When forages are cut for hay or silage, physiological changes occur in the plants that result in a certain level of unavoidable nutrient losses. These post-harvest compositional changes occur in forages prior to removing the dry or wilted forage from the field and in the forage material that is in storage. With hay, the changes in storage under good conditions are generally minimal, but major compositional changes may occur when forage is ensiled. This chapter will discuss the plant physiological changes that occur from the time the forage is cut until the plant material is no longer living or moved to storage. Compositional changes that occur later are brought about primarily by the physical environment or microorganisms that will be addressed in later chapters.

PREHARVEST MORPHOLOGICAL AND PHYSIOLOGICAL STATUS

Forage standing in the field may vary greatly in composition and in physiological activity. The physiological activity occurs in the protoplasm or living portion of the plant (symplast). The nonliving portion of the plant (apoplast), such as the cell walls, once formed, have no intrinsic physiological activity. They may affect the physiology indirectly by modifying water removal and interacting with outside forces such as microorganisms. Forage leaves are much more metabolically active than stems and contain much of the protoplasm of the plant. Leaf blades consist of mostly thin-walled mesophyll cells in legumes and cool-season grasses protected by an epidermis with a waxy cuticle. Warm-season grasses have a higher proportion of vascular tissue and bundle sheath cells. Stomata may be located on both leaf blade surfaces, through which gas exchange can occur readily. Leaf sheaths and stems are not as metabolically active as the blades. Leaves of both legumes and grasses dry more quickly than the stems, hence, metabolism ceases more quickly in leaves. Stems vary in composition and are not harvested in grasses until stem elongation occurs. When immature, both grass and legume stems contain nonstructural carbohydrates and protein. As stems mature, the cell