PROPOSED SYMBOLS FOR ANTHRACNOSE RESISTANCE GENES.

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In the current list of Genes in Phaseolus vulgaris L. published in the 1993 BIC report, the only genes included which confer resistance to bean anthracnose (caused by Colletotrichum undemuthianum (Sacc. & Magnus) Lams.-Scrib.; Schwartz, 1991) are the A and Are genes despite published information on other genes and their utilization as resistance sources in differential cultivars used in the characterization of anthracnose races (Fouilloux, 1979; Pastor-Corrales et al., 1994; Schwartz et al., 1982). We wish to propose a system of nomenclature for all genes conferring resistance to anthracnose to assist in race characterization, gene mapping and tagging, gene deployment and pyramiding and breeding for durable resistance.

The proposal is to name all genes which confer resistance to bean anthracnose with the symbol Co for Colletotrichum. This would follow the system used for rust resistance genes (Ur for Uromyces) in P. vulgaris. The use of the symbol Cl (Colletotrichum undemuthianum) is not recommended because the symbol cl (lower case) is used for circumlineatus (BIC 36:viii, 1993). The system would be applied to both new and previously reported genes.

1) Although the A gene is the first anthracnose resistance gene reported in the literature (McRostie, 1919) and, therefore should take precedent as the symbol, it has not received widespread recognition in the literature. The few references to the A gene are papers by Cardenas et al., (1964), Fouilloux (1979) and most recently by Kelly et al., 1994. The letter A is not very descriptive of the function of the gene and over the years, the symbol A appears all too frequency to be used as a gene symbol for a diverse group of functions (BIC 36:xv, 1993).

We would propose that the single dominant A gene present in the second differential cultivar, Michigan Dark Red Kidney be renamed Co-1. The original report on the A gene demonstrated that it afforded resistance to the alpha race (McRostie, 1919), but recent studies are now showing that it has a broader resistance spectrum (Kelly et al., 1994; Tu, 1994) and confers resistance to many of the more virulent races of anthracnose present in Central America (Pastor-Corrales et al., 1995; Schwartz et al., 1982). Linked markers confirm the extensive use of this gene in both Andean and Middle American cultivars (Young, 1995).

2) The Are gene, since its discovery and publication by Mastenbroek (1960), has been widely utilized by breeders as a source of resistance and extensively reported in the literature (gene tagging: Adam-Blondon et al., 1994; Young and Kelly, 1996a; genetics: Fouilloux, 1979; Muhalet et al., 1981; breeding: Bannerot, 1971; Menezes and Dianese, 1988; Tu, 1992).

We would propose that the independent dominant Are gene present in the differential cultivar Cornell 49242 be renamed Co-2. The A and Are genes are independent and are combined in the cultivars Newport (Kelly et al., 1995) and Isles (Kelly et al., 1994).
3) The next group of independent single dominant anthracnose resistance genes are the *Mexique 1*, *2, 3* genes (Schwartz et al., 1982). These genes originated in Mexican germplasm and were identified in France by Bannerot and Fouilloux. *Mexique 1* gene present in Mexico 222 was originally described by Bannerot, (1965) and demonstrated by Fouilloux (1979) to be allelic to the single dominant gene present in Mexico 227. *Mexique 2* gene present in TO was originally described by Bannerot et al., (1971) and Fouilloux (1976). *Mexique 3* gene present in TU was reported by Fouilloux (1976, 1979) to be independent of the other two *Mexique* genes. All three genes are independent of the *Are* gene (Fouilloux, 1979; Pastor-Corrales and Tu, 1989) and with the exception of the allele in Mexico 227 are currently used in the anthracnose differential series as major discriminating genes for race characterization.

With the consent and support of the following French authors; M. Dron, C. Neema, V. Geffroy, A.F. Adam-Blondon, H. Bannerot and G. Fouilloux, we would propose tentatively renaming these genes as follows: *Mexique 1* gene present in the differential cultivar Mexico 222 as *Co-3*; the gene present in Mexico 227 cultivar shown to be allelic to the *Mexique 1* gene as *Co-3^2*; *Mexique 2* gene present in the differential cultivar TO as *Co-4*; and the *Mexique 3* gene present in the differential cultivar TU as *Co-5*. Although all three Mexique genes are independent of each other and the *Are* gene, *Co-3* and *Co-4* are assigned tentative symbols since their independency from the *A* gene has not been clearly established. Young and Kelly (1996b) demonstrated the independency of the *Mexique 3* gene in Sel 1360 from all other genes, so *Co-5* is clearly independent of the *A* gene.

4) The next gene not previously reported is a single dominant independently assorting gene present in the anthracnose differential cultivar AB 136 first described by Schwartz et al., 1982. This gene has been shown to be independent of all other previously characterized genes and linked RAPD markers confirm that it is unique to the differential cultivar AB 136 and lines derived from that cultivar (Young, 1995).

We would propose naming the dominant gene present in the differential cultivar AB 136 as *Co-6*.

5) The next group of genes are the two independently inherited single dominant genes present in the anthracnose differential cultivar G2333 (Colorado de Teopisca; Pastor-Corrales et al., 1994). Since G2333 possesses two independently assorting genes, their relationship to other resistance genes was not studied. Using two lines (Sel 1360, Sel 1308 received from S.Beebe in CIAT) derived from G2333 through backcrossing with a susceptible cultivar (Talamanca), Young and Kelly (1996b) showed that the resistance gene present in Sel 1360 was the previously characterized *Mexique 3* gene in the differential cultivar TU. This fact was confirmed with a linked RAPD marker which was present in Sel 1360, TU and G2333 (Young, 1995). The gene present in Sel 1360 is not as broad based as the second gene(s) present in Sel 1308.

We would propose that the single dominant gene present in Sel 1360 and G2333 be assigned the symbol *Co-5* for the *Mexique 3* gene.
6) Based on additional data, Young and Kelly (1996b) have suggested that G2333 may in fact carry three independent factors conditioning resistance to anthracnose, rather than the two proposed by Pastor-Corrales et al., (1994). Since those authors used race 521 to screen their segregating population, the *Mexique 3* gene would not have been detected because it is overcome by race 521. Research to separate and tag the other resistance factors in G2333 is underway using Sel 1308 as the source of the second independently inherited resistance gene.

The second gene(s) in G2333 which conditions a broader resistance spectrum (Race 1545 overcomes the resistance gene in Sel 1360 but not the resistance gene in Sel 1308) could tentatively be known as *Co-7* and its presence in both Sel 1308 and the differential cultivar G2333 will be confirmed with linked markers.

### PROPOSED GENE SYMBOLS FOR NEW AND PREVIOUSLY DESCRIBED ANTHRACNOSE RESISTANCE GENES.

<table>
<thead>
<tr>
<th>GENE</th>
<th>SYMBOLS</th>
<th>SOURCE</th>
<th>GENE POOL</th>
<th>LINKED MARKERS</th>
<th>REFERENCES</th>
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<td>New</td>
<td>Original</td>
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<tr>
<td>Co-1</td>
<td>A</td>
<td>Michigan DR Kidney</td>
<td>Andean</td>
<td>OF10&lt;sub&gt;530&lt;/sub&gt;</td>
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<td>Are</td>
<td>CN-49242</td>
<td>MA</td>
<td>OQ4&lt;sub&gt;440&lt;/sub&gt;, OH20&lt;sub&gt;450&lt;/sub&gt;, B355&lt;sub&gt;1000&lt;/sub&gt;</td>
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<tr>
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<td>Mexico 222</td>
<td>MA</td>
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<td>MA</td>
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<td>Pastor-C., 1994</td>
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* NA - None assigned previously; MA - Middle American.
LITERATURE CITED


