Charcoal root rot limits potential of chickpea in the Central Valley

Andrew C. Magyarosy □ Richard M. Hoover
Joseph G. Hancock

The fungus is also present in coastal areas but doesn't cause disease

Macrophomina root rot causes dark brown to black (charcoal) discoloration and loss of feeder roots. Microsclerotia fill affected roots, which will decompose by the end of the growing season.

Chickpea, or garbanzo bean, is an important high-protein staple crop in many parts of the world, especially in the Middle East and Southeast Asia. In the United States it is mostly used as an ingredient in Italian and Greek salads. Ninety percent of the U.S. crop is grown on about 8,000 acres along the Pacific coast near Santa Maria and San Luis Obispo, California.

Chickpea, *Cicer arietinum* L., has been reported to be affected by several soil-borne diseases in California, including Fusarium and Verticillium wilts, and a variety of root rots caused by *Pythium, Rhizoctonia,* and *Macrophomina. Macrophomina* has not been a serious problem in the past, because the relatively cool coastal areas in which chickpeas have traditionally been grown in California are not favorable for development of the disease. In 1984, severe Macrophomina root rot occurred on chickpea in a Central Valley test plot, raising the question of its potential to limit production of the crop in that area.

In the spring of 1984, on a 2-acre plot at the West Side Field Station near Five Points, California, three cultivars of chickpea were grown with the aim of introducing it as a winter crop in the San Joaquin Valley. The attempt met with little success because of an unexpected infection of the plants by a soil-borne fungus, *Macrophomina phaseolina,* which made harvest uneconomical.

In addition to chickpea, important crops such as corn, sunflower, soybean, cotton, and sorghum are susceptible to this fungus. Unlike other root-rot-causing organisms such as *Pythium* and *Rhizoctonia, Macrophomina* causes damage only in soils with temperatures of about 80°F or higher. Crop damage is particularly severe where extreme fluctuations in soil temperatures occur between day and night. This condition is especially prevalent in San Joaquin Valley agricultural soils.

Above-ground symptoms of the disease include yellowing and stunting of the plants and premature ripening of pods, but no visible discoloration of stem conducting tissue. These symptoms make the disease easily distinguishable from the common wilts caused by *Fusarium* and *Verticillium.* The most striking below-ground symptoms are a black (charcoal) discoloration of the roots and a lack of feeder roots; thus, the disease is often referred to as charcoal rot. The root cortex and the pith of diseased plants are filled with microsclerotia of the fungus, giving it a grayish appearance. The fungus survives in the soil for a number of years as microsclerotia but becomes a pest only in soils with relatively high temperatures.

Isolations from roots and stems of yellowing plants from the West Side Field Station plot consistently resulted in recovery of *Macrophomina phaseolina.* We performed pathogenicity tests of the chickpea isolates in temperature-controlled greenhouses in Berkeley at 60° and 90°F with two cultivars, UC #5 and Saratato 77. Plants that were either experimentally inoculated with the fungus or grown in naturally infested soil from the chickpea field showed symptoms of charcoal root rot only when incubated in the 90°F room. *Macrophomina phaseolina* was consistently reisolated from the infected roots and soil.

Similarly treated plants in the 60°F environmental room remained disease-free, although the fungus was present and was readily recovered from the soil. When the same plants were transferred to the 90°F room, they all became diseased. These studies clearly show that *Macrophomina phaseolina* is the causal agent of the observed root rot of chickpea at the West Side Field Station, and they support the contention that the fungus, even if present in the soil, may cause damage only in areas with high summer soil temperatures.

Macrophomina phaseolina has been reported to be seed-borne on many crops, including cotton, sunflower, sorghum, and corn. In this connection, it is interesting to mention that Dr. R. Raabe, UC Berkeley, found that soil particles of the same size and shape as chickpea seeds were the source of initial inoculum of this fungus and two other root-infecting fungi in the King City area. Most chickpea seeds are produced in the cooler coastal area of California, where the fungus is present in the soil but does not cause disease. When such seeds are planted in areas with high soil temperatures, *Macrophomina* may infect the plant and cause crop losses.

Based on our findings, we recommend caution in any decision to grow chickpeas in the Central Valley. Both the source of inoculum (possibly seeds contaminated with soil particles) and the population of the fungal microsclerotia in the soil should be assessed before planting. Further studies on the economics of this important soil-borne plant pathogen in the Central Valley are clearly needed.

Andrew C. Magyarosy is Research Scientist, Department of Plant Pathology, University of California, Berkeley; Richard M. Hoover is Superintendent, UC West Side Field Station, Five Points; and Joseph G. Hancock is Professor, Department of Plant Pathology, UC Berkeley.