# Soviet Grain Harvests: CIA Study Pessimistic on Effects of Weather

A recent Central Intelligence Agency (CIA) study of Soviet crop growing conditions has concluded that there is a good probability that the weather will continue to be unfavorable in the next 5 years and that crop production in the Soviet Union will fall short of official goals by 15 to 20 million metric tons each year. Such a shortfall would drive the Soviet Union to buy these amounts on world grain markets, principally from the United States, and therefore would have important foreign policy implications.

The CIA study is pessimistic by comparison with current statements made by the U.S. Department of Agriculture (USDA), which predicts that the Soviets will meet their projected goals. USDA has been using a period centered on the 1960's from which to extrapolate its more optimistic estimates; the CIA report, on the other hand, argues that the 1960's were abnormally favorable and should not be used as the sole basis for extrapolating future trends.

Since 1972, when the Soviets secretly bought up 14 million tons, or 20 percent of all U.S. grain exports, at bargain prices, the subject of Soviet grain production has been one of deep concern to USDA, CIA, and other government agencies. In addition, scientists' predictions of a steadily worsening global climate in the next 25 to 100 years has spurred new government studies of conditions in key world food producing areas. The Soviet Union is a crucial piece of the world food supply and demand puzzle.

The CIA study projects that weather in the grain-growing regions of the Soviet Union is getting worse and will not return to the favorable conditions of the middle and late 1960's. The middle and late 1960's, it finds, were unusually favorable for food production, not only by comparison with the period immediately before and after, but by comparison with long-term trends going back to the early part of the century. This finding has been seconded by independent work at the University of Missouri.

The study, done by CIA's Office of Economic Research, was presented by its author, CIA meteorologist Russell Ambrosiac, to a small group of government experts on 7 January at the National War College at Fort McNair in Washington, D.C., where a study of the world climate and food situation is under way. Although some of the officials who heard the presentation and who have read Ambrosiac's "official use only" paper have reservations about certain aspects, their general view seems to be that the work is sound.

The CIA study attempted to answer a question many U.S. analysts have about Soviet agriculture, namely, how much of the spectacular improvement in crop yields which the Soviets have experienced since the early 1960's has been due to the weather and how much has been due to improvements in technology, such as the widespread application of mineral fertilizer introduced by former premier Nikita Khrushchev in the 1960's. World Meteorological Organization data and data on individual crop yields for the grain-growing regions of European Russia and Kazakhstan were modeled to see what trends could be identified.

Ambrosiac concluded that small shifts in the weather could make great differences in Soviet crop yields, especially in the relatively dry region of Kazakhstan, where most of the spectacular yield improvements of the early 1960's occurred. Soviet weather was poor during the early 1960's, but improved as the decade advanced. Now, Ambrosiac found, it is getting worse again.

The climatological reason behind this shift to worse, drier weather in many grain-growing regions of the Soviet Union, according to Ambrosiac and other experts, is that the Arctic circumpolar air mass, which determines much of the Northern Hemisphere's weather and which was found to be expanding a few years ago (*Science*, 22 February 1974), is now believed to be contracting. This shift, climatologists explain, is pulling northward various dry weather belts such as the one which previously lay across the Russian deserts in southern Kazakhstan. Such belts are also shifting over Africa and northern India; both of these areas are also critical to the world balance of food demand and supply.

Whatever the cause, Ambrosiac estimated the result of this drier weather to be that the Soviets would produce, on the average, only 200 million metric tons of grain on the average each year during the next 5 years. But the official Soviet 5-year plan calls for production on the average of 215 to 220 million metric tons, and for production of 235 million metric tons in 1980. (In fact, Soviet grain production has undergone notorious, wild fluctuations. The 1975 crop was a mere 140 million metric tons, whereas 1976 saw a bumper harvest of 223 million metric tons.)

The CIA's findings about past Soviet weather trends have also been observed by Wayne Decker, a professor at the University of Missouri who is making a study for USDA of long-term weather data for the world's major food-producing regions, including the Soviet Union, Australia, Canada, and Argentina.

"By just about any standard the middle and late 1960's were a period of unusually good Soviet weather," Decker says, on the basis of data going back to the 1880's. "The latest deterioration started in the winter of 1971–72; the years which have followed have not in general been good for growing crops."

The problem is, however, that USDA now uses crop yield data from the 1960's —and not weather data—to project future, "normal" trends in Soviet agriculture. USDA claims that the Soviet Union will be able to meet their grain production goals. Explains Fletcher Pope, a Soviet specialist in the USDA Economic Research Service (ERS), in defining a "normal" Soviet grain crop year, "We take a simple average of the 11 year period from 1962 to 1972 and consider that to be the norm." Pope says this period is used because "it was the one for which data was available." If it turns out to have been an abnormally favorable period, he adds, USDA will have to revise its methodology.

David Schoonover, of ERS, who witnessed Ambrosiac's presentation, says, "Our basic conclusion over the next few years is that the Soviets are likely to meet their planned goals for grain production, assuming an equal distribution of good and bad years. He is disagreeing and saying, well, the chances are that the good years will be outnumbered by the bad." Schoonover also says that Ambrosiac's paper, although only a preliminary look at the problem, has already spurred some rethinking in his division of ERS over USDA's assumptions and forecasts.

The CIA-USDA controversy over forecasting Soviet crop production is part of a larger issue now being debated in scientific and government circles, over the future of world climate and food supplies (*Science*, 24 September 1976). The issue came to public attention last

year when another study, from the Office of Research and Development of the CIA, predicted "mass migrations" and other forms of global political "instability" as a result of a long-term cooling trend in the Northern Hemisphere. The analysis—which was highly controversial at the time—predicted that U.S. food exports could be the key to resolving the political controversies caused by lack of food. In the course of the debate about this study and others which have been undertaken, a number of leading climatologists have criticized USDA's methods of forecasting crop yields because their weather assumptions, based on the unusually favorable Northern Hemisphere conditions of the last 20 years, are much too optimistic.

Soviet crop production is extremely sensitive to fluctuations in the weather. According to a recent speech by a former Soviet minister of agriculture, 66 percent of Russia's arable land already has insufficient precipitation. (By contrast, only 1 percent of the arable land in the United States has this handicap.) During the 1960's, Khrushchev opened "new lands" to farming by extending Russia's major agricultural region eastward from European Russia across Kazakhistan to the Chinese border. But the new CIA prediction, if true, could mean that these "new lands," which get little rainfall as it is, could become harder and harder to cultivate in coming years. Should this happen, the Soviet Union would become even more dependent on imported food than it is already.

Decker, in his review of Soviet data, is impressed by certain correlations between Soviet weather conditions and the country's political history. Not only did Khrushchev's "new lands" policy coincide with a period of abnormally favorable weather, but the Stalinist era correlates with a period of poor weather, in the late 1930's. "I'm not qualified to relate it to the politics of the era, but boy, there must have been some hunger in Russia in the 1930's," he says. It seems obvious that, as far as CIA goes, such correlations will not go unnoticed.—DEBORAH SHAPLEY

# Dicing with Nature: Three Narrow Escapes

A new life-form often cited as a theoretical example of the health hazards that could be created by the gene-splicing technique has already been constructed, *Science* has learned. Since it was made by an in vivo method, it is not covered by the NIH guidelines, which define recombinant DNA organisms in terms of the gene-splicing technique, a test-tube method, instead of by their inherent properties.

The organism is an *E. coli* bacterium carrying the gene for cellulase. *Escherichia coli* is a common inhabitant of the human gut; the cellulase enzyme breaks down the plant structural protein cellulose which, being indigestible by humans, gives bulk to the feces. Should such an *E. coli* gain a selective advantage and spread throughout the population, the result might be a large number of people suffering from chronic, maybe fatal, diarrhea, theorists warned.

A cellulase-containing *E. coli* was put together by A. Chakrabarty of the General Electric Research and Development Center at Schenectady, New York. Chakrabarty planned also to insert methane-forming genes into the bacterium so that it would be able to turn wastes such as sewage sludge directly into usable methane gas.

After he had inserted the cellulase enzyme gene it occurred to him that such an organism might not be a comfortable thing to have in one's gut. The cellulose breakdown products might not be properly absorbed in the lower intestine, and other bacteria might turn them into gas. "Every time you ate a lettuce you might have a lot of gas in the stomach and that is not a very bright prospect," Chakrabarty observes. "So because of this consideration, without any other kind of evidence, we destroyed the bug." The incident occurred 2 years ago, and the gene transfer was conducted with the use of plasmids, not with the restriction enzymes used in the present gene-splicing technique.

Another potentially scary incident, also involving a recombinant DNA constructed by methods antedating the gene-splicing technique, concerns a family of laboratory-made viruses that are hybrids between the tumor virus, SV40, and the adenoviruses which cause the common cold. The hybrids are a useful research tool for mapping the genes of SV40, a monkey virus which causes tumors in some animals but not, it would seem, in man. The threat posed by the viruses is that should they escape they could, like the pure adenoviruses, become established in the population for generations to come, exposing people meanwhile to the effects of SV40.

Andrew M. Lewis, the NIH virologist who developed the hybrids in 1971, realized this danger and, with the advice of his institute, asked scientists needing samples of the viruses to sign an agreement promising to take certain safety precautions. This seemingly minor restriction on the traditional free exchange of scientific materials ran into considerable resistance. Even three of the eleven-member group that later called for the Asilomar conference on controlling gene-splicing research were among those who initially refused to sign the agreement, Lewis recalls. One of the three even threatened Lewis with congressional action, action by the director of NIH, and collective pressure from the scientific community, if the viruses were not immediately made available to other laboratories.

A third example of a possibly unpleasant recombinant organism is the experiment contemplated by Paul Berg of Stanford in which an SV40 virus genome would have been inserted into *E. coli*. As with the adenovirus × SV40 hybrids, such an organism might, if it got loose and survived, expose people to the unknown effects of SV40 virus. It was this experiment, never performed, that set in train the process which led to the NIH guidelines on gene-splicing research.

These three incidents all show how easily with modern techniques the biologist can stumble, almost before he has realized it, into making research organisms of potentially grave hazard. The past 30 months of debate have probably made most biologists more aware of such dangers. Even without this advantage, the scientists concerned in these three incidents behaved in a responsible manner. Chakrabarty destroyed his cellulase-containing *E. coli*, Lewis asked for a safety agreement from the recipients of his viruses, and Berg decided not to carry out his experiment. But in wielding their ever increasing powers for manipulating the stuff of life, will all biologists in the future always act with as much intelligence and restraint?

—NICHOLAS WADE