Seed Bomb- The Need of The Hour

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Propagating a native species by the use of seed balls, also known as seed bombs, is a simple and long-lasting method because it creates an ideal environment for seed germination and allows for more time for seedlings to multiply. Masanobu Fukuoka, a Japanese pioneer in natural farming, he discovered the method of making seed balls. The concept of aerial replanting was inspired by the traditional Japanese custom of tsuchidango (earth dumpling). Tamilarasan *et al.*, (2021) reported that the seed ball technique proved to be low cost and can be used to recover vegetation in deforested areas. This technique can overcome biotic and abiotic stresses which hinder seed germination and viability. It can be effectively utilized for better seedling establishment, vigour and survival even in resource-limited conditions. Under non- irrigated condition, seed ball performed better then control. The nutrients in the seed ball medium provided additional nutrients and growth promoting factors for enhancing the establishment and survival rate of the seedlings.

Suitable time for seed ball preparation and propagation

Seed balls can be propagated before monsoon on damp soil based on climatic calendars of the respective country. By October, winter-planting seed balls should be ready. Seed ball propagation should be done after two to three days of rain in drier areas. At monsoon, coastal seed ball propagation should begin. Late propagation may fail

Criteria for selection of site: A site survey should be conducted before selection of plant species for making seed balls. In coastal areas neem seed may not germinate and grow easily. The seeds should be collected from local vendors or from forest areas. The viability and germination percentage of seeds should be assessed before making a seed ball. In annual grass or legume species, seed should not be older than one year.

Suitable species for seed ball propagation

Seeds of native species from same climatic conditions must be selected for making seed balls. This improves the chances of germination. Native trees species should be selected for propagation along highways, avenue plantation etc. Along railway tracks tree *sps.* are not advised, as during cyclone or monsoon it may fall on it. Deep rooted, non-palatable, nature ornamental shrubs are most suitable for these areas. In tree *sps.* viz. Neem, Ficus sps. seeds may be collected, shade dried and propagated in same year.

Pre-treatment of Seeds

Some seeds remain dormant in soil after propagation due to the immature embryo, chemicals on seed coat or hard seed coat. These types of seeds require pretreatment. Annual grass and herbaceous legume seeds do not require pretreatment. In leguminous trees, mechanical scarification, hot water scarification, soaking in cold water and acid scarification improves the seed germination. After scarification seeds should be shade dried to remove the traces of moisture. It reduces the chances of pre germination of seeds in seed ball.

Preparation of Seed Balls

Well drained native soil should be collected and sieved from 0.075 mm (200 no.) sieve to get clay particles. Clay, organic fertilizer and perlite

/Vermiculite should be mixed well as per convenience in the ratio of 1:0.5:0.25. A culture of beneficial microorganism's viz. N fixers, P solubilizers and mobilizers should be added for improving the germination of seeds and growth of seedling even in adverse conditions. By adding *Trichoderma sp.,* the occurrence and infestation of root zone pests and diseases can be reduced. Water must be added in the seed ball substrate to prepare dough. If dough is very sticky, coco peat may be mixed. 1 kg substrate can make 90-100 balls of 0.5 to 1inch that may accommodate 2-4 seeds depending on the size of seed. In 5000 kg of substrate 5,00,000 seed balls can be prepared in advance before propagation. Seed balls must be air dried for 24-48 hours in a shade before sowing or storing.

Methods of seed balls application

Dibbling Method: In the first method, called "dibbling," a dibbler (either a metal rod or a bamboo stick) is used to drop seed balls in a hole or cavity at regular intervals. To find a level area, usually a plain landscape can be selected. Such places include the side of the road, a garden, a patch of grass, etc. Depending on the desired plantation and the desired number of tiers or rows of propagation, the seedballs can be propagated in a variety of shapes and patterns, such as a triangle, a square, a single hedge, a double hedge, etc.

Broadcasting/Aerial Throwing: In order to grow the most grass possible on knolls and other inhospitable, strewn landscapes, it is advised to use aerial throwing. Seed balls can be dispersed by hand or by being dropped from a helicopter or a drone; neither ploughing nor digging of pits is necessary. Seeds need a particular climate for optimum germination and survival, and it covers a wide region in a short amount of time. Aerial broadcasting along steep slopes is not advised since the seed balls could be lost in the rain. As a result, it might be difficult to keep track of how many seeds germinated and how many of them became healthy seedlings.

Distance to maintain in seedball propagation

Depending on size and canopy of tree, seedballs must be propagated at specific distance. Distance to be maintained in seed ball propagation:

Sl. No	Height of plant	Preferable position for plantation	Distance to maintain
1.	Tall	On Boundary	10m x 10m
2.	Medium	Roadside	7m x 7m
3.	Short	Block Plantation	5m x 5m

Precautionary measures taken after propagation

Grazing should be controlled to get better survival ratio of germinated seedlings. In waterlogged land, small bunds can be prepared near germinated seedlings to prevent deterioration of seed. In case of long break in rain fall, light irrigation should be done.

Counting & monitoring of germinated sapling

After 45 days of propagation 1st monitoring should be done to check the germination and calculate germination ratio. Along with this, information of rainfall, nature of area, slope, mode of propagation etc. can be recorded.

Future Prospects in Seed Bomb Technique Aerial Seeding: An Effective Afforestation Method

Spraying seeds from a drone, plane, or helicopter is called "aerial seeding," and it's used to quickly and effectively reduce erosion risks and suppress the growth of invasive plant species. Aerial seeding is commonly used to spread various grasses and legumes to large areas of land in need of vegetative cover after fires. Aerial seeding, the practice of broadcasting seeds from aircrafts, has been used for nearly 80 years. It was first performed in 1926 in Hawaii to recover large areas of burned tropical forest. The main goal of aerial seeding projects has been the re-establishment of specific ecosystem services, rather than the reconstruction of viable, resistant, and resilient ecosystems that are representative of biodiverse reference communities.

Benefits of aerial seeding using seed bomb

Drones can readily reach places that are difficult to reach by humans. This is a common argument used to persuade nations to implement aerial seeding programmes. When the globe needs to guarantee effective coverage of a large region in a short length of time, seed bombardment by drones is increasingly being regarded a viable choice. Not only do high-tech drones make forest restoration easier on humans, but they also boost crop yields through aerial planting. What's more, seed bombing is a gentle technique for plants. Aerial reforestation is the most efficient method of treatment when wet soil and undulating land render other methods ineffective. Because it does not lead to soil compaction, aerial application reduces runoff. Most of the benefits of this planting strategy will accrue to tropical forests since they are more efficient carbon sinks and host a greater variety of plant and animal life.

Conclusion

Numerous global threats are pushing humanity nearly to the brink of devastation and catastrophe. These include pandemics, economic hardship, food insecurity, poverty, climate change, conflicts, land and water degradation, and biodiversity loss. Unhealthy planet leads to an unhealthy economy. Environmental degradation causes climate change, biodiversity loss, and new diseases. Forests and trees can help solve these challenges and create sustainable economies. The UN Strategic Plan for Forests goal of increasing forest acreage by 3% by 2030 is not on track (FAO, 2022). Afforestation projects manage forests and counteract global warming and climate change by helping huge populations survive (Mohan *et al.,* 2021). Forests and trees can provide global, cost-effective, egalitarian, and fast solutions. Forests and trees can maintain nature, improve human well-being, and create money, especially for rural people. Seedball propagation greens fractured and degraded lands cheaply. Seedballs can quickly cover enormous areas. It's inexpensive, sustainable, and effective for planting in challenging areas. Seedball intervention works well in grazing-free environments. This method overcomes biotic and abiotic factors that prevent seed germination and viability. Even in resource-limited situations, it improves seedling establishment, vigour, and survival (Tamilarasan *et al.,* 2021).

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