

Comparison of Germination Efficiency of Sunflower (*Helianthus annuus*) Seeds Using Three Mixtures of Seed Balls*

BEVERLY B. AMPARADO^{1,**}, ART BENHUR B. AMPARADO²,
LUCIAN KHYLLE G. UNABIA², and JOBELLE J. TINGCANG²

ABSTRACT

Reforestation and greening are topmost priority considering that only less than 24% of the original forest cover remains. The cost of reforestation and tillage, however, are both costly and the latter may be destructive to the soil structure. Thus, this study was conducted to introduce the use of seed balls as cheaper alternative and to determine which among the three seed ball mixtures could best support seed germination and growth of seedlings of sunflower (*Helianthus annuus*). Seed balls were made and sun-dried before sowing. Results show that a combination of 5 parts red clay, 3 parts cow manure, 1 part seeds (seed ball or treatment 1) was the best growth medium for *H. annuus*. Another combination of 3 parts clay, 3 parts shredded paper, 2 parts manure, 1 part seeds (seed ball or treatment 2) was able to support germination stage of sunflower seeds similar to the first mixture. However, growth and development of the seedlings from two-leaf to four-leaf stage were not as efficient as compared to the first seed ball mixture. The third seed ball mixture composed of 3 parts clay, 3 parts wood charcoal, 2 parts manure, 1 part seeds was the growth medium with the least number of seed germination as well as two-leaf to four-leaf seedlings of *H. annuus*. Thus, it is recommended that seed ball preparations using 5 parts red clay, 3 parts cow manure, and 1 part seeds of tree species be used and field tested for reforestation and urban greening.

Keywords: Environmental Science, seed balls, seed germination, seedlings, sunflower seeds

I. INTRODUCTION

A tree is life. Trees and vegetation give life to the Earth through the amount of oxygen released during photosynthesis. Plants maintain the habitable warmth of our environment and prevent climate change by absorbing the “greenhouse gas”, carbon dioxide (CO₂), emitted from the processes of decomposition and combustion of various sources. Unfortunately, forests are being diminished with the expansion of the urban and industrial establishments. With less than a quarter of the original forest cover that remains, reforestation and greening become imperative, if we are to save our environment. Philippines, as a tropical country, can support growth of trees and vegetation all throughout the year. However, the cost of reforestation is costly and risky. Thus, this idea is conceived to introduce the use of seed balls as an effort towards greening and large scale reforestation.

Seeds balls or “clay dumplings” are an ancient technique for propagating plants from

seeds without opening up soil with cultivation tools such as a plow. Seed balls are mixtures of red clay, compost, and seeds, which are moistened and formed into compact lumps or balls, allowed to dry, and then cast out into fields at the appropriate time of year, depending on the seed mixture, climate and rainfall patterns [1]. If prepared for reforestation, tree seed balls consist of indigenous tree seeds, encapsulated in protective substrate that provides the seeds with protection from seed-eating predators. Seed balls allow for easy distribution across vast landscapes and can simply be thrown out into the ecosystem and sit until the rain comes. Seed balls are also commonly employed in urban areas where tillage is simply not an option. Seed balls can also be used to “over seed” existing ecosystems, without damaging the soil structure or to seed productive plants into forested areas and steep hillsides where tillage is not possible. The rediscovery and popularization of seed balls in modern times is typically ascribed to Japanese natural farmer and philosopher Masanobu Fukuoka [2] who believed that seed balls can become an important aspect of natural farming and conservation enterprises around the world.

*This paper was imparted as a Poster Presentation in the *International Conference on Environment and Forest Conservation (ICEFC) of 2018*.

¹Mindanao State University, Marawi City, Philippines

^{*}Corresponding Author. E-mail Address: amparadobevs@yahoo.com

²Tambo Central School, Iligan City, Philippines

This research was conducted to test and promote the use of seed balls in growing plants more easily with the hope of using this simple method in the effort of reforestation and re-establishment of vegetation. The use of seed balls will both lower the cost of reforestation and field sowing and will also prevent erosion and soil disturbance associated with farming practices. To carry out this purpose in mind, this research was conducted to determine and compare the germination efficiency of sunflower seeds using three different mixtures of seed balls. Specifically, experimental set-up was designed to determine if germination of sunflower seeds will occur in seed balls, to determine the number of sunflower seeds that germinated in the three seed ball preparations from sowing and up to the third day, to determine the number of two-leaf seedlings among the three seed ball preparations from fourth day up to the eighth day after sowing, to determine the number of four-leaf seedlings among the three seed ball preparations from ninth day and until the twelfth day after sowing, and to compare which among the three seed ball mixtures is best as growth medium in the germination of sunflower seeds.

With knowledge, skill, and patience, seed balls can be an effective way of establishing trees and plants by anyone anywhere in the world (even deserts) that has access to clay, soil, and seed — for no money. The research project can also help lessen problem on wastes because scratch papers, charcoal, and manure can all be used in the preparation of seed balls. Plus, it could help save our climate, and give opportunity for the birth of localized cottage industries.

II. METHODS AND MATERIALS

This research made use of experimental research design to determine the germination efficiency of sunflower seeds using three seed ball mixtures. Data collection was done by quantitative method whereby the number of germinating seeds per seed ball, the number of

two-leaf and four-leaf seedlings was noted and compared among the three seed ball mixtures, each with five replicates.

Materials (Figure 1) used in the seed ball preparation were collected from open fields (for clay and manure) or brought from the market (for wood charcoal and sunflower seeds). These were sun-dried, pulverized, and sifted. Seed balls were made by gradually adding water to each mixture and then hand-rolling each ball. Seed ball mixtures (Figure 1) include: Treatment 1 (5 parts dry powdered clay, 3 parts cow dung, 1 part seeds); Treatment 2 (3 parts dry powdered clay, 3 parts shredded paper, 2 parts cow dung, 1 part seeds); and Treatment 3 (3 parts dry powdered clay, 3 parts wood charcoal, 2 parts cow dung, 1 part seeds). The seed balls were dried under the heat of the sun straight away for two days to prevent premature sprouting before the experimental was set to be started. Dried seed balls were kept in a cool, dry place ready for the experiment.

Sowing started by randomly choosing five dried seed balls of each type and placed in separate dishes for germination. The seed balls were sprinkled with 10 ml of tap water to initiate seed germination. Observation of seed germination was done from the day of sowing and until the 12th day. From the first day after sowing until the third day, the number of germinating seeds was noted based on the appearance of the first root. The seed balls were then transferred into separate pots for further observation. From the fourth and until the eighth day after sowing, the number of two-leaf

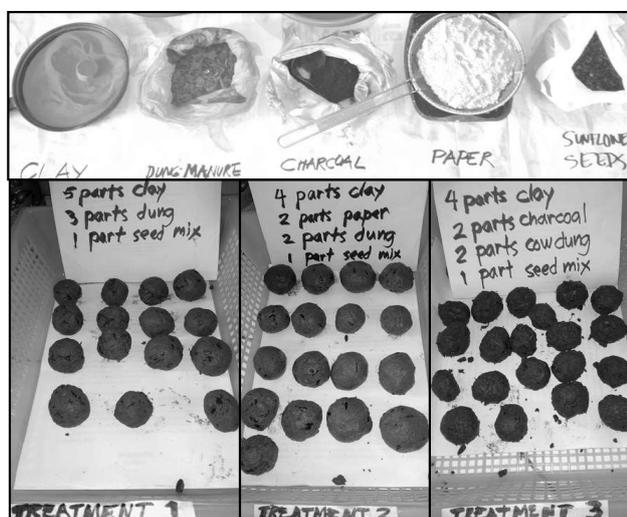


Figure 1. Raw materials (clay, manure, wood charcoal, paper, sunflower seeds) and the three mixtures of seed balls.

seedlings was counted. Then from ninth to 12th day after sowing, the number of four-leaf seedlings was determined.

Data on the number of germinating seeds were recorded daily and the final recording of data was done on the 12th day from sowing. The data on the number of germinating seeds was subjected to *Statistica* version 10 software for Multivariate Analysis of Variance (MANOVA) for analysis to determine if there was homogeneity or heterogeneity of the results. The treatment means were compared using post hoc Tukey's test to identify which treatments are similar and different from each other.

III. RESULTS AND DISCUSSION

The experiment showed that the sunflower seeds started to germinate a day after sowing. Germination was based on the appearance of the first root (radicle) that appeared as blunted hairy white structure. First and second day after sowing, the seed balls with shredded paper had the highest number of germinating seeds. This could be explained by the greater ability of paper to absorb the sprinkled water, which is needed for germination. On the third day, however, seed balls with 5 parts clay, 3 parts manure, and 1 part sunflower seeds had the highest number of seeds that germinated; which was statistically similar to seed balls with paper. Seed balls with charcoal had the lowest number of germinating seeds (**Figure 2**), which could be explained by its less absorbing and holding capacity of charcoal to moisture.

From the fourth day until the eight day after sowing, the number of two-leaf stage (cotyledon) seedling stage was noted (**Figure 3**). On the 4th and 5th day after sowing, seed balls with shredded paper had the highest number of seedlings at cotyledon stage. On the sixth day and until the eight day after sowing, however, seed ball mixture with 5 parts clay, 3 parts manure, 1 part seeds (Treatment 1) had the highest number of two-leaf seedlings as compared to those seed balls with shredded paper (Treatment 2) and wood charcoal (Treatment 3). This may be due to the greater

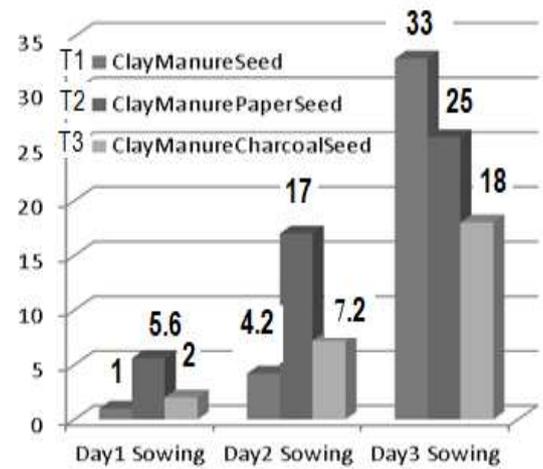


Figure 2. Number of germination of sunflower seeds from day 1 up to 3 after sowing.

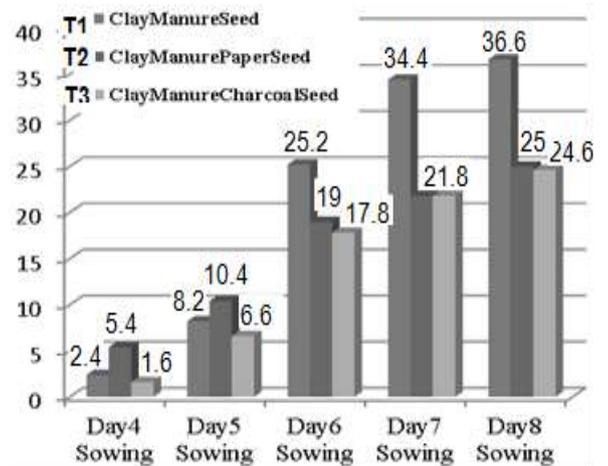


Figure 3. Average number of two-leaf seedling (cotyledon) stage of sunflower in three seed ball mixtures from fourth to eight day after sowing.

amount of manure in Treatment 1 that provides source of nutrients for the seedlings as compared to that in Treatments 2 and 3.

The number of four-leaf seedlings of sunflower (**Figure 4**) was noted from the ninth until twelfth day after sowing. Results show that the first seed ball mixture (Treatment 1 with 5 parts clay, 3 parts manure, 1 part seeds) had the highest average number of 34.8 seedlings per seed ball. Seed balls with 3 parts clay, 3 parts shredded paper, 2 parts manure, 1 part seeds (Treatment 2) and those with 3 parts clay, 3 parts wood charcoal, 2 parts manure, 1 part seeds (Treatment 3) had 22.2 and 19.2 seedlings per seed ball, respectively, on the twelfth day after sowing, thus, statistically lower than Treatment 1. The latter contained more amount of manure (3 parts) as compared to 2 parts, thus, more amount of nutrient source for seedling development.

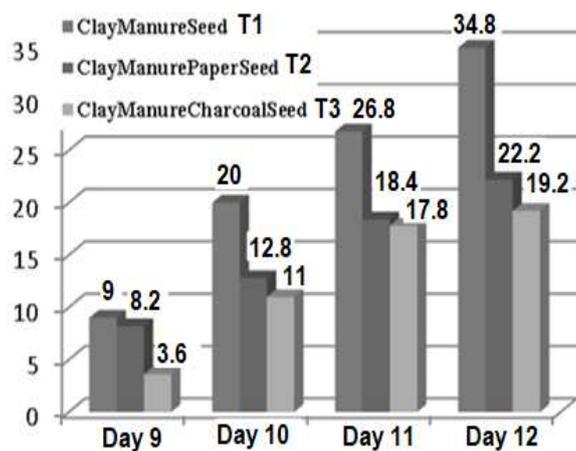


Figure 4. Average number of four-leaf seedlings per seed ball from 9th to 12th day after sowing.

Moisture is critical for germinating seeds. All seeds need the correct amount of moisture to initiate internal processes leading up to germination. In field soil, this is generally about 50-75 percent of field capacity. A fine-textured seedbed and good seed-to-soil contact are necessary for optimal germination [3]. Importance of moisture is evident in the highest number of seed germination in seed balls with shredded paper (Treatment 2) which increases ability of the seed balls to absorb and retain water needed for initial metabolic activation of plant embryo.

Oxygen gas, appropriate temperature, light, and nutrients are also needed to support seed germination and seedling development. Nutrient availability is a more important requirement for seeds germinated indoor [3], which was the case in this study. Highest germination of sunflower seeds in seed balls with highest amount of manure in Treatment 1 (5 parts dry powdered clay, 3 parts cow dung, 1 part seeds) may be associated to the greater amount of nutrient present in this seed ball mixture. In Treatment 2 and 3, there was reduced amount of cow manure from three parts to two parts only, thereby reducing the source of nutrients available to the growing and developing seedlings from two-leaf to four-leaf stages.

The mixture of 5 parts clay, 3 parts manure, and 1 part seeds had best supported growth and development of sunflower seedlings from the third day and until the 12th day after sowing. Therefore, these raw

materials (clay and manure) must be present in seed ball preparations in higher proportion as compared to other additives such as paper and charcoal. The right proportion of these raw materials in seed ball preparations that could best support the germination of seeds and the growth of the seedlings must be studied in order to ensure success in its purpose, which is for reforestation and urban greening.

IV. CONCLUSIONS AND RECOMMENDATIONS

Seed balls at different mixtures of clay, cow manure, paper, wood charcoal, and sunflower seeds supported seed germination and growth of seedlings. The number of germinating sunflower seeds, however, was initially highest in seed ball mixture with 3 parts clay, 3 parts shredded paper, 2 parts manure, 1 part sunflower seeds (Treatment 2). Germination of sunflower seeds in seed ball mixture of 5 parts clay, 3 parts manure, 1 part sunflower seeds (Treatment 1) also increased on the third day similar to Treatment 2. The seed ball mixture of 3 parts clay, 3 parts charcoal, 2 parts manure, 1 part sunflower seeds (Treatment 3) allowed germination of the least number of seeds.

The number of two-leaf seedlings on the sixth to eighth day after sowing was highest in seed balls with 5 parts clay, 3 parts manure, 1 part sunflower seeds as compared to those with shredded paper and wood charcoal. Similarly, the number of four-leaf seedlings from the ninth to twelfth day after sowing was also highest in clay, manure, and seed mixture. With these results, the best growth medium for seed germination and seedling development was the 5 parts clay, 3 parts manure, 1 part sunflower seeds combination.

ACKNOWLEDGMENTS

To the organizers of the 1st International Conference of Environment and Forest Conservation (ICEFC) and to the Editorial Staff

of the ASEAN Journal of Science and Technology (AJOST) for the opportunity afforded the authors to share this research. To both the Mindanao State University, Marawi City and Tambo Central School, Iligan City, for allowing the conduct of this research. And to our ever-supportive family and mentors, our sincere gratitude.

REFERENCES

- [1] Seedballs Kenya. September 2016.
<http://www.seedballskenya.com>. Accessed on July 8, 2018.
- [2] Schreiber, Andrew. 2014. Making Seedballs: An Ancient Method of No-Till Agriculture. Accessed on July 8, 2018.
- [3] Rindels, Sherry. Successful Seed Germination. Iowa State University. Horticulture and Home Pest News. <https://hortnews.extension.iastate.edu/1996/seed.html>. Accessed 23 September 2018.