ANNUAL REPORT OF THE
BEAN IMPROVEMENT
COOPERATIVE

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TO EFFECT THE EXCHANGE OF INFORMATION AND MATERIALS

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Report of The
BRAIN IMPROVEMENT COOPERATIVE

No. 32 March 1989

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The Coordinating Committee received many useful and constructive suggestions from BIC members at the last biennial meeting and during 1988. The Committee approved the creation of a BIC Student Recognition Award to acknowledge outstanding student paper or poster presentations at the biennial BIC meeting. Guidelines will be established and implemented by the coordinating committee prior to the biennial meeting in Toronto. Students are encouraged to participate and those selected will also receive a small monetary award from the BIC.

The Coordinating Committee also approved the creation of a BIC Achievement Award to acknowledge a scientist (s) with fewer than 15 years of service who has (have) demonstrated outstanding contributions to an area of bean research and/or education. The guidelines and selection process are outlined in the following information provided by the BIC Awards Committee (D. P. Coyne- chairman, M. J. Silbernagel and D. H. Wallace). The Awards Committee has also provided updated guidelines for the BIC Meritorious Service Award.

An analysis of printing and postage charges during 1988 revealed that the BIC dues were not adequate to pay expenses without using income for future years to cover the current years deficit. International postage rates, especially airmail charges to Asia, Australia and Africa, were very costly. Therefore, the Coordinating Committee approved my request to increase annual dues, back issue charges and postage rates to more fairly cover the actual costs for members to receive the BIC in different regions of the world. We apologize for any difficulties this may cause for some of our members, but we really have no alternative without turning to advertising revenue or industry donations. In general, I feel that the BIC dues and postage rates are still very fair considering the value of the interactions and contacts provided by the annual research report and biennial meeting.

The 1989 BIC annual rates are summarized as follows:

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<th>Region</th>
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<tr>
<td>A. North and Central America</td>
<td>$ 7.00</td>
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<tr>
<td>B. Europe/South America</td>
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<tr>
<td>(surface mail)</td>
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<td>(air mail)</td>
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<tr>
<td>C. Africa/Asia/Australia</td>
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<td>(air mail)</td>
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<td>D. Back Issues:</td>
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<tr>
<td>(1981 - 1988)</td>
<td>5.00 +</td>
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<td>North and Central America</td>
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<td>Europe/South America</td>
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<tr>
<td>Africa/Asia/Australia</td>
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<tr>
<td>(air mail postage)</td>
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The 1989 BIC/NPIA/NDBC Meetings are being organized by Drs. Robert Hall, Greg Boland and Tom Michaels. They are enthusiastic about the site and its accommodations, and welcome your input regarding the structure and content of the program. We are looking forward to an exciting and stimulating meeting.

Howard F. Schwartz for the Coordinating Committee
B.I.C. Meritorious Award

The Awards Committee

Comprised of 3 BIC members, the senior member to act as chair, 1 also remaining from the previous committee, and 1 new member appointed each biennium by the Chairman of the Coordinating Committee.

 Nominees

(1) To be nominated by the membership at large. Nominations should be received any time up to 4 months before the next BIC meeting. The nomination should include a one page typewritten summary of the nominee's accomplishments and other information on status, etc. - also include date of birth and home of institution(s) and where work was done.

(2) Awards would be made to no more than 4 nominees, unless to a team of more than two, at any one biennial meeting, for an outstanding single accomplishment, or sustained high performance over a period of years. Age or approaching retirement should not influence such choices (except that the older most worthy candidates in any one biennium should receive the awards).

Recognition of Retirees

So that every member would have the opportunity of being recognized and appreciated for his contributions to bean improvement, a brief biography (no more than one typed page) prepared by a close associate or friend would be published, with approval of the retiree, in the first BIC Report after his retirement. The membership at large, through the awards committee, would be responsible for submitting nominations and/or biographies for recognition of retirees.

Responsibility

The awards committee would be responsible for implementation of all phases of the above awards program in cooperation with the BIC Coordinating Committee and current BIC Program President. Time and methods of presentation would be decided by each new awards committee.

Award

A certificate will be presented to the recipient(s) at the BIC Awards banquet or luncheon.

Publicity

News releases would be appropriate.

Approval of policy: The original policy was adopted by the members attending the BIC business meeting on November 9, 1971, in the Sheraton-Schroeder Hotel, Milwaukee, Wisconsin. The revised policy was developed by the 1988-89 BIC Awards Committee and approved by the BIC President, Howard Schwartz, in February, 1989.
Policy and Procedures for the "Early Career" BIC Distinguished Achievement Award

The Award Committee
Same as for the career "BIC Meritorious Award."

Nomination Procedures
Nominations may be made by any member or group of members and sent to the chairman of the BIC Award Committee up to four months prior to the biennial BIC meeting. The call for nominations will be published in the BIC Annual Report published during the year in which the award(s) will be presented and in the call for contributions to the BIC Report in that same year (the latter is also adopted in case there is a delay in the publication of the report).

Nomination Materials
A BIC Achievement Award will honor a selected scientist with 15 or fewer years of postgraduate experience and/or service. The nominations should be accompanied by a summary statement of approximately one typewritten page giving place of birth, date and name of institutions granting degrees, and accomplishments.

Expected Qualifications and Standards
An "Early Career" BIC Achievement Award will honor a selected scientist with 15 or fewer years for a single outstanding contribution or for sustained significant and notable contributions.

Selection and Recognition of Awardees
Usually, no more than two nominees will be selected for this award. The Awards Committee will be responsible for the implementation of this awards program (along with the former BIC Meritorious Award(s)) in conjunction with the BIC coordinating committee and the current President of the BIC. The time and methods of presentation would be decided by each new Awards Committee. A certificate will be presented to the recipient(s) by the chairperson of the Awards Committee at the BIC Awards banquet. The banquet will be held in conjunction with the BIC biennial meeting. Highlights of the contributions of the award recipient(s) will be presented at the banquet and brochure containing a biographical sketch of each recipient will also be distributed. A suitable certificate(s) of the award would be prepared by the current President of the BIC.

Publicity
The chairperson of the biennial meeting would prepare appropriate news releases.

Approval of Policy
This policy was developed by the 1989 Awards Committee and adopted by the BIC President, Howard Schwartz, in February, 1989.
REPORT OF THE GENETICS COMMITTEE

During the past year, the members of the Genetics Committee (Bassett, Gepts, Leakey, Mueller, Myers, Singh, Vallejos, and Weeden) have accomplished the following items:

1) Rules of genetic analysis and nomenclature: Rules for the establishment of the genetic control of traits and the nomenclature of new genes were written up by J. Myers and N. Weeden and were published in BIC Annu. Rept. 31: 16-19.

2) Gene list: An gene list updated by M. Bassett is published in this issue of the BIC Annu. Rept.

3) Distribution of DL genes: J. Kelly has agree to serve as coordinator to establish a list of genotypes that carry of do not carry the DL genes causing hybrid weakness in Mesoamerican x Andean lines. A call for contributions to this list is published in this issue.

4) New gene symbols: Two proposals for new gene symbols were reviewed and approved by the committee: "reclined foliage (Rf-2, Rf-3) by M. Bassett and "supernodulating" (nod) by S.J. Park). An additional proposal is currently under review.

5) Collection of genetic stocks: Discussions have been initiated with the U.S. Plant Germplasm system and the Phaseolus World Collection at CIAT to establish a collection of genetic stocks. Agreement in principle has been reached; a few practical problems still need to be solved.

By: Paul Gepts
Chair, Genetics Committee
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1989 BIC/NPIA MEETING

The 1989 BIC/NPIA meetings will be held in The Westbury Hotel, 475 Yonge Street, Toronto, Ontario, Canada M4Y 1X7 (416-924-0611) during the week of November 5-10, 1989. The daily room rates are $86.00 Canadian single or double occupancy plus sales tax (currently 5%). Limousine service from Lester Pearson airport is approximately $30 Canadian. Further information will be provided early in July along with the call for papers.

The members of the planning committee are Dr. Robert Hall and Dr. Greg Boland, Department of Environmental Biology and Dr. Tom Michaels, Department of Crop Science, University of Guelph, Guelph, Ontario (tel. 519-824-4120). The committee would be pleased to receive ideas regarding the structure and content of the program.

The tentative program schedule is as follows:

Nov. 5 - National Pea Improvement Association (NPIA)
    7:00 - 9:00 pm. Business Meeting

Nov. 6 - NPIA Business - 8:30 am to 5:30 pm.
    Posters 9:00 am - 5:00 pm.
    NPIA Luncheon
    Phaseolus Crop Advisory Committee - 7:00 - 9:00 pm.
    Pisum Crop Advisory Committee - 7:00 - 9:00 pm.

Nov. 7 - NPIA 8:30 am - noon
    National Dry Bean Council 8:30 am - noon
    Bean Improvement Cooperative 1:30 - 5:30 pm.
    Posters 9:00 am - 5:00 pm.
    Rooms will be available for special meetings 7:00 - 9:00 pm
    (e.g. Crop Advisory Committee for Special Food Legumes, Public
    Breeders, Genetics).

Nov. 8 - BIC 8:30 am - 5:30 pm
    Posters 9:00 am - 5:00 pm
    BIC Awards Dinner

Nov. 9 - BIC 8:30 am - 12:30 pm
    Posters 9:00 am - 5:00 pm
    Regional W-150 1:00 - 5:30 pm

Nov. 10 - Regional W-150 8:30 am - 12:30 pm.
List of Genes - *Phaseolus vulgaris* L.

The original comprehensive gene list was prepared by S.H. Yarnell (Bot. Rev. 31:247-330, 1965) and published in the BIC 8:4-20, 1965. An updated list was prepared by M.H. Dickson and associates and published in the BIC 25:109-127, 1982. The current list was prepared by M.J. Bassett, involving extensive additions, corrections and revisions.

*Am* confers resistance to the *alpha* race of anthracnose (McRostie 1919).

*ace* produces shiny pod (Yen 1957).

*Adk* structural gene for adenylate kinase enzyme (Weeden 1984).

*Aeq* *Aequicoloratus* (Latin): with *P T E Lic Und* and *R* or *R* darkens the banner petal (Lamprecht 1935c, 1948a); with *Sal* the effect is similar to *V* (Lamprecht 1948b).

*Am* *amaranth*: with *No* and *Sal* geranium flower color, and scarlet flower with *Beg No Sal* (Lamprecht 1948b, 1961a).

*Amv-1* high level resistance to a strain of *alfalfa mosaic virus* (Wade and Zaumeyer 1940).

*Amv-2* resistance to the same strain of *alfalfa mosaic virus* as for *Amv* (Wade and Zaumeyer 1940).

*Ane* *Anebulosus* (Latin): produces nebulosus-mottling on testa (Prakken 1977a).

*aph* *aphyllus* (Latin): plants have only two leaves, both unifoliate, 4 to 6 nodes, and are sterile (Lamprecht 1958).

*Arc* with *Bip* gives *virgarcus* seed coat pattern, with *bip* gives *virgata*; *arc* with *Bip* gives *arcus*, with *bip* gives *bipunctata*; extends seed coat color in partly colored seeds (Lamprecht 1940b).

*Are* confers resistance to four races of *anthracnose* (Mastenbrock 1960); also confers resistance to the lambda and epsilon races (Tu 1984).

argon *argentum* (Latin): with *Y* produces a "silver" or greenish gray pod (Lamprecht 1947b), formerly *s* (Currence 1930, 1931); *arg* with *y* gives a white pod (Currence 1931; Lamprecht 1947b).

*Arl* (Arc) structural gene for the seed protein *arcelin* (Osborn et al. 1986).

*B* (Br, Vir) as used by Lamprecht (1932a, 1939, 1951a). With *P* gives a seed coat that is whitish with a pale lilac tinge, his Vielchenartig Weiss, with a yellowish brown hilum ring; described by Smith (1961) as gray-white. With other color factors it changes chamois to bronze (1932a).

According to Prakken (1934, 1940-41) *B* with the basic color factors produces a gray-greenish-brown seed coat without a hilum ring, and changes yellow-brown to brown. Its use with suitable genes as a bluing factor (Lamprecht 1932a; Prakken 1934; Sirks 1922; Tjebbes and Kooiman 1922b) appears to be similar to its original concept; this effect is regarded by Smith (1939) to be due to a distinct gene, *Bl*. Similar or equivalent genes, according to Feenstra (1960) are the *C* of Tschermak (1912), the *D* of Shull (1908), the *E* of Kooiman (1920), the *H* of Shaw and Norton (1918), and the *L* of Sirks (1922).

*bc-u* strain-unspecific complementary gene, giving resistance to strains of *bean common mosaic virus* (BCMV) only when together with one or more of the strain-specific resistance genes (Drijfhout 1978b).

*bc-1* with *bc-u* gives resistance to BCMV strains NL1 and NL8 (Drijfhout 1978b).

*bc-2* with *bc-u* gives resistance to BCMV strains NL1, NL2, NL7, and NL8 (Drijfhout 1978b).

*bc-3* with *bc-u* gives resistance to all strains of BCMV (Drijfhout 1978b).


*bc-2* strain-specific gene for temperature sensitive resistance to *blackeye cowpea mosaic virus* (Dickson 1968).

*bc-3* strain-specific gene for temperature sensitive resistance to *bean yellow mosaic virus* (Dickson 1968).

*bc-4* strain-specific gene for temperature sensitive resistance to *bean yellow mosaic virus* (Dickson 1968).

*bc-5* strain-specific gene for temperature sensitive resistance to *bean yellow mosaic virus* (Dickson 1968).

*bc-6* strain-specific gene for temperature sensitive resistance to *bean yellow mosaic virus* (Dickson 1968).

*bc-7* strain-specific gene for temperature sensitive resistance to *bean yellow mosaic virus* (Dickson 1968).

*bc-8* strain-specific gene for temperature sensitive resistance to *bean yellow mosaic virus* (Dickson 1968).

*bc-9* strain-specific gene for temperature sensitive resistance to *bean yellow mosaic virus* (Dickson 1968).

*bc-10* strain-specific gene for temperature sensitive resistance to *bean yellow mosaic virus* (Dickson 1968).

*Bcm* confers temperature-sensitive resistance to *blackeye cowpea mosaic virus*. Tightly linked, if not identical, to the *I* gene for resistance to *bean common mosaic virus* (Provvidenti et al. 1983; Kyle and Provvidenti 1987).

* Beg with *P Gri* gives *begonia* red flower color (Lamprecht 1948b).

*Bip* *bipunctata* (Latin): *Bip* and *bip* combine with *Are* and *arc* to form seed coat patterns based on the hilum; extends seed coat color in partly colored seeds (Lamprecht 1932d, 1940b).

*Bpm* confers resistance to *bean pod mottle virus* (Thomas and Zaumeyer 1950); symbol proposed by Provvidenti (1987).

* Bsm confers resistance to *bean southern mosaic virus* (Zaumeyer and Harter 1943); symbol proposed by Provvidenti (1987).

*By-1* confers strain-specific resistance to *pea mosaic virus*, a strain of *bean yellow mosaic virus* (Schroeder and Provvidenti 1968).

*By-2* strain-unspecific gene for temperature sensitive resistance to *bean yellow mosaic virus* (Dickson 1968).
C

with *P Gri*, sulfur-white or primrose yellow testa; no color in the hilum ring (Lamprecht 1932a, 1939, 1951b; Tjebbes and Kooiman 1922b). According to Feenstra (1960) this *C* is the equivalent of the *B* of Tjebbes (1927), of Kooiman (1920), and of Sirks (1922), and the *Cm* of Prakken (1934).

C/c

inconstant (ever-segregating) mottling with color genes (Lamprecht 1932a, 1939; Prakken 1940-1941; Shaw and Norton 1918; Tschermak 1912). According to Prakken (1974) the "complex *C* locus" includes 6 tightly linked loci, including *M, Pr, Acc, C/c*, *R*, and *St*.

C" (inh)

completely recessive: the heterozygote *C"* shows the pure dark pattern color *CC*, without mottling as in *Cc* and *C"* (Nakayama 1965).

C" (inh)

unchangeable: produces a creamish testa (Feenstra 1960).

C" (inf)

intense unchangeable: causes an intense stem and flower color (Nakayama 1964).

Cam

confers temperature sensitive resistance to *cowpea aphid-borne mosaic virus*. Tightly linked, if not identical, to the *f* gene for resistance to bean common mosaic virus (Provvidente et al. 1983; Kyle and Provvidente 1987).

Cav

*Caruncula vernaca* (Latin): causes a wrinkling of the testa radiating from the caruncula (Lamprecht 1955). The heterozygote is less distinct.

c

*chlorotic cup* leaf mutation (Nagata and Bassett 1984).

chl

pale green *chlorophyll* deficiency (Nakayama 1959a).

cl

*circumlineatus* (Latin): in partly colored seed coats, each of the color centers and even the smallest dots are bordered by a sharp precipitation-like line (Prakken 1972b).

Cor

dark corona around hilum; *Cor/cor* produces pale corona with white flowers; and *cor* produces no corona, flowers light laelia (Lamprecht 1934a, 1936).

cr-1 cr-2

complementary recessive genes for crippled morphology, i.e., stunted plants with small, crinkled leaves (Coyne 1965).

cry

crypto-dwarf: a dwarfing gene; with *Fin* intermediate height (Nakayama 1957); with *la* produces long internodes resulting in slender type of growth in bush (*fin*) but not in tall (*Fin*) forms (Lamprecht 1947b).

cs

*chlorotic stem* mutant (Nagata and Bassett 1984).

Ct

for *curved* pod *tip* shape; *ct* for straight pod tip (Al-Muktar and Coyne 1981).

ctv-1 ctv-2

confer resistance to beet *curly top virus* (Schultz and Dean 1947); symbol proposed by Provvidente (1987).

cyy (by-3)

high level resistance to *clover yellow vein* virus, formerly known as the severe, necrotic, or pod-distorting strain of bean yellow mosaic virus (Provvidente and Schroeder 1973; Tu 1983); symbol proposed by Provvidente (1987).

D (Can, Ins)

color gene with basic factors (Feenstra 1960; Kooiman 1920; Prakken 1940-41). According to Lamprecht (1960) this *D* is the equivalent of his *B*.

Da

straight pod (Lamprecht 1932b).

Db

polymeric with *Da* for straight pod (Lamprecht 1932b, 1947b). [Polymeric genes have identical functions (expression) but different loci.]

dgs (gl, le)

dark green *savoy* leaf mutant (Frazier and Davis 1966; Nagata and Bassett 1984). According to Nagata and Bassett (1984), *dgs* is synonymous with the *wrinkled leaf* mutant of Moh (1968) and the *gl* (glossy) of Motto et al. (1979); also synonymous with the *le* (leathery leaf) of Van Rheenen et al. (1984).

dia

diamond leaf mutant (Nagata and Bassett 1984). Leaflets are angular, slightly chlorotic, thick, and reduced in area.

Diap-1

structural gene for *diaphorase* enzyme (Weeden and Liang 1985).

Diap-2

structural gene for *diaphorase* enzyme (Sprecher 1988).

diff

diffundere (Latin): with *exp* gives completely colored testa except for one end of the seed; *diff* with *Bip Arc* gives maximus phenotype, with *bip Arc* gives major phenotype; extends seed coat color in partly colored seeds (Lamprecht 1940b).

dis

disperses (Latin): mottled or striped flower of scarlet runner bean (Lamprecht 1951c).

Di-1 Di-2 (DL₁DL₂)

complementary genes for *dosage-dependent lethality* and developmental abnormality; *Di Di Di₂ Di₂* is lethal, *Di dl Di₂ Di₂* and *Di dl Di₂ dl₂* are sublethal, *Di dl Di₂ dl₂* is temperature dependent abnormal, and *Di dl Di₂ dl₂*, *dl dl Di₂ Di₂*, *Di dl dl₂ dl₂*, *dl dl Di₂ dl₂*, and *dl dl dl₂ dl₂* are normal; *Di* inhibits root development and *Di₂* inhibits shoot development (Shii et al. 1980).
do dwarf out-crossing mutant (Nagata and Bassett 1984). Out-crossing rates up to 56% are observed due to delayed pollen dehiscence (Nagata and Bassett 1985).

dt-1 ^ dt-2 ^ daylength temperature: produce early, day-length neutral flowering with complex temperature interactions (Massaya 1978).

dt-1 ^ dt-2 ^ daylength temperature: control flowering response to short days with complex temperature interactions; dt-2 ^ causes increased production of branches (Massaya 1978).

dw-1 dw-2 duplicate genes causing dwarf plant (Nakayama 1957).

c (z-2, restr) E required for complete coloring of seed coat (Emerson 1909b); the action of e is hypostatic on t, producing much reduced partial coloring of seed coat and required for the soldier series of seed coat patterns (Emerson 1909b; Tschermak 1912; Lamprecht 1939b; Sax and McPhee 1923; Smith 1939; Prakken 1972b; Leakey 1988).

\[
\begin{align*}
Ea & \quad Eb \\
\text{polymeric genes for "flat" pod, elliptical in cross-section vs. ea eb round pod (Lamprecht 1932b, 1947b; Tschermak 1916).} \\
\text{Est-1} & \quad \text{structural gene for most anodal esterase enzyme (Weeden and Liang 1985).} \\
\text{Est-2} & \quad \text{structural gene for second most anodal esterase enzyme (Weeden and Liang 1985).} \\
\text{exp} & \quad \text{expandere (Latin): with diff gives solid color to seed coat except for one end of the seed, giving minimum and minor phenotypes (Lamprecht 1940b).} \\
F & \quad \text{confers resistance to the F strain of anthracnose (McRostie 1919).} \\
Fg & \quad \text{basic gene for pod membrane (Lamprecht 1932b).} \\
\text{fast} & \quad \text{fastigate shape of seed (Lamprecht 1934a).} \\
Fh \quad Fc & \quad \text{supplementary genes for pod membrane (Lamprecht 1932b).} \\
fa \quad fb \quad fc & \quad \text{weak pod membrane; pod may be constricted (Lamprecht 1932b); may give 9:7, 15:1, or 63:1 ratios (Lamprecht 1932b, 1947b).} \\
\text{fd} & \quad \text{delayed flowering response under long days (Coyne 1970).} \\
\text{Fe-1 Fe-2} & \quad \text{Ferrum (Latin): complementary dominant genes controlling resistance to leaf chlorosis due to iron deficiency in plants grown on calcareous soils (Coyne et al. 1982; Zaiter et al. 1987).} \\
Fin (in) & \quad \text{Finitus (Latin): indeterminate vs. fin determinate plant growth (Lamprecht 1935b; Rudorf 1958); long vs. short internode; later vs. earlier flowering.} \\
\text{Fop-1} & \quad \text{confers resistance to the Brazilian race of Fusarium oxysporum f. sp. phaseoli (Ribeiro and Hagedorn 1979).} \\
\text{Fop-2} & \quad \text{confers resistance to the U.S. race of Fusarium oxysporum f. sp. phaseoli (Ribeiro and Hagedorn 1979).} \\
\text{Fr} & \quad \text{a dominant fertility restoring gene (Mackenzie and Bassett 1987) for the cytoplasmic male sterility source derived from CIAT accession line G08063. Restoration is partial in F1, complete and irreversible in fertile F2 segregants, i.e., the gene alters the cytoplasm.} \\
\text{G} & \quad \text{(Flav, Ca, Och)} \\
\text{Gpi-cl} & \quad \text{structural gene for glucose phosphate isomerase enzyme, i.e., the more anodal of the two cytosolic isozymes (Weeden 1986).} \\
\text{Gr} & \quad \text{in the presence of ih, produces green dry pod color; in the presence of lh, produces tan dry pod color; in the presence of ih or lh, produces tan dry pod color (Honma et al. 1968).} \\
\text{gri} & \quad \text{griseoalbum (Latin): Gri is one of the two basic color factors (Lamprecht 1936); gri with P produces grayish white (blubber white) testa without a hilum ring (Lamprecht 1936).} \\
\text{Hb} & \quad \text{L (Thn-1)} \\
\text{Hbc} & \quad \text{(SCThn-1)} \\
\text{Hbp} & \quad \text{(PDThn-1)} \\
\text{Hsw} & \quad \text{hypersensitivity watermelon: confers temperature sensitive resistance (lethal hypersensitivity) to watermelon mosaic virus 2. Very tightly linked, if not identical, to the I gene for bean common mosaic virus (Kyle and Provvidenti 1987).} \\
\text{Ht-1 Ht-2} & \quad \text{(L-1 L-2)} \\
\text{I} & \quad \text{genes of equal value for height of plant (Norton 1915). They also increase length of seed (Frets 1951).} \\
\end{align*}
\]
Sh, Asp) 

Joker: Lamprecht gives light yellow-brown or pale ochraceous buff testa (Lamprecht 1933), P Gri (Weeden 1984).

malic enzyme structural gene for Me

miv (Lamprecht end of seed flattened and a short distance between funicles minor intervallis: 1934a). 

mancha na flor (Portuguese): brownish-violet blotch on the base of the standard flower petal (Vieira and Shands 1969).

M (Rmn) responsible for constant (non-segregating) mottling of the seed coat; the colors depend on other genes (Emerson 1909a; Shull 1908; Smith 1939, 1947; Tschermak 1912). Later interpreted to be an allele of R and redesignated Rmn (Lamprecht 1947a). M was originally used by Shull (1908) for inconstant mottling. M with Ro and V produces marbling of the pod (Lamprecht 1940a, 1951b). According to Prakken (1974), C, R, and M are 3 distinct but very closely linked loci that are included in the "complex C locus."

mar margo: broad colored zone around hilum ring (Lamprecht 1933). 

Me structural gene for malic enzyme (Weeden 1984).

Mf mancha na flor (Portuguese): brownish-violet blotch on the base of the standard flower petal (Vicira and Shands 1969).

mi micropilar stripe pattern (Lamprecht 1934a).

Mic micropyle inpunctata (Latin): small dots near the micropile (Lamprecht 1940c).

miv minor intervallis: end of seed flattened and a short distance between funicles (Lamprecht 1947b).
Mrf  
Mosaico rugoso del frijol (Portuguese): confers immunity to bean rugose mosaic virus (Machado and Pinchinat 1975).

Mrf*  
Mosaico rugoso del frijol (Portuguese): confers the localized lesion type of resistance to bean rugose mosaic virus; the order of dominance in the allelic series is $Mrf > Mrf^* > mrf$ (Machado and Pinchinat 1975).

mrf  
mosaico rugoso del frijol (Portuguese): confers susceptibility (systemic infection) to bean rugose mosaic virus (Machado and Pinchinat 1975).

mu  
mutator locus that produces mutations of $u$ to $U$, thus giving normal green leaf sectors in yellow leaves due to $u$ $mu$, where the ratio of normal to variegated plants is 15:1 (Coyne 1966).

Nag  
structural gene for $N$-acyetyl glucoseaminidase enzyme (Weeden 1986).

Nd-1 Nd-2  
(D-1 D-2) additively control the variation in node number on the main stem of determinate beans and additively control the number of days to flowering (Evans et al. 1975).

Neu'  
short day vs. day neutral flowering response to length of day (Rudorf 1958).

No  
with V Sal and Am produces nopal red (light salmon with brownish tinge) flower color; no geranium to salmon red (Lamprecht 1948b, 1961a).

ntn  
nitrogen tolerant nodulation: an induced mutation that permits abundant nodulation in the presence of high nitrogen (Park and Buttery 1988).

P  
basic color gene with Gri (Emerson 1909a; North and Squibbs 1952; Prakken 1934; Schricker 1934; Shaw and Norton 1918; Shull 1908; Skoog 1952). $P$ without Gri and color genes is colorless as is $p$ (Lamprecht 1939; Smith 1939). According to Feenstra (1960) $P$ is the equivalent of the $A$ of Tschermak (1912), of Kooiman (1920), and of Sirks (1922).

pa  
pale green leaves (Smith 1934).

Pc  
persistant green pod color (Dean 1968).

pg (pa,)  
pale-green foliage mutant (Wyatt 1981).

Pfs (Pha)  
structural gene for the seed protein phaseolin (Osborn et al. 1986).

Pmv  
confers incomplete dominance for resistance to peanut mottle virus (Providiaenti and Chirco 1987).

prc (pc)  
progressive chlorosis mutant (Nagata and Bassett 1984); redesignated pre (Awuma and Bassett 1988).

Prp  
with P Gri V Ro produces dark-purple corolla and pod; with Ro produces medium-purple pod; flower color is fully dominant and pod color codominant with other alleles at this locus (Okonkwo and Clayberg 1984).

prp*  
with P Gri V ro produces light-purple corolla and green pod shaded with purple; with Ro produces red pod (Okonkwo and Clayberg 1984).

prp#  
with P Gri V ro produces light-purple corolla and medium-purple pod; with Ro, red pod; with prp, green pod shaded with purple (Okonkwo and Clayberg 1984).

prp"  

prp  

Prx  
structural gene for peroxidase enzyme, i.e., the most cathodal of the peroxidase isozymes (Weeden 1986).

punc  
punctatus (Latin): causes dotting of the testa (Lamprecht 1940c).

R  
with P Gri produces a red seed coat (Emerson 1909b; Lamprecht 1935a; Tjebbes and Kooiman 1921) that has been variously described as light vinaceous (Tjebbes and Kooiman 1921), light purple vinaceous (Lamprecht 1947a), and deep oxblood red (Smith 1939), the differences possibly due to modifying genes. The flowers are red (Tjebbes and Kooiman 1922b). It does not affect the color of the hilum ring (Lamprecht 1939).

r  
white seed coat (Emerson 1909b; Lamprecht 1940a, 1947a). $R$, $R^e$, $R^r$, $R^e_r$, and $R^s$ are allelic. Because some authors report that $C$ and $R$ are tightly linked, they use $C$ rather than $R$ as the base letter to symbolize this allelic series (Prakken 1970). According to Lamprecht (1947a), $C$ and $R$ do not form a "complex locus", but have a linkage of 8 cM.

$R^e$  
circumdatus (Latin): lateral accumulation of medium sized spots on the testa (Lamprecht 1947a).

$R'$  
indistinct, inconstant mottling of the seed coat (Lamprecht 1940a, 1947a; Smith 1939).

$R^{res}$  
resperus (Latin): sprinkled or speckled seed coat (Lamprecht 1940a, 1947a).

$R^{rho}$  
rhomboïdus (Latin): rhomboid spotting of the testa (Lamprecht 1947a).

ram  
ramifera (Latin): branched inflorescence (Lamprecht 1935b).
RbcS (rbcS) small subunit of the rubisco enzyme (Wecden 1984).

rf-1 reclining foliage due to downward slanting petioles (Bassett 1976).

rf-2 reclining foliage due to downward slanting petioles (Bassett and Awuma 1989).

rf-3 reclining foliage due to downward slanting petioles (Bassett and Awuma 1989).

rfi (i) reclining foliage inhibitor: recessive epistatic factor to rf-1 and rf-3 (Bassett 1976; Bassett and Awuma 1989).

Rfs (m) reclining foliage suppressor: dominant suppressor of rf (Bassett 1976).

Rk red kidney: with P Gri J pinkish buff seed coat (Gloyer 1928; Smith 1939); with J(Sh) chamois or cream testa (Smith and Madsen 1948).

rk red kidney: with r for white seed gives a pink or red testa (Smith 1939); with J (Sh) gives testaceous (the buff of kidney bean) testa (Smith 1939, 1947); rk J (Sh) are dominant over red-brown but recessive to cream (Smith 1939; Smith and Madsen 1948); not effective with C but modifies J (Lamprecht 1961c).

rk^d (lin) dark red kidney: with Sh red-brown or garnet-brown testa (Smith and Madsen 1948). Found in 'Dark Red Kidney'; with P T C, v or v^v, rk^d always gives red veins in the wing petals, whether clear or faint (Prakken 1972a).

m-1 m-2 (r r') together confer resistance to root-knot nematode, where 2-4 dominant alleles give susceptible reaction and 1 dominant allele gives intermediate resistance in a 11:4:1 ratio (Barrons 1940).

md round leaf mutant with lateral leaflet tips rounded (Nagata and Bassett 1984).

Ro with P Gri rose color (Lamprecht 1951b).

Sal with P and Am salmon to geranium red flower color and a reddish tinge to the testa; with Aeq the effect is similar to V (Lamprecht 1948b); sal with P and Am give clear amaranth flower (Lamprecht 1961a).

sb spindly branch mutant (Awuma and Bassett 1988).

sil silver colored leaves and severe plant stunting under high intensity light (Frazier and Davis 1966; Nagata and Bassett 1984).

Skdh structural gene for shikimate dehydrogenase enzyme (Wecden 1984).

sl stipelless lanceolate leaf mutant (Nagata and Bassett 1984) gives a lanceolate leaf form with loss of stipels from the terminal leaflet.

Smv confers incompletely dominant resistance to soybean mosaic virus (Provvidenti et al. 1982).

St stringless pod; st gives a complete string (Prakken 1934); has modifiers.

Str (S, R^m) striping on seed coat and pod (Kooiman 1931; Lamprecht 1939; Sirks 1922; Smith 1939; Tjebbes and Kooiman 1919b; Tschermak 1912); considered by Lamprecht (1947a) to be due to R^m; Str also darkens the tip of the banner petal (Prakken 1972b) and is independent of the R locus although both are tightly linked within the 'complex C locus' (Prakken 1974).

Sur Sursum versus (Latin): causes leaves and petals to point downward (Lamprecht 1937) with pulvinule rotated 180°. See X^v.

sw-1 sw-2 the double recessive genotype produces seedling wilt (Provvidenti and Schroeder 1969), i.e., epinasty of primary leaves, necrosis of terminal bud, and death of the plant in primary leaf stage.

T self-colored seed coat and colored flowers (Emerson 1909a; Lamprecht 1934b; Shaw and Norton 1918).

t (z-I) a seed coat pattern gene, required for either the soldier series (t e) or trout series (t only), gives white flowers (Schreiber 1934; Shaw and Norton 1918); functions with e, Z and z (Lamprecht 1934b; Sax 1923; Shaw and Norton 1918).

te (ds) tenuis (Latin): pod short (5-8 cm) and narrow (Lamprecht 1961a); ds (dwarf seed) produces small seeds and short pod, whereas cross pollination with Ds gives normal size seeds and pods on ds plant (Bassett 1982).

Th-1 Th-2 genes of equal value for seed thickness (Frets 1951).

Tm confers immunity to tobacco mosaic virus (Thompson et al. 1952).

To cell wall fiber (Prakken 1934).

Tor (T) torquere (Latin): twining habit vs. tor non-twining (Norton 1915; Lamprecht 1947b); confers phytochrome-controlled climbing habit in indeterminate bush bean types (Kretchner et al. 1961; Kretcher and Wallace 1978).

Tr testa rapture (Dickson 1969); an incompletely dominant gene with 25-30% penetrance.

tri tricotyledonae (Latin): produces three cotyledons (Lamprecht 1961b) with 40-50% penetrance.

trv confers resistance to tobacco ringspot virus (Tu 1983); symbol proposed by Provvidenti (1987).

Ts temperature-dependant string formation (Drijfhout 1978a); St Ts is without string, St Ts gives
incomplete string, and $st$ $Ts$ and $st$ $ts$ have complete string.

$Uc$ $Unc$  $(I_1 \ I_2)$  *uni coloris* (Latin): with appropriate genes darken the banner petal (Lamprecht 1948a); either $Uc$-$uc$ and $Unc$-$unc$ (Lamprecht 1948a) or $I_1$-$i_1$ and $I_2$-$i_2$ (Nakayama 1958) for the presence or not of anthocyanin in hypocotyl and stem. According to Prakken (1972h), both of these gene pairs are synonyms for genes in the "complex C locus", e.g., $Unc$ is the equivalent of $Str$.

$uni$  *unifoliate* (Latin): unifoliate leaves; complete sterility (Lamprecht 1935c).

$Ur$  *Uromyces*: bean rust resistance (Ballantyne and McIntosh 1977).

$ur$? (Pompadour)  *Uromyces*: bean rust resistance, where $Ur$? (Pompadour) is epistatic to susceptible $ur$? (Tara) (Finke et al. 1986).

$us$  *unstable* gene that mutates to $Us$ in presence of $mu$ to produce green leaf sectors in a yellow leaf background due to $us$ $mu$, resulting in variegation (Coyne 1966).

$V$  $(Bl)$  with $P$ $Gi\i$ produces pale glaucescens testa without a hilum ring (Lamprecht 1939). The color ranges from pale violet to black depending upon other color genes present (Lamprecht 1932a; Prakken 1934). According to Prakken (1972a) the $Bl$ of Smith is the same as $V$. $Bl$ with the basic color factors produces purple-violet seed coat (Smith 1939; Tjebbes and Kooiman 1921, 1922a), changes oxblood red to purple (Smith 1939), and is responsible for bluish tints to plant colors (Tjebbes and Kooiman 1921). $bl$ with appropriate genes produces red seed coat (Tjebbes and Kooiman 1922a). According to Feenstra (1960) $V$ is the equivalent of the $B$ of Shull (1908) and of Tschermak (1912), the $F$ of Kooiman (1931), the $G$ of Shaw and Norton (1918), and the $Z$ of Sirks (1922).

$v^{ae}$  with $P$ $Gri$ gives laelia flowers and rose stem (Lamprecht 1935c).

$v^{pal}$  with $P$ $Gri$ gives clear light red flowers (Lamprecht 1936).

$v$  white flowers (Lamprecht 1935c).

$var$  *variegated*: environment-sensitive gene, in combination with $mu$ and $ur$ produces yellow lethal plants in a ratio of 63 normal:1 variegated (Coyne 1966).

$vi$  $(vir)$  *virecent* foliage mutant (Graften et al. 1983).


$X^{nu}$  *ex parte sursum versus*: causes the leaves and petals to point downward (Lamprecht 1961b); effect is similar to $Sur$, but pulvinule is rotated only 90°.

$y$  with $Arg$ produces yellow wax pod; with $arg$ the pod is white; $Y$ with $Arg$ produces green pod; $Y$ with $arg$ gives a greenish gray (silvery) pod (Currence 1931; Lamprecht 1947b).

$Z$  similar to $e$ in affecting size of eye pattern on seed coat (Smith 1939; Tschermak 1912); enters into sellatus and piebald patterns (Lamprecht 1934b); with $L$ and $t$ accounts for seven seed coat patterns (Schreiber 1940).
Appendix

Obsolete symbols removed from list

\( A \) basic color factor, producing yellow-brown (Kooiman 1931; Sirks 1922; Tjebbes and Kooiman 1922b; Tschermak 1912). It is the equivalent of \( P \), which has priority.

\( A \) indeterminate versus determinate, \( a \) plant habit (Emerson 1916; Norton 1915). Symbol superseded by \( \text{Fin} \) (Lamprecht 1935b).

\( A, B, C \) schematic genes contributing to the length and number of internodes (Emerson 1916). Also used as schematic genes contributing to hybrid vigor (Malinowski 1924).

\( A, B, C, D \) schematic genes each contributing 1 eg to a minimum seed weight (Sirks 1925).

\( an \) appears to have the functions of \( P \) (Hilpert 1949).

\( av, sv, iv \) confer resistance to bean common mosaic virus (Ali 1950; Petersen 1958).

\( B \) originally a "blackener", producing anthocyanin with the basic color gene \( P = A \) (Shull 1908; Sirks 1922; Tschermak 1912). According to Feenstra (1960) this gene is the equivalent of the \( G \) of Shaw and Norton (1918), the \( F \) of Kooiman (1920), the \( Z \) of Sirks (1922), and the \( V \) of Lamprecht (1932a) and Prakken (1934). It is the equivalent of Feenstra's \( C \) (1960).

\( B I \) hypothetical genes for testa vein color and orientation (Sarafi 1974). Data not sufficient to establish new genes (Bassett, editor).

\( Br \) According to Prakken (1972a) the \( Br \) of Smith is the same as \( B \). \( Br \) with \( PRk \) produces brown seed coat (Smith 1947), \( br \) with \( PRk \) pink seed coat, \( Br \) with \( PRk \) pink seed coat (Smith 1947). \( Br \) considered by Lamprecht (1967) to be identical with \( Och \).

\( C R \) hypothetical genes for seed coat color where \( C \) gives cream, \( R \) produces milky phenotypes, and \( r c \) produces pink (Sarafi 1974). The real genotypes probably involve the \( Rk \) locus and its modifiers (Bassett, editor).

\( C \) with \( P G r i V \) gives a bluish violet seed coat, violet flower and a violet tinge to other plant parts (Feenstra 1960); the equivalent of Lamprecht's \( R \) (Lamprecht 1940a).

\( Ca \) with color genes, \( canuncula \) stripe (Lamprecht 1932c). Prakken (1970) believed this gene is a synonym for \( G \).

\( Can \) according to Prakken (1972a) \( D \) is the equivalent of \( Can \) or \( Ins \) of Lamprecht (1939). \( Can \) with color genes gives a whitish (Speckwiss) testa (Lamprecht 1939) or blubber white (Lamprecht 1951a), with a yellowish brown hilum ring (Lamprecht 1939).

\( E \) intensifier with color genes (Tjebbes and Kooiman 1922b).

\( Epi Hyp \) interspecific genes for epigeal and hypogeal cotyledons in \( P. vulgaris \) and \( P. coccineus \), respectively (Lamprecht 1945, 1958). Lamprecht's model with \( Epi \) and \( Hyp \) giving 9 distinct phenotypes for cotyledon attachment position has been superseded by a quantitative model (Wall and York 1957).

\( Ext Int \) interspecific genes for \( external \) and \( internal \) stigma positions in \( P. coccineus \) and \( P. vulgaris \), respectively (Lamprecht 1945). Lamprecht's Mendelian model with the \( Ext \) and \( Int \) loci giving 9 distinct phenotypes for stigma form has been superseded by a quantitative model (Manshardt and Bassett 1984).

\( F \) was used as a color gene by Shaw and Norton (1918) with basic genes and their \( C \) for yellow to produce coffee-brown. It was also used similarly by Kooiman (1931) with \( C \) for yellow or orange-brown plus \( E \), producing coffee brown, to give black (\( ABECEF \)). The combinations \( ABF, ACF, \) and \( ADF \) had pale lilac flowers (Tjebbes and Kooiman 1922b) perhaps the equivalent of \( v^b \). The gene is no longer recognized.

\( Flav \) has a light yellow influence (Lamprecht 1951a) on seed-coat color; previously considered to be recessive (Lamprecht 1939). Prakken (1970) believed this gene is a synonym for \( G \).

\( H \) described by Shaw and Norton (1918) as producing light brown or olive. Considered by Feenstra (1960) as the equivalent of the \( D \) of Shull (1908), the \( C \) of Tschermak (1912), the \( E \) of Kooiman (1931), the \( L \) of Sirks (1922), the \( B \) of Lamprecht (1939), the \( B \) of Prakken (1934), the \( B \) of Feenstra (1960), and the \( Bl \) of Smith (1939).

\( inh \) inhibits the action of \( V \) on seedcoat colors (Lamprecht 1940c).

\( Ins \) according to Prakken (1972a) \( D \) is the equivalent of \( Can \) or \( Ins \) of Lamprecht (1939). \( Ins \) with appropriate factors gives light buff (Lamprecht 1939) or raw silk (Lamprecht 1951a) testa; has a hilum ring.

\( lin \) \( lineatus \) (Latin): produces red veins in wing petals (Lamprecht 1935c). According to Prakken (1972a) red veins in wing petals are a pleiotropic effect of the testa color gene \( Rk^2 \).

\( Ms^a \) causes striping of the seed coat (Smith 1947); redesignated \( R^a \) (Lamprecht 1947a).
Ms In-ms  

*Ms* confers male sterility and *In-ms* inhibits action of *Ms*, restoring pollen fertility; *in-ms Ms* is lethal (Mutschler and Bliss 1980). Without translocation heterozygosity to account for the semisterile class, the validity of the model is questionable (Ashraf and Basset 1986).

Nud

with *P Gri* gives purple, waxy stem and crimson flowers (Lamprecht 1935c).

Och

with *P Gri C j* gives ochre yellow tints such as ochraceous, Hell Lohnfarben, light tawny brown, tawny olive to clay (Lamprecht 1933, 1939); has colored hilum ring (Lamprecht 1939); epistatic to *Vir* (Lamprecht 1939). Prakken (1970) believed this gene is a synonym for *G*.

P

(schematic) increases vigor with *ABC* (Malinowski 1924).

Pur

obsolete symbol for *V* (Lam-Sanchez and Vicira 1964; Okonkwo and Clayberg 1984), originally *Pur Ro* has a deep purple pod (Lamprecht 1951b).

R

(schematic) increases vigor with *ABC* (Malinowski 1924).

rk

*rk* gives pink background color with *C R* or *C R* and recessive to *rk* for red background color (Messiaen et al. 1983). Probably *rk* is equivalent to the *rk* of Smith (1961) and the *rk* of Messiaen et al. (1983) is equivalent to the *rk* of Smith (1961).

S

(schematic) increases vigor with *ABC* (Malinowski 1924).

Vir

with *P Gri C virescens* or greenish shades on the testa (Lamprecht 1933); among these are Russgrun or olive black. Prakken (1970) believed that *Vir* is a synonym for *B*.

Ws

confers resistance to *Whizelina* (now *Sclerotinia sclerotiorum*). Gene is no longer in use (Abawi and Provvidenti 1978).

Xx

early designation for inconstant mottling of the seed coat (Emerson 1909a); now *Cc* (Lamprecht 1940a).

Z

constant mottling of the seed coat (Tjebbes and Kooiman 1919a); now *R*.

Z-1

self-colored seed coat (Tschermak 1912); the equivalent of *T*.

Z-2

pigment extender (Tschermak 1912); the equivalent of *E*.  

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- *Ms* confers male sterility and *In-ms* inhibits action of *Ms*, restoring pollen fertility; *in-ms Ms* is lethal (Mutschler and Bliss 1980). Without translocation heterozygosity to account for the semisterile class, the validity of the model is questionable (Ashraf and Basset 1986).

- Nud: with *P Gri* gives purple, waxy stem and crimson flowers (Lamprecht 1935c).

- Och: with *P Gri C j* gives ochre yellow tints such as ochraceous, Hell Lohnfarben, light tawny brown, tawny olive to clay (Lamprecht 1933, 1939); has colored hilum ring (Lamprecht 1939); epistatic to *Vir* (Lamprecht 1939). Prakken (1970) believed this gene is a synonym for *G*.

- P: (schematic) increases vigor with *ABC* (Malinowski 1924).

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<td>Terry E. Marquardt</td>
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</tbody>
</table>
BEAN IMPROVEMENT COOPERATIVE
FINANCIAL STATEMENT

Balance on hand March 31, 1988 $ 3,816.13

Income

Dues collected $ 3,527.50
Bank account interest earned 98.26

Expenses (1988 issue)

Printing and Photocopying $ 1,875.99
Postage 1,436.41
Office Supplies 323.67
Secretarial Services 465.50

Cash on hand

1989 dues $ 1,974.82
1990 dues 1,011.50
1991 dues 282.00
1992 dues 65.00
1993 dues 7.00

Balance on hand March 15, 1989 $ 3,340.32