

Brassica oleracea

Tissue culture protocol profile built from the published literature



Family	Brassicaceae
Common names	wild cabbage; (Wil) Kual; Atlantischer Wildkohl (DE); Cabbage (EN); Berça; Cabbage; Chou Mollier
Authority	Brassica oleracea L., 1753
Literature scanned	16 Oct 2026

VERIFIED RECORDS

26

10 from full text

PAPERS

14

2007 - 2025

EVIDENCE

Limited

24 protocols graded

GRADE A / B / C

0 / 1 / 23

A = 3+ papers agree

Every figure below was extracted from a published sentence by a rule-based reader, re-derived by a second independent reader, and kept only if both agreed. Unclear sentences were skipped, not guessed. Check the cited paper and validate on your own material before relying on any protocol.

Key findings

- Shoot regeneration & multiplication: MS with 0.1 mg/L NAA. Median response 100% (grade B, 2 papers).
- For shoot regeneration & multiplication, NAA is the most reported regulator (7 papers; typical 0.1–0.15 mg/L, median 0.1).
- For callus induction, 2,4-D is the most reported regulator (3 papers; typical 0.9–2.75 mg/L, median 1.5).
- For rooting, NAA is the most reported regulator (3 papers; typical 0.15–0.6 mg/L, median 0.2).
- 2 atypical doses flagged for a second look.
- No verified data yet for: acclimatization.

Recommended workflow

1

Surface sterilization

Evidence C

70% ethanol · 30 s -> 4% NaOCl · 15 min

1 paper. Reported by a single paper; treat as a lead to check, not an established protocol.

2

Callus induction

Evidence C

MS with 0.3 mg/L 2,4-D + 1 mg/L BAP. Median response 57%

1 paper. Reported by a single paper; treat as a lead to check, not an established protocol. Hormone balance: cytokinin-dominant.

3

Somatic embryogenesis

Evidence C

Medium not stated with 0.2 mg/L TDZ

1 paper. Reported by a single paper; treat as a lead to check, not an established protocol. Hormone balance: cytokinin only.

4

Shoot regeneration & multiplication

Evidence B

MS with 0.1 mg/L NAA. Median response 100%

2 papers. Two independent papers report this protocol. Hormone balance: auxin only.

5

Rooting

Evidence C

MS with 0.1 mg/L NAA. Median response 100%

1 paper. Reported by a single paper; treat as a lead to check, not an established protocol. Hormone balance: auxin only.

Surface sterilization

#	Grade	Steps	Aseptic	Papers
1	C	70% ethanol · 30 s -> 4% NaOCl · 15 min	-	1
2*	C	75% ethanol · 3 min -> 8% NaOCl · 8 min	-	1
3*	C	70% ethanol · 40 s -> 3% NaOCl · 10 min	-	1

Rank 1 evidence [1]: "They were rinsed in 70% ethanol for 30 s, then immersed in a 4% sodium hypochlorite solution for 15 min, followed by three washings with sterile distilled water then placed on sterile filter paper to extract the anthers."

Callus induction

#	Grade	Growth regulators	Explant	Medium	Outcome	Papers
1	C	2,4-D 0.3 + BAP 1 mg/L	-	MS	57%	1
2	C	2,4-D 1.5 + NAA 1 mg/L	-	MS	optimum reported, no figure	1
3	C	2,4-D 4 mg/L	-	MS	10%	1

Rank 1 evidence [1]: "While the maximum rate of callus induction (56.8%) was detected in MS medium (0.3 mg/L 2,4-D and 1 mg/L BAP)."

Somatic embryogenesis

#	Grade	Growth regulators	Explant	Medium	Outcome	Papers
1	C	TDZ 0.2 mg/L	-	-	optimum reported, no figure	1

Rank 1 evidence [2]: "For 'Starbor F2', 0.2 mg/L TDZ treatment achieved the highest embryogenesis rate (1.83-fold higher than the control group) and direct seeding rate (1.61-fold increase), and the lowest mortality rate."

Shoot regeneration & multiplication

#	Grade	Growth regulators	Explant	Medium	Outcome	Papers
1	B	NAA 0.1 mg/L	-	MS	100%	2
2	C	TDZ 0.22 mg/L	hypocotyl	MS	93%	1
3	C	TDZ 0.33 mg/L	cotyledon	MS	91%; 3 shoots/explant	1
4	C	TDZ 0.99 + NAA 0.02 mg/L	cotyledon	MS	84%; 2.6 shoots/explant	1
5	C	TDZ 0.88 + NAA 0.02 mg/L	hypocotyl	MS	81%	1
6	C	BAP 3 + Kinetin 2 mg/L	-	MS	optimum reported, no figure	1
7	C	TDZ 0.5 + NAA 0.1 mg/L	cotyledon	-	87%	1
8	C	TDZ 0.1 + NAA 0.1 mg/L	cotyledon	-	77%	1

Rank 1 evidence [3]: "High percentage root regeneration (100%) in in vitro developed shoots was obtained on MS medium supplemented with 0.10mg/l NAA."

Rank 1 evidence [4]: "MS medium supplemented with 0.10 mg/l NAA was found best for root regeneration (100 %) from in vitro developed shoots."

Rooting

#	Grade	Growth regulators	Explant	Medium	Outcome	Papers
1	C	NAA 0.1 mg/L	-	MS	100%	1
2*	C	NAA 0.2 mg/L	-	MS	94%	1
3*	C	NAA 1 mg/L	-	MS	optimum reported, no figure	1

Rank 1 evidence [5]: "Rooting was achieved within two to three weeks on all the rooting media, but MS medium containing 0.10 mg/l NAA produced the maximum number of strong and healthy roots (100%)."

Typical growth regulator doses

One value per paper. Range = interquartile range with 3+ papers, otherwise min-max.

Shoot regeneration & multiplication

Regulator	Papers	Typical range, mg/L	Median	Most common
NAA	7	0.1 - 0.15 (IQR)	0.1	0.1
BAP	3	1.5 - 2.5 (IQR)	2	1
TDZ	2	0.3 - 0.605 (min-max)	0.453	0.3
2iP	1	2 - 2 (min-max)	2	2
GA3	1	0.1 - 0.1 (min-max)	0.1	0.1
IAA	1	0.1 - 0.1 (min-max)	0.1	0.1
Kinetin	1	2 - 2 (min-max)	2	2

Callus induction

Regulator	Papers	Typical range, mg/L	Median	Most common
2,4-D	3	0.9 - 2.75 (IQR)	1.5	4
BAP	1	1 - 1 (min-max)	1	1
NAA	1	1 - 1 (min-max)	1	1

Rooting

Regulator	Papers	Typical range, mg/L	Median	Most common
NAA	3	0.15 - 0.6 (IQR)	0.2	1

Somatic embryogenesis

Regulator	Papers	Typical range, mg/L	Median	Most common
TDZ	1	0.2 - 0.2 (min-max)	0.2	0.2

Points to double-check

- Surface sterilization - close competitor: 75% ethanol · 3 min -> 8% NaOCl · 8 min (1 paper).
- Surface sterilization - close competitor: 70% ethanol · 40 s -> 3% NaOCl · 10 min (1 paper).
- Rooting - close competitor: MS with 0.2 mg/L NAA (1 paper).
- Rooting - close competitor: MS with 1 mg/L NAA (1 paper).
- Shoot regeneration & multiplication - atypical dose: NAA at 0.02 mg/L (low; usual 0.1-0.15).
- Shoot regeneration & multiplication - atypical dose: NAA at 0.5 mg/L (high; usual 0.1-0.15).

References for quoted evidence

- [1] Jabal S, Murshed R, Alabdalla O (2025) In vitro haploid plantlet regeneration through anther culture in some local types of Syrian cauliflower (*Brassica Oleracea* var. *botrytis* L.).. Scientific reports. doi:10.1038/s41598-025-12802-0
- [2] Jiaqi Zou, Xiao Zou, Zhichao Gong, et al. (2023) Thidiazuron Promoted Microspore Embryogenesis and Plant Regeneration in Curly Kale (*Brassica oleracea* L. convar. *acephala* var. *sabellica*). Horticulturae. doi:10.3390/horticulturae9030327
- [3] Geetika Gambhir Srivastava DK (2015) Thidiazuron Induces High Frequency Shoot Regeneration in Leaf and Petiole Explants of Cabbage (*Brassica Oleracea* L. Var. *Capitata*). Journal of Biotechnology & Biomaterials. doi:10.4172/2155-952x.1000172
- [4] Pankaj Kumar, Dinesh Kumar Srivastava (2015) High frequency organogenesis in hypocotyl, cotyledon, leaf and petiole explants of broccoli (*Brassica oleracea* L. var. *italica*), an important vegetable crop. Physiology and Molecular Biology of Plants. doi:10.1007/s12298-015-0282-6
- [5] Gambhir G, Kumar P, Srivastava DK (2017) High frequency regeneration of plants from cotyledon and hypocotyl cultures in *Brassica oleracea* cv. *Pride of India*.. Biotechnology reports (Amsterdam, Netherlands). doi:10.1016/j.btre.2017.02.005

How to read this report

- Summaries combine different papers. Media, explants, genotypes and culture conditions differ, so trends are associations, not controlled comparisons.
- Grades reflect how many independent papers agree, not how good the science is. Always read the cited sentence and its paper.
- Papers without open-access full text are read from abstracts only, so some protocols will be missing.
- * close competitor: score within 15% of the leader. Doses are in mg/L after unit conversion.