A Decision Support Tool for Seed Mixture Calculations

B. P. Berg
Alberta Agriculture, Food and Rural Development, Canada

G. Hutton
Alberta Agriculture, Food and Rural Development, Canada

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A decision support tool for seed mixture calculations

B.P. Berg and G. Hutton
Alberta Agriculture, Food and Rural Development, Agriculture Center, Lethbridge, Alberta, Canada, T1J 4V6
Email: bjorn.berg@gov.ab.ca

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Introduction Grassland species are normally seeded in mixtures rather than monocultures. In theory, seeding rates for mixtures are simply a sum of the amount of pure live seed (PLS) of each seed lot in the mix, an amount sufficient to ensure establishment and survival of each species. Mixtures can be complex because of the number of species used (especially in conservation and reclamation programs) and variations in seed purity and seed size. Soil limitations and seeding equipment settings need to be considered and in Canada, a metric conversion may be required. All these conditions make by-hand calculations of mixtures containing more than 3 species tedious and complicated. Thus, in practice, agronomists and growers use simple rules to set rates. The easiest rule is to estimate the mixture's components as a percentage by weight of a standardized total weight of the seed required (e.g. 10% of 10 kg/ha). The resulting errors can be observed in the predominance of thin stands, the unexpected dominance of small seeded species and the added costs of interseeding to compete with weeds and fertilizer to increase yield. The objective of this project was to develop a decision support tool, a seed mixture calculator to simplify conversion and improve the estimates of seed required for individual seeding projects.

Materials and methods Initial programming was done using Lotus 1-2-3®. Input data (such as seed density and purity) were entered step-wise in a standard array of interim calculations and results. In 2004 the program was converted to Microsoft Excel®. Toggle buttons were introduced to make unit conversions, and list boxes were used to limit the selection of species so that reference information could be placed in uniform tables. The old linear spreadsheet solution was rewritten and Microsoft VBA® subroutines were installed to handle input errors and manage tabular data as arrays. Thus, tables could be edited without changing the new programming solution and vice versa. The final version was exported to Java® as an interactive calculator on an Internet website.

Results A user of the original Lotus 1-2-3® program would follow customary practice and first choose a maximum seeding rate for bulk seed (MBR). This made economic sense because the user could compare project costs simply by multiplying the MBR by the bulk seed price. However, the linear programming solution that divided each species in the mix into its relative proportions was convoluted and overly complicated. More critically, if the user underestimated the MBR, (for example by using a MBR appropriate to a monoculture) the amount of seed of each species in the mixture (calculated as a proportion of the MBR) would be inadequate. Field experience suggests the MBR for mixtures of large seeded species should be much higher than for monocultures (S. Acharya, 1997, pers. comm.) and could be considerably lower for small seeded species or high quality seed. Low seeding rates impacted establishment and reduced yields for 2 years after seeding in the semiarid climate on the Canadian prairie (Leyshon *et. al.* 1981). Biodiverse mixtures should add stability to the stand but may be less stable than a comparable monoculture if important components in the mix fail to establish.

In the new Microsoft Excel® and Java® versions, the user manipulates the maximum PLS rates (MPR) for either broadcast or row seeding systems. Using MPR refocuses the solution onto issues about seed quality rather than the bulk seed cost. In fact, basing the new model on PLS makes it easier to compare and justify seed costs, refine mixtures and compare substitute cultivars. MBR is not ignored, just calculated in a different fashion. The model's output summarizes the amount of bulk seed required from each seed lot to achieve the MPR, calculates the MBR and gives the required seeding density on the ground (for seeder calibration) for each species. The model is also interactive because the user can readily change the mixture to observe the response of seeding density and seed cost. Selecting seed lots and mixtures with higher quality seed will invariably allow the user to reduce the total bulk seed purchased. Other refinements in the new model included converting database information to arrays to customize the worksheet for different institutional users.

Conclusions Seed mixtures are widely used in grassland seedings but are difficult to calculate. A customized, interactive seed mixture calculator was developed as a decision support aid for growers, seed sales agents, extension personnel and parks and reclamation projects. The calculator refocuses attention on issues of seed quality and seeding management for establishing grassland seed mixtures.

References

Leyshon, A.J., M.R. Kilcher, & J.D. McElgunn (1981). Seeding rates and row spacings for three forage crops grown alone or in alternate grass-alfalfa rows in southwestern Saskatchewan. *Canadian Journal of Plant Science* 61,711-717.