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Bean common mosaic virus (BCMV) and bean common mosaic necrosis virus (BCMNV) are seed-borne viruses of dry and snap beans. The viruses are transmitted by several aphid species and result in yield losses and delay in maturity in susceptible bean varieties grown for seed or green pod production. BCMV and BCMNV viruses were once considered to be the same virus, but recent research has shown that the two viruses are distinct and different.

BCMV originated in the Americas and is one of the earliest reported virus diseases of plants in the world. BCMNV originated later in eastern Africa, probably as a result of recombination of BCMV strains after beans were introduced into the region in the 1600s. BCMNV spread from eastern Africa in bean seed of susceptible bean varieties shipped to other countries. Strains of both BCMV and BCMNV occur in Michigan. Field infections by BCMV have been reported as high as 100 percent in susceptible bean varieties. Yield losses vary, depending on varieties, environment and time of infection, and whether the disease originates as a seed-borne infection or is carried in later by aphids. BCMNV causes a hypersensitive reaction known as black root on certain bean varieties that carry the dominant I gene, regardless of the temperature. This hypersensitive reaction can result in the death of whole plants and can cause yield losses of 100 percent.

Infected seeds and plants of susceptible bean varieties serve as sources of initial inoculum of BCMV and BCMNV. Plants grown from infected seed are almost always stunted and unproductive. Plants infected by aphids later in the growing season usually show less yield loss, but seeds harvested from such plants may be infected and should not be used for planting stock.

Symptoms

The typical symptoms of both BCMV and BCMNV are a light green or yellow and dark green mosaic pattern (Figs. 1a and 1b) on leaves, usually accompanied by puckering, distortion and rolling of the leaves. Other symptoms seen on susceptible hosts include mottling, curling and malformation of leaves, as well as general stunting of the plant. Plants infected early in the growing season or grown from infected seed may suffer a delay in maturity and have fewer pods and fewer seeds per pod than healthy plants.

In varieties possessing the dominant I gene, BCMNV causes black root disease (Fig. 3). Symptoms of the hypersensitive black root reaction begin as small, red-brown spots on leaves that expand into a dead area, and eventually the

Figure 1a. Leaf puckering and mosaic symptoms (alternating areas of light and dark green) characteristic of the susceptible reaction to BCMV and BCMNV.

Figure 1b. Typical leaf distortion in susceptible bean plants infected with BCMV and BCMNV. Note the elongated and rolled up leaves.

death of the whole plant (Figs. 2 and 3). Certain strains of BCMV can cause black root in I gene varieties only at high temperatures (above 90 degrees F). The death of plants as a result of the hypersensitive reaction prevents the plants from serving as a source of inoculum or infected seed for the next planting generation. When black root affects a large number of plants in the field, substantial yield losses result (Fig. 3).

Figure 2. Hypersensitive reaction observed on inoculated leaves of plant in the greenhouse. Note: The resulting plant death is due to inoculation with BCMNV.

Figure 3. Black root symptoms in the field. Entire plantings of beans may die.

Control of BCMV and BCMNV

Chemical control of the aphid vector is ineffective, so the most effective control is to plant resistant varieties whenever possible. Resistant varieties with the dominant I gene are available for planting (Table 1). In addition, some varieties contain recessive genes with specific resistance to BCMV and BCMNV.

Bean breeders have combined these recessive genes with the I gene in new bean varieties as a reasonable way to achieve a long-lasting resistance against a large number of strains of both BCMV and BCMNV.

The use of clean, virus-free seed is critical if there is no choice of resistant varieties. Plants developing from infected seed are generally stunted and may not produce seed. Even a low rate of infected seed can result in rapid and widespread disease development when an abundant population of aphid vectors is present, so the safest procedure is to use seed with no detectable seed-borne BCMV and BCMNV, and plant only resistant varieties.

When susceptible varieties are used, field establishment should be done in isolated areas far from bean production, and the seed should be tested by the Michigan Department of Agriculture (MDA) lab to determine that it is free of seed-borne BCMV and BCMNV. Because the test is a grow-out test, it is critical to supply a representative sample of seed for testing to ensure that the seedlot is adequately tested.

Table 1. Reaction of Michigan commercial dry bean varieties to inoculation with BCMNV.*

Variety	Disease reaction	Variety	Disease reaction
Schooner	R-I	Tebo	Mosaic
Mayflower	R-I	Chinook2000	R-I
Vista	R-I	Red Kanner	R-I
Navigator	R-I	Calif. ELRK	R-I
ROG 331	R-I	Beluga	R-I
T-39	R-I	Montcalm	R-I
Midnight	R-I	Red Hawk	R-I
Onyx	R-I	Isles	R-I
Jaguar	R-I	Hooter	R-I
Black Jack	R-I	Taylor	Mosaic
Domino	R-I	Mi. Improve Vine	Mosaic
Buster	R-I	Brooks	Mosaic
Othello	R	Merlot	MM
Vision	Mosaic	Rufus	MM
Matterhorn	R-I	UI 239	R

R-I = Resistance from I gene.
R = Resistance from recessive genes.
MM = Mild mosaic or partial resistance.
Mosaic = susceptible.
* = inoculated with NL3 strain of BCMNV.

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