**Online Resource 1** (Electronic Supplementary Information)

Vectors of Efficiency in Hybrid Poplar Genotype Testing

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Greenhouse Breeding Description, Tables A1 – A4 and Figures A1 – A3

**Greenhouse Breeding in the NRRI Poplar Program**

Breeding matrices detailing male and female combinations to be made were developed with the year’s target of generating a maximum number of full-sib families controlled pollinations in our greenhouse. A typical breeding matrix consisted of separate sets of unique five female clones to be crossed by another set of unique five male clones. Each breeding cycle was designed to produce between 100 and 200 full-sib families if viable scionwood was available. Breeding success rate ranged from 45% to 65% in most breeding cycles. Success rates were less than 100 % due to a number of biological constraints or phenomena: lack of rooting of seed-bearing scionwood; incompatibilities within a cross; branchlet abscission; capsule abscission; failure of embryos to develop into seed; and failure of seed to germinate. With each breeding year we attempted to introduce new parents along with a small set of standard Minnesota-origin *P. deltoides* females.

We developed a method to successfully initiate root primordia on the female scionwood by using thermostatically controlled heat mats to supply bottom heat (18 – 20 degrees C) to potted female branches. A modification of an old French plant-in-pot technique (no known reference) was used to establish the excised female scions on their own vigorous root system. Three-gallon pots containing peat-perlite soilless mix over a 3-inch base of coarse perlite (for drainage) were submerged in water trays containing water with no additives. Base heat provided by the heat mats was captured in a jacketed Styrofoam box containing the pots, water trays and heat mats. Above-pot aerial portions of the female scions were kept in the dark and at cold temperatures (3 – 4 degrees C) in an enclosed controlled environment chamber. A total of 80 breeding pots were in each breeding cycle. Number of crosses was increased by adding single scions of multiple females in each pot. Therefore, in recent breeding cycles, up to 240 crosses could be attempted by placing 3 separate female clones in each of the 80 breeding pots. Female breeding pots were kept for up to four weeks (28 days) in the controlled-environment chamber, while the male branches were forced and pollens were assembled at a separate greenhouse facility (UM NCROC, Grand Rapids, MN, Tim O’Brien).

Male branches were forced in isolation cages for a period of two months (January & February) each year while the female branches were in the pre-rooting chamber at NRRI. Male branches had most of their vegetative buds removed to conserve energy directed to the floral bud break and staminate flower development. Maturing anthers shed pollen over a period of 7 to 14 days for most male clones. Pollens were collected by hand, dried in paper boxes overnight, sieved to clean away bracts, insects, and debris contaminants, and stored in cotton-stoppered glass vials. Stoppered pollen vials were stored over moisture-retaining desiccant in bell jars in a standard laboratory refrigerator. Once adequate pollen volumes were available, the female pots were moved from the rooting chamber to isolation breeding hoods constructed at the NRRI greenhouse. The breeding hoods were constructed of PVC tubing frames covered with a breathable, white horticultural cloth (example: N-Sulate, fabric manufactured in Missouri, USA). Each pollen hood received only one pollen, and all the breeding pots within a specific hood were pollinated by that pollen. Hoods were removed following successful pollinations and apparent seed set among the potted female branches. Vegetative buds flushed and leaves developed soon after, along with emergent basal and visible rooting in the water trays. Both vegetative leaves and rooting systems were needed to sustain the branches for seed maturation. Breeding pots were maintained in water trays placed on heat mats to maintain bottom heat to the root zone contained in the pots. Air temperatures of the greenhouse were initially at 20 degrees C with automated computer-controlled greenhouse shading. After leaf flush and root emergence, the greenhouse was vented automatically opened at temperatures over 24 degrees C to prevent wilting and sudden heat shock to the newly developing seed capsules among the potted female clones.

Pollinations began in March and sometimes continued into April. Seed maturation was dependent on taxon or cross attempted and more controlled by the vigor of the individual mother seed parent. Seed maturation could take from 6 to 14 weeks, but typically was complete by late June or early July. Mature seed was harvested immediately, stored until adequate amounts were on hand to begin germination flats. Germination of seed flats was also done at the NRRI greenhouse using an intermittent mist system. In 10 – 14 days, new germinating seedlings were hand-transplanted to seedling racks containing Spencer Lemaire, Cone-Tainer tubes, manufactured by and obtained from Stewie & Sons, Oregon, USA.

Full-sib (control pollinated) families were grown over the summer and fall of the same year. Viable seedling racks were moved outside for development and growth through the onset of dormancy. Frozen winter storage was provided in dark, cold greenhouse bays at NRRI for the winter months. Progeny trials were established in the following spring in the research nurseries of the NRRI poplar program, which over the years included the nurseries of Lee Nursery (Fertile, MN), Verso Paper Company (Belle River, MN) and the UM NCROC (Grand Rapids, MN).

**Table A1.**

Family pedigree information for the six Family Field Trials**:** Woelfel 2001; Sturges 1 2002; Housman 2004; Schultz 2007; Wanderscheid 2008; Minnesota Power 2015

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **FFT Year** | **Site** | **Family** | **Number of clones/family** | **Species Type** | **Female Parent** | **Tested\*** | **Male Parent** | **Tested\*** |
| 2001 | Woelfel | 98001 | 30 | DxD | 288-5 | Yes | D130 | Yes |
| 2001 | Woelfel | 98003 | 30 | DxD | 288-5 | Yes | D124 | Yes |
| 2001 | Woelfel | 98011 | 27 | DxD | 288-5 | Yes | D111 | Yes |
| 2001 | Woelfel | 98013 | 30 | DxD | 288-5 | Yes | D105 | Yes |
| 2001 | Woelfel | 98016 | 27 | DxD | 180-1 | Yes | D113 | Yes |
| 2001 | Woelfel | 98019 | 28 | DxD | 180-1 | Yes | D105 | Yes |
| 2001 | Woelfel | 98021 | 27 | DxD | 180-1 | Yes | D124 | Yes |
| 2001 | Woelfel | 98023 | 28 | DxD | 180-1 | Yes | D111 | Yes |
| 2001 | Woelfel | 98026 | 29 | DxD | 180-1 | Yes | D101 | Yes |
| 2001 | Woelfel | 98036 | 29 | DxD | D125 | Yes | D113 | Yes |
| 2001 | Woelfel | 98038 | 23 | DxD | D125 | Yes | D111 | Yes |
| 2001 | Woelfel | 98040 | 25 | DxD | D125 | Yes | D124 | Yes |
| 2001 | Woelfel | 98041 | 29 | DxD | D125 | Yes | D105 | Yes |
| 2001 | Woelfel | 98044 | 27 | DxD | D125 | Yes | D130 | Yes |
| 2001 | Woelfel | 98045 | 30 | DxD | D125 | Yes | D101 | Yes |
| 2001 | Woelfel | 98052 | 27 | DxD | D132 | Yes | D124 | Yes |
| 2001 | Woelfel | 98056 | 20 | DxD | Sun31 | No | D111 | Yes |
| 2001 | Woelfel | 98071 | 23 | DxD | D125 | Yes | D111 | Yes |
| 2001 | Woelfel | 98072 | 29 | DxD | D125 | Yes | D105 | Yes |
| 2001 | Woelfel | 98082 | 24 | DxM | D125 | Yes | M4 | No |
| 2001 | Woelfel | 98085 | 20 | DxM | Sun33 | No | M5 | No |
| 2001 | Woelfel | 98087 | 22 | DxM | Sun33 | No | M1051-4 | No |
| 2001 | Woelfel | 98088 | 24 | DxM | Sun33 | No | M4 | No |
| 2001 | Woelfel | 98089 | 24 | DxD | Sun33 | No | D105 | Yes |
| 2001 | Woelfel | 98090 | 26 | DxM | Sun33 | No | M1050-3 | No |
| 2001 | Woelfel | 98106 | 22 | DxM | Man2 | No | M1051-4 | No |
| 2001 | Woelfel | 98121 | 29 | DxN | D132 | Yes | N149 | No |
| 2001 | Woelfel | 98128 | 24 | DxM | D132 | Yes | M1051-4 | No |
| 2001 | Woelfel | 98130 | 17 | DxD | D132 | Yes | D111 | Yes |
| 2001 | Woelfel | 98136 | 24 | DxM | 180-1 | Yes | M1051-4 | No |
| 2001 | Woelfel | 98141 | 30 | DxD | 180-1 | Yes | D111 | Yes |
| 2001 | Woelfel | 98149 | 24 | DxD | 172-5 | Yes | D111 | Yes |
| 2001 | Woelfel | 98182 | 23 | DxM | Man3 | No | M1050-3 | No |
| 2001 | Woelfel | 98183 | 21 | DxM | Man3 | No | M4 | No |
| 2001 | Woelfel | 98196 | 20 | DxM | Sun31 | No | M1051-4 | No |
| 2001 | Woelfel | 98203 | 23 | DxM | Man1 | No | M1051-4 | No |
| 2002 | Sturges 1 | 99002 | 30 | DxM | D121 | Yes | M1052-5 | No |
| 2002 | Sturges 1 | 99004 | 26 | DxM | D121 | Yes | M1050-5 | No |
| 2002 | Sturges 1 | 99005 | 22 | DxT | D121 | Yes | MJF-2-99 | No |
| 2002 | Sturges 1 | 99006 | 27 | DxM | D121 | Yes | M1051-2 | No |
| 2002 | Sturges 1 | 99008 | 22 | DxN | D121 | Yes | N944-4 | No |
| 2002 | Sturges 1 | 99013 | 27 | DxM | D143 | Yes | M1052-5 | No |
| 2002 | Sturges 1 | 99018 | 26 | DxM | D143 | Yes | M1050-5 | No |
| 2002 | Sturges 1 | 99022 | 28 | DxN | D143 | Yes | N947-5 | No |
| 2002 | Sturges 1 | 99024 | 28 | DxT | D143 | Yes | MJF-2-99 | No |
| 2002 | Sturges 1 | 99034 | 18 | DxM | D110 | Yes | M1050-4 | No |
| 2002 | Sturges 1 | 99037 | 27 | DxN | D200 | No | N964-6 | No |
| 2002 | Sturges 1 | 99038 | 22 | DxN | D200 | No | N944-4 | No |
| 2002 | Sturges 1 | 99039 | 14 | DxM | D200 | No | M1051-2 | No |
| 2002 | Sturges 1 | 99045 | 28 | DxM | D200 | No | M1050-4 | No |
| 2002 | Sturges 1 | 99057 | 21 | DxM | D123 | Yes | M1052-5 | No |
| 2002 | Sturges 1 | 99058 | 24 | DxT | D123 | Yes | MJF-3-99 | No |
| 2002 | Sturges 1 | 99059 | 22 | DxN | D123 | Yes | N949-2 | No |
| 2002 | Sturges 1 | 99063 | 25 | DxN | Onstad N. | No | N949-2 | No |
| 2002 | Sturges 1 | 99068 | 26 | DxN | Onstad N. | No | N964-6 | No |
| 2002 | Sturges 1 | 99071 | 21 | DxM | S. Onstad 16 | No | M1050-5 | No |
| 2002 | Sturges 1 | 99072 | 21 | DxN | S. Onstad 16 | No | N944-4 | No |
| 2002 | Sturges 1 | 99073 | 24 | DxM | S. Onstad 16 | No | M1050-4 | No |
| 2002 | Sturges 1 | 99075 | 24 | DxM | S. Onstad 16 | No | M1052-5 | No |
| 2002 | Sturges 1 | 99088 | 16 | DxM | 12 Crkstn | No | M1050-5 | No |
| 2002 | Sturges 1 | 99102 | 24 | DxN | 14 Crkstn | No | N964-1 | No |
| 2002 | Sturges 1 | 99103 | 14 | DxM | 14 Crkstn | No | M1051-2 | No |
| 2002 | Sturges 1 | 99105 | 27 | DxN | 14 Crkstn | No | N944-4 | No |
| 2002 | Sturges 1 | 99106 | 25 | DxM | 14 Crkstn | No | M1052-5 | No |
| 2002 | Sturges 1 | 99107 | 28 | DxM | 14 Crkstn | No | M1050-3 | No |
| 2002 | Sturges 1 | 99179 | 28 | DxN | 14 Crkstn | No | N964-3 | No |
| 2004 | Housman | 9732 | 28 | DxN | D125 | Yes | N946-2 | No |
| 2004 | Housman | 22003 | 13 | DxM | D109 | Yes | M1050-5 | No |
| 2004 | Housman | 22004 | 21 | DxN | D109 | Yes | N40 | No |
| 2004 | Housman | 22007 | 29 | DxM | D109 | Yes | M1052-6 | No |
| 2004 | Housman | 22011 | 27 | DxT | D109 | Yes | BCT #3 | No |
| 2004 | Housman | 22014 | 26 | DxM | D109 | Yes | M1050-8 | No |
| 2004 | Housman | 22018 | 2 | DxT | D125 | Yes | BCT #1 | No |
| 2004 | Housman | 22021 | 28 | DxN | D125 | Yes | N40 | No |
| 2004 | Housman | 22026 | 15 | DxT | D125 | Yes | BCT #3 | No |
| 2004 | Housman | 22033 | 29 | DxN | D125 | Yes | N46 | No |
| 2004 | Housman | 22048 | 20 | DxM | D110 | Yes | M1050-8 | No |
| 2004 | Housman | 22052 | 9 | DxM | D121 | Yes | M1052-6 | No |
| 2004 | Housman | 22053 | 20 | DxM | D121 | Yes | M1050-5 | No |
| 2004 | Housman | 22057 | 29 | DxN | D121 | Yes | N40 | No |
| 2004 | Housman | 22068 | 14 | DxT | 180-1 | Yes | BCT #1 | No |
| 2004 | Housman | 22069 | 12 | DxN | 180-1 | Yes | N88 | No |
| 2004 | Housman | 22156 | 26 | DxM | D121 | Yes | M1050-7 | No |
| 2004 | Housman | 99002 | 19 | DxM | D121 | Yes | M1052-5 | No |
| 2004 | Housman | 99013 | 16 | DxM | D143 | Yes | M1052-5 | No |
| 2004 | Housman | 99018 | 12 | DxM | D143 | Yes | M1050-5 | No |
| 2004 | Housman | 99034 | 18 | DxM | D110 | Yes | M1050-4 | No |
| 2004 | Housman | 99038 | 12 | DxN | D200 | No | N944-4 | No |
| 2004 | Housman | 99059 | 10 | DxN | D123 | Yes | N949-2 | No |
| 2004 | Housman | 99079 | 9 | DxN | S. Onstad 16 | No | N947-5 | No |
| 2004 | Housman | 99105 | 19 | DxN | 14 Crkstn | No | N944-4 | No |
| 2004 | Housman | 99179 | 16 | DxN | 14 Crkstn | No | N964-3 | No |
| 2007 | Schultz | 23045 | 1 | DxT | D109 | Yes | Tricho 4 | No |
| 2007 | Schultz | 23065 | 1 | DxT | D110 | Yes | Tricho 2 | No |
| 2007 | Schultz | 23066 | 1 | DxT | D110 | Yes | Tricho 1 | No |
| 2007 | Schultz | 23069 | 2 | DxT | D125 | Yes | Tricho 3 | No |
| 2007 | Schultz | 23071 | 2 | DxN | D125 | Yes | SO N150 | No |
| 2007 | Schultz | 23074 | 14 | DxN | D125 | Yes | SO N149 | No |
| 2007 | Schultz | 23074 | 4 | DxN | D125 | Yes | SO N149 | No |
| 2007 | Schultz | 23077 | 5 | DxT | D125 | Yes | Tricho 3 | No |
| 2007 | Schultz | 23078 | 1 | DxT | D125 | Yes | Tricho 1 | No |
| 2007 | Schultz | 23079 | 9 | DxN | D125 | Yes | SO N148 | No |
| 2007 | Schultz | 24032 | 3 | DxN | D107 | Yes | N SO-101 | No |
| 2007 | Schultz | 24033 | 8 | DxN | D107 | Yes | N SO-103 | No |
| 2007 | Schultz | 24042 | 4 | DxN | D125 | Yes | N SO-100 | No |
| 2007 | Schultz | 24042 | 19 | DxN | D125 | Yes | N SO-100 | No |
| 2007 | Schultz | 24044 | 20 | DxN | D125 | Yes | N SO-103 | No |
| 2007 | Schultz | 24044 | 51 | DxN | D125 | Yes | N SO-103 | No |
| 2007 | Schultz | 24045 | 5 | DxN | D125 | Yes | N SO-101 | No |
| 2007 | Schultz | 24045 | 12 | DxN | D125 | Yes | N SO-101 | No |
| 2007 | Schultz | 24049 | 2 | DxT | D125 | Yes | TPS 04-88 | No |
| 2007 | Schultz | 24052 | 4 | DxN | D125 | Yes | N SO-115 | No |
| 2007 | Schultz | 24052 | 21 | DxN | D125 | Yes | N SO-115 | No |
| 2007 | Schultz | 24053 | 12 | DxN | D125 | Yes | N SO-105 | No |
| 2007 | Schultz | 24055 | 6 | DxT | D125 | Yes | Prin 2 | No |
| 2007 | Schultz | 24064 | 6 | DxN | D134 | Yes | N SO-101 | No |
| 2007 | Schultz | 24067 | 6 | DxN | D134 | Yes | N SO-103 | No |
| 2008 | Wanderscheid | 25023 | 15 | DxN | D125 | Yes | SO N113 | No |
| 2008 | Wanderscheid | 25030 | 15 | DxN | D125 | Yes | SO N118 | No |
| 2008 | Wanderscheid | 25032 | 14 | DxN | D121 | Yes | SO N97 | No |
| 2008 | Wanderscheid | 25036 | 5 | DxD | D121 | Yes | D113 | Yes |
| 2008 | Wanderscheid | 25041 | 4 | DxN | D110 | Yes | SO N97 | No |
| 2008 | Wanderscheid | 25043 | 19 | DxD | D110 | Yes | D113 | Yes |
| 2008 | Wanderscheid | 25046 | 4 | DxN | D110 | Yes | SO N113 | No |
| 2008 | Wanderscheid | 25048 | 9 | DxN | D110 | Yes | SO N117 | No |
| 2008 | Wanderscheid | 25050 | 12 | DxD | D110 | Yes | D124 | Yes |
| 2008 | Wanderscheid | 25051 | 13 | DxN | D118 | Yes | SO N113 | No |
| 2008 | Wanderscheid | 25057 | 12 | DxN | D134 | Yes | SO N97 | No |
| 2008 | Wanderscheid | 25060 | 13 | DxN | D134 | Yes | SO N117 | No |
| 2008 | Wanderscheid | 25061 | 2 | DxN | D117 | Yes | SO N97 | No |
| 2008 | Wanderscheid | 25064 | 10 | DxT | D117 | Yes | Tricho CdA-5 | No |
| 2008 | Wanderscheid | 25067 | 13 | DxN | 180-1 | Yes | SO N118 | No |
| 2008 | Wanderscheid | 25069 | 16 | DxN | 180-1 | Yes | SO N117 | No |
| 2008 | Wanderscheid | 25075 | 12 | DxN | D107 | Yes | SO N113 | No |
| 2008 | Wanderscheid | 25076 | 5 | DxN | IS910304 | No | SO N117 | No |
| 2008 | Wanderscheid | 25078 | 19 | DxT | IS910304 | No | Tricho CdA-5 | No |
| 2008 | Wanderscheid | 26021 | 2 | DxD | 2801-05 | Yes | 9608-02 | Yes |
| 2008 | Wanderscheid | 26036 | 10 | DxD | 9607-23 | Yes | 9608-26 | Yes |
| 2008 | Wanderscheid | 26037 | 2 | DxD | 9607-23 | Yes | 2809-04 | Yes |
| 2008 | Wanderscheid | 26038 | 6 | DxD | 9607-23 | Yes | OP 30-01 | Yes |
| 2008 | Wanderscheid | 26041 | 2 | DxD | 9608-47 | Yes | 9608-26 | Yes |
| 2008 | Wanderscheid | 26044 | 1 | DxN | 9608-47 | Yes | NSO-108 | No |
| 2008 | Wanderscheid | 26045 | 2 | DxN | D125 | Yes | NSO-108 | No |
| 2008 | Wanderscheid | 26046 | 9 | DxD | D125 | Yes | 2809-04 | Yes |
| 2008 | Wanderscheid | 26047 | 30 | DxD | D125 | Yes | OP 55-38 | Yes |
| 2008 | Wanderscheid | 26048 | 12 | DxN | D125 | Yes | NSO-113 | No |
| 2008 | Wanderscheid | 26049 | 17 | DxD | D125 | Yes | 9608-26 | Yes |
| 2008 | Wanderscheid | 26050 | 17 | DxD | D125 | Yes | OP 30-01 | Yes |
| 2008 | Wanderscheid | 26051 | 8 | DxD | D110 | Yes | 9608-02 | Yes |
| 2008 | Wanderscheid | 26052 | 15 | DxD | D110 | Yes | OP 30-01 | Yes |
| 2008 | Wanderscheid | 26053 | 18 | DxD | D110 | Yes | 9608-26 | Yes |
| 2008 | Wanderscheid | 26062 | 1 | DxD | OP 64-30 | Yes | 9608-02 | Yes |
| 2008 | Wanderscheid | 26073 | 7 | DxD | OP 2-29 | Yes | 2809-04 | Yes |
| 2015 | MN Power | 12004016 | 21 | DxN | 98130020 | Yes | N944-4 | Yes |
| 2015 | MN Power | 12005010 | 21 | DxN | 98038018 | Yes | N946-2 | Yes |
| 2015 | MN Power | 12007010 | 20 | DxN | 98038018 | Yes | N964-1 | Yes |
| 2015 | MN Power | 12012013 | 20 | DxN | 98052010 | Yes | N944-4 | Yes |
| 2015 | MN Power | 12013013 | 20 | DxN | 98052010 | Yes | N946-2 | Yes |
| 2015 | MN Power | 12015013 | 20 | DxN | 98052010 | Yes | N964-1 | Yes |
| 2015 | MN Power | 12016013 | 20 | DxN | 98052010 | Yes | N945-3 | Yes |
| 2015 | MN Power | 12020012 | 19 | DxN | 98041007 | Yes | N944-4 | Yes |
| 2015 | MN Power | 12021008 | 19 | DxN | 98036031 | Yes | N946-2 | Yes |
| 2015 | MN Power | 12021012 | 20 | DxN | 98041007 | Yes | N946-2 | Yes |
| 2015 | MN Power | 12022008 | 20 | DxN | 98036031 | Yes | N949-2 | Yes |
| 2015 | MN Power | 12025006 | 20 | DxN | 98021024 | Yes | N944-4 | Yes |
| 2015 | MN Power | 12026007 | 20 | DxN | 98023024 | Yes | N964-3 | Yes |
| 2015 | MN Power | 12027007 | 20 | DxN | 98023024 | Yes | N946-2 | Yes |
| 2015 | MN Power | 12030007 | 32 | DxN | 98023024 | Yes | N944-4 | Yes |
| 2015 | MN Power | 12030009 | 20 | DxN | 98038004 | Yes | N944-4 | Yes |
| 2015 | MN Power | 12031006 | 20 | DxN | 98021024 | Yes | N964-1 | Yes |
| 2015 | MN Power | 12031007 | 21 | DxN | 98023024 | Yes | N964-1 | Yes |
| 2015 | MN Power | 12032006 | 20 | DxN | 98021024 | Yes | N945-3 | Yes |
| 2015 | MN Power | 12032007 | 21 | DxN | 98023024 | Yes | N945-3 | Yes |
| 2015 | MN Power | 12034009 | 20 | DxN | 98038004 | Yes | N946-3 | Yes |
| 2015 | MN Power | 12040011 | 20 | DxN | 98040035 | Yes | N945-3 | Yes |
| 2015 | MN Power | 12042011 | 21 | DxN | 98040035 | Yes | N946-2 | Yes |
| 2015 | MN Power | 12043015 | 14 | DxN | 98072056 | Yes | N949-2 | Yes |
| 2015 | MN Power | 12048015 | 20 | DxN | 98072056 | Yes | N945-3 | Yes |
| 2015 | MN Power | 12049015 | 21 | DxN | 98072056 | Yes | N944-4 | Yes |
| 2015 | MN Power | 12049017 | 20 | DxN | 98149012 | Yes | N944-4 | Yes |
| 2015 | MN Power | 12050017 | 20 | DxN | 98149012 | Yes | N946-2 | Yes |
| 2015 | MN Power | 12078014 | 20 | DxN | 98071016 | Yes | N964-1 | Yes |
| 2015 | MN Power | 12116021 | 21 | DxN | D125 | Yes | N946-2 | Yes |

**Table A2.**

Family pedigree information for the five (5) Clone Trials:Hansen 2006; Schultz 2007; and Captain, Hansmeyer and Smith 2009

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CT Year** | **Site** | **Family** | **Family origination** | **Individual Clone IDs** | **Number of clones/family** | **Species Type** | **Female Parent** | **Tested\*** | **Male Parent** | **Tested\*** |
| 2006 | Hansen | Aud-T '105' | University of Minnesota | D140 | 1 | OP *P. deltoides* | Aud-T '105' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '204' | University of Minnesota | D114 | 1 | OP *P. deltoides* | Aud-T '204' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '204' | University of Minnesota | D123 | 1 | OP *P. deltoides* | Aud-T '204' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '209' | University of Minnesota | D121 | 1 | OP *P. deltoides* | Aud-T '209' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '400' | University of Minnesota | D109 | 1 | OP *P. deltoides* | Aud-T '400' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '400' | University of Minnesota | D113 | 1 | OP *P. deltoides* | Aud-T '400' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '400' | University of Minnesota | D116 | 1 | OP *P. deltoides* | Aud-T '400' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '400' | University of Minnesota | D124 | 1 | OP *P. deltoides* | Aud-T '400' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '400' | University of Minnesota | D125 | 1 | OP *P. deltoides* | Aud-T '400' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '904' | University of Minnesota | D105 | 1 | OP *P. deltoides* | Aud-T '904' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '908' | University of Minnesota | D110 | 1 | OP *P. deltoides* | Aud-T '908' | No | wind-pollinated | No |
| 2006 | Hansen | Aud-T '908' | University of Minnesota | D111 | 1 | OP *P. deltoides* | Aud-T '908' | No | wind-pollinated | No |
| 2006 | Hansen | Rosemount '1905' | University of Minnesota | D136 | 1 | OP *P. deltoides* | Rosemount '1905' | No | wind-pollinated | No |
| 2006 | Hansen | 2802 | NRRI | 2802-44 | 1 | OP *P. deltoides* | 192-3 | Yes | wind-pollinated | No |
| 2006 | Hansen | 2805 | NRRI | 2805-28 | 1 | OP *P. deltoides* | D125 | Yes | wind-pollinated | No |
| 2006 | Hansen | 9605 | NRRI | 9605-12; 35 | 2 | DxD | D129 | Yes | D124 | Yes |
| 2006 | Hansen | 9608 | NRRI | 9608-13; 15; 17 | 3 | DxD | D132 | Yes | D113 | Yes |
| 2006 | Hansen | 9701 | NRRI | 9701-10; 15; 23 | 3 | DxD | 180-1 | Yes | 178-4 | Yes |
| 2006 | Hansen | 9704 | NRRI | 9704-17 | 1 | DxD | D110 | Yes | 175-4 | Yes |
| 2006 | Hansen | 9732 | NRRI | 9732-06; 11; 16; 19; 24; 31; 36 | 7 | DxN | D125 | Yes | N946-2 | No |
| 2006 | Hansen | 9752 | NRRI | 9752-09 | 1 | DxD | 288-5 | Yes | D124 | Yes |
| 2006 | Hansen | 59129 | University of Illinois | 5912917 | 1 | OP *P. deltoides* | 59129 | No | wind-pollinated | No |
| 2006 | Hansen | 73002 | University of Illinois | 7300216 | 1 | OP *P. deltoides* | 73002 | No | wind-pollinated | No |
| 2006 | Hansen | 98003 | NRRI | 98003020; 45 | 2 | DxD | 288-5 | Yes | D124 | Yes |
| 2006 | Hansen | 98009 | NRRI | 98009044 | 1 | DxD | 288-5 | Yes | NW197 | No |
| 2006 | Hansen | 98015 | NRRI | 98015009; 19 | 2 | DxD | 288-5 | Yes | D113 | Yes |
| 2006 | Hansen | 98016 | NRRI | 98016004; 5; 14; 58 | 4 | DxD | 180-1 | Yes | D113 | Yes |
| 2006 | Hansen | 98038 | NRRI | 98038008; 18 | 2 | DxD | D125 | Yes | D111 | Yes |
| 2006 | Hansen | 98041 | NRRI | 98041011 | 1 | DxD | D125 | Yes | D105 | Yes |
| 2006 | Hansen | 98052 | NRRI | 98052013 | 1 | DxD | D132 | Yes | D124 | Yes |
| 2006 | Hansen | 98121 | NRRI | 98121016; 19; 22; 34 | 4 | DxN | D132 | Yes | N149 | No |
| 2006 | Hansen | 152x11861 | UM / USFS | 152x11861 | 1 | DxM | Delt '152' | Yes | Max '11861' | No |
| 2006 | Hansen | M/R '113' | UM / USFS | 113.64 | 1 | DxN | unknown | No | unknown | No |
| 2006 | Hansen | M/R '502' | UM / USFS | 502.37 | 1 | DxM | unknown | No | unknown | No |
| 2006 | Hansen | OP NW22 | NRRI | OP NW22-13 | 1 | OP *P. deltoides* | OP NW22 | No | wind-pollinated | No |
| 2006 | Hansen | NC-51 '180' | University of Minnesota | 180-1 | 1 | OP *P. deltoides* | NC-51 '180' | No | wind-pollinated | No |
| 2006 | Hansen | NC-51 '252' | University of Minnesota | 252-4 | 1 | OP *P. deltoides* | NC-51 '252' | No | wind-pollinated | No |
| 2006 | Hansen | NC-51 '288' | University of Minnesota | 288-5 | 1 | OP *P. deltoides* | NC-51 '288' | No | wind-pollinated | No |
| 2006 | Hansen | unknown | UM / USFS | DM110 | 1 | DxM | unknown | No | unknown | No |
| 2006 | Hansen | unknown | unknown | DN2 | 1 | DxN | unknown | No | unknown | No |
| 2006 | Hansen | unknown | unknown | DN34 | 1 | DxN | unknown | No | unknown | No |
| 2006 | Hansen | unknown | USFS | NC14103 | 1 | DxM | unknown | No | unknown | No |
| 2006 | Hansen | unknown | USFS | NC14104 | 1 | DxM | unknown | No | unknown | No |
| 2006 | Hansen | unknown | USFS | NC14105 | 1 | DxM | unknown | No | unknown | No |
| 2006 | Hansen | unknown | USFS | NC14106 | 1 | DxM | unknown | No | unknown | No |
| 2006 | Hansen | unknown | USFS | NC14107 | 1 | DxM | unknown | No | unknown | No |
| 2006 | Hansen | unknown | unknown | NM6 | 1 | NxM | unknown | No | unknown | No |
| 2007 | Schultz | AudT '400' | University of Minnesota | D124 | 1 | OP *P. deltoides* | AudT '400' | No | wind-pollinated | No |
| 2007 | Schultz | 2801 | NRRI | 2801-05 | 1 | OP *P. deltoides* | 180-1 | Yes | wind-pollinated | No |
| 2007 | Schultz | 2802 | NRRI | 2802-44 | 1 | OP *P. deltoides* | 192-3 | Yes | wind-pollinated | No |
| 2007 | Schultz | 2805 | NRRI | 2805-28 | 1 | OP *P. deltoides* | D125 | Yes | wind-pollinated | No |
| 2007 | Schultz | 9603 | NRRI | 9603-16 | 1 | DxD | D129 | Yes | D105 | Yes |
| 2007 | Schultz | 9605 | NRRI | 9605-05; 06; 13; 35  | 4 | DxD | D129 | Yes | D124 | Yes |
| 2007 | Schultz | 9607 | NRRI | 9607-27 | 1 | DxD | D132 | Yes | D111 | Yes |
| 2007 | Schultz | 9608 | NRRI | 9608-02; 13; 15; 17; 18; 26 | 6 | DxD | D132 | Yes | D113 | Yes |
| 2007 | Schultz | 9701 | NRRI | 9701-15; 23  | 2 | DxD | 180-1 | Yes | 178-4 | Yes |
| 2007 | Schultz | 9704 | NRRI | 9704-17; 59 | 2 | DxD | D110 | Yes | 175-4 | Yes |
| 2007 | Schultz | 9732 | NRRI | 9732-06; 11; 19; 24 31; 36 | 6 | DxN | D125 | Yes | N946-2 | No |
| 2007 | Schultz | 9752 | NRRI | 9752-09; 22 | 2 | DxD | 288-5 | Yes | D124 | Yes |
| 2007 | Schultz | 98003 | NRRI | 98003007; 013; 015 | 3 | DxD | 288-5 | Yes | D124 | Yes |
| 2007 | Schultz | 98013 | NRRI | 98013046 | 1 | DxD | 288-5 | Yes | D105 | Yes |
| 2007 | Schultz | 98015 | NRRI | 98015001; 004; 013; 019 | 4 | DxD | 288-5 | Yes | D113 | Yes |
| 2007 | Schultz | 98016 | NRRI | 98016004; 005; 058 | 3 | DxD | 180-1 | Yes | D113 | Yes |
| 2007 | Schultz | 98019 | NRRI | 98019060 | 1 | DxD | 180-1 | Yes | D105 | Yes |
| 2007 | Schultz | 98023 | NRRI | 98023020 | 1 | DxD | 180-1 | Yes | D111 | Yes |
| 2007 | Schultz | 98040 | NRRI | 98040021 | 1 | DxD | D125 | Yes | D124 | Yes |
| 2007 | Schultz | 98052 | NRRI | 98052003 | 1 | DxD | D132 | Yes | D124 | Yes |
| 2007 | Schultz | 98121 | NRRI | 98121034 | 1 | DxN | D132 | Yes | N149 | No |
| 2007 | Schultz | 152x11861 | UM / USFS | 152x11861 | 1 | DxM | Delt '152' | Yes | Max '11861' | No |
| 2007 | Schultz | M/R 113 | UM / USFS | 113.64 | 1 | DxN | unknown | No | unknown | No |
| 2007 | Schultz | M/R 502 | UM / USFS | 502.37 | 1 | DxM | unknown | No | unknown | No |
| 2007 | Schultz | 1996 'OP 1' | NRRI | OP 1-23 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP 2' | NRRI | OP 2-29 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP 3' | NRRI | OP 3-14 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP 30' | NRRI | OP 30-01 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP 35' | NRRI | OP 35-53 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP 5' | NRRI | OP 5-35 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP 52' | NRRI | OP 52-21 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP 55' | NRRI | OP 55-32 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP 55' | NRRI | OP 55-38 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP 64' | NRRI | OP 64-30 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP 69' | NRRI | OP 69-39 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | 1996 'OP NW22' | NRRI | OP NW22-13 | 1 | OP *P. deltoides* | unknown | No | wind-pollinated | No |
| 2007 | Schultz | unknown | unknown | DM110 | 1 | DxM | unknown | No | unknown | No |
| 2007 | Schultz | unknown | unknown | DN2 | 1 | DxN | unknown | No | unknown | No |
| 2007 | Schultz | unknown | unknown | DN5 | 1 | DxN | unknown | No | unknown | No |
| 2007 | Schultz | unknown | unknown | NC14106 | 1 | DxM | unknown | No | unknown | No |
| 2009 | Captain, Hansmeyer, Smith | 20111 | NRRI | 20111344 | 1 | DxN | D109 | Yes | N964-1 | No |
| 2009 | Captain, Hansmeyer, Smith | 20113 | NRRI | 20113217; 233 | 2 | DxN | D109 | Yes | N949-2 | No |
| 2009 | Captain, Hansmeyer, Smith | 22007 | NRRI | 22007002 | 1 | DxM | D109 | Yes | M1052-6 | No |
| 2009 | Captain, Hansmeyer, Smith | 22033 | NRRI | 22033018 | 1 | DxN | D125 | Yes | N46 | No |
| 2009 | Captain, Hansmeyer, Smith | 22057 | NRRI | 22057033 | 1 | DxN | D121 | Yes | N40 | No |
| 2009 | Captain, Hansmeyer, Smith | 23057 | NRRI | 23057006 | 1 | DxN | D110 | Yes | SO N148 | No |
| 2009 | Captain, Hansmeyer, Smith | 23059 | NRRI | 23059018 | 1 | DxN | D110 | Yes | SO N147 | No |
| 2009 | Captain, Hansmeyer, Smith | 23071 | NRRI | 23071040; 042; 057 | 3 | DxN | D125 | Yes | SO N150 | No |
| 2009 | Captain, Hansmeyer, Smith | 23074 | NRRI | 23074002; 008; 009; 037; 038 | 5 | DxN | D125 | Yes | SO N149 | No |
| 2009 | Captain, Hansmeyer, Smith | 23079 | NRRI | 23079041; 047; 069 | 3 | DxN | D125 | Yes | SO N148 | No |
| 2009 | Captain, Hansmeyer, Smith | 98149 | NRRI | 98149027 | 1 | DxD | 172-5 | Yes | D111 | Yes |
| 2009 | Captain, Hansmeyer, Smith | 99001 | NRRI | 99001111 | 1 | DxN | D121 | Yes | N947-5 | No |
| 2009 | Captain, Hansmeyer, Smith | 99002 | NRRI | 99002017; 026; 030 | 3 | DxM | D121 | Yes | M1052-5 | No |
| 2009 | Captain, Hansmeyer, Smith | 99007 | NRRI | 99007087; 108; 115 | 3 | DxN | D121 | Yes | N949-2 | No |
| 2009 | Captain, Hansmeyer, Smith | 99008 | NRRI | 99008070; 080 | 2 | DxN | D121 | Yes | N944-4 | No |
| 2009 | Captain, Hansmeyer, Smith | 99022 | NRRI | 9902203; 069 | 2 | DxN | D143 | Yes | N947-5 | No |
| 2009 | Captain, Hansmeyer, Smith | 99037 | NRRI | 99037017; 046; 049; 051 | 4 | DxN | D200 | Yes | N964-6 | No |
| 2009 | Captain, Hansmeyer, Smith | 99038 | NRRI | 99038002; 013; 022; 036 | 4 | DxN | D200 | Yes | N944-4 | No |
| 2009 | Captain, Hansmeyer, Smith | 99059 | NRRI | 99059016; 023; 043; 066 | 4 | DxN | D123 | Yes | N949-2 | No |
| 2009 | Captain, Hansmeyer, Smith | N944 | University of Toronto | N944-4 | 1 | *P. nigra* | unknown | Yes | unknown | No |

**Table A3.**

Family pedigree information for the two (2) Yield Blocks:Hansen 2006 and LEA Grand Rapids 2007

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **YB Year** | **Site** | **Clone IDs** | **Family** | **Individual IDs** | **Number of clones/family** | **Species Type** | **Female Parent** | **Tested\*** | **Male Parent** | **Tested\*** |
| 2006 | Hansen | 502.37 | 502 | 502.37 | 1 | DxM | unknown | No | unknown | No |
| 2006 | Hansen | 98003020 | 98003 | 98003020; 045 | 2 | DxD | 288-5 | Yes | D124 | Yes |
| 2006 | Hansen | 98052013 | 98052 | 98052013 | 1 | DxD | D132 | Yes | D124 | Yes |
| 2006 | Hansen | 98121016 | 98121 | 98121016; 019; 022 | 3 | DxN | D132 | Yes | N149 | No |
| 2006 | Hansen | 152x11861 | unknown | 152x11861 | 1 | DxM | Delt '152' | Yes | Max '11861' | No |
| 2006 | Hansen | 9732-06 | 9732 | 9732-06; 11; 16; 19; 24; 31; 36 | 7 | DxN | D125 | Yes | N946-2 | No |
| 2006 | Hansen | D105 | 904 | D105 | 1 | D | Aud-T '904' | No | wind-pollinated | No |
| 2006 | Hansen | D109 | 400 | D109 | 1 | D | Aud- T '400' | No | wind-pollinated | No |
| 2006 | Hansen | D113 | 400 | D113 | 1 | D | Aud- T '400' | No | wind-pollinated | No |
| 2006 | Hansen | D124 | 400 | D124; D125 | 2 | D | Aud- T '400' | No | wind-pollinated | No |
| 2006 | Hansen | DM110 | unknown | DM110 | 1 | DxM | unknown | No | unknown | No |
| 2006 | Hansen | NC 14106 | unknown | NC14106 | 1 | DxM | unknown | No | unknown | No |
| 2007 | LEA Grand Rapids | 9732-06 | 9732 | 9732-06; 11 | 2 | DxN | D125 | Yes | N946-2 | No |
| 2007 | LEA Grand Rapids | DM110 | unknown | DM110 | 1 | DxM | unknown | No | unknown | No |
| 2007 | LEA Grand Rapids | NC14106 | unknown | NC14106 | 1 | DxM | unknown | No | unknown | No |
| 2007 | LEA Grand Rapids | NM6 | unknown | NM6 | 1 | NxM | unknown | No | unknown | No |

**Table A4.**

The rank of clones for DBH2 in the Clone Trials from the highest (rank =1) to the lowest for each site based on DBH2 at different years

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Site** | **Species Type** | **Clone** | **3Yrs** | **4Yrs** | **5Yrs** | **9Yrs** | **10Yrs** |
| Captain | DD | 98148027 | 35 | 28 | 25 |  | 18 |
| Captain | DM | 22007002 | 42 | 42 | 42 |  | 42 |
| Captain | DM | 99002017 | 28 | 27 | 36 |  | 32 |
| Captain | DM | 99002026 | 38 | 40 | 39 |  | 40 |
| Captain | DM | 99002030 | 34 | 33 | 35 |  | 29 |
| Captain | DN | 20111344 | 23 | 21 | 20 |  | 22 |
| Captain | DN | 20113217 | 14 | 14 | 13 |  | 10 |
| Captain | DN | 20113233 | 7 | 8 | 12 |  | 20 |
| Captain | DN | 22033018 | 3 | 1 | 2 |  | 14 |
| Captain | DN | 22057033 | 41 | 41 | 41 |  | 41 |
| Captain | DN | 99001111 | 32 | 22 | 16 |  | 13 |
| Captain | DN | 99007087 | 10 | 9 | 7 |  | 8 |
| Captain | DN | 99007108 | 37 | 35 | 33 |  | 19 |
| Captain | DN | 99007115 | 27 | 24 | 17 |  | 12 |
| Captain | DN | 99008070 | 18 | 12 | 11 |  | 4 |
| Captain | DN | 99008080 | 12 | 11 | 5 |  | 9 |
| Captain | DN | 99022003 | 31 | 29 | 27 |  | 23 |
| Captain | DN | 99022069 | 21 | 20 | 24 |  | 25 |
| Captain | DN | 99037017 | 8 | 6 | 1 |  | 1 |
| Captain | DN | 99037046 | 11 | 4 | 3 |  | 2 |
| Captain | DN | 99037049 | 19 | 25 | 18 |  | 24 |
| Captain | DN | 99037051 | 26 | 23 | 15 |  | 16 |
| Captain | DN | 99038002 | 5 | 5 | 6 |  | 7 |
| Captain | DN | 99038013 | 9 | 10 | 8 |  | 6 |
| Captain | DN | 99038022 | 36 | 32 | 32 |  | 31 |
| Captain | DN | 99038036 | 16 | 15 | 19 |  | 33 |
| Captain | DN | 99059016 | 2 | 3 | 9 |  | 5 |
| Captain | DN | 99059023 | 33 | 34 | 29 |  | 15 |
| Captain | DN | 99059043 | 17 | 17 | 22 |  | 27 |
| Captain | DN | 99059066 | 22 | 18 | 21 |  | 17 |
| Captain | DN | 23057 32006 | 40 | 36 | 30 |  | 11 |
| Captain | DN | 23071 33040 | 30 | 30 | 31 |  | 34 |
| Captain | DN | 23071 33042 | 6 | 7 | 10 |  | 28 |
| Captain | DN | 23071 33057 | 24 | 16 | 14 |  | 21 |
| Captain | DN | 23074 16002 | 20 | 38 | 38 |  | 36 |
| Captain | DN | 23074 16008 | 25 | 36 | 37 |  | 37 |
| Captain | DN | 23074 16037 | 29 | 31 | 34 |  | 30 |
| Captain | DN | 23074 37038 | 4 | 19 | 26 |  | 39 |
| Captain | DN | 23079 17041 | 15 | 26 | 28 |  | 35 |
| Captain | DN | 23079 17047 | 39 | 39 | 40 |  | 38 |
| Captain | DN | 23079 17069 | 13 | 13 | 23 |  | 26 |
| Captain | N | N944-4 | 1 | 2 | 4 |  | 3 |
| Hansen | D | 5912917 | 63 | 63 | 63 | 63 |  |
| Hansen | D | 7300216 | 65 | 66 | 66 | 65 |  |
| Hansen | D | 180-1 | 57 | 61 | 62 | 54 |  |
| Hansen | D | 252-4 | 62 | 62 | 59 | 50 |  |
| Hansen | D | 2802-44 | 7 | 17 | 19 | 24 |  |
| Hansen | D | 2805-28 | 21 | 11 | 5 | 6 |  |
| Hansen | D | 288-5 | 58 | 60 | 61 | 58 |  |
| Hansen | D | D105 | 26 | 28 | 32 | 31 |  |
| Hansen | D | D109 | 24 | 21 | 23 | 22 |  |
| Hansen | D | D110 | 37 | 48 | 50 | 59 |  |
| Hansen | D | D111 | 61 | 59 | 58 | 61 |  |
| Hansen | D | D113 | 30 | 24 | 25 | 9 |  |
| Hansen | D | D114 | 15 | 18 | 15 | 38 |  |
| Hansen | D | D116 | 59 | 57 | 44 | 44 |  |
| Hansen | D | D121 | 56 | 54 | 48 | 37 |  |
| Hansen | D | D123 | 60 | 55 | 51 | 46 |  |
| Hansen | D | D124 | 36 | 34 | 29 | 20 |  |
| Hansen | D | D125 | 54 | 52 | 35 | 34 |  |
| Hansen | D | D136 | 64 | 65 | 65 | 66 |  |
| Hansen | D | D140 | 35 | 47 | 41 | 18 |  |
| Hansen | D | OP NW22-13 | 39 | 37 | 40 | 26 |  |
| Hansen | DD | 98003020 | 17 | 19 | 21 | 8 |  |
| Hansen | DD | 98003045 | 53 | 56 | 53 | 47 |  |
| Hansen | DD | 98009044 | 66 | 67 | 67 | 67 |  |
| Hansen | DD | 98015009 | 34 | 25 | 45 | 17 |  |
| Hansen | DD | 98015019 | 42 | 51 | 52 | 48 |  |
| Hansen | DD | 98016004 | 29 | 44 | 46 | 27 |  |
| Hansen | DD | 98016005 | 44 | 50 | 55 | 45 |  |
| Hansen | DD | 98016014 | 40 | 53 | 57 | 51 |  |
| Hansen | DD | 98016058 | 16 | 42 | 43 | 39 |  |
| Hansen | DD | 98038008 | 27 | 35 | 33 | 25 |  |
| Hansen | DD | 98038018 | 28 | 41 | 34 | 16 |  |
| Hansen | DD | 98041011 | 20 | 49 | 38 | 29 |  |
| Hansen | DD | 98052013 | 48 | 32 | 22 | 33 |  |
| Hansen | DD | 9605-12 | 33 | 39 | 37 | 40 |  |
| Hansen | DD | 9605-35 | 22 | 22 | 16 | 3 |  |
| Hansen | DD | 9608-13 | 6 | 8 | 6 | 5 |  |
| Hansen | DD | 9608-15 | 11 | 15 | 17 | 36 |  |
| Hansen | DD | 9608-17 | 3 | 2 | 1 | 1 |  |
| Hansen | DD | 9701-10 | 51 | 46 | 56 | 53 |  |
| Hansen | DD | 9701-15 | 32 | 31 | 31 | 49 |  |
| Hansen | DD | 9701-23 | 31 | 45 | 49 | 55 |  |
| Hansen | DD | 9704-17 | 50 | 33 | 27 | 21 |  |
| Hansen | DD | 9752-09 | 52 | 40 | 24 | 12 |  |
| Hansen | DM | 502.37 | 5 | 9 | 11 | 32 |  |
| Hansen | DM | 152x11861 | 2 | 1 | 4 | 43 |  |
| Hansen | DM | DM110 | 4 | 5 | 28 | 64 |  |
| Hansen | DM | NC14103 | 12 | 4 | 7 | 11 |  |
| Hansen | DM | NC14104 | 8 | 12 | 8 | 42 |  |
| Hansen | DM | NC14105 | 1 | 3 | 2 | 15 |  |
| Hansen | DM | NC14106 | 13 | 16 | 26 | 28 |  |
| Hansen | DM | NC14107 | 10 | 20 | 13 | 57 |  |
| Hansen | DN | 113.64 | 47 | 58 | 60 | 56 |  |
| Hansen | DN | 98121016 | 9 | 10 | 12 | 14 |  |
| Hansen | DN | 98121019 | 18 | 13 | 18 | 41 |  |
| Hansen | DN | 98121022 | 19 | 7 | 9 | 13 |  |
| Hansen | DN | 98121034 | 41 | 26 | 14 | 7 |  |
| Hansen | DN | 9732-06 | 67 | 64 | 64 | 62 |  |
| Hansen | DN | 9732-11 | 55 | 43 | 42 | 35 |  |
| Hansen | DN | 9732-16 | 25 | 38 | 39 | 19 |  |
| Hansen | DN | 9732-19 | 14 | 6 | 3 | 4 |  |
| Hansen | DN | 9732-24 | 49 | 29 | 30 | 30 |  |
| Hansen | DN | 9732-31 | 43 | 23 | 10 | 2 |  |
| Hansen | DN | 9732-36 | 45 | 36 | 36 | 10 |  |
| Hansen | DN | DN2 | 23 | 14 | 20 | 23 |  |
| Hansen | DN | DN34 | 46 | 30 | 54 | 60 |  |
| Hansen | NM | NM6 | 38 | 27 | 47 | 52 |  |
| Hansmeyer | DD | 98148027 | 41 | 41 | 40 |  | 30 |
| Hansmeyer | DM | 22007002 | 34 | 37 | 41 |  | 37 |
| Hansmeyer | DM | 99002017 | 16 | 11 | 19 |  | 26 |
| Hansmeyer | DM | 99002026 | 37 | 39 | 38 |  | 36 |
| Hansmeyer | DM | 99002030 | 31 | 32 | 36 |  | 38 |
| Hansmeyer | DN | 20111344 | 4 | 4 | 7 |  | 9 |
| Hansmeyer | DN | 20113217 | 25 | 27 | 26 |  | 17 |
| Hansmeyer | DN | 20113233 | 14 | 18 | 20 |  | 21 |
| Hansmeyer | DN | 22033018 | 2 | 1 | 1 |  | 3 |
| Hansmeyer | DN | 22057033 | 42 | 43 | 43 |  | 43 |
| Hansmeyer | DN | 99001111 | 38 | 34 | 31 |  | 16 |
| Hansmeyer | DN | 99007087 | 13 | 19 | 14 |  | 5 |
| Hansmeyer | DN | 99007108 | 24 | 21 | 18 |  | 11 |
| Hansmeyer | DN | 99007115 | 16 | 14 | 12 |  | 10 |
| Hansmeyer | DN | 99008070 | 26 | 22 | 25 |  | 14 |
| Hansmeyer | DN | 99008080 | 28 | 29 | 28 |  | 19 |
| Hansmeyer | DN | 99022003 | 32 | 35 | 35 |  | 31 |
| Hansmeyer | DN | 99022069 | 33 | 31 | 32 |  | 25 |
| Hansmeyer | DN | 99037017 | 10 | 6 | 3 |  | 2 |
| Hansmeyer | DN | 99037046 | 15 | 12 | 11 |  | 6 |
| Hansmeyer | DN | 99037049 | 22 | 26 | 27 |  | 24 |
| Hansmeyer | DN | 99037051 | 30 | 28 | 29 |  | 15 |
| Hansmeyer | DN | 99038002 | 9 | 8 | 5 |  | 4 |
| Hansmeyer | DN | 99038013 | 20 | 17 | 16 |  | 7 |
| Hansmeyer | DN | 99038022 | 7 | 5 | 6 |  | 22 |
| Hansmeyer | DN | 99038036 | 18 | 20 | 21 |  | 33 |
| Hansmeyer | DN | 99059016 | 6 | 9 | 8 |  | 12 |
| Hansmeyer | DN | 99059023 | 23 | 25 | 23 |  | 13 |
| Hansmeyer | DN | 99059043 | 5 | 7 | 10 |  | 27 |
| Hansmeyer | DN | 99059066 | 11 | 16 | 13 |  | 8 |
| Hansmeyer | DN | 23057 32006 | 29 | 24 | 24 |  | 20 |
| Hansmeyer | DN | 23071 33040 | 8 | 10 | 9 |  | 29 |
| Hansmeyer | DN | 23071 33042 | 1 | 2 | 4 |  | 28 |
| Hansmeyer | DN | 23071 33057 | 36 | 33 | 33 |  | 32 |
| Hansmeyer | DN | 23074 01609 | 35 | 38 | 39 |  | 39 |
| Hansmeyer | DN | 23074 16002 | 39 | 40 | 37 |  | 40 |
| Hansmeyer | DN | 23074 16008 | 19 | 30 | 30 |  | 35 |
| Hansmeyer | DN | 23074 16037 | 40 | 36 | 34 |  | 42 |
| Hansmeyer | DN | 23074 37038 | 12 | 15 | 17 |  | 34 |
| Hansmeyer | DN | 23079 17041 | 43 | 42 | 42 |  | 41 |
| Hansmeyer | DN | 23079 17047 | 27 | 23 | 22 |  | 23 |
| Hansmeyer | DN | 23079 17069 | 21 | 13 | 15 |  | 18 |
| Hansmeyer | N | N944-4 | 3 | 3 | 2 |  | 1 |
| Schultz | D | 2801-05 | 29 | 44 | 44 |  | 46 |
| Schultz | D | 2802-44 | 39 | 30 | 26 |  | 31 |
| Schultz | D | 2805-28 | 40 | 20 | 14 |  | 16 |
| Schultz | D | D124 | 4 | 4 | 2 |  | 3 |
| Schultz | D | OP 1-23 | 18 | 39 | 35 |  | 44 |
| Schultz | D | OP 2-29 | 55 | 49 | 54 |  | 56 |
| Schultz | D | OP 30-01 | 52 | 60 | 53 |  | 42 |
| Schultz | D | OP 3-14 | 46 | 55 | 58 |  | 57 |
| Schultz | D | OP 35-53 | 6 | 29 | 20 |  | 29 |
| Schultz | D | OP 52-21 | 53 | 59 | 61 |  | 63 |
| Schultz | D | OP 5-35 | 24 | 22 | 15 |  | 4 |
| Schultz | D | OP 55-32 | 27 | 18 | 10 |  | 6 |
| Schultz | D | OP 55-38 | 23 | 25 | 25 |  | 13 |
| Schultz | D | OP 64-30 | 49 | 57 | 55 |  | 49 |
| Schultz | D | OP 69-39 | 14 | 16 | 13 |  | 26 |
| Schultz | D | OP NW22-13 | 20 | 17 | 17 |  | 17 |
| Schultz | DD | 98003007 | 30 | 33 | 32 |  | 19 |
| Schultz | DD | 98003013 | 17 | 24 | 23 |  | 23 |
| Schultz | DD | 98003015 | 41 | 37 | 37 |  | 24 |
| Schultz | DD | 98013046 | 50 | 53 | 57 |  | 55 |
| Schultz | DD | 98015001 | 31 | 35 | 42 |  | 32 |
| Schultz | DD | 98015004 | 62 | 63 | 63 |  | 61 |
| Schultz | DD | 98015013 | 56 | 46 | 49 |  | 48 |
| Schultz | DD | 98015019 | 45 | 47 | 48 |  | 36 |
| Schultz | DD | 98016004 | 7 | 10 | 16 |  | 14 |
| Schultz | DD | 98016005 | 48 | 40 | 40 |  | 51 |
| Schultz | DD | 98016058 | 21 | 19 | 21 |  | 20 |
| Schultz | DD | 98019060 | 8 | 21 | 22 |  | 30 |
| Schultz | DD | 98023020 | 36 | 43 | 46 |  | 45 |
| Schultz | DD | 98040021 | 43 | 42 | 36 |  | 37 |
| Schultz | DD | 98052003 | 44 | 45 | 47 |  | 47 |
| Schultz | DD | 9603-16 | 63 | 62 | 62 |  | 59 |
| Schultz | DD | 9605-05 | 61 | 56 | 50 |  | 43 |
| Schultz | DD | 9605-06 | 10 | 12 | 11 |  | 7 |
| Schultz | DD | 9605-13 | 35 | 31 | 27 |  | 12 |
| Schultz | DD | 9605-35 | 22 | 11 | 5 |  | 2 |
| Schultz | DD | 9607-27 | 26 | 32 | 24 |  | 28 |
| Schultz | DD | 9608-02 | 54 | 51 | 51 |  | 39 |
| Schultz | DD | 9608-13 | 51 | 50 | 45 |  | 33 |
| Schultz | DD | 9608-15 | 38 | 41 | 41 |  | 34 |
| Schultz | DD | 9608-17 | 2 | 1 | 1 |  | 1 |
| Schultz | DD | 9608-18 | 33 | 38 | 39 |  | 21 |
| Schultz | DD | 9608-26 | 32 | 36 | 34 |  | 15 |
| Schultz | DD | 9701-15 | 19 | 14 | 31 |  | 38 |
| Schultz | DD | 9701-23 | 37 | 34 | 33 |  | 52 |
| Schultz | DD | 9704-17 | 57 | 58 | 56 |  | 54 |
| Schultz | DD | 9704-59 | 59 | 61 | 60 |  | 60 |
| Schultz | DD | 9752-09 | 58 | 48 | 43 |  | 35 |
| Schultz | DD | 9752-22 | 34 | 28 | 30 |  | 18 |
| Schultz | DM | 502.37 | 5 | 13 | 28 |  | 53 |
| Schultz | DM | 152x11861 | 1 | 3 | 12 |  | 41 |
| Schultz | DM | DM110 | 13 | 26 | 38 |  | 62 |
| Schultz | DM | NC14106 | 47 | 52 | 59 |  | 58 |
| Schultz | DN | 113.64 | 60 | 54 | 52 |  | 50 |
| Schultz | DN | 98121034 | 15 | 9 | 7 |  | 9 |
| Schultz | DN | 9732-06 | 28 | 27 | 29 |  | 27 |
| Schultz | DN | 9732-11 | 3 | 2 | 3 |  | 8 |
| Schultz | DN | 9732-19 | 16 | 5 | 6 |  | 10 |
| Schultz | DN | 9732-24 | 11 | 6 | 9 |  | 22 |
| Schultz | DN | 9732-31 | 42 | 23 | 18 |  | 11 |
| Schultz | DN | 9732-36 | 25 | 15 | 8 |  | 5 |
| Schultz | DN | DN2 | 9 | 7 | 4 |  | 25 |
| Schultz | DN | DN5 | 12 | 8 | 19 |  | 40 |
| Smith | DM | 22007002 | 18 | 35 | 29 |  | 21 |
| Smith | DM | 99002017 | 14 | 25 | 32 |  | 32 |
| Smith | DM | 99002026 | 35 | 22 | 28 |  | 38 |
| Smith | DM | 99002030 | 7 | 4 | 5 |  | 16 |
| Smith | DN | 20111344 | 22 | 10 | 12 |  | 11 |
| Smith | DN | 20113217 | 31 | 36 | 37 |  | 31 |
| Smith | DN | 20113233 | 24 | 19 | 21 |  | 33 |
| Smith | DN | 22033018 | 3 | 1 | 2 |  | 2 |
| Smith | DN | 22057033 | 40 | 41 | 41 |  | 42 |
| Smith | DN | 99001111 | 28 | 28 | 31 |  | 5 |
| Smith | DN | 99007087 | 23 | 27 | 27 |  | 10 |
| Smith | DN | 99007108 | 37 | 38 | 39 |  | 27 |
| Smith | DN | 99007115 | 33 | 15 | 9 |  | 3 |
| Smith | DN | 99008070 | 15 | 11 | 15 |  | 9 |
| Smith | DN | 99008080 | 19 | 13 | 11 |  | 8 |
| Smith | DN | 99022003 | 42 | 43 | 43 |  | 40 |
| Smith | DN | 99022069 | 41 | 40 | 40 |  | 25 |
| Smith | DN | 99037017 | 6 | 7 | 3 |  | 1 |
| Smith | DN | 99037046 | 34 | 39 | 35 |  | 14 |
| Smith | DN | 99037049 | 29 | 26 | 20 |  | 20 |
| Smith | DN | 99037051 | 21 | 18 | 14 |  | 12 |
| Smith | DN | 99038002 | 39 | 32 | 19 |  | 7 |
| Smith | DN | 99038013 | 10 | 16 | 22 |  | 13 |
| Smith | DN | 99038022 | 17 | 9 | 10 |  | 34 |
| Smith | DN | 99038036 | 32 | 17 | 18 |  | 41 |
| Smith | DN | 99059016 | 8 | 8 | 8 |  | 4 |
| Smith | DN | 99059023 | 13 | 30 | 33 |  | 17 |
| Smith | DN | 99059043 | 5 | 14 | 17 |  | 29 |
| Smith | DN | 99059066 | 25 | 37 | 38 |  | 26 |
| Smith | DN | 23057 32006 | 38 | 20 | 13 |  | 15 |
| Smith | DN | 23059 32018 | 26 | 5 | 7 |  | 39 |
| Smith | DN | 23071 33040 | 2 | 3 | 1 |  | 6 |
| Smith | DN | 23071 33042 | 1 | 2 | 4 |  | 19 |
| Smith | DN | 23071 33057 | 20 | 31 | 24 |  | 24 |
| Smith | DN | 23074 01609 | 4 | 6 | 6 |  | 18 |
| Smith | DN | 23074 16002 | 30 | 34 | 34 |  | 37 |
| Smith | DN | 23074 16008 | 36 | 33 | 23 |  | 22 |
| Smith | DN | 23074 16037 | 27 | 23 | 26 |  | 28 |
| Smith | DN | 23074 37038 | 9 | 21 | 25 |  | 35 |
| Smith | DN | 23079 17041 | 43 | 42 | 42 |  | 43 |
| Smith | DN | 23079 17047 | 16 | 24 | 30 |  | 30 |
| Smith | DN | 23079 17069 | 12 | 12 | 16 |  | 23 |
| Smith | N | N944-4 | 11 | 29 | 36 |  | 36 |

**Table A5**.

Family Field Trials - Mean Dbh2 (cm2) of species types and overall mean. The mean was the average of the mean clone Dbh2 for each site

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Site** | **Species Type** | **Count of clones** | **3YrsOld** | **4YrsOld** | **5YrsOld** |
| **Woelfel** | DD | 612 | 11.42 | 31.71 | 65.81 |
| DM | 269 | 9.19 | 22.53 | 34.59 |
| DN | 29 | 11.29 | 37.37 | 65.80 |
| **Overall** | 910 | 10.76 | 29.18 | 56.58 |
| **Sturges1** | DM | 361 | 9.11 | 25.52 | 49.51 |
| DN | 256 | 6.71 | 24.42 | 56.21 |
| DT | 73 | 7.72 | 21.88 | 41.01 |
| **Overall** | 690 | 8.07 | 24.73 | 51.09 |
| **Housman** | DM | 228 | 9.80 | 23.42 | 41.37 |
| DN | 189 | 7.96 | 22.76 | 50.79 |
| DT | 58 | 8.17 | 20.50 | 37.29 |
| **Overall** | 475 | 8.87 | 22.80 | 44.62 |
| **Schultz** | DN | 200 | 21.21 | 62.75 | 110.89 |
| DT | 19 | 18.01 | 49.30 | 84.14 |
| **Overall** | 219 | 20.93 | 61.58 | 108.57 |
| **Wanderscheid** | DD | 180 | 17.24 | 56.89 | 91.27 |
| DN | 162 | 16.25 | 48.95 | 77.71 |
| DT | 29 | 13.16 | 24.92 | 32.68 |
| **Overall** | 371 | 16.49 | 50.92 | 80.77 |
| **MN Power** | DN | 611 | 2.8 | 7.53 |  |
| **Overall** | 611 | 2.8 | 7.53 |  |

**Table A6.**

Clone Trials - Mean Dbh2 (cm2) of species types and overall mean. The mean was the average mean clone Dbh2 for each site

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Site** | **Species Type** | **Count of clones** | **3YrsOld** | **4YrsOld** | **5YrsOld** | **9YrsOld** | **10YrsOld** |
| **Hansen** | D | 21 | 19.89 | 57.23 | 102.18 | 243.00 |  |
| DD | 23 | 23.69 | 63.50 | 109.91 | 271.34 |  |
| DM | 8 | 33.92 | 87.30 | 137.82 | 251.44 |  |
| DN | 14 | 22.25 | 69.06 | 117.06 | 281.72 |  |
| NM | 1 | 21.08 | 68.16 | 102.60 | 215.26 |  |
| **Overall** | 67 | 23.38 | 65.61 | 112.21 | 261.41 |  |
| **Schultz** | D | 16 | 18.77 | 59.08 | 109.33 |  | 314.63 |
| DD | 33 | 16.88 | 55.50 | 101.42 |  | 306.55 |
| DM | 4 | 23.99 | 69.64 | 104.73 |  | 213.46 |
| DN | 10 | 21.27 | 76.76 | 133.04 |  | 352.42 |
| **Overall** | 63 | 18.51 | 60.68 | 108.66 |  | 309.98 |
| **Captain** | DD | 1 | 13.39 | 38.20 | 80.59 |  | 387.69 |
| DM | 4 | 11.34 | 26.27 | 51.63 |  | 158.28 |
| DN | 36 | 18.40 | 45.24 | 88.44 |  | 351.18 |
| N | 1 | 28.94 | 68.70 | 122.47 |  | 571.97 |
| **Overall** | 42 | 17.86 | 43.82 | 85.55 |  | 338.93 |
| **Hansmeyer** | DD | 1 | 7.17 | 22.81 | 47.21 |  | 181.46 |
| DM | 4 | 14.69 | 38.71 | 59.49 |  | 122.47 |
| DN | 37 | 20.62 | 49.16 | 85.63 |  | 252.17 |
| N | 1 | 34.92 | 71.77 | 130.73 |  | 530.58 |
| **Overall** | 43 | 20.09 | 48.10 | 83.36 |  | 244.93 |
| **Smith** | DM | 4 | 11.23 | 28.07 | 53.48 |  | 197.39 |
| DN | 38 | 10.65 | 27.56 | 53.34 |  | 228.28 |
| N | 1 | 12.73 | 24.68 | 42.09 |  | 172.16 |
| **Overall** | 43 | 10.75 | 27.54 | 53.09 |  | 224.10 |

**Table A7.**

Yield Blocks - Mean Dbh2 (cm2) of species (cross) types and overall mean. The mean was the average mean clone Dbh2 for each site. N is number of clones

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Site | Species Type | N | 3YrsOld | 4YrsOld | 5YrsOld | 9YrsOld | 10YrsOld |
| Hansen | D | 5 | 25.41 | 69.19 | 120.85 | 276.15 |  |
| DD | 3 | 24.14 | 66.74 | 111.73 | 259.03 |  |
| DM | 4 | 33.85 | 79.90 | 121.76 | 204.48 |  |
| DN | 10 | 21.95 | 66.26 | 116.63 | 271.24 |  |
| overall | 22 | 25.20 | 69.47 | 117.85 | 258.55 |  |
| LEA Grand Rapids | DM | 2 |  | 31.62 | 65.33 |  | 181.79 |
| DN | 2 |  | 55.26 | 108.24 |  | 247.01 |
| NM | 1 |  | 64.65 | 119.31 |  | 229.61 |
| overall | 5 |  | 47.68 | 93.29 |  | 217.44 |



**Figure A1.** The canker scores for different species (taxon) types over all sites in the Clone Trials. Each row represents one canker score value (one data point for one individual tree).

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**Figure A2.** Scatterplot matrix between NPT and FFT growth measures pertaining to the MN Power site. Family means versus family means.



**Figure A3.** Scatterplot matrix between NPT and FFT growth measures pertaining to the Woelfel site. Family means versus family means.