were DDT, DDE, and dieldrin, with maximum values of 0.071 ppm, 0.051 ppm, and 0.018 ppm, respectively. (ii) Also present were TDE, TCNB, endrin, chlorbenside, and carbaryl. (iii) Bromides were present (2.6 ppm to 22.1 ppm) in 14 of 18 composite samples. (iv) Arsenic was present (0.10 ppm) in 1 of 18 composite samples.

Garden fruits (raw peppers, fresh and canned tomatoes, raw cucumbers, catsup, raw eggplant, and raw and frozen summer squash): (i) Small residues of chlorinated organic pesticides were present in varying combinations in 16 of 18 composite samples. The most common were DDT, DDE, TDE, lindane, and dieldrin, with maximum values of 0.15 ppm, 0.009 ppm, 0.049 ppm, 0.025 ppm and 0.012 ppm respectively. (ii) Also present were heptachlor epoxide, chlordane, BHC, endrin, and carbaryl. (iii) Bromides were present (1.7 ppm to 18.9 ppm) in 15 of 18 composite samples.

Fruits (including fruit filling from pies, fresh oranges, bananas, raisins, raw and canned apricots, and raw and canned pears): (i) Small residues of chlorinated organic pesticides were present in varying combinations in 16 of 18 composite samples. The most common were DDT, DDE, and aldrin, with maximum values of 0.027 ppm, 0.005 ppm, and 0.020 ppm, respectively. (ii) Also present were lindane, Kelthane, dieldrin, TDE, PCNB, Tedion, Perthane, and carbaryl. (iii) Bromides were present (0.7 ppm to 31.4 ppm) in 12 of 18 composite samples. (iv) Arsenic was present (0.18 ppm) in 1 of 18 composite samples.

Oils, fats, and shortening (French dressing, mayonnaise, salad dressing, shortening, and peanut butter): (i) Small residues of chlorinated organic pesticides were present in varying combinations in 7 of 18 composite samples. The most common were heptachlor epoxide, DDT, DDE, and TDE, with maximum values of 0.004 ppm, 0.049 ppm, 0.014 ppm, and 0.037 ppm, respectively. (ii) Also present were dieldrin, lindane, endrin, heptachlor, BHC, aldrin, 2,4-D, and TBA. (iii) Bromides were present (1.1 ppm to 261 ppm) in 16 of 18 composite samples.

Sugar and adjuncts (including white sugar, jam or jelly, pudding mix, blended syrup, molasses, candy bars, baking powder, and salt): (i) Small residues of chlorinated organic pesticides were present in varying combinations in 9 of 18 composite samples. The most common were 2,4-D and DDT, with maximum values of 0.16 ppm and 0.085 ppm, respectively. (ii) Also present were aldrin, BHC, lindane, TDE, DDE, heptachlor epoxide, dieldrin, and carbaryl. (iii) Bromides were present (0.7 ppm to 55.1 ppm) in all composites.

Beverages (tea leaves, ground coffee, cocoa, soft drinks, and drinking water): (i) One residue of a chlorinated organic pesticide was found in 1 of 18 composite samples (DDE, > 0.003 ppm). (ii) Also present was carbaryl (maximum value 0.5 ppm) in 4 of 18 composite samples. (iii) Bromides were present (0.9 ppm to 17.0 ppm) in 10 of 18 composite samples.

The analytical scheme used in this investigation will detect at least 50 of the most commonly used pesticide chemicals. The amounts of pesticide residues found in the foods ready for consumption were very small; they were substantially less than the tolerances established for specific pesticides and products in those instances where the tolerances are finite. Residues of all pesticides reported in earlier studies (*4*), except methoxychlor, were found in this series of samples. The amounts of these residues were of the same order of magnitude as those reported in the earlier studies. Aldrin, carbaryl, dithiocarbamates, TCNB, Tedion, PCP, 2,4-D, MCP and TBA residues, however, have not been reported in studies of foods ready for consumption.

R. E. DUGGAN
H. C. BARRY*
L. Y. JOHNSON
Bureau of Regulatory Compliance, Food and Drug Administration, Washington, D.C.

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* Present address: New Orleans District, 423 Canal Street, New Orleans, La.

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Gibberellin and Growth in Isolated Wheat Embryos

Abstract. *Gibberellic acid promoted elongation growth in the coleoptiles and leaves of embryos from gamma-irradiated wheat grains whether the embryos were isolated or attached to the endosperm. Thus gibberellic acid affected this growth directly rather than indirectly through an effect upon endosperm. However, root growth was promoted by gibberellic acid only on embryos attached to endosperm, suggesting an indirect effect of gibberellic acid upon growth.*

Shoot growth in cereal seedlings, after the treatment of whole seedlings with gibberellin, has been used to investigate the basis of the effects of gibberellin upon plant development (*1, 2*). In his recent review of the mechanisms of gibberellin action, Paleg (*3*) has stated that the interpretation of results so obtained must be queried because the effects upon growth are confounded with another effect of gibberellin upon cereal grains—the mobilization of nutrient reserves in cereal endosperm.

To decide whether gibberellin has a direct effect upon growth, or only an indirect effect through a changed nutritional status of the seedling due to greater or earlier endosperm mobilization, we have compared the effect of gibberellin upon embryos attached to endosperm and upon isolated embryos from which the endosperm, the potential source of a confounding effect upon growth, was removed. We have also taken the opportunity to make this com-

parison on one of the experimental systems from which conclusions concerning the effect of gibberellin upon growth have been drawn. Haber and Luippold (*1*) studied the effects of gibberellin upon the growth of wheat seedlings in which cell division was completely suppressed by exposure of the grains to γ-irradiation. Gibberellin promoted leaf elongation in these plantlets and these investigators concluded that gibberellin can promote growth in the absence of cell division. We repeated the experiment of Haber and Luippold and compared the effect of gibberellin upon isolated irradiated embryos and on irradiated embryos attached to endosperm.

Wheat grains (*Triticum vulgare*, cv. Nabawa) of selected grain weight (50 to 60 mg) received 500 kr of γ-irradiation from a cobalt-60 source. The surfaces of these grains were sterilized with sodium hypochlorite and, after washing, the grains were germinated in sterile, distilled water for 26 hours at 23°C. The grains that germinated uniformly were selected and from half of these the embryos, with scutellum attached, were dissected. Embryos were cultured in McCartney bottles on 8 ml of nutrient medium solidified with 0.8 percent agar. The embryo medium contained sucrose, $10^{-1}M$; asparagine, $2 \times 10^{-3}M$; casein hydrolysate, 10 mg/liter; $Ca(NO_3)_2$, $4 \times 10^{-4}M$; and other salts, micronutrients, and vitamins according to Rijven (*4*). As an addendum to this medium some treatments received $10^{-4}M$ gibberellic acid (GA_3). Whole grains were similarly cultured but their growth medium contained only the inorganic salts of the medium described above. Some cultures of whole grains also contained $10^{-4}M$ GA_3. Both embryos and whole grains were cultured at 25°C under white fluorescent light, 16 hours of light alternating with 8 hours of darkness. Harvests of six or seven plantlets per treatment were made 3, 6, and 10 days after placing on culture medium. The lengths of coleoptiles, first leaves, and main roots were measured, and the embryos from the embryo cultures and those excised from the whole grain cultures were then thoroughly extracted with 70 percent ethanol, after which their insoluble dry weights and insoluble nitrogen contents were determined.

The results are shown in Table 1. The embryos attached to endosperm grew and were affected by treatment with GA_3 in the way observed by Haber and Luippold (*1*). Gibberellin increased growth, principally in the first leaf. Isolated embryos in general grew faster than those attached to endosperm, even though the latter accumulated more insoluble nitrogen.

Table 1. Effect of gibberellin upon the growth of irradiated wheat embryos attached to (whole grain) or isolated from the endosperm. Treated embryos received $10^{-4}M$ gibberellic acid (GA_3) after germination and harvests of treated and untreated embryos were made 3, 6, and 10 days thereafter. Standard errors are in parentheses.

Day of harvest	Whole grains		Isolated embryos	
	$-GA_3$	$+GA_3$	$-GA_3$	$+GA_3$
	First leaf (length in mm)			
3	5.78(0.23)	10.78(1.13)	6.07(0.23)	16.14(1.02)
6	13.91(0.24)	26.58(1.14)	18.0 (0.21)	31.33(0.12)
10	18.64(0.14)	25.71(1.18)	24.78(1.10)	35.14(0.30)
	Coleoptile (length in mm)			
3	15.28(1.97)	19.21(2.49)	16.21(1.65)	20.28(1.26)
6	19.91(1.06)	22.83(0.74)	19.5 (0.19)	23.42(0.19)
10	19.14(0.14)	22.28(0.11)	18.43(0.18)	24.0 (0.22)
	Main root (length in mm)			
3	13.14(0.67)	14.71(0.41)	13.57(1.30)	14.43(0.26)
6	12.5 (0.27)	17.33(0.15)	14.5 (0.18)	14.33(0.27)
10	13.0 (0.21)	16.57(1.30)	14.14(0.17)	14.43(0.27)
	Embryo insoluble dry weight (mg)			
3	3.02	2.86	2.82	2.36
6	3.92	4.68	3.66	3.52
10	5.04	5.45	4.19	4.01
	*Embryo insoluble nitrogen (μg)**			
3	141.6 (5.63)	139.4 (4.2)	106.2 (3.43)	94.8 (3.04)
6	135.7 (6.13)	161.1 (6.3)	105.6 (3.52)	98.2 (6.05)
10	133.0 (4.02)	147.5 (7.35)	110.5 (3.91)	105.7 (3.12)

* Insoluble nitrogen content of embryos at time of explantation, 79.8 (2.94) μg.

The mean, insoluble dry weights of endosperm excised from GA_3-treated and untreated plantlets after 10 days were 6.2 mg and 20.9 mg, respectively. Thus treatment with GA_3 had hastened the mobilization of seed reserves, and, therefore, the distinct possibility existed that gibberellin promoted growth by this mechanism. Such a mechanism, however, cannot explain the observed enhanced growth of the leaves and coleoptiles of isolated embryos. Moreover, this extra growth cannot have been at the expense of root growth, since this was unchanged. Similar results have been obtained with isolated wheat embryos, exclusive of scutella, grown in darkness with glucose as the carbohydrate source (*5*). The conclusion is that the promotion of cell expansion, in the absence of cell division in leaves and coleoptiles, by gibberellin is a direct effect, and Paleg's (*3*) conclusion that gibberellin predominantly affects the endosperm and only indirectly affects embryo growth does not apply.

The growth of roots on isolated embryos was not promoted by gibberellin whereas on embryos attached to endosperm root growth was promoted. The promotion of root growth by treatment with GA_3 in the presence of endosperm was statistically highly significant on day 6. Therefore, the growth of one organ, the root, may be affected by gibberellin only indirectly as the result of an influence on the nutrient status of the embryos. An interaction between treatment with GA_3 and the presence of endosperm appears also to be expressed in the insoluble nitrogen contents of the embryos.

N. P. KEFFORD
A. H. G. C. RIJVEN
Division of Plant Industry, Commonwealth Scientific and Industrial Research Organization, Canberra, A.C.T., Australia

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