

SEEDING YOUR VEGETABLES

A Quick User Guide On



Seed Genetics



Seed Storage & Treatment



Seed Quality Assessment

Modern agriculture relies on high quality seeds to achieve productivity targets and ensure sustainable crop production. Seeds with superior genetics can offer advantages such as higher yields, adaptability to changing environmental conditions, and improved resistance to pests and diseases. These qualities could help commercial farmers maximize productivity and achieve consistent crop performance, thereby sustaining profitable harvests and contribute to local food security. To harness the potential of quality seeds, growers should also prioritize proper seed storage to preserve viability and maintain optimal seed health prior to usage.

Seed Genetics

THE GENES MATTERS

Smart Seed Selection: DNA within seeds delivers more than just observable characteristics. Growth and fitness attributes such as maximum yield, disease resistance and environmental adaptability are pre-determined by genetic profiles of seeds. Savvy growers can use seeds with superior genetics to reduce crop losses and achieve consistent harvests, thereby improving productivity of their cultivation systems. Likewise, seeds that offer benefits such as longer shelf-life and better post-harvest quality can fetch higher market value, as these vegetables tend to be more appealing to consumers. Table 1 highlights some desirable traits of leafy and fruited vegetables that are relevant for modern controlled environment agriculture (CEA), which includes greenhouse and indoor systems.

Hybrid Seeds' Value: Despite higher prices, hybrid seeds are preferred by commercial vegetable growers eager to maximize productivity and improve market demand. Developed by cross-breeding two closely-related parent plants chosen for their unique desirable traits, hybrid seeds are known to exhibit enhanced characteristics such as uniform growth, increased stress resilience, or enhanced taste and texture. However, here is the catch: if you try to produce seeds from hybrid plants, the next generation will not display the same qualities.

Table 1. Desirable traits of vegetables for cultivation in controlled environment agriculture

	Leafy Vegetables	Fruited Vegetables
Unique Traits	Short growth cycle Bolting resistant	Early flowering Parthenocarp
Common Traits	Fast and compact growth High yield and uniformity High-density tolerant Heat tolerant Pest and disease resistant High nutrient content Extended shelf-life	

Information referenced from Sustainable Agriculture¹

This is due to the first filial generation (F1) hybrids inheriting genes from parent plants with different genetic profiles, which leads to variation of traits in successive generations, because of random recombination of genes during seed propagation. To ensure consistent crop quality, it is common practice for local commercial growers to purchase F1 hybrid seeds for each crop cycle, instead of engaging in seed saving practices.

HOW TO STORE YOUR SEEDS

Commercial vegetable seeds can remain viable in storage for one to four years, when maintained under optimal conditions. Given that seeds contain living embryos, keeping them in a cool environment away from heat and sunlight is essential for sustaining a low metabolic rate and slow down seeds' deterioration in storage. In addition, seeds should be kept in a dry place with relative humidity (RH) below 40%. Between an RH of 30-40%, most vegetable seeds can dry and equilibrate to a moisture content (MC) of 5-8%, which is a suitable range for extended dormancy². Storing seeds at MC levels that are lower or higher than optimal can lead to structural damage or fungal growth, respectively. Specific storage conditions for some common vegetable seeds are listed in Table 2.

As seeds are sensitive to changes in their environment, exposing them to fluctuating conditions can lead to premature aging and reduction in viability. To prevent heat and moisture exchange with the environment, seeds should be stored in air-tight containers and kept at a location with stable conditions. Furthermore, silica gel desiccants can be placed in storage containers to absorb excess moisture. Each container should also be properly labelled with key information such as seed type or purchase date, to ensure that storage duration can be tracked and utilized before the end of their lifespans.

Table 2. Practical storage conditions for common vegetable seeds*

Vegetable	Storage Temperature	Optimal Relative Humidity	Target Moisture Content	Expected Shelf-Life
Cabbage	8-15 °C	30%	5.5-6.0%	3-4 years
Cucumber	8-15 °C	30%	6.0-7.0%	3-4 years
Lettuce	8-15 °C	30%	6.0-6.5%	2-3 years
Peas	Ambient	Variable	10.0-11.0%	1-2 years
Spinach	8-15 °C	30%	8.0-9.0%	2-3 years
Tomato	8-15 °C	30%	6.0-7.0%	3-4 years

Information referenced from APSA³; *Specific storage conditions for Asian leafy vegetables not available

Seed Treatment

BETTER SEEDS, BETTER CROPS

Most vegetable seeds sold in the market are pre-treated by seed companies to promote seed health and longevity. Some examples of seed treatment methods and their intended outcomes are listed in Table 3. Seeds are commonly treated for protection from pests and diseases during germination and early seedling growth. On the other hand, some methods are applied to boost germination rate and seedling vigor to attain higher crop yield. Besides, commercial seeds are often processed to manage storage stress and ease of handling. For instance, pelleted or coated seeds offer improved uniformity and compatibility for automated and precision sowing in CEA. With the appropriate enhancement, treated seeds are suitable for meeting the increased efficiency and productivity demands of CEA, hence justifying their premium prices and higher costs.

Table 3. Examples of seed treatment methods

Method	Treatment Outcome
Physical Treatment	Heat or radiation are applied to eradicate pathogens and improve germination
Chemical Treatment	Coated with fungicides or pesticides to protect against seed-borne pathogens
Biological Treatment	Beneficial microbes are applied to promote seedlings vigor
Pelleting and Coating	Coated with inert materials to attain size and shape uniformity for ease of planting
Priming	Activation of early-stage metabolic processes to improve germination and seedlings uniformity

Information adapted from JPP journal⁴

CHECK YOUR SEEDS

For seeds that have been kept in prolonged storage, it is good practice to do a physical check before use. High-quality seeds should remain uniform in size, shape, color and without signs of pests or diseases. In addition, seed coats should retain a firm and dry texture. While growers can usually rely on the germination rates provided by reputable seed suppliers, simple tests can be used to quickly assess seeds if there is concern that quality has been compromised. Some examples of viability and germination testing methods used for seed quality assessment are listed in Table 4. Basically, viability tests assess if seeds are alive and typically require a shorter time (few minutes), which are useful for quick evaluations but not always accurate. Germination tests directly measure seeds' ability to sprout and grow into seedlings and are more practical for growers' planting estimate and resource planning. Knowing the germination rate would allow growers to avoid planting non-viable seeds and adjust the seedlings requirement accordingly. Labor and resources such as substrates, water and nutrient solutions can also be used more efficiently as growers can make informed decisions and reduce wastage.

Table 4. Examples of seed viability and germination tests

Method	Feature	Duration
Seed Viability Tests		
Float Test	Place seeds in water; viable seeds sink while non-viable seeds float	5-15 mins
Cut Test	Cut seeds and observe for firm and healthy internal tissues	1-2 mins
Seed Germination Tests		
Paper Towel Test	Place seeds between moist paper towels and observe for radicle growth	12-24 hours
Petri Dish Test	Place seeds on wet filter or blotter paper in covered petri dishes and observe for radicle growth	12-24 hours
Germination Tray Test	Sow seeds evenly in trays filled with moist growth substrate and keep warm; observe for radicle growth	1-2 days

Information adapted from FAO and ISTA⁵



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About the Author

Terence Tay is from the Urban Food Solutions Division, Agri-Technology and Food Innovation Department. His research background is in molecular engineering and genetics. Currently his research interest is in seed genetics and breeding for new varieties development.

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4. Somveer et al. (2020). Methods of vegetable seed treatment and its effect: A review. *Journal of Pharmacognosy and Phytochemistry*
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The Singapore Food Agency (SFA) had recently announced the \$70 mil Agri-food Cluster Transformation (ACT) Fund 2 which supports capability development, productivity improvements, and infrastructure upgrades. Farms can leverage on the Capability Upgrading component of ACT Fund 2 to adopt energy-efficient equipment and technologies from SFA's pre-qualified list. This will help farms improve energy efficiency and manage production costs to strengthen long-term resilience.



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