

age, developmental stage, and environment (Aung 1974). The S/R of pea seedlings increased from 0.5 at 5 days to 1.7 at 12 days (Aung 1974). The S/R often declines during reproduction as photosynthates are monopolized by developing fruits (Aung 1974). Went (1957) found that the S/R increased as rootzone temperature increased for tobacco, from 5 at 3° C to 14 at 23° C, but did not vary with temperature for pea. Because of the great plasticity of the S/R, it is not a useful factor to identify dandelion clones; one would need to use isozyme electrophoresis (Solbrig & Simpson 1974; Soltis & Soltis 1989) or other techniques.

The dandelion S/R averaged 22.9 in mowed plots and 35.2 in unmowed plots. Bray (1963) noted that S/Rs for 28 herbaceous species ranged from 0.18 for taprooted beets (*Beta* spp.) to 6.7 for broadbean (*Vicia faba*). Based on Bray's data, mean S/Rs of 35 for the taprooted dandelion are unexpectedly high, suggesting a measurement or reporting error. The fact that the dandelion roots "often weighed only a few milligrams" indicates that the 2- to 3-month-old seedlings were extremely small, perhaps suffering from overwatering or root diseases. Overwatering (i.e. low soil aeration) is likely in shallow containers, like flats, because of the physics of container soils (Hershey 1990). Another possible explanation is that there was an incomplete recovery of roots. Growing dandelions in flats makes it difficult to separate the roots of individual plants and makes it difficult for taproots to develop normally.

Another possible reason for the unrealistically high S/Rs may have involved use of fresh rather than dry masses. By convention, S/Rs are calculated using the oven dry masses. Plant tissue is dried at about 65° C for 24 hours or until it reaches a constant mass. Dry mass is used because the water content of plant tissues varies widely. The water content of dandelion leaves would likely be higher than the taproot water content, so use of fresh masses to calculate the S/R would inflate the value. For example, 5 g of fresh shoot biomass with a water content of 90% would have a dry mass of 0.5 g, and 0.2 g of fresh root biomass with a water content of 50% would have a dry mass of 0.1 g. The S/R based on fresh mass would be 25, but the "real" S/R based on dry mass would only be 5.

Another error is the use of an S/R based on length of the longest leaf divided by the length of the primary taproot. A length-based S/R has no biological significance so should not be

used unless it is found to be highly correlated with the "real" S/R based on dry mass. The length-based S/R appears to be a misapplication of a common scientific technique. To simplify data collection, scientists often try to find correlations between easily measured factors and not easily measured factors. For example, leaf length X leaf width is highly correlated with summer squash leaf area (NeSmith 1992), so scientists measure squash leaf dimensions and estimate leaf area using the predetermined correlation.

Another questionable assumption is that mowing pressure was the only selection factor to differ between the two plots. Other potential differences between the plots include fertilizer use, herbicide use, soil pH, soil moisture, soil type, and competition from grasses. Any or all of these factors could be more important than the mowing pressure. Reader (1992) found that dandelion seed germination was reduced by the presence of competing plants indirectly through increased herbivory. Thus, the greater plant cover in the mowed plots might be the key factor and act through seed germination rather than on S/R.

Several key experimental methods were not detailed, e.g. the collection of 30 seedheads for each of the two plots. Was each seedhead from a different plant so that a random sample was obtained? Were two seedlings grown from each seedhead so the random sample was maintained? Were few enough seedlings grown per flat so that the S/R was not affected by competition? Were the seedlings adequately fertilized so that the S/R was not affected by nutrient deficiency? Were all seedlings of the same age in each treatment so that age effects on the S/R were avoided? Solbrig and Simpson (1974) used seedlings rather than seeds because dandelion seed germination was so variable and unreliable.

Dandelions are often useful in classroom experiments (Bergquist 1981; Clifford & Oxlade 1991; Freeland 1974; Knapp & Knapp 1980; Oxlade 1985), however, the exercise described by Hillbish and Goodwin (1994) does not provide a satisfactory demonstration of natural selection. It does illustrate how easy it is to reach incorrect conclusions by basing a study on unwarranted assumptions. It also demonstrates the importance of checking the scientific literature on the factor of interest (i.e. S/R) so that correct mea-

surement techniques are used and realistic values are obtained.

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## CORRECTION:

The scientific name of the Golden-Mantled Ground Squirrel featured on the cover of the May 1994 issue of ABT should have read *Citellus lateralis*, not *Citellus lateraus*. We regret the error.