

A Device for Measuring Bean Plant Anchorage and its Relation to Root Rot Severity

Sidney R. Siemer and Edward K. Vaughan

Former Research Assistant and Professor, respectively, Department of Botany and Plant Pathology, Oregon State University, Corvallis 97331. Present address of senior author: Agricultural and Veterinary Products Division, Agricultural and Veterinary Products Division, Abbott Laboratories, 2035 E. Shields Avenue, Fresno, California 93726.

ABSTRACT

Data are presented showing close agreement between a root disease rating system and the tension required to pull bean plants from the ground by means of a spring scale coupled to visegrip pliers. Where applicable, this method is capable of quantitative measurements of anchorage and disease with significant time savings and greater reliability than is possible by any subjective method. *Phytopathology* 61:590-591.

Additional key words: *Fusarium solani* f. sp. *phaseoli*, *Phaseolus vulgaris*.

Until recently, the Blue Lake bean industry in Oregon was based entirely upon pole varieties. All were susceptible to *Fusarium* dry root rot (*Fusarium solani* f. sp. *phaseoli* [Burk.] Snyd. & Hans.) which has not yielded to chemical control. In most cases, the original root systems rotted away but the plants were of high vigor, and if given adequate water and fertilizer were able to produce adventitious roots fast enough to keep the aboveground portion of the plants healthy and to produce good yields of beans.

The acreage is now shifting rapidly from pole varieties, which are harvested by hand, to bush varieties, harvested mechanically. All bush varieties are susceptible to root rot. Poorly anchored plants are uprooted and clog the harvester reels, causing expensive delays.

In the past, root rot has been rated on a disease severity scale. Such rating systems require individual judgment of each plant, and at best are subjective. Sustained periods of evaluation, varying light intensity, and different varieties cause variations in interpretation. Differences among individuals rating plants in the same field add to the variations.

A device was developed that measures the tension required to pull a plant from the soil. Experimentation showed that increased root rot severity, as rated by several people, coincided with a decrease in anchorage, as measured by the mechanical device.

A Hansen Viking Jr. scale with a 25-lb. capacity was modified by adding a sliding maximum indicator. With this modification, 5 lb. of the scale span was lost, reducing the maximum capacity to 20 lb. The scale was attached to a 6-inch vise grip pliers. It was found essential to attach the scale to the pliers as close as possible

to the point of attachment to the plant to minimize the shear angle. A flexible method of linkage between the pliers and the scale was found more desirable than a rigid link.

Attachment to the plant was easy and rapid after the jaws of the pliers were properly adjusted. The screw adjustment on the pliers allowed any desired interval between the jaws, minimizing crushing of the plants. An efficient jaw setting was found by a short trial period of operation. Once determined, the setting required only occasional adjustment. Sampling was done by randomly selecting plants in a row, moving far enough away from the last pulled plant to pull one with roots in undisturbed soil.

The scale used produced the desired results; however, one having a greater capacity and a mechanically attached indicator might improve over-all operation. The device was tested by pulling many plants from a field where root rot was present, recording the number of lb. "pull" required for each plant, then rating the roots of each plant with a typical disease rating system where 1 = no disease; 2 = slight disease; 3 = moderate disease; 4 = severe disease; and 5 = very severe disease, plants usually dead. Table 1 compares disease ratings with pounds of resistance categories (PRC), which were 5-lb. increments. The distribution was more distinct than would be obtained with a rating system, and also reflects differing levels of disease more meaningfully.

In the comparison study, whenever the rating system showed severe disease, resistance to removal from the soil always was reduced, but when the scale showed reduced resistance, there was not always a corresponding high disease rating. Small plants crowded out by competition but still having sound roots often gave lower readings, accounting for part of this paradox. Some larger plants yielded upon reduced pull, but usually these had fewer fibrous roots, and generally a less well-developed root system than other plants of the same variety and of comparable size.

The tension method was used to measure root rot disease in two large root rot control trials (261 plots total) and one plant spacing trial. Results were obtained with fewer differences of opinion between individual examiners than when disease ratings were used.

TABLE 1. Comparison of bean root rot disease (*Fusarium solani* f. sp. *phaseoli*) ratings and plant anchorage of Thoroughgreen beans expressed in pounds of resistance categories (PRC)

Disease rating ^a	% Distribution of disease-rated plants in lb. of resistance categories			
	PRC			
	0-5	6-10	11-15	16-20+
1	0	1	5	94
2	0	3	35	62
3	8	54	38	0
4	83	17	0	0
5	0	0	0	0

^a 1 = no disease; 2 = slight disease; 3 = moderate disease; 4 = severe disease; 5 = very severe disease, plants usually dead.

With the scale measurements, differences were present but could easily be settled by averaging; with the examiners' observation differences, each had to be arbitrated or re-established. Time savings with the device were measurable in days.

Inherent differences existed between bean cultivars when tested by this method. All other conditions being equal, some cultivars had stronger root systems and were anchored better than others. This would require

consideration if cultivars were to be compared. Spacing influenced resistance to pull, as did soil type, soil compaction, and soil moisture. No doubt other factors also influenced resistance to pull, but if adequate replication is used, most variables may be compensated for by evaluating all plots of one trial on the same day. If a test is too large for evaluation in 1 day, it would be desirable to evaluate whole replicates in each unit of time.