controls. In CAF_1 female mice the effect of these carcinogens on the —SH content increases with age.

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RADIOBIOLOGY

Role of the Genotype in Controlling Accumulation of Strontium-89 by Plants

THE entry of radioactive materials into the food-chain from soils contaminated by intentional or accidental explosion of atomic devices is a potential hazard worthy of considerable attention. Once deposited in the soil, the isotopes are taken up by plants from which they may pass directly to man or to animals and then to man. Within the body, serious damage can result from levels of radioactive material that would be trivial as a source of external radiation. Much research has been done to find ways of reducing the movement of radioactive isotopes into plants. Because of its relative abundance, long half-life, and site of deposition in the body, strontium-90 has received more attention than other fission products. Factors known to influence strontium-90 uptake from contaminated soils are soil type, organic matter content, method of cultivation, calcium content, and fertility level[1,2]. A number of investigators[3,4] have reported that plant species differ in amount of strontium-90 that they accumulate from the soil and that plant parts may differ in content of strontium-90.

In 1960 Myers[5] suggested that entry of radioisotopes into the food-chain could be reduced by using plants that would take lower than normal amounts of the material from the soil or that would deposit the material in plant parts that would not be utilized for food. The success of this approach depended on finding genetically controlled differences for isotope accumulation. A recent investigation[6] revealed major differences for accumulation of strontium-89 among varieties in three plant species —barley, wheat, soybeans. In these investigations the observed differences were for strontium-90 content in grain. This communication is concerned with genetic control of accumulation of strontium-89 in stems, leaves, and grain.

Six varieties of barley and of wheat known to differ for accumulation of strontium-89 in the grain were used in the work. Plants were grown in the greenhouse in pots containing 4 lb. of soil to which 25 μc. strontium-89 was added prior to planting. Strontium-89 was used rather than strontium-90, which is of greater concern, since strontium-89 is easier to handle experimentally. They are assumed to be chemically and biologically similar. Two plants were grown in each pot and there were five pots of each variety. The soil was a mixture of 3 parts Waukegan silt loam to 1 part sand. Soil analysis revealed 11·9 and 0·03 m.equiv. of exchangeable calcium and strontium respectively, per 100 g of soil. Content of strontium-89 in stem, leaves, and grain was determined using a 1-g sample of finely ground material. The ground material was ashed and assayed using a Geiger–Müller detector. Observed disintegrations were corrected for background, counting efficiency, self-absorption, and decay where appropriate.

The activity of strontium-89 found in grain, stems, and leaves of the two species is given in Table 1. In each species the highest concentration of strontium-89 occurred in the leaves. The stems were intermediate, and the grain contained the least activity. For barley and wheat the average activity of strontium-89 per gram dry matter in the grain was only 3 per cent of that found in the leaves.

Table 1. AVERAGE STRONTIUM-89 ACTIVITY (DIS./SEC/G DRY MATTER) IN PLANT PARTS OF BARLEY AND WHEAT VARIETIES

Variety	Grain	Stems	Leaves
Barley			
Dorsett	110	332	2,682
Anoidium	105	356	2,309
Regal	87	1,062	4,487
Trebi	78	274	1,777
Vantage	72	625	3,109
Tregal	49	493	2,339
Average	84	524	2,784
Standard error*	9	62	283
Wheat			
Kentana 52	106	1,026	3,815
Canus	91	398	2,370
Progress	81	518	1,695
Cadet	76	290	2,181
Carleeds	49	799	2,484
Great Northern	41	347	1,918
Average	74	563	2,410
Standard error*	6	78	247

* Standard error of variety means.

The stems of barley and wheat contained 22 and 26 per cent, respectively, of the activity found in the leaves.

Varieties within each species differed significantly for strontium-89 activity in grain, stems, and leaves. The finding of significant differences in the grain is in agreement with previous work[6]. For stems and leaves the barley variety, highest in strontium-89 activity, exceeded the lowest by a factor of 3·8 and 2·5, respectively. For wheat stems and leaves, the high variety had a strontium-89 activity exceeding the low by a factor of 3·5 and 2·2, respectively. Amounts of strontium-89 activity in the grain were not associated with activity in stems. There was an association between activity of strontium-89 in the grain and leaf tissue in wheat but not in barley. In each species, strontium-89 activity in stems and leaves was positively associated. Correlation coefficients for association between the components are given in Table 2.

Table 2. CORRELATION VALUES FOR ASSOCIATION OF STRONTIUM-89 CONTENT AMONG PLANT PARTS

Correlation between	Barley	Wheat
Grain and stems	−0·05	0·28
Grain and leaves	0·08	0·52*
Stems and leaves	0·77*	0·64*

* Significant 1 per cent level.

The results verify the earlier finding[1] that large genotypic differences exist for strontium-89 accumulation in the grain and further indicate that accumulation in stems and leaves is subject to significant genotypic control. The mechanism which causes one genotype to accumulate more strontium-89 than another is not known, but it is likely that the genes in the various varieties affect both absorption and transport. Differential transport in the different genotypes is suggested by lack of association between strontium-89 content in the various plant parts. Suggestive of differential absorption is the observation that certain varieties contain more strontium-89 in all plant parts than do other varieties. The magnitude of the differences in strontium-89 content among the varieties studied indicates that the hazard associated with radiostrontium in the soil can be reduced. This could be done by growing varieties that absorb low quantities of strontium or by growing varieties that accumulate low concentrations of strontium in plant parts used for food.

This work was supported by the U.S. Atomic Energy Commission.

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