Lima Bean Tolerant to Stem Rot

strain of large seeded lima resistant to stem disease offers possible transference of resistance to commercial varieties

J. B. Kendrick, Jr., and R. W. Allard

Basal stem rot of the lima bean in California is a destructive disease.

The most severe phase of basal stem rot—induced by Rhizoctonia solani Kuhn—occurs within the initial four weeks after emergence. Characteristic brick-red, oval, sunken lesions marked with concentric rings develop on the hypocotyls of infected plants. These lesions may ultimately enlarge and girdle the stem. Lateral roots are not extensively infected. Infected plants are often stunted, especially when subjected to water stress. Occasionally severely infected seedling plants are killed, reducing stands by 10% or more in heavily infested fields. As plants become older, development of the disease slows down and partial to nearly complete recovery is frequent.

Rhizoctonia basal stem rot is particularly serious in coastal southern California on lima beans grown for quick freezing. Besides reducing yields, it causes uneven maturity resulting in higher processing costs and lower quality.

A survey of lima bean varieties or strains has been conducted to discover sources of resistance which may be useful in the control of this disorder if it is possible to make the transfer to commercial varieties in the lima bean breeding program.

One hundred fifteen varieties or strains of lima beans were tested for reaction to basal stem rot. The majority were from the lima bean accession series maintained at Davis. The rest were supplied by the United States Department of Agriculture. The varieties or strains tested each season included the most promising material of previous tests.

All testing was conducted in commercial fields having a history of poor plant stands and severe root decay. Field plantings were arranged in randomized complete blocks with four replications. Individual plots consisted of single rows 25’ long. Approximately four to eight weeks after emergence, 10 plants were pulled from each plot and rated in one of five arbitrarily chosen classes for hypocotyl decay. Plants with no visible decay or discoloration were placed in class 0; those with superficially discolored hypocotyls, in class 25; those with definite lesions involving not more than 50% of the hypocotyl, in class 75; and those with from 75% to 100% hypocotyl decay, in class 100. A disease index was calculated for each plot as the sum of the products of the class values multiplied by the number of individuals within the class, divided by the number of individuals sampled in the plot. The predominant edible lima bean varieties of southern California, Concentrated Fordhook—for freezing—and Ventura—dry—were included as controls in all trials.

The initial test, in 1949, included 10 varieties and 22 strains of lima beans and was located in Ventura County on a sandy loam soil known to be heavily infested with Rhizoctonia solani. The response of the 10 varieties and one of the strains is shown in the table on page 15. The remaining seed lots tested were all highly susceptible to this disease. Of the 32 items tested in 1949, US 403A was the only one which had significantly less hypocotyl decay than Concentrated Fordhook.

Four varieties and 46 strains were tested the next season in Ventura County in another field—clay loam soil—located farther inland and subject to fewer coastal fogs. The reactions of the four varieties and two of the strains are shown in the table. The remaining 44 strains were found to be highly susceptible to basal stem rot. Both control varieties were less severely diseased in this trial than in the previous trial. Under the cir-

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Growth of strain 1-4 (row 312) compared with that of two susceptible strains in soil naturally infested by Rhizoctonia solani.
The resistance shown by US 4Q3A in the only superficial hypocotyl discoloration. The mean trials, were tested in 1951 on a heavy loam soil in Orange County. The mean difference in response by one variety em-
cluded 42 lines derived from single plants subject to coastal fogs. The sandy soil of L-4 fell in class 75, 30 in class 50, and seven in class 25. One of the seven lines with the lowest disease index was selected as the source of tolerance in a breeding program designed to improve the reaction of Concentrated Fordhook to this disease.

Strain L-4 is very similar to the Giant Calico variety which was reported to have germinated significantly better in unsterilized soil at 50°F than the Ford-
hook, Henderson, and Jackson varieties. The superiority is attributed in a large measure to resistance of the cotyledon to infection by Rhizoctonia. The two types—L-4 and Giant Calico—may be ident-
tical. Transfer of their tolerance to Rhizoctonia solani into commercial vari-
eties should prove a major step in reducing losses in yield and quality of lima beans caused by the poor stands and root destruction resulting from attacks of this organism.

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CONTROLS

The diverted acres in the central San Joaquin Valley trended heavily into grain, hay, and pasture. In both these last two subareas, dairying and beef are well established, although on the East-
side dairying, in particular, tended to decline from 1947 to 1953.

The soil and water conditions on the Westside limited possible adjustments. Water costs are high; establishing and developing a well often involves invest-
ments of $35,000 to $50,000. Common practice has been to combine a winter crop—such as barley—with cotton in such an acreage ratio as to use the full capacity of the well for 10 months or more of the year. Growers have found alternatives for cotton—such as alfalfa—assuring them a net return, much less an equivalent level of earnings.

Farmers operating all farm sizes re-

capacity—resulting from the acreage cut—was followed by a drop in custom rates for mechanical picking as well as for hand picking during the 1954 cotton harvest season. The majority of Cali-

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The tendency of growers to increase capital investment in permanent im-
provements and equipment is most evi-
dent on the part of larger operators and of farmers who either own their land or have a longtime lease, frequently some type of development lease.

The acreage control programs have varied in effect depending on tenure. For example, a cash-lease grower—operating in a high water-cost area—might be paying $20 an acre year for 80 acres in cotton. Under the control program he would be cut to 40 acres of cotton. Therefore, he would, in effect, be paying $100 an acre rent, and—in a high water-cost area—it is difficult to find a profitable alternative crop for cotton.

The farmer with a development lease finds himself with a similar difficulty. He has undertaken to pay for a considerable investment in farm improvements— in lieu of rent—over a period of years. He finds his financial position weakened or endangered to the degree that the control program lessens his ability to meet the fixed payments he has assumed.

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