The germination, growth, development, and maturation of the oat plant result from physiological and biochemical processes that are active in specific tissues at particular growth stages. The morphological and chemical properties of oat are determined by the levels of activity of these various processes. These, in turn, are regulated by the levels of expression of particular genes that are determined by genotype, environment, and developmental stage. Our knowledge of these processes in oat is incomplete, but some have received more attention by plant physiologists than others. For some processes, oat has served as a model system, and the physiology is relatively well understood. For others, little is known about oat, but processes may be inferred from research on related species. Consequently, this chapter provides an uneven coverage of physiology, emphasizing topics that have received the most study in oat and those most relevant to the production of oat in the field. Finally, I have pointed out knowledge gaps that should be addressed by researchers in the future.

4-1 DORMANCY

A dormant seed is one that fails to germinate when it is rehydrated in an environment that supports normal germination of rehydrated, nondormant seeds of the same population (Simpson, 1978). Loss of dormancy over time after seed maturity, as affected by the environmental conditions, is termed after-ripening. In cultivated oat the dormant period is generally short, a few days to several weeks, but in the wild oat species, particularly Avena fatua L., A. barbata Pott. ex Link, and A. ludoviciana Dur. (Banting, 1974; Thurston, 1962), longer dormant periods are usual. Because of the stronger dormancy response of wild oat, and because of practical effects of dormancy on control of wild oat in commercial grain fields, most dormancy research has been conducted on wild species.