Rehabilitation of disturbed by mining activities lands in high floristic diversity areas: the case of Mt Giona

by
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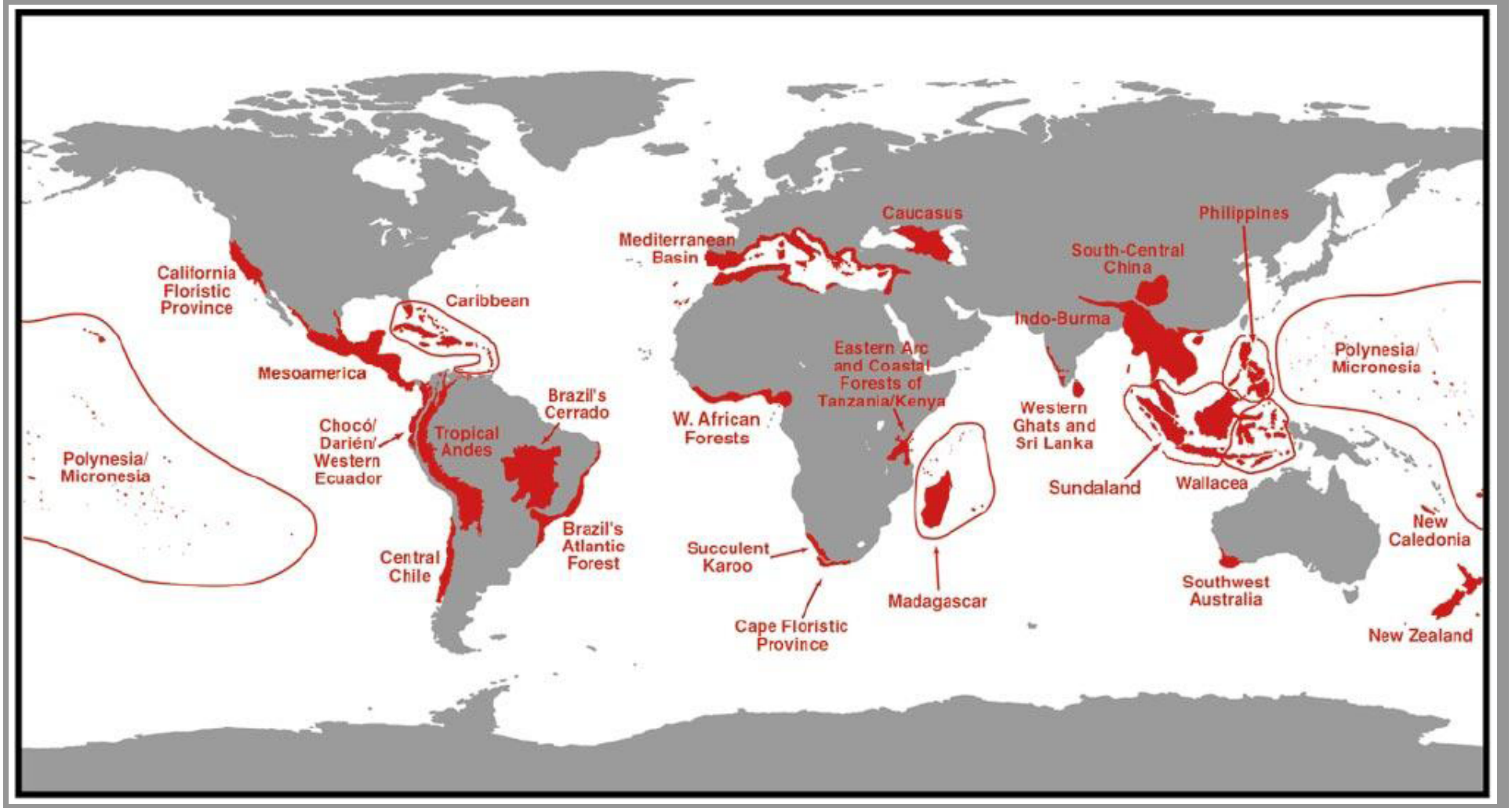
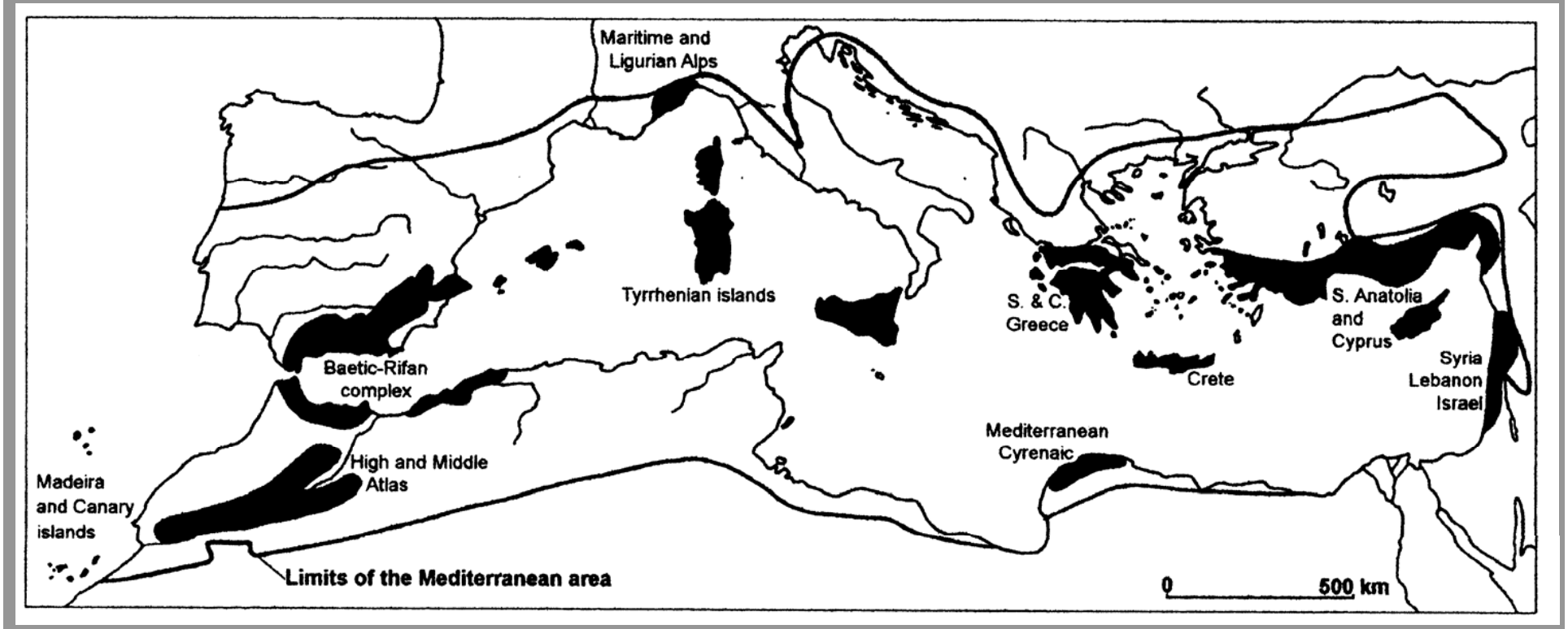
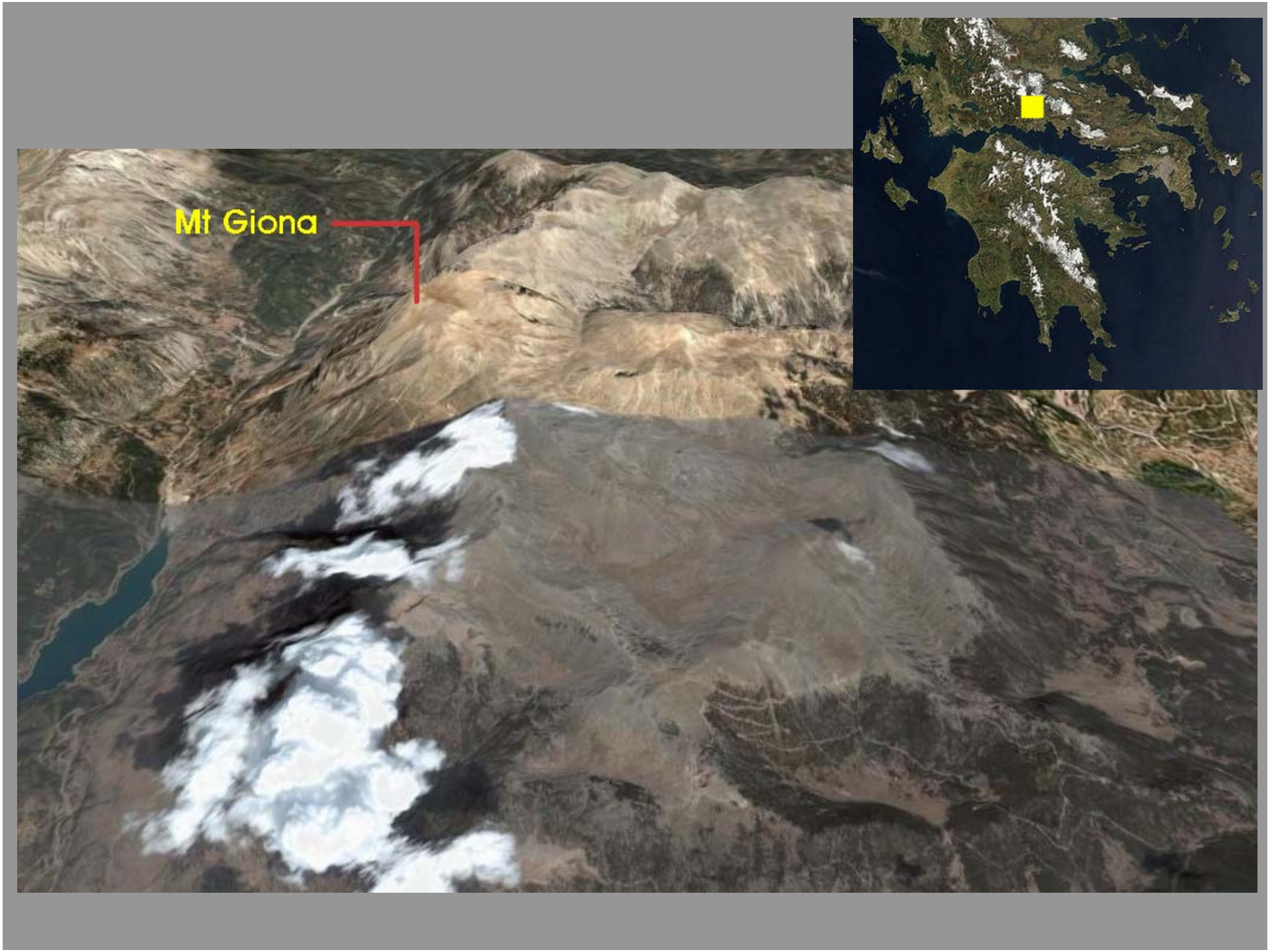


The 25 biodiversity hotspots of the Earth (according to Myers et al., 2000)



The 10 Mediterranean Basin hotspots based on plant endemism and richness (according to Médail & Quézel, 1999)


Mt Giona

FLORISTIC RICHNESS

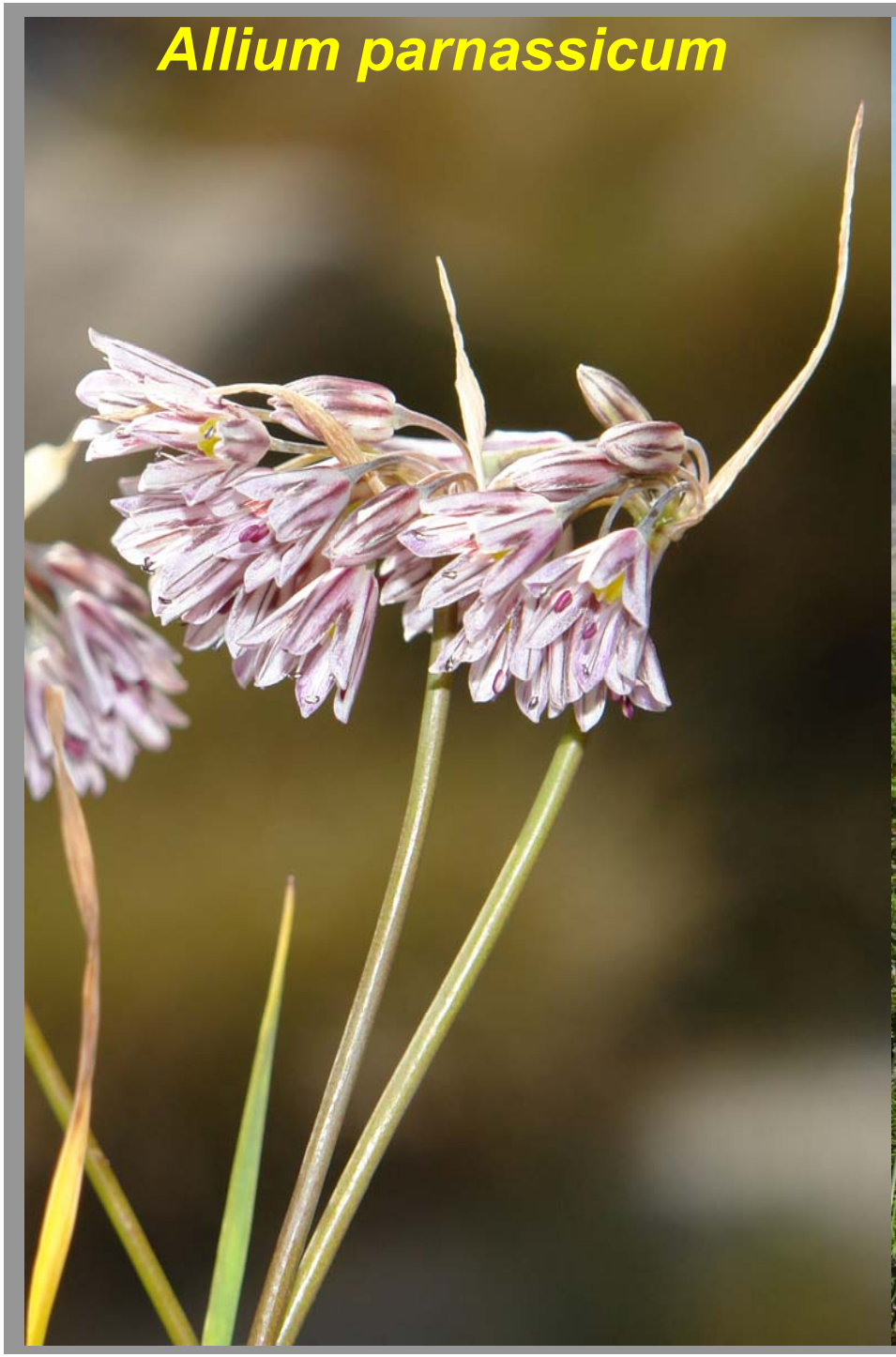
- **The flora of Mt Giona consists of c. 1000 vascular plant taxa (species and subspecies).**
- **The endemic flora consists of 101 taxa.**
- **Two species (*Arenaria gionae*, *Potentilla kionaea*) have a distribution range restricted to Mt Giona.**
- **99 taxa have a wider distribution in the neighbouring mountains of Sterea Ellas and/or the mountains of Peloponnese and central-northern Greece.**

THREATENED SPECIES

- **Critically Endangered (CR): 0 taxa**
- **Endangered (EN): 0 taxa**
- **Vulnerable (VU): 7 taxa**

  Allium parnassicum, *Alyssum taygeteum*, *Aquilegia ottonis* ssp. *ottonis*, *Arenaria gionae*, *Campanula aizoon* ssp. *aizoon*, *Potentilla kionaea*, *Silene barbeyana*

- **Near Threatened (NT): 25 taxa**
- **Least Concern (LC): 53 taxa**
- **Data Deficient (DD): 16 taxa**


Allium parnassicum

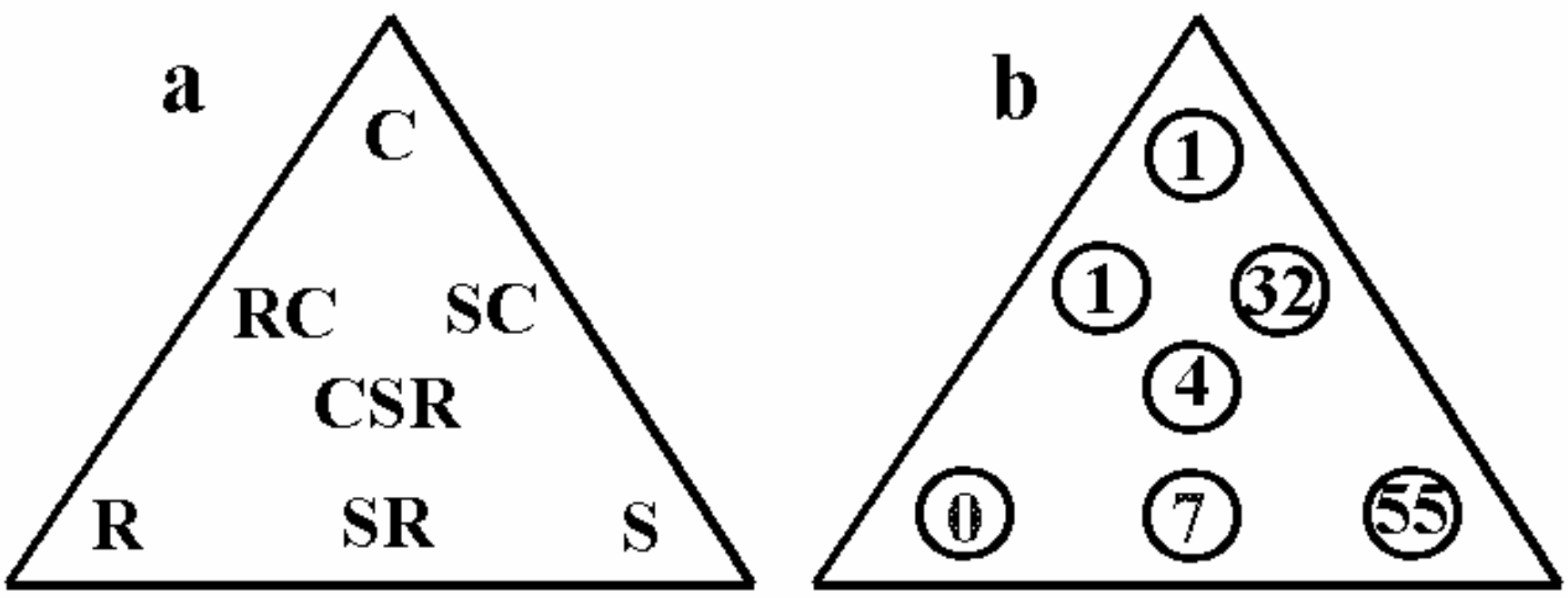

Campanula aizoon ssp. aizoon


Silene barbeyana


Potentilla kionaea

Habitat classification and vulnerability of the endemic plants of Mt Giona

	Habitat type	Number of endemic plants			Vulnerability
		Total	Threatened	Near Threatened	
1	Sclerophyllus scrubs	6	0	0	Low
2	*Abies cephalonica* woodlands	2	0	0	Low
3	Low altitude forest edges and glades	5	0	0	Low
4	Mid and high altitude forest edges and glades	14	0	2	Low
5	Mid-altitude cliffs and rocks	8	0	1	Low
6	High altitude cliffs and rocks	46	5	11	Medium
7	Calcareous rocky grasslands at mid-altitudes	13	0	1	Low
8	Calcareous rocky grasslands at high altitudes	58	3	15	Low
9	Screes	25	2	6	Medium
10	Moist sub-alpine pastures	15	0	3	Low
11	Fallows, roadsides	11	0	1	Low
12	Ravines, springs and rivulets	6	1	2	Medium



Grime's CSR plant strategies (a) and percentage of life strategies of endemic plants from Mt Giona (b)

Proposals for the endemic taxa

- Conservation
- Use of SR endemics in rehabilitation projects
- Creation of artificial micro-reserves

Native species that play an important role in re-vegetation were selected according to the following criteria:

- Rich above-ground plant parts,

- Effective soil cover,

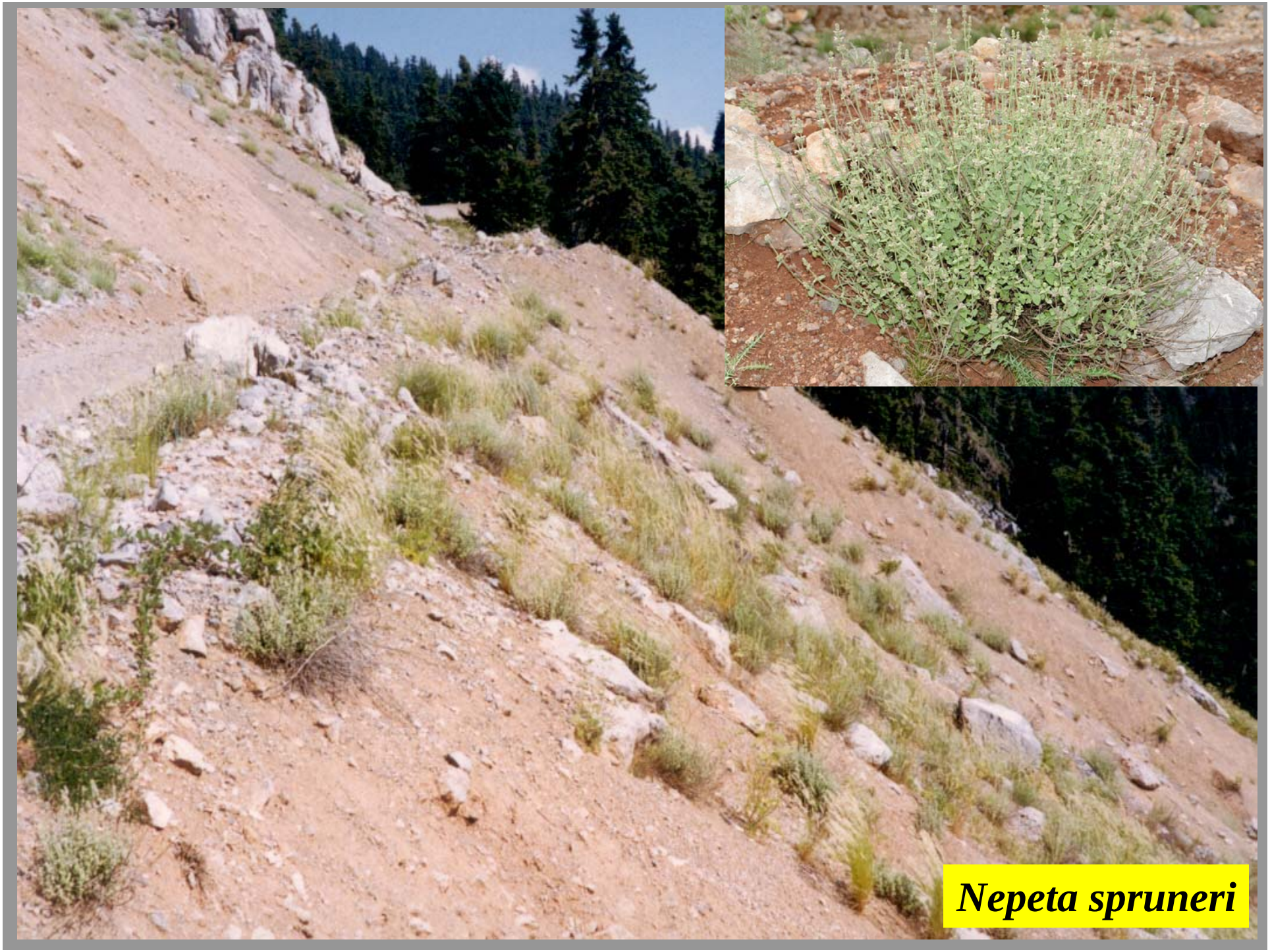
- Good radical system,

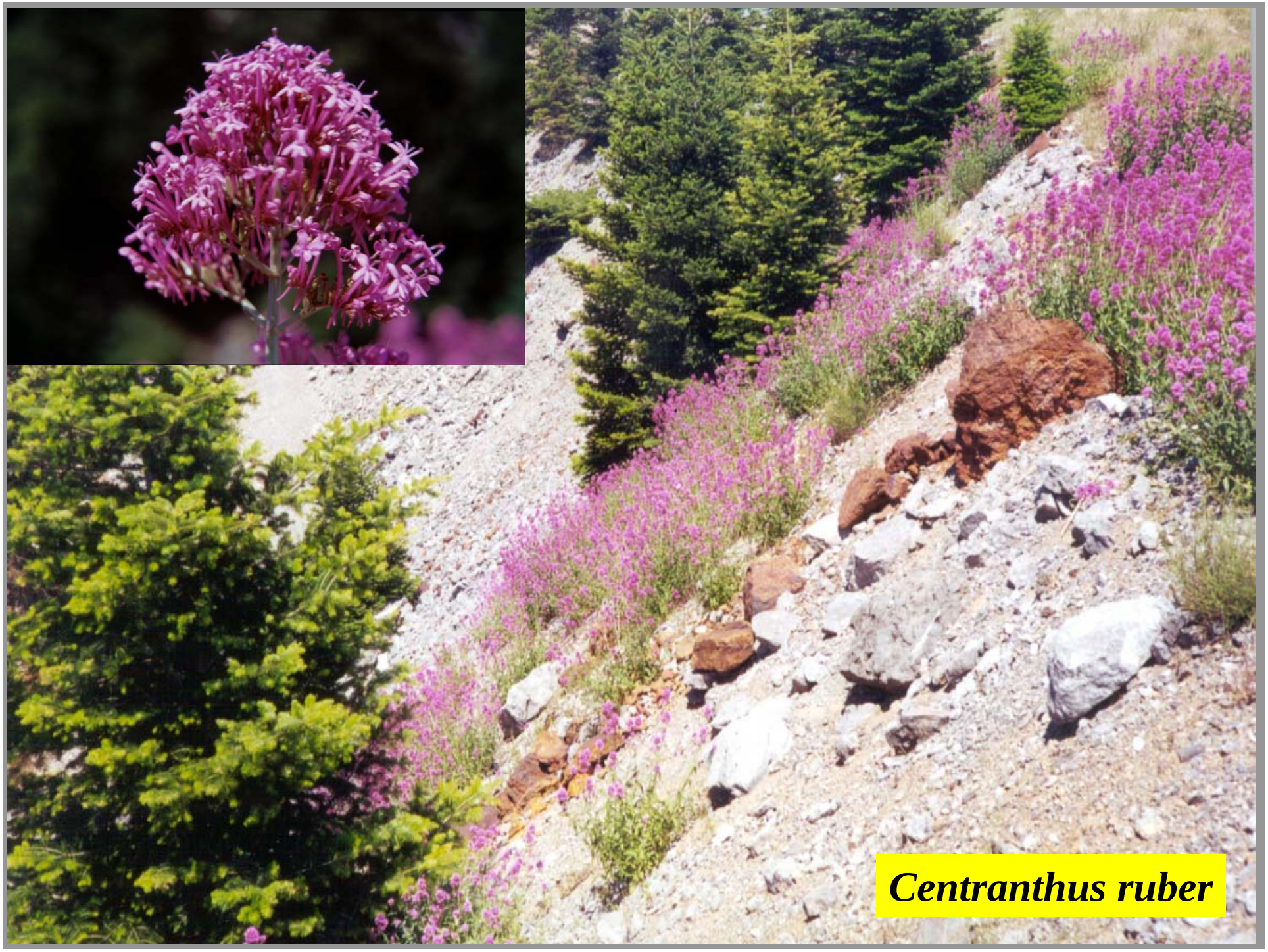
- Effective soil stabilization,

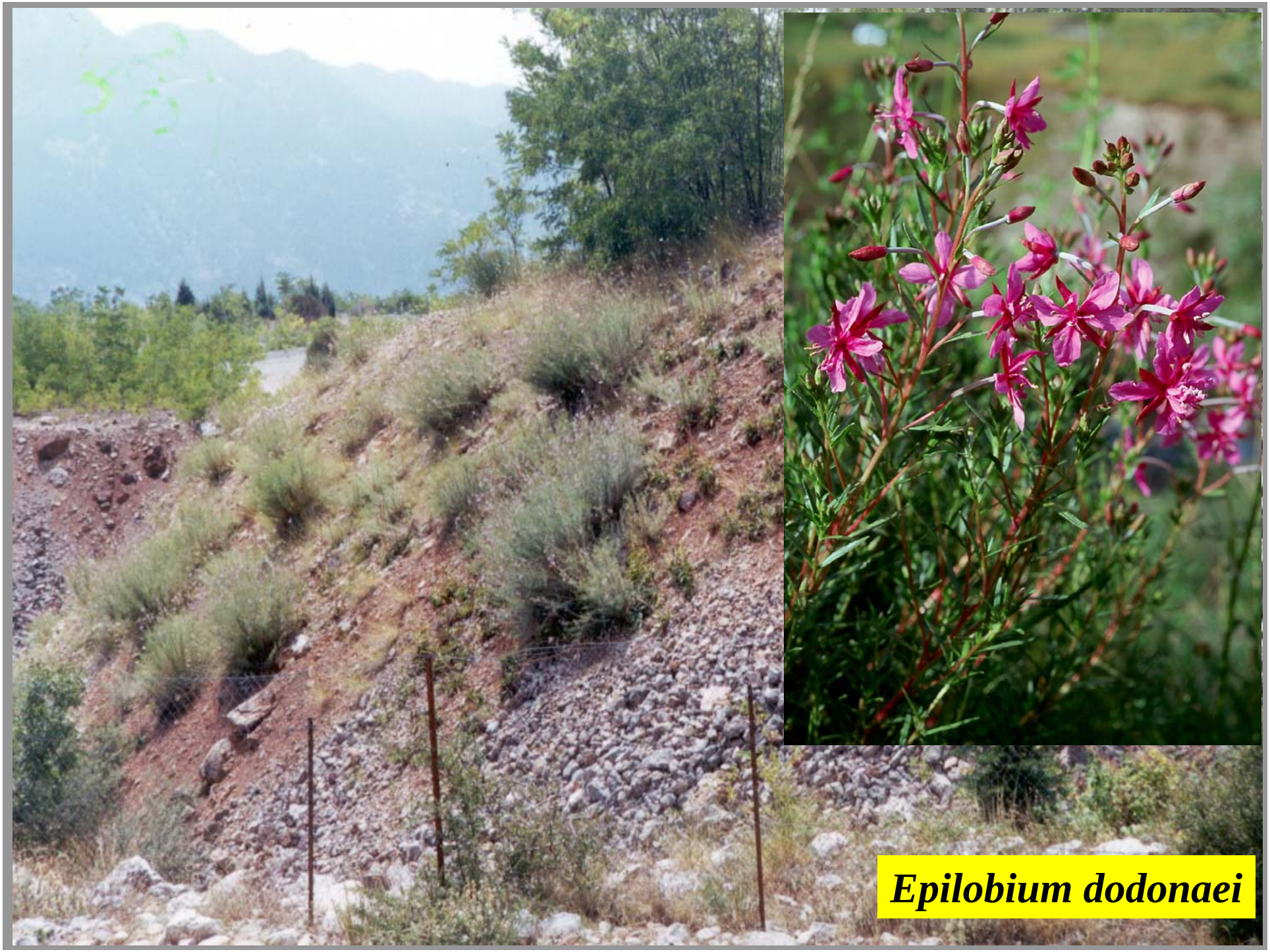
- Establishment ability in soil poor in nutrients,

- Perennial.


Rhus coriaria


Nepeta spruneri

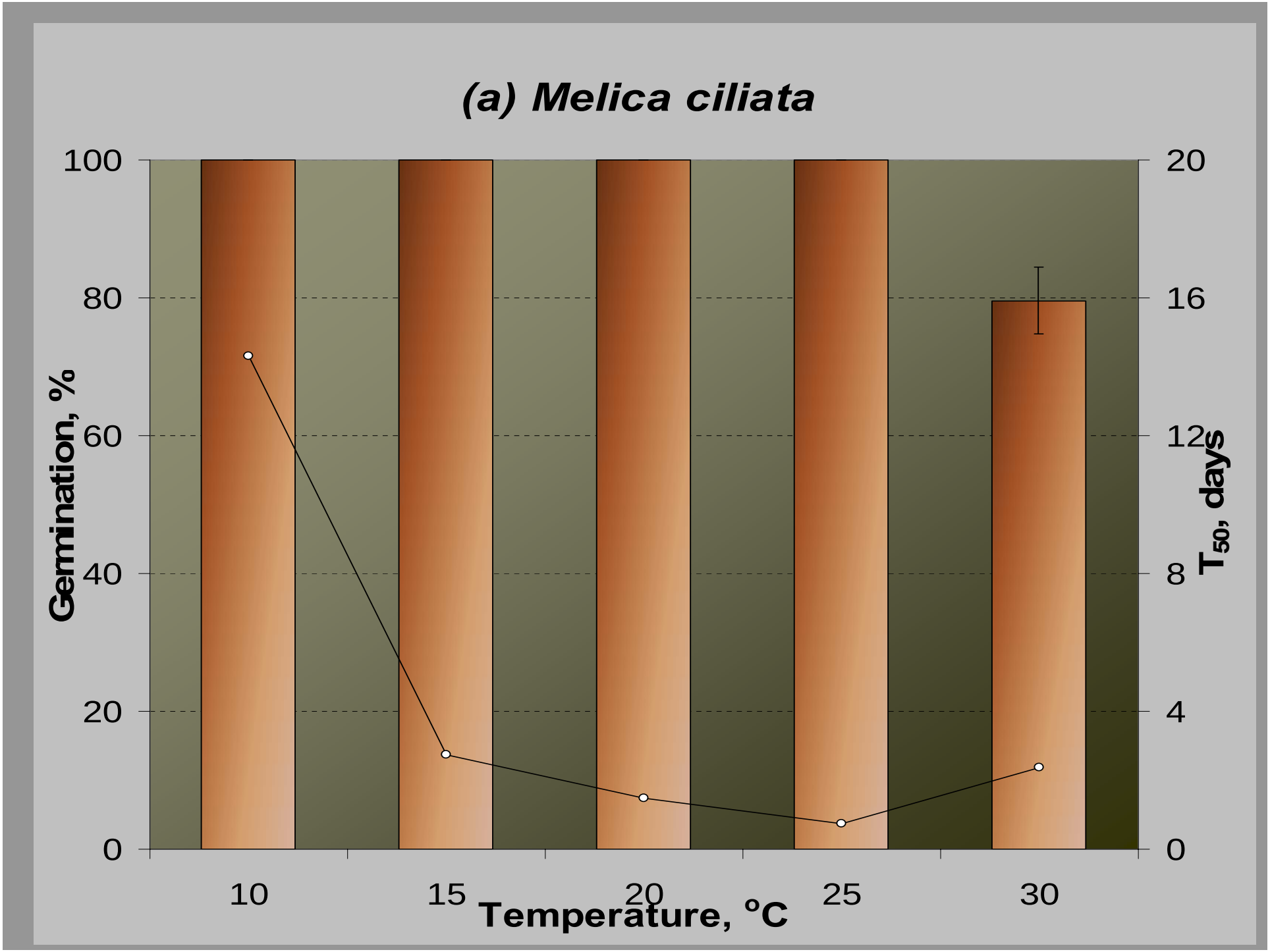

Centranthus ruber

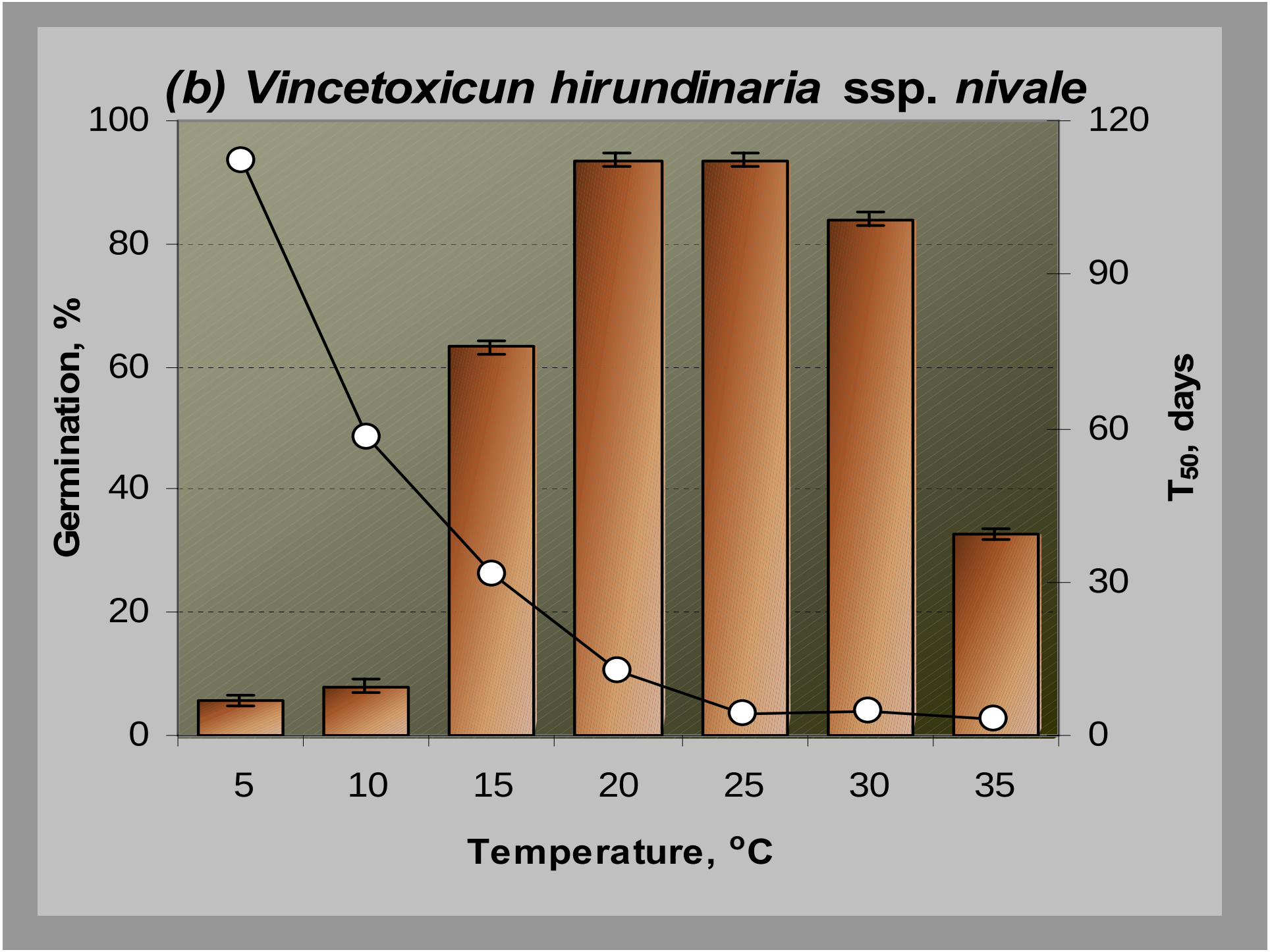

Epilobium dodonaei

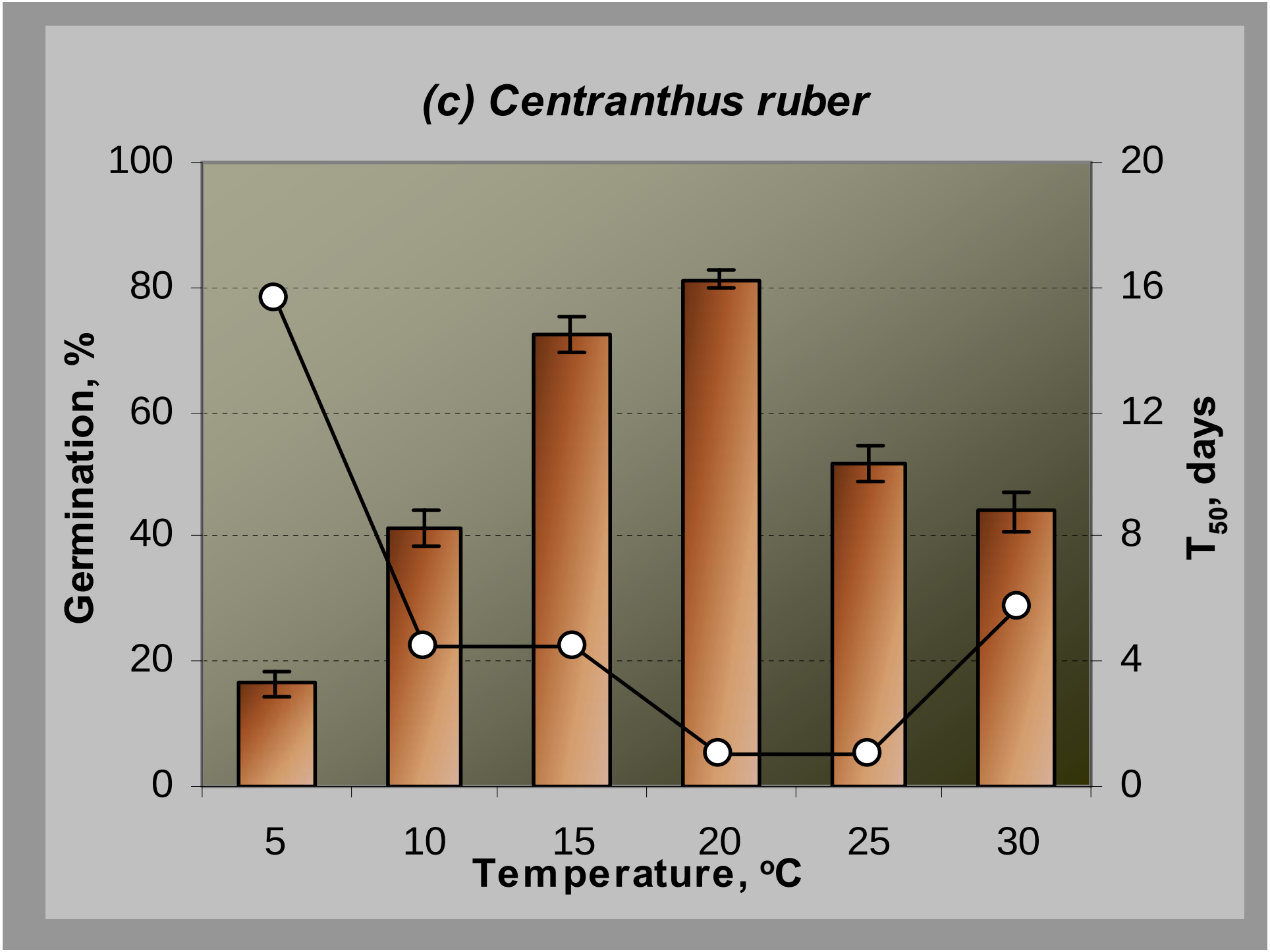

Melica ciliata

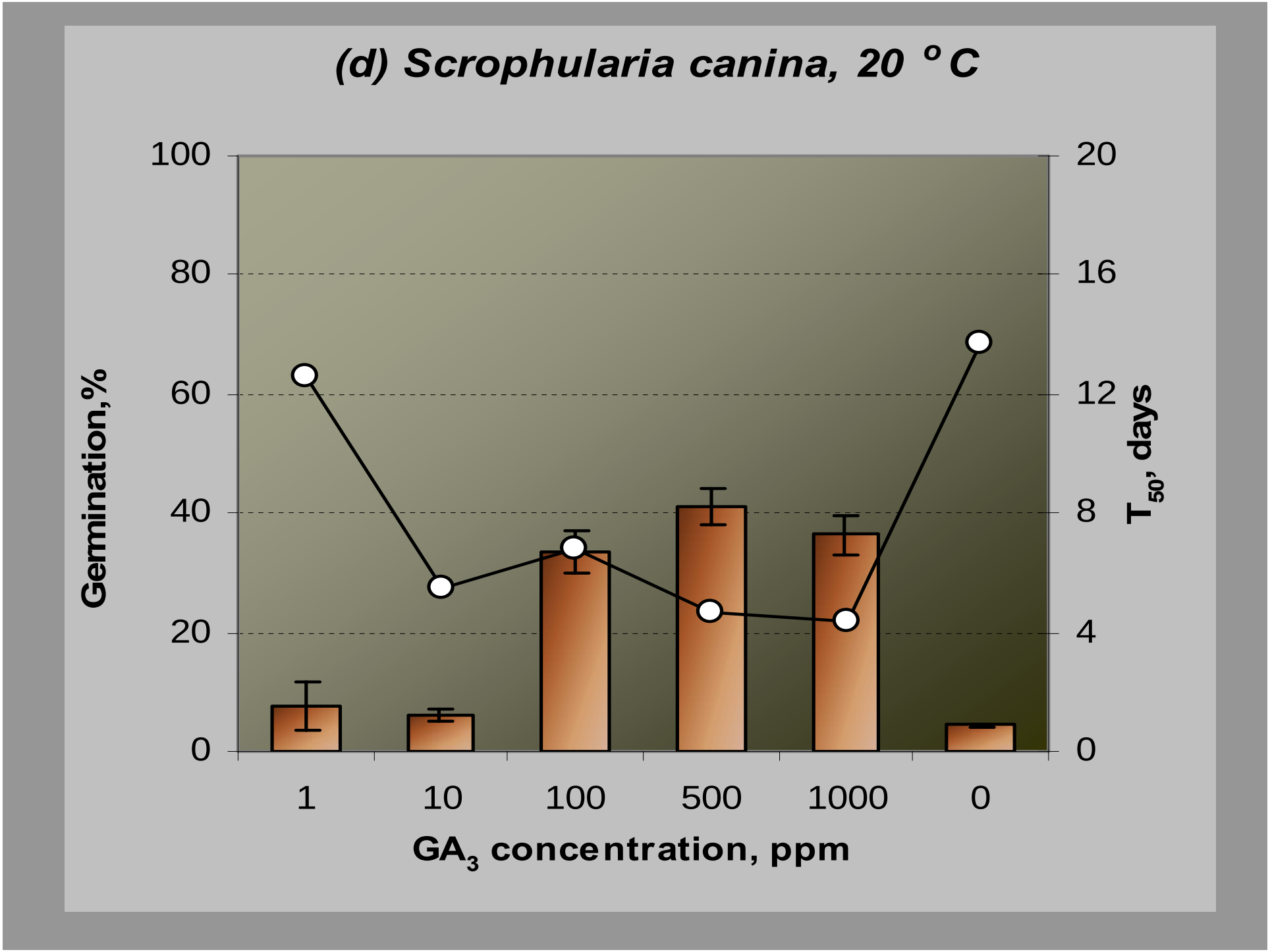

Vincetoxicum hirudinaria ssp. *nivale*

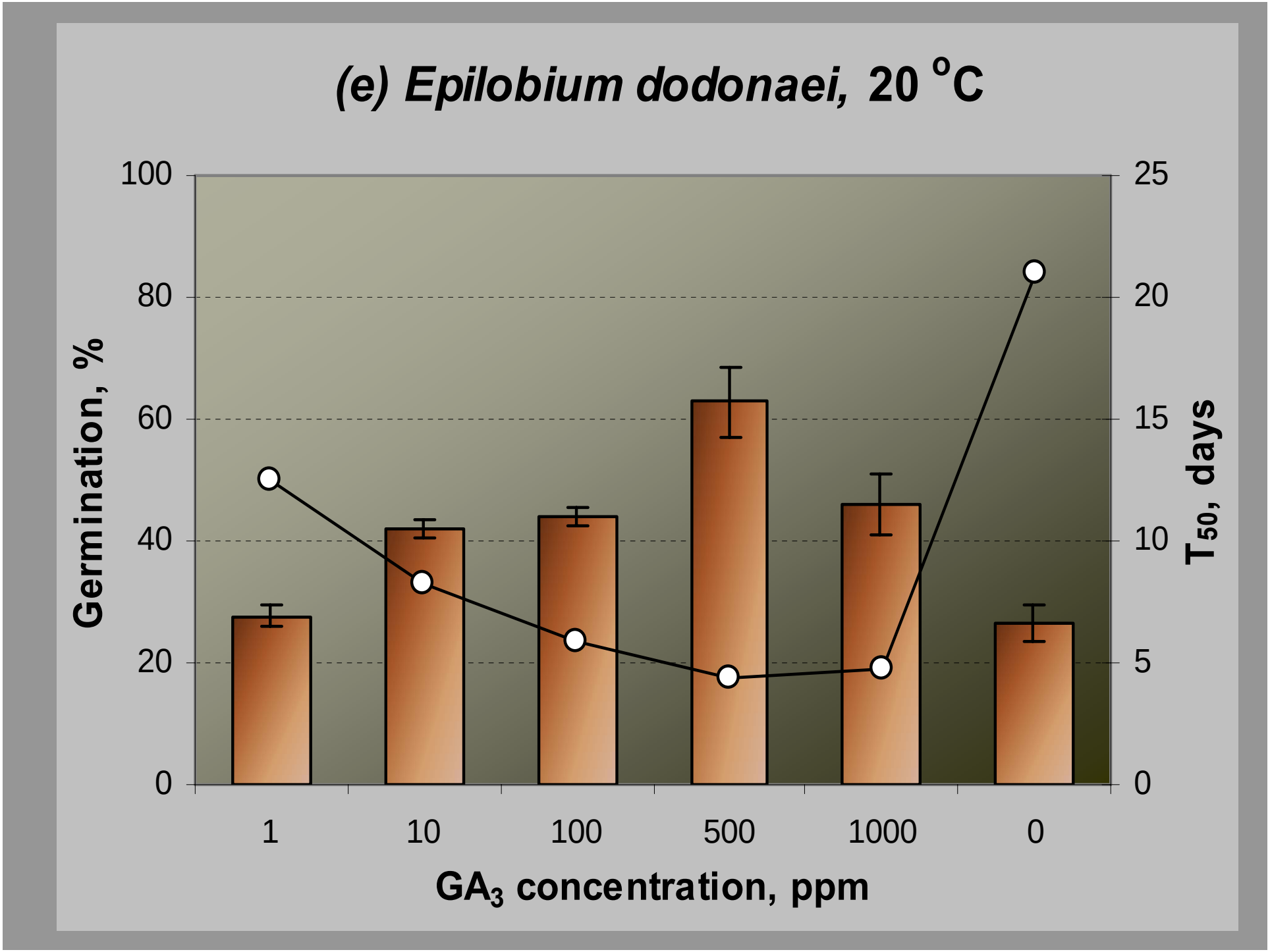

Scrophularia canina


(a) Melica ciliata
100
80
60
40
20
0
Germination, %
20
16
12
8
4
0
T50, days
10
15
20
25
30
Temperature, °C

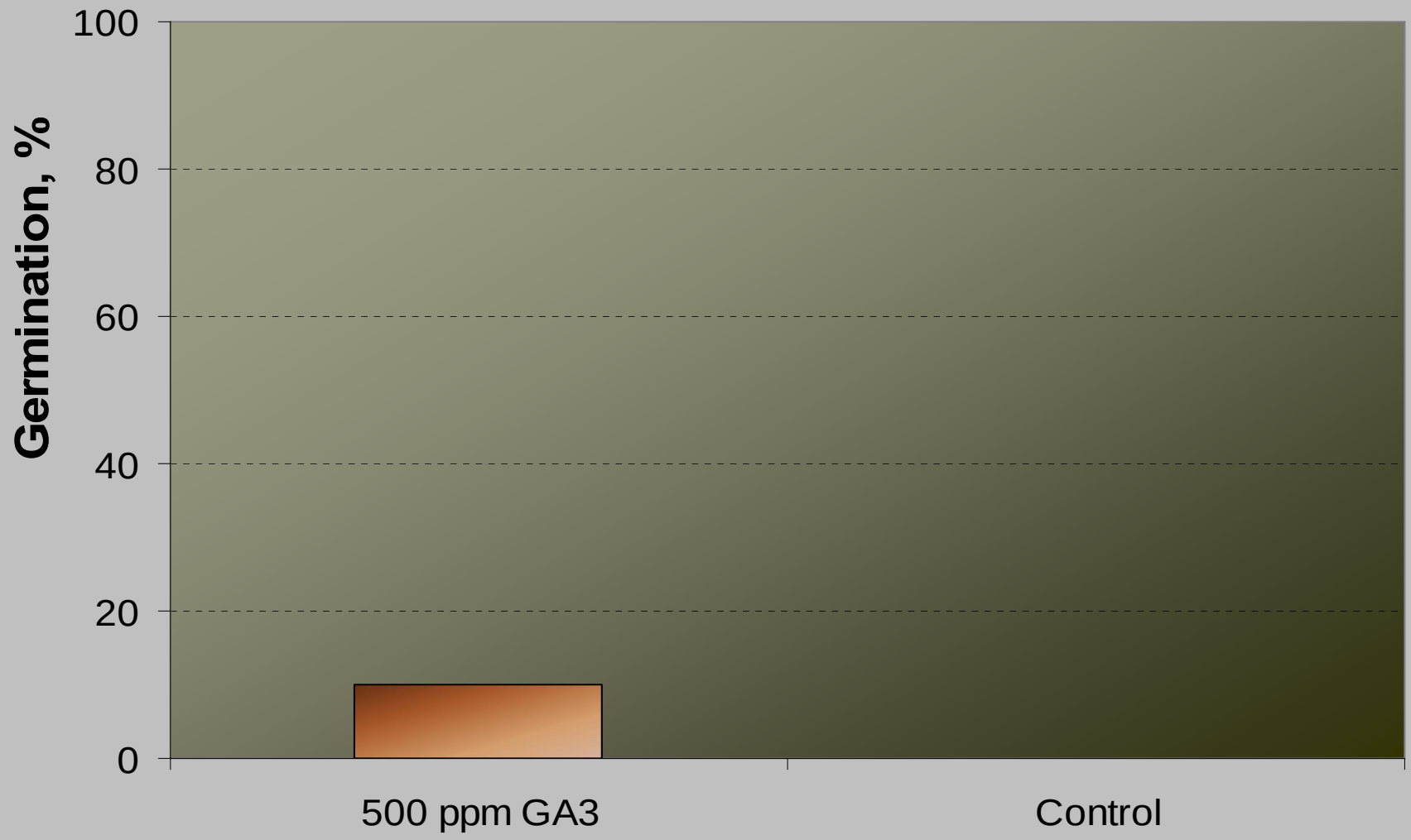

(b) Vincetoxicun hirundinaria ssp. nivale
Germination, %
100
80
60
40
20
0
120
90
60
30
0
T50, days
5
10
15
20
25
30
35
Temperature, °C

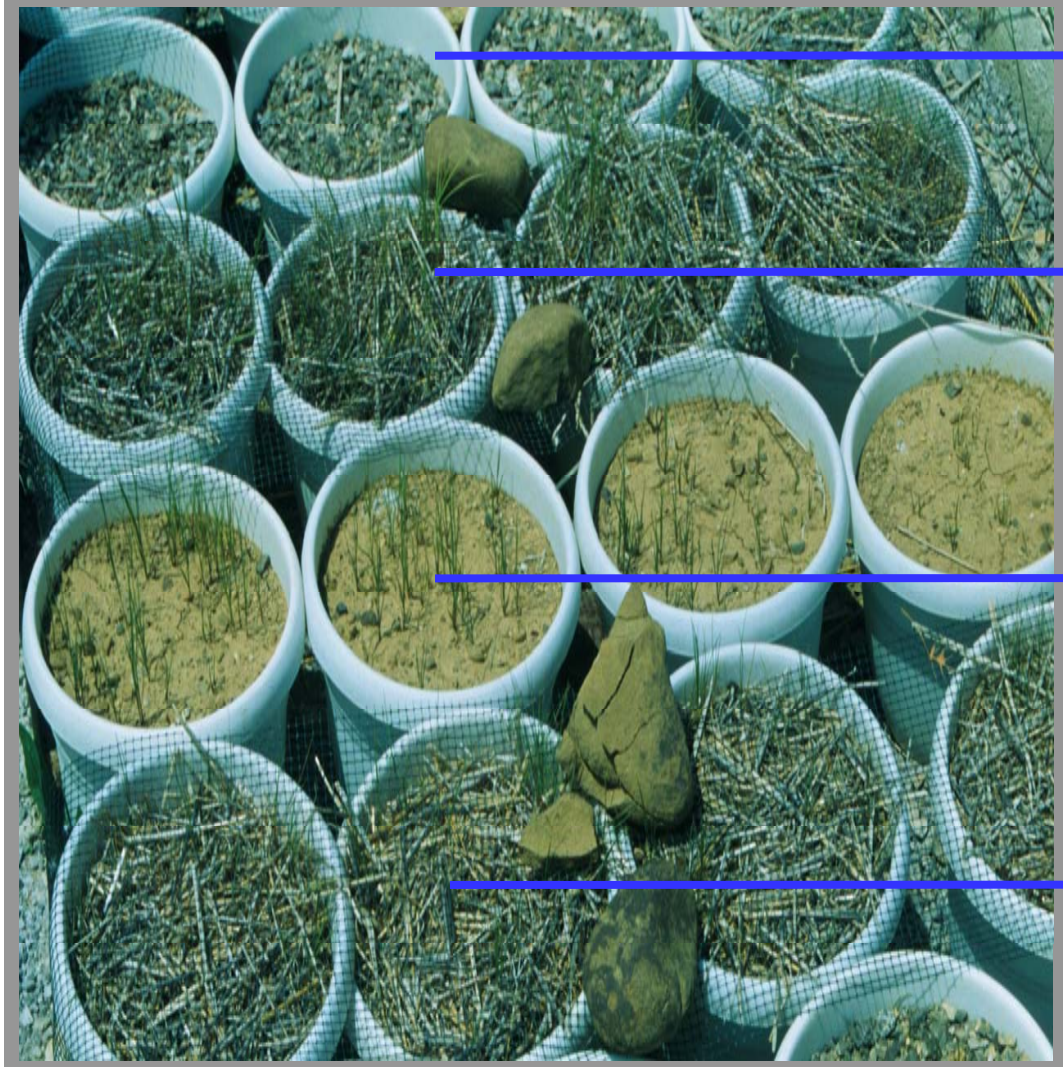

(c) Centranthus ruber
100
80
60
40
20
0
Germination, %
20
16
12
8
4
0
T50, days
5
10
15
20
25
30
Temperature, oC


(d) Scrophularia canina, 20 °C
100
80
60
40
20
0
Germination,%
20
16
12
8
4
0
T50, days
1
10
100
500
1000
0
GA3 concentration, ppm


(e) Epilobium dodonaei, 20 °C
Germination, %
T50, days
100
80
60
40
20
0
25
20
15
10
5
0
1
10
100
500
1000
0
GA3 concentration, ppm

(f) Nepeta spruneri, 20 °C





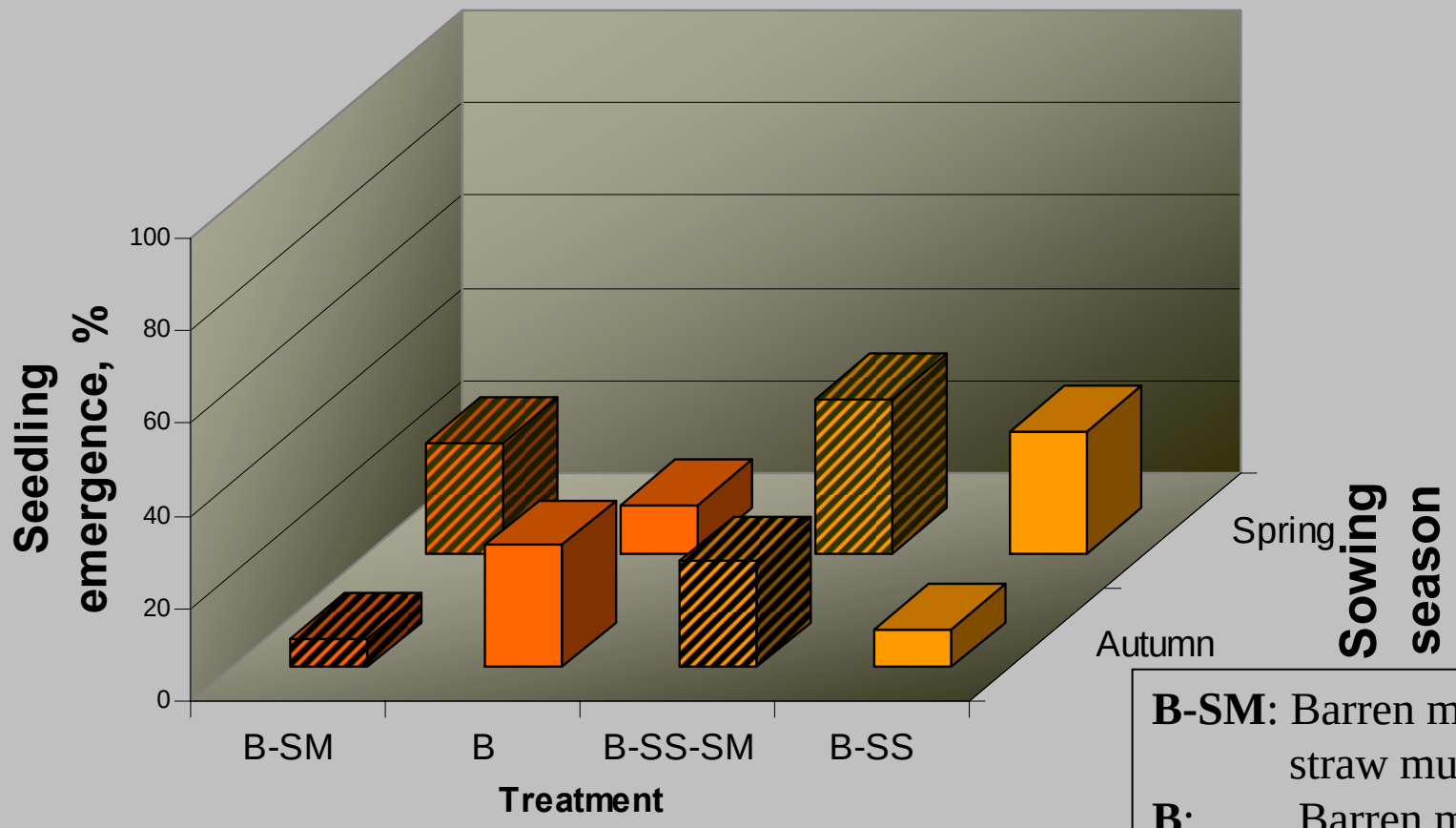
B: Barren material

B-SM: Barren material and straw mulching

B-SS: Barren material with surface soil

B-SS-SM: Barren material with surface soil and straw mulching

Melica cilliata

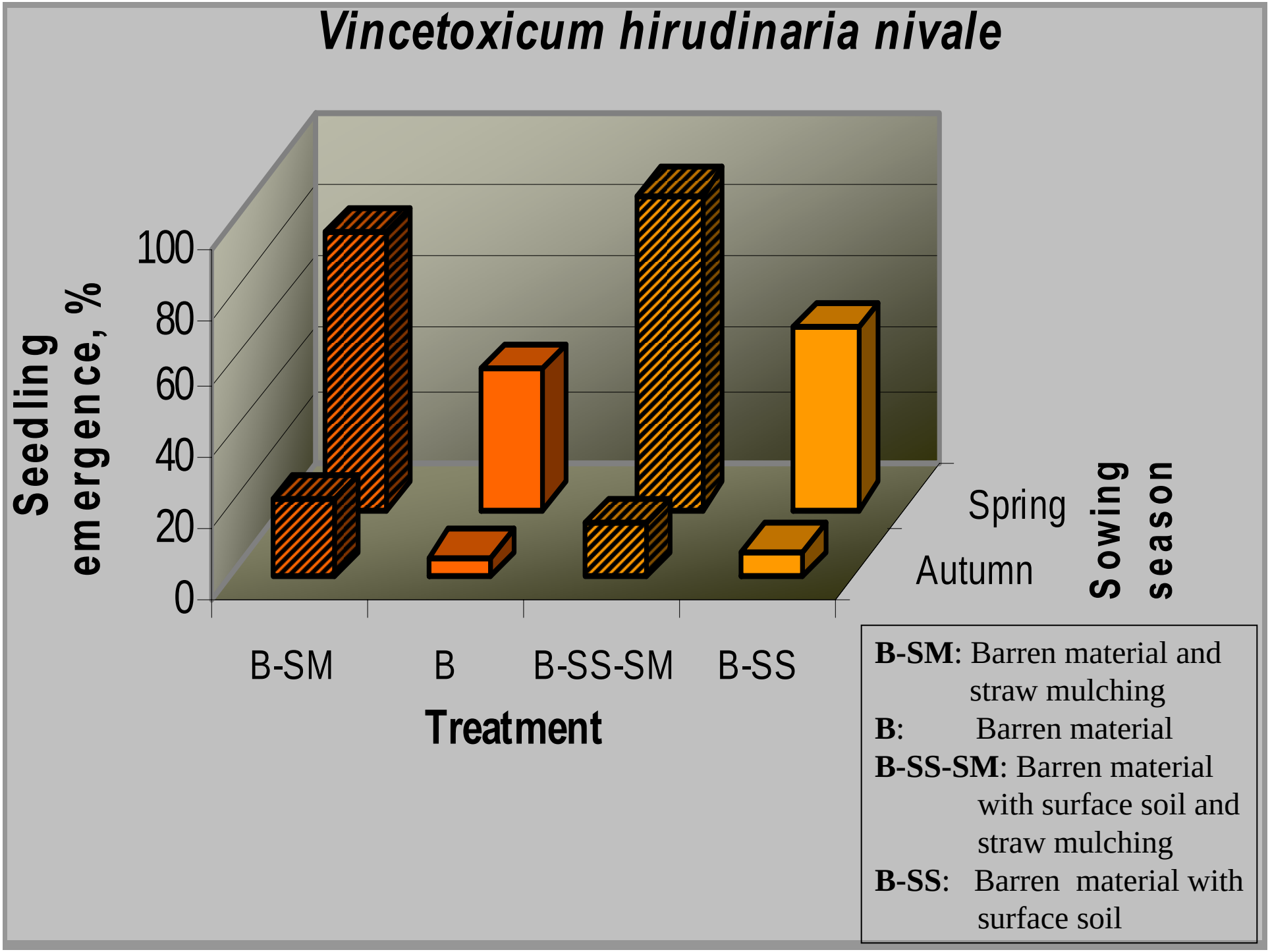


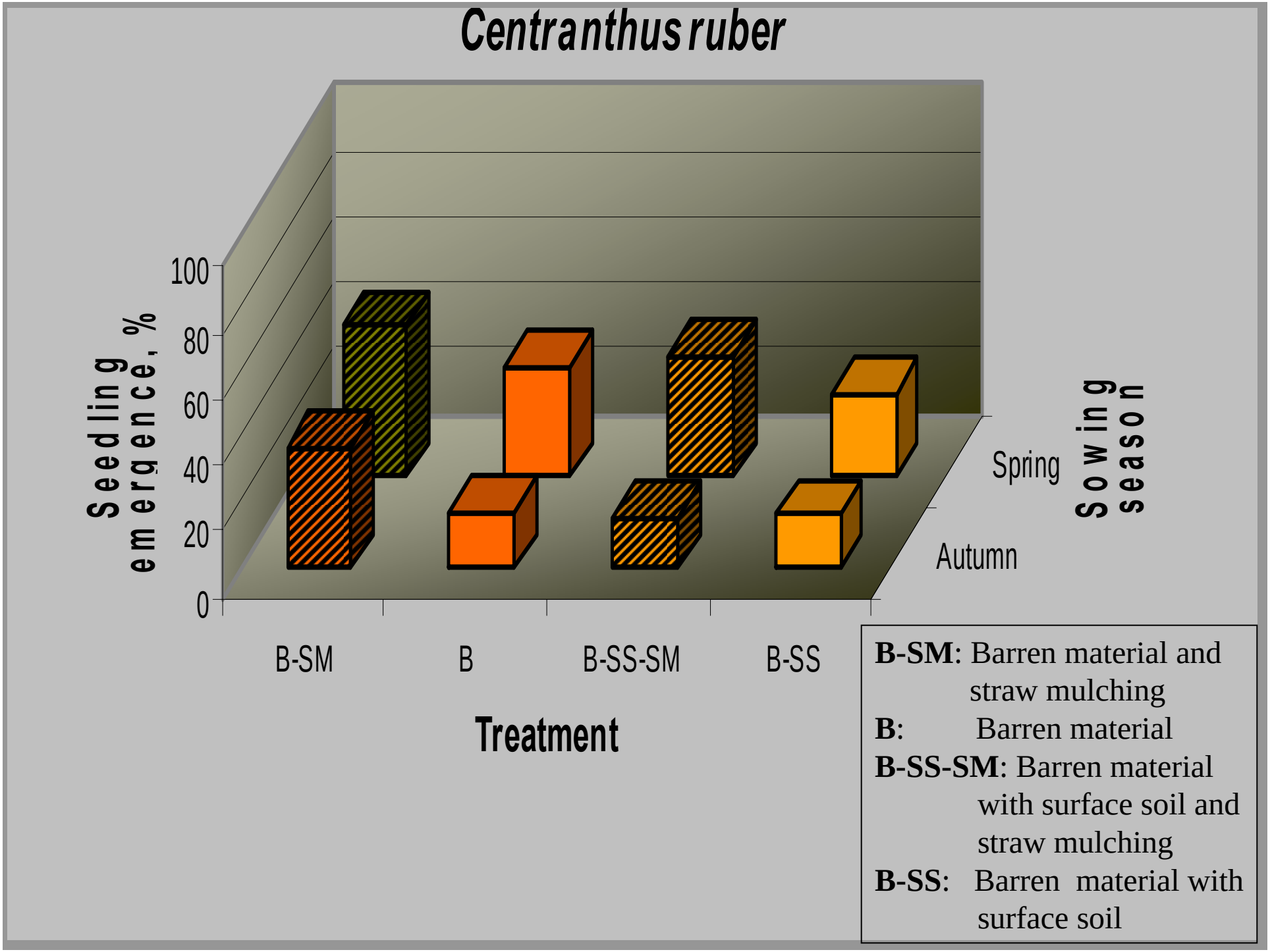
B-SM: Barren material and straw mulching

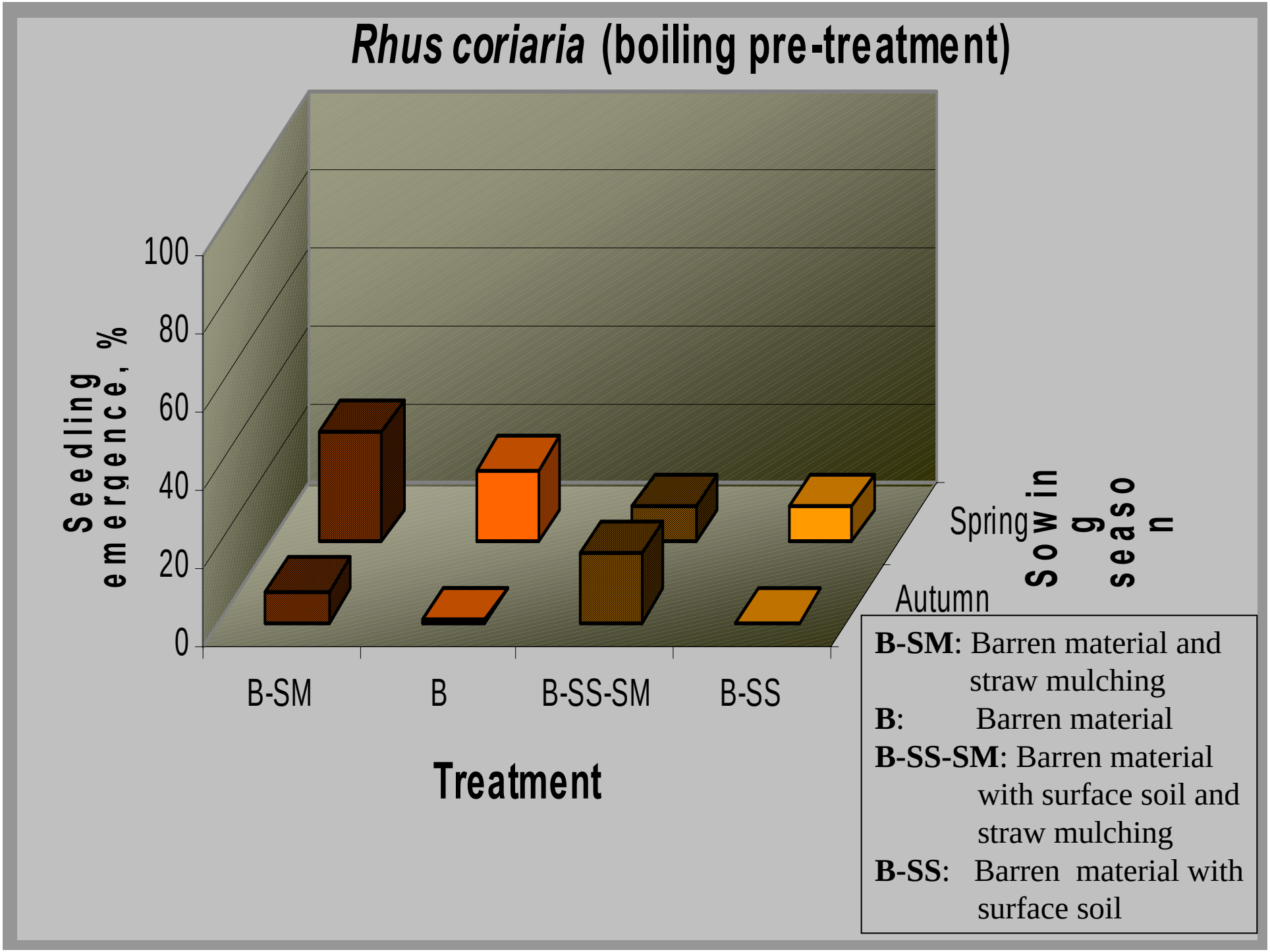
B: Barren material

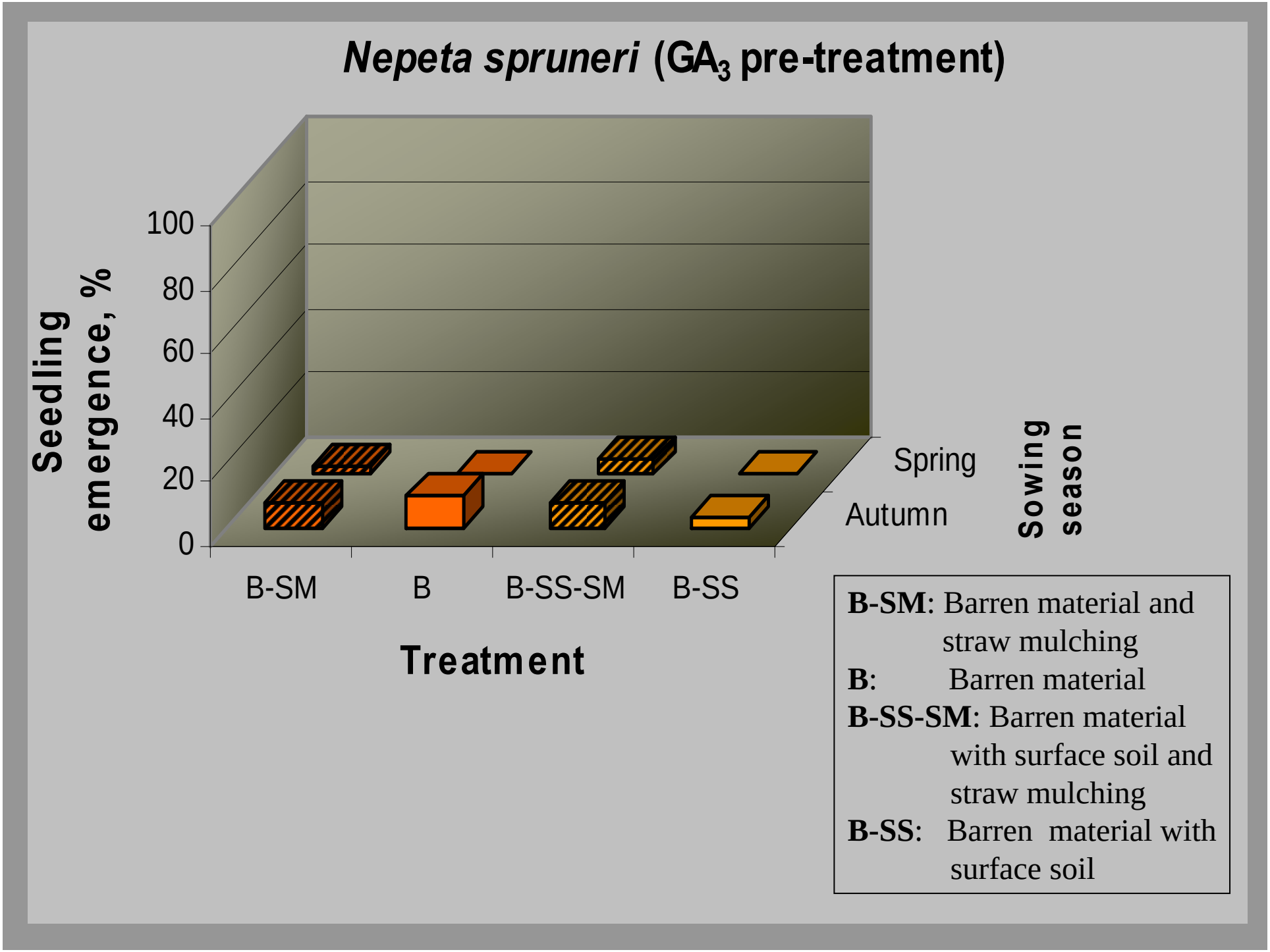
B-SS-SM: Barren material with surface soil and straw mulching

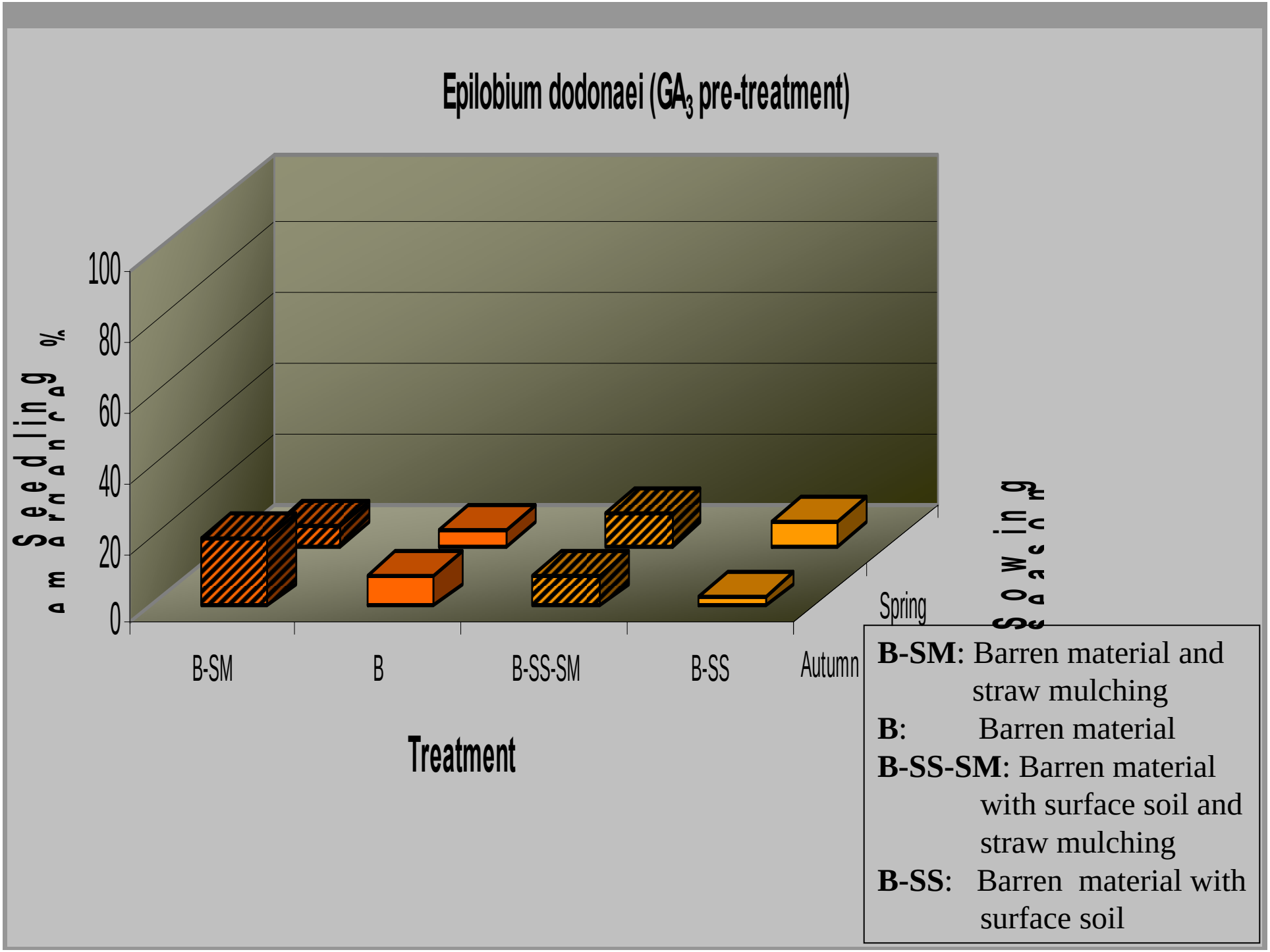
B-SS: Barren material with surface soil


Vincetoxicum hirudinaria nivale
Seedling emergence, %
100
80
60
40
20
0
B-SM
B
B-SS-SM
B-SS
Treatment
Spring
Autumn
Sowing season
B-SM: Barren material and straw mulching
B: Barren material
B-SS-SM: Barren material with surface soil and straw mulching
B-SS: Barren material with surface soil

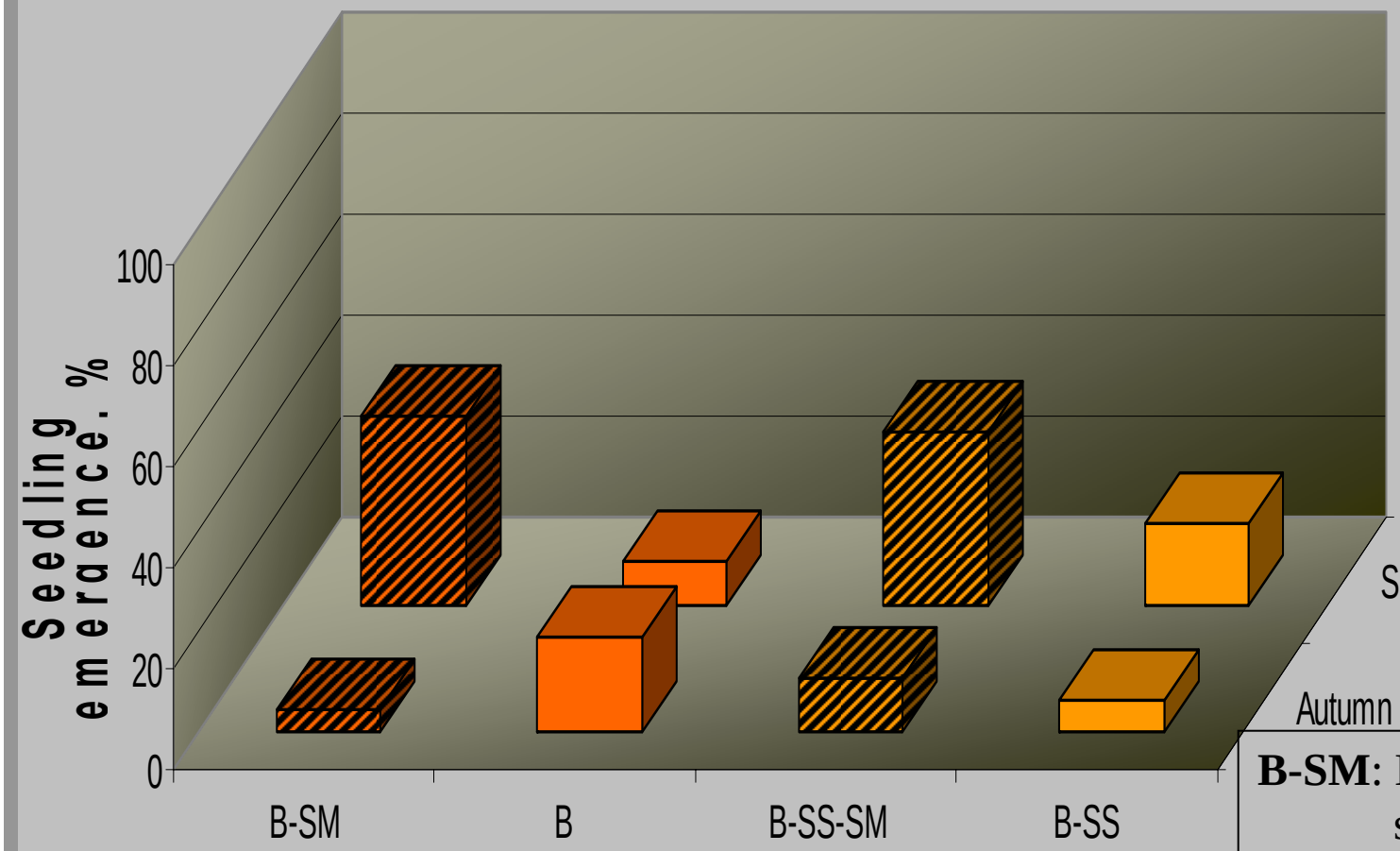

Centranthus ruber
Seedling emergence, %
100
80
60
40
20
0
B-SM
B
B-SS-SM
B-SS
Treatment
Spring
Autumn
Sowing season
B-SM: Barren material and straw mulching
B: Barren material
B-SS-SM: Barren material with surface soil and straw mulching
B-SS: Barren material with surface soil


Rhus coriaria (boiling pre-treatment)
Seedling emergence, %
100
80
60
40
20
0
B-SM
B
B-SS-SM
B-SS
Treatment
Spring
Autumn
Sowing season
B-SM: Barren material and straw mulching
B: Barren material
B-SS-SM: Barren material with surface soil and straw mulching
B-SS: Barren material with surface soil


Nepeta spruneri (GA3 pre-treatment)
Seedling emergence, %
100
80
60
40
20
0
B-SM
B
B-SS-SM
B-SS
Treatment
Spring
Autumn
Sowing season
B-SM: Barren material and straw mulching
B: Barren material
B-SS-SM: Barren material with surface soil and straw mulching
B-SS: Barren material with surface soil


Epilobium dodonaei (GA3 pre-treatment)
Seedling %
100
80
60
40
20
0
B-SM
B
B-SS-SM
B-SS
Treatment
Spring
Autumn
Sowing season
B-SM: Barren material and straw mulching
B: Barren material
B-SS-SM: Barren material with surface soil and straw mulching
B-SS: Barren material with surface soil

Scrophullaria canina (GA$_3$ pre-treatment)



B-SM: Barren material and straw mulching

B: Barren material

B-SS-SM: Barren material with surface soil and straw mulching

B-SS: Barren material with surface soil

CONCLUSIONS

•The seeds of *Melica ciliata*, *Vincetoxicum hirundinaria* subsp. *nivale* and *Centranthus ruber* are non-dormant and no germination pre-treatment is necessary.

•The seeds of *Epilobium dodonaei*, *Nepeta spruneri* and *Scrophularia canina* are dormant and require gibberelic acid (GA_3) for germination promotion.

•The dormant seeds of *Rhus coriaria* require a pre-treatment in boiled water (100°C, 1 min) for dormancy breakage. Seedling production in the nursery is suggested for outplanting.

- The sowing in the barren material with the treatments used is not suggested, whereas plant production in the nursery and trans-plantation in the disturbed areas is suggested.

- Of the seven native species selected for rehabilitation of disturbed by mining activities areas, no one is recommended for direct sowing in the soil substrate.