MegaChip — A New Potato Variety for Chipping

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ABSTRACT

‘MegaChip’ is a medium-late variety for chipping, with round-oval tubers of white tan skin and white flesh. MegaChip has consistently shown good to high yield potential. The tubers bulk early and produce a good size distribution for chipping. The specific gravity is consistently high and is close to the solid content of ‘Atlantic’. MegaChip has longer dormancy than ‘Snowden’ and Atlantic and stores well. It produces high quality chips that have an excellent color both from the field and after storage at 7.2 to 10 C. MegaChip showed a high level of resistance to common scab at most locations in North Central Regional trials and is moderately resistant to foliar early blight, powdery scab, pink rot, dry rot and soft rot. MegaChip is also fairly resistant to shatter bruise.

RESUMEN

‘MegaChip’ es una variedad para hojuelas medianamente tardía, con tubérculos redondos a ovales, de piel bronceada y pulpa blanca. MegaChip ha mostrado siempre un potencial de rendimiento bueno a alto. Los tubérculos son de crecimiento precoz y de una buena distribución de tamaño como para hojuelas. La gravedad específica es consistentemente alta y cercana al contenido de sólidos de ‘Atlantic’. MegaChip tiene mayor periodo de dormancia que ‘Snowden’ y Atlantic y se almacena bien. Produce hojuelas de alta calidad que tienen un excelente color de tubérculos recién cosechados y después de almacenados de 7.2 a 10 C. MegaChip muestra un alto nivel de resistencia a sarra común en la mayoría de pruebas Regionales de Norte Centro y es moderadamente resistente al tizón temprano del follaje, sarra polvorienta, pudrición rosada, pudrición seca y pudrición blanda. MegaChip es también medianamente resistente a magulladuras por golpe.

INTRODUCTION

‘MegaChip’ (W1201) is a round white potato variety with good tuber size and specific gravity for chipping. The variety was the result of a cross between ‘Wischip’ and FYF85 (Figure 1) and several years of selection. MegaChip was developed at the Rhinelander Agricultural Research Station in Wisconsin. The maternal parent, Wischip, was an old chipping variety released by the Wisconsin potato breeding program and was a parent to several successful chipping varieties including

![Figure 1. Pedigree of MegaChip.](image-url)
'Snowden', 'Chipeta' and 'Niska'. The paternal parent, FY85, was a breeding line also derived within the Wisconsin potato breeding program, with yellow hue flesh and resistance to scab. FY85 was derived from 'Spunta', a Dutch variety with high adaptability. The cross resulting in MegaChip was made in 1985. MegaChip was in seedling stage in 1986, single-hill plots in 1987, four-hill plots in 1988, eight-hill plots in 1989 and 1990, 20-hill plots in 1991, replicated trials at Hancock (120 day season) and Rhinelander (100 day season) from 1993 to 1996 and 1999 to 2001, in the Wisconsin State Trial in 1994, and in the North Central Regional Trial from 2001 to 2003. MegaChip was in a multiplication field under certification rules from 1999 to 2001 at Rhinelander and entered the tissue culture system of the Wisconsin Seed Potato Certification Program in the summer of 2002, where 7.5 and 20.2 ha of seed were certified in 2004 and 2005, respectively.

**VARIETAL DESCRIPTION**

**Vine and Foliage Characteristics**

*Hautne:* MegaChip has a spreading growth habit, with a medium- to large-sized canopy and robust vines (Figure 2). MegaChip is a mid-season variety with 120 days to maturation similar to Snowden. *Stems:* MegaChip has medium-high number of stems with three to five stems per plant. Stems are branched with weak anthocyanin coloration and weak stem wings. *Leaves:* MegaChip leaves are dark green (7.5 GY 5/4 Munsell Color Chart) with medium-short pubescence, open silhouette, and medium leaf stipule size (Figure 2). *Terminal leaflets:* MegaChip has medium ovate terminal leaflet shape with an acuminate tip and cordate base shape, and slight margin waviness. *Primary leaflets:* Primary leaflets are narrowly ovate, medium-sized, with three pairs of leaflets per leaf. *Secondary and tertiary leaflets:* MegaChip has six pairs of secondary and tertiary leaflets. *Petiole:* Petioles exhibit medium anthocyanin coloration. *Flowers:* MegaChip has four to seven inflorescences per plant with 12 florets per inflorescence, and medium peduncle length. *Calyx:* The calyx is devoid of anthocyanin coloration. *Corolla:* The corolla is pentagonal with light purple pigmentation. *Stigma:* MegaChip stigmas are capitate and pale green (2.5 GY 8/8 Munsell). *Anthers:* MegaChip has a narrow cone shape with fairly abundant pollen. *Berries:* Berries are moderately frequent.

**Tuber Characteristics and Quality**

*Tuber shape and size:* MegaChip tubers are round to oval with medium to large size (Figure 2). Mean tuber length is 63.5 mm, ranging from 40 to 105 mm (standard deviation 13.8 mm). Mean tuber width is 62.5 mm, ranging from 34 to 96 mm (SD 12.8 mm). Mean tuber thickness is 53.6 mm, ranging from 34 to 77 mm (SD 9.5). Average number of tuber numbers per plant is eight to 15. *Indices:* Tuber length to width ratio is 1.01, length to thickness ratio is 1.18, and thickness to width ratio is 0.85. *Skin:* MegaChip has white tan skin color (2.5 Y 7/4 Munsell). *Flesh:* The flesh is white. *Eyes:* MegaChip has medium-shallow eyes with seven to nine evenly distributed eyes per tuber. *Sprouts under diffuse light:* Sprouts are beween broad cylindrical and narrow cylindrical in shape, medium pubescent on the sprout base, red-violet sprout base with medium intensity of anthocyanin coloration (Figure 2); the sprout tip is medium pubescent, with weak anthocyanin coloration; medium frequency of sprout root initials, medium protrusion of lenticels, short lateral shoots. *Physiologic characteristics:* MegaChip has a high specific gravity and medium-long dormancy.

The tubers of MegaChip are medium to large size averaging 250 to 320 g. The general appearance of the tubers is similar to Snowden tubers. MegaChip is more dormant than Snowden or 'Atlantic', as indicated by a longer delay in sprout
initiation at 7.2 C and 85% RH in storage (Porter et al. 2003, 2004). MegaChip did not peep until 136 days after storage, compared to 129 and 118 days for Atlantic and Snowden, respectively. MegaChip sprouts did not grow to 1.27 cm long until 167 days after harvest, compared to 153 and 143 days for Atlantic and Snowden, respectively. The tubers of MegaChip have little shrinkage in storage; Porter et al. (2003, 2004) reported 13.5% average weight loss for MegaChip when stored at 7.2 C and 85% RH. Under identical storage conditions, weight loss was 17.2% for Atlantic and 19.2% for Snowden.

MegaChip vine maturity is a medium-late to late. The total yields and the US#1 yields of MegaChip are close to the standard chipping cvs Atlantic, NorValley and Snowden (Tables 1 and 2). MegaChip yields are stable from year to year, potentially due to its early tuber bulking. The two-year, seven-location Snack Food Association (SFA) Trial conducted in California, Florida, Idaho, Maine, Michigan, North Dakota and Pennsylvania revealed no significant yield differences between MegaChip and standard chipping varieties at each location. Average MegaChip yield was 41.8 t/ha compared to 41.7 and 39.7 t/ha for Atlantic and Snowden, respectively (Chase et al. 2004, 2005). Porter et al. (2002, 2003, 2004) reported no difference in yield between MegaChip or Atlantic and Snowden over three years and two locations in Maine. MegaChip had tuber size distribution similar to that of Atlantic and tended to have bigger size tubers than Snowden at Hancock and Antigo, Wisconsin (Kostichka 2002, 2004). Averaged over two years, the proportion of MegaChip tubers in the 170.1 to 368.5 g category...
Table 5—Chip color of the variety MegaChip and standard varieties in North Central Regional Trials.

<table>
<thead>
<tr>
<th>Treatment*</th>
<th>MegaChip</th>
<th>Atlantic</th>
<th>NorValley</th>
<th>Snowden</th>
<th>Atlantic</th>
<th>NorValley</th>
<th>Snowden</th>
</tr>
</thead>
<tbody>
<tr>
<td>0/15.5/D</td>
<td>60.8</td>
<td>57.6</td>
<td>62.1</td>
<td>62.7</td>
<td>3.1</td>
<td>-1.3</td>
<td>-1.9</td>
</tr>
<tr>
<td>3/8.9/D</td>
<td>57.2</td>
<td>55.7</td>
<td>59.6</td>
<td>58.8</td>
<td>1.5</td>
<td>-2.3</td>
<td>-1.6</td>
</tr>
<tr>
<td>7/8.9/D</td>
<td>57.8</td>
<td>56.6</td>
<td>58.1</td>
<td>55.6</td>
<td>1.2</td>
<td>-0.3</td>
<td>2.1</td>
</tr>
<tr>
<td>3/5.5/D</td>
<td>44.6</td>
<td>42.2</td>
<td>50.3</td>
<td>48.8</td>
<td>0.4</td>
<td>-5.7</td>
<td>-4.1</td>
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<tr>
<td>7/5.5/D</td>
<td>59.9</td>
<td>47.4</td>
<td>54.0</td>
<td>52.3</td>
<td>3.5</td>
<td>-0.0</td>
<td>-1.4</td>
</tr>
<tr>
<td>7/5.5/R</td>
<td>53.6</td>
<td>51.0</td>
<td>56.9</td>
<td>54.9</td>
<td>2.6</td>
<td>-3.3</td>
<td>-1.2</td>
</tr>
</tbody>
</table>

* Treatments: Months of storage/temperature of storage/ chipped direct or reconditioned at 20 C. Trials were conducted in Alberta, Manitoba, Michigan, Minnesota, Nebraska and Wisconsin (2001-2003); Ontario (2001-2002); North Dakota (2001).

was 47%, compared to 48% for Atlantic and 33% for Snowden.

MegaChip tubers tended to have fewer external defects than three standard varieties in the North Central Regional Trials (Table 3). The most frequent external defects in MegaChip were caused by greening or second growth, except in Iowa and Manitoba, where the main defects were due to scab lesions. Greening and secondary growth can be avoided with appropriate cultural practices such as replanting and irrigation. MegaChip internal defects were higher than those of Atlantic, but lower than those of NorValley and Snowden. The most frequent internal defect was vascular discoloration.

The specific gravity of MegaChip was consistently high across sites and years, and was similar to Atlantic and higher than NorValley (Table 4). MegaChip chips have a better fry color upon chipping than Atlantic from the field and out of storage, but not as good as the color of NorValley and Snowden (Table 5). The SFA Trials reported chip color of 63.1 Atron when MegaChip tubers were processed from the field, compared to 64.9 and 63.8 Atron for Atlantic and Snowden, respectively, in 2003 (Chase et al. 2004). In 2004, chip color was 67.6 Atron for MegaChip, compared to 63.8 and 66.8 Atron for Atlantic and Snowden, respectively (Chase et al. 2005). After six weeks of preconditioning (cooling down) and storage at 4.4 C in Aberdeen, Idaho, the chip color for MegaChip was 3.4 (scale 1 to 5 where 1 is light color), compared to 3.3 for Atlantic and 3.4 for Snowden. After six weeks of preconditioning and storage at 10 C in the same location, MegaChip color was 1.5, compared to 2.2 and 1.3 for Atlantic and Snowden, respectively (Chase et al. 2005). In Michigan State University experimental storage, chip color for MegaChip was 1.5 at 7.2 C and 1.0 at 10 C out of storage in February and 1.5 at 10 C out of storage in April of 2004 (Chris Long and Richard Chase, unpublished). In contrast, Atlantic had chip colors of 2.5, 1.5 and 1.5 and Snowden had chip colors of 2.0, 1.0 and 1.5 under the same conditions within the same experiment.

Despite the high specific gravity, MegaChip tubers were as resistant to shatter bruise as Atlantic and Snowden (Porter et al. 2002, 2003, 2004). MegaChip tended to be less sensitive to skinning and less susceptible to black spot bruise than Snowden when dropped from a height of 15.2 cm. MegaChip showed less black spot bruise on tubers than Atlantic at harvest. However, MegaChip was more susceptible to black spot bruise than Atlantic when tested in a six-sided plywood drum rotated ten times (Chase et al. 2005).

Disease Evaluations

MegaChip consistently exhibited high levels of resistance to common scab. In the North Central Regional Trials from 2001 to 2003, MegaChip showed 0% tuber infection in Alberta, Ontario, Michigan (except in 2001, when MegaChip showed 12% infected tubers vs. 20% for Snowden) and Nebraska, 0 to 4% in Wisconsin (vs. 0 to 2% for Snowden), 1% in North Dakota on irrigated land and 14% on dry land (vs. 11% and 19%, respectively, for Snowden), 3 to 20% in Manitoba (vs. 0% for Snowden), and 70% in 2001 in Iowa (vs. 0% for Snowden), according to the North Central Regional Trial data in 2002-2004. The variation of response to common scab is likely due to the diversity of scab populations in different regions, which suggests that MegaChip may be resistant to specific strains of scab.

MegaChip was classified with intermediate scab resistance with scab surface area index of 0.37 and average lesion index of 0.52 in the National Common Scab Trial at the Aroostook State Farm, Maine. MegaChip was similar to Atlantic (0.32 surface area index and 0.62 lesion index) and Superior (0.29 surface area index and 0.49 lesion index), according to the National Scab Trial in 2004.

MegaChip was consistently more resistant to common scab than Snowden in the Wisconsin common scab test plots.
MegaChip showed common scab infection on 33.3% of tubers with a mean affected area score of 7.3 and a maximum affected area score of 7.8 at the heavily infested Rhinelander test plot. The same figures were 86.7%, 6.7 and 3.3 for Snowden and 86.7%, 4.3 and 3.0 for Atlantic (Jiang et al. 2004). The scab lesion area index for MegaChip was 5.3, 3.9 and 3.1 while the lesion area index for Snowden was 15.9, 0.8 and 3.5 from 2003 to 2005, respectively, at the test plot in Antigo, Wisconsin (Stevenson et al. 2003, 2004, 2005). In Hartland, New Brunswick, MegaChip proved to be highly resistant to common scab with 0 t/ha infected tubers compared to 7.6 t/ha for Atlantic and 5.7 t/ha for Snowden (data provided by Peter Scott). Navarro et al. (2006) emphasized the outstanding scab resistance of MegaChip in Wisconsin, with results in accordance with those obtained in New Brunswick, Michigan and Maine.

MegaChip responded to early blight (Alternaria solani) in the foliage similarly to Snowden and Atlantic in trials at Hancock and Rhinelander, Wisconsin, from 2001 to 2003. Early blight ratings for MegaChip, Snowden and Atlantic were 6.0, 6.5 and 6.4, respectively, on a scale of 1 to 9 where 9 had no disease symptoms. Early blight area under the disease progress curves (AUDPC) was 0.329 for MegaChip, compared to 0.339 for ‘Kennebec’ in 2003, and 0.366 for MegaChip in 2004 (James and Stevenson 2003; Stevenson and James 2004). The incidence of early blight on tubers after artificial wound inoculation was 96.7% for MegaChip with 1.3 cm² mean lesion area vs. 91.7% infection and 0.2 cm² for Kennebec (James et al. 2004).

MegaChip was as susceptible to foliar late blight (Phytophthora infestans) as Atlantic and Snowden, with 18.3 AUDPC compared to 22.8 and 18.3, respectively (David Douches, unpublished). Tubers of MegaChip were as susceptible to late blight as Kennebec. MegaChip tubers had an infection rate of 85.0% with 42.7 % surface area infected, 0.9 cm maximum lesion depth, 31.2 cm² mean area affected and 19.0 cm² estimated volume affected. In contrast, Kennebec tubers had an infection rate of 88.3% with 61.0% surface area infected, 0.7 cm maximum lesion depth, 26.2 cm² area affected and 13.2 cm³ estimated volume affect (Stevenson et al. 2004).

MegaChip tubers have a similar level of resistance to pink rot (Phytophthora erythroseptica) as Kennebec. MegaChip infection incidence was 50.7% with 38.2% area affected and 7.8 cm² estimated volume of cut tubers, compared to Kennebec infection incidence of 66.7% with 37.8% area affected and 9.9 cm³ estimated volume of cut tubers (Stevenson et al. 2004).

The tubers of MegaChip and Snowden were similar in their response to bacterial soft rot (Erwinia carotovora) inoculation with 8.2 mm rotted area for MegaChip compared to 7.5 mm for Snowden (Robert Rand, unpublished data). No black scurf sclerotia (Rhizoctonia solani) were found on MegaChip tubers in replicated trials conducted from 1999 to 2003 in Hancock, Wisconsin, compared to Russet Burbank that frequently showed symptoms. MegaChip showed potential tolerance to early die nematode (Bird 2003).

MegaChip expressed bacterial ring rot (Clavibacter michiganensis ssp. sepedonicum) symptoms (Lisa Fiche, Julie Pasche and Neil Gudmestad, unpublished data). The foliar symptoms of bacterial ring rot were obvious 99 days after planting, with marginal leaf necrosis, leaf roll and inter-veinal chlorosis. Tubers symptoms included external periderm cracking and internal rot.

The levels of powdery scab resistance were moderate for MegaChip, Snowden and Atlantic tubers in test plots in Potter County, Pennsylvania (Christ 2005).

**AGRONOMIC PRODUCTION**

MegaChip total yield was not influenced by in-row spacings of 23 to 41 cm (Table 6). US #1 yield was consistently near 90% of the total yield across trials. Narrow row spacings did not increase undersized tubers. However, increasing the in-row spacing did increase the amount of cull potatoes in 2003 and tended to have the same effect during 2004 (Table 6). MegaChip tuber size profile was similar to slightly larger than Atlantic. MegaChip produced fewer tubers <113 g and more tubers >280 g than Atlantic. Atlantic is known to occasionally produce tubers too large for processing. The larger tuber size profile of MegaChip relative to Atlantic suggested management will be necessary to optimize time of vine kill or planting at the appropriate density to manage tuber size. Planting MegaChip at 23 cm in-row spacing reduced the tuber size profile with little effect on yield and did not increase yield of tubers < 47 mm in diameter (Table 6). Optimal planting density for MegaChip appears to be between 23 and 30 cm based on yield and size profile. Specific spacing recommendations should also consider potato seed costs.

MegaChip emerged at approximately the same time as Atlantic in field trials during 2004 (data not shown). Canopy closure for MegaChip was 7 to 10 days earlier than Atlantic (Figure 3). These preliminary results suggest MegaChip may
Table 6—Influence of in-row spacing on yield and size distribution of MegaChip compared to Atlantic at Hancock, Wisconsin.

<table>
<thead>
<tr>
<th>Year</th>
<th>Variety</th>
<th>Spacing Cm</th>
<th>Yield (ton/ha)</th>
<th>Size grade (% of US #1 yield)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>US #1</td>
</tr>
<tr>
<td>2003</td>
<td>MegaChip</td>
<td>23</td>
<td>35.0</td>
<td>33.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>35.0</td>
<td>32.7</td>
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<tr>
<td></td>
<td></td>
<td>41</td>
<td>35.2</td>
<td>31.5</td>
</tr>
<tr>
<td>LSD</td>
<td>(P=0.05)</td>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>2004</td>
<td>MegaChip</td>
<td>23</td>
<td>50.8</td>
<td>47.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>52.6</td>
<td>46.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41</td>
<td>48.9</td>
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</tr>
<tr>
<td>Atlantic</td>
<td>23</td>
<td>55.3</td>
<td>51.8</td>
<td>1.1</td>
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<td></td>
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</tr>
<tr>
<td>LSD</td>
<td>(P=0.05)</td>
<td></td>
<td></td>
<td>NS*</td>
</tr>
</tbody>
</table>

*NS indicates no response in variable to in-row spacing or variety.

![Graph](image1.png)

FIGURE 3.
Comparison of canopy cover development between MegaChip and Atlantic.

be less vulnerable to competition from late emerging weeds due to earlier crop canopy development. MegaChip and Atlantic appeared to initiate tubers at the same time. Atlantic tubers bulked earlier than MegaChip in July, but MegaChip continued to bulk in late-August and into September after Atlantic bulking started to decline (Figure 4). These results suggest that the late bulking capacity of MegaChip may contribute to its yield potential and the ability to produce large tubers. To prevent tubers from becoming too large during long season production, narrower row spacing may be necessary to increase tuber density per m of row. Conversely, MegaChip may need to be vine-killed to stop tuber bulking and prevent over-size tubers for chipping, but desiccation also needs to be timed to ensure chemical maturity.

![Graph](image2.png)

FIGURE 4.
Tuber bulking rates of MegaChip and Atlantic in 2003 (Hancock, Wisconsin).

Tubers collected to assess tuber bulking were also processed to determine chemical maturity (sucrose concentrations). Both MegaChip and Atlantic tuber glucose concentrations were less than 0.05 mg/g FW through August and September. The critical glucose concentration for high quality chip color is typically 0.10 mg/g fresh weight. MegaChip and Atlantic both had sucrose concentrations below 1.0 mg/g fresh weight (chemical maturity) by early August. Yet both varieties and especially MegaChip continued to bulk into September. Processing for chips of either variety directly out of the field should be possible throughout August and September based on tuber sucrose and glucose concentrations.

MegaChip was not sensitive to metribuzin. Metribuzin (Sencor 75 DF) applied postemergence at 425.6 g a.i./ha and
1120.8 g a.i./ha caused 0% and 27% injury, respectively, without affecting the yield (Binning et al. 2003).

**CHEMISTRY**

The glycoalkaloid content of MegaChip was acceptable at 10.75 mg/100 g fresh tissue in comparison with 11.94 mg/100 g for Atlantic and 14.84 mg/100 g for Snowden (K. Deahl and F. Perez, unpublished data).

The isozyme pattern of MegaChip was: *Mdh-1 1F14F1*, *Mdh-2 2F22F2*, *Got-1 1F14F1*, *Got-2 2F22F22*; *Pgm-1 1F14F1*, *Pgm-2 2F22F22*, *Pgi-1 1F14F1*, 6-*Pydh-3 3F13F13*. The normal script digit represents the locus and the superscript digit represents the allele for the enzymes Malate dehydrogenase (*Mdh*), Glutamate oxaloacetate transaminase (*Got*), Phosphoglucomutase (*Pgm*), Phosphogluucose isomerase (*Pgi*), and 6-Phosphogluconic acid dehydrogenase (*6-Pydh*), according to the procedure and nomenclature of Douches and Ludlam (1991).

**SEED AVAILABILITY**

MegaChip was initiated as tissue culture plantlets in 2002 by the Wisconsin Seed Potato Certification Program in the Department of Plant Pathology, University of Wisconsin-Madison. Seed is available from a number of Wisconsin certified seed potato growers. MegaChip has been submitted for Plant Variety Protection.

**ACKNOWLEDGEMENTS**

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**LITERATURE CITED**


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Porter GA, PC Ocaya, B MacFarline, P Wardwell and B Plummer. 2004. 2003 Maine potato variety trials, NE184 regional trials and advanced breeding lines. University of Maine, Orono, ME.

