Feedback Loops Support the Integral Role of Nurseries in the Reforestation Pipeline

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Abstract

Often overlooked, reforestation nurseries are now in the spotlight to meet increasing demands for tree planting. Improved efficiencies and expanded capacities are needed to meet increased seedling demand for the next decade and beyond. As an integral part of the reforestation pipeline, nurseries must coordinate their efforts with all other phases of the pipeline. Feedback loops to optimize seedling success are critical. First, nurseries must work closely with seed suppliers to maximize seed-use efficiency. Second, nurseries must focus within to address labor shortages by directing resources toward attracting and maintaining a skilled and effective workforce. Finally, nurseries must work with land managers to evaluate existing and new technologies to produce high-quality seedlings that will perform well in the field. The Target Plant Concept provides a continuous improvement framework to guide the feedback loops among seed, nursery, and field professionals. This paper was presented at The Reforestation Pipeline in the Western United States–Joint Annual Meeting of the Western Forest and Conservation Nursery Association, the Intertribal Nursery Council, and the Intermountain Container Seedling Growers Association (Missoula, MT, September 27–29, 2022).

Introduction

In a landmark paper evaluating the current status of reforestation and restoration, Fargione et al. (2021) underscored the need to fund, support, and expand all aspects of the reforestation pipeline, including seed collection, seedling production, workforce development, and pre- and post-planting practices to meet increased replanting goals. Nurseries form an integral part of the pipeline and are a focus of recently approved congressional funding via the Repairing Existing Public Land by Adding Necessary Trees (REPLANT) Act and executive funding through the Bipartisan Infrastructure Law (U.S. Department of Agriculture 2022). The legislation provides substantial funding to support reforestation efforts. Such resources occur perhaps once in a generation (Brown 2022). This funding presents an opportunity to reexamine the role that nurseries play in the overall success of reforestation and restoration programs.

To best achieve increased seedling production efficiencies and capacity, nursery professionals should visualize their role in the pipeline not as a straight line where production starts and ends at the nursery gate but rather as a series of feedback loops (figure 1). This article describes interactions and feedback between nursery professionals and seed suppliers within the nursery workforce itself and with land managers involved in outplanting and post-planting activities. Close collaboration regarding all aspects of the pipeline is required to meet the ambitious replanting goals set forth.

The Seed Supplier and Nursery Feedback Loop to Improve Seed-Use Efficiency

Seed is an increasingly valuable, and often limited, resource. Current retail value of the Washington Department of Natural Resources (WADNR) seed bank is approximately $9 million USD. This inventory has taken decades to develop through orchard breeding, woods-run collection, cone processing, seed cleaning and testing, and appropriate storage. The replacement cost is considerably higher than the current value (deGraan 2022).

In the vertically integrated reforestation program at WADNR, an inevitable tension exists between seed supplier and nursery manager. The seed supplier wants to maximize seed-use efficiency from each seed bank withdrawal. The nursery manager understands the value of seed but must also consider full occupancy of

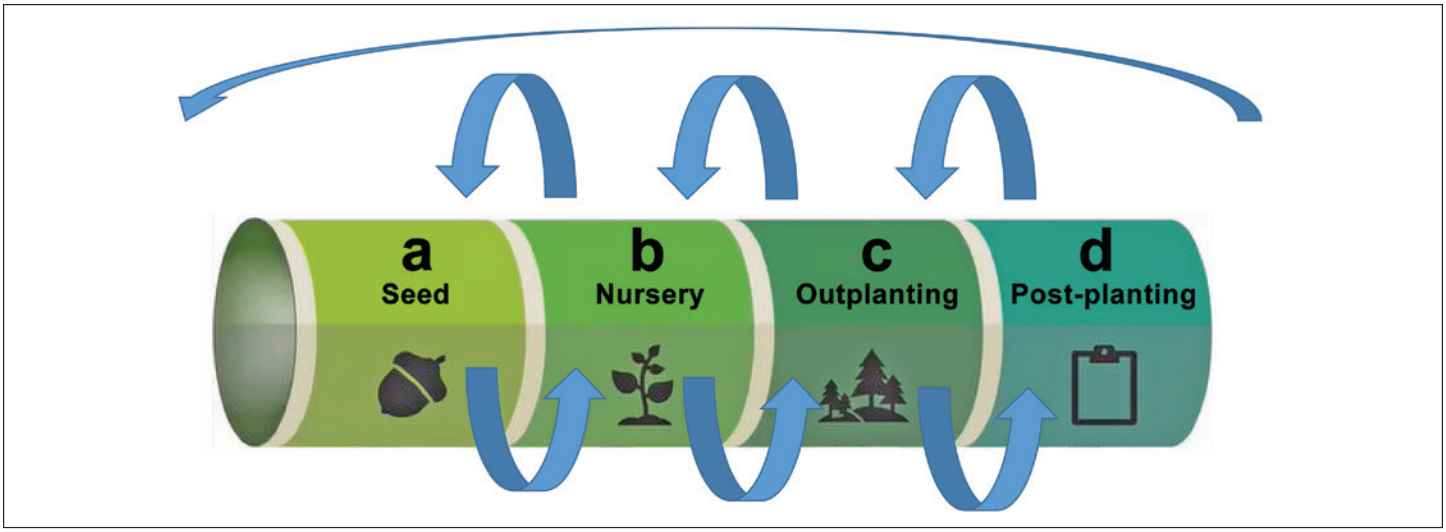


Figure 1. The reforestation pipeline can be thought of as a series of feedback loops for process improvement. This paper describes interactions of nursery professionals (a) with seed producers, (b) within the nursery workforce itself, and (c and d) with land managers involved in outplanting and post-planting activities. (Adapted from Fargione et al. 2021)

limited and expensive space in the facility. Ideally, a feedback loop exists between seed supplier and nursery manager (figure 2). The seed supplier strives to provide seed with high germination and purity, verified by regular retesting. The nursery requests an appropriate volume of seed and uses that seed efficiently. The end of the sowing season and completion of seedling packout provide opportunities for the nursery and seed supplier to review these efficiencies based on species or seed lot for future guidance. The following four sections describe scenarios where communication between nursery and seed supplier can improve seed-use efficiency.

Scenario #1: Only Low-Germination Capacity Seed Is Available

A grower considers several factors in determining how much seed to request. These factors include the germination capacity of the seed lot and associated confidence in that number based on age of the most recent germination test and past experience with the seed lot. When only seed with low germination capacity seed is available, a nursery will often over request to meet orders while reducing unused space. Growers typically request one additional seed per cell based on each 13-percent drop in germination

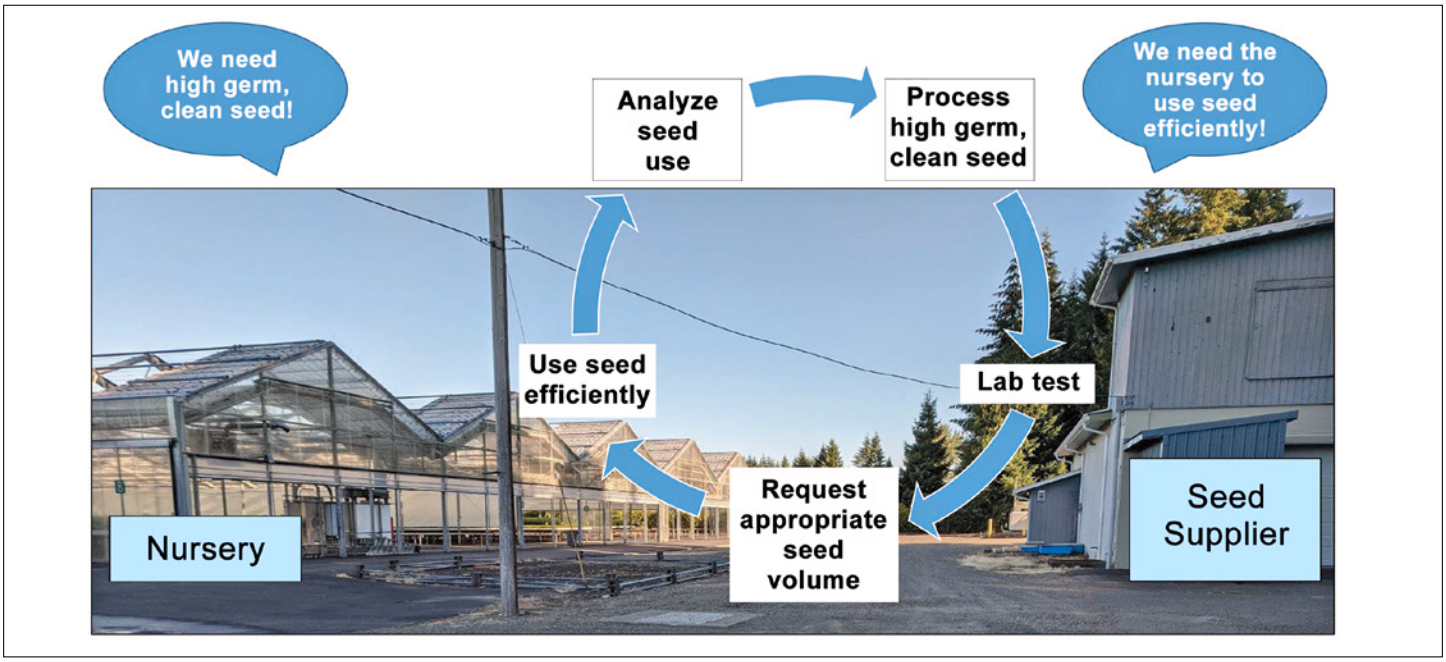


Figure 2. Clear and sustained feedback between the seed supplier and the nursery leads to improved seed-use efficiency. (Photo by Nabil Khadduri, 2022)

capacity to avoid empty cells and therefore unused greenhouse space (Kolotelo et al. 2001). For example, a grower may sow two seeds per cell of a lot with 90-percent germination capacity, increase that to three seeds per cell at 77-percent germination capacity, and double that to four seeds per cell if germination capacity is 64 percent. Since seed usage rapidly increases with decreasing germination capacity, a seed supplier/owner may conserve both labor and resources by taking steps to high grade low-germination or declining lots. Where high grading is not possible, a seed supplier can flag the lots in question for sowing in small containers, bareroot fields, or open compounds where space is less of a premium.

Scenario #2: Seed Is Only Available in Limited Supply or Is of Very High Value

In cases of limited and/or high-value seed, the seed supplier may suggest a contract between nursery and customer to cover the expense of single sowing. Nursery and customer should explore the following questions when determining the seed request: How valuable is the greenhouse space? What are the capabilities of the sowing equipment to conserve seed? How confident is the grower in meeting yield targets based on their skill, the species being grown, and the seed lot history?

Yield targets are typically 110 to 125 percent of the order amount to account for falldown during the growing process and still fulfill 100 percent of the order. Typically, 10 to 25 percent is the minimum oversow, but this will increase based on expected empty cells which, by definition, will not produce a viable seedling. To account for additional empty cells based on single sowing, communication and planning between seed supplier, nursery, and customer can conserve these seed lots.

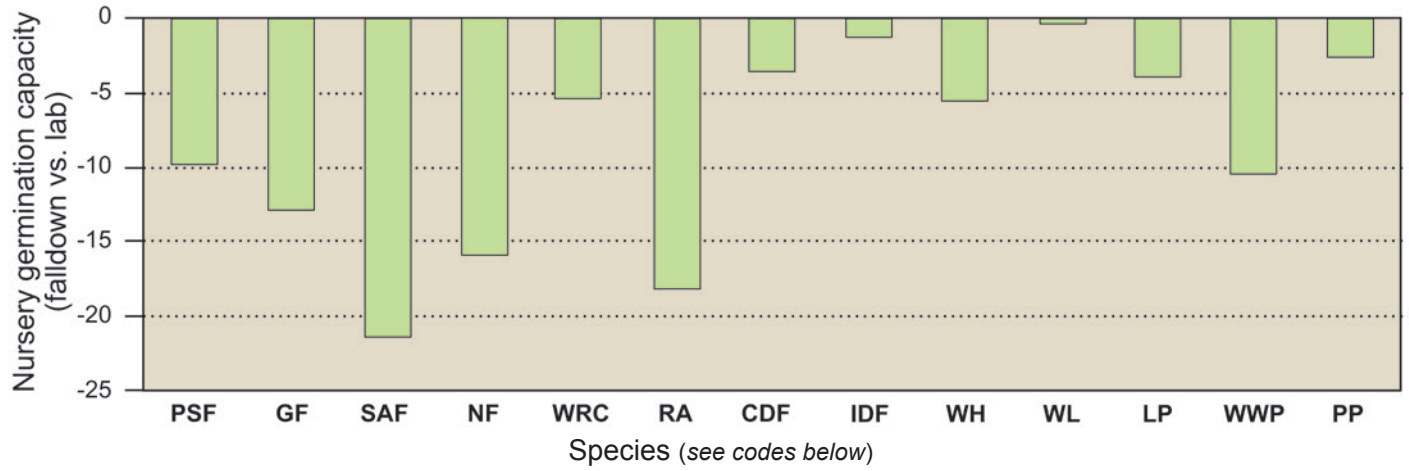
Scenario #3: Discrepancies Exist Between Seed-Supplier Germination Capacity Tests and Actual Germination in the Nursery

Lab data and actual greenhouse germination capacity can differ for various reasons. The lab is a controlled environment with standard germination conditions of 8-h light/16-h dark intervals at 30 °C (86 °F)/20 °C (68 °F), respectively. Labs standardize testing for year-to-year internal comparisons as well as comparisons across labs. The only pathogens present in the lab test will be seedborne in nature. Lab germination for most species is defined as extension of the radicle four times the length of the seed coat. Tests are replicated with 4 samples of 100 seeds evaluated to capture some measure of variability from test to test (ISTA 2022).

While greenhouses offer more control than bareroot environments, fully automated structures can still only be considered semi-controlled environments. Invariably, even the most advanced greenhouses will experience more variation in temperature and moisture compared with a lab setting. In addition to seedborne pathogens, other pressures may arise in the nursery. Despite best efforts to maintain a clean environment, additional pathogens from hard surfaces such as floors, walls, containers, equipment, and soil or growing media can infect seeds. Additionally, seed predation by animals, particularly birds, can occur. A grower defines germination much further along in the developmental stage than the lab test: when the seedling has fully emerged above the soil or growing medium. Additional time to reach the definition of nursery germination means additional opportunities for pathogens and pests to affect germination. Further delay of greenhouse germination can occur due to inconsistencies in top dressing, particularly excessive application over the seed. Finally, nursery germination tracking tends to involve smaller sample sizes than lab evaluations or does not use replication to account for variability.

Germination capacity across several western Canada and Pacific Northwest species shows that true firs (*Abies* Mill.), red alder (*Alnus rubra* Bong.), and western white pine (*Pinus monticola* Douglas ex D. Don) stand out as particularly susceptible to nursery germination capacity falldown compared with lab tests (figure 3) (Kolotelo 2021).

Fortunately, there are several seed treatments that a grower can use to close the gap between lab and nursery germination performance. Nurseries apply seed sanitation to reduce fungal pathogen loads on the seed. Growers can also manage moisture content after seed imbibition by surface drying seeds so that the necessary moisture to release dormancy is on the inside of the seed, rather than on the outside of the seed where it might lead to pathogen buildup. Surface drying seed allows the grower to extend stratification beyond general lab prescriptions. Operational germination



Species	Common name	Scientific name
PSF	Pacific silver fir	*Abies amabilis* (Douglas ex Loudon) Douglas ex Forbes
GF	Grand fir	*Abies grandis* (Douglas ex D. Don) Lindl.
SAF	Subalpine fir	*Abies lasiocarpa* (Hook.) Nutt.
NF	Noble fir	*Abies procera* Rehder
WRC	Western redcedar	*Thuja plicata* Donn ex D. Don
RA	Red alder	*Alnus rubra* Bong.
CDF	Coastal Douglas-fir	*Pseudotsuga menziesii* (Mirb.) Franco
IDF	Interior Douglas-fir	*Pseudotsuga menziesii* (Mirb.) Franco var. *glauca* (Beissn.)
WH	Western hemlock	*Tsuga heterophylla* (Raf.) Sarg.
WL	Western larch	*Larix occidentalis* Nutt.
LP	Lodgepole pine	*Pinus contorta* Douglas ex Loudon
WWP	Western white pine	*Pinus monticola* Douglas ex D. Don
PP	Ponderosa pine	*Pinus ponderosa* Lawson & C. Lawson var. *scopulorum* Engelm.

Figure 3. Discrepancies often occur in germination capacity between the lab and nursery for several western Canada and Pacific Northwest species. Data from British Columbia Ministry of Forests Tree Seed Centre and cooperating nurseries, 2015–2020 (Kolotelo 2021).

temperatures are generally lower and more variable than lab temperatures. Extending stratification releases seed dormancy more completely and allows seed lots to uniformly approach full germination capacity despite varied environmental conditions. In some cases, delayed dryback or "surface wet-surface dry" stratification is appropriate, such as with many true firs and western white pine. In this case, seeds may be kept in a surface-wet condition for the first 4 weeks of chilling, followed by surface drying to reduce the risk of pathogen development during the remaining weeks to months of stratification. Differences in seed weight between live and dead seed at this midpoint of stratification or at the end of stratification also present an opportunity to high grade seed.

Growers often maintain relatively warm greenhouse temperatures during germination to shorten the time to germination. Accelerating germination with heat produces a uniform crop while also reducing exposure to pathogen attack and animal predation but comes at an energy cost. To reduce this cost, some growers use a thermal priming technique by prewarming seed in a smaller space that is cheaper to heat while still providing adequate heat units to accelerate germination. For more in-depth descriptions of the above techniques, see Khadduri (2021).

In practice, most growers extend stratification beyond a standard lab prescription (figure 4). Depending on species, many growers will use a delayed dryback during stratification, and a smaller percentage use mid-stratification high grading and thermal priming to improve seed performance. Ultimately, detailed and sustained germination feedback between seed supplier and nursery facilitates the justification of additional resources needed to carry out the treatments described above.

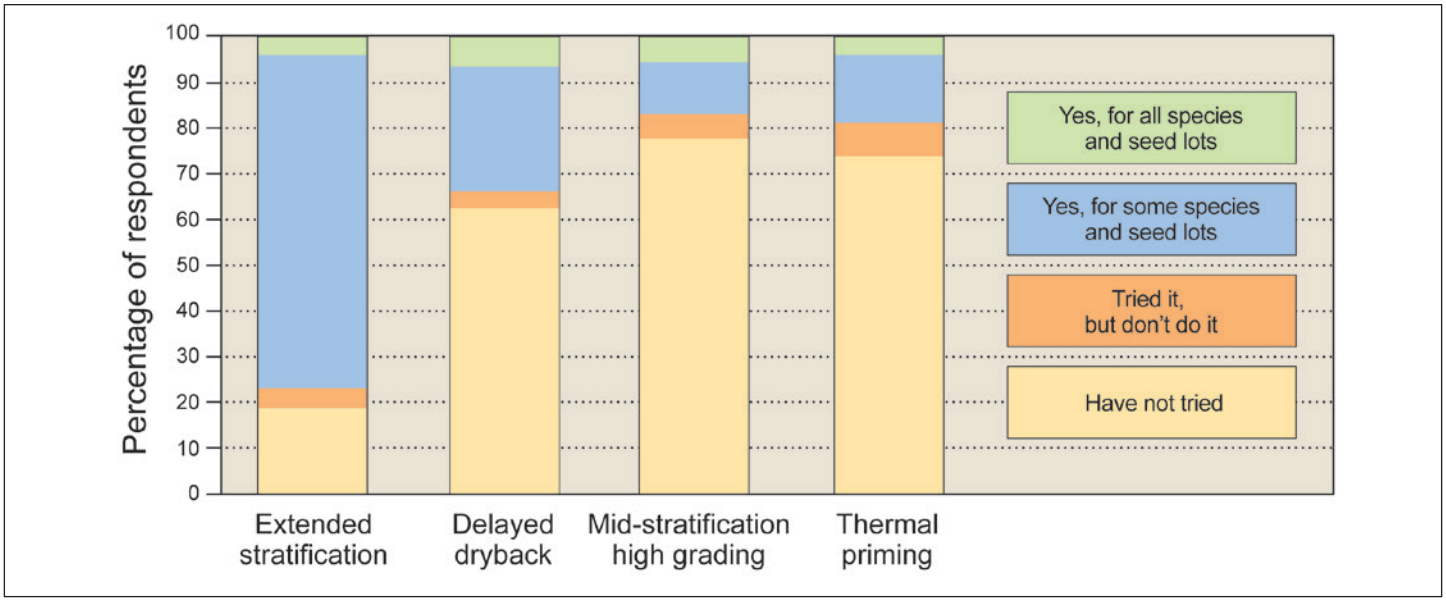


Figure 4. Respondents from the United States and Canada (n = 59) practice various seed germination techniques as surveyed in a 2020 live webinar poll (Khadduri, 2021).

Scenario #4: Sowing Equipment Value is Not in Line With Seed Value

Feedback between the seed and nursery programs within WADNR identified upgrades to sowing equipment as a critical priority to increase overall seed-use efficiency. With the increasing cost of seed and occasional seed scarcity, the latest automated seeders allow for more precise placement and distribution of seeds in containers in addition to increased speed (figure 5). While expensive, needle and vacuum sowers are particularly useful in fractional sowing. For example, advanced seeders can sow an average of 1.5 seeds per cell by evenly distributing cells with 1 or 2 seeds, saving considerable seed in the process.

Investing in modern sowing equipment can quickly pay for itself as the value of seed increases. This investment comes with two caveats for success. First, a nursery must communicate to the seed supplier that clean, high-purity seed is particularly important with automated seeders as machines will sow whatever material is in front of them (figure 6). Second,

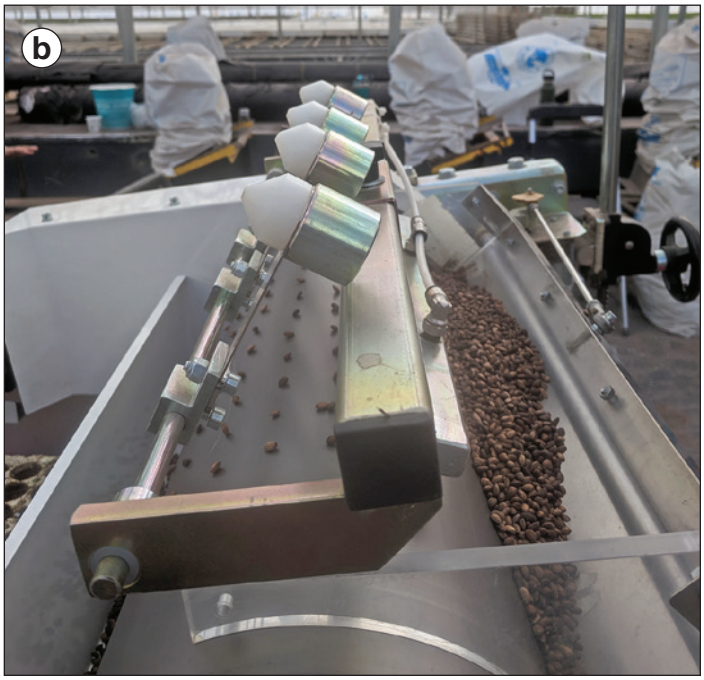


Figure 5. Automated seeders, such as (a) the vacuum needle seeder and (b) the vacuum drum seeder, speed up sowing and increase sowing accuracy. While expensive, increased time savings and seed-use efficiency will quickly recoup costs. (Photos by Nabil Khadduri, 2022)

Figure 6. Clean, high-purity seed is important for automated sowing to ensure all cells are filled. Additional cleaning steps may be needed, such as pitch separation, to prevent equipment clogging. (Photo by Nabil Khadduri, 2021)

automated equipment will only be effective with a skilled and experienced operator who is able to finesse the machine to accomplish sowing objectives.

The Nursery Workforce Feedback Loop to Recruit and Retain Nursery Staff

Recruiting and maintaining a skilled workforce is increasingly challenging in many industries, and the reforestation community is no exception. Within WADNR, and anecdotally across many other forestry organizations, an "even-aged stand" retirement has occurred. Driven in part by the extraordinary events of 2020, organizations already weighted towards an older workforce experienced many people retiring within a 1- or 2-year period. Additionally, employment opportunities within and outside the reforestation community have led to increased shifts in the workforce.

To build and maintain a skilled workforce, the reforestation community must consider three strategies. First, increase pay to keep up with the rising tide of salaries and inflation. Second, identify and invest in young talent through competitive internship programs that pay a reasonable salary and provide a housing stipend where appropriate. Third, reward and retain existing employees through continuing education and promotion opportunities.

Money Talks: Recruiting Through Pay

Many people gravitate to the reforestation industry because they enjoy the tangible results of hard work in the outdoors and feel good about contributing to environmental well-being. Nevertheless, employees also pursue salary and benefits. Positions must be competitive both within and outside the industry. Inflation has increased by 29 percent during the last 10 years (U.S. Bureau of Labor and Statistics 2022) (figure 7). The average cost of a seedling at the

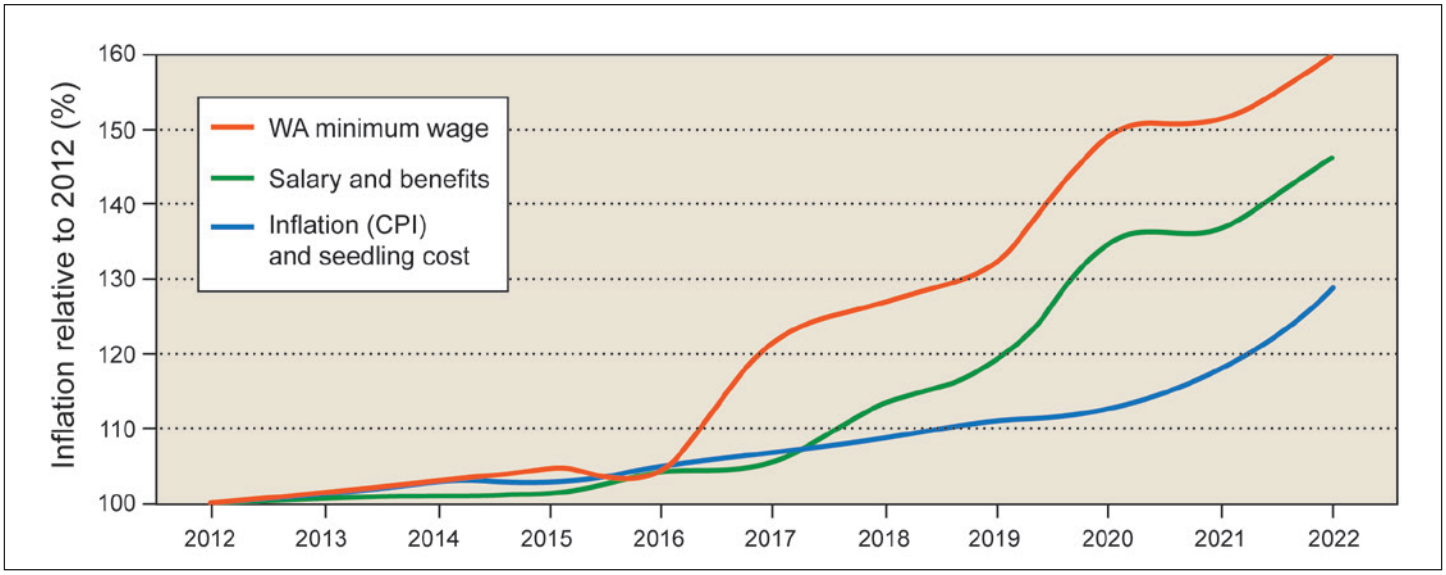


Figure 7. At the WADNR Webster Nursery, seedling prices have risen with inflation (Consumer Price Index [CPI]) over the past 10 years. Nursery salary and benefits have risen comparatively faster, especially over the past 5 years. This increase is driven in part by a steady increase in the Washington State (WA) minimum salary wage.

WADNR Webster Nursery increased by 31 percent in the same time period, roughly keeping pace with inflation. To attract and retain staff during that time, salary and benefits increased by 46 percent (figure 7). This increase may be due in part to upward pressure resulting from a 61-percent increase in Washington State's minimum wage. The University of Idaho Pitkin Nursery, which operates in a different minimum wage structure, has increased salary and benefits 20 percent in the past 5 years to attract and retain employees (Nelson 2022). Ultimately, the increased discrepancy between nursery salary and benefits and current seedling prices means price hikes are unavoidable to keep nurseries solvent.

Recruiting Students Through Competitive Internship Programs

Recent retirements have emphasized the need for the reforestation industry to focus on building a pipeline of people. In a 2020 survey, workforce was identified as the top limiting factor to nursery production and expansion (Fargione et al. 2021). Only certain individuals in certain circumstances can afford unpaid internships and volunteer opportunities. These positions, however, are often the only opportunities available to students interested in reforestation. Internship programs need to be competitive and able to cast as wide a net as possible by providing reasonable hourly rates and housing stipends where appropriate. In the case of WADNR, executive funds have been allocated recently to fund internship programs across a range of agency work groups, thereby reducing the financial burden on any one individual working group and enabling better student recruitment.

During a panel of AmericanHort Scholars at the Cultivate '22 conference (Columbus, OH), Dr. Melinda Knuth noted, "The younger generation in today's workforce will be loyal to their employer, but they expect their employer to build a positive work environment and help them reach their goals. If you don't give them the same amount of energy, they will quit. It's a partnership and they will be loyal to you" (Hullett 2022).

Internships operate as extended interviews, giving the employer and the intern an opportunity to evaluate each other. More than ever in today's competitive hiring market, such an upfront investment into future employees can help ensure effective recruitment and long-term retention.

Rewarding and Retaining Employees Through Continuing Education Opportunities

Providing continuing education opportunities shows employees that their employer cares about their professional development. Applied education rewards motivated employees and provides them a pathway to career advancement. Following is a curated list of continuing education resources for the nursery industry, with a focus on greenhouse-related education.

- **Reforestation, Nurseries, and Genetic Resources (RNGR) website**

  Maintained by the U.S. Department of Agriculture, Forest Service RNGR program, this clearinghouse website (https://rngr.net) is accessed throughout the world and includes an abundance of resources for reforestation professionals (Haase et al. 2011). Users can download or order nursery manuals, search by topic or author for articles from the database of nearly 12,000 articles (including all past issues of Tree Planters' Notes), and learn about upcoming events. In addition, the site includes specific information on seed technology, Tribal resources, and tropical reforestation.

- **University of Florida and Michigan State University extension courses**

  The University of Florida's Institute of Food and Agricultural Sciences offers several online greenhouse training courses (https://hort.ifas.ufl.edu/training). Each of these extension courses costs $250 USD and requires 3 to 4 hours per week in an on-demand format. Course topics include an introduction to greenhouses, pest management, irrigation, and nursery administration. Many of the courses use the Back Pocket Grower resource (https://www.backpocketgrower.org). The program has partnered with Michigan State University extension greenhouse courses to also offer a plant health certificate (https://www.canr.msu.edu/online-college-of-knowledge/index).

- **University of Idaho associate degree program in Forest Nursery Management and Technology**

  Starting in fall 2023, this 2-year program will offer a range of courses to prepare people for a career in forest nurseries (https://www.uidaho.edu/cnr/center-for-forest-nursery-and-seedling-research). The courses will cover topics in career development, growing media, pest management, nursery management, and nursery design. The goal is to eventually make several courses available as non-credit extension classes in a hybrid format.

- **Publications and online resources**

  Many scientific and trade magazines provide extension and industry-supported articles relevant to methods, technologies, and trends in reforestation. These include Greenhouse Grower (https://www.greenhousegrower.com/), Growertalks (https://www.growertalks.com/), and e-Gro (Electronic Growers Resources Online; https://www.e-gro.org/), which is specifically supported by extension horticulturalists.

  Also, *Water, Root Media, and Nutrient Management for Greenhouse Crops* (Merhaut et al. 2018) is an excellent manual authored by 17 extension and industry professionals with applied, up-to-date knowledge on important aspects of greenhouse growing.

The Nursery and Land Manager Feedback Loop to Evaluate Existing and New Seedling Production Techniques

The Target Plant Concept (figure 8) provides a continuous improvement framework in which nurseries work with field professionals to evaluate seedling stock type performance and identify opportunities for increased survival and rapid establishment (Dumroese et al. 2016). By partnering with the silviculturist or restoration specialist, the nursery professional can better understand the challenges faced on the landscape and what attributes will make a seedling most fit for specific sites and goals. Defining and refining target plants at the outplanting site improves reforestation success and helps the land manager and nursery grower to understand that seedling quality, not appearance, dictates success.

The Value of Outplanting Trials

A well-designed and executed outplanting trial (Haase 2014) will provide meaningful answers about which reforestation practices work and which need improvement (figure 9). Together, the nursery and reforestation professional target morphological and physiological characteristics that can be quantitatively linked to outplanting success on specific sites. Next, well-designed trials to compare stock types, seed lots, nurseries, planting dates, or other factors are established to evaluate survival and growth performance. Feedback from these trials can then be used to improve production or outplanting practices for the future.

Pinto et al. (2011) describe some of the dangers of poorly designed stock type trials. It is important to keep seedling quality, seed sources (genetics), originating nursery, density, and culturing regimes the same within a trial unless one of those factors is the treatment to be evaluated. Avoid conducting single-year analyses as performance may change from year to year due to environmental variability. Where possible, supplement morphological measurements

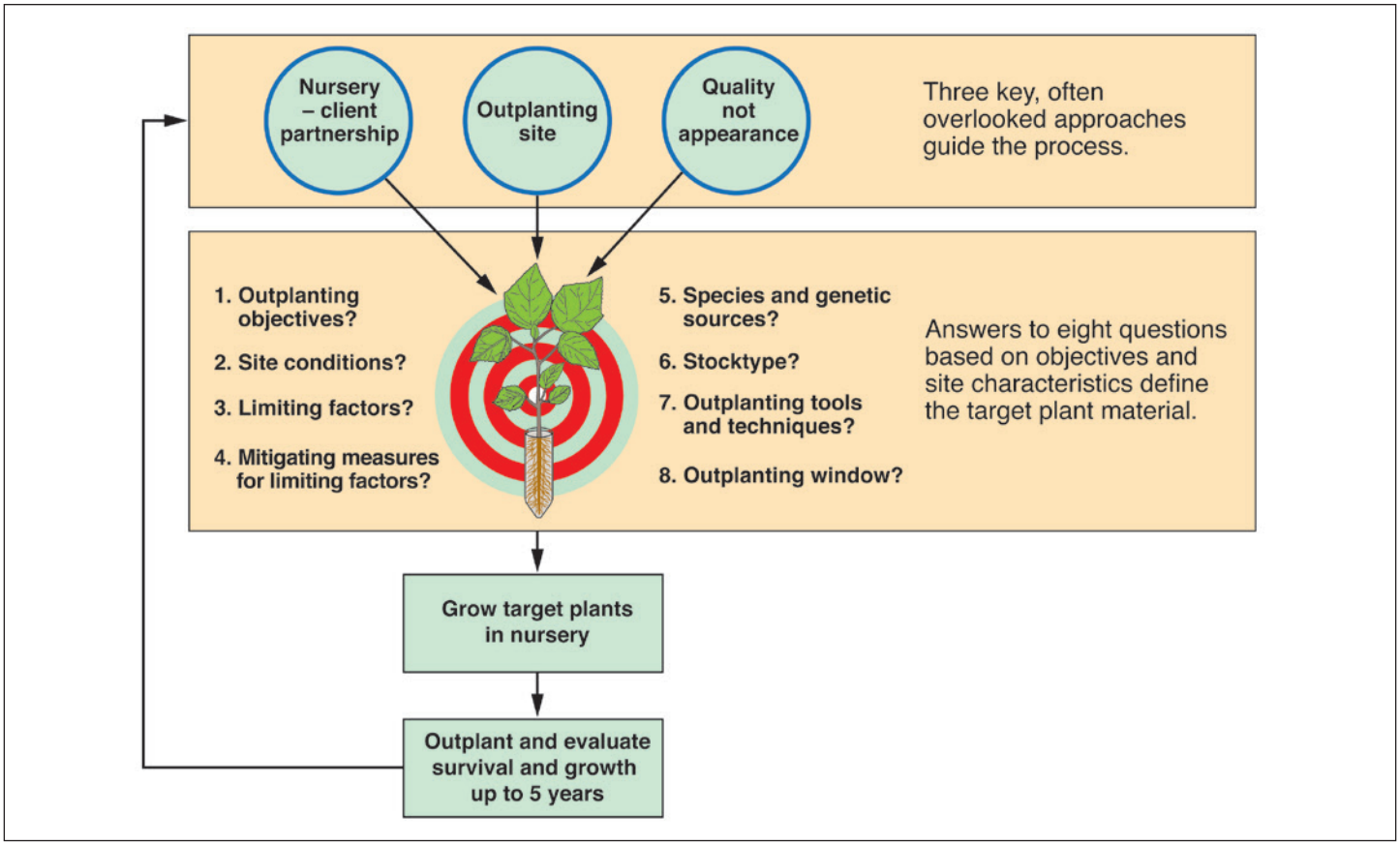


Figure 8. The Target Plant Concept is a holistic approach to reforestation that emphasizes communication between the nursery and land manager. This continuous improvement process identifies seedlings that are "fit for purpose" based on appropriate morphological and physiological characteristics matched to the outplanting site (from Dumroese et al. 2016).

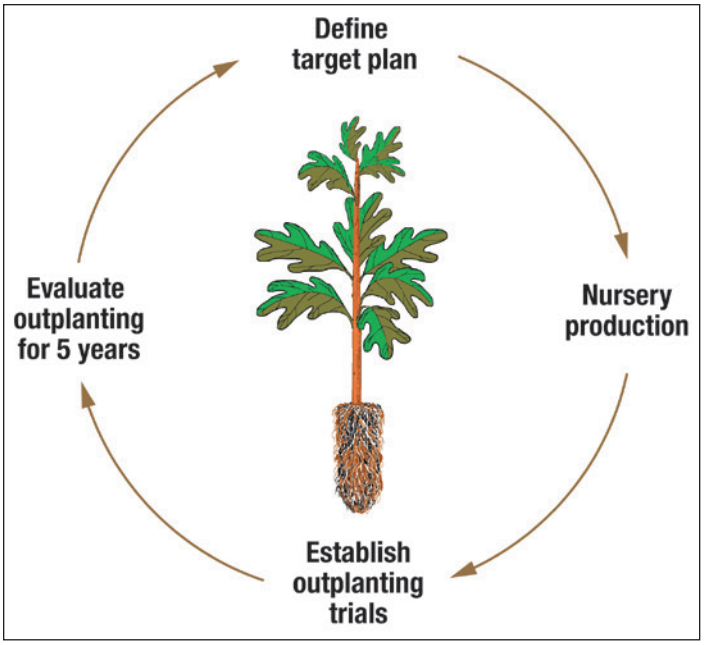


Figure 9. A well-designed and executed outplanting trial will provide meaningful answers to what works and what needs improvement (adapted from Pinto et al. 2011).

with physiological measurements to get a deeper understanding of differences that may or may not occur.

Conclusion

Nurseries are just one part of the reforestation pipeline, but their role is central to its success (Haase and Davis 2017). To operate efficiently, the pipeline should not be seen as a linear process consisting of separate parts with minimal interaction. Rather, feedback communication loops—between the seed supplier and the nursery, within the nursery itself, and between the nursery and the land manager—provide the best opportunity to refine and optimize the process. Forthcoming investments in nursery infrastructure are surely needed to meet increased seedling demands. In the end, lofty reforestation goals will only be met by also investing in people, including nursery staff eager to interact with, and learn from, other reforestation pipeline professionals.

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REFERENCES

Brown, A. 2022. Forestry leaders scramble to turn massive new funding into trees. Stateline. Pew Charitable Trusts. https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2022/10/05/forestry-leaders-scramble-to-turn-massive-new-funding-into-trees. (November 2022)

deGraan, J. 2022. Personal communication. Seed Program Manager, Washington Department of Natural Resources, Olympia, WA.

Dumroese, K.R.; Landis, T.D.; Pinto, J.R.; Haase, D.L.; Wilkinson, K.W.; Davis, A.S. 2016. Meeting forest restoration challenges: using the target plant concept. Reforesta. 1(1): 37–52. https://doi.org/10.21750/REFOR.1.03.3.

Fargione, J.; Haase, D.L.; Burney, O.T.; Kildisheva, O.A.; Edge, G.; Cook-Patton, S.C.; Chapman, T.; Rempel, A.; Hurteau, M.D.; Davis, K.T.; Dobrowski, S.; Enebak, S.; De La Torre, R.; Bhuta, A.A.R.; Cubbage, F.; Kittler, B.; Zhang, D.; Guldin, R.W. 2021. Challenges to the reforestation pipeline in the United States. Frontiers in Forests and Global Change. 4: 629198. https://doi.org/10.3389/ffgc.2021.629198.

Haase, D.L. 2014. Beyond cowboy science: simple methods for conducting credible and valid research. Tree Planters' Notes. 57(2): 32–43.

Haase, D.L.; Davis, A.S. 2017. Developing and supporting quality nursery facilities and staff are necessary to meet global forest and landscape restoration needs. Reforesta. 4: 69–93. https://doi.org/10.21750/REFOR.4.06.45.

Haase, D.L.; Pinto, J.R.; Dumroese, R.K.; Hernández, G.; Karrfalt, B.; Overton, R. 2011. RNGR: a national resource for reforestation, restoration, and nursery professionals. Tree Planters' Notes. 54(1): 28–34.

Hullett, J. 2022. Why the younger horticulture workforce views employment as a partnership. Greenhouse Grower. https://www.greenhousegrower.com/management/why-the-younger-horticulture-workforce-views-employment-as-a-partnership/. (November 2022)

International Seed Testing Association (ISTA). 2022. International rules for seed testing. https://www.seedtest.org/en/international-rules-for-seed-testing-rubric-3.html. (November 2022)

Khadduri, N. 2021. Seed preparation techniques to maximize germination of Pacific Northwest conifers. Tree Planters' Notes. 64(1): 47–61.

Kolotelo, D. 2021. Personal communication. Cone and Seed Improvement Officer, British Columbia Ministry of Forests Tree Improvement Branch, Surrey, BC.

Kolotelo, D.; Van Steenis, E.; Peterson, M.; Bennett, R.; Trotter, D.; Dennis, J. 2001. Seed handling guidebook. Vancouver, BC: British Columbia Ministry of Forests, Tree Improvement Branch. 106 p.

Landis, T.D. 2011. The target plant concept—a history and brief overview. In: Riley, L.E.; Haase, D.L.; Pinto, J.R., tech. coordinators. National proceedings: Forest and Conservation Nursery Associations—2010. Proc. RMRS-P-65. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 61–66.

Merhaut, D.; Williams, K.; Mangiafico, S., eds. 2018. Water, root media, and nutrient management for greenhouse crops. Publication 3551. Oakland, CA: University of California Agriculture and Natural Resource Publications. 330 p.

Nelson, A. 2022. Personal communication. Director, Pitkin Forest Nursery and Professor of Native Plant Regeneration, University of Idaho, Moscow, ID.

Pinto, J.R.; Dumroese, K.R.; Davis, A.S.; Landis, T.D. 2011. Conducting seedling stocktype trials: a new approach to an old question. Journal of Forestry. 109(5): 293–299.

U.S. Bureau of Labor and Statistics. 2022. The Consumer Price Index (CPI). https://www.bls.gov/cpi/. (September 2022)

U.S. Department of Agriculture. 2022. Biden-Harris administration announces plans for reforestation, climate adaptation, including new resources from Bipartisan Infrastructure Law. Press release. https://www.usda.gov/media/press-releases/2022/07/25/biden-harris-administration-announces-plans-reforestation-climate. (November 2022)