BGS 401, Eceriferum-f, *cer-f*

Stock number: BGS 401
Locus name: Eceriferum-f
Locus symbol: *cer-f*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Located in chromosome 1H (1); associated with SNP markers 1_0764 to 2_1126 (positions 61.51 to 110.10) in 1H of the Bowman backcrossed-derived line BW110 (1). Previously located in chromosome 7H (8); near the centromere and about 4.5 cM proximal from the *ert-d* (erectoides-d) locus (8, 9, 10); about 6.3 cM distal from the *nud1* (naked caryopsis 1) locus (9, 10).
Description:
In the original stock surface wax coating on the spike, leaf sheath, and stem is reduced (wax code + + ++) (3). Reduced surface wax coating was apparent only on the spike (wax code + ++ ++) in the Bowman backcross-derived line, BW110. Plants BW110 were slightly taller than Bowman. Kernel weights varied from slightly lower to slightly more; grain yields were slightly less (2). Allelism tests need to be conducted to confirm that BW110 has a *cer-f* mutant.
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (3).
Mutational events:
cer-f.9 (NGB 110893, GSHO 427) in Bonus (PI 189763) (3, 4); *cer-f.230* (NGB 111117) in Foma (CIho 11333) (4, 7); *cer-f.1002* (NGB 111890) in Carlsberg II (CIho 10114) (4); *cer-f.763* (NGB 111651) in Bonus (5); *cer-f.1423* (NGB 112311) in Bonus (6).
Mutant used for description and seed stocks:
cer-f.9 (GSHO 427, NGB 110893) in Bonus; *cer-f.9* in Bowman (PI 483237)*6 (GSHO 1846); *cer-f.9* in Bowman*7 (BW110, NGB 20516).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2010. Genetic dissection of barley morphology and development. Plant Physiology. Epubl. 2010 November 18, 2010 as DOI:10.1104/pp110.166249.
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4. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
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7. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
8. Søgaard, B. 1971. Linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 1:41-47.
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Genet. Newsl. 3:57-61.
10. Søgaard, B. 1974. The localization of eceriferum loci in barley III. Three point tests of genes on chromosome 1 in barley. Hereditas 76:41-48.

Prepared:

U. Lundqvist. 1975. Barley Genet. Newsl. 5:119.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:348.
U. Lundqvist and J.D. Franckowiak. 2010. Barley Genet. Newsl. 40:104-105.

BGS 402, Eceriferum-g, *cer-g*

Stock number: BGS 402
Locus name: Eceriferum-g
Locus symbol: *cer-g*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Located in chromosome 2HL (2, 14); about 15.9 cM distal from the *vrs1* (six-rowed spike 1) locus (14, 15); *cer-g.10* is associated with SNP markers 1_0317 to 2_0374 (positions 98.35 to 104.81 cM) in 2H bin 08 and SNP markers 1_0619 to 1_0533 (positions 133.59 to 141.56 cM) in 2H bin 09 of the Bowman backcross-derived line BW111 (1), in 2H bin 08.
Description:
Mutants have reduced surface wax coating on spike, leaf sheath, and stem (wax code + + ++) with the wax coating of the leaf sheath and stem wax present in broad horizontal bands (4). Double and triple stomatal complexes are produced during stomatal development (4, 16). All *cer-g* mutants have globe-shaped or globosum kernels (4). Plants of the Bowman backcross-derived line for *cer-g.10*, BW111, headed 1 to 2 days later than Bowman and about 10% shorter. Kernels of BW111 were shorter (8.2 vs. 9.5 mm), narrower (3.5 vs. 3.8 mm) and weighed 15 to 20% less. Grain yields of BW111 were 2/3 to 3/4 those of Bowman (3).
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (4).
Mutational events:
cer-g.10 (NGB 110894, GSHO 428), *-g.11* (NGB 110895), *-g.23* (NGB 110907), *-g.47* (NGB 110931), *-g.55* (NGB 110939) in Bonus (PI 189763) (4); *cer-g.106* (NGB 110991) in Bonus, *-g.202* (NGB 111089), *-g.208* (NGB 111095), *-g.210* (NGB 111097), *-g.494* (NGB 111382) in Foma (CIho 11333) (13); *cer-g.166* (NGB 111052) in Bonus, *-g.553* (NGB 111441), *-g.568* (NGB 111456), *-g.700* (NGB 111588), *-g.709* (NGB 111546), *-g.710* (NGB 111597) in Foma, *-g.1026* (NGB 111914) in Carlsberg II (CIho 10114) (5); *cer-g.746* (NGB 111634), *-g.818* (NGB 111706), *-g.875* (NGB 111763) in Bonus, *-g.1033* (NGB 111921), *-g.1071* (NGB 111959) in Carlsberg II, *-g.1097* (NGB 111985), *-g.1116* (NGB 112004) in Kristina (NGB 1500) (6); *cer-g.893* (NGB 111781), *-g.976* (NGB 111864) in Bonus, *-g.1172* (NGB 112060) in Kristina (7); *cer-g.1161* (NGB 117268), *-g.1169* (NGB 112057) in Kristina (8); *cer-g.1038* (NGB 111926) in Carlsberg II, *-g.1289* (NGB 111177) in Kristina, *-g.1332* (NGB 112220) in Bonus (9); *cer-g.1410* (NGB 112298), *-g.1451* (NGB 112339), *-g.1454* (NGB 112342) in Bonus (10); *cer-g.1495* (NGB 112383) in Bonus, *-g.1510* (NGB 112398) in Nordal, *-g.1736* (NGB 112549, 117328), *-g.1740* (NGB 112553), *-g.1741* (NGB 112554) in Bonus (11); *cer-g.1573* (NGB 112461) in Nordal (12).
Mutant used for description and seed stocks:
cer-g.10 (GSHO 428, NGB 110894) in Bonus; *cer-g.10* in Bowman (PI 483237)*6 (GSHO 1906); *cer-g.10* in Bowman*7 (BW111, NGB 20517).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
2. Fester, T., and B. Søgaard. 1969. The localization of eceriferum loci in barley.

Hereditas 61:327-337.
3. Franckowiak, J.D. (Unpublished).
4. Lundqvist, U., and D. von Wettstein. 1962. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. Hereditas 48:342-362.
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6. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
7. Lundqvist, U., and D. von Wettstein. 1975. Stock list for the eceriferum mutants III. Barley Genet. Newsl. 5:88-91.
8. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
9. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
10. Lundqvist, U., and D. von Wettstein. 1982. Stock list for the eceriferum mutants VI. Barley Genet. Newsl. 12:169-172.
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12. Lundqvist, U., and D. von Wettstein. 1988. Stock list for the eceriferum mutants VIII. Barley Genet. Newsl. 18:88-91.
13. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
14. Søgaard, B. 1971. Linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 1:41-47.
15. Søgaard, B. 1973. Continued linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 3:57-61.
16. Zeiger, E., and G.L. Stebbins. 1972. Developmental genetics in barley: a mutant for stomatal development. Am. J. Bot. 59:143-148.

Prepared:

U. Lundqvist. 1975. Barley Genet. Newsl. 5:120.

Revised:

J.D. Franckowiak and U. Lundqvist. 1997. Barley Genet. Newsl. 26:349-350.
U. Lundqvist and J.D. Franckowiak. 2011. Barley Genet. Newsl. 41:155-156.

BGS 403, Eceriferum-h, *cer-h*

Stock number: BGS 403
Locus name: Eceriferum-h
Locus symbol: *cer-h*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Located in chromosome 4HS (1); *cer-h.13* is associated with SNP markers 2_1056 to 2_0210 (positions 5.24 to 38.41 cM) in 4H bins 01 to 04 of the Bowman backcross-derived line BW112 (1).
Description:
Surface wax coating on the spike appears absent (wax code - ++ ++) (3). The original stock has wide leaves, pointed lateral spikelets, and a high level of sterility (10 to 25% seed set). In the Bowman backcross-derived line, BW112, plants are semidwarf (about 80% of normal height) and have short, slightly lax spikes with reduced seed set. The original *cer-h.13* stock may have a translocation (2), but sterility in the Bowman stock is not associated with a translocation. The kernels of BW112 plants were 20 to 30% lighter than those of Bowman; and seed yields were very low (2).
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (3).
Mutational events:
cer-h.13 (trans) (NGB 110897, GSHO 429) in Bonus (PI 189763) (3, 4); *cer-h.125* (NGB 111010), in Bonus (4); *cer-h.233* (NGB 111120)*, -h.355* (NGB 111242) in Foma (CIho 11333) (4, 7); *cer-h.721* (NGB 117259) in Bonus (5); *cer-h.1698* (NGB 112557) in Bonus (6).
Mutant used for description and seed stocks:
cer-h.13 (GSHO 429, NGB 110897) in Bonus; *cer-h.13* in Bowman (PI 483237)*5 (GSHO 2190); *cer-h.13* in Bowman*7 (BW112, NGB 20518).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
2. Franckowiak, J.D. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1962. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. Hereditas 48:342-362.
4 Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
5. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
6. Lundqvist, U., and D. von Wettstein. 1985. Stock list for the eceriferum mutants VII. Barley Genet. Newsl. 15:89-93.
7. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:121.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:351.

U. Lundqvist and J.D. Franckowiak. 2011. Barley Genet. Newsl. 41:157.

BGS 404, Eceriferum-i, *cer-i*

Stock number: BGS 404
Locus name: Eceriferum-i
Locus symbol: cer-i

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (2).
Located in chromosome 5HL (2, 12); about 5.6 cM distal from the *ari-e* (breviarisatum-e) locus (2, 13, 14); *cer-i.16* is associated with SNP markers 2_0206 to 2_0449 (positions 9.61 to 154.37 cM) in 5H bins 01 to 09 of the Bowman backcross-derived line BW113 (1), likely in 5H bins 08 or 09.
Description:
Surface wax coating on the spike appears absent (wax code - ++ ++) (4). A translocation is present in the *cer-i.25* stock, with one of the breakpoints being close to the *cer-i* locus (4). Concerning epicuticular wax composition, the wax tubes are much shorter in the mutant, and the amount of two types of diketones (β$-diketone and hydroxy-β$-diketone) is proportionally reduced (15, 16, 17). Plants of the Bowman backcross-derived line for *cer-i.16*, BW113, were similar to Bowman for agronomic traits (3).
Origin of mutant:
An alpha-ray induced mutant in Bonus (PI 189763) (4).
Mutational events:
cer-i.16 (NGB 110900, GSHO 430), *-i.25* (trans) (NGB 110909), *-i.27* (NGB 110911), *-i.30* (NGB 110914), *-i.32* (NGB 110916), *-i.45* (NGB 110929), *-i.51* (NGB 110935), *-i.112h* (NGB 110997), *-i.112l* (NGB 111087) in Bonus (PI 189763) (4, 5); *cer-i.92* (NGB 110976), *-i.110* (NGB 110995) in Bonus (5, 11); *cer-i.156* (NGB 111042), *-i.168* (NGB 111054), *-i.195* (NGB 111081) in Bonus (3); *cer-i.205* (NGB 111092), *-i.212* (NGB 111099), *-i.255* (NGB 111142), *-i.256* (NGB 111143), *i.257* (NGB 111144), *-i.263* (NGB 111150), *-i.415* (NGB 111303), *-i.419* (NGB 111307), *-i.430* (NGB 111318), *-i.435* (NGB 111323), *-i.477* (NGB 111365), *-i.486* (NGB 111374) in Foma (CIho 11333) (5, 11); *cer-i.426* (NGB 111314), *-i.434* (NGB 111322), *-i.535* (NGB 111423), *-i.554* (NGB 111442) in Foma, *-i.651* (NGB 111539), *-i.653* (NGB 117258), *-i.655* (NGB 111543), *-i.679* (NGB 111567), *-i.702* (NGB 111590), *-i.704* (NGB 111592), *-i.720* (NGB 111608), *-i.722* (NGB 117259), *-i.732* (NGB 111620, 117260), *-i.734* (NGB 111622), *-i.740* (NGB 111628) in Bonus (5); *cer-i.802* (NGB 111690), *-i.805* (NGB 111693), *-i.811* (NGB 111699), *-i.814* (NGB 111702), *-i.867* (NGB 111755), *-i.878* (NGB 111766) in Bonus (6); *cer-i.747* (NGB 111635), *-i.894* (NGB 111802), *-i.921* (NGB 111809), *-i.922* (NGB 111810), *-i.927* (NGB 111815), *-i.928* (NGB 111816), *-i.936* (NGB 11124), *-i.958* (NGB 111846) in Bonus, *-i.1175* (NGB 112063), *-i.1181* (NGB 112069) in Kristina (NGB 1500) (6); *cer-i.891* (NGB 111799), *-i.953* (NGB 111841) in Bonus, *-i.1196* (NGB 112084), *-i.1220* (NGB 112108), *-i.1257* (NGB 112154) in Kristina (7); *cer-i.1354* (NGB 112242) in Bonus (8); *cer-i.1397* (NGB 112285), *-i.1711* (NGB 112524), *-i.1743* (NGB 112556), *-i.1823* (NGB 116832, 117371) in Bonus (9); *cer-i.1764* (NGB 112579) in Bonus (10).
Mutant used for description and seed stocks:
cer-i.16 (GSHO 430, NGB 110900) in Bonus; *cer-i.25* in Bonus was used for allelism tests; *cer-i.16* in Bowman (PI 483237)*7 (GSHO 2112, BW113, NGB 20519).
References:
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Prepared:

U. Lundqvist. 1975. Barley Genet. Newsl. 5:122.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:352-353.
U. Lundqvist and J.D. Franckowiak. 2011. Barley Genet. Newsl. 41:158-159.

BGS 405, Eceriferum-k, *cer-k*

Stock number: BGS 405
Locus name: Eceriferum-k
Locus symbol: *cer-k*

Previous nomenclature and symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Located in chromosome 4HL (1); *cer-k.39* is associated with SNP markers 1_0387 to 1_1019 (positions 179.78 to 183.54 cM) in 4H bins 12 to 13 of the Bowman backcross-derived line BW115 (1). Previously located in 7HS, based on a linkage drag association with the *ant1* (anthocyanin-less 1) locus (3).
Description:
Surface wax coating on the spike is slightly reduced compared to the parent (wax code + ++ ++) (4). In the Bowman backcross-derived line for *cer-k.39*, BW115, leaf blades and kernels appeared slightly thinner compared to those of Bowman (2). BW115 plants headed 5 to 10 days later than Bowman and were slightly shorter, but they had up to 5 more kernels per spike. Kernel weights of BW115 were 10 to 15% lower and grain yields were about 75% of the Bowman yields (2).
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (4).
Mutational events:
cer-k.39 (NGB 110923, GSHO 432) in Bonus (PI 189763) (4, 5).
Mutant used for description and seed stocks:
cer-k.39 (GSHO 432, NGB 110923) in Bonus; *cer-k.39* in Bowman (PI 483237)*6 (GSHO 1837); *cer-k.39* in Bowman*7 (BW115, NGB 20521).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
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Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:123.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:354.
U. Lundqvist and J.D. Franckowiak. 2011. Barley Genet. Newsl. 41:160.

BGS 406, Eceriferum-l, *cer-l*

Stock number: BGS 406
Locus name: Eceriferum-l
Locus symbol: *cer-l*

Previous nomenclature and symbolization:
None.
Inheritance:
Monofactorial recessive (1).
Location is unknown.
Description:
Surface wax coating on the spike is slightly reduced (wax code + ++ ++) (1).
Identification of mutant plants is difficult in the Bowman backcrosses-derived progenies.
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (1).
Mutational events:
cer-l.14 (NGB 110898, GSHO 433) in Bonus (PI 189763) (1, 2).
Mutant used for description and seed stocks:
cer-l.14 (NGB 110898, GSHO 433) in Bonus; *cer-l.14* in Bowman (PI 483237)*3 (GSHO 2191); *cer-l.14* in Bowman*4 (BW116, NGB 20522*).*
References:
1. Lundqvist, U., and D. von Wettstein. 1962. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. Hereditas 48:342-362.
2. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1: 97-102.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:124.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:355.

BGS 407, Eceriferum-m, *cer-m*

Stock number: BGS 407
Locus name: Eceriferum-m
Locus symbol: *cer-m*

Previous nomenclature and symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Location in chromosomes 1HL or 3HL (1); based on SNP markers retained in the Bowman backcross-derived line BW117 for *cer-m.15*, between 2_0229 to 2_1126 (positions 106.61 to 110.10 cM) in 1H bin 10 and between 1_0918 and 1_1172 (positions 187.28 to 190.87 cM) in 3H bin 12 (1).
Description:
Surface wax coating on the spike appears reduced or normal, and the wax coating on the leaf sheath and stem is reduced (wax code +/++ + ++) (3, 5). The mutant is a semidwarf (3/4 to 5/6 of normal height) and may be semi-sterile (25 to 50% seed set) (3). Rachis internodes of plants in Bowman backcross-derived line BW117 plants were slightly shorter than those of Bowman. The number of kernels per spike for BW117 was 4 or 6 fewer than for Bowman. Kernel weights and test weights were 10 to 20% lower. Seed yields of BW117 were about 1/3 of those of Bowman (2).
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (3).
Mutational events:
cer-m.15 (NGB 110899, GSHO 434) in Bonus (PI 189763) (3, 4).
Mutant used for description and seed stocks:
cer-m.15 (GSHO 434, NGB 110899) in Bonus; *cer-m.15* in Bowman (PI 483237)*6 (GSHO 2192, BW117, NGB 20523).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
2. Franckowiak, J.D. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1962. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. Hereditas 48:342-362.
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Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:125.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:356.
U. Lundqvist and J.D. Franckowiak. 2011. Barley Genet. Newsl. 41:161.

BGS 408, Eceriferum-n, *cer-n*

Stock number: BGS 408
Locus name: Eceriferum-n
Locus symbol: *cer-n*

Previous nomenclature and gene symbolization:
Eceriferum-zm = *cer-zm* (15).
Glossy sheath 9 = *gs9* (3, 5).

Inheritance:
Monofactorial recessive (6), except *Cer-n.969* (11).
Located in chromosome 2HL (2, 16, 17); *gsh9.al* is about 8.8 cM distal from the *eog1* (elongated outer glume 1) locus (1); about 23.3 cM proximal from the *vrs1* (six-rowed spike 1) locus (1, 3).

Description:
Mutants appear to lack surface wax coating on the spike, and surface wax on the sheath may be reduced or absent (wax codes - - ++ and - +/- ++) (6, 15). The allele *cer-n.20* does not recombine with the *eog1* locus because a translocation is present in the original stock (4). The *cer-n.20* stock seems to have a translocation breakpoint about 13.0 cM proximal from the *vrs1* locus (4).

Origin of mutant:
A neutron induced mutant in Bonus (PI 189763) (6).

Mutational events:
cer-n.20 (trans) (NGB 110904, GSHO 435), *-n.26* (NGB 110910), *-n.53* (NGB 110937), *-n.101* (NGB 110986) in Bonus (PI 189763) (6); *cer-n.86* (*cer-zm.86*) (NGB 110970), *cer-n.731* (*cer-zm.731*) (NGB 111619) in Bonus (7, 8, 15, 16); *cer-n.93* (NGB 110977), *-n.97* (NGB 110981) in Bonus, *-n.211* (NGB 111098), *-n.236* (NGB 111123), *-n.289* (NGB 111176) in Foma (CIho 11333) (15); *cer-n.155* (NGB 111041), *-n.162* (NGB 111048), *-n.163* (NGB 111049), *-n.170* (NGB 111056) in Bonus, *-n.422* (NGB 111310), *-n.529* (NGB 111417), *-n.547* (NGB 111435), *-n.562* (NGB 111450), *-n.580* (NGB 111468), *-n.599* (NGB 111487), *-n.666* (NGB 111554), *-n.715* (NGB 111603) in Foma, *-n.1077* (NGB 111965) in Carlsberg II (CIho 10114) (7); *cer-n.608* (NGB 111496) in Foma, *-n.829* (NGB 111717), *-n.877* (NGB 111765), *-n.880* (NGB 111768) in Bonus, *-n.1085* (NGB 111973), *-n.1139* (NGB 112027) in Kristina (NGB 1500, 14661) (8); *cer-n.624* (NGB 111512), *-n.926* (NGB 111814), *-n.948* (NGB 111836), *-n.954* (NGB 111842), *-n.957* (NGB 111845) in Bonus, *-n.1173* (NGB 112061) in Kristina (9); *cer-n.963* (NGB 111851), *-n.985* (NGB 111873) in Bonus, *-n.1133* (NGB 112021) in Kristina (10); *Cer-n.969* (NGB 111857), *cer-n.97* (NGB 110981) in Bonus, *-n.1296* (NGB 112184), *-n.1303* (NGB 112191), *-n.1307* (NGB 112195) in Kristina, *-n.1337* (NGB 112225) in Bonus (11); *cer-n.998* (NGB 111886) in Bonus, *-n.1093* (NGB 111981) in Kristina, *-n.1391* (NGB 112279), *-n.1437* (NGB 112325), *-n.1449* (NGB 112337), *-n.1456* (NGB 112344 in Bonus (12); *cer-n.996* (NGB 111884), *-n.1438* (NGB 112326) in Bonus, *-n.1700* (NGB 112513) in Kristina, *-n.1787* (NGB 117335) in Bonus (13); *cer-n.1765* (NGB 112580) in Bonus (14); *gsh9.al* (OUM029, GSHO 1761) in Akashinriki (PI 467400, OUJ659) (3).

Mutant used for description and seed stocks:
cer-n.20 (GSHO 435, NGB 110904) in Bonus; *gsh9.al* (GSHO 1761, OUM029) in Akashinriki; *cer-n.20* in Bowman (PI 483237)*8 (GSHO 1893; BW118, NGB 20524); *gsh9.al* in Bowman*7 (GSHO 1894; BW412, NGB 20645).

References:
1. Ban, T., and N. Kawada. 1996. Linkage analysis of high pI esterase isozyme Est11 in barley. Barley Genet. Newsl. 25:59-61.

2. Fester, T., and B. Søgaard. 1969. The localization of eceriferum loci in barley. Hereditas 61:327-337.
3. Hayashi, J., T. Konishi, I. Moriya, and R. Takahashi. 1984. Inheritance and linkage studies in barley VI. Ten mutant genes located on chromosomes 1 to 7, except 3. Ber. Ohara Inst. landw. Biol., Okayama Univ. 18:227-250.
4. Luna Villafaña, A. 1995. Mapping marker genes in chromosome 2 of barley. M.S. Thesis. North Dakota State Univ., Fargo.
5. Lundqvist, U. 1992. Coordinator's report. *Eceriferum* genes. BGN 21:99-101.
6. Lundqvist, U., and D. von Wettstein. 1962. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. Hereditas 48:342-362.
7. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants.Barley Genet. Newsl. 1:97-102.
8. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
9. Lundqvist, U., and D. von Wettstein. 1975. Stock list for the eceriferum mutants III. Barley Genet. Newsl. 5:88-91.
10. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
11. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
12. Lundqvist, U., and D. von Wettstein. 1982. Stock list for the eceriferum mutants VI. Barley Genet. Newsl. 12:169-172.
13. Lundqvist, U., and D. von Wettstein. 1985. Stock list for the eceriferum mutants VII. Barley Genet. Newsl. 15:89-93.
14. Lundqvist, U., and D. von Wettstein. 1988. Stock list for the eceriferum mutants VIII. Barley Genet. Newsl. 18:88-91.
15. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
16. Søgaard, B. 1971. Linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 1:41-47.
17. Søgaard, B. 1973. Continued linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 3:57-61.

Prepared:

U. Lundqvist. 1975. Barley Genet. Newsl. 5:120.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:357-358.

BGS 409, Eceriferum-o, *cer-o*

Stock number: BGS 409
Locus name: Eceriferum-o
Locus symbol: *cer-o*

Previous nomenclature and symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Located in chromosome 1HL (1); *cer-o.28* is associated with SNP markers 2_0229 to 1_0006 (positions 106.61 to 110.10 cM) in 1H bin 10 of the Bowman backcrossed-derived line BW119 (1), in 1H bin 10.
Description:
Surface wax coating on the spike appears absent or reduced (wax code -/+ ++ ++) (3). All *cer-o* mutants have pointed lateral spikelets and semi-sterility (50 to 75% seed set). Mutant segregates in the Bowman backcross-derived progenies were about 3/4 of normal height and had spikes with about 20% fewer fertile rachis nodes. Plants of Bowman backcross-derived line BW119 headed about two days later than Bowman and were about 15% shorter. Kernel weights were 10-15% lower and grain yields were about half those of Bowman (2).
Origin of mutant:
A gamma-ray induced mutant in Bonus (PI 189763) (1).
Mutational events:
cer-o.28 (NGB 110912, GSHO 436) in Bonus (PI 189763) (3, 4); *cer-o.687* (NGB 111575), *-o.787* (NGB 11675) in Bonus (5); *cer-o.251* (NGB 111138) in Foma (CIho 11333), *-o.1144* (NGB 112032) in Kristina (NGB 1500) (6).
Mutant used for description and seed stocks:
cer-o.28 (GSHO 436, NGB 110912) in Bonus; *cer-o.28* in Bowman (PI 483237)*5 (GSHO 2193); *cer-o.28* in Bowman*7 (BW119, NGB 20525).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2010. Genetic dissection of barley morphology and development. Plant Physiology. Epubl. 2010 November 18, 2010 as DOI:10.1104/pp110.166249.
2. Franckowiak, J.D. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1962. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. Hereditas 48:342-362.
4. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
5. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
6. Lundqvist, U., and D. von Wettstein. 1982. Stock list for the eceriferum mutants VI. Barley Genet. Newsl. 12:169-172.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:127.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:359.
U. Lundqvist and J.D. Franckowiak. 2010. Barley Genet. Newsl. 40:106.

BGS 410, Eceriferum-p, *cer-p*

Stock number: BGS 410
Locus name: Eceriferum-p
Locus symbol: *cer-p*

Previous nomenclature and symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Located in chromosome 7HL (1); c*er-p.43* is associated with SNP markers 1_0174 to 1_0547 (positions 229.66 to 232.00 cM) in 7H bins 13 to 14 of the Bowman backcrossed-derived line BW120 (1).
Description:
Surface wax coating on the leaf blade appears reduced (wax code ++ ++ +) (4). Concerning the chemical epicuticular wax composition, a new form of wax crystals, lobe shaped bodies, were observed in the leaf blade. The amount of wax per unit surface area is reduced, but the wax class distribution is the same as in the wild type (3, 12, 13). The Bowman backcross-derived line containing *cer-p.43*, BW120, was morphologically and agronomically similar to Bowman in trials (2).
Origin of mutant:
A gamma-ray induced mutant in Bonus (PI 189763) (4).
Mutational events:
cer-p.37 (NGB 110921), *-p.43* (NGB 114379; GSHO 437), *-p.57* (NGB 110941) in Bonus (PI 189763) (4, 5); *cer-p.77* (NGB 110961) in Bonus, *-p.252* (NGB 111139), *-p.259* (NGB 111146), *-p.300* (NGB 111187), *-p.339* (NGB 111226) in Foma (CIho 11333) (5, 12); *cer-p.522* (NGB 111410), *-p.573* (NGB 111461) in Foma, *-p.707* (NGB 111595) in Bonus (3); *cer-p.322* (NGB 111209) in Foma, *-p.777* (NGB 111665), *-p.795* (NGB 111683), *-p.874* (NGB 111762) in Bonus, *-p.1118* (NGB 112006), *-p.1142* (NGB 112030) in Kristina (NGB 1500) (6); *cer-p.631* (NGB 111519), *-p.646* (NGB 111534), *-p.888* (NGB 111776), *-p.889* (NGB 111777), *-p.905* (NGB 111793), *-p.972* (NGB 111860) in Bonus (7); *cer-p.939* (NGB 111827) in Bonus, *-p.1201* (NGB 112089), *-p.1206* (NGB 112094), *-p.1207* (NGB 112095), *-p.1210* (NGB 112098), *-p.1235* (NGB 112123) in Kristina (8); *cer-p.1292* (NGB 112180) in Kristina, *-p.1339* (NGB 112232), *-p.1344* (NGB 112232) in Bonus (9); *cer-p.1058* (NGB 111946) in Carlsberg II (CIho 10114), *-p.1383* (NGB 112271), *-p.1424* (NGB 112312) in Bonus (10); *cer-p.1442* (NGB 112330), *-p.1797* (NGB 117345) in Bonus (11).
Mutant used for description and seed stocks:
cer-p.43 (GSHO 437, NGB 114379) in Bonus; *cer-p.37* (NGB 110921), *-p.43* (NGB 114379), and *-p.57* (NGB 110941) in Bonus were used for wax chemistry and wax structure studies (3, 12, 13); *cer-p.43* in Bowman (PI 483237)*5 (GSHO 2194); *cer-p.43* in Bowman*7 (BW120, NGB 20526).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
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4. Lundqvist, U., and D. von Wettstein. 1962. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. Hereditas 48:342-362.
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Genet. Newsl. 3:110-112.
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9. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
10. Lundqvist, U., and D. von Wettstein. 1982. Stock list for the eceriferum mutants VI. Barley Genet. Newsl. 12:169-172.
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Prepared:

U. Lundqvist and P. von Wettstein-Knowles. 1975. Barley Genet. Newsl. 5:128.

Revised:

U. Lundqvist and J.D. Franckowiak, 1997. Barley Genet. Newsl. 26:360.
U. Lundqvist and J.D. Franckowiak, 2011. Barley Genet. Newsl. 41:162-163.

BGS 411, Eceriferum-r, *cer-r*

Stock number: BGS 411
Locus name: Eceriferum-r
Locus symbol: *cer-r*

Previous nomenclature and symbolization:
None.
Inheritance:
Monofactorial recessive (2).
Located in chromosome 3HL (1); about 4.3 cM distal from the *uzu1* (uzu 1) locus (9, 10, 11, 12).
Description:
Surface wax coating on the spike appears greatly reduced or absent, while the wax coating on the leaf sheath and stem appears greatly reduced (wax code +/- + ++) (2, 8). The wax coating on the spike appears absent in the Bowman backcross-derived line.
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (2).
Mutational events:
cer-r.19 (NGB 110903, GSHO 439) in Bonus (PI 189763) (2, 3); *cer-r.127* (NGB 111012) in Bonus (3, 8); *cer-r.181* (NGB 111067) in Bonus (3); *cer-r.231* (NGB 111118) in Foma (CIho 11333) (3, 8); *cer-r.801* (NGB 111689) in Bonus (4); *cer-r.773* (NGB 111661) in Bonus (5); *cer-r.911* (NGB 111798) in Bonus, *-r.1300* (NGB 112188) in Kristina (NGB 1500, 14661) (6); *cer-r.1290* (NGB 112178) in Kristina (7).
Mutant used for description and seed stocks:
cer-r.19 (GSHO 439, NGB 110903) in Bonus; *cer-r.19* in Bowman (PI 483237)*7 (GSHO 1977, BW121, NGB 20527).
References:

1. Fester, T., and B. Søgaard. 1969. The localization of eceriferum loci in barley. Hereditas 61:327-337.
2. Lundqvist, U., and D. von Wettstein. 1962. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. Hereditas 48:342-362.
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5. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
6. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
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11. Søgaard, B. 1976. Three-point tests on barley chromosome 3. Barley Genet. Newsl. 6:65-67.

12. Søgaard, B. 1977. The localization of eceriferum loci in barley. V. Three point tests of genes on chromosome 1 and 3 in barley. Carlsberg Res. Commun. 42:67-75.

Prepared:

U. Lundqvist. 1975. Barley Genet. Newsl. 5:129.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:361.

BGS 412, Eceriferum-t, *cer-t*

Stock number: BGS 412
Locus name: Eceriferum-t
Locus symbol: *cer-t*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4), except *Cer-t.977* (11).
Located in chromosome 5HL (2, 13); about 9.4 cM proximal from the *var1* (variegated 1) locus (2, 14, 15, 16); about 8.5 cM distal from the *cer-zp* (eceriferum-zp) locus (15, 16); *cer-t.22* is associated with SNP markers 2_0884 to 2_1077 (positions 210.59 to 223.57 cM) in 5H bin 11 of the Bowman backcross-derived line BW123 (1), in 5H bin 11.
Description:
Surface wax coating on the spike appears greatly reduced or absent (wax code +/- ++ ++) (4). Concerning the chemical epicuticular wax composition on the spike, the amount of the β-diketones and hydroxy-β-diketones is reduced and the alkan-2-ol containing esters are absent. The wax tubes are much shorter than in the wild type (17, 18). Plants of the Bowman backcross-derived line for *cer-t.22*, BW123, were similar to Bowman in agronomic traits, expect plants were 10% shorter and grain yields were slightly lower (3).
Origin of mutant:
A gamma-ray induced mutant in Bonus (PI 189763) (2).
Mutational events:
cer-t.22 (NGB 110906, GSHO 441), *-t.46* (NGB 110938) in Bonus (PI 189763) (4, 5); *cer-t.75* (NGB 110959), *-t.87* (NGB 110971) in Bonus, *-t.216* (NGB 111103), *-t.226* (NGB 111113), *-t.243* (NGB 111230), *-t.264* (NGB 111151), *-t.285* (NGB 111172), *-t.356* (NGB 111243), *-t.384* (NGB 111271), *-t.493* (NGB 111381) in Foma (CIho 11333) (5, 12); *cer-t.172* (NGB 111058), *-t.197* (NGB 111083), *-t.198* (NGB 111084), *-t.199* (NGB 111085) in Bonus, *-t.500* (NGB 111388), *-t.537* (NGB 111425), *-t.564* (NGB 111452) in Foma, *-t.657* (NGB 111545), *-t.664* (NGB 111552), *-t.671* (NGB 111559), *-t.719* (NGB 111607), *-t.726* (NGB 111614), *-t.738* (NGB 111626), *-t.743* (NGB 111631) in Bonus (5); *cer-t.617* (NGB 111505) in Foma, *-t.708* (NGB 111596), *-t.806* (NGB 111694), *-t.819* (NGB 111707), *-t.871* (NGB 111759) in Bonus, *-t.1088* (NGB 111976), *-t.1115* (NGB 112003) in Kristina (NGB 1500) (6); *cer-t.959* (NGB 111847), *-t.961* (NGB 111849) in Bonus, *-t.1176* (NGB 112064) in Kristina (7); *cer-t.625* (NGB 111513), *-t.641* (NGB 111529), *-t.933* (NGB 111821) in Bonus, *-t.1154* (NGB 112042), *-t.1171* (NGB 112059), *-t.1219* (NGB 112107), *-t.1244* (NGB 112132) in Kristina (8); *cer-t.1245* (NGB 112133) in Kristina (9); *cer-t.1360* (NGB 112248), *-t.1393* (NGB 112281), *-t.1401* (NGB 112289) in Bonus (10); *Cer-t.977* (NGB 111865), *-t.1710* (NGB 112523), *-t.1718* (NGB 112531) in Bonus (11).
Mutant used for description and seed stocks:
cer-t.22 (GSHO 441, NGB 110906) in Bonus; *cer-t.46* in Bonus was used for wax chemistry and wax structure studies (18); *cer-t.22* in Bowman (PI 483237)*3 (GSHO 2119); *cer-t.22* in Bowman*7 (BW123, NGB 20529).
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2. Fester, T., and B. Søgaard. 1969. The localization of eceriferum loci in barley.

Hereditas 61:327-337.
3. Franckowiak, J.D. (Unpublished).
4. Lundqvist, U., and D. von Wettstein. 1962. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. Hereditas 48:342-362.
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7. Lundqvist, U., and D. von Wettstein. 1975. Stock list for the eceriferum mutants III. Barley Genet. Newsl. 5:88-91.
8. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
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U. Lundqvist and P. von Wettstein-Knowles. 1975. Barley Genet. Newsl. 5:130.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:363-364.
U. Lundqvist and J.D. Franckowiak. 2011. Barley Genet. Newsl. 41:164-165.

BGS 413, Glossy sheath 8, *gsh8*

Stock number: BGS 413
Locus name: Glossy sheath 8
Locus symbol: *gsh8*

Previous nomenclature and gene symbolization:
Eceriferum-u = *cer-u* (6).
Glossy sheath 8 = *gs8* (4).
Inheritance:
Monofactorial recessive (6).
Located in chromosome 2HS (17, 18); based on close association with the *gsh6* (glossy sheath 6) locus (2, 5, 17, 18); in a subterminal position (16); *gsh8.ag* is associated with SNP markers 2_1377 to 1_0919 (positions 20.11 to 66.78 cM) in 2H bin 02 to 03 of in 2HS of the Bowman backcross-derived line BW411 (1), in 2H bin 02 or 03.
Description:
The wax coating on the spike, stem and leaf sheath appears reduced (wax code + + ++) (6). The *gsh8* locus is the *cer-u* component of the complex locus *cer-cqu* which controls epicuticular wax layer formation on the surface of the spike, leaf sheath, and stem (19, 20). Deposition of ∃-diketone lipids is reduced or eliminated by mutants in the *cer-cqu* locus (20), specifically the *cer-u* mutants have impaired hydroxyl group insertion (19). The original *cer-u.21* stock has reduced seed set (6). Morphological differences, except for surface waxes, were not observed between Bowman and its backcross-derived line BW411 (3).
Origin of mutant:
A gamma-ray induced mutant in Bonus (PI 189763) (6).
Mutational events:
cer-u.21 (NGB 110905, GSHO 442), -*u.58* (NGB 110942) in Bonus (PI 189763) (6, 7); *cer-u.69* (NGB 110953), -*u.76h* (NGB 110960), -*u.76l* (NGB 110985), -*u.80* (NGB 110964), -*u.99* (NGB 110983), -*u.107* (NGB 110992), -*cu.108* (NGB 110993), -*u.119* (NGB 111004), -*u.120* (NGB 111005) in Bonus, -*u.204* (NGB 111091), -*u.237* (NGB 111124), -*u.258* (NGB 111145), -*u.265* (NGB 111152), -*u.281* (NGB 111168), -*u.304* (NGB 111191), -*u.305* (NGB 111192), -*u.307* (NGB 111194), -*u.324* (NGB 111211), -*u.330* (NGB 111217), -*u.338* (NGB 111225), -*u.344* (NGB 111231), -*u.371* (NGB 111258), -*u.376* (NGB 111263), -*u.387* (NGB 111274), -*cqu.416* (NGB 111304), -*cqu.420* (NGB 111308), -*u.443* (NGB 111331), -*u.446* (NGB 111334), -*u.452* (NGB 111340), -*u.464* (NGB 111352), -*u.466* (NGB 111354), -*u.468* (NGB 111356), -*u.472* (NGB 111360),-*u.485* (NGB 111373), -*u.491* (NGB 111379), -*u.497* (NGB 111385), -*u.498* (NGB 111386), -*u.505* (NGB 111393), -*qu.510* (NGB 111398) in Foma (CIho 11333) (7, 15); *cer-cqu.124* (NGB 111009), -*u.177* (NGB 111063), -*u.178* (NGB 111064), -*u.189* (NGB 111075) in Bonus, -*u.525* (NGB 111413), -*u.538* (NGB 111426), -*u.542* (NGB 111430), -*u.543* (NGB 111431), -*u.556* (NGB 111444), -*u.570* (NGB 111458), -*u.581* (NGB 111469), -*u.600* (NGB 111488), -*u.605* (NGB 111493), -*u.606* (NGB 111494) in Foma, -*u.677* (NGB 111565), -*u.686* (NGB 111574), -*u.689* (NGB 111577), -*u.697* (NGB 111585), -*cqu.724* (NGB 111612), -cqu.733 (NGB 111621) in Bonus, -*u.1003* (NGB 111891), -*u.1009* (NGB 111897), -*u.1042* (NGB 111930), -*u.1043* (NGB 111931), -*u.1048* (NGB 111936), -*u.1060* (NGB 111948), -*u.1076* (NGB 111964), -*u.1078* (NGB 111966) in Carlsberg II (CIho 10114) (7); *cer-u.610* (NGB 111498), -*u.613* (NGB 111501) in Foma, -*u.737* (NGB 111625), -*u.766* (NGB 111654), -*u.775* (NGB 111663), -*u.779* (NGB 111667), -*u.784* (NGB 111672), -*u.789* (NGB 111677), -*u.798* (NGB 111686), -*qu.813* (NGB 111701), -*u.823* (NGB 111711), -*u.825* (NGB 111713), -

u.830 (NGB 111718), *-u.835* (NGB 111723), *-u.839* (NGB 111727), *- u.840* (NGB 111728), *-u.842* (NGB 111730), *-u.843* (NGB 111731), *-u.844* (NGB 111732), *-u.855* (NGB 111743), *-u.861* (NGB 111749) in Bonus, *-u.1091* (NGB 111979), *-u.1096* (NGB 111984), *-u.1101* (NGB 111989), *-u.1107* (NGB 111995), *-u.1108* (NGB 111996), *-u.1111* (NGB 111999), *-u.1114* (NGB 112002), *-u.1120* (NGB 112008), *-u.1137* (NGB 112025), *-u.1146* (NGB 112034), *-u.1148* (NGB 112036) in Kristina (NGB 1500) (8); *cer-cu.644* (NGB 111532), *-u.695* (NGB 111583), *-u.850* (NGB 111738), *-u.887* (NGB 111775), *-u.892* (NGB 111780), *-u.895* (NGB 111783), *-u.901* (NGB 111789), *-cqu.925* (NGB 111813), *-cqu.944* (NGB 111832), *-cu.947* (NGB 111835) in Bonus, *-u.1177* (NGB 112065) in Kristina (9); *cer-u.699* (NGB 111587), *-u.776* (NGB 111664), *-u.986* (NGB 111874) in Bonus, *-u.1165* (NGB 112053), *-u.1184* (NGB 112072), *-u.1188* (NGB 112076), *-u.1202* (NGB 112090), *-u.1215* (NGB 112103), *-u.1227* (NGB 112115), *-u.1232* (NGB 112120), *-u.1237* (NGB 112125), *-u.1253* (NGB 112141), *-u.1272* (NGB 112160) in Kristina (10); *cer-u.1208* (NGB 112096), *-u.1261* (NGB 112149), *-u.1268* (NGB 112156), *-u.1282* (NGB 112170), *-u.1288* (NGB 112176), *-u.1295* (NGB 112183), *-u.1306* (NGB 112194), *-u.1309* (NGB 112197), *-u.1310* (NGB 112198) in Kristina, *-u.1327* (NGB 112215), *-u.1340* (NGB 112228), *-u.1341* (NGB 112229) in Bonus (11); *cer-u.457* (NGB 111345), *-u.578* (NGB 111466) in Foma, *-u.1364* (NGB 112252), *-u.1370* (NGB 112258), *-u.1372* (NGB 112260), *-u.1373* (NGB 112261), *-u.1390* (NGB 112278), *-u.1402* (NGB 112290), *-u.1409* (NGB 112297), *-u.1411* (NGB 112299), *-u.1420* (NGB 112308), *-u.1429* (NGB 112317) in Bonus (12); *cer-u.1496* (NGB 112384), *-u.1500* (NGB 112388), *-u.1734* (NGB 112547), *-u.1759* (NGB 112574), *-u.1763* (NGB 112567) in Bonus, *-u.1540* (NGB 112428), *-u.1541* (NGB 112429) in Nordal (13); *cer-u.678* (NGB 111566), *-u.1825* (NGB 117373) in Bonus, *-u.602b* (NGB 111490) in Foma, *-u.1870* (NGB 117418) in Sv 79353 (14); *gsh8.ag* (OUM024, GSHO 1760), *gsh8.am* (OUM031) in Akashinriki (PI 467400, OUJ659) (4, 5).

Mutant used for description and seed stocks:

cer-u.21 (NGB 110905, GSHO 442) in Bonus; *gsh8.ag* (OUM024, GSHO 1760) in Akashinriki; *gsh8.ag* in Bowman (PI 483237)*4 (GSHO 1870); *gsh8.ag* in Bowman*5 (BW411, NGB 20644).

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13. Lundqvist, U., and D. von Wettstein. 1985. Stock list for the eceriferum mutants VII. Barley Genet. Newsl. 15:89-93.
14. Lundqvist, U., and D. von Wettstein. 1988. Stock list for the eceriferum mutants VIII. Barley Genet. Newsl. 18:88-91.
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Prepared:

U. Lundqvist and P. von Wettstein-Knowles. 1975. Barley Genet. Newsl. 5:131 as BGS 413, Eceriferum-u, *cer-u.*

Revised:

J.D. Franckowiak and U. Lundqvist. 1997. Barley Genet. Newsl. 26:364-365.
U. Lundqvist and J.D. Franckowiak. 2010. Barley Genet. Newsl. 40:107-109.

BGS 414, Eceriferum-v, *cer-v*

Stock number: BGS 414
Locus name: Eceriferum-v
Locus symbol: *cer-v*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (1).
Located in chromosome 2HS (6); near the *fch15* (chlorina seedling 15) locus (7).
Description:
Surface wax coating on the spike appears absent or greatly reduced (wax code +/- ++ ++) (1). Pointed lateral spikelets are observed in the original stock, but not in the Bowman backcross-derived line. The vigor of the Bowman backcross-derived line is reduced somewhat.
Origin of mutant:
An ethylene oxide induced mutant in Bonus (PI 189763) (2).
Mutational events:
cer-v.49 (NGB 110933, GSHO 443) in Bonus (PI 189763) (1); *cer-v.489* (NGB 111377), *-v.590* (NGB 111478) in Foma (CIho 11333) (2); *cer-v.515* (NGB 111403) in Foma (3); *cer-v.752* (NGB 111640) in Bonus (4); *cer-v.1434* (NGB 112322) in Bonus (5).
Mutant used for description and seed stocks:
cer-v.49 (GSHO 443, NGB 110933) in Bonus; *cer-v.49* in Bowman (PI 483237)*7 (GSHO 1895, BW124, NGB 20530).
References:
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3. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
4. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
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Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:132.
Revised:
J.D. Franckowiak and U. Lundqvist. 1997. Barley Genet. Newsl. 26:366.

BGS 415, Eceriferum-w, *cer-w*

Stock number: BGS 415
Locus name: Eceriferum-w
Locus symbol: *cer-w*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Located in chromosome 5HL (10); about 2.6 cM proximal from the *raw1* (smooth awn 1) locus (3, 11); but longer distances are reported (10); *cer-w.48* is associated with SNP markers 3_0098 to 2_0320 (positions 161.82 to 166.29 cM) in 5H bin 10 of the Bowman backcross-derived line BW125 (1), in 5H bin 10.
Description:
Surface wax coating on the spike appears greatly reduced or absent (wax code +/- ++ ++) (4, 9). Reduced surface wax coating occurs on the leaf sheath and the stem in the Bowman backcross-derived line (wax code - + ++) (2). Nodes lack surface wax and have a glossy appearance. Other morphological difference between the Bowman backcross-derived line with *cer-w.48*, BW125, and Bowman were not observed (2).
Origin of the mutant:
A gamma-ray induced mutant in Bonus (PI 189763) (4).
Mutational events:
cer-w.48 (NGB 110932, GSHO 1519) in Bonus (PI 189763) (4, 5); *cer-w.280* (NGB 111167), *-w.347* (NGB 111234, GSHO 444), *-w.351* (NGB 111238), *-w.359* (NGB 111246), *-w.375* (NGB 111262), *-w.402* (NGB 111290) in Foma (CIho 11333) (5, 9); *cer-w.380* (NGB 111267), *-w.484* (NGB 111372), *-w.495* (NGB 111383), *-w.559* (NGB 111447), *-w.569* (NGB 111457), *-w.603* (NGB 111491), *-w.604* (NGB 111492) in Foma, *-w.691* (NGB 111579) in Bonus (5); *cer-w.771* (NGB 111659) in Bonus (6); *cer-w.858* (NGB 111746) in Bonus, *-w.1192* (NGB 112080) in Kristina (NGB 1500) (7); *cer-w.1445* (NGB 112333) in Bonus (8).
Mutant used for description and seed stocks:
cer-w.48 (GSHO 1519, NGB 110932) in Bonus; *cer-w.48* in Bowman (PI 483237)*3 (GSHO 2122); *cer-w.48* in Bowman*7 (BW125, NGB 20531).
References:
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7. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
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Prepared:

U. Lundqvist. 1975. Barley Genet. Newsl. 5:133.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:367.
U. Lundqvist and J.D. Franckowiak. 2011. Barley Genet. Newsl. 41:166-167.

BGS 417, Eceriferum-y, *cer-y*

Stock number: BGS 417
Locus name: Eceriferum-y
Locus symbol: *cer-y*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Location is unknown.
Description:
Surface wax coating on the spike appears greatly reduced, and the wax coating on the leaf sheath and stem is reduced or normal (wax code + +/++ ++). The original *cer-y.72* stock has semi-sterility (4). The Bowman backcross-derived line has normal fertility and surface wax on the leaf sheath and stem appears normal (wax code + ++ ++).
Origin of mutant:
An ethylene imine induced mutant in Bonus (PI 189763) (4).
Mutational events:
cer-y.72 (NGB 110956, GSHO 446) in Bonus (PI 189763) (1, 4); *cer-y.884* (NGB 111772) in Bonus (2); *cer-y.828* (NGB 111716) in Bonus (3).
Mutant used for description and seed stocks:
cer-y.72 (GSHO 446, NGB 110956) in Bonus; *cer-y.72* in Bowman (PI 483237)*5 (GSHO 2195); *cer-y.72* in Bowman*6 (BW131, NGB 20537).
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4. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:135.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:368.

BGS 418, Eceriferum-z, *cer-z*

Stock number: BGS 418
Locus name: Eceriferum-z
Locus symbol: *cer-z*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (2).
Located in chromosome 7HS (1); close to the *ant1* (anthocyanin-less 1) locus based on linkage drag (1).
Description:
Surface wax coating on the spike, leaf sheath, and stem appears absent (wax code - - ++). The original stock shows leaf streaks, late maturity, and semi-sterility (partial seed set) (2). The Bowman backcross-derived line has waxy nodes, normal maturity and fertility, and no leaf streaks.
Origin of mutant:
A neutron induced mutant in Bonus (PI 189763) (2).
Mutational events:
cer-z.52 (NGB 110936, GSHO 447) in Bonus (PI 189763) (2, 3); *cer-z.74* (NGB 110958) in Bonus (3); *cer-z.113* (NGB 110998) in Bonus (3, 6); *cer-z.512* (NGB 111400) in Foma (CIho 11333) (4); *cer-z.705* (NGB 111593), *-z.981* (NGB 111869), *-z.988* (NGB 111876), *-z.989* (NGB 111977), *-z.990* (NGB 111978) in Bonus (5).
Mutant used for description and seed stocks:
cer-z.52 (GSHO 447, NGB 110936) in Bonus; *cer-z.52* in Bowman (PI 483237)*7 (GSHO 1838, BW156, NGB 21988).
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3. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
4. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
5. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
6. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:136.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26.369.

BGS 419, Eceriferum-za, *cer-za*

Stock number: BGS 419
Locus name: Eceriferum-za
Locus symbol *cer-za*

Previous nomenclature and symbolization:
None.
Inheritance:
Monofactorial recessive (9).
Located in chromosome 5HL (1); close to the *raw1* (smooth awn 1) locus based on linkage drag (1).
Description:
Surface wax coating on the leaf blade appears absent (wax code ++ ++ -) (9).
Origin of mutant:
An ethylene imine induced mutant in Foma (CIho 11333) (9).
1Mutational events:
cer-za.126 (NGB 111011; GSHO 1521), *-za.173* (NGB 111059), *-za.185* (NGB 111071), *-za.186* (NGB 111072) in Bonus (PI 189763) (2); *cer-za.227* (NGB 111114, GSHO 1521), *-za.232* (NGB 111119), *-za.318* (NGB 111205), *-za.323* (NGB 111210), *-za.328* (NGB 111215), *-za.441* (NGB 111329), *-za.462* (NGB 111350), *-za.482* (NGB 111370), *-za.490* (NGB 111378), *-za.504* (NGB 111392) in Foma (CIho 11333) (2, 9); *cer-za.378* (NGB 111365), *-za.465* (NGB 111353), *-za.530* (NGB 111418), *-za.541* (NGB 111429), *-za.552* (NGB 111440), *-za.572* (NGB 111460), *-za.575* (NGB 111463), *-za.583* (NGB 111471), *-za.587* (NGB 111475), *-za.588* (NGB 111476) in Foma, *-za.672* (NGB 111560), *-za.676* (NGB 111564), *-za.685* (NGB 111573), *-za.735* (NGB 111623), *-za.739* (NGB 111627), *-za.741* (NGB 111629) in Bonus (2); *cer-za.681* (NGB 111569), *-za.768* (NGB 111656), *-za.782* (NGB 111670), *-za.812* (NGB 111700), *-za.831* (NGB 111719), *-za.833* (NGB 111721), *-za.853* (NGB 111741), *-za.854* (NGB 111742), *-za.869* (NGB 111757) in Bonus, *-za.1122* (NGB 112010), *-za.1126* (NGB 112014) in Kristina (NGB 1500) (3); *cer-za.628* (NGB 111516), *-za.637* (NGB 111525), *-za.639* (NGB 111527), *-za.643* (NGB 111531), *-za.917* (NGB 111807) in Bonus, *-za.1159* (NGB 112047), *-za.1186* (NGB 112074), *-za.1190* (NGB 112078), *-za.1191* (NGB 112079) in Kristina (4); *cer-za.478* (NGB 117257) in Foma, *-za.1157* (NGB 112045), *-za.1178* (NGB 112066), *-za.1189* (NGB 112077), *-za.1203* (NGB 112091), *-za.1224* (NGB 112109), *-za.1228* (NGB 112116), *-za.1252* (NGB 112140) in Kristina (5); *cer-za.1286* (NGB 112174) in Kristina, *-za.1324* (NGB 112212), *-za.1346* (NGB 112234) in Bonus (6); *cer-za.1284* (NGB 112172) in Kristina, *-za.1357* (NGB 112245), *-za.1399* (NGB 112287), *-za.1407* (NGB 112295), *-za.1408* (NGB 112296), *-za.1431* (NGB 112319) in Bonus (7); *cer-za.1546* (NGB 112434) in Nordal, *-za.1713* (NGB 112526, *-za.1738* (NGB 117330), *-za.1745* (NGB 117331), *-za.1747* (NGB 112561), *-za.1800* (NGB 117348), *-za.1805* (NGB 117353), *-za.1806* (NGB 117354), *-za.1807* (NGB 117355), *-za.1812* (NGB 117360, *-za.1813* (NGB 117361) in Bonus (8).
Mutant used for description and seed stocks:
cer-za.227 in Foma (GSHO 1521, NGB 111114); *cer-za.227* in Bowman (PI 483237)*6 (GSHO 2126); *cer-za.227* in Bowman*7 (BW157, NGB 21989).
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4. Lundqvist, U., and D. von Wettstein. 1975. Stock list for the eceriferum mutants III. Barley Genet. Newsl. 5:88-91.
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Prepared:

U. Lundqvist. 1975. Barley Genet. Newsl. 5:137.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:370.

BGS 420, Eceriferum-zb, *cer-zb*

Stock number: BGS 420
Locus name: Eceriferum-zb
Locus symbol: *cer-zb*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Located in chromosome 5HS (1); *cer-zb.38* is associated with SNP markers 1_1198 to 2_0306 (positions 73.70 to 88.81 cM) in 5H bins 04 to 05 of the Bowman backcross-derived line BW158 (1).
Description:
Surface wax coating on the spike appears absent (wax code - ++ ++), and all *cer-zb* mutants have pointed lateral spikelets, reduced fertility and narrow leaves (3). Plants of the Bowman backcross-derived line for *cer-zb.38*, BW158, showed reduced vigor, small spikes (about 2/3 normal), and short, narrow leaves (2). Heading dates for BW158 were 2 to 10 days later than Bowman; plants were about 2/3 normal height; and the number of kernels per spike varied from 60% to almost normal. Kernels of BW158 were slight longer and thinner than those of Bowman and weighted 40 to 50% less. Grain yields of BW158 varied from 10 to 30% of the Bowman yields (2).
Origin of mutants:
A gamma-ray induced mutant in Bonus (PI 189763) (3).
Mutational events:
cer-zb.38 (NGB 110922, GSHO 1522) in Bonus (PI 189763) (3, 4); *cer-zb.105* (NGB 110990) in Bonus, *-zb.279* (NGB 111166) in Foma (CIho 11333) (4, 8); *cer-zb.1164* (NGB 112052) in Kristina (NGB 1500) (5); *cer-zb.1279* (NGB 112167) in Kristina (6); *cer-zb.1273* (NGB 112161) in Kristina (7).
Mutant used for description and seed stocks:
cer-zb.38 (GSHO 1522, NGB 110922) in Bonus; *cer-zb.38* in Bowman (PI 483237)*5 (GSHO 2196); *cer-zb.38* in Bowman*7 (BW158, NGB 21990).
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Prepared:

U. Lundqvist. 1975. Barley Genet. Newsl. 5:138.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:371.

U. Lundqvist and J.D. Franckowiak. 2012. Barley Genet. Newsl. 42:508-509.

BGS 421, Eceriferum-zc, *cer-zc*

Stock number: BGS 421
Locus name: Eceriferum-zc
Locus symbol: *cer-zc*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Located in chromosome 4HL or 2HS (1); *cer-zc.65* is associated with SNP markers 2_0384 and 2_0732 (positions 133.48 to 134.44 cM) in 4H bin 10 and with SNP marker 2_05634 (position 21.19 cM) in 2H bin 02 of the Bowman backcross-derived line BW159 (1).
Description:
Surface wax coating on the spike appears greatly reduced or absent (wax code +/- ++ ++) (3). Plants of BW159, the Bowman backcross-derived line for *cer-zc.65*, were similar to Bowman except that they were about 25% shorter (2).
Origin of mutant:
An ethylene imine induced mutant in Bonus (PI 189763) (3).
Mutational events:
cer-zc.65 (NGB 110949, GSHO 450) in Bonus (PI 189763) (3, 4); *cer-zc.221* (NGB 111108), *-zc.249* (NGB 111136), *-zc.393* (NGB 111280) in Foma (CIho 11333) (4, 9); *cer-zc.442* (NGB 111330), *-zc.501* (NGB 111389), *-zc.518* (NGB 111408), *-zc.545* (NGB 111433) in Foma (4); *cer-zc.616* (NGB111504) in Foma, *-zc.785* (NGB 111673) in Bonus, *-zc.1149* (NGB 112037) in Kristina (NGB 1500) (5); *cer-zc.967* (NGB 111895) in Bonus, *-zc.1223* (NGB 117269) in Kristina (6); *cer-zc.642* (NGB 111530) in Bonus, *-zc.1305* (NGB 112193) in Kristina (7); *cer-zc.1758* (NGB 112573) in Bonus (8).
Mutant used for description and seed stocks:
cer-zc.65 (GSHO 450, NGB 110949) in Bonus; *cer-zc.65* in Bowman (PI 483237)*5 (GSHO 2197); *cer-zc.65* in Bowman*6 (BW159, NGB 21991).
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6. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
7. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
8. Lundqvist, U., and D. von Wettstein. 1988. Stock list for the eceriferum mutants VIII. Barley Genet. Newsl. 18:88-91.
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Prepared:

U. Lundqvist. 1975. Barley Genet. Newsl. 5:139.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:372.

U. Lundqvist and J.D. Franckowiak. 2012. Barley Genet. Newsl. 42:510-511.

BGS 422, Eceriferum-zd, *cer-zd*

Stock number: BGS 422
Locus name: Eceriferum-zd
Locus symbol: *cer-zd*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (8).
Located in chromosome 3HL (2, 9); about 9.4 cM proximal from the *uzu1* (uzu 1) locus, and about 4.6 cM distal from the breakpoint in the *ert-c.1* (erectoides-c) line (10, 11, 12, 13); *cer-zd.67* is associated with SNP markers 1_0672 to 1_0281 (positions 58.56 to 98.41)) in 3H bins 03 to 06 of the Bowman backcross-derived line BW160 (1), likely in 3H bin 05.
Description:
Surface wax coating on the leaf blade appears absent (wax code ++ ++ -) (8). Concerning the chemical epicuticular wax composition, the amount of wax cm^{-2} is reduced and is accompanied by a decrease of the size and morphological complexity of the wax bodies. The bodies are smaller, simpler, and less dense. The wax class distribution is the same as in the mother variety (14). Plants of the Bowman backcross-derived line BW160 were 10 to 15% shorter than Bowman and headed about 2 days later. Kernels of BW160 were slightly thinner and 10 to 15% lighter. Grain yields were about 2/3 of normal (3)
Origin of mutant:
A neutron induced mutant in Bonus (PI 189763) (8).
Mutational events:
cer-zd.67 (NGB 110951, GSHO 451) in Bonus (PI 189763) (4, 8); *cer-zd.592* (NGB 111480) in Foma (CIho 11333), *-zd.665* (NGB 111553), *-zd.668* (NGB 111556) in Bonus (4); *cer-zd.946* (NGB 111834) in Bonus (5); *cer-zd.1351* (NGB 112239) in Bonus (6); *cer-zd.1356* (NGB 112244) in Bonus (7).
Mutant used for description and seed stocks:
cer-zd.67 (GSHO 451, NGB 110951) in Bonus; *cer-zd.67* in Bowman (PI 483237)*2 (GSHO 1962); *cer-zd.67* in Bowman*3 (BW160, NGB 21992).
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Prepared:

U. Lundqvist and P. von Wettstein-Knowles. 1975. Barley Genet. Newsl. 5:140.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:373.

U. Lundqvist and J.D. Franckowiak. 2010. Barley Genet. Newsl. 40:110-111.

BGS 423, Eceriferum-ze, *cer-ze*

Stock number: BGS 423
Locus name: Eceriferum-ze
Locus symbol: *cer-ze*

Previous nomenclature and gene symbolization:
Glossy seedling 5 = *gl5* (3, 4).
Inheritance:
Monofactorial recessive (4, 14).
Located in chromosome 7HS (4, 15); over 23.7 cM proximal from the *brh1* (brachytic 1) locus (4); *cer-ze.81* is associated with SNP markers 2_0495 to 1_0451 (positions 32.35 to 41.79 cM) in 7H bins 02 to 03 of the Bowman backcross-derived line BW161 (1); *glf5.e* is associated with SNP markers 2_0495 to 2_0758 (positions 32.35 to 41.79 cM) in 7H bins 02 to 03 of the Bowman backcross-derived line BW387 (1), likely in 7H bin 03.
Description:
Surface wax coating on the leaf blade appears absent (wax code ++ ++ -) (14). Concerning the chemical epicuticular wax composition, the reduction in the amount of surface wax is accompanied by a decrease in the size and morphological complexity of the wax bodies. The wax body structure is arranged in single, double, and triple finger-like forms (16). Plants of the Bowman backcross-derived line for *cer-ze.81*, BW161, occasionally showed slightly delayed heading, but delayed heading of the stock for *glf5.e*, BW387, was not observed. The grain yields of both BW161 and BW387 were about ¾ those of Bowman (2).
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (14).
Mutational events:
cer-ze.81 (NGB 110965, GSHO 452), *-ze.145* (NGB 111031), *-ze.152* (NGB 111038) in Bonus (PI 189763), *-ze.203* (NGB 111090), *-ze.247* (NGB 111134), *-ze.253* (NGB 111140), *-ze.298* (NGB 111185), *-ze.331* (NGB 111218), *-ze.333* (NGB 111220), *-ze.391* (NGB 111278), *-ze.392* (NGB 111279), *-ze.460* (NGB 111348), *-ze.506* (NGB 111394) in Foma (CIho 11333) (6, 14); *cer-ze.179* (NGB 111065), *-ze.196* (NGB 111082), *-ze.660* (NGB 111548), *-ze.662* (NGB 111550), *-ze.694* (NGB 111582), *-ze.714* (NGB 111602), *-ze.725* (NGB 111613), *-ze.729* (NGB 111617), *-ze.736* (NGB 111624), *-ze.745* (NGB 111633) in Bonus, *-ze.584* (NGB 111472) in Foma (6); *cer-ze.620* (NGB 111508) in Foma, *-ze.816* (NGB 111704), *-ze.817* (NGB 111705), *-ze.824* (NGB 111712), *-ze.834* (NGB 111722), *-ze.864* (NGB 111752), *-ze.885* (NGB 111773) in Bonus, *-ze.1086* (NGB 111974) in Kristina (NGB 1500) (7); *cer-ze.621* (NGB 111509) in Foma, *-ze.638* (NGB 111526), *-ze.918* (NGB 111808) in Bonus (8); *cer-ze.934* (NGB 111822) in Bonus, *-ze.1241* (NGB 112129), *-ze.1274* (NGB 112182) in Kristina (9); *cer-ze.1160* (NGB 112048), *-ze.1297* (NGB 112185), *-ze.1298* (NGB 112186), *-ze.1299* (NGB 112187) in Kristina, *-ze.1322* (NGB 112210) in Bonus (10); *cer-ze.1349* (NGB 112237), *-ze.1350* (NGB 112238), *-ze.1367* (NGB 112255), *-ze.1380* (NGB 112268), *-ze.1392* (NGB 112280), *-ze.1417* (NGB 112305), *-ze.1422* (NGB 112310), *-ze.1432* (NGB 112320) in Bonus (11); *cer-ze.1781* (NGB 112596), *-ze.1782* (NGB 112597), *-ze.1804* (NGB 117352), *-ze.1809* (NGB 117357), *-ze.1814* (NGB 117362), *-ze.1815* (NGB 117363) in Bonus (12); *cer-ze.1817* (NGB 117365) in Bonus, *-ze.1832* (NGB 117380), *-ze.1834* (NGB 117382), *-ze.1836* (NGB 117384), *-ze.1838* (NGB 117386), *-ze.1840* (NGB 117388), *-ze.1842* (NGB 117390), *-ze.1845* (NGB 117393), *-ze.1846* (NGB 117394), *-ze.1848* (NGB 117396), *-ze.1849* (NGB 117397), *-ze.1851* (NGB 117399), *-ze.1854* (NGB 117402), *-ze.1855* (NGB 117403), *-ze.1856* (NGB 117404), -

ze.1869 (NGB 117417) in Sv 79353 (13); *glf5.e* in Kirin Choku 1 (Kmut 239, OUM294, GSHO 1753) (4, 5).

Mutant used for description and seed stocks:

cer-ze.81 (GSHO 452, NGB 110965) in Bonus; *cer-ze.81* in Bowman (PI 483237)*6 (GSHO 1831); *cer-ze.81* in Bowman*7 (BW161, NGB 21993); *glf5.e* in Bowman*7 (GSHO 1830, BW387, NGB 20625).

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Prepared:

U. Lundqvist and P. von Wettstein-Knowles. 1975. Barley Genet. Newsl. 5:141.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:374-375.

U. Lundqvist and J.D. Franckowiak. 2012. Barley Genet. Newsl. 42:514-515.

BGS 424, Eceriferum-zf, *cer-zf*

Stock number: BGS 424
Locus name: Eceriferum-zf
Locus symbol: *cer-zf*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Located in chromosome 3H or 7HS (1); *cer-zf.70* is associated with SNP markers 1_0672 to 2_0093 (positions 58.56 to 127.91 cM) in 3H bins 05 to 08 and with SNP markers 1_0851 to 2_0495 (positions 17.32 to 32.35 cM) in 7H bin 02 of the Bowman backcross-derived line BW162 (1).
Description:
Surface wax coating on the leaf blade appears reduced, but only on the three upper leaf blades (wax code ++ ++ +) (4). Short awns are present in the original stock (4), but not in the stock selected as the Bowman backcross-derived line (2). Agronomic differences between Bowman and its backcross-derived line for *cer-zf.70*, BW162, were not observed (2).
Origin of mutant:
An ethylene imine induced mutant in Bonus (PI 189763) (4).
Mutational events:
cer-zf.70 (NGB 110954, GSHO 453) in Bonus (PI 189763) (3).
Mutant used for description and seed stocks:
cer-zf.70 in Bonus (GSHO 453, NGB 110954); *cer-zf.70* in Bowman (PI 483237)*3 (GSHO 2198); *cer-zf.70* in Bowman*4 (BW162, NGB 21994).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
2. Franckowiak, J.D. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
4. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:142.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:376.
U. Lundqvist and J.D. Franckowiak. 2012. Barley Genet. Newsl. 42:516.

BGS 425, Eceriferum-zg, *cer-zg*

Stock number: BGS 425
Locus name: Eceriferum-zg
Locus symbol: *cer-zg*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Located in chromosome 4HL (7); about 7.0 cM distal from the *lks5* (short awn 5, *ari-c*) locus (1, 2, 3, 8); about 14.0 cM distal from the *lbi2* (long basal rachis internode 2) locus (8).
Description:
Surface wax coating on the leaf blade is reduced, but only on the three upper leaf blades (wax code ++ ++ +) (6).
Origin of mutant:
An ethylene imine induced mutant in Foma (CIho 11333) (6).
Mutational events:
cer-zg.214 (NGB 111105, GSHO 454) in Foma (CIho 11333) (4, 6); *cer-zg.1195* (NGB 112083) in Kristina (NGB 1500) (5).
Mutant used for description and seed stocks:
cer-zg.214 (NGB 111105, GSHO 454) in Foma; *cer-zg.214* in Bowman (PI 483237)*2 (BW163, NGB 21995).
References:
1. Forster, B.P. 1993. Coordinator's report: Chromosome 4. Barley Genet. Newsl. 22:75-77.
2. Haus, T.E. 1984. Coordinator's report: Chromosome 4. Barley Genet. Newsl. 14:61-62.
3. Jensen, J. 1987. Linkage map of barley chromosome 4. p.189-199. *In* S. Yasuda and T. Konishi (eds.) Barley Genetics V. Proc. Fifth Int. Barley Genet. Symp., Okayama, 1986. Sanyo Press Co., Okayama.
4. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
5. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
6. Lundqvist, U., P. von Wettstein-Knowles and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
7. Søgaard, B. 1971. Linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 1:41-47.
8. Søgaard, B. 1973. Continued linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 3:57-61.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:143.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:377.

BGS 427, Eceriferum-zi, *cer-zi*

Stock number: BGS 427
Locus name: Eceriferum-zi
Locus symbol: *cer-zi*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (11).
Located in chromosome 1HL (12); about 1.3 cM proximal from the *cer-e* (eceriferum-e) locus (3, 12); about 16.1 cM proximal from the *nec1* (necrotic leaf spot 1) locus (3, 4), *cer-zi. 68* is associated with SNP markers 1_0744 to 2_1361 (positions 39.84 to 82.35 cM) in 1H bins 05 to 08 of the Bowman backcross-derived line BW165 (1), likely in 1H bin 08.
Description:
Surface wax coating on the spike, leaf sheath, and stem is reduced somewhat (wax code + + ++) (11). No agronomic differences between plants of the Bowman backcross-derived line for *cer-zi.68*, BW165, and Bowman plants were observed (2).
Origin of mutant:
An ethylene imine induced mutant in Bonus (PI 189763) (11).
Mutational events:
cer-zi.68 (NGB 110952, GSHO 456) in Bonus (PI 189763), *-zi.219* (NGB 111106), *-zi.409* (NGB 111297), *-zi.410* (NGB 111298) in Foma (CIho 11333) (5, 11); *cer-zi.138* (NGB 111023), *-zi.674* (NGB 111562), *-zi.701* (NGB 111589) in Bonus (5); *cer-zi.815* (NGB 111703), *-zi.846* (NGB 111734), *-zi.971* (NGB 111859) in Bonus (6); *cer-zi.1104* (NGB 111992), *-zi.1119* (NGB 112007), *-zi.1145* (NGB 112033) in Kristina (NGB 1500) (7); *cer-zi.1314* (NGB 112202) in Kristina (8); *cer-zi.979* (NGB 111867) in Bonus (9); *cer-zi.633* (NGB 111521), *-zi.1414* (NGB 112302), *-zi.1465* (NGB 112353) in Bonus (10).
Mutant used for description and seed stocks:
cer-zi.68 in Bonus (GSHO 456, NGB 110952); *cer-zi.68* in Bowman (PI 483237)*6 (GSHO 2047); *cer-zi.68* in Bowman *8 (BW165, NGB 21997).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
2. Franckowiak, J.D. (Unpublished).
3. Jensen, J. 1978. Location of the *eceriferum* locus *cer-zi* on barley chromosome 5. Barley Genet. Newsl. 8:59-60.
4. Jensen, J. 1981. The barley chromosome 5 linkage map. p. 947-951. *In* M.J.C. Asher, R.P. Ellis, A.M. Hayter, and R.N.H. Whitehouse (eds.) Barley Genetics IV. Proc. Fourth Int. Barley Genet. Symp., Edinburgh. Edinburgh University Press, Edinburgh.
5. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
6. Lundqvist, U., and D. von Wettstein. 1975. Stock list for the eceriferum mutants III. Barley Genet. Newsl. 5:88-91.
7. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
8. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
9. Lundqvist, U., and D. von Wettstein. 1982. Stock list for the eceriferum mutants VI.

Barley Genet. Newsl. 12:169-172.
10. Lundqvist, U., and D. von Wettstein. 1985. Stock list for the eceriferum mutants VII. Barley Genet. Newsl. 15:89-93.
11. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
12. Søgaard, B. 1973. Continued linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 3:57-61.

Prepared:

U. Lundqvist. 1975. Barley Genet. Newsl. 5:145.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:378.
U. Lundqvist and J.D. Franckowiak. 2011. Barley Genet. Newsl. 41:168-169.

BGS 428, Eceriferum-zj, *cer-zj*

Stock number: BGS 428
Locus name: Eceriferum-zj
Locus symbol: *cer-zj*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (12).
Located in chromosome 5HL (2, 13); about 11.4 cM proximal from the *cer-t* (eceriferum-t) locus (13, 14, 15, 16); about 4.8 cM distal from the *ert-g* (erectoides-g) locus (15, 16); *cer-zj.78* is associated with SNP markers 1_1198 to 2_1148 (positions 73.70 to 87.73 cM) in 5H bins 04 to 05 of the Bowman backcross-derived line BW166 (1).
Description:
Surface wax coating on the leaf blade appears absent (wax code ++ ++ -) (12). Concerning the chemical epicuticular wax composition, the amount of surface wax cm^{-2} is reduced and is accompanied by a decrease of the size and morphological complexity of the wax bodies. The amount of aldehydes is slightly increased, and no diketones are observed. Wax bodies are smaller and simpler and less densely scattered over the surface than those of the wild type (17, 18). Plants of the Bowman backcross-derived line for *cer-zj.78*, BW166, lodged easily than Bowman and the grain yields of BW166 were about 1/3 lower than those of Bowman. Other agronomic traits of BW166 were similar to those of Bowman (3).
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (12).
Mutational events:
cer-zj.78 (NGB 110962, GSHO 457), -*zj.88* (NGB 110972) in Bonus (PI 189763), -*zj.278* (NGB 111165), -*zj.314* (NGB 111201), -*zj.360* (NGB 111247), -*zj.369* (NGB 111256), -*zj.394* (NGB 117295), -*zj.428* (NGB 111316), -*zj.448* (NGB 111336), -*zj.454* (NGB 111342), -*zj.496* (NGB 111384) in Foma (CIho 11333) (4, 12); *cer-zj.194* (NGB 111080) in Bonus, -*zj.461* (NGB 111349), -*zj.532* (NGB 111420), -*zj.567* (NGB 111455) in Foma, -*zj.659* (NGB 111547), -*zj.670* (NGB 111558), -*zj.727* (NGB 111615), -*zj.728* (NGB 111616), -*zj.730* (NGB 111618) in Bonus (4); *cer-zj.765* (NGB 111653), -*zj.781* (NGB 111669), -*zj.796* (NGB 111684), -*zj.807* (NGB 111695), -*zj.820* (NGB 111708), -*zj.859* (NGB 111747) in Bonus, -*zj.1124* (NGB 112012), -*zj.1130* (NGB 112018) in Kristina (NGB 1500), -*zj.619* (NGB 111507), in Foma (5); *cer-zj.626* (NGB 111514), -*zj.930* (NGB 111818), -*zj.931* (NGB 111819), -*zj.940* (NGB 111828), -*zj.951* (NGB 111839), -*zj.960* (NGB 111848) in Bonus, -*zj.1185* (NGB 112073) in Kristina (6); *cer-zj.618* (NGB 111506) in Foma, -*zj.1216* (NGB 1121044), -*zj.1221* (NGB 112109), -*zj.1222* (NGB 112110), -*zj.1240* (NGB 112128), -*zj.1271* (NGB 112159), -*zj.1275* (NGB 112163) in Kristina (7); *cer-zj.1294* (NGB 112182), -*zj.1311* (NGB 112199), -*zj.1315* (NGB 112203), -*zj.1316* (NGB 112204) in Kristina, -*zj.1328* (NGB 112216) in Bonus (8); *cer-zj.1342* (NGB 112230), -*zj.1384* (NGB 112272), -*zj.1413* (NGB 112301), -*zj.1436* (NGB 112324) in Bonus (9); *cer-zj.1488* (NGB 112375), -*zj.1732* (NGB 1112545, -*zj.1746* (NGB 112580), -*zj.1783* (NGB 112598) in Bonus (10); *cer-zj.1441* (NGB 112329) in Bonus (11).
Mutant used for description and seed stocks:
cer-zj.78 (GSHO 457, NGB 110962) in Bonus; *cer-zj.78* in Bowman (PI 483237)*5 (GSHO 2113); *cer-zj.78* in Bowman*7 (BW166, NGB 21998).
References:

1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
2. Fester, T., and B. Søgaard. 1969. The localization of eceriferum loci in barley. Hereditas 61:327-337.
3. Franckowiak, J.D. (Unpublished).
4. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
5. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
6. Lundqvist, U., and D. von Wettstein. 1975. Stock list for the eceriferum mutants III. Barley Genet. Newsl. 5:88-91.
7. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
8. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
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10. Lundqvist, U., and D. von Wettstein. 1985. Stock list for the eceriferum mutants VII. Barley Genet. Newsl. 15:89-93.
11. Lundqvist, U., and D. von Wettstein. 1988. Stock list for the eceriferum mutants VIII. Barley Genet. Newsl. 18:88-91.
12. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
13. Søgaard, B. 1971. Linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 1:41-47.
14. Søgaard, B. 1973. Continued linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 3:57-61.
15. Søgaard, B. 1974. Three-point tests on chromosome 1 and 7. Barley Genet. Newsl. 4:70-73.
16. Søgaard, B. 1977. The localization of eceriferum loci in barley. IV. Three point tests of genes on chromosome 7 in barley. Carlsberg Res. Commun. 42:35-43.
17. Wettstein-Knowles, P. von. 1971. The molecular phenotypes of the eceriferum mutants. p.146-193. *In* R.A. Nilan (ed.) Barley Genetics II. Proc. Second Int. Barley Genet. Symp., Pullman, WA, 1969. Washington State Univ. Press, Pullman.
18. Wettstein-Knowles, P. von. 1972. Genetic control of β-diketone and hydroxy-β-diketone synthesis in epicuticular waxes of barley. Planta 106:113-130.

Prepared:

U. Lundqvist and P. von Wettstein-Knowles. 1975. Barley Genet. Newsl. 5:146.

Revised:

U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:379-380.
U. Lundqvist and J.D. Franckowiak. 2012. Barley Genet. Newsl. 42:520-521.

BGS 429, Eceriferum-zk, *cer-zk*

Stock number: BGS 429
Locus name: Eceriferum-zk
Locus symbol: *cer-zk*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (7).
Located in chromosome 2H; based on the presence of the *gth1.a* allele at the *Gth1* (toothed lemma 1) locus in the BC_3F_3 stock.
Description:
Surface wax coating on the spike, leaf sheath, and stem is greatly reduced, and surface wax on the leaf blade is greatly reduced or absent (wax code + + +/-) (7). In the Bowman backcross-derived line, the reduction in surface wax on the leaf sheath and stem is not observed (wax code + ++ +/-).
Origin of mutant:
A neutron induced mutant in Bonus (PI 189763) (7).
Mutational events:
cer-zk.85 (NGB 110969, GSHO 458), *-zk.117* (NGB 111002) in Bonus (PI 189763) (1, 7); *cer-zk.91* (NGB 110975) in Bonus (1); *cer-zk.157* (NGB 111043) in Bonus, *-zk.593* (NGB 111481), *-zk.611* (NGB 111499), *-zk.612* (NGB 111500) in Foma (CIho 11333) (2); *cer-zk.952* (NGB 111840) in Bonus (3); *cer-zk.872* (NGB 111760) in Bonus, *-zk.1214* (NGB 112102), *-zk.1218* (NGB 112106) in Kristina (NGB 1500) (4); *cer-zk.165* (NGB 111051) in Bonus, *-zk.614* (NGB 111502) in Foma, *-zk.749* (NGB 111637) , *-zk.1396* (NGB 112284) in Bonus (5); *cer-zk.1716* (NGB 112529), *-zk.1720* (NGB 112533) in Bonus (6).
Mutant used for description and seed stocks:
cer-zk.85 (GSHO 458, NGB 110969) in Bonus; *cer-zk.85* in Bowman (PI 483237)*4 (GSHO 2199); *cer-zk.85* in Bowman*6 (BW167, NGB 21999).
References:
1. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
2. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
3. Lundqvist, U., and D. von Wettstein. 1975. Stock list for the eceriferum mutants III. Barley Genet. Newsl. 5:88-91.
4. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
5. Lundqvist, U., and D. von Wettstein. 1982. Stock list for the eceriferum mutants VI. Barley Genet. Newsl. 12:169-172.
6. Lundqvist, U., and D. von Wettstein. 1985. Stock list for the eceriferum mutants VII. Barley Genet. Newsl. 15:89-93.
7. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:147.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:381.

BGS 430, Eceriferum-zl, *cer-zl*

Stock number: BGS 430
Locus name: Eceriferum-zl
Locus symbol: *cer-zl*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Location is unknown.
Description:
Surface wax coating on the spike, leaf sheath, and stem appears absent (wax code - - ++). Low seed set and poor plant vigor occur in the original mutants (1) and in the Bowman backcross-derived line.
Origin of mutant:
A proton induced mutant in Bonus (PI 189763) (1).
Mutational events:
cer-zl.17 (NGB 110901, GSHO 459) in Bonus (PI 189763) (1, 2); *cer-zl.269* (NGB 111157) in Foma (CIho 11333) (1, 4); *cer-zl.1027* (NGB 111915) in Carlsberg II (CIho 10114) (3).
Mutant used for description and seed stocks:
cer-zl.17 (GSHO 459, NGB 110901) in Bonus; *cer-zl.17* in Bowman (PI 483237)*5 (BW168, NGB 22000).
References:
1. Lundqvist, U., and D. von Wettstein. 1962. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. Hereditas 48:342-362.
2. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
3. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
4. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:148.
Revised:
U. Lundqvist. 1997. Barley Genet. Newsl. 26:382.

BGS 431, Eceriferum-zn, *cer-zn*

Stock number: BGS 431
Locus name: Eceriferum-zn
Locus symbol: *cer-zn*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Located in chromosome 1H (1); *cer-zn.244* is association with SNP markers 1_0764 to 1_0396 (positions 61.55 to 143.47 cM)) in 1H bins 06 to 11 of the Bowman backcross-derived line BW169 (1). Previously mapped in 3HL (6, 7); over 12.0 cM distal from the uzu 1 (*uzu1*) locus (6, 7, 8, 9, 10);
Description:
Surface wax coating on the spike appears greatly reduced or absent (wax code +/- ++ ++) (5). No significant changes in other morphological traits were observed when Bowman backcross-derived line BW169 was compared to Bowman (2). The series of SNP markers heterogeneous in 3HL of BW169 are identical to those from the donor parent Foma in other Bowman backcross-derived lines (1, 2).
Origin of mutant:
An ethylene imine mutant in Foma (CIho 11333) (3).
Mutational events:
cer-zn.244 (NGB 111131, GSHO 1523), *-zn.362* (NGB 111249) in Foma (CIho 11333) (3, 5); *cer-zn.348* (NGB 111235), *-zn.385* (NGB 111282), *-zn.540* (NGB 111428) in Foma (3); *cer-zn.1270* (NGB 112158) in Kristina (NGB 1500) (4).
Mutant used for description and seed stocks:
cer-zn.244 (GSHO 1523, NGB 111131) in Foma; *cer-zn.244* in Bowman (PI 483237)*5 (GSHO 1983), *cer-zn.244* in Bowman*7 (BW169, NGB 22001).
References:
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7. Søgaard, B. 1973. Continued linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 3:57-61.
8. Søgaard, B. 1976. Three-point tests on barley chromosome 3. Barley Genet. Newsl. 6:65-67.
9. Søgaard, B. 1977. The localization of eceriferum loci in barley V. Three point tests of genes on chromosome 1 and 3 in barley. Carlsberg Res. Commun. 42:67-75.
10. Takahashi, R. 1983. Coordinator's report: Chromosome 3. Barley Genet. Newsl.

13:89-93.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:149.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:383.
U. Lundqvist and J.D. Franckowiak. 2010. Barley Genet. Newsl. 40:112-113.

BGS 432, Eceriferum-zo, *cer-zo*

Stock number: BGS 432
Locus name: Eceriferum-zo
Locus symbol: *cer-zo*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Location is unknown.
Description:
Surface wax coating on the spike appears absent in the original stock (wax code - ++ ++) (3). Pointed lateral spikelets are observed in the original stock (3), but not in the Bowman backcross-derived line. Only reduced surface wax coating on the spike occurs in the Bowman backcross-derived line (wax code + ++ ++).
Origin of mutant:
An ethylene imine induced mutant in Foma (CIho 11333) (3).
Mutational events:
cer-zo.229 (NGB 111116, GSHO 462), *-zo.352* (NGB 111239) in Foma (CIho 11333) (1, 3); *cer-zo.565* (NGB 111493) in Foma (1); *cer-zo.718* (NGB 111606), *-zo.882* (NGB 111770 in Bonus (PI 189763) (2).
Mutant used for description and seed stocks:
cer-zo.229 (GSHO 462, NGB 111116) in Foma; *cer-zo.229* in Bowman (PI 483237)*3 (GSHO 2201); *cer-zo.229* in Bowman*5 (BW170, NGB 22002).
References:
1. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
2. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
3. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
Prepared:
U. Lundqvist, U. 1975. Barley Genet. Newsl. 5:150.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:384.

BGS 433, Eceriferum-zp, *cer-zp*

Stock number: BGS 433
Locus name: Eceriferum-zp
Locus symbol: *cer-zp*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Located in chromosome 5HL (5); about 7.5 cM distal from the *ert-g* (erectoides-g) locus (6, 7, 8); about 8.9 cM proximal from the *cer-t* (eceriferum-t) locus (7, 8).
Description.
Surface wax coating on the leaf blade appears absent (wax code ++ ++ -). Plant vigor is reduced, leaf blades are narrow and rolled, and they are maculated with dark and light green zones (4). Expression of the maculated trait is less pronounced in the Bowman backcross-derived line, and the plant vigor is better.
Origin of mutant:
An ethyl methanesulfonate induced mutant in Foma (CIho 11333) (4).
Mutational events:
cer-zp.313 (NGB 111200, GSHO 463), *-zp.382* (NGB 111269), *-zp.397* (NGB111274), *-zp.404* (111292) in Foma (CIho 11333) (1, 4); *cer-zp.1205* (NGB 112093) in Kristina (NGB 1500) (2); *cer-zp.1795* (NGB 117343), *-zp.1796* (NGB 117344) in Bonus (PI 189763) (3).
Mutant used for descriptions and seed stocks:
cer-zp.313 (GSHO 463, NGB 111200) in Bonus; *cer-zp.313* in Bowman (PI 483237)*7 (GSHO 2114, BW171, NGB 22003).
References:
1. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
2. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
3. Lundqvist, U., and D. von Wettstein. 1985. Stock list for the eceriferum mutants VII. Barley Genet. Newsl. 15:89-93.
4. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
5. Søgaard, B. 1971. Linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 1:41-47.
6. Søgaard, B. 1973. Continued linkage studies on eceriferum mutants in barley. Barley Genet. Newsl. 3:57-61.
7. Søgaard, B. 1974. Three-point tests on chromosome 1 and 7. Barley Genet. Newsl. 4:70-73.
8. Søgaard, B. 1977. The localization of eceriferum loci in barley. IV. Three point tests of genes on chromosome 7 in barley. Carlsberg Res. Commun. 42:35-43.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:151.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:385.

BGS 434, Eceriferum-zq, *cer-zq*

Stock number: BGS 434
Locus name: Eceriferum-zq
Locus symbol: *cer-zq*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (5).
Location is unknown.
Description:
Surface wax coating on the leaf blades appears absent, but only on the three upper leaf blades (wax code ++ ++ -) (5). Plants of the original stock remain as a vegetative tuft for a long time before heading (5). The Bowman backcross-derived line is a semidwarf (about 3/4 normal height).
Origin of mutant:
A diethyl sulfate induced mutant in Foma (CIho 11333) (5).
Mutational events:
cer-zq.248 (NGB 111135, GSHO 1524) in Foma (CIho 11333) (1, 5); *cer-zq.761* (NGB 111649) in Bonus (PI 189763) (2); *cer-zq.1343* (NGB 111231) in Bonus (3); *cer-zq.1378* (NGB 112266) in Bonus (4).
Mutant used for description and seed stocks:
cer-zq.248 (GSHO 1524, NGB 111135) in Foma; *cer-zq.248* in Bowman (PI 483237)*5 (GSHO 2202); *cer-zq.248* in Bowman*7 (BW172, NGB 22004).
References:
1. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
2. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
3. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants. V. Barley Genet. Newsl. 9:135-137.
4. Lundqvist, U., and D. von Wettstein. 1982. Stock list for the eceriferum mutants. VI. Barley Genet. Newsl. 12:169-172.
5. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:152.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:386.

BGS 435, Eceriferum-zr, *cer-zr*

Stock number: BGS 435
Locus name: Eceriferum-zr
Locus symbol: *cer-zr*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (2).
Location is unknown.
Description:
Surface wax coating on the spike appears reduced or absent (wax code +/ - ++ ++) (2). In the Bowman backcross-derived line, the wax coating appears absent on the spike and nodes and may be reduced on stem and leaf sheath (wax code - +/++ ++).
Origin of mutant:
An ethylene imine induced mutant in Foma (CIho 11333) (2).
Mutational events:
cer-zr.260 (NGB 111147, GSHO 1525) in Foma (CIho 11333) (1, 2); *cer-zr.528* (NGB 111416) in Foma (1).
Mutant used for description and seed stocks:
cer-zr.260 (GSHO 1525, NGB 111147) in Foma; *cer-zr.260* in Bowman (PI 483237)*3 (GSHO 2203); *cer-zr.260* in Bowman*6 (BW173, NGB 22005).
References:
1. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
2. Lundqvist, U., P. von Wettstein-Knowles, and D. von Wettstein. 1968. Induction of eceriferum mutants in barley by ionizing radiations and chemical mutagens. II. Hereditas 59:473-504.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:153.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:387.

BGS 436, Eceriferum-zs, *cer-zs*

Stock number: BGS 436
Locus name: Eceriferum-zs
Locus symbol: *cer-zs*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (2).
Location is unknown.
Description:
Surface wax coating on the spike is reduced (wax code + ++ ++), maturity is delayed, and vigor is somewhat reduced (2).
Origin of mutant:
An ethyl methanesulfonate induced mutant in Foma (CIho 11333) (1).
Mutational events:
cer-zs.467 (NGB 111355, GSHO 1526), *-zs.474* (NGB 111362), *-zs.475* (NGB 111363) in Foma (CIho 11333) (2); *cer-zs.594* (NGB 111482) in Foma (3).
Mutant used for description and seed stocks:
cer-zs.467 (GSHO 1526, NGB 111355) in Foma; *cer-zs.467* in Bowman (PI 483237)*3 (BW174, NGB 22006).
References:
1. Lundqvist, U. (Unpublished).
2. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
3. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:154.
Revised:
U. Lundqvist. 1997. Barley Genet. Newsl. 26:388.

BGS 437, Eceriferum-zt, *cer-zt*

Stock number: BGS 437
Locus name: Eceriferum-zt
Locus symbol: *cer-zt*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Location in chromosome 2HS (1); about 16.8 distal from SSR marker Bmac0134 in 2H bin 01 (1).
Description:
Surface wax coating on the spike appears slightly reduced (wax code + ++ ++) (3). The reduction in the surface wax seemed greater in plants selected from the backcrosses to Bowman (wax code +/- ++ ++).
Origin of mutant:
An ethyl methanesulfonate and neutron induced mutant in Foma (CIho 11333) (2).
Mutational events:
cer-zt.389 (NGB 111276, GSHO 1527), *-zt.479* (NGB 111367) in Foma (CIho 11333) (2).
Mutant used for description and seed stocks:
cer-zt.389 (GSHO 1527, NGB 111276) in Foma; *cer-zt.389* in Bowman (PI 483237)*2 (GSHO 2205); *cer-zt.389* in Bowman*5 (BW175, 22007).
References:
1. Dahleen, L.S., and J.D. Franckowiak. 2006. SSR linkages to eight additional morphological marker traits. Barley Genet. Newsl. 36:12-16.
2. Lundqvist, U. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1971. Stock list for the eceriferum mutants. Barley Genet. Newsl. 1:97-102.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:155.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:389.
U. Lundqvist and J.D. Franckowiak. 2007. Barley Genet. Newsl. 37:270.

BGS 438, Eceriferum-zu, *cer-zu*

Stock number: BGS 438
Locus name: Eceriferum-zu
Locus symbol: *cer-zu*

Previous nomenclature and symbolization:
None.
Inheritance:
Monofactorial recessive 4).
Located in chromosome 1HS (1); *cer-zu.122* is associated with SNP markers 1_0764 to 2_0095 (positions 61.55 to 89.85 cM) in 1H bins 06 to 08 of the Bowman backcrossed-derived line BW176 (1).
Description:
Surface wax coating on the spike appears absent, the wax coating on the leaf sheath and stem is reduced (wax code - + ++) (4). Leaf blades become golden yellow at or shortly after heading and later necrotic spots develop on the upper surface of the leaf blade (3). The necrosis is observed in crosses to Bowman, but is not retained in the backcross-derived line for *cer-zu.122*, BW176. Plants of the BW176 line were morphologically and agronomically similar to Bowman in trials (2).
Origin of mutant:
An ethyl methanesulfonate induced mutant in Bonus (PI 189763) (3).
Mutational events:
cer-zu.122 (NGB 111007, GSHO 1528) in Bonus (PI 189763) (4); *cer-zu.973* (NGB 111861) in Bonus (5); *cer-zu.1163* (NGB 112051) in Kristina (NGB 1500), *-zu.1419* (NGB 112307), *-zu.1428* (NGB 112316), *-zu.1447* (NGB 112325); *-zu.1494* (NGB 112382) in Bonus (6); , *cer-zu.1570* (NGB 112458), *-zu.1571* (NGB 112459) in Nordal, *cer-zu.1762* (NGB 112577), *-zu.1784* (NGB 112599) in Bonus (7).
Mutant used for description and seed stocks:
cer-zu.122 (GSHO 1528, NGB 111007) in Bonus; *cer-zu.122* in Bowman (PI 483237)*5 (GSHO 2206, BW176, NGB 22008).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
2. Franckowiak, J.D. (Unpublished).
3. Lundqvist, U. (Unpublished).
4. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
5. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
6. Lundqvist, U., and D. von Wettstein. 1982. Stock list for the eceriferum mutants VI. Barley Genet. Newsl. 12:169-172.
7. Lundqvist, U., and D. von Wettstein. 1985. Stock list for the eceriferum mutants VII. Barley Genet. Newsl. 15:89-93.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:156.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:390.
U. Lundqvist and J.D. Franckowiak. 2011. Barley Genet. Newsl. 41:170.

BGS 439, Eceriferum-zv, *cer-zv*

Stock number: BGS 439
Locus name: Eceriferum-zv
Locus symbol: *cer-zv*

Previous nomenclature and symbolization:
None.
Inheritance:
Monofactorial recessive (2).
Location is unknown.
Description:
Surface wax coating on the spike, the leaf sheath and stem, and the leaf blade appears absent (wax code - - -) (2). Plants are semidwarf, very weak, and head late, and the hull is poorly attached to the seed. The Bowman backcross-derived line is a semidwarf (2/3 normal height) with a kinked upper peduncle and a strong wax coating on the nodes.
Origin of mutant:
An ethylene imine induced mutant in Foma (CIho 11333) (1).
Mutational events:
cer-zv.268 (NGB 111155, GSHO 1529), *-zv.342* (NGB 111229), *-zv.576* (NGB 111464) in Foma (CIho 11333) (2); cer-zv.1256 (NGB 112144) in Kristina (NGB 1500) (3).
Mutant for description and seed stocks:
cer-zv.268 (GSHO 1529, NGB 111155) in Foma; *cer-zv.268* in Bowman (PI 483237)*5 (GSHO 2207); *cer-zv.268* in Bowman *7 (BW177, NGB 22009).
References:
1. Lundqvist, U. (Unpublished).
2. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
3. Lundqvist, U., and D. von Wettstein. 1979. Stock list for the eceriferum mutants V. Barley Genet. Newsl. 9:135-137.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:157
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:391.

BGS 440, Eceriferum-zw, *cer-zw*

Stock number: BGS 440
Locus name: Eceriferum-zw
Locus symbol: *cer-zw*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (2).
Location is unknown.
Description:
Surface wax coating on the spike, leaf sheath, and stem appears reduced (wax code + + ++), and the leaf sheath and stem have alternating, broad horizontal bands of waxless and wax covered zones (zebra-like stripes) (2).
Origin of mutant:
An ethyl methanesulfonate induced mutant in Foma (CIho 11333) (1).
Mutational events:
cer-zw.286 (NGB 111173, GSHO 1530) in Foma (CIho 11333) (2).
Mutant used for description and seed stocks:
cer-zw.286 (GSHO 1530, NGB 11173) in Foma; *cer-zw.286* in Bowman (PI 483237)*2 (GSHO 2208); *cer-zw.286* in Bowman*3 (BW178, NGB 22010).
References:
1. Lundqvist, U. (Unpublished).
2. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:158.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:392.

BGS 441, Eceriferum-zx, *cer-zx*

Stock number: BGS 441
Locus name: Eceriferum-zx
Locus symbol: *cer-zx*

Previous nomenclature and symbolization:
None.
Inheritance:
Monofactorial recessive (2).
Location is unknown.
Description:
Surface wax coating on the spike, leaf sheath, and stem appears reduced (wax code + + ++) (2).
Origin of mutant:
An ethyl methanesulfonate induced mutant in Bonus (PI 189763) (1).
Mutational events:
cer-zx.100 (NGB 110984, GSHO 1531) in Bonus (PI 189763) (2).
Mutant used for description and seed stocks:
cer-zx.100 (GSHO 1531, NGB 110984) in Bonus; *cer-zx.100* in Bowman (PI 483237)*2 (GSHO 2209); *cer-zx.100* in Bowman*5 (BW179, NGB 22011).
References:
1. Lundqvist, U. (Unpublished).
2. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:159.
Revised:
U. Lundqvist. 1997. Barley Genet. Newsl. 26:393.

BGS 442, Eceriferum-zy, *cer-zy*

Stock number: BGS 442
Locus name: Eceriferum-zy
Locus symbol: *cer-zy*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Located in chromosome 1HS (1); *cer-zy.118* is associated with SNP markers 2_0479 to 2_0502 (positions 0.0 to 3.18 cM) in 1H bin 01 of the Bowman backcross-derived line BW180 (1), in 1H bin 01.
Description:
Surface wax coating on the leaf blade appears slightly reduced on the upper three leaves (wax code ++ ++ +) (4). Seedling leaves have a slightly yellow green color similar to that found in some chlorina mutants. Other morphological traits and plant vigor appeared normal in Bowman backcross-derived line BW180 (2).
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (3).
Mutational events:
cer-zy.118 (NGB 111103, GSHO 1532) in Bonus (PI 189763) (4); *cer-zy.136* (NGB 111021) in Bonus (5).
Mutant used for description and seed stocks:
cer-zy.118 (NGB 111003, GSHO 1532) in Bonus; *cer-zy.118* in Bowman (PI 483237)*5 (BW180, NGB 22012).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2010. Genetic dissection of barley morphology and development. Plant Physiology. Epubl. 2010 November 18, 2010 as DOI:10.1104/pp110.166249.
2. Franckowiak, J.D. (Unpublished).
3. Lundqvist, U. (Unpublished).
4. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
5. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:160.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:394.
U. Lundqvist and J.D. Franckowiak. 2010. Barley Genet. Newsl. 40:116.

BGS 443, Eceriferum-zz, *cer-zz*

Stock number: BGS 443
Locus name: Eceriferum-zz
Locus symbol: *cer-zz*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (2).
Location is unknown.
Description:
Surface wax coating on the leaf blade appears absent (wax code ++ ++ -) (2).
Origin of mutant:
An ethyl methanesulfonate induced mutant in Foma (1).
Mutational events:
cer-zz.615 (NGB 111503, GSHO 1533) in Foma (CIho 11333) (2).
Mutant used for description and seed stocks.
cer-zz.615 (GSHO 1533, NGB 111503) in Foma; *cer-zz.615* in Bowman (PI 483237)*2 (GSHO 2210); *cer-zz.615* in Bowman *4 (BW181, NGB 22013).
References:
1. Lundqvist, U. (Unpublished).
2. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:161.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:395.

BGS 444, Eceriferum-ya, *cer-ya*

Stock number: BGS 444
Locus name: Eceriferum-ya
Locus symbol: *cer-ya*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Located in chromosome 3HS (1); probably linked to the *btr1* (non-brittle rachis 1) locus based on linkage drag (1).
Description:
Surface wax coating on the leaf blade appears absent (wax code ++ ++ -) (3). Leaves have a light green color that persists from the seedling stage until maturity. Heading and maturity are delayed in plants homozygous for the *cer-ya.180* gene.
Origin of mutant:
A propane disulfonic acid diethyl ester induced mutant in Bonus (PI 189763) (2).
Mutational events:
cer-ya.180 (NGB 111066, GSHO 1534) in Bonus (PI 189763) (3).
Mutant used for description and seed stock:
cer-ya.180 (GSHO 1534, NGB 111066) in Bonus; *cer-ya.180* in Bowman (PI 483237)*3; *cer-ya.180* in Bowman*7 (BW132, NGB 20538).
References:
1. Franckowiak, J.D. 1995. Notes on linkage drag in Bowman backcross derived lines of spring barley. Barley Genet. Newsl. 24:63-70.
2. Lundqvist, U. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3.110-112.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:162.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:396.

BGS 445, Eceriferum-yb, *cer-yb*

Stock number: BGS 445
Locus name: Eceriferum-yb
Locus symbol: *cer-yb*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (5).
Located in chromosome 2HL (3); near the *Gth1* (toothed lemma 1) locus based on linkage drag (3); *cer-yb.200* is associated with SNP markers 2_0647 to 1)1533 (positions 85.71 to 141.56 cM) in 2H bins 07 to 10 of the Bowman backcross-derived line BW133 (1), likely in 2H bin 09.
Description:
Surface wax coating on the leaf blade appears absent (wax code ++ ++ -) (5). Plants of the Bowman backcross-derived line with *cer-yb.200*, BW133, headed 2 to 3 days later than Bowman and had 4 to 5 more kernels per spike. Other morphological traits of BW133 were similar to those of Bowman (2).
Origin of mutant:
A neutron induced mutant in Bonus (PI 189763) (4).
Mutational events:
cer-yb.200 (NGB 111086, GSHO 1535) in Bonus (PI 189763), *-yb.316,* (NGB 111203), *-yb.453* (NGB 111341) in Foma (CIho 11333) (5); *cer-yb.1174* (NGB 112062) in Kristina (NGB 1500) (6); *cer-yb.1211* (NGB 112099) in Kristina (7).
Mutant used for description and seed stocks:
cer-yb.200 (GSHO 1535, NGB 111086) in Bonus; *cer-yb.200* in Bowman (PI 483237)*6 (GSHO 1896); *cer-yb.200* in Bowman*7 (BW133, NGB 20539).
References.
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
2. Franckowiak, J.D. (Unpublished).
3. Franckowiak, J.D. 1995. Notes on linkage drag in Bowman backcross derived lines of spring barley. Barley Genet. Newsl. 24:63-70.
4. Lundqvist, U. (Unpublished).
5. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
6. Lundqvist, U., and D. von Wettstein. 1975. Stock list for the eceriferum mutants III. Barley Genet. Newsl. 5:88-91.
7. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:163.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:397.
J.D. Franckowiak and U. Lundqvist. 2011. Barley Genet. Newsl. 41:171.

BGS 446, Eceriferum-yc, *cer-yc*

Stock number: BGS 446
Locus name: Eceriferum-yc
Locus symbol: *cer-yc*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (4).
Location in chromosome 6H or 7HS (1); *cer-yc.135* is associated with SNP markers 1_0061 to 1_1261 (positions 70.15 to 107.26 cM) in 6H bins 05 to 07 and SNP markers 2_1419 to 1_0838 (positions 0.0 to 49.53 cM) in 7H bins 01 to 04 of the Bowman backcross-derived line BW134 (2);
Description:
Surface wax coating on the spike appears absent (wax code - ++ ++) (3). Surface wax on the leaf sheath appears reduced in the Bowman backcross-derived line (wax code - + ++). The long-chain *n*-alkanes on the spike were reduced without greatly altering the chain-length distributions of the minor hydrocarbons (7). Compared to Bowman, the Bowman backcross-derived line for *cer-yc.135*, BW134, had kernels that were slightly smaller with weights about 10% less. Grain yields for BW134 were about 3/4 those for Bowman. Other morphological differs from Bowman were not observed (2).
Origin of mutant:
An ethylene imine mutant in Bonus (PI 189763) (1).
Mutational events:
cer-yc.135 (NGB 111020, GSHO 1536) in Bonus (PI 189763) (4); *cer-yc.523* (NGB 111411) in Foma (CIho 11333) (5); *cer-yc.438* (NGB 111326), *-yc.439* (NGB 111327) in Foma, *-yc.783* (NGB 111671 in Bonus (6).
Mutant used for description and seed stocks:
cer-yc.135 (GSHO 1536, NGB 111020) in Bonus; *cer-yc.135* in Bowman (PI 483237)*3 (GSHO 2211); *cer-yc.135* in Bowman*5 (BW134, NGB 20540).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2011. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
2. Franckowiak, J.D. (Unpublished).
3. Lundqvist, U. (Unpublished).
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Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:164.
Revised:
U. Lundqvist and J. D. Franckowiak. 1997. Barley Genet. Newsl. 26:398.
U. Lundqvist and J. D. Franckowiak. 2011. Barley Genet. Newsl. 41:172.

BGS 447, Eceriferum-yd, *cer-yd*

Stock number: BGS 447
Locus name: Eceriferum-yd
Locus symbol: *cer-yd*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Located in chromosome 3HS (1); based on linkage drag with the *btr1* (non-brittle rachis 1) locus (1).
Description:
Surface wax coating on the spike appears absent (wax code - ++ ++). The original *cer-yd.139* stock has narrow leaf blades, pointed lateral spikelets, and semi-sterility (3). In the Bowman backcross-derived line, surface wax coating appears reduced (wax code + ++ ++). The Bowman backcross-derived line has few stigma hairs and very poor to slightly reduced seed set occurs in various environments, but male fertility is normal. Lodicules appear pistiloid in plants grown in the greenhouse.
Origin of mutant:
A gamma-ray induced mutant in Bonus (PI 189763) (2).
Mutational events:
cer-yd.139 (NGB 111024, GSHO 1537) in Bonus (PI 189763) (3).
Mutant used for description and seed stocks:
cer-yd.139 (GSHO 1537, NGB 111024) in Bonus; *cer-yd.139* in Bowman (PI 483237)*4 (GSHO 1946); *cer-yd.139* in Bowman*5 (BW135, NGB 20541).
References:
1. Franckowiak, J.D. 1995. Notes on linkage drag in Bowman backcross derived lines of spring barley. Barley Genet. Newsl. 24:63-70.
2. Lundqvist, U. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:165.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:399.

BGS 448, Eceriferum-ye, *cer-ye*

Stock number: BGS 448
Locus name: Eceriferum-ye
Locus symbol: *cer-ye*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Located in chromosome 5HL (1); based on linkage drag with the *raw1* (smooth awn 1) locus (1).
Description:
Surface wax coating on the leaf blade appears absent (wax code ++ ++ -) (3).
Origin of mutant:
An ethylene imine induced mutant in Foma (CIho 11333) (2).
Mutational events:
cer-ye.267 (NGB 111154, GSHO 1538), *-ye.582* (NGB 111470) in Foma (CIho 11333, *-ye.792* (NGB 111680) in Bonus (PI 189763) (3); *cer-ye.1103* (NGB 111991) in Kristina (NGB 1500) (4); *cer-ye.1395* (NGB 112283) in Bonus (5).
Mutant used for description and seed stocks:
cer-ye.267 (GSHO 1538, NGB 111154) in Foma; *cer-ye.267* in Bowman (PI 483237)*6 (GSHO 2127); *cer-ye.267* in Bowman*7 (BW136, NGB 20542).
References:
1. Franckowiak, J.D. 1995. Notes on linkage drag in Bowman backcross derived lines of spring barley. Barley Genet. Newsl. 24:63-70.
2. Lundqvist, U. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
4. Lundqvist, U., and D. von Wettstein. 1977. Stock list for the eceriferum mutants IV. Barley Genet. Newsl. 7:92-96.
5. Lundqvist, U., and D. von Wettstein. 1982. Stock list for the eceriferum mutants VI. Barley Genet. Newsl. 12:169-172.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:166.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:40.

BGS 449, Eceriferum-yf, *cer-yf*

Stock number: BGS 449
Locus name: Eceriferum-yf
Locus symbol: *cer-yf*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Location is unknown.
Description:
Surface wax coating on the leaf blade is reduced (wax code ++ ++ +) (3). In the Bowman backcross-derived line, mutant plants have pale green leaves, heading is delayed by several days, and plants are slightly shorter (1).
Origin of mutant:
A neutron induced mutant in Bonus (PI 189763) (2).
Mutational events:
cer-yf.652 (NGB 111540, GSHO 1539), -*yf.804* (NGB 111692) in Bonus (PI 189763) (3).
Mutant used for description and seed stocks:
cer-yf.652 (GSHO 1539, NGB 111540) in Bonus; *cer-yf.652* in Bowman (PI 483237)*3 (GSHO 2212); *cer-yf.652* in Bowman*5 (BW137, NGB 20543).
References:
1. Franckowiak, J.D. (Unpublished).
2. Lundqvist, U. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
Prepared.
U. Lundqvist. 1975. Barley Genet. Newsl. 5:167.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:401.
U. Lundqvist. 2007. Barley Genet. Newsl. 37:271.

BGS 450, Eceriferum-yg, *cer-yg*

Stock number: BGS 450
Locus name: Eceriferum-yg
Locus symbol: *cer-yg*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Located in chromosome 7HS (1); based on linkage drag with the *ant1* (anthocyanin-less 1) locus (1).
Description:
Surface wax coating on the spike, leaf sheath, stem, and leaf blade appears absent (wax code - - -) (3). The Bowman backcross-derived line is semidwarf (3/4 normal), and surface wax is present on the leaf blades (wax code - - +).
Origin of mutant:
A diethyl sulfate induced mutant in Carlsberg II (CIho 10114) (2).
Mutational events:
cer-yg.1014 (NGB 111902, GSHO 1540) in Carlsberg II (CIho 10114) (3).
Mutant used for description and seed stocks:
cer-yg.1014 (GSHO 1540, NGB 111902) in Carlsberg II; *cer-yg.1014* in Bowman (PI 483237)*5 (GSHO 1839); *cer-yg.1014* in Bowman*7 (BW138, NGB 20544).
References:
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2. Lundqvist, U. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:168.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:402.

BGS 451, Eceriferum-yh, *cer-yh*

Stock number: BGS 451
Locus name: Eceriferum-yh
Locus symbol: *cer-yh*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (3).
Located in chromosome 3HS (1); based on linkage drag with the *Btr1* (brittle rachis 1) locus (1).
Description:
Surface wax coating on the spike appears absent (wax code - ++ ++) (3). Mutant plants are semi-sterile, heading is delayed, and lateral spikelets have a pointed apex. In the Bowman backcross-derived line, seed set is low because few hairs develop on the stigma. Although the anthers are slightly malformed, male fertility is good.
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (2).
Mutational events:
cer-yh.116 (NGB 111001, GSHO 1541), *-yh.654* (NGB 111542) in Bonus (PI 189763) (3).
Mutant used for description and seed stocks:
cer-yh.116 (GSHO 1541, NGB 111001) in Bonus; *cer-yh.116* in Bowman (PI 483237)*5 (GSHO 1947, BW139, NGB 20545).
References:
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2. Lundqvist, U. (Unpublished).
3. Lundqvist, U., and D. von Wettstein. 1973. Stock list for the eceriferum mutants II. Barley Genet. Newsl. 3:110-112.
Prepared:
U. Lundqvist. 1975. Barley Genet. Newsl. 5:169.
Revised:
U. Lundqvist and J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:403.

BGS 454, Non-blue aleurone xenia 5, *blx5*

Stock number: BGS 454
Locus name: Non-blue aleurone xenia 5
Locus symbol: *blx5*

Previous nomenclature and gene symbolization:
Non-blue aleurone 5 = *bl5* (1).
Inheritance:
Monofactorial recessive when complementary dominant alleles are present at the *Blx1, Blx2, Blx3,* and *Blx4* loci (1).
Located in chromosome 7HL (1, 5); associated with a red stem trait controlled by the dominant allele at the *ant5* (anthocyanin-less 5) locus (1); linked to the *blx2* (non-blue aleurone xenia 2) locus, but not to the *fch12* (chlorina seedling 12) locus (5).
Description:
Blue aleurone color is due to anthocyanin pigments (4), which occur as lumps inside many aleurone granules in some or all aleurone cells (1). Variation in blue color expression from dark blue to an off-white is caused by environmental factors and modifying genes (1, 2). Aleurone color is best observed in well filled grain that is magnified to show individual aleurone cells, after more superficial tissues have been peeled off (3).
Origin of mutant:
Natural occurrence in BGM 122 (1).
Mutational events:
blx5.e in BGM 122 (GSHO 2509) (1).
Mutant used for description and seed stocks:
blx5.e in BGM 122 (GSHO 2509).
References:
1. Finch, R. A., and E. Simpson. 1978. New colours and complementary colour genes in barley. Z. Pflanzenzücht. 81:40-53.
2. Kushnak, G.D. 1974. Utilizing linkages of genetic male sterile and aleurone color genes in hybrid barley (*Hordeum vulgare* L.) systems. Ph.D. Thesis. Montana State Univ., Bozeman.
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Prepared:
R.A. Finch. 1978. Barley Genet. Newsl. 8:167.
Revised:
J.D. Franckowiak and R.A. Finch. 1997. Barley Genet. Newsl. 26:404.

BGS 455, Shrunken endosperm genetic 8, *seg8*

Stock number: BGS 455
Locus name: Shrunken endosperm genetic 8
Locus symbol: *seg8*

Previous nomenclature and gene symbolization:
None.
Inheritance:
Monofactorial recessive (2).
Located in chromosome 7H (4).
Description:
Seed size is reduced and maturity is delayed. Seed weights of 24, 23, and 27% of normal are reported for plants grown in the field in Arizona, in the field in Montana, and in the greenhouse in Arizona, USA, respectively (4). Pollen mother cell meiosis and pollen fertility are normal. Seed from *seg8.k* plants can be used to establish stands under field conditions (4). Endosperms of *seg8* developed as two-filled lateral lobes with no central endosperm lobe, resulting in a distinct dorsal crease (1).
Origin of mutant:
A spontaneous mutant in 60Ab1810-53 (CIho 15686) (3).
Mutational events:
seg8.k (GSHO 2469) in 60Ab1810-53 (CIho 15686) (3, 4).
Mutant used for description and seed stocks:
seg8.k (GSHO 2469) in 60Ab1810-53; *seg8.k* in Bowman (PI 483237)*5 (GSHO 1854. BW840, NGB 22277).
References:
1. Felker, F.C., D.M. Peterson, and O.E. Nelson. 1985. Anatomy of immature grains of eight material effect shrunken endosperm barley mutants. Amer. J. Bot. 72:248-256.
2. Ramage, R.T. 1983. Chromosome location of shrunken endosperm mutants *seg6g* and *seg8k*. Barley Genet. Newsl. 13:64-65.
3. Ramage, R.T., and C.L. Crandall. 1981. BGS 453, Shrunken endosperm, *seg8*. Barley Genet. Newsl. 11:103.
4. Ramage, R.T., and C.L. Crandall. 1981. Shrunken endosperm mutant *seg8*. Barley Genet. Newsl. 11:34.
Prepared:
R.T. Ramage and C.L. Crandall. 1981. Barley Genet. Newsl. 11:103 as BGS 453.
Revised:
R.T. Ramage. 1983. Barley Genet. Newsl. 13:116 as BGS 453.
T. Tsuchiya. 1983. Barley Genet. Newsl. 13:117. BGS number changed to BGS 455.
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:405.
J.D. Franckowiak. 2007. Barley Genet. Newsl. 37:272.

BGS 460, Curly 4, *cur4*

Stock number: BGS 460
Locus name: Curly 4
Locus symbol: *cur4*

Previous nomenclature and gene symbolization:
Curly 4 = *cu4* (10).
Spiral neck = *spn* (3, 9, 10).
Globosum-d = *glo-d* (4).

Inheritance:
Monofactorial recessive (4, 6, 9, 10).
Located in chromosome 2HL (3, 4, 7, 11); close to the *Gth1* (toothed lemma 1) locus based on linkage drag with the *glo-d.1006* allele at the *cur4* locus (2).

Description:
Diagnostic characteristics can be observed from the seedling stage to maturity. Roots are curved compared to straight roots in normal plants (9). Leaves tend to coil or bend and may have wrinkles at the margins. Culms are bent slightly at the nodes and about 3/4 normal length, and awns are frequently slightly coiled (4, 9).

Origin of mutant:
An X-ray induced mutant in Asahi 5 (OUJ509) (3, 10).

Mutational events:
cur4.f (Kmut 118, GSHO 1708) in Asahi 5 (OUJ509) (3, 10); *glo-d.1006* (1114/66, GSHO 1754) in Donaria (PI 161974) (1, 4); *glo-d.13* (*glo-d.1009*), *glo-d.14* in Bonus (PI 189763) (5, 6); *cur4.i* (OUM163, GSHO 1709) in Akashinriki (OUJ659, PI 467400).

Mutant used for description and seed stocks:
cur4.f (GSHO 1708) in Asahi 5; *cur4.f* in Bowman (PI 483237)*7 (GSHO 1915, BW223, NGB 22050); *glo-d.1006* from Donaria in Bowman*7 (GSHO 1917. BW395, NGB 20633); *cur4.i* from Akashinriki in Bowman*7 (GSHO 1916, BW224, NGB 22051).

References:
1. Franckowiak, J.D. 1992. Allelism tests among selected semidwarf barleys. Barley Genet. Newsl. 21:17-23.
2. Franckowiak, J.D. 1995. Notes on linkage drag in Bowman backcross derived lines of spring barley. Barley Genet. Newsl. 24:63-70.
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7. Hwang, J.J., and T. Tsuchiya. 1988. Primary trisomic analysis of the gene *cu4* for curly 4 (spiral) mutant in KM118. Barley Genet. Newsl. 18:18-20.
8. Tsuchiya, T. 1974. Further results of allelism testing in barley. Barley Genet. Newsl. 4:82-85.
9. Tsuchiya, T. 1974. Root character of curly mutants in barley. Barley Genet. Newsl. 4:88-90.
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11. Wang, S., and T. Tsuchiya. 1990. Further investigation on mutant gene *cu4* (spiral)

in barley by means of primary trisomic analysis. Barley Genet. Newsl.19:60.
Prepared:
T. Tsuchiya. 1984. Barley Genet. Newsl. 14:97.
Revised:
J.D. Franckowiak and U. Lundqvist. 1997. Barley Genet. Newsl. 26:406.

BGS 461, Zebra stripe 2, *zeb2*

Stock number: BGS 461
Locus name: Zebra stripe 2
Locus symbol: *zeb2*

Previous nomenclature and gene symbolization:
Zoned leaf = *zd* (2).
Zoned leaf = *z* (3, 5, 11).
Zoned leaf c = zb_c (5, 10, 12).
Zebra leaf or zoned Colorado = z_c (4, 11).
Zebra striped leaves = *zd* (6).
Zebra stripe 2 =*zb2* (11).
Chlorina seedling 10 = *f10* (1, 8).

Inheritance:
Monofactorial recessive (2, 3, 9).
Located in chromosome 4HS (1, 2); about 9.3 cM distal from the *Kap1* (hooded lemma 1) locus (1); about 17.0 cM proximal from the *glf3* (glossy leaf 3) locus (1).

Description:
Leaves are chlorina throughout the life cycle, independent of light and temperature (2). Plants may be killed by low temperature during the winter when normal plants are unaffected (2). A zonate pattern of different degrees of chlorina is observed in seedling leaves. After much confusion about this gene, the locus was named zebra stripe 2 = *zb2* (11). Plants are very weak or non-viable in the field in North Dakota, but only reduced vigor is noted when grown in the greenhouse.

Origin of mutant:
A spontaneous mutant in an unknown cultivar (2, 12).

Mutational events:
zeb2.b (GSHO 93) in an unknown cultivar (2, 3, 9, 11); *fch10.s* in an unknown cultivar (GSHO 1234) (7, 8); both stocks may have originated from the same mutant used by Woodward (12) and first isolated by Immer and Henderson (2).

Mutant used for description and seed stocks:
zeb2.b (GSHO 93) in an unknown cultivar; *zeb2.b* in Bowman (PI 483237)*3 (GSHO 2012); *zeb2.b* in Bowman*7 (BW931, NGB 22360).

References:
1. Hayashi, J., T. Konishi, I. Moriya, and R. Takahashi. 1984. Inheritance and linkage studies in barley. VI. Ten mutant genes located on chromosomes 1 to 7, except 3. Ber. Ohara Inst. landw. Biol., Okayama Univ. 18:227-250.
2. Immer, F.R., and M.T. Henderson. 1943. Linkage studies in barley. Genetics 28:419-440.
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10. Tsuchiya, T. 1983. Proposed new gene symbol for two different mutant types for zebra Colorado, or zoned leaf. Barley Genet. Newsl. 13:84.
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Prepared:

T.E. Haus. 1984. Barley Genet. Newsl. 14:93 as BGS 177, Chlorina 10, *f10*.

T. Tsuchiya. 1984. Barley Genet. Newsl. 14:98 as BGS 461, Zebra or zoned leaves 2, *zb2*.

Revised:

J.D. Franckowiak and A. Hang. 1997. Barley Genet. Newsl. 26:407-408.

BGS 462, Yellow streak 3, *yst3*

Stock number: BGS 462
Locus name: Yellow streak 3
Locus symbol: *yst3*

Previous nomenclature and gene symbolization:
Yellow streak c = *yst,,c* (2).
Inheritance:
Monofactorial recessive (1, 2).
Located in chromosome 3HS (1); may be linked to the *btr2* (non-brittle rachis 2) locus based on linkage drag (1); trisomic analyses of the *yst3* locus have not been successful (3, 4, 5).
Description:
Yellow streaks of variable width and number develop in the leaves, stems, and spikes of homozygous plants. Some plants are almost entirely yellow, similar to chlorina plants. Penetrance is 100%, but expressivity is highly variable and may require careful observation. Cold treatment increases the number and width of the yellow streaks (1).
Origin of mutant:
A spontaneous mutant in Lion (CIho 923) (1).
Mutational events:
yst3.c (GSHO 48) in Lion (CIho 923) (1).
Mutant used for description and seed stocks:
yst3.c (GSHO 48) in Lion; *yst3.c* in Bowman (PI 483237)*6 (GSHO 1939); *yst3.c* in Bowman*7 (BW926, NGB 22355).
References:
1. Franckowiak, J.D. 1995. Notes on linkage drag in Bowman backcross derived lines of spring barley. Barley Genet. Newsl. 24:63-70.
2. Singh, R.J., and T. Tsuchiya. 1973. Allelism testing among three yellow streak mutants. Barley Genet. Newsl. 3:54-55.
3. Tsuchiya, T., and J.V. Alanko. 1976. Genetic studies of two mutations by means of primary trisomic analysis. Barley Genet. Newsl. 6:84-85.
4. Tsuchiya, T., and A. Hang. 1979. Telotrisomic analysis of *yst3* and *i* in barley. Barley Genet. Newsl. 9:106-108.
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Prepared:
Tsuchiya, T. 1984. Barley Genet. Newsl. 14:99.
Revised:
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:409.

BGS 463, Gigas 1, *gig1*

Stock number: BGS 463
Locus name: Gigas 1
Locus symbol: *gig1*

Previous nomenclature and gene symbolization:
Female sterile = *sf* (2, 4).
Gigas = *gig* (6).
Inheritance:
Monofactorial recessive (2).
Location in chromosome 2H is possible (3, 4, 7, 8); a possible linkage drag association with the *Gth1* (toothed lemma 1) locus in chromosome 2H was noted (1).
Description:
Culm length and diameter, leaves, spikes, and glumes are greater than the control; awns are shorter than the control; leaves are dark green; spikes are lax; spikes, culms, and leaf sheaths have a heavy wax coating (5). Anther development is good, but the stigma has few hairs and seed set is poor (2, 5). In the Bowman backcross-derived line, plant height is normal and plants appear normal except spikelets are abnormal and the wax coating is heavy. The lemma is large and long, awns are 1/2 normal length, stigma hairs are few, and selfed seed set is 10 to 15%. Hand pollination can increase seed set.
Origin of mutant:
A spontaneous mutant in a population from the cross Montcalm//Galore/Daples (GB96) (2); an X-ray induced mutant in Tochigi Golden Melon (OUJ808) (5, 6).
Mutational events:
gig1.a (Kmut 72, GSHO 1650) in Tochigi Golden Melon (OUJ808) (5, 6); *gig1.b* in Montcalm//Galore/Daples (2, 6).
Mutant used for description and seed stocks:
gig1.a (GSHO 1650) in Tochigi Golden Melon; *gig1.a* in Bowman (PI 483237)*7 (GSHO 1924, BW381, NGB 20620).
References:
1. Franckowiak, J.D. 1995. Notes on linkage drag in Bowman backcross derived lines of spring barley. Barley Genet. Newsl. 24:63-70.
2. Harvey, B.L., E. Reinbergs, and B.H. Somaroo. 1968. Inheritance of female sterility in barley. Can. J. Plant Sci. 48:417-418.
3. Shim, J.W., E. Furst, and T. Tsuchiya. 1983. Primary trisomic analysis of a mutant "gigas" in barley. Barley Genet. Newsl. 13:49.
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5. Tsuchiya, T. 1962. Annual report on breeding of malting barley. Kihara Inst. Biol. Res., Japan. 28 p. with 8 tables, Mimeo.
6. Tsuchiya, T. 1975. Allelic relationships of some morphological and chlorophyll mutants in barley. Barley Genet. Newsl. 5:64-67.
7. Tsuchiya, T., and R.L. Haines. 1975. Trisomic analysis of nine mutant genes in barley. Barley Genet. Newsl. 5:67-69.
8. Wang, S. 1992. Telotrisomic analysis of the mutant gigas (*gig*) in barley. Barley Genet. Newsl. 21:76-77.
Prepared:
T. Tsuchiya. 1985. Barley Genet. Newsl. 15:88 as BGS 460, Gigas, *gig*.
Revised:
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:410.

BGS 464, Male sterile genetic 27, *msg27*

Stock number: BGS 464
Locus name: Male sterile genetic 27
Locus symbol: *msg27*

Previous nomenclature and gene symbolization:
Male sterile ae = *msg,,ae* (5).
Inheritance:
Monofactorial recessive (2, 7).
Located in chromosome 2HL (1); about 20.5 cM distal from the *vrs1* (six-rowed spike 1) locus (6).
Description:
Selfing - none (3, 5, 7).
Outcrossing - complete female fertility (7).
Stamens - anthers rudimentary, no stomium or filament elongation (3, 7).
Origin of mutant:
A spontaneous mutant in Firlbecks III (PI 223985) (7).
Mutational events:
msg27.ae (MSS097, GSHO 2379) in Firlbecks III (PI 223985) (2, 5, 7); *msg27.jr* (MSS523) in Mona (PI 466726) (3, 4).
Mutant used for description and seed stocks:
msg27.ae (GSHO 2379) in Firlbecks III; *msg27.ae* in Bowman (PI 483237)*7 (GSHO 1921, BW562, NGB 23430).
References:
1. Franckowiak, J.D. 1991. Association of male sterility genes with a specific chromosome using multiple marker stocks. Barley Genet. Newsl. 20:31-36.
2. Hockett, E.A. 1977. The genetic male sterile barley collection. Barley Genet. Newsl. 7:97-100.
3. Hockett, E.A. 1984. Coordinator's report. The genetic male sterile barley collection. Barley Genet. Newsl. 14:70-75.
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5. Hockett, E.A., and R.F. Eslick. 1971. Genetic male sterile genes useful in hybrid barley production. p. 298-307. *In* R.A. Nilan (ed.) Barley Genetics II. Proc. Second Int. Barley Genet. Symp., Pullman, WA, 1969. Washington State Univ. Press, Pullman.
6. Luna Villafaña, A. 1995. Mapping marker genes in chromosome 2 of barley. M.S. Thesis. North Dakota State Univ., Fargo.
7. Somnus, P. 1968. Allelism of a male-sterile gene in barley. M.S. Thesis. Colorado State Univ., Ft. Collins.
Prepared:
E.A. Hockett. 1986. Barley Genet. Newsl. 16:47.
Revised:
E.A. Hockett. 1991. Barley Genet. Newsl. 20:94.
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:411.

BGS 465, Male sterile genetic 28, *msg28*

Stock number: BGS 465
Locus name: Male sterile genetic 28
Locus symbol: *msg28*

Previous nomenclature and gene symbolization:
Male sterile as = *msg,,as* (3).
Inheritance:
Monofactorial recessive (3, 6).
Located in chromosome 2HS (1); associated with SNP markers 2_1015 to 2_0864 (positions 48.68 to 55.52 cM) in 2HS bin 05 of a plant presumed to be a heterozygote from the Bowman backcross-derived line BW563 (1). Previously located in chromosome 6 near the *rob1* (orange lemma 1) locus (2).
Description:
Selfing - none (3).
Outcrossing - complete female fertility (3, 6).
Stamens - anthers rudimentary, with no stomium or filament elongation (6).
Pollen - non-staining, shrunken, and no normal-appearing grains (6).
Cytology - normal meiosis (6).
Origin of mutant:
A spontaneous mutant in York (CIho 10075) (6).
Mutational events:
msg28.as (MSS311, GSHO 2380) in York (CIho 10075) (4, 5, 6).
Mutant used for description and seed stocks:
msg28.as (GSHO 2380) in York; *msg28.as* in Bowman (PI 483237)*7 (GSHO 2079, BW563, NGB 24132).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2010. Genetic dissection of barley morphology and development. Plant Physiol. 155:617-627.
2. Franckowiak, J.D. 1991. Association of male sterility genes with a specific chromosome using multiple marker stocks. Barley Genet. Newsl. 20:31-36.
3. Hockett, E.A. 1972. Coordinator's report on the genetic male sterile barley collection. Barley Genet. Newsl. 2:139-144.
4. Hockett, E.A. 1977. The genetic male sterile barley collection. Barley Genet. Newsl. 7:97-100.
5. Hockett, E.A., and R.F. Eslick. 1971. Genetic male sterile genes useful in hybrid barley production. p. 298-307. *In* R.A. Nilan (ed.) Barley Genetics II. Proc. Second Int. Barley Genet. Symp., Pullman, WA, 1969. Washington State Univ. Press, Pullman.
6. Sharma, R.K. 1970. Studies of sterility mutants in spring barley (*Hordeum vulgare* L.). Ph.D. Thesis. Univ. of Guelph, Ontario.
Prepared:
E.A. Hockett. 1986. Barley Genet. Newsl. 16:48.
Revised:
E.A. Hockett. 1991. Barley Genet. Newsl. 20:95.
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:412.
J.D. Franckowiak. 2011. Barley Genet. Newsl. 41:173.

BGS 466, Male sterile genetic 29, *msg29*

Stock number: BGS 466
Locus name: Male sterile genetic 29
Locus symbol: *msg29*

Previous nomenclature and gene symbolization:
Male sterile a = *msg,,a* (3).
Male sterile = 63msx1 and 63msx2 (*ms-aa*) (4).
Inheritance:
Monofactorial recessive (3).
Located in chromosome 5HL (1); about 22.7 cM from the *raw1* (smooth awn 1) locus (1).
Description:
Selfing - none (3).
Outcrossing - complete female fertility (3).
Stamens - anthers smaller than fertile sibs, with no stomium or filament elongation (3).
Origin of mutant:
A spontaneous mutant in Ackermans MGZ (CIho 11491) (4).
Mutational events:
msg29.a (MSS069, GSHO 2381) in Ackermans MGZ (CIho 11491) (2, 5); *msg29.aa* in Ackermans MGZ (MSS070) (3, 5).
Mutant used for description and seed stocks:
msg29.a (GSHO 2381) in Ackermans MGZ; *msg29.a* in Bowman (PI 483237)*7 (GSHO 2140, BW564, NGB 24133).
References:
1. Franckowiak, J.D. 1991. Association of male sterility genes with a specific chromosome using multiple marker stocks. Barley Genet. Newsl. 20:31-36.
2. Hockett, E.A. 1979. The genetic male sterile barley collection. Barley Genet. Newsl. 9:124-128.
3. Hockett, E.A., and R.F. Eslick. 1971. Genetic male sterile genes useful in hybrid barley production. p. 298-307. *In* R.A. Nilan (ed.) Barley Genetics II. Proc. Second Int. Barley Genet. Symp., Pullman, WA, 1969. Washington State Univ. Press, Pullman.
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5. Hockett, E.A., and D.A. Reid. 1981. Spring and winter genetic male-sterile barley stocks. Crop Sci. 21:655-659.
Prepared:
E.A. Hockett. 1986. Barley Genet. Newsl. 16:47.
Revised:
E.A. Hockett. 1991. Barley Genet. Newsl. 20:94.
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:413.

BGS 467, Male sterile genetic 30, *msg30*

Stock number: BGS 467
Locus name: Male sterile genetic 30
Locus symbol: *msg30*

Previous nomenclature and gene symbolization:
Male sterile c = *msg,,c* (4).
Male sterile = msx2 (*msa*) (5).
Inheritance:
Monofactorial recessive (4).
Located in chromosome 7HL (1); about 11.4 cM from the *lks2* (short awn 2) locus (1).
Description:
Selfing - 0.7% at Bozeman, Montana, USA (4).
Outcrossing - complete female fertility (4), open pollinated seed set of 15% at Bozeman, MT and 2% at Elimäki, Finland (3).
Stamens - anthers smaller than fertile sibs, stomium present and the filament elongates (3).
Origin of mutant:
A spontaneous mutant in Compana (PI 539111) (5).
Mutational events:
msg30.c (MSS072, GSHO 2382) in Compana (PI 539111) (2, 5, 6).
Mutant used for description and seed stocks:
msg30.c (GSHO 2382) in Compana; *msg30.c* in Bowman (PI 483237)*7 (GSHO 1859, BW566, NGB 23431).
References:
1. Franckowiak, J.D. 1991. Association of male sterility genes with a specific chromosome using multiple marker stocks. Barley Genet. Newsl. 20:31-36.
2. Hockett, E.A. 1979. The genetic male sterile barley collection. Barley Genet. Newsl. 9:124-128.
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4. Hockett, E.A., and R.F. Eslick. 1971. Genetic male sterile genes useful in hybrid barley production. p. 298-307. *In* R.A. Nilan (ed.) Barley Genetics II. Proc. Second Int. Barley Genet. Symp., Pullman, WA, 1969. Washington State Univ. Press, Pullman.
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6. Hockett, E.A., and D.A. Reid. 1981. Spring and winter genetic male-sterile barley stocks. Crop Sci. 21:655-659.
Prepared:
E.A. Hockett. 1986. Barley Genet. Newsl. 16:50.
Revised:
E.A. Hockett. 1991. Barley Genet. Newsl. 20:97.
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:414.

BGS 468, Male sterile genetic 31, *msg31*

Stock number: BGS 468
Locus name: Male sterile genetic 31
Locus symbol: *msg31*

Previous nomenclature and gene symbolization:
Male sterile d = *msg,,d* (4).
Male sterile dwarf = *msdwf* (4).
Inheritance:
Monofactorial recessive (3).
Located in chromosome 1HL (1); distal from the *sls1* (small lateral spikelet 1) locus (3); associated with SNP markers 1_1037 to 2_0909 (positions 125.59 to 149.90 cM) in 1HL of a heterozygous plant from the Bowman backcross-derived line BW567 (1), in 1H bin 11.
Description:
Selfing - none (6).
Outcrossing - complete female fertility (6).
Stamens - anthers rudimentary, no stomium or filament elongation (5).
In addition to male sterility, mutant plants are weak and short (about 1/2 normal height), show delayed development, and appear to lack surface wax on the spike (wax code - ++ ++) (2, 4).
Origin of mutant:
A spontaneous mutant in the six-rowed line 51Ab4934 (CIho 15245) (6).
Mutational events:
msg31.d (MSS306, GSHO 2383) in 51Ab4934 (CIho 15245) (4, 6).
Mutant used for description and seed stocks:
msg31.d (GSHO 2383) in 51Ab4934; *msg31.d* in Bowman (PI 483237)*6 (GSHO 2031, BW567, NGB 23432).
References:
1. Druka, A., J. Franckowiak, U. Lundqvist, N. Bonar, J. Alexander, K. Houston, S. Radovic, F. Shahinnia, V. Vendramin, M. Morgante, N. Stein, and R. Waugh. 2010. Genetic dissection of barley morphology and development. Plant Physiology. Epubl. 2010 November 18, 2010 as DOI:10.1104/pp110.166249.
2. Franckowiak, J.D. (Unpublished).
3. Franckowiak, J.D. 1995. Notes on linkage drag in Bowman backcross derived lines of spring barley. Barley Genet. Newsl. 24:63-70.
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5. Hockett, E.A. 1979. The genetic male-sterile barley collection. Barley Genet. Newsl. 9:124-128.
6. Hockett, E.A., and D.A. Reid. 1981. Spring and winter genetic male-sterile barley stocks. Crop Sci. 21:655-659.
Prepared:
E.A. Hockett. 1986. Barley Genet. Newsl. 16:51.
Revised:
E.A. Hockett. 1991. Barley Genet. Newsl. 20:98.
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:415.
J.D. Franckowiak. 2010. Barley Genet. Newsl. 40:117.

BGS 469, Male sterile genetic 32, *msg32*

Stock number: BGS 469
Locus name: Male sterile genetic 32
Locus symbol: *msg32*

Previous nomenclature and gene symbolization:
Male sterile w = *msg,,w* (3).
Male sterile = 63msx7 (4).
Inheritance:
Monofactorial recessive (3).
Located in chromosome 7H (1, 3); linked to the *nud1* (naked caryopsis 1) locus (1).
Description:
Selfing - none (3).
Outcrossing - complete female fertility (3).
Stamens - anthers smaller than fertile sibs, no stomium or filament elongation (3).
Origin of mutant:
A spontaneous mutant in Betzes (PI 129430) (4).
Mutational events:
msg32.w (MSS090, GSHO 2384) in Betzes (PI 129430) (2, 3, 5).
Mutant used for description and seed stocks:
msg32.w (GSHO 2384) in Betzes; *msg32.w* in Bowman (PI 483237)*7 (GSHO 1860, BW568, NGB 23433).
References:
1. Franckowiak, J.D. 1988. Mapping four male sterile genes on chromosome 1. Barley Newsl. 31:111.
2. Hockett, E.A. 1979. The genetic male sterile barley collection. Barley Genet. Newsl. 9:124-128.
3. Hockett, E.A., and R.F. Eslick. 1971. Genetic male sterile genes useful in hybrid barley production. p. 298-307. *In* R.A. Nilan (ed.) Barley Genetics II. Proc. Second Int. Barley Genet. Symp., Pullman, WA, 1969. Washington State Univ. Press, Pullman.
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5. Hockett, E.A., and D.A. Reid. 1981. Spring and winter genetic male-sterile barley stocks. Crop Sci. 21:655-659.
Prepared:
E.A. Hockett. 1986. Barley Genet. Newsl. 16:52.
Revised:
E.A. Hockett. 1991. Barley Genet. Newsl. 20:99.
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:416.

BGS 470, Male sterile genetic 33, *msg33*

Stock number: BGS 470
Locus name: Male sterile genetic 33
Locus symbol: *msg33*

Previous nomenclature and gene symbolization:
Male sterile x = *msg,,x* (4).
Male sterile = 63msx8 (5).
Inheritance:
Monofactorial recessive (4).
Located in chromosome 2HS (1); about 5.2 cM distal from the centromere, and 25.6 cM proximal from the *vrs1* (six-rowed spike 1) locus (7).
Description:
Selfing - 20% at Bozeman, Montana, 17% at Tucson, Arizona, USA, and 0% at Elimäki, Finland (3).
Outcrossing - complete female fertility (4).
Stamens - anthers smaller than fertile sibs, stomium present, and filament elongation (4).
Origin of mutant:
A spontaneous mutant in Betzes (PI 129430) (5).
Mutational events:
msg33.x (MSS091, GSHO 2385) in Betzes (PI 129430) (2, 4, 5, 6).
Mutant used for description and seed stocks:
msg33.x (GSHO 2385) in Betzes; *msg33.x* in Bowman (PI 483237)*7 (GSHO 1884, BW569, NGB 23434).
References:
1. Franckowiak, J.D. 1991. Association of male sterility genes with a specific chromosome using multiple marker stocks. Barley Genet. Newsl. 20:31-36.
2. Hockett, E.A. 1979. The genetic male sterile barley collection. Barley Genet. Newsl. 9:124-128.
3. Hockett, E.A., and H. Ahokas. 1979. Male and female fertility levels of genetic male sterile barley grown at two different latitudes. Hereditas 91:65-71.
4. Hockett, E.A., and R.F. Eslick. 1971. Genetic male sterile genes useful in hybrid barley production. p. 298-307. *In* R.A. Nilan (ed.) Barley Genetics II. Proc. Second Int. Barley Genet. Symp., Pullman, WA. Washington State Univ. Press, Pullman.
5. Hockett, E.A., R.F. Eslick, D.A. Reid, and G.A. Wiebe. 1968. Genetic male sterility in barley. II. Available spring and winter stocks. Crop Sci. 8:754-755.
6. Hockett, E.A., and D.A. Reid. 1981. Spring and winter genetic male-sterile barley stocks. Crop Sci. 21:655-659.
7. Luna Villafaña, A. 1995. Mapping marker genes in chromosome 2 of barley. M.S. Thesis. North Dakota State Univ., Fargo.
Prepared:
E.A. Hockett. 1986. Barley Genet. Newsl. 16:53.
Revised:
E.A. Hockett. 1991. Barley Genet. Newsl. 20:100.
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:417.

BGS 471, Male sterile genetic 34, *msg34*

Stock number: BGS 471
Locus name: Male sterile genetic 34
Locus symbol: *msg34*

Previous nomenclature and gene symbolization:
Male sterile av = *msg,,av* (2).
Male sterile = 63msy1 (2).
Inheritance:
Monofactorial recessive (2, 5).
Located in chromosome 6H (1); recombination with the *rob1* (orange lemma 1) locus was not observed (1).
Description:
Selfing - none (2).
Outcrossing - complete female fertility (2).
Stamens - anthers rudimentary, with no stomium or filament elongation (2).
Heterozygotes show reduced fertility (75 to 85% seed set), and male sterile plants always have a long glume awn 1 (*Lga1*) trait from Paragon. Thus, the *msg34.av* allele probably involves a translocation between chromosome 6HS and an unknown chromosome.
Origin of mutant:
A spontaneous mutant in Paragon (CIho 13649) (5).
Mutational events:
msg34.av (MSS314, GSHO 2386) in Paragon (CIho 13649) (3, 4).
Mutant used for description and seed stocks:
msg34.av (GSHO 2386) in Paragon; *msg34.av* in Bowman (PI 483237)*7 (GSHO 2070, BW570, NGB 24134).
References:
1. Franckowiak, J.D. 1991. Association of male sterility genes with a specific chromosome using multiple marker stocks. Barley Genet. Newsl. 20:31-36.
2. Hockett, E.A. 1972. Coordinator's report on the genetic male sterile barley collection. Barley Genet. Newsl. 2:139-144.
3. Hockett, E.A. 1984. Coordinator's report. The genetic male sterile barley collection. Barley Genet. Newsl. 14:70-75.
4. Hockett, E.A., and D.A. Reid. 1981. Spring and winter genetic male-sterile barley stocks. Crop Sci. 21:655-659.
5. Sharma, R.K. 1970. Studies of sterility mutants in spring barley (*Hordeum vulgare* L.). Ph.D. Thesis. Univ. of Guelph, Ontario.
Prepared:
E.A. Hockett. 1986. Barley Genet. Newsl. 16:54.
Revised:
E.A. Hockett. 1991. Barley Genet. Newsl. 20:101.
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:418.

BGS 472, Accordion basal rachis internode 1, *abr1*

Stock number: BGS 472
Locus name: Accordion basal rachis internode 1
Locus symbol: *abr1*

Previous nomenclature and gene symbolization:
Laxatum-3 = *lax-3* (1, 2, 3).
Inheritance:
Monofactorial recessive (2, 3).
Located in chromosome 2HL (5); about 7.4 cM proximal from the *fch15* (chlorina seedling 15) locus (5); about 6.3 cM proximal from the *Gth1* (toothed lemma 1) locus (6).
Description:
Rachis internodes in the upper part of the spike are about 12% longer than normal. Secondary and tertiary shoots may form at the accordion-like basal rachis nodes (2, 5). Manifestation of the extra shoots may be a day-length response and genotype dependent. Heading is delayed in the Bowman backcross-derived line. Recombination with the *eog1.a* (elongated outer glume) allele has not been observed (5, 6), and recombination with the *vrs1.a* (six-rowed spike 1) allele is low (6).
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (2).
Mutational events:
abr1.a (*lax.3*, NGB 116337, GSHO 1563), *abr1.b* (*lax.12*, NGB 116346) in Bonus (PI 189763), *abr1.c* (*lax.337*, NGB 116556) in Foma (CIho 11333) (2, 4).
Mutant used for description and seed stocks:
abr1.a (GSHO 1563, NGB 116337) in Bonus; *abr1.a* in Bowman (PI 483237)*7 (GSHO 1887, BW001, NGB 20409).
References:
1. Gustafsson, Å., A. Hagberg, U. Lundqvist, and G. Persson. 1969. A proposed system of symbols for the collection of barley mutants at Svalöv. Hereditas 62:409-414.
2. Larsson, H.E.B. 1981. Branching spike mutants from two loci in two-row barley. BGN 11:25-28.
3. Larsson, H.E.B. 1985. Morphological analysis of *laxatum* barley mutants. Hereditas 103:239-253.
4. Larsson, H.E.B. 1985. Genetic analysis of *laxatum* barley mutants. Hereditas 103:255-267.
5. Larsson, H.E.B. 1985. Linkage studies with genetic markers and some *laxatum* barley mutants. Hereditas 103:269-279.
6. Luna Villafaña, A. 1995. Mapping marker genes in chromosome 2 of barley. M.S. Thesis. North Dakota State Univ., Fargo.
Prepared:
H.E.B. Larsson and U. Lundqvist. 1986. Barley Genet. Newsl. 16:55.
Revised:
J.D. Franckowiak and U. Lundqvist. 1997. Barley Genet. Newsl. 26:419.

BGS 473, Compositum 1, *com1*

Stock number: BGS 473
Locus name: Compositum 1
Locus symbol: *com1*

Previous nomenclature and gene symbolization:
Laxatum-270 = *lax-270* (5, 7, 9).
Short-haired, inflorescent rachilla = s^i (7).
Branching, inflorescent rachilla = *bir1a* (8).
Compositum = *com1a* (9, 10, 11).

Inheritance:
Monofactorial recessive (7, 8, 9).
Located in chromosome 5HL (11, 12); near the *srh1* (short rachilla hair 1) locus (12); between the *ert-n* (erectoides-n) and the *lax-a* (laxatum-a) loci (11), but widely different estimates of their distance from the *srh1* (short rachilla hair 1) locus are reported (6, 11); *com1.a* is associated with SNP markers 1_0974 to 1_0641 (positions 41.99 to 108.33 cM) in 5H bins 02 to 06 of the Bowman backcrossed-derived line BW189 (1); *com1.l* is associated with SNP markers 3_0745 to 1_0641 (positions 99.51 to 108.33 cM) in 5H bin 06 of the Bowman backcross-derived line BW605 (1), likely in 5H bin 06.

Description:
The spike is branched from the rachis of the bottom 1 to 10 spikelets. Awns, which vary from normal to thread-like, and protruding branches are bent in various directions because of "packing" problems in the boot (7). More spike branches develop from rachis nodes under favorable environmental conditions. Plants of Bowman backcross-derived lines BW189, BW190, and BW605 had slightly lower kernel weight and test weights compared to Bowman, slightly reduced kernel width (3).

Origin of mutant:
An ethyl methanesulfonate and neutron induced mutant in Foma (CIho 11333) (2, 7).

Mutational events:
com1.a (*lax.270*, NGB 116495, GSHO 1702), *com1.b* (*lax.271*, NGB 116496), *com1.*c (*lax.27*2, NGB 116497), *com1.d* (*lax.206*, NGB 116433), *com1.e* (*lax.213*, NGB 116442) in Foma (CIho 11333) (9); *com1.i* (lax.296, NGB 116520, GSHO 1699) in Foma (3, 9); *com1.l* (*mul.c*, Mut. 2227, GSHO 2412) in Donaria (PI 161974) (3, 13).

Mutant used for description and seed stocks:
com1.a (GSHO 1702, NGB 116495) in Foma; *com1.a* in Bowman (PI 483237)*6 (GSHO 2098); *com1.a* in Bowman*7 (BW189, NGB 22021); *com1.i* (NGB 116520, GSHO 1699) in Foma; *com1.i* in Bowman*3 (GSHO 2232); *com1.i* in Bowman*5 (BW190, NGB 22022); *com1.l* (*mul.c*) in Donaria (GSHO 2412); *com1.l* in Bowman*6 (GSHO2312); *com1.l* in Bowman*7 (BW605, NGB 22171).

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Revised:

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BGS 474, Laxatum-a, *lax-a*

Stock number: BGS 474
Locus name: Laxatum-a
Locus symbol: *lax-a*

Previous nomenclature and gene symbolization:
Laxatum-01 = *lax-01* (5, 9, 14).
Laxatum-a = *lax-a*^{01} (15).

Inheritance:
Monofactorial recessive (10, 14).
Located in chromosome 5HL (10, 13); about 2.4 cM proximal from the *ari-e* (breviaristatum-e) locus (7, 16); about 3.1 cM from the *ert-g* (erectoides-g) locus (7, 15, 16); *lax-a.8* is associated with SNP markers 2_1065 to 2_1275 (positions 40.91 to 104.73 cM) in 5H bins 02 to 06 of the Bowman backcross-derived line BW457 (2); *lax-a.ap* is associated with SNP markers 1_0621 to 2_1275 (positions 56.40 to 104.73 cM) in 5H bins 03 to 06 of the Bowman backcross-derived line BW458 (2), in 5H bin 06.

Description:
Florets have five anthers with two developing from transformed lodicules (5, 18); however, the extra anthers are deficient in having two rather than four microsporangia (1). The grain is thin and angular and caryopses are exposed between the lemma and palea. The awn has a very wide base, without a distinct notch in the lemma attachment region. Rachis internodes are about 15% longer than normal. Tillers arise at oblique angles giving isolated plants an appearance of a tufty growth habit (9). Treatment of leaves after tillering with GA_3 increases rachis internode length (17). Plants of Bowman backcross-derived line BW457 are 4/5 of normal height and anthesis is delayed by 3 to 4 days. Awns can be slightly shorter than normal. Kernels are generally short and thin and highly variable in size. Compared to Bowman, BW457 plants had kernel weights about 60% of normal, test weights were low, and grain yields were about half of normal (4).

Origin of mutant:
A gamma-ray induced mutant in Bonus (PI 189763) (3, 9, 12).

Mutational events:
lax-a.01 (NGB 116334), *-a.4* (NGB 116338), *-a.8* (NGB 116342, GSHO 1775), *-a.20* (NGB 116354), *-a.37* (NGB 116372), *-a.39* (NGB 116374), *-a.54* (NGB 116388) in Bonus (10, 11); *lax-a.92* (NGB 116425, NGB 116426) in Bonus (11); *lax-a.208* (NGB 116435, NGB 116436), *-a.218* (NGB 116446), *-a.222* (NGB 116450), *-a.229* (NGB 116457, NGB 116458), *-a.249, -a.256* (NGB 116483), *-a.278* (NGB 116503), *-a.286* (NGB 116510) in Foma (CIho 11333) (9, 11); *-a.353* (NGB 116559, NGB 116560), *-a.369* (NGB 116578, 116579), *-a.373* (NGB 116583), *-a.398* (NGB 116608), *-a.405* (NGB 116613), *-a.406* (NGB 116614) in Kristina (NGB 14661) (10); *-a.413* (NGB 116621, NGB 116622), *-a.434* (NGB 116647), *-a.437* (NGB 116650), *-a.444* (NGB 116658, NGB 116659), *-a.448* (NGB 116664), *-a.450* (NGB 116667, NGB 116668), *-a.455* (NGB 116674, NGB 116675), *-a.472* (NGB 116695) in Bonus (11); a *lax-a* mutant (Mut 2100/61) in Proctor (PI 280420) (6); *lax-a.ap* (FN50) in Steptoe (CIho 15229) (8).

Mutant used for description and seed stocks:
lax-a.8 (GSHO 1775, NGB 116342) in Bonus; *lax-a.8* in Bowman (PI 483237)*7 (GSHO 2103, BW457, NGB 20689); *lax-a.ap* from Steptoe in Bowman*4 (BW458, NGB 22153).

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BGS 475, Laxatum-c, *lax-c*

Stock number: BGS 475
Locus name: Laxatum-c
Locus symbol: *lax-c*

Previous nomenclature and gene symbolization:
Laxatum-21 = *lax-21* (3, 4, 5).
Inheritance:
Monofactorial recessive (5).
Located in chromosome 6HL (6); over 27.3 cM distal from the *lax-b* (laxatum-b) locus (6); *lax-c.21* is associated with SNP markers 1_0015 to 2_0733 (positions 160.38 to 180.69 cM) in 6H bins 10 to 11 of the Bowman backcross-derived line BW460 (1).
Description:
The grain is thin and angular and caryopses are exposed between the lemma and palea. The awn has a very wide base. Rachis internodes are about 7% longer than normal. In the original Bonus stock, the tip of the spike is frequently sterile, and the tiller number is reduced (4). Plants of the Bowman backcross-derived line for *lax-c.21*, BW460, were 3/4 the height of Bowman. Rachis internodes of BW460 plants were slightly longer in some trials. The awns and peduncle were slightly shorter than small part of the Bowman plants. Kernels were about 10% shorter and thinner and their weights were about 20% lighter, 4.8 mg vs. 5.7 mg, than those of Bowman. Grain yields were about 3/4 those of Bowman (2). Plants of the Bowman backcross-derived line for *lax-c.231* (*sld.l*), BW858, were similar to those of BW460, except they had more pronounced spiral coiling of the neck and occasionally formed small branches on the awn (2).
Origin of mutant:
An X-ray induced mutant in Bonus (PI 189763) (4).
Mutational events:
lax-c.21 (NGB 116355, GSHO 1777), *-c.23* (NGB 116358) in Bonus (PI 189763) (4, 5); *lax.231* (*sld.l*, NGB 116459, GSHO 2478) in Foma (CIho 11333) may be an allele based on phenotype and SNP markers retained in 6HL of its Bowman backcross derived line, BW858, NGB 22295) (1, 2).
Mutant used for description and seed stocks:
lax-c.21 (GSHO 1777, NGB 116355) in Bonus; *lax-c.21* in Bowman (PI 483237)*6 (GSHO 2086); *lax-c.21* in Bowman*7 (BW460, NGB 20691); *lax-c.231* (*sld.l*) in Bowman*3 (GSHO 2359); *lax-c.231* in Bowman*6 (BW858, NGB 22295).
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Revised:

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BGS 498, Male sterile genetic 35, *msg35*

Stock number: BGS 498
Locus name: Male sterile genetic 35
Locus symbol: *msg35*

Previous nomenclature and gene symbolization:
Male sterile genetic,,dr = *msg,,dr* (2).
Male sterile = 76Y17 (2).
Inheritance:
Monofactorial recessive (2).
Located in chromosome 2HL (1); about 23.0 cM from the *wst7* (white streak 7) locus (1).
Description:
Selfing - none (2).
Outcrossing - complete female fertility (2).
Stamens - anthers smaller than fertile sib, with no stomium of filament elongation (2).
Origin of mutant:
A spontaneous mutant in Karl (CIho 15487) (2).
Mutational events:
msg35.dr (MSS366, GSHO 2387) in Karl (CIho 15487) (2, 3, 4).
Mutant used for description and seed stocks:
msg35.dr (GSHO 2387) in Karl; *msg35.dr* in Bowman (PI 483237)*7 (GSHO 1933, BW571, NGB 23435).
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Revised:
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BGS 499, Male sterile genetic 36, *msg36*

Stock number: BGS 499
Locus name: Male sterile genetic 36
Locus symbol: *msg36*

Previous nomenclature and gene symbolization:
Male sterile bk = *msg,,bk* (5).
Male sterile = 867N-89 (5).
Inheritance:
Monofactorial recessive (5).
Located in chromosome 6HS (1); about 10.8 cM distal from the *rob1* (orange lemma 1) locus (1, 2, 8).
Description:
Selfing - about 1.1% (5).
Outcrossing - complete female fertility (5).
Stamens - anthers nearly normal sized with stomium and filament elongation (5).
Origin of mutant:
A spontaneous mutant in Betzes (PI 129430) (5).
Mutational events:
msg36.bk (MSS325, GSHO 2388) in Betzes (PI 129430) (4, 5, 7); *msg36.eg* (MSS382) in Pavo P57 (3, 6).
Mutant used for description and seed stocks:
msg36.bk (GSHO 2388) in Betzes; *msg36.bk* in Bowman (PI 483237)*7 (GSHO 2067, BW 572, NGB 23436).
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Prepared:
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Revised:
J.D. Franckowiak. 1997. Barley Genet. Newsl. 26:425.

BGS 500, Male sterile genetic 37, *msg37*

Stock number: BGS 500
Locus name: Male sterile genetic 37
Locus symbol: *msg37*

Previous nomenclature and gene symbolization:
Male sterile hl = *msg,,hl* (2).
Inheritance:
Monofactorial recessive (2, 3).
Location is unknown, but is not located in chromosome 2H (4).
Description:
Selfing - none to 6% or more (2), the degree of selfing seems sensitive to environmental conditions, favored by cool conditions.
Outcrossing - complete female fertility (2).
Stamens - anthers shrunken, no stomium or filament elongation (3) to nearly normal (2).
Origin of mutant:
A spontaneous mutant in Clermont (PI 343724) (2).
Mutational events:
msg37.hl (MSS465, GSHO 2389) in Clermont (PI 343724) (1, 2); *msg37.jx* (MSS529, GSHO 2389) in a dwarf mutant 17:17:2 (*sdw.ax*, DWS1009, GSHO 2437) selected from Birgitta (NSGC 1870) (1, 3).
Mutant used for description and seed stocks:
msg37.hl (GSHO 2389) in Clermont; *msg37.hl* in Bowman (PI 483237)*5 (BW970, NGB 24149); *msg37.jx* (GSHO 2437) from Birgitta; *msg37.jx* in Bowman (PI 483237)*7 (GSHO 2303, BW573).
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