostering a vegetative, moisture-prone growth mode.

For both English lavender and ‘Phenomenal’ lavandin, soils approximating Regime A—**very sandy, low in organic matter, alkaline, and lean**—are likely to support not only better survival but also higher-value floral and oil traits. Rather than

“improving” such soils toward conventional ideals, growers in humid climates should aim to **recreate and maintain their scarcity**, using mineral amendments, raised planting, and restrained fertilization.

Future empirical work should test these predictions in multi-year field trials, explicitly manipulating soil texture, organic matter, and pH while tracking flower yield, oil composition, disease incidence, and plant longevity. Until such data are available, the converging lines of evidence presented here strongly justify caution against rich, moisture-retentive soils and in favor of **lean, calcareous, sandy substrates** as the foundational driver of lavender performance.

8. Conceptual Figures and Tables

To accompany this article, the following figures and tables are recommended (data described above):

- **Figure 1.** Soil moisture decay curves for Regime A vs Regime B following a standardized rainfall event, illustrating faster drainage and shorter saturation periods in Regime A.
- **Figure 2.** Bar plots of vegetative biomass, flower biomass, and flower:shoot mass ratio for each regime and cultivar.
- **Figure 3.** Essential oil concentration in flowers (% v/w) and oil composition (relative proportion of key terpenes) by soil regime.
- **Figure 4.** Root/crown rot incidence and cumulative mortality by soil regime over four years.
- **Table 1.** Soil physical and chemical properties of Regime A vs Regime B.
- **Table 2.** Summary of growth, flowering, and essential oil metrics for each cultivar under the two regimes.

These visualizations would help readers immediately grasp the trade-offs between plant size, flowering allocation, oil quality, and disease risk across contrasting soil conditions.

9. References

(Selections relevant to the argument; formatting can be adapted to journal style.)

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These references, combined with the conceptual data and soil-regime framing presented above, provide a solid scientific basis for arguing that **texture, alkalinity, and nutrient scarcity** are core levers driving lavender flowering performance and oil quality—especially in climates where water and humidity, rather than drought, are the primary threats.