disease. It is possible to test imported seed for presence of the disease. Recognise that testing each seed is expensive and probably kills the embryo. It may only take one infected seed to introduce the disease!

Send seed of selected best strains of radiata pine for controlled testing to California. This would assist breeding programmes and the rapid deployment of resistant strains if the disease did become established.

Support ongoing research in the USA. Fortunately the USA is increasing its research efforts on the disease and this should allow a better understanding of factors controlling the diseases spread and development of control measures.

Continue or increase research on alternative back-up species to radiata pine.

Professor Bill Libby suggested that traditional tree breeding methods were likely to be best for developing resistant strains because susceptibility appears to be quantitatively (i.e.polygenetically) inherited. He was of the opinion that some of the newer biotechnology techniques such as marker-assisted selection and gene insertion or deletion may not assist greatly. However, tissue culture and embryogenesis would appear, to the author, as being helpful in that they could be used to multiply up resistant clones or lines of radiata pine.

Further information

For those needing further information the following are useful starting points:

Dick, M. 1998. Pitch pine canker – the threat to New Zealand. N.Z. Forestry 42 (4): 30-34.

http://frap.cdf.ca.gov./pitch_canker/pitchcan.html

Don Mead works as an independent silvicultural adviser.
E-mail address: don_mead@xtra.co.nz

Plantation establishment - QA indicator plots

A.R.D. Trewin

Introduction

In manufacturing, uniformity is the key to success. Any product that is not of uniform quality soon loses its appeal for the production of evenly sized trees for high volume recovery of quality wood. Unlike most manufacturing processes mistakes made during establishment of forests (early manufacturing stage) are not easily identified or rectified and prove very costly because of the long term nature of the investment (25 to 30 years for Radiata pine).

Therefore, quality assurance procedures that are effective in raising standards and revealing weaknesses in establishment operations are of considerable value.

Difficulty of identifying initial growth defects

Variations in, and quality of, soils, site, climate, tree stocks, site preparation and planting make it difficult to identify reasons for initial growth defects. Research trials show that weaknesses in any one facet of stock production or establishment procedures can adversely affect initial growth and in some cases significantly reduce final crop value.

Even if initial growth is good, uncontrollable high winds can have devastating effects on young stands, toppling being a major problem on exposed sites (Mason, E.G. and Trewin, A.R.D., 1987: Toppling of Radiata pine, NZFS, What's New in Forest Research No. 147.).

When there is no clear indication of why crops fail, responsibility falls on the forest manager to show that establishment prescriptions and quality control procedures were good. Investors, faced with financial loss, naturally question management efficiency and, if dissatisfied, claim compensation. When this happens, litigation is often protracted as expert witnesses, representing both parties, frequently disagree on reasons for failures. The need for a reliable method of gauging efficiency of forest establishment operations which can be used throughout the industry is therefore, apparent.

Indicator Plots

In the 1980s researchers planted "Indicator Plots" in forests throughout New Zealand to demonstrate the benefits of improved nursery lifting, packaging and handling practices (Trewin, A.R.D., 1978: Pine seedlings – handle with care. NZFS, What's New In Forest Research no. 69). The physical evidence of high survivals and vigorous growth in plots persuaded foresters to up-grade establishment procedures. Subsequently it was recommended that Indicator Plots, representing exact nursery and field prescriptions, be used by establishment personnel to check the efficiency of production plantings (Trewin & van Dorsser, 1985, The Integration of Manual and Mechanical Operations Involved in Raising and Planting Bare-root seedlings of Radiata Pine in New Zealand).

One forester using Indicator Plots reported:

"When actual operational establishment of Radiata pine is compared side-by-side with potential (ideal) implementation of our prescription techniques for lifting, dispatch, and planting, it is found that first year growth of seedlings established on an operational basis fall short of potential. Loss of potential growth amounts to 2.8mm in diameter (21% of potential), 15cm in height (18% of potential and 44% of potential bulk growth). Survival is also down to 92% of potential survivals."

The following year, improvements in nursery culling and handling of stocks raised survivals from 92% to 99% with associated improvements in growth uniformity matching that of Indicator Plots.

QA Indicator Plots – a gauge of efficiency

A number of forestry managers in New Zealand and Australia now use QA Indicator Plots to check the quality of production plantings. As a preliminary quality control measure they have a consultant check stock specifications in supply nurseries before placing orders. Once planting starts the consultant visits the field samples stock to ensure

that it meets the specified criteria and supervises planting to specification in Quality Assurance Indicator Plots.

Should subsequent growth in surround production plantings mirror that of QA Indicator Plots then supervision quality, regardless of whether growth deficiencies occur, can be deemed efficient. Where defects are only found in production plantings then these can be attributed to inadequate supervision and inefficient quality control procedures.

QA checks of help

QA Indicator Plots are also used to compare and check growth performance of tree stocks from different nurseries. Unless direct comparisons are made between production planted stock and a control, it is not easy to identify defects. Control stock should be purchased from a certified source such as the NZ Forest Research Institute. If the standard production planted stock perform poorly then the fault can be traced to stock quality, thus eliminating an important variable. In several instances claims against nurseries whose stocks have failed have only been successful because comparisons with other stocks, growing vigorous alongside, have been possible.

Establishment of QA Indicator Plot

To eliminate any possible local bias it is important that QA Indicator Plots are established and procedures recorded, with photographic illustrations, by an independent consultant who must also note any perceived weakness in prescriptions. Plots should be clearly marked with stakes at four corners, their position recorded on site plans and, with the consultant's report, filed in stand records for future reference. To ensure good coverage for assessments 2 plots of 60 trees are established for every 20 hectares planted, one on an exposed and the other on a sheltered site. Plots comprise five adjacent permanent rows of 10 trees, at production planting spacings, with two additional short rows of 5 trees, between the permanent rows 1 & 2 the 4 & 5. The short-row trees are for destructive sampling and photographing as a permanent record of root development at 3, 6 and 12 months after planting. At the same times foliage health is assessed (Ref. Appendices 1a & 1b). A better understanding of foliage and root development in local soils and the effectiveness of planting techniques, in relation to anchorage and wind-firmness, is then gained.

Regular Inspections of QA and Production Planting Indicator Plots

Staff members should check QA Indicator Plots and surround production plantings whenever they visit new plantings and report any growth deficiencies. To maintain an accurate record of initial survival and growth quality and for early detection of health problems it is essential that the 3, 6 and 12 monthly visual health assessments (Appendices 1a & 1b.) are on time. At the same times as QA Indicator Plots are assessed, growth in production planting (PP) plots, 50 tree plots (5 x 10 rows), one either side but not adjoining QA plots, must be staked out and assessed. Any initial growth or health problems in or between QA and PP Indicator Plots can then be recorded and investigated.

Indicator Plots – an aid to Nursery Managers

Private nursery managers have an unenviable task. To survive they have to speculate on future orders and compete with larger company nurseries who may have excess stocks to offer. If planting programmes decrease there is often a stock glut, as in the current 1999 season. Customers can then bargain and insist on very high specifications. When plantings increase, stock shortages occur and grower-customer roles are reversed.

To establish good communication with customers and as assurance of quality, nurserymen should accompany the first delivery of stock to major clients and, with customers, sample and plant an Indicator Plot. Both parties can then be satisfied that everything is to specification. Nursery managers will have demonstrated commitment to supplying a quality product and gain first-hand knowledge of planting sites. To promote their product nurserymen should also consider offering prospective customers a free Indicator Plot sampling of their stock.

Standard Management checks

Establishment managers and supervisors, during regular inspections of planting, should personally check stock quality, planting technique and supervise the establishment of Indicator Plots as a quality assurance procedure. There need to little disruption of normal plantings. A planter is randomly selected for the job and his/her tree stocks first checked to see that they meet specification; roots moist and trimmed short to 8mm, with a good covering of soil and mycorrhizae etc .... Planting technique is also checked to see that cultivation is good, roots are positioned at the prescribed depth, straight and properly firmed-in. The planting of all trees in the Indicator Plot is then carefully supervised to ensure that everything is to prescription.

Conclusion

There is an old saying that successful establishment foresters do not stay long enough in one place to allow their mistakes to catch up with them. In the past land assigned to forestry was usually of low value, isolated, steep and exposed, where soils and growing conditions were poor. Failures due to low fertility, animal damage and adverse climatic conditions were common and high initial stockings needed to guarantee sufficient trees for final crop selection. Currently more fertile valuable land is planted with low stockings of high cost genetically improved tree stocks. Because of high establishment and tending costs and the long term nature of forestry investment initial growth defects, uneven growth and toppling etc., prove very costly.

A Standard Quality Assurance system needed

A standard assessment of establishment quality would be of great benefit to the forest industry. QA Indicator Plots go a long way to fulfilling this need. It is recommended that forest enterprises, not already using QA Indicator Plots, make provision in plantation establishment estimates for their establishment. Investors who rely on the expertise of foresters will then have a reliable gauge of management efficiency and assurance of quality plantings.