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IDAHO Agricultural
Experiment Station

BULLETIN 217
August 1954

IDAHO BOUNTIFUL AND GOLDEN GEM SNAP BEANS RESISTANT TO MOSAIC AND CURLY TOP

by

Leslie Dean and C. W. Hungerford¹

INTRODUCTION

Virus diseases of beans have long been recognized as a major limitation to further expansion of Idaho's bean-seed industry. As early as 1925 the University of Idaho began research for alleviating the bean-virus disease problems. Attention was first directed to the common mosaic disease which is not only spread in the field by insect vectors but is seed-borne as well. Important contributions were soon forthcoming which have proved of great value. Field bean types, then universally susceptible to common mosaic, were replaced by new varieties resistant to this widespread virus. Shortly thereafter mosaic-resistant Refugee garden beans were developed and became important varieties. Idaho Refugee and Wisconsin Refugee, developed by the University of Idaho in cooperation with the University of Wisconsin, and U. S. 5 Refugee, developed by the United States Department of Agriculture, were soon considered to be the standards of quality and yield in snap bean varieties for bean processors. Plants affected by mosaic gave low yields, were slow to mature and produced a high percent of misshapen pods of low quality.

The serious restriction of the bean-seed production area by extensive damage from curly top indicated the importance of incorporating the resistance factors of Burtner Blight-Proof and Red Mexican into other varieties. Beans infected with curly top in an early stage of growth were killed. Older plants becoming infected are only stunted but produce little seed. This virus, not being seed-borne, is prevalent only in arid areas where the sugar-beet leaf-hopper is a common insect. Curly top is, however, the disease which limits the area in southern Idaho where susceptible bean varieties can be successfully grown. Breeding for resistance to this disease began in 1931.

In 1942 a variant strain of common bean mosaic was found to be present in certain bean varieties until then considered resistant to mosaic. Fortunately certain other mosaic-resistant varieties were also resistant to the variant strain of mosaic and had been used as parents in the improvement program. Many susceptible varieties are more severely affected by the variant than by the common virus.

In spite of the limitation by curly top, the bean growing area in southern Idaho has become the most important area of the

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United States in the production of high quality bean seed. Freedom from seed-borne bacterial and fungus diseases, due to favorable climate, are primarily responsible for location of the garden bean-seed industry in Idaho. To allow for extension of this industry into other favorable areas in southern Idaho, it is essential that curly top resistance also be incorporated into the important snap bean varieties.

New Snap Beans Developed

Resistance to curly top has been obtained from Burtner Blight-Proof. This variety produces short pods that are fibrous and have strings. The undesirable characteristics inherited from this parent have been difficult to eliminate.

Mosaic-resistant Corbett Refugee, a field selection made by Ralph Corbett, from a susceptible Refugee variety, has been used throughout this program as the source of mosaic resistance. Fortunately this variety also proved to be resistant to the variant strain of common bean mosaic, and this resistance was maintained in a relatively large number of breeding lines known to be resistant to curly top and common bean mosaic. From these lines the present releases of Idaho Bountiful and Golden Gem were chosen as being suitable for introduction. These new varieties are then immune to common mosaic and the variant strain, and, at least highly resistant to curly top.

Both forms of common bean mosaic are readily transmissible by mechanical means, and testing by such means is well adapted to greenhouse use where controlled conditions are maintained. This gives accurate selection of the virus involved and eliminates the possibility of chance natural infection with some mosaic virus with which the breeding project is not concerned. Immunity of both Idaho Bountiful and Golden Gem from each of the forms of common bean mosaic has been thus established through repeated unsuccessful attempts to transmit these diseases to them.

Curly top is not mechanically transmitted with any degree of success. Effective evaluation must depend upon natural transmission in the field by the sugar-beet leafhopper. This insect is the sole known vector of the curly top virus in the United States. The curly top elimination plot is situated in an area near desert breeding grounds favorable to production of high populations of this insect. Infection of susceptible plants is further aided by interplanting the beans, which are unfavorable hosts to the leafhopper, with susceptible type sugar beets on which the insect reproduces readily. Infected overwintered beet roots are spaced throughout the beet-rows to serve as a reservoir of infection. Leafhopper populations vary from season to season and between locations within seasons. Plantings, for elimination of curly top-susceptible selections, are made in at least two and often three locations to enhance the possibility of obtaining infection in susceptible segregants. The primary plot is located in south-central Idaho near Buhl, another at the Parma Branch Station in southwestern Idaho, and a third planting is made at Prosser, Washington, in cooperation with Washington State College. All lines and selections are grown in the Buhl plot, only certain ones are represented at the other locations.

When it is determined that a line is resistant to the diseases concerned and has concurrently been selected for quality and desirable horticultural characteristics, it then becomes necessary to evaluate the quality and acceptability in areas where beans are produced for processing and marketing. Cooperative yield and quality evaluations are then arranged with mid-western, southern and eastern experiment stations and processors.

Idaho Bountiful

Idaho Bountiful was originated from a backcross of Bountiful with a curly top and mosaic resistant flat poded type, proceeding as follows: A progeny of the cross, Red Valentine by Corbett Refugee was crossed with Burtner Blight-Proof. One selection, resistant to mosaic and curly top, was crossed with Bountiful. Then, subsequently, a resistant selection from this cross was backcrossed to Bountiful again and from the segregants Idaho Bountiful was developed through 13 generations of selection among the self-pollinated progeny.

Idaho Bountiful, as suggested by the name, is similar to the standard Bountiful variety except that it is a darker green. The plant is upright, approximately 15 or more inches tall. Maturity is 3 to 5 days later than Bountiful.



Figure 1. On the right, common Bountiful bean is entirely eliminated by the curly-top disease. On the left, Idaho Bountiful bean is not infected.



Figure 2. A plant of Idaho Bountiful bean showing pod shape and plant type.

Pods are flat, and slightly narrower and thinner than Bountiful. They are approximately 5 1/2 inches long, straight, medium green in color, and superior in quality. Pods are entirely stringless with firm, medium green flesh. Seeds average 85 per ounce, and are a darker brown color than Bountiful seed. Cooperative yield tests have shown that Idaho Bountiful can be expected to yield approximately the same as a disease-free Bountiful planting. Wherever mosaic or curly top presents a disease problem, Idaho Bountiful will be found to be most productive. It should be especially valuable for shoe-string style beans and is rated superior to Bountiful for this purpose.

Golden Gem

Golden Gem was developed through crossing an Idaho Refugee type with Corbett Refugee, and selecting a mosaic resistant segregant which was then crossed with Burtner Blight-Proof. A curly top and mosaic resistant selection from this combination was then crossed with Early Wonder Wax, and Golden Gem obtained from the resulting progeny through 12 generations of selection. Golden Gem is a white-seeded, round, wax bean of exceptionally high quality.



Figure 3. In the front center were two rows of common Bountiful bean entirely eliminated by the curly-top disease. In the rear left the Golden Gem variety and on the right the Red Mexican U. I. 34 varieties are not infected. Border rows on each side are old type sugar beets to attract sugar beet leaf-hoppers.

Plants of Golden Gem are low and somewhat spreading. The golden wax pods are 4 to 4 1/2 inches long, straight, slender, 100 percent Number 1 sieve size, entirely round, and very uniform. They are stringless, without noticeable fiber, and have dark, firm flesh. The seeds average 100 per ounce. This variety is expected primarily to be of value to home gardeners but should be suitable for a high quality, whole-pod pack also.

Golden Gem has consistently out-yielded mosaic susceptible varieties, and has, in some trials, approximated the yield of certain of the better mosaic resistant Tendergreen types.

Idaho Bountiful and Golden Gem, resistant to both strains of common bean mosaic as well as to curly top, have been released to commercial seed companies for production. They represent the first high-quality bush-type snap beans released that are resistant to curly top. The fact that these beans are resistant to the two



Figure 4. A plant of Golden Gem bean showing pod shade and distribution.

mosaic diseases referred to above and to curly top will in itself make these varieties valuable to seed producers and processors as well as to home gardeners.