

Frequently asked questions on seed drying beads

What are seeds? Seeds are the products of plant reproductive processes that when planted can germinate and produce a new plant of the same species. Many crops like lettuce, onion, tomatoes, cotton, corn, rice, etc. are planted each year from seeds. In addition, seeds are also part of our daily diet, providing about 70% of the total calories for human food needs.

Why do we need to dry seeds? Seeds are dried to preserve seed quality. Traditionally, farmers have dried seeds using sunlight and stored seeds in porous bags. Such seeds are exposed to ambient temperature and humidity conditions during storage. Seeds absorb moisture from the atmosphere until their moisture content (MC) is in equilibrium with the air humidity. High temperature and MC, particularly in combination, reduce seed storage life. Each 1% reduction in seed MC between 5-15% or 5°C reduction in seed temperature between 0 and 50°C doubles the life of the seed. Since controlling temperature is expensive in resource poor areas, drying seed to low MC by using seed drying beads is an effective alternative to maintain seed quality.

What are seed drying beads? Seed drying beads are modified ceramic materials (aluminum silicates) that specifically absorb water molecules and hold them very tightly in their microscopic pores. These beads remove water from the air, creating very low humidity inside of closed containers. Storing seeds inside of containers with the drying beads will remove water from the seeds and dry them without heating. The beads can be regenerated by heating above 200°C for 1 to 2 hours. Currently, beads are available in 5 mm and 8 mm sizes.

Are seed drying beads toxic? These beads are non-toxic and essentially inert, like ceramics. However, adding liquid water directly to dry beads will generate heat, so care should be taken not to rapidly wet quantities of dry beads as the temperature can increase to over 100°C.

What equipment is needed to use seed drying beads? All that is needed is an airtight container. Any locally available simple airtight container (plastic, metal can, etc.) will work. A gasket inside the cap can ensure an airtight seal in plastic/metallic containers. Seeds and beads can be mixed together in the container and the beads screened out later, or the beads can be inside of a porous packet for ease of use. Wet seeds should be surface dried before using seed drying beads. The seed:bead system has to be airtight and one should be quick while opening the beads, transferring the beads into a porous bag and closing the lid of seed:bead mixture to minimize water absorption by the beads from the air before sealing with the seeds.

Can the beads be reused? Seed drying beads can be re-used essentially indefinitely. As the beads hold water tightly, they must be heated in an oven at more than 200°C for 2-3 hours to drive out the moisture completely from the beads. Local bread baking ovens can be used to dry the beads in either metallic cans or aluminum foil. Allow the



beads to cool inside the oven for 10 min using a cover and transfer regenerated beads into a dry metal container using sturdy gloves and dry funnels and cap airtight. In resource poor areas, regeneration of beads could be achieved by seed/nursery dealers or by co-operatives through an exchange program. Exhausted beads could be returned to the dealer or co-operative for regeneration and exchanged for dry beads.

Do the beads lose water retention capacity with repeated use? Repeated heating at high temperature does not cause any loss of water retention capacity of seed drying beads. This is in contrast to silica gel, for example, that loses effectiveness with repeated regeneration.

What quantity of beads is needed to dry seeds? The amount of beads required depends on the quantity of seeds, the initial seed MC and the final MC desired. The beads can absorb up to 25% of their weight in water. If a seed lot has 15% MC (fresh weight basis), there is 1.5 kg water in 10 kg of seed. To dry this seed to 7.5% final MC, we need to remove 0.75 kg water. Since 4 kg of beads remove 1 kg water, we need 3 kg beads per 10 kg of seeds. Charts and tables are available to easily calculate the appropriate bead:seed ratio depending upon the initial and final MC of the seed.

How do you know the water absorbing capacity of beads? Since the beads have stronger affinity for water than silica gel, a color change of a small quantity of silica gel mixed with the beads can indicate when the beads need to be regenerated. Other types of humidity indicator labels or monitoring devices could also be used.

Can all seeds be dried using seed drying beads? Only desiccation-tolerant (or “orthodox”) seeds should be dried using these beads. Desiccation-intolerant (“recalcitrant”) seeds like mango, durian, or citrus should not be dried by these beads.

Why can't we just dry the seed in the sun in sub-tropical/tropical regions? The temperature and humidity of the air determine how much water is present in the seed. The seeds cannot be dried to lower MC than is determined by the ambient humidity, even by multiple and prolonged exposures. Even with heated air drying, only limited seed drying may be possible if the ambient air is already warm and humid. The seeds can only be dried to lower MC by enclosing the seeds away from the ambient air and lowering the relative humidity in the container.

Can the seeds be damaged when dried by these beads? Most orthodox seeds are not damaged even when dried to 3-5 % moisture. Some seeds can be damaged when rehydrated too rapidly from very low MC. Thus, particularly for larger seeds like beans, the seeds should be removed from the storage containers and allowed to absorb moisture from the air for a few days before coming in contact with liquid water.

Are there any precautions needed while using seed drying beads? The beads heat up by an exothermic reaction if free water is added directly to the dry beads, which could result in seed damage. Similarly, **do not** add beads directly to very wet seeds like

cucumber, melons or tomato after washing. These seeds should be surface dried before being brought into contact with the beads. Large seeds like beans become brittle when very dry and need careful handling to prevent cracking. Seeds be taken out from the beads and left under ambient conditions for several days prior to sowing.

What are other advantages of seed drying beads? Since the seeds are inside airtight containers, they are also protected from molds, insects and rodents. Once the seeds are dry, the beads can be removed and re-used. So long as the seeds remain inside of the airtight container, they will remain at the same MC even after the beads are removed.

Can seed drying beads be used for other purposes? These beads can be used to dry herbs, fruits or vegetables.

Can the bead drying system be scaled up for large quantities of seeds? Based on the need, from a few grams to metric tons of seeds can be dried. For larger quantities, forced air systems have been designed that use the beads to dry the air that is circulated through the seeds.

Why not to use silica gel to dry seeds? Silica gel can and has been used to dry seeds. However, silica gel has a lower affinity for water than seed drying beads at the low humidity that we wish to obtain. Although silica gel can be regenerated by heating at a lower temperature, there is loss of water holding capacity of silica gel due to polymerization after repeated heating. There is no loss of water holding capacity of seed drying beads after repeated regeneration.

How do I know that the containers are airtight? If a small quantity of fresh silica gel placed inside an empty, sealed container changes its color within a few days, it indicates that the container is not moisture proof. Using a rubber gasket in the cap or lid helps to make an airtight seal.

Can seed drying beads help women in resource poor areas? Mostly women are involved in seed production. Traditionally, seeds have been dried under the sun, which requires constant vigilance against birds, rodents and rainfall. Women need to collect seeds in the evening and spread them out the next morning for several days. Since the seed drying beads are used inside an airtight container, women will avoid the above problems and hence save time for other activities.

What is the cost of the beads to the farmers? The cost of the beads in a particular location is uncertain, as each country may have import duties or other costs that must be considered. There is a one-time initial investment for the beads that we estimate to be approximately €10-20 per kg. However, as the beads can be re-used indefinitely, this cost can be spread over many years. A cooperative bead exchange program could also provide only the quantity needed, when it is needed. Good seed storage is an investment in terms of value added to seeds, time saved and loss that would normally

take place from birds, insects, rodents, fungi in ambient air drying. Additionally, no pesticides are needed to combat these pests as long as the seeds are dry and in sealed containers. With extended seed storage life, growers can produce more seed in one year and save the seeds for several years, allowing the land to be used for growing other crops. This practice provides an insurance against possible natural calamities like bad weather conditions or outbreak of diseases or insects.

When the beads will be available in the market? We are currently investigating market-based systems that will provide the mechanism to make the beads available and encourage entrepreneurial enterprises to support their use. Smaller quantities are available for pilot studies or research.

How can the seed drying beads help a national agriculture system? In the short run, value-added seeds help growers produce quality crops which become the backbone of national food security system. National gene banks in resource poor areas of the globe can use the seed drying beads for germplasm conservation, thus minimizing the seed multiplication frequency. This approach may be particularly valuable for preserving indigenous crops that contribute to stable local food systems.