

MNUS 210 (Winona™) Strawberry

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MNUS 210 (Fig. 1) is a late-season, Junebearing (short-day) strawberry (*Fragaria ×ananassa* Duchesne) cultivar that is notable for bearing large fruit, being resistant to multiple diseases, and tolerating cold winter and warm summer temperatures that characterize the continental climate of the north central United States. It will likely be useful for strawberry producers in the midwestern and north-eastern United States and adjacent parts of Canada. MNUS 210 has been productive in matted row production systems on soils of heavy and light texture.

MNUS 210 is the first cultivar to be released from a breeding program begun in 1980 through the collaboration of the Univ. of Minnesota and the U.S. Dept. of Agriculture (USDA), Agricultural Research Service (ARS), Fruit Laboratory in Beltsville, Md. The program was initiated to address the needs of strawberry producers in the midwestern United States who desired cold-hardy cultivars that had resistance to red stele root rot (caused by *Phytophthora fragariae* Hickman), as well as other diseases. In this program, seedlings were germinated and screened for resistance to red stele root rot in bench tests in Maryland and subsequently planted in Minnesota, where selection and testing were performed. MNUS 210 is sold as “Winona™” strawberry. Winona is a transliteration of the Dakota word often given as a name to a daughter who was the first-born child in a family. By analogy, Winona is a fitting designation for the first cultivar introduced from this collaboration.

Origin

MNUS 210 was raised as a seedling from the cross ‘Earliglow’ × MNUS 52 (Fig. 2), made in 1985 at St. Paul, Minn. MNUS 210 was selected at Becker, Minn., in 1987 by

G.J.G. and J.J.L. It was propagated for later observation in trials at the Univ. of Minnesota Horticultural Research Center (HRC) near Excelsior, Minn., and the North Central Research and Outreach Center (NCROC) at Grand Rapids, Minn., from 1988 to 1990, and at the USDA Beltsville Agricultural Research Center, Beltsville, Md., in 1991 to 1997. Although it was not well adapted at Beltsville because of relatively low yield, MNUS 210 performed well at Minnesota locations and was subsequently included in replicated yield trials.

MNUS 210 was evaluated in replicated yield trials from 1992 through 1997 at three Minnesota locations. Plantings were established in 1991, 1993, and 1995 and harvested for the two subsequent seasons at three Univ. of Minnesota sites: the HRC, the NCROC, and the West Central Research and Outreach Center at Morris (WCROC). The HRC and WCROC have loam soils and are in USDA hardiness zone 4a (annual average minimum temperature of –31.7 to –34.4 °C) and the NCROC has a sandy loam soil and is in USDA hardiness zone 3b (average annual minimum

temperature of –34.5 to –37.2 °C). For further descriptions of these sites, see Luby et al. (1984). Trials at the HRC could not be harvested in 1993 due to flooding of plots from excessive rains. MNUS 210 and other common cultivars of the midwestern United States and eastern Canada were planted in a randomized complete-block design. Plants were spaced 0.45 m apart within rows that were 1.2 m apart and 4 m long. The plants were permitted to form a matted row that was ≈0.4 m wide. At the HRC and WCROC, the entire plots were mulched for protection during the winter in late October or early November with 10 to 15 cm of straw, which was removed in April. At the NCROC, however, a split-plot design was employed on 7-m-long plots that were split, with half of the plot being mulched and the other half receiving no mulch. All trials had straw mulch applied between the rows in the spring. All plots were irrigated, fertilized, and sprayed with fungicides and insecticides as needed in accordance with standard commercial recommendations.

The plots were harvested every 2 to 4 d as fruit ripened. The marketable yield and the weight of a sample of 20 berries were recorded for each plot. Relative season of each entry was calculated in each trial by determining the proportion of total yield for each plot that was harvested during the first 7 to 10 d of the harvest season for that location–year combination. Plots were also rated subjectively on a scale ranging from 1 to 9 for various diseases and apparent winter injury as opportunities arose to observe these situations in particular years or at particular locations. Data were analyzed using SAS (SAS Institute, Cary, N.C.).

Performance

The performance of MNUS 210 in replicated trials is documented in Tables 1, 2, and 3. MNUS 210 generally has produced larger



Fig. 1. Fruit of MNUS 210 strawberry.

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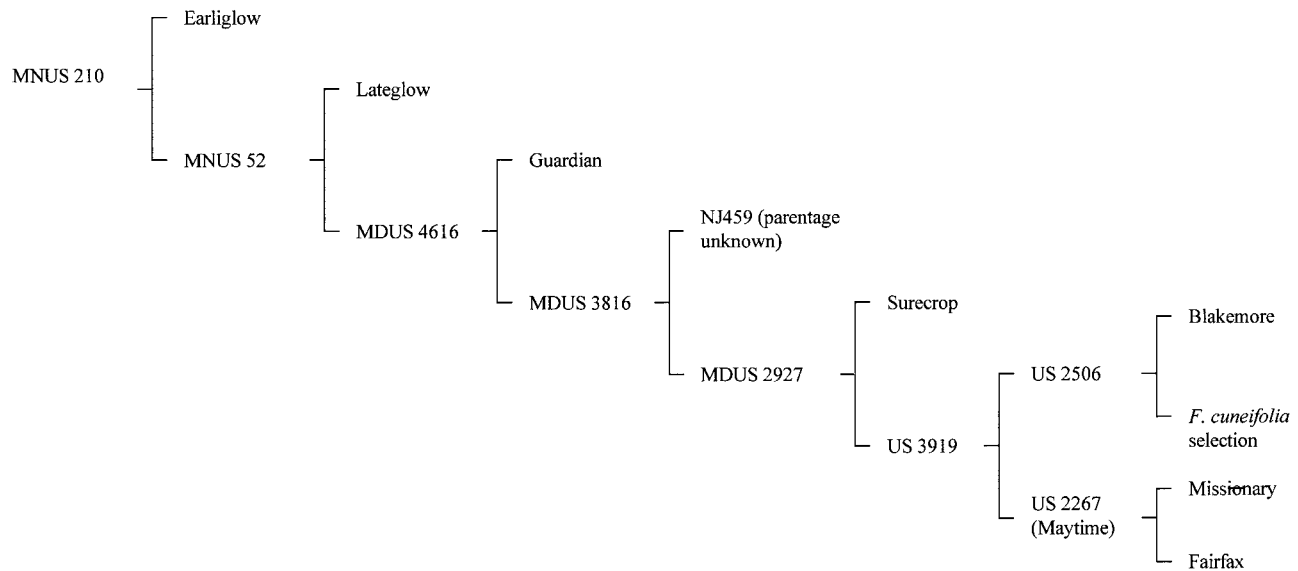


Fig. 2. Pedigree of MNUS 210 strawberry.

Table 1. Mean performance over 1992–97 for yield, average fruit weight, and early crop of strawberry cultivars at three locations in Minnesota. Plantings were established in 1991, 1993, and 1995 and harvested for the subsequent 2 years. The planting at Excelsior was not harvested in 1993 due to flooding.

Cultivar	Yield (mg·ha ⁻¹)				Fruit wt (g)				Early crop ² (%)			
	Grand Rapids		Morris	Excelsior	Grand Rapids		Morris	Excelsior	Grand Rapids		Morris	Excelsior
	Mulched	Unmulched			Mulched	Unmulched			Mulched	Unmulched		
Annapolis	9.9	6.8	8.6	8.7	13.5	12.2	9.7	12.3	54	71	53	72
Cavendish	11.4	10.9	14.2	12.0	14.9	13.9	13.1	11.9	27	40	26	36
Glooscap	11.3	10.7	11.3	10.9	12.0	11.6	9.0	9.1	25	37	36	44
Honeoye	9.6	10.4	11.1	10.8	11.5	11.1	10.8	9.9	43	56	40	66
Jewel	6.5	6.9	11.1	10.1	11.9	12.0	11.2	11.8	21	31	23	45
Kent	13.7	12.9	13.2	10.4	12.5	12.6	10.6	10.7	26	38	30	50
Lateglow	6.1	6.8	9.1	8.6	14.3	12.9	10.0	11.3	9	31	10	18
MNUS 210	11.2	11.4	11.1	11.1	16.0	14.5	12.1	14.0	7	17	15	22
LSD _{0.05}	3.8	4.4	3.9	3.5	1.9	2.1	1.8	1.9	12	15	12	16

¹Proportion of total yield harvested during the first 7 to 10 d of the season.

²At Grand Rapids, plots were split, with half of each plot being mulched with 10 to 15 cm of straw from November through April. Plots at Morris and Excelsior were also similarly mulched during the winter. All trials had straw mulch applied between the rows in the spring.

Table 2. Means of fruit quality evaluation scores for strawberry cultivars at Grand Rapids (by D.K.W.), Morris (by J.J.L.), and Excelsior (by J.J.L.) for 1992–97. Ratings for each trait were on a scale from 1 = very poor to 9 = outstanding.

Cultivar	Appearance			Firmness			Skin toughness		Flavor			External color	Internal color
	Grand Rapids	Morris	Excelsior	Grand Rapids	Morris	Excelsior	Morris	Excelsior	Grand Rapids	Morris	Excelsior	Grand Rapids	Grand Rapids
	Annapolis	7.4	7.4	7.9	7.1	7.8	7.5	7.3	7.3	7.1	7.1	6.6	7.3
Cavendish	7.1	6.5	7.5	7.1	7.8	7.8	6.5	7.5	7.5	7.0	7.1	7.6	8.3
Glooscap	8.0	7.4	6.6	7.0	7.1	6.8	6.8	7.3	7.1	7.0	6.8	8.2	8.6
Honeoye	7.7	6.9	7.4	6.7	6.8	6.8	6.6	6.5	6.6	6.5	6.9	7.7	8.2
Jewel	7.8	7.7	8.0	7.3	7.3	7.8	7.6	7.3	7.5	7.3	7.3	7.9	8.1
Kent	7.7	7.4	7.8	6.9	7.0	7.5	6.4	6.3	6.8	6.8	6.8	7.9	7.8
Lateglow	7.8	7.5	7.3	7.3	6.9	7.1	6.8	7.3	7.4	7.1	7.4	7.4	7.5
MNUS 210	7.2	7.5	7.3	7.6	8.2	8.0	7.3	7.8	7.3	7.5	7.5	7.3	7.4
LSD _{0.05}	0.4	0.6	0.9	0.4	0.4	0.7	0.8	0.9	0.5	0.6	0.7	0.5	0.6

fruit (as measured by average weight) and had yields similar to other adapted midseason or late-season cultivars commonly grown in Minnesota (Table 1). The fruit matures in the later part of the season for short-day cultivars (late June to mid-July in Minnesota), at about the same time as ‘Lateglow’ (Table 1). Subjective comparisons of the fruit characteristics of MNUS 210 with other adapted cultivars are presented in Table 2. The flavor is well balanced between sugars and acids and is slightly aromatic, sometimes reminiscent of that of

peach [*Prunus persica* (L.) Batsch]. The flesh is firm and the skin is medium to firm. Skin breakdown has been observed in warm and wet harvest seasons.

Relative to other cultivars tested in Minnesota, MNUS 210 has moderate to high resistance to the common foliar diseases, powdery mildew (*Sphaerotheca macularis* Walls ex Fr.), leaf scorch (*Diplocarpon earliana* Ell. and Ev.), and leaf spot (*Mycosphaerella fragariae* Tul.) (Table 3). MNUS 210 is resistant to five eastern North American races of *P. fragariae* (Races

A-1, A-2, A-3, A-4, and A-6), (Galletta et al., 1994). It is also tolerant, relative to other cultivars tested, of iron chlorosis induced by high pH soils (pH 7.5 to 8.0) at Morris, Minn., and of black root rot associated with *Rhizoctonia* sp. and *Pythium* sp., based on field observations at the HRC. (Table 3). Plants of MNUS 210 have exhibited symptoms of winter injury in some Minnesota trials with severity similar to that of ‘Annapolis’ and ‘Cavendish’ but generally greater than that of ‘Glooscap’, ‘Honeoye’, or ‘Kent’ (data not shown).

Table 3. Relative severity ratings for diseases and iron chlorosis for strawberry cultivars in Minnesota.^z

Cultivar	Leaf spot ^y	Powdery mildew ^y	Leaf scorch ^x	Black root rot ^w	Iron chlorosis ^v
Annapolis	7.4	6.0	8.1	6.5	6.4
Cavendish	6.9	6.0	7.8	7.5	6.8
Glooscap	7.0	6.4	7.8	7.0	5.6
Honeoye	6.4	6.4	6.7	4.3	6.3
Jewel	7.0	7.1	7.4	6.8	7.4
Kent	5.3	6.9	5.0	5.3	6.0
Lateglow	4.8	5.8	6.8	7.5	7.4
MNUS 210	7.5	7.2	7.8	7.5	7.1
LSD _{0.05}	0.9	0.7	0.8	1.7	1.0

^zDisease and iron chlorosis reactions rated on a scale from 1 (severe symptoms) to 9 (no symptoms).

^yLeaf spot and powdery mildew reactions were evaluated in July 1992–97 at Grand Rapids, Minn.

^xLeaf scorch reactions were evaluated in July 1994–96 at Excelsior, Minn.

^wBlack root rot was evaluated in June 1995 at Excelsior, Minn.

^vIron chlorosis reaction was evaluated in June 1996–97 at Morris, Minn.

Strawberry growers in Minnesota who have fruited MNUS 210 have reported that it is winter-hardy, vigorous, makes abundant plants, has medium to high yields of large attractive berries, and avoids frost injury due to late bloom, but the fruit are prone to rotting under wet conditions and are not well exposed because of a short peduncle, making them difficult to pick.

Description

Plants of MNUS 210 have large crowns with many petioles and usually form a matted row of medium density. Stolons are thick and green proximal to the mother plant and have a strong red coloration in the distal portions. Pubescence on the stolons is sparse to moderate in density and is appressed.

The leaves have long petioles, giving the appearance of a tall, upright to globose canopy. Pubescence on the petioles is thick and spread-

ing (divaricate). The leaves have three leaflets with weak interveinal blisters and medium pubescence on the adaxial side of the leaflets. Leaflets are equal in size, broadly elliptic, sparsely pubescent, medium green on top, light green on the bottom, with prominent veins. The terminal leaflet is equal in length and width, has a flat profile, an obtuse base, and single teeth that are obtuse on younger leaves and rounded on older leaves. Stipules are of medium length, pointed, and tan to brown (if dry).

The inflorescence is usually below the level of the foliage when the flowers are open. The flower is medium to large. The diameter of the inner calyx is similar to that of the outer calyx and larger than the corolla. Flowers usually have five petals that touch or overlap one another.

The berries are very glossy and scarlet. The surface of the fruit is smooth to slightly uneven. The flesh is orange-red and ranges to pink at the center. The shape is blunt-wedge on

primary berries to blunt-conic on the secondary and tertiary berries. The berries are equal in length and width to slightly longer than broad. The fruiting truss is medium in length and prostrate by the time of the first harvest. The calyx is large (equal in diameter to the fruit), showy, generally not inserted in a basin, and partially reflexed, especially on primary berries. Sepals are borne in two whorls, with the inner whorl being broadly elliptic with sharp points, and the outer whorl being narrow lanceolate with rounded tips. The achenes are yellow and level with or slightly raised from the surface of the fruit.

Availability

Rights to MNUS 210 have been assigned to the Regents of the Univ. of Minnesota. MNUS 210 has been granted U.S. Plant Patent 10,191 and plant breeders' rights have been applied for in Canada and Europe. Plants will be available from licensed nurseries in the United States and Canada. Parties interested in propagating this cultivar should contact Patents and Technology Marketing, Office of Research and Technology Transfer Administration, Univ. of Minnesota, 1100 Washington Ave. Suite 201, Minneapolis, MN 55415.

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