Role of Potassium in Oil Metabolism

EVELYN J. WEBER

Agricultural Research Service, USDA
University of Illinois
Urbana, Illinois

Vegetable oils are important sources of energy and nutrients for both humans and animals. With the increasing need for calories as the population of the world grows, vegetable oils represent a concentrated form of energy. On a weight basis, the total caloric value of oil is 2.3 times greater than carbohydrate or protein. Vegetable oils also supply essential fatty acids. A third nutritional function of vegetable oils is their role as carriers of the fat-soluble vitamins A, E, and K.

Although many studies have addressed the effect of varying potassium (K) fertilization upon yield, few researchers have determined the effect of K on the oil content or fatty acid composition of the seeds. The oil content has been assumed to be positively correlated with yield. We now know that many factors, such as breeding, temperature, and soil moisture, can alter the oil content and fatty acid composition of seeds (Morrison, 1978; Chu & Sheldon, 1979). We also need to know how the elements that fertilizers provide affect oil and fatty acid biosynthesis. We should be concerned not only with yield but also with the nutritional quality of the food produced.

Until the late 1960s, oil content and fatty acid composition of seeds were seldom determined in fertilizer experiments because the analyses were tedious and time consuming. Now instruments are available that can easily and quickly measure oil content. Wide-line nuclear magnetic resonance (NMR) spectroscopy has been adapted for analysis of the oil content of seeds (Conway & Earle, 1963; Alexander et al., 1967; Collins et al., 1967). Nuclear magnetic resonance analysis has several advantages over the classic procedure of grinding the seeds and extracting the oil with an organic solvent. It is feasible for even a single seed and is nondestructive; hence, the seed can be planted after the analysis. Large numbers of samples can be analyzed, because the scan time may be as brief as 2 s. The greatest disadvantage of NMR analysis is the initial high cost of the instrument. A less expensive instrument that can be used to determine oil content is the infrared grain analyzer (Hymowitz et al., 1974). This analysis is also a relatively rapid procedure; however, the seed must be ground in sample preparation. The method of grinding is a critical factor, because the accuracy of the instrument depends on uniform light reflectance from the surface of the sample. The fatty acid composition of vegetable oils also can be determined easily and quickly at the present time. Gas chromatography is the most widely used technique for fatty acid analysis (Caster, 1969).

This chapter presents a review of (i) the production and consumption of vegetable oils, (ii) the biochemistry of the oils, and (iii) recent studies that have measured...