**Growth Regulators – Plant Tissue Culture Protocol**

The importance of plant growth regulators in plant tissue culture is well documented. We offer a broad range of plant growth regulators specifically tested for plant cell culture. Each product is assayed for physical and chemical characteristics, then is biologically tested following the criteria established for powdered media. Each auxin is tested for enhancement of callus growth and/or root initiation *in vitro*. Each cytokinin is tested for stimulation of shoot production.

The plant growth regulator solutions are sterile filtered through a double 0.2 µm filter unit into sterile bottles. Each lot of plant growth regulator solution is tested for sterility according to specifications established by U.S. Pharmacopeia Vol. XXI, as well as biological testing in plant cell culture using criteria identical to those established for our plant tissue culture media.

FOR LABORATORY USE, PLANT TISSUE CULTURE MEDIA PREPARATION AND PLANT RESEARCH PURPOSES ONLY. NOT FOR USE AS A PLANT GROWTH REGULATOR ON DEVELOPED PLANTS. NOT FOR DRUG OR HOUSEHOLD USES.

**PREPARATION AND USE**

To prepare a 1 mg/mL stock solution: Add 100 mg of the plant growth regulator to a 100 mL volumetric flask or other glass container. Add 2-5 mL of solvent to dissolve the powder. Once completely dissolved, bring to volume with double processed water (Product No. W3500). Stirring the solution while adding water may be required to keep the material in solution. Store the stock solution as recommended in the tables. Add 1.0 mL of the stock solution to 1 liter of medium to obtain a final concentration of 1.0 mg/L of the plant growth regulator in the culture medium **(Tables 1-3)***.*

**Volume of Stock Solution = (Desired Hormone Conc. X Medium Volume) / Stock Solution Conc.**

**Plant Cell Culture Tested Auxins** are generally used in plant cell culture at a concentration range of 0.01-10.0 mg/L. When added in appropriate concentrations, they may regulate cell elongation, tissue swelling, cell division, formation of adventitious roots, inhibition of adventitious and axillary shoot formation, callus initiation and growth, and induction of embryogenesis.

**Plant Cell Culture Tested Cytokinins** are generally used in plant cell culture at a concentration range of 0.1-10.0 mg/L. When added in appropriate concentrations, they may regulate cell division, stimulate axillary and adventitious shoot proliferation, regulate differentiation, inhibit root formation, activate RNA synthesis and stimulate protein and enzyme activity.

**TABLE FOR MOLAR EQUIVALENCE AND SOLUTION PREPARATION**

* [**Auxins**](https://www.sigmaaldrich.com/TR/en/technical-documents/technical-article/cell-culture-and-cell-culture-analysis/plant-tissue-culture/growth-regulators#Auxins)
* [**Cytokinins**](https://www.sigmaaldrich.com/TR/en/technical-documents/technical-article/cell-culture-and-cell-culture-analysis/plant-tissue-culture/growth-regulators#Cytokinins)
* [**Miscellaneous Plant Growth Regulators**](https://www.sigmaaldrich.com/TR/en/technical-documents/technical-article/cell-culture-and-cell-culture-analysis/plant-tissue-culture/growth-regulators#Miscellaneous)

**Auxins**

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|  |  | **Molar Equivalence** | **Solution Preparation** |
| **Product Name** | **Product No.** | **Mol. Wt.** | **µM for 1 mg/L** | **Solvent** | **Diluent** | **Powder Storage** | **Liquid Storage** | **Steriliz-ation\*** | **Working Conc. (mg/L)** |
| p-Chlorophenoxyacetic acid (4-CPA) | [**C0413**](https://www.sigmaaldrich.com/product/sigma/C0413) | 186.6 | 5.36 | EtOH | — | RT | 2-8 °C | CA | 0.1-10.0 |
| 2,4-Dichlorophenoxyacetic acid | [**D7299**](https://www.sigmaaldrich.com/product/sigma/D7299) | 221 | 4.53 | — | — | RT | 2-8 °C | CA | 0.01-6.0 |
| 2,4-Dichlorophenoxyacetic acid Sodium salt | [**D6679**](https://www.sigmaaldrich.com/product/sigma/D6679) | 243 | 4.12 | Water | — | RT | 2-8 °C | CA | 0.01-6.0 |
| Indole-3-acetic acid Free acid (IAA) | [**I2886**](https://www.sigmaaldrich.com/product/sigma/I2886) | 175.2 | 5.71 | EtOH/1N NaOH | Water | -0 °C | -0 °C | CA/F | 0.01-3.0 |
| Indole-3-acetic acid Sodium salt | [**I5148**](https://www.sigmaaldrich.com/product/sigma/I5148) | 197.2 | 5.07 | Water | Water | 2-8 °C | -0 °C | CA/F | 0.01-3.0 |
| Indole-3-acetic acid methyl ester | [**I9770**](https://www.sigmaaldrich.com/product/sigma/I9770) | 189.2 | 5.29 | — | — | 2-8 °C | 2-8 °C | — | — |
| Indole-3-acetyl-L-aspartic acid | [**I9387**](https://www.sigmaaldrich.com/product/sigma/I9387) | 290.3 | 3.45 | 0.5N NaOH | Water | -0 °C | -0 °C | F | 0.01-5.0 |
| Indole-3-butyric acid (IBA) | [**I5386**](https://www.sigmaaldrich.com/product/sigma/I5386) | 203.2 | 4.90 | EtOH/1N NaOH | Water | 2-8 °C | -0 °C | CA/F | 0.1-10.0 |
| Indole-3-butyric acid Potassium salt (K-IBA) | [**I7512**](https://www.sigmaaldrich.com/product/sigma/I7512) | 241.3 | 4.14 | Water | — | 2-8 °C | -0 °C | CA/F | 0.1-10.0 |
| alpha-Naphthaleneacetic acid Free acid (NAA) | [**N0640**](https://www.sigmaaldrich.com/product/sigma/N0640) | 186.2 | 5.37 | 1N NaOH | Water | RT | 2-8 °C | CA | 0.1-10.0 |
| beta-Naphthoxyacetic acid Free acid (NOA) | [**N3019**](https://www.sigmaaldrich.com/product/sigma/N3019) | 202.2 | 4.95 | 1N NaOH | Water | RT | 2-8 °C | CA | 0.1-10.0 |
| Phenylacetic acid (PAA) | [**P6061**](https://www.sigmaaldrich.com/product/sigma/P6061) | 136.2 | 7.34 | EtOH | — | RT | 2-8 °C | CA/F | 0.1-50.0 |
| Picloram | [**P5575**](https://www.sigmaaldrich.com/product/sigma/P5575) | 241.5 | 4.14 | DMSO | — | RT | 2-8 °C | CA | 0.01-10.0 |
| 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) | [**T5785**](https://www.sigmaaldrich.com/product/sigma/T5785) | 255.5 | 3.91 | EtOH | — | RT | 2-8 °C | CA | 0.01-5.0 |
| 2,3,5-Triiodobenzoic acid Free acid (TIBA) | [**T5910**](https://www.sigmaaldrich.com/product/sigma/T5910) | 499.8 | 2.00 | 1N NaOH | Water | -0 °C | -0 °C | F | 0.05-5.0 |

**\*CA** = coautoclavable with other media components. **F**= filter sterlize. **CA/F** = coautoclavable with other media components, however, some loss of activity may occur. This can be compensated for by increasing component concentration. Component may be filter sterilized.

**Cytokinins**

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|  |  | **Molar Equivalence** | **Solution Preparation** |
| **Product Name** | **Product No.** | **Mol. Wt.** | **µM for 1 mg/L** | **Solvent** | **Diluent** | **Powder Storage** | **Liquid Storage** | **Steriliz-ation\*** | **Working Conc. (mg/L)** |
| Adenine Free base | [**A5665**](https://www.sigmaaldrich.com/product/sigma/A5665) | 135.1 | 7.40 | 1.0 HCl | Water | RT | 2-8 °C | CA | 50-250 |
| Adenine hemisulfate Hemisulfate salt | [**A2545**](https://www.sigmaaldrich.com/product/sigma/A2545) | 184.2 | 5.43 | Water | — | RT | 2-8 °C | CA | 50-250 |
| 6-Benzylaminopurine (BA) | [**B3408**](https://www.sigmaaldrich.com/product/sigma/B3408) | 225.3 | 4.44 | 1N NaOH | Water | RT | 2-8 °C | CA/F | 0.1-5.0 |
| 6-Benzylaminopurine Hydrochloride | [**B5920**](https://www.sigmaaldrich.com/product/sigma/B5920) | 261.7 | 3.82 | Water | — | RT | 2-8 °C | CA/F | 0.1-5.0 |
| 6-Benzylaminopurine (BA) | [**B3274**](https://www.sigmaaldrich.com/product/sigma/B3274) | 225.3 | 4.44 | 1N NaOH | Water | RT | 2-8 °C | CA/F | 0.1-5.0 |
| N-Benzyl-9-(2-tetrahydropyranyl)adenine (BPA) | [**B2275**](https://www.sigmaaldrich.com/product/sigma/B2275) | 309.4 | 3.23 | EtOH | — | -0 °C | -0 °C | CA/F | 0.1-5.0 |
| N-(2-Chloro-4-pyridyl)-N'-phenylurea (4-CPPU) | [**C2791**](https://www.sigmaaldrich.com/product/sigma/C2791) | 247.7 | 4.04 | DMSO | — | 2-8 °C | 2-8 °C | F | 0.001-1.0 |
| 6-(gamma,gamma-Dimethylallylamino)purine (2iP) | [**D7674**](https://www.sigmaaldrich.com/product/sigma/D7674) | 203.2 | 4.92 | 1N NaOH | Water | -0 °C | -0 °C | CA/F | 1.0-30.0 |
| 6-(gamma,gamma-Dimethylallylamino)purine (2iP) | [**D5912**](https://www.sigmaaldrich.com/product/sigma/D5912) | 203.2 | 4.92 | 1N NaOH | Water | -0 °C | -0 °C | CA/F | 1.0-30.0 |
| 1,3-Diphenylurea (DPU) | [**D7535**](https://www.sigmaaldrich.com/product/sigma/D7535) | 212.3 | 4.71 | DMSO | — | RT | 2-8 °C | F | 0.1-1.0 |
| Kinetin | [**K0753**](https://www.sigmaaldrich.com/product/sigma/K0753) | 215.2 | 4.65 | 1N NaOH | Water | -0 °C | -0 °C | CA/F | 0.1-5.0 |
| Kinetin | [**K3378**](https://www.sigmaaldrich.com/product/sigma/K3378) | 215.2 | 4.65 | 1N NaOH | Water | -0 °C | -0 °C | CA/F | 0.1-5.0 |
| Kinetin | [**K3253**](https://www.sigmaaldrich.com/product/sigma/K3253) | 215.2 | 4.65 | 1N NaOH | Water | -0 °C | -0 °C | CA/F | 0.1-5.0 |
| Kinetin Hydrochloride | [**K1885**](https://www.sigmaaldrich.com/product/sigma/K1885) | 251.7 | 3.97 | Water | — | -0 °C | -0 °C | CA/F | 0.1-5.0 |
| 1-Phenyl-3-(1,2,3-thiadiazol-5-yl)urea | [**P6186**](https://www.sigmaaldrich.com/product/sigma/P6186) | 220.2 | 4.54 | DMSO | — | RT | 2-8 °C | CA/F | 0.001-0.05 |
| trans-Zeatin Free base | [**Z0876**](https://www.sigmaaldrich.com/product/sigma/Z0876) | 219.2 | 4.56 | 1N NaOH | Water | -0 °C | -0 °C | CA/F | 0.01-5.0 |
| Zeatin | [**Z0164**](https://www.sigmaaldrich.com/product/sigma/Z0164) | 219.2 | 4.56 | 1N NaOH | Water | -0 °C | -0 °C | CA/F | 0.01-5.0 |
| trans-Zeatin Hydrochloride | [**Z2753**](https://www.sigmaaldrich.com/product/sigma/Z2753) | 255.7 | 3.91 | Water | — | -0 °C | -0 °C | CA/F | 0.01-5.0 |
| trans-Zeatin riboside | [**Z3541**](https://www.sigmaaldrich.com/product/sigma/Z3541) | 351.4 | 2.85 | 1N NaOH | Water | -0 °C | -0 °C | F | 0.01-5.0 |

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**MISCELLANEOUS PLANT GROWTH REGULATORS**

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|  |  | **Molar Equivalence** | **Solution Preparation** |
| **Product Name** | **Product No.** | **Mol. Wt.** | **µM for 1 mg/L** | **Solvent** | **Diluent** | **Powder Storage** | **Liquid Storage** | **Steriliz-ation\*** | **Working Conc. (mg/L)** |
| (±)-cis,trans-Abscisic acid (ABA) | [**A1049**](https://www.sigmaaldrich.com/product/sigma/A1049) | 264.3 | 3.78 | 1N NaOH | Water | -0 °C | -0 °C | CA/F | 0.1-10.0 |
| Ancymidol | [**A9431**](https://www.sigmaaldrich.com/product/sigma/A9431) | 256.3 | 3.90 | DMSO | — | 2-8 °C | -0 °C | CA/F | 1.0-10.0 |
| Chlorocholine chloride (CCC) | [**C4049**](https://www.sigmaaldrich.com/product/sigma/C4049) | 158.1 | 6.33 | Water | — | RT | 2-8 °C | F | up to 500 |
| 3,6-Dichloro-o-anisic acid (Dicamba) | [**D5417**](https://www.sigmaaldrich.com/product/sigma/D5417) | 221.0 | 4.52 | EtOH/Water | — | 2-8 °C | 2-8 °C | F | 0.01-10.0 |
| Gibberellic acid (GA3) | [**G7645**](https://www.sigmaaldrich.com/product/sigma/G7645) | 346.4 | 2.89 | EtOH | — | RT | 2-8 °C | CA/F | 0.01-5.0 |
| Gibberellic acid Potassium salt (K-GA3) | [**G1025**](https://www.sigmaaldrich.com/product/sigma/G1025) | 384.5 | 2.60 | Water | — | 2-8 °C | -0 °C | CA/F | 0.01-5.0 |
| Gibberellin A4 Free acid (GA4) | [**G7276**](https://www.sigmaaldrich.com/product/sigma/G7276) | 332.4 | 3.01 | EtOH | — | -0 °C | -0 °C | F | 0.01-5.0 |
| (±)-Jasmonic acid | [**J2500**](https://www.sigmaaldrich.com/product/sigma/J2500) | 210.3 | 4.76 | EtOH | — | 2-8 °C | -0 °C | F | 0.01-100.0 |
| Phloroglucinol | [**P1178**](https://www.sigmaaldrich.com/product/sigma/P1178) | 126.1 | 7.93 | Water | — | RT | 2-8 °C | CA/F | up to 162 |
| N-(Phosphonomethyl)glycine (Glyphosate) | [**P9556**](https://www.sigmaaldrich.com/product/sigma/P9556) | 169.1 | 5.91 | 1N NaOH | Water | RT | 2-8 °C | F | — |
| Succinic acid 2,2-dimethylhydrazide | [**S2022**](https://www.sigmaaldrich.com/product/sigma/S2022) | 160.2 | 6.24 | Water | — | 2-8 °C | 2-8 °C | CA/F | 0.1-10.0 |

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