

## Fungicides Needed to Protect Spinach After Failure of Plant Resistance to Mildew

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Downy mildew, also known as blue mold, is probably the most widespread and potentially destructive disease of spinach worldwide [1]. The disease first appears on leaves as small pale or yellow spots that enlarge rapidly. The spots, yellow on top and gray beneath, later die producing light brown areas on the leaves [2]. A fuzzy bluish gray growth appears on the underside of the leaves (hence the common name 'blue mold'). Spores are transported by wind to other sites [3]. When environmental conditions are favorable, epidemics can progress very rapidly and an entire crop may be lost in a short period [4].

Until the late 1950's the U.S. spinach industry was not highly viable. Cultivars were susceptible to downy mildew, which caused severe reductions in quality and in some cases complete loss of the crop [3]. Control by fungicide spray was not practical. Because there were no effective controls, a search for resistance to downy mildew was begun in 1946. As a result of cross breeding with commercial varieties, new commercial hybrids with immunity to downy mildew were released in the mid 1950s. At this time, there were only two races of the organism causing downy mildew on spinach worldwide and the hybrid plants had immunity to both races [3].

For twenty years, downy mildew was unknown on spinach in the U.S. In the late 1970s a new race of the downy mildew fungus appeared and spread rapidly in U.S. spinach fields causing heavy losses [3],[5]. A gene for resistance to race three was used in spinach cultivars as early as 1982 and provided resistance to downy mildew on spinach in the U.S. until 1989 when race 4 became established [4]. As a result, spinach cultivars with resistance to races 1,2 and 3 became infected with downy mildew [6]. Since then, downy mildew races 5-10 have been discovered.

Little or no work had been done with fungicides on spinach because the resistance had been so effective. Research revealed that certain fungicides were highly effective in controlling downy mildew; whereas untreated plots incurred a 43 percent reduction in yield, the treatments reduced the yield loss to 1 percent [7]. Downy mildew is relatively rare in spinach fields because of the use of fungicides [8].

### References

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Downy mildew on spinach  
in field



Downy mildew on spinach



Magnified downy mildew on  
spinach leaf