Woody Plant Medium (WPM)

Exploring Woody Plant Medium (WPM): A Key Tool in Plant Tissue Culture

In the world of plant tissue culture, one of the primary factors determining successful growth and development of plants in-vitro is the medium used. Each medium is designed to provide essential nutrients in the right balance depending on the specific requirements of the plants being cultured. For applying tissue culture techniques to woody plants, one of the most standard and widely used media is **Woody Plant Medium (WPM)**. In this blog post, we'll explore what WPM is, its applications, and its formulation.

What is Woody Plant Medium (WPM)?

Developed by Lloyd and McCown in 1980, **Woody Plant Medium (WPM)** was specifically formulated to suit species that fall within the category of woody perennials—plants that have lignified stems (those that build wood as structural tissue). While a scion of tissue culture research revolves around herbaceous plants, the needs of woody plants are quite different, due to their slower growth and the physiological nature of their tissue.

WPM became an essential medium tailored to address the requirements for:

- **In vitro propagation** (micropropagation) of trees, shrubs, and other woody perennials.
- The **regeneration of woody species** through shoot organogenesis and somatic embryogenesis.
- The process of **germplasm conservation** for endangered tree species.

WPM proved particularly effective for species in the genus *Rhododendron*, *Malus* (apple), *Prunus* (cherry, plum, peach), *Juglans (walnut)*, *Populus* (poplar), and many others.

Characteristics of Woody Plant Medium

When comparing WPM to other commonly used plant tissue culture media, such as Murashige and Skoog medium (MS), a few characteristics stand out:

1. **Lower Salt Concentration**: WPM contains reduced levels of inorganic salts, which makes it less concentrated in ions than the MS medium. This low-salt characteristic is more suitable for optimizing growth in woody perennials that tend to be adversely affected by higher salt concentrations.

2. **Essential Elements for Woody Species**: The macro and micronutrient composition of WPM is tweaked for species with lignified tissues. It includes all the major and minor elements needed to sustain growth.

3. **Adaptability**: WPM is highly tunable, meaning researchers and horticulturalists can modify components such as the levels of hormones (auxins and cytokinins) and vitamins for different plant species or experiments.

In essence, WPM is designed to provide an optimized and balanced nutrient environment that enables efficient rooting, callus formation, and shoot proliferation in woody plants.

Applications of Woody Plant Medium

Some of the key uses of WPM include:

- **Plant micropropagation**: Micropropagation is a rapid multiplication process to produce plants with desired traits. For woody species, WPM provides an ideal nutrient composition to ensure healthy root and shoot development.

- **Somatic embryogenesis**: This process involves producing an embryo from somatic cells rather than from sexual reproduction, and WPM is used extensively to regenerate plants in this way.

- **Callus Induction and Organogenesis**: Woody plants often need media that support cell dedifferentiation (callus formation) and subsequent redifferentiation into shoots or roots. WPM is ideal for inducing this response in numerous woody species.

- **Conservation of endangered species**: Many woody plants are endangered, and in vitro conservation allows their tissue to be stored and regenerated when needed. Species such as certain oak or rare tree varieties are preserved in tissue banks using WPM.

- **Breeding programs**: Researchers involved in breeding woody tree species often turn to WPM-based tissue culture methods to produce hybrids or modify plant genetic makeup via genetic transformation experiments.

Woody Plant Medium (WPM) Formulation

Below is the basic formulation of Woody Plant Medium per liter (1 L). Keep in mind that modification of this basic medium may be necessary depending on the exact plant species or type of culture (callus formation, somatic embryogenesis, etc.):

Component	Concentration (mg/L)
Macronutrients	
Ammonium nitrate ((NH_4NO_3))	400 mg/L
Calcium nitrate ((Ca(NO_3)_2 cdot 4H_2O))	556 mg/L
Magnesium sulfate ((MgSO_4 cdot 7H_2O))	370 mg/L
Potassium Phosphate monobasic ((KH_2PO_4))	170 mg/L
Potassium sulfate ((K_2SO_4))	990 mg/L
Sodium chloride ((NaCl))	100 mg/L

| **Micronutrients** | |

Boric acid ((H_3BO_3))	6.2 mg/L
Cobalt chloride ((CoCl_2 cdot 6H_2O))	0.025 mg/L
Copper sulfate ((CuSO_4 cdot 5H_2O))	0.025 mg/L
Ferrous sulfate ((FeSO_4 cdot 7H_2O))	27.85 mg/L
Manganese sulfate ((MnSO_4))	16.9 mg/L
Zinc sulfate ((ZnSO_4 cdot 7H_2O))	8.6 mg/L

| **Iron Chelate Complex** | |
| NaEDTA | 37.25 mg/L |

Vitamins and Organic Components	
Myo-Inositol	100 mg/L
Nicotinic acid	0.5 mg/L
Thiamine-HCl (Vitamin B1)	0.5 mg/L
Pyridoxine-HCl	0.5 mg/L
Glycine	2 mg/L

| **Carbon Source** | |
| Sucrose | 20000 mg/L (20 g/L) |

| **Gelling Agent (Optional, for solid media)** | |
| Agar | 6000–8000 mg/L (6–8 g/L) |

In many applications, growth hormones may also be added depending on the goal of the tissue culture experiment. For instance:

- **Auxins**, like Indole-3-acetic acid (IAA) or Naphthaleneacetic acid (NAA), are often added to induce rooting.
- **Cytokinins**, such as 6-Benzylaminopurine (BAP), stimulate shoot proliferation.

Depending on the purpose, the pH is adjusted to 5.6–5.8 before autoclaving the medium for sterilization.

Conclusion

Woody Plant Medium (WPM) is a crucial development in the field of plant tissue culture, offering a specialized environment for the culture of trees, shrubs, and other woody plants. Its low-salt composition and essential nutrients make it ideal for the propagation, conservation, and experimental research of hard-to-grow woody species. Whether you're a researcher working on genetic transformation, a horticulturalist employing micropropagation, or contributing to conservation efforts, WPM serves as a reliable nutrient base for woody plant in-vitro experiments.

By understanding the precise formulation and flexible nature of WPM, you can adapt it to suit the needs of various species and projects, bringing us one step closer to meaningful applications in forestry, horticulture, and biodiversity conservation.

References:

- Lloyd, G. & McCown, B. (1980). Commercially feasible micropropagation of mountain laurel, *Kalmia latifolia*, by use of shoot tip culture. *Proceedings of the International Plant Propagation Society*, 30, 421-427.

Happy culturing!