Registration of NC114 and NC115 Small-Seeded Soybean Germplasm Lines

Soybean [Glycine max (L.) Merr.] germplasm lines NC114 (Reg. no. GP-324, PI 640432) and NC115 (Reg. no. GP-325, PI 640433) were cooperatively developed and released by the USDA-ARS and the North Carolina Agricultural Research Service in August 2005. NC114 and NC115 are the equivalent of full sibs, with a coefficient of parentage of 0.54 (Carter et al., 2004). They are the first public USA release of determinate group VI maturity soybean germplasm lines with small seed. NC114 and NC115 are adapted to the southern USA and released as parental material for development of soyfoods cultivars.

NC114 is an F1–derived selection from the cross of two USDA small-seeded parents, soybean breeding line NCPR90–143 and cultivar Pearl (Carter et al., 1995). The parents of NCPR90–143 were ‘Gasoy 17’ and ‘Vance’ (Baker and Harris, 1979). Vance was obtained from the cross of ‘Essex’ and an unknown wild (Glycine soja Sieb. and Zucc.) or semi-wild soybean (Smith and Camper, 1973; G. Buss, personal communication, 1994). The F1 seeds were produced in 1991 at Clayton, NC, and F1 plants were grown during the winter at the USDA-ARS Tropical Agriculture Research Station (TARS), Isabela, PR. The F2 and F3 generations were advanced using the single seed descent breeding method at Clayton, NC in 1992 and at TARS in the winter of 1993 (Brim, 1966). In 1993, individual F2 plants were grown and harvested at Clayton, NC, and seeds were evaluated for 100-seed weight and appearance. Approximately 40 F2 plants were selected and grown in F3 progeny rows at Clayton, NC in 1994. The bulked harvest of progeny row N94–7440 was designated as NC114.

NC115 is an F2–derived plant selection from the cross of two small-seeded USDA soybean breeding lines, EBBH91–6 and N89–1284. EBBH91–6 is a sub-line selected from Pearl and is phenotypically identical to Pearl. N89–1284 was developed and N89–1284. EBH91–6 is a sub-line selected from Pearl and the winter at TARS. The F2 and F3 generations were advanced using the single seed descent breeding method at Clayton, NC in 1992 and at TARS in the winter of 1993 (Brim, 1966). In 1993, individual F2 plants were grown and harvested at Clayton, NC, and seeds were evaluated for 100-seed weight and appearance. Approximately 40 F2 plants were selected and grown in F3 progeny rows at Clayton, NC in 1994. The bulked harvest of progeny row N96–6429 was designated as NC115.

During 1998–2001, NC114 and NC115 were evaluated in replicated trials at two NC locations in each year for yield and other agronomic traits. The 100-seed weights for NC114 and NC115 were each 8.5 g, and both were much smaller than ‘Dillon’ (15.9 g) or ‘Brim’ (13.9 g) (Shipe et al., 1997; Burton et al., 1994). Seed yields of NC114 and NC115 were equal to Brim and Dillon, averaging 2580 kg ha\(^{-1}\). Plant height of NC115 was about six cm shorter than NC114 (77 cm), and both lines were shorter than Brim (92 cm) or Dillon (86 cm). Plant lodging was rated using a scale 1 to 5, where 1 is no lodging and 5 is completely lodged before harvest. NC115 (score 1.7) exhibited less plant lodging than did NC114 (2.1), Brim (2.3), or Dillon (2.1). NC114 had a higher seed protein content and lower seed oil content than NC115. Seed protein and oil concentrations of NC114 (421 g kg\(^{-1}\)) and 179 g kg\(^{-1}\) on a zero moisture basis) were similar to Brim (407 g kg\(^{-1}\) and 207 g kg\(^{-1}\)). Seed protein and oil concentrations of NC115 (402 g kg\(^{-1}\) and 193 g kg\(^{-1}\)) were similar to Dillon (407 g kg\(^{-1}\) and 195 g kg\(^{-1}\)). The ability of the seed to imbibe water, the first step in production of natto soyfoods, was measured using the swell ratio. Swell ratio is defined as the ratio of seed weight after soaking the seed in water for 16 h to the weight of dry seed before soaking. A larger swell ratio generally results in a softer final product, which is preferred by natto manufacturers (Cui et al., 2005). NC114 had a greater swell ratio than did NC115 (2.29 vs. 2.25), averaged over six NC environments. NC114 and NC115 had smaller swell ratios than Dillon (2.31), but greater swell ratios than Brim (2.23). A swell ratio of 2.23 is considered too low for most market needs, whereas the higher values are usually considered acceptable. (T. Carter, personal communication, 2006). In 2002, NC114 and NC115 were evaluated for seed yield at seven locations in the USDA-ARS Southern Region Uniform Preliminary Group VI Test (Paris, 2002). The 100-seed weights for NC114 and NC115 were 7.7 and 9.0 g, respectively, averaged over three environments. Both had much smaller 100-seed weights than Dillon (14.8 g) or ‘NC-Roy’ (13.5 g) (Burton et al., 2005). Plant height of NC115 was about 18 cm shorter than NC114 (76 cm), and both were shorter than Dillon or NC-Roy (86 cm for each). NC114 and NC115 lodged about the same (1.7 vs. 1.8), and both exhibited less plant lodging than Dillon or NC-Roy (each scored 2.1). Seed protein content was similar for NC114 and NC115 (432 g kg\(^{-1}\) and 427 g kg\(^{-1}\)), and both were higher than Dillon or NC-Roy (416 and 423 g kg\(^{-1}\)). Oil concentration of NC114 (175 g kg\(^{-1}\)) was less than NC115 (185 g kg\(^{-1}\)), Dillon (188 g kg\(^{-1}\)), or NC-Roy (191 g kg\(^{-1}\)). NC114 yielded 222 kg ha\(^{-1}\) less than NC115 (2264 kg ha\(^{-1}\)), and both yielded less than Dillon (2653 kg ha\(^{-1}\)) or NC-Roy (2694 kg ha\(^{-1}\)).

During 2002–2004, NC114 and NC115 were evaluated in 14 environments of the North Carolina State University Official Variety Trials (Bowman, 2004). Plant height of NC115 was about 11 cm shorter than NC114 (90 cm), and both were shorter than Dillon (104 cm) or NC-Roy (93 cm). NC115 had less plant lodging than NC114 (1.3 vs. 1.8); and both compared favorably with Dillon (1.5) and NC-Roy (2.2). Yield of NC114 (2105 kg ha\(^{-1}\)) was similar to NC115 (1949 kg ha\(^{-1}\)) and both yielded less than Dillon (2822 kg ha\(^{-1}\)) or NC-Roy (2934 kg ha\(^{-1}\)).

NC114 and NC115 are mid group VI maturity as compared to Dillon, which is early group VI maturity, or to Brim and NC-Roy, which are late group VI maturity. NC114 and NC115 have narrow leaflets, white flowers, gray pubescence, tan pod wall color at maturity, and shiny yellow seeds with clear hilum. Roy, which are late group VI maturity. NC114 and NC115 are resistant to Soybean Mosaic Virus, and bacterial pustule [caused by Xanthomonas campestris pv. glycines (Nakano) Dye], but susceptible to frogeye leaf spot (caused by Cercospora sojina K. Hara), soybean cyst (Heterodera glycines Ichinohe) and root knot (Meloidogyne species) nematodes.

Seed coat mottling has been minimal for NC114 and NC115 in test plots in NC. However, local conditions greatly influence the severity of mottling. Based on past experiences with mottling in soyfoods soybean lines, it is possible that the two releases may react dissimilarly in terms of mottling in a new environment. Users are advised to carefully evaluate mottling in the intended geographic area of breeding or production.

Small seed quantities of NC114 and NC115 will be available for research purposes from Dr. Thomas E. Carter, Jr., 3127 Ligon St, Raleigh, NC 27607, 919-513-1480, tommy_carter@ncsu.edu. It is requested that appropriate recognition be made for Genetic Resources Preservation. USDA Soybean Germplasm Collection and National Center for Genetic Resources Preservation.

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