with the 'Michelite' strain necrotic lesions were visible in the treated young leaves or green pods. Within seven days inoculated seedlings exhibited top necrosis and died.

Nevertheless, another group of varieties probably possessing recessive a and dominant I genes showed a typical localized hypersensitivity reaction of the inoculated leaves, especially after testing with the 'Michelite' strain. Most of such varieties proved to be extremely resistant to all strains, the very virulent 'Great Northern' strain included. The differentiation of bean seedlings with a localized necrosis from those which can develop systemic necrosis, is easy with the 'Michelite' strain since plants with dominant A and I genes showed a total necrosis within a few weeks. The first variety, in which localized necrosis was detected as a genetic character, was the Dutch dwarf snap bean 'Cordon', though still in some plants a retarded systemic black root reaction developed. The American dwarf snap bean variety 'Trugreen' did not show any systemic necrosis in our trials.

In beans with homozygous recessive a genes and heterozygous I genes, the necrosis was not restricted to the inoculated leaves only, but a slowly proceeding systemic necrosis often resulted in some black root symptoms of pods and seeds. Perhaps in this case more genes are involved. Petersen (1958) described the genes, which might be a duplicate of gene a. Consequently, the combination of genes aaSSII perhaps could induce virtually the same slowly-developing black root reactions. Likely the combination aassII limits the necrosis at most.

Up to now all varieties, reacting with localized necrosis, proved to be 'extremely' resistant in the field and never exhibited any seed transmission of bean common mosaic virus. There is no indication that the resistance based on localized necrosis can be overcome by other strains of the virus.

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Effect of Heat, Cold, and Drought Hardening on Stability of Bean Malic Dehydrogenase

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Heat, cold, and drought tolerance of plants is normally increased by short exposure to environmental stress. Mild environmental stress causes changes in plants that enables the plants to survive greater stresses. This is the "hardening process".

One theory explaining differences in tolerance of plants to environmental extremes, is that the tolerant plants have more stable proteins and enzymes. In our laboratory we have shown that heat hardening significantly increased the thermal stability of malic dehydrogenase. Malic dehydrogenase extracted from heat hardened Phaseolus acutifolius gray var. latifolius Freeman 'Tepary Buff', P. vulgaris L. var. 'Harvester' and 'G.N. Nebraska #1' was more thermal stable than the enzyme extracted from the unhardened plants. Heat hardening consisted of exposing 4- to 5-week-old plants to 45 C and 60 to 80% relative humidity for 2 hours on 4 consecutive days. This treatment increased the heat tolerance of the plants.

'Harvester' plants were drought hardened by withholding water. This treatment increased the drought tolerance of the plants. Malic dehydrogenase extracted from the drought hardened plants was significantly more thermal stable than the enzyme extracted from the unhardened plants. The stability of the drought hardened enzyme was greater over a wider pH range than the unhardened enzyme.

'Tepary Buff' plants were subjected to 7 to 10 C for 4 or 7 days. These treatments generally rendered the plants more susceptible to cold injury. This cold treatment tended to increase the stability of the extracted malic dehydrogenanse. Additional work must be conducted to verify this interesting trend.

The results obtained in our laboratory indicate that environmental stresses do influence the stability of proteins and enzymes.

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Cook Book Embryo Culture

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Considerations of the amount of time and laboratory equipment usually associated with embryo-culture techniques doubtless have been a deterrent to many plant breeders becoming involved with this sometimes valuable adjunct to their research.

I was, therefore, prompted after the perusal of an article describing a simplified embryo-culture technique used with lily embryos by Yeates (1964), to attempt to modify and adapt essentially the same technique to the culture of bean embryos.

The procedure is as follows:

1. Prepare the following nutrient solution:

Complete fertilizer mix (Hygro, Hyponex or other)	1 part
Sucrose	12 parts
Water	600 parts

2. Fill shell vials (approximately 17 mm. i.d. x 60 mm. long) about 1/3 full with washed and dried sand.

3. Saturate sand with nutrient solution to a supernatant depth of about 2 mm. above the surface of the sand.

4. Cover the culture vial with an inverted vial of the next larger but somewhat shorter size (approximately 22 mm. i.d. x 50 mm. long).

5. Autoclave or sterilize in a pressure cooker at 15 lbs. psi. for 20 minutes.

6. Remove bean ovules and place briefly in a 50% clorox in sterilized water mixture.