Physiological Factors Affecting Composition of Soybeans.

I. Correlation of Temperatures During Certain Portions of the Pod Filling Stage with Oil Percentage in Mature Beans

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The rapid increase in the importance of the soybean as an agricultural product in recent years has been due in considerable measure to its high oil content and to the usefulness of this oil as a constituent of food and industrial products. While there have been extensive research programs to develop new varieties that will produce more oil, and to develop new uses for the oil, there has been relatively little study of the physiological factors that affect oil formation, i.e., the response of the oil forming mechanism to environment.

That elements of the climate might affect the composition of soybeans was suggested many years ago by Garner, et al. (2), who concluded that under usual conditions climate is a more potent factor than soil in controlling size and oil content of soybean seeds.

Viljoen (9) studied the relation of temperature during the growing season to oil content at maturity. He found no correlation between maximum temperatures and oil percentage. He did, however, find a highly significant correlation between mean minimum temperature and oil percentage, and between mean temperature and oil percentage. These correlations existed for two varieties and two growing seasons at from 9 to 12 field locations in South Africa. The temperatures of the different locations ranged from a monthly mean maximum of 91.3° to a monthly mean minimum of 46.0°. The extreme temperatures for single days were 102.2° and 34.5°. There was also a wide variation in rainfall at the different locations, the total for the growing season ranging from 1.88 in. to 25.67 in.

Dillman and Hopper (1) determined correlations between oil percentages of four varieties of flax and July temperatures at a group of nonirrigated and irrigated stations. For the nonirrigated stations, the correlation coefficients of oil percentage with average maximum, average minimum, and average mean were negative and were significant at the .01 probability level for all four varieties. For the irrigated stations, the only significant correlation coefficients were negative coefficients for two varieties with average minimum (P = .01) and the same two varieties with average mean (P = .05). It thus appeared that the oil level of the flaxseed in the area surveyed and Hopper was inversely related to July temperatures.

More recently, Weiss, et al. (10) have reviewed the literature on the relationship of climatic factors to the composition of soybeans, and have studied the correlation of mean temperature during the bean developmental period with oil percentage in five soybean varieties at different dates at three midwestern locations. They found that among the means of the number of days from planting there was a significant positive correlation between mean temperature and oil content.

In the work of Viljoen (9), Pahigian (7), Keirstead (4), and Weiss, et al. (10) temperatures were only partial correlation with rainfall, when the influence of temperature was removed. Keirstead (4) found an increase of 1°F in temperature during the two growing seasons of 1949–1950 associated with an increase in oil content of 0.41 and 0.47%, respectively.

In the work of Viljoen (9), Pahigian (7), and Keirstead (4), and Weiss, et al. (10) temperature-oil relations. Extended periods might include periods of extension of the association between the two factors, so that the observed would represent an average effect over the period.

There are at least two general ways in which temperatures during short periods might affect the oil content of soybeans at maturity: (1) Temperatures might development of the oil-forming mechanism in an effect would be exerted at an early stage; temperatures during such a period would have an effect than might be expected from the amount of oil synthesized. (2) Temperatures might affect the rate of oil synthesis, i.e., the direct effect and would be expected to occur at a time when the rate of oil synthesis is at a peak when the rate is not limited by some other factor.

It was, therefore, of interest to determine the effect of temperatures during short periods could be shown. Although a clear distinction between these two types of effects discussed above is beyond...