Registration of Spring Wheat Germplasm ND 735
Combining Tan Spot, Leaf, and Stem Rusts

ND 735, a hard red spring wheat (HRSW) (*Triticum aestivum* L.) (Reg. no. GP-800, PI 639729), was developed at North Dakota State University (NDSU), Fargo, ND. ND 735 was released by the North Dakota Agricultural Experiment Station (NDAES) mainly for its high level of resistance to prevalent races of tan spot [caused by *Pyrenophora tritici-repentis* (Died.) Drechs.] in the northern plains. ND 735 is also resistant to the dominant races of stem rust (caused by *Puccinia graminicola* Pers.:Pers. *f.* *sp.* *tritici* Eriks. & E. Henn.) and leaf rust (caused by *Puccinia triticina* Eriks.) in the region. ND 735 has moderate resistance to Fusarium head blight (FHB) (caused by *Fusarium graminearum* Schwabe [teleomorph *Gibberella zeae* (Schwein.) Petch]) which has been a sporadic and major problem since wheat was first introduced in the region.

ND 735 was derived from the ND 2709/3/‘Grandin’ (PI 531005)*3/‘Ramsey’ (Citr 13246)/ND 622/4/ND 2809 cross made at NDSU by Dr. R.C. Frohberg in the fall of 1996. ND 2709 (‘Sumai3’ (PI 481542)/Wheaton (PI 469271)/‘Grandin’), a sister line of ND 2710 (Frohberg et al., 2004), was previously selected as the least susceptible genotype for FHB infection and early maturity (Stack and Frohberg, 1997) out of the cross involving the Chinese source of FHB resistance, Sumai3. Grandin is a HRSW cultivar developed by NDAES and released in 1989 due to its high milling and baking quality requirements. Ramsey is a durum wheat (*Triticum turgidum* L. subsp. *durum* (Desf.) Husn.) cultivar developed by NDAES and released in 1955. ND 622 [Waldron (Citr 13958) *×* *S*6579/ *SU28–1*3/Agent (Citr 13523)] and ND 2809 (ND 688/ND 674) are two experimental lines developed by NDAES HRSW breeding program.

The F1 generation of the cross resulting in ND 735 was planted in the greenhouse in the spring of 1997, and the F2 population was grown in the field at the Prosper, ND, experiment station in the summer of 1997. One hundred selected spikes from the F2 population were threshed separately and grown as F2:3 head-rows in 2-m row plots at Christchurch, New Zealand in an off-season nursery in the winter of 1998. Ten spikes from the best selected F2:3 head-rows were harvested, bulked, and planted as F2 plots in a preliminary yield trial in Casselton, ND, in the spring of 1998. Subsequently, 10 selected spikes from each of the F2 plots were threshed individually and sent to Christchurch, New Zealand, in an off-season nursery in the winter of 1999 to be sown as F2:3 head rows. The best selected row plots were bulked and planted as F3:4 plots in advanced yield trials in North Dakota in the summer of 1999. Selection of spikes in F2:3 and F4 generations were based on resistance to FHB, resistance to other leaf and stem diseases, and good agronomic appearance. In New Zealand, spikes were selected visually based on agronomic traits and grain shattering.

ND 735 was produced from a bulk of one F4:5 head row selected in 1999 at the Christchurch, New Zealand, off-season nursery. ND 735 was tested for its reaction to different races of tan spot, leaf and stem rusts, and FHB in the greenhouse and in the field during the period of 1999 to 2004. ND 735 was also entered into advanced yield trials as an F4:5 line at Casselton and Prosper, ND, in 1999 and subsequently, was tested in elite yield trials at four ND locations during 2000 and 2001.

Tan spot of wheat can cause two phenotypically distinct and independent symptoms: tan necrosis and extensive chlorosis (Lamari and Bernier, 1989). Currently, 11 races of tan spot have been identified (Ali et al., 2002; Lamari et al., 2003). From 2000 to 2004, ND 735 was tested for resistance to five races of tan spot across six trials in the greenhouse. The races included race 1, the most dominant tan spot race in ND, and races 3, 5, 10, and 11. ND 735 was evaluated for tan spot under natural field infection in six location-years during the period of 1999 to 2004. ND 735 was also tested against the Ptr ToxA (*Pyrenophora tritici-repentis* Toxin A), one of the five toxins of tan spot that have been reported to date (Lamari et al., 2003). The Ptr ToxA and Ptr ToxB have been well characterized and found in races 1, 2, 7, and 8 and 5, 6, 7, and 8, respectively (Ballance et al., 1989; Lamari et al., 2003). On a 1-to-5 lesion type scale developed by Lamari and Bernier (1989) where 1 is resistant with small, dark brown to black spots without any surrounding chlorosis or tan necrosis and 5 is susceptible with dark brown or black centers may or may not be distinguishable, most lesions consist of coalescing chlorotic or tan necrotic zones. ND 735 had average scores of 1 to 2 for all five tan spot races in all greenhouse screening trials. ND 735 scores (1–2) to the five races of tan spot race used to inoculate plants, were similar to ‘Erik’ (PI 478849) scores (1–2) and not significantly different than ‘Salamouni’ (PI 182673) score (1). ‘Erik’ and Salamouni wheat cultivars are considered among the best resistance sources to tan spot. In the same trials, ‘Glenlea’ (Citr 172772) had scores of 4 to 5, 1 to 2, 1 to 2, 4 to 5, and 4 to 5 for races 1, 3, 5, 10, and 11, respectively. ‘Steele-ND’ (PI 634981) for the same races were 2 to 3, 2, 3 to 5, 2 to 3, and 2 to 3, respectively. Under field conditions, ND 735 had similar a reaction (scores of 1–2) as in the greenhouse tests to tan spot (the predominant race in North Dakota fields is race 1) while Steele-ND: ‘Dapp’s’ (PI 638662), and the susceptible check ND 495 scored 3,3, and 4 to 5, respectively. The reaction to Ptr ToxA recorded based on the seven greenhouse trials, showed that ND 735, Steele-ND, Salamouni, and Dapp’s are insensitive, while ND 495 was sensitive to the toxin.

Septoria nodorum leaf blotch [caused by *Stagonospora nodorum* (Berk.) Castellani & E.G. Germaino] was evaluated based on a 1-to-5 lesion type scale developed by Feng et al. (2004) wherein 1 = pinpoint dark brown lesions without chlorosis; 2 = small lesions with very little necrosis or chlorosis; 3 = chlorotic or necrotic lesions completely surrounded by a chlorotic ring; 4 = lesions completely surrounded by chlorotic zones, some of the lesions coalescing; and 5 = extensive chlorosis and large necrotic lesions. The reaction of ND 735, based on 10 field and greenhouse trials, was 3 compared with 3 to 4, 4 to 5, 4 to 5, and 1 to 2 scored for Dapp’s, Steele-ND: ND 495, and Salamouni, respectively. ND 735 showed an insensitive reaction to the toxin produced by *Stagonospora nodorum* (Liu et al., 2004). A similar reaction was recorded for Dapp’s and Salamouni, while ND 495 and Steele-ND were sensitive to the same toxin.

Under severe FHB disease pressure, the disease severity (Stack and Frohberg, 2000) recorded on ND 735 over 4 location-years (76%) was significantly lower (*P* < 0.05) than the incidence of the susceptible checks ‘B331’ (93%) and ‘2398’ (87%). In the same trials, the FHB severity recorded on ‘Alsen’ (PI 615543) and ND 2710 was 63 and 38%, respectively. Alsen was released in 2000 as the first NDSU HRSW cultivar with resistance to FHB and has been widely grown in the Northern Plains since 2001. On the basis of field reactions at four location-year field tests and six screening tests under greenhouse conditions from 2000 to 2004, ND 735 exhibited a resistant reaction type to pathotype THBL, the predominant race of leaf rust in the region. ND 735 was also evaluated in six greenhouse screening tests for resistance to stem rust and was found to be highly resistant to pathotypes Pgt-QCCJ, -QTHJ, -QFCQ, -RTOQ, -TPMK, -RHTS, and -HPHJ.

ND 735 is an awned, medium-early maturing semidwarf hard spring wheat. It has a lax head type with plant height (91 cm), 5 cm shorter than ‘Parshall’ (PI 613587) and 2 and 9 cm...