THE VALUE OF QUALITY SEED IN FOREST TREE NURSERY OPERATIONS AND REFORESTATION PROGRAMS

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INTRODUCTION

Seed quality, seed source, high quality planting stock; these are items at the top-of-the-list when nurserymen, geneticists, and silviculturists confer. We believe that all are well aware of the need to improve planting stock and constantly strive to achieve this in day-to-day operations. The prerequisites to improved planting stock are the obtaining, maintaining, and use of high quality seed in our nursery and forestation programs.

Seed quality is one of those familiar terms that we all understand but find difficult to define. Seed quality means different things to different people. The definition of seed quality is usually restricted to the physical and biological condition of the seed used in nursery operations (i.e., clean, sound seed that has high viability, and consistently produces thrifty, vigorous seedlings). As pointed out earlier, a primary requirement for regeneration of forest land is the use of planting stock from a seed source of proven adaptability to the planting site. In order to obtain maximum yields, seeds from each source must be planted in an environment to which it is best adapted. Thus seed source is also an important component of quality seed. In addition, we should be using genetically improved seed of known origin.

Thus, in-our definition, quality seed is seed that(l) has high viability, (2) is of high nursery performance, (3) is of known geographic origin, and (4) hopefully is genetically improved.

NURSERY SOWING FORMULA

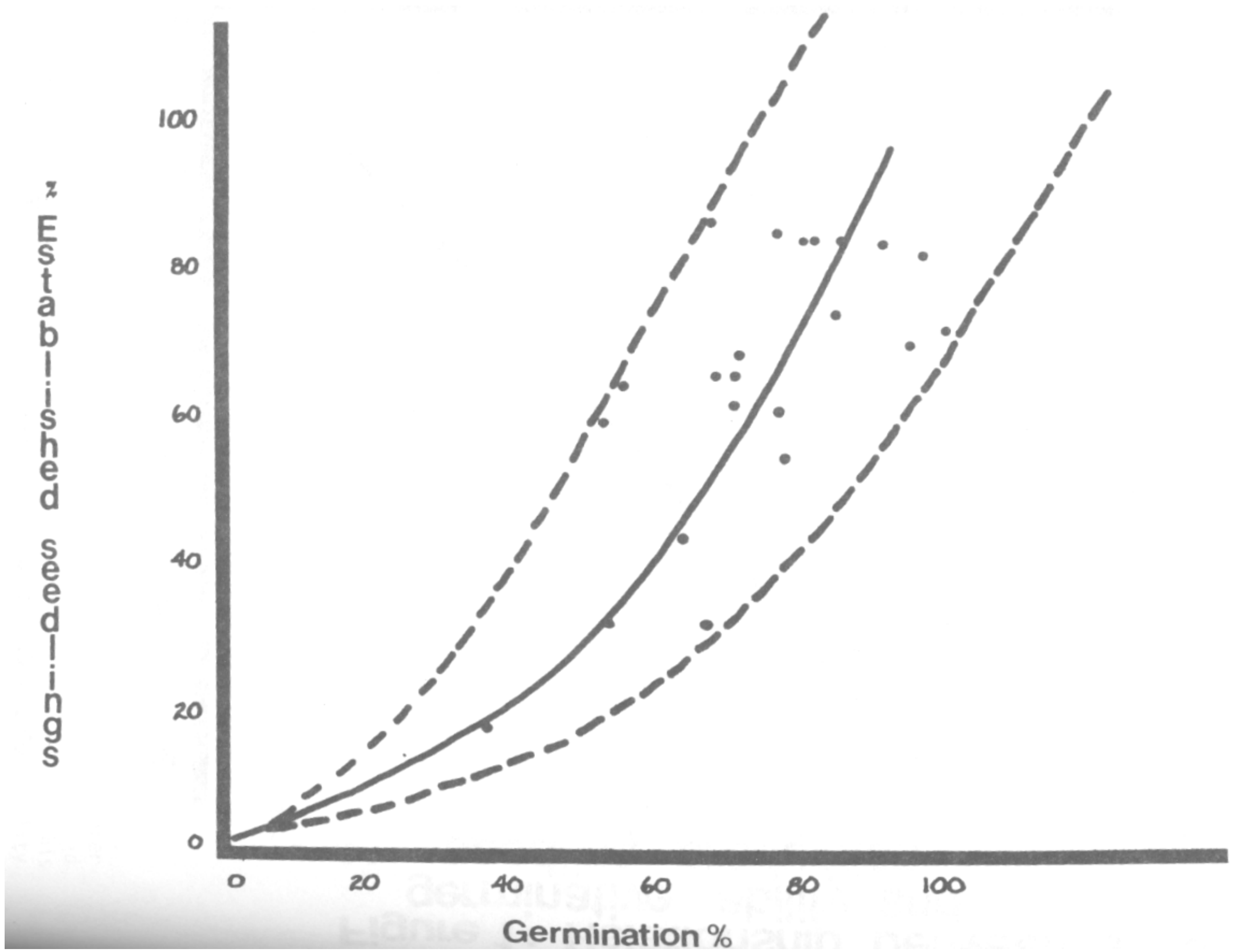
The first two components of our definition of seed quality are familiar to nurserymen in the algebraic equation called the sowing formula:

Seeds per Kg. x % Purity x % Germination x % Survival x % Cull =

Shippable Seedlings per Kg. of Seed

The nurseryman uses this equation to determine the amount of seed that will be needed to produce a given number of shippable seedlings. This sowing formula is a very practical *way* of expressing these components of seed quality. The equation is actually a series of quality discounts which adjust the number of seeds to reflect losses during seed processing and nursery growth. The equation consists of:

Figure 2: Germinative ability of seed lots as related to seedling establishment in a container nursery



It can also be seen that germination tests should not be used by themselves to determine seed quality. In Figure 2 there are seven seed lots ranging from 65-95;" germination which all produced approximately 30'. established seedlings.

SEED SOURCE AND GENETICALLY IMPROVED SEED

The last two components of our definition are not usually expressed or measured in standard nursery operation. Seedlings produced from high germination seed and under optimum nursery condition are essentially worthless without proper identification of seed origin. Quality with respect to seed origin is quantifiable by the use of provenance tests.

Genetically improved seed is also important in the definition of seed quality. Assuming that the first three components of seed quality are met there is an additional gain from using genetically improved seed in reforestation. Thus, high quality seed would be of high germination test, of proven nursery performance, be source identified, and hopefully genetically improved.

SEED QUALITY AND OPEPATIONAL COSTS

As with other commodities, quality incurs cost. The cost of seed quality can be separated into two phases, the cost of procuring improved seed and the cost of maintaining that seed through the reforestation process.

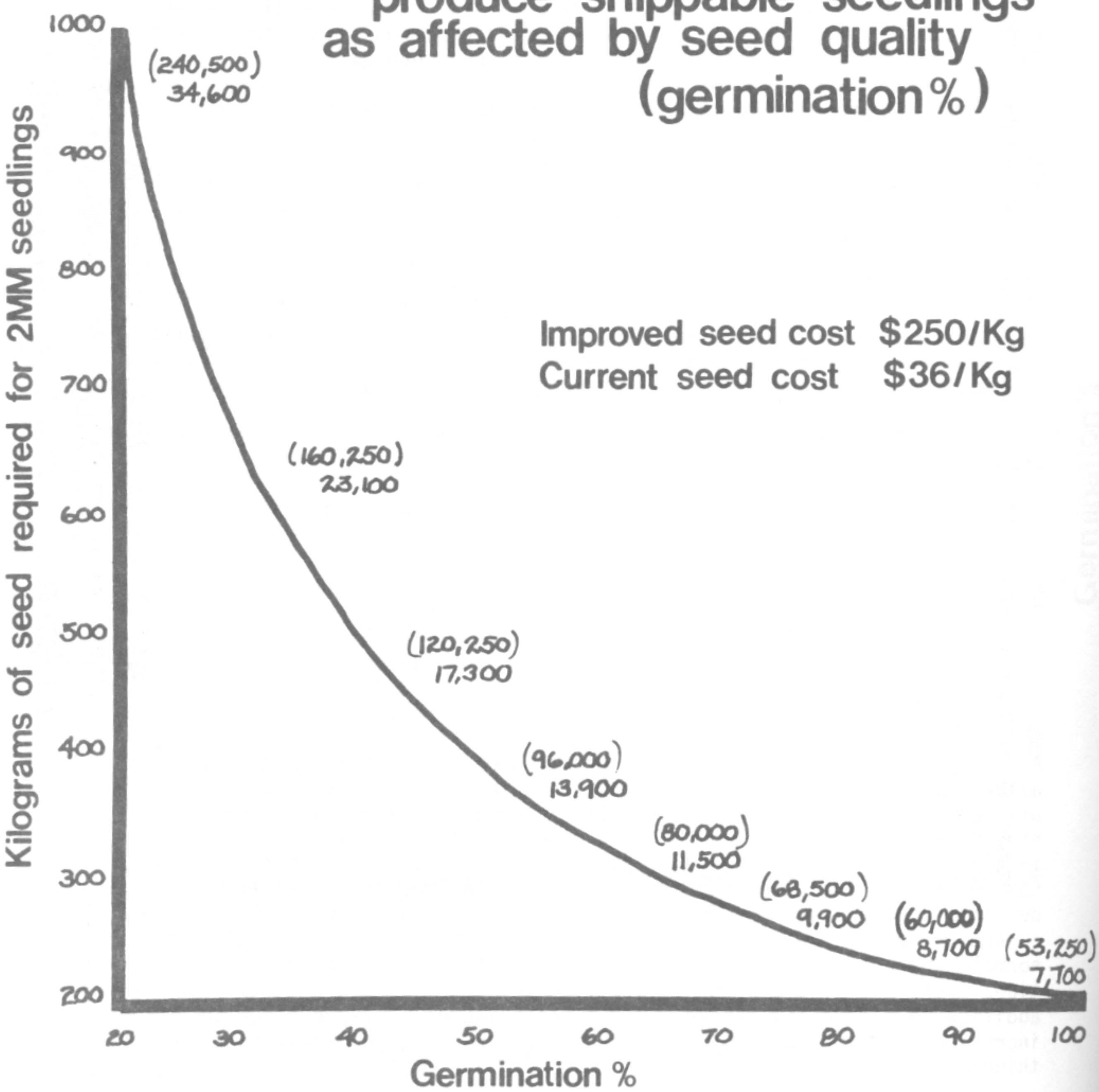
Average seed procurement costs this past year at Mt. Sopris Nursery are shown in Table 1.

Table 1. Seed Procurement Cost By Species, Mt. Sopris Nursery, 1977

Species	Cost $/Kg
Ponderosa pine	$35.75
Douglas-fir	46.45
Lodgepole pine	53.60
Engelmann spruce	60.75
White fir	71.45

An example of what can happen to seed procurement costs if seed quality is allowed to deteriorate in storage is found in Figure 3. Here the amount of seed required to produce two million shippable seedlings of ponderosa pine is shown along with corresponding seed cost at 102, incremental drops in germination. As can be seen, allowing germination to drop from 90% to 50%. nearly doubles the amount of seed needed to produce two million ponderosa pine. A drop from 90% to 20% would more than quadruple the amount of seed. Even though seedlots with less than 50% germination would not normally be used, the figure points out that there is a definite operational cost associated with not striving to maintain seed quality. In addition to seed costs, there would also be increased expense due to increased handling and sowing of the extra seed and presumably seedbed thinning.

Figure 3: Seed requirements to produce shippable seedlings as affected by seed quality (germination %)



Also, ii: is important to reflect on the cost. of seed in Table ! as re lated to Figure 3. The lower set of figures along the curve represent the current seed price for ponderosa pine ($36/Kg.). What if the seed were genetically improved seed from a seed orchard and the corresponding seed cost was $250 Kg or even higher, as represented by the figures in parenthesis? We believe the point has been made!

The following example is based on Mt. Sopris Nursery data and illustrates the effects of oversow factors on seed costs:

Next year Mt. Sopris will be producing 7.5 million seedlings and seed cost is $75,000 or $10/thousand seedlings. This amounts to approximately 10% of the cost of seedling production. Using the nursery sowing formula and with 70% germination, an oversow factor of 40%, is required to produce these 7.5 million trees. The cost of the oversow factor would add an extra $30,000 for seed or an additional $4/thousand seedlings.

While the previous example is based upon bareroot seedling production, seed quality costs are even greater in container nurseries as illustrated in Table 2.

Table 2. Effect of Seed Quality on Production Costs For One Million Engelmann spruce in a Container Nursery

	GERMINATIVE ABILITY		
	86%	(Difference)	38%
Seeds/Cavity	3	3	6
Seed Used	12 Kg	12 Kg	24 Kg
Seed Cost at $60/Kg	$720	$720	$1,440
Empty Cells	6%	28%	34%
Trees Produced	994M	334M	660M
Seed Cost/M	$0.72	$1.46	$2.18
Tree Revenue Produced at $200/M	$198,800	$66,800	$132,000

As can be seen in Table 2, the economic penalty of using lower quality seed can be considerable.

Price of seed is not the only cost incurred by the nursery. The use of seed of known origin and/or genetically improved means handling smaller seedlots and maintaining their integrity as they progress through the nursery to the field with resultant cost increases in cone handling, seed extraction, seed storage, seeding and the lifting, sorting, and transportation of the resultant seedlings.

MAINTENANCE OF SEED QUALITY

With the increased costs of obtaining and handling quality seed and seedlings, it is very important that in each nursery operational step precautions are taken to protect and maintain seed Quality. Losses in seed quality because of improper seed extraction or storage cannot be tolerated in forest nurseries. By the same token, field foresters should exhibit utmost care during cone collection, transport and storage as an unknown but significant loss in seed quality occurs before reaching the nursery. Seed lots should be used as soon as possible after extraction because they suffer a gradual loss of germinative energy over time.

SUMMARY

1. Seed quality is a function of seed viability, nursery performance, seed origin and genetic improvement.

2. Production of shippable seedling is directly correlated with seed germinative ability.

3. Germination tests should not be used as the sole determinant of seed quality.

4. The operational costs of seed quality are manifested not only in seed procurement but also throughout the reforestation process.