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Breeding for White Mold Resistance in Snap Beans

Phillip D. Griffiths
Vegetable Breeder
Cornell University NYSAES

Abstract:

White mold (*Sclerotinia sclerotiorum*) is an important disease of snap beans in the northeast particularly during cool, damp seasons. Incorporation of high levels of resistance to this pathogen in commercial type snap bean lines is a major focus of the breeding program. 'Cornell 501' was released in 2001 and tested nationally in white mold nurseries in 2002-2006, 'Cornell 504' was released in 2007 and has been used in the development of new populations segregating for improved plant type. The breeding lines have ranked among the best commercial type common bean entries with other Cornell dry bean lines following evaluation in multiple field and greenhouse tests throughout the US between 2002-2010 in collaboration with W-1150/W-2150 national trials and in yield performance trials with Ballerstein/Reiners at Cornell. Crosses have been made between 2005 and 2010 between commercial snap bean and breeding lines have been advanced through white mold greenhouse inoculation trials. New cycles were initiated through crosses with lines A-195 and Cornell 504, are being advanced to segregating populations that will be tested in 2011. Advanced lines and lines from new crosses will be tested in 2011 to develop snap beans with acceptable yield/quality with a high level of resistance to white mold. Additional crosses of resistant materials to small-sieve snap beans were made in 2008/2009 from which 12 new lines were selected in 2009. These 12 lines were crossed with two commercial whole beans and F_2 lines are currently being increased to develop 23 F_3 populations for selection in 2011.

Objectives:

[1] To greenhouse/field evaluate and advance breeding lines for resistance to white mold, yield and quality.

[2] To screen and cross white mold resistant selections and advanced breeding populations in the greenhouse, and advance the generations with further screens to determine resistant types with good horticulture.

Results:

[1] Snap bean breeding lines were evaluated for white mold resistance in 2011 in primarily the small-sieve plant types for selection of breeding lines with high levels of resistance. These evaluations were based on populations developed from crosses with the resistant breeding lines and previously released lines including lines selected in the light red and dark red kidney market classes that contained enhanced resistance to that observed in snap beans. Common bean lines were also inoculated and compared to W-2150 national white mold entries, where they continue to perform as the most resistant lines (Table 1). New lines were selected with high levels of resistance and crossed to small sieve snap beans. From these segregating populations, F_4 lines were selected in one background WM12 in particular, where major gene control for white mold resistance appeared to exist based on fixed and segregating resistance in the lines from the same lineage. If the combined dry bean/snap bean WM resistance in these lines can be stabilized at a moderate level it can be introduced into large-sieve white-seeded lines reasonably quickly providing moderate resistance that can be introgressed into the virus resistance breeding lines/materials. Progeny of these lines are currently being inoculated and will be evaluated for confirmation through progeny testing. Additional evaluation of resistance in greenhouse trials will help to determine the best snap bean materials for development of tolerant cultivars and combinations with other important traits.

[2] Snap bean breeding lines have been developed by accumulating minor genes for white mold resistance using sources that include PI 204717 and PI 169787. The accumulation of genes in these breeding lines requires extensive greenhouse screening through multiple generations in order to recover lines with high levels of physiological resistance to white mold. Crosses have been made to improve horticultural type focusing on crosses to ‘Hystyle’ and small sieve cultivars. Snap bean lines were evaluated for white mold resistance in two greenhouse screens in 2011 focusing on population lineages WM1-WM15 developed from the previous 12 breeding lineages, and advancement of the those populations. These lineages were mostly selected from accelerated backcrossing via F3/F4 generations from the light red kidney breeding lines Cornell 605 and Cornell 611. Lines exhibiting any significant level of disease symptoms were eliminated during the trials. Additional populations to improve horticultural type were included in populations developed following crosses and backcrosses to ‘Hystyle’ and two small-sieve bush types. The most promising lineages appear to be the WM2 and WM12 types for crossing and selection of resistance back into large sieve which will be made in Spring 2012. A total of 23 selections were made of F6 lines in fall 2011, and approximately 30 F4 lines to further improve the horticultural type.

Table 1: Evaluation of Cornell breeding lines (bold) at Geneva NY relative to W-2150 multi-state white mold resistant entries (October 2011).

Line	Rk.	Rating 1	Rating 2	Line	Rk.	Rating 1	Rating 2
Cornell 607	**1**	**2.7 kl**	**3.2 l**	**Cornell 612**	**20**	**4.3 d-k**	**5.6 e-k**
Cornell 608	**2**	**3.4 h-l**	**3.2 l**	**FV10-1203-1**	**21**	**3.6 g-l**	**5.6 e-k**
1144-2	3	3.4 i-l	3.3 l	**FV10-1113-1**	**22**	**4.0 f-l**	**5.6 e-k**
FV10-1217-1	**4**	**4.4 c-j**	**3.6 kl**	NE10-11-16	23	4.3 d-k	5.8 e-j
1144-1	5	3.6 g-l	3.8 j-l	**FV10-1218-1**	**24**	**4.8 c-h**	**6.2 d-i**
Cornell 611	**6**	**3.8 f-l**	**3.9 j-l**	**FV10-1218-3**	**25**	**4.6 c-j**	**6.4 c-h**
FV10-1210-1	**7**	**2.6 l**	**4.0 j-l**	NE10-11-20	26	4.5 c-j	6.7 b-g
FV10-1215-1	**8**	**3.6 g-l**	**4.0 j-l**	NE2-10-22	27	5.4 b-f	7.1 a-f
FV10-1214-2	**9**	**3.2 i-l**	**4.2 i-l**	1144-4	28	5.9 b-d	7.2 a-f
Cornell 605	**10**	**3.1 j-k**	**4.3 h-l**	NE14-11-16	29	4.4 c-j	7.3 a-e
FV10-1203-3	**11**	**3.2 i-l**	**4.4 h-l**	1144-5	30	6.0 bc	7.3 a-e
FV10-1203-2	**12**	**4.2 e-l**	**4.6 g-l**	Wallace (773)	31	5.7 b-d	7.9 a-d
FV10-1207-1	**13**	**3.6 g-l**	**4.6 g-l**	NE2-10-19	32	5.2 b-g	8.0 cd
1144-3	14	3.7 g-k	4.7 g-l	**FV10-1218-2**	**33**	**5.4 b-f**	**8.2 a-d**
Cornell 609	**15**	**3.1 j-k**	**4.8 g-l**	C91-GM11-14	34	6.0 b	8.4 a-c
Cornell 610	**16**	**3.8 f-l**	**4.8 g-l**	NE1-10-15	35	5.1 b-h	8.5 ab
FV10-1222-1	**17**	**3.4 i-l**	**4.8 g-l**	NEI-10-21	36	6.0 bc	8.5 ab
FV10-1203-4	**18**	**3.6 g-l**	**5.2 f-l**	NE13-11-4	37	8.3 a	9.0 a
FV10-1214-3	**19**	**4.0 f-l**	**5.2 f-l**	C86-GM11-11	38	5.2 b-g	9.0 a