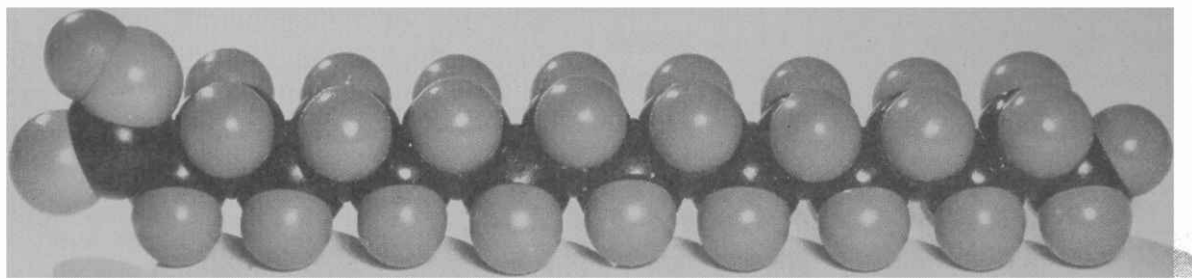


Oil Production in Seeds



E. B. Kurtz

Please, don't reach for the flit gun. That "caterpillar" is only a fatty acid molecule enlarged 50 million times. The head end of the "caterpillar" is an acid, and the long body and tail give the molecule its greasy, fat-like properties; hence the name, fatty acid. When fatty acids are combined chemically with glycerol a fat is formed. When a fat is a liquid, it is called an oil.

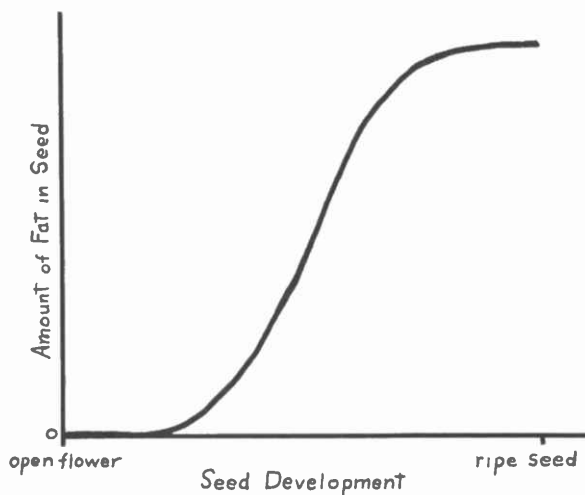
Most commercial vegetable fats or oils are obtained from such seeds as flax, cotton, sunflower, castor bean, safflower, and soybean. In 1956 the world production of vegetable oils was 17 million tons and was valued at \$5,120 million. For comparison, the world production of cotton in 1956 was 38 million tons.

Yet, in spite of this great economic importance of oil crops, practically nothing is known about how fatty acids and oils are formed in plants. Indeed, only two university experiment stations in the United States, Arizona and California, are making a continuing effort to unravel the story.

How Are They Made?

Our work at the University of Arizona, which has been supported generously by the U. S. Atomic Energy Commission, began nine years ago with the simple question: What are the building blocks from which the fatty acids are made in the plant? To find an answer we used young developing seeds of flax.

Flax and most oil-producing seeds are nearly devoid of oil until they reach a certain stage of development, then they



MOST OF the oil in seeds is made during a brief period of time.

begin to form oil at a terrific pace. Rapid oil production continues for about 10 days and then suddenly very little oil is formed even though the seeds do not fully ripen until several days or weeks later.

Our plan was to take developing seeds of flax which are ready to start forming oils, but have not yet done so, and to grow them in the laboratory in a test tube. If we could provide the proper conditions for the seeds, and also supply the building blocks from which the fatty acids are made, then the flax seeds should continue to make fatty acids and oils. In this way we hoped to be able to learn things about oil formation that could not be learned with the whole, intact plant.

Built From Vinegar

We soon found that if we treat the flax seeds kindly, satisfy their needs, and also feed them acetic acid (pure vinegar), they would use the acetic acid as the building block to make fatty acids. In fact, if just the right conditions are provided for the seeds, they continue to make fatty acids and oil as fast as they would have if they were still inside the fruit attached to the flax plant. Not only

the flax seeds make oil, but the oil characteristic of field-grown linseed oil is formed in the test tube.

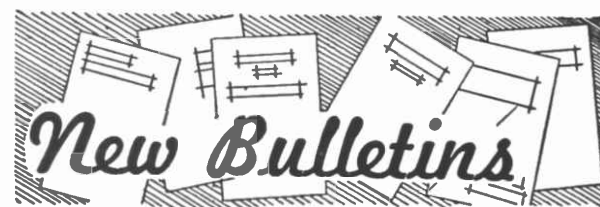
But the young flax seed is very particular and has very finicky requirements in order for it to make fatty acids and oils. For instance, if the developing seeds are supplied just acetic acid, only non-drying oils are formed. But, if only 0.01 part per million of the B-vitamin, biotin, is fed to the seeds in addition to the acetic acid, then all of the fatty acids and drying oils found in linseed oil are formed.

A little biotin goes a long way, because one pound of biotin aids in the formation of about 1,000,000 pounds of oil.

Light Is Important, Too

From our studies to learn how fats are made in plants, we soon found that more fats are made in the light than in the dark. This is not simply a matter of photosynthesis, because only a small amount of the right color of light is needed to stimulate fat formation. Further, not only more fats are formed in the light, but different kinds of fat are made. Both flax seeds and cotton seeds need light for the formation of fats. As we learn more about how light is used in the manufacture of fats it may be possible to control the process and have tailor-made fats in these or other oil crops.

As one observes a developing cotton boll or flax fruit, it is difficult to imagine all the complex activity that is going on so effortlessly inside the boll or fruit. Some of this complexity is now understood, and it is becoming apparent that some day man will be able to control oil production in plants just as readily as he now controls weeds.



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Dr. Kurtz is an associate botanist in the Agricultural Experiment Station.