Soluble sugars comprise 6 to 17% of total dry wt. in mature soybean seeds (Hymowitz et al., 1972). Sucrose is present throughout seed development, while raffinose and stachyose are only detected during late seed fill (Yazdi-Samadi et al., 1977). These soluble sugars remain in processed soy meal used in livestock feed and edible-grade soy flour. Raffinose and stachyose provide little metabolizable energy and contribute to flatulence caused by soybean products (Cris- tofaro et al., 1974; Kass et al., 1980). Because of these undesirable characteristics, determination of the regulation of raffinose and stachyose metabolism and dry matter accumulation in soybean seeds is important for the improvement of soy meal quality.

The formation of raffinose oligosaccharides requires sucrose and galactinol. Sucrose is the primary photosynthetic translocated into developing soybean embryos (Thorne, 1982; Thorne and Rainbird, 1983), and accumulation of raffinose and stachyose during late seed development may be dependent on sucrose metabolism subsequent to uptake. Active $^{14}$C-sucrose transport into embryos is age-dependent (VerNooy et al., 1986) and occurs without significant apoplastic sucrose hydrolysis (Thorne, 1980). The appearance of $^{14}$C-label in sugars other than sucrose subsequent to uptake suggests sucrose metabolism in embryos during seed fill (Thorne, 1980).

Sucrose synthase and invertase activities have not been extensively studied in developing soybean seeds despite their importance in initial sucrose metabolism in sink tissues. Sucrose synthase is present in germinated cotyledons from light-grown and etiolated soy-
bean seedlings and functions in the mobilization of sucrose to the seedling (Brown and Huber, 1987). Low acid invertase activity was measured in immature 'Wye' seed (Ackerson, 1985). Sucrose synthase and invertase (primarily alkaline) are involved in sucrose catabolism in soybean root nodules (Morell and Cope-land, 1984) and soybean suspension cells (MacDonald and ap Rees, 1983). The contribution of these two enzymes to sucrose cleavage varied with age in soybean sink leaves (Schmalstig and Hitz, 1987). All sucrose cleavage was attributed to sucrose synthase in young sink leaves, while up to 54% of this cleavage was attributed to acid invertase in older sink leaves (Schmalstig and Hitz, 1987).

Galactinol synthase initiates the committing step in the biosynthetic pathway for raffinose sugars. This enzyme catalyzes an irreversible reaction that forms galactinol from myo-inositol and uridine 5'-diphosphogalactose (UDP-galactose). Galactosyl transferses subsequently catalyze the formation of raffinose and its higher homologs from sucrose and galactinol. Sucrose and initial raffinose and stachyose accumulations coincide with galactinol synthase activity during soybean seed development (Saravitz et al., 1987). A linear relationship occurs between esterified galactinol formation and raffinose oligosaccharide content (Saravitz et al., 1987).

The α-galactosidase functions in the degradation of reserve raffinose saccharides and cell wall galactomannans (Pridham and Dey, 1974). McCleary and Matheson (1974) reported that two isoforms of α-galactosidase in mature soybean seeds were specific for the hydrolysis of raffinose oligosaccharides. The α-galactosidase activity increases linearly during soybean cotyledon growth, while specific activity remains constant (Herman and Shannon, 1985).

For the present work, enzymes related to oligosaccharide metabolism were measured in two soybean cultivars, Williams 82 and Wolverine, that differ in the oligosaccharide content of the defatted soy meal (Kuo et al., 1988; Kuo, unpublished data).

**MATERIALS AND METHODS**

Twelve soybean plants of Williams 82 and nine of Wolverine (Maturity Group III) were grown in a controlled environment chamber in 25-cm pots with Redi-earth™ (Florist Products, Schaumburg, IL) at 60% relative humidity, 14/10-h day/night cycle (27/20 °C). Three plants were grown in each pot with a total of four and three replicates for Williams 82 and Wolverine, respectively. Pots were randomly distributed in the growth chamber. Plants were illuminated by fluorescent and incandescent lamps with an intensity of 90 W/m² at plant height as measured by a model 40X optometer (United Dector Technology, Inc., Santa Monica, CA). The plants were watered daily and fertilized weekly with a modified Hoagland nutrient solution that contained 5 mM Ca(NO₃)₂, 5 mM KNO₃, 1 mM NH₄NO₃, 2 mM MgSO₄, 0.5 mM KH₂PO₄, 0.5 mM K₂HPO₄, 0.4 μM ZnSO₄, 0.15 μM CuSO₄, 4 μM MnSO₄, 0.025 μM Na₂MoO₄, 25 μM H₂BO₃, and 50 μM Sequestrene 13Fe (iron chelate) (Ciba-Geigy, Greensboro, NC). Flowers were tagged upon opening. Developing soybean seeds were collected at seven reproductive growth stages (GS) for both cultivars (Table 1). Seeds from each GS were pooled and immediately frozen on dry ice and stored at −85 °C for up to 120 d. Additional seeds were weighed, subsequently lyophilized, and weighed again to obtain fresh and dry weights.

**Enzyme Extraction and Assays**

Extraction of enzymes was conducted at 0 to 5 °C. Water used in enzyme extractions and assays, and carbohydrate analysis was distilled and further purified by an ion-exchange system (Barnstead Nanopure II; Sybron/Barnstead, Boston, MA). Soybean seeds at each GS were randomly selected, and all enzymes were extracted by homogenizing seeds for 2 to 3 min with a Brinkmann Polytron tissue homoge­nizer (Westbury, NY) using a ratio of 1 g: 5 mL 100 mM N-2-hydroxyethylpiperazine-N'-ethanesulfonic acid (HEPES), pH 7.2, containing 1 mM dithiothreitol (DTT) and 10 mL L⁻¹ Triton X-100. The homogenate was centri­fuged at 20,000 g for 20 min, and the supernatant was filtered through one layer of Miracloth (Calbiochem, La Jolla, CA) and glass wool. The supernatant was used directly for enzyme assays without desalting. In preliminary studies, the supernatant was desalted by dialysis overnight with two changes (3 L each) of 10 mM HEPES, pH 7.2, and 1 mM DTT with or without the addition of 5 mM MgCl₂ and 100 mM NaCl or by passing the supernatant through a Sephadex G-25M PD-10 column (Pharmacia, Piscataway, NJ) equilibrated with 10 mM HEPES, pH 7.2, and 1 mM DTT. Sucrose synthase and galactinol synthase showed no difference in activity with or without desalting, while α-galactosidase decreased in activity up to 20% with desalting (data not shown). All enzyme activities were linear with time to 1 h and with protein concentration under assay conditions.

Combined soluble and insoluble invertase (α-D-fructo­anose fructohydrolase, EC 3.2.1.26) activity was immediate­ly analyzed from the homogenate. Activity was assayed at 37 °C for 30 min in a mixture containing 200 μL homogenate, 200 mM acetate-potassium phosphate buffer, pH 4.5 or 7.5, and 100 mM sucrose in a final volume of 0.5 mL. Reactions were adjusted to pH 7.0 by the addition of 250 μL 1M potassium phosphate buffer, pH 7.0, just prior to termination by heating in a boiling water bath 3 min. Ac-

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Table 1. Description of soybean seed growth stages. Developing soybean seeds were sorted into five reproductive growth stages (GS) (Spaeth & Sinclair, 1984; Dornbos & McDonald, 1986). Two additional GS, R5.5 and R6.5, were selected according to Fehr et al. (1971).

<table>
<thead>
<tr>
<th>GS</th>
<th>Stage name</th>
<th>Days after flowering</th>
<th>Color†</th>
<th>Seed/Pod description</th>
<th>Seed length</th>
</tr>
</thead>
<tbody>
<tr>
<td>R4</td>
<td>Full pod</td>
<td>23</td>
<td>G G G</td>
<td>1-4</td>
<td>mm</td>
</tr>
<tr>
<td>R5</td>
<td>Beginning seed</td>
<td>30</td>
<td>G G</td>
<td>5-6</td>
<td>mm</td>
</tr>
<tr>
<td>R5.5</td>
<td>Beginning seed</td>
<td>35</td>
<td>G G</td>
<td>7-8</td>
<td>mm</td>
</tr>
<tr>
<td>R6</td>
<td>Full seed</td>
<td>40</td>
<td>G G G</td>
<td>9-12/14</td>
<td>mm</td>
</tr>
<tr>
<td>R6.5</td>
<td>Beginning maturity</td>
<td>45</td>
<td>Y-G</td>
<td>11-14</td>
<td></td>
</tr>
<tr>
<td>R7</td>
<td>Physiological maturity</td>
<td>50</td>
<td>Y Y</td>
<td>9-11</td>
<td></td>
</tr>
<tr>
<td>R8</td>
<td>Harvest maturity</td>
<td>60</td>
<td>Y B</td>
<td>7-9</td>
<td></td>
</tr>
</tbody>
</table>

† Seed/pod descriptions correspond to the color of the soybean seed and pod: G = green; Y-G = yellow-green (approx. 50% yellow); Y = yellow; B = brown.
‡ Seed length at full seed stage was 9-12 mm for Williams 82 and 13-14 mm for Wolverine.
tility was determined by measuring glucose produced in the glucose oxidase assay method (Gascon and Lampen, 1968) in which the reaction volume was reduced to 260 \( \mu L \), and absorbance at 540 nm was determined with a Dynatech spectrophotometer (Chantilly, VA).

Sucrose synthase (UDP-glucose:D-fructose 2-\( \alpha \)-D-galactosyltransferase, EC 2.4.1.13) activity was assayed by determining sucrose produced in the presence of 25 mM fructose, 10 mM UDP-glucose, 10 mM MgCl\(_2\), and 5 mM KCN in 200 mM HEPES (pH 7.0) at 37 °C for 20 min by the procedure modified from Cardini et al. (1955).

Galactinol synthase (UDP-galactose:inositol galactosyltransferase) assay was assayed for 15 min at 32 °C by determining \(^{14}\)C-incorporation into galactinol by a procedure adapted from Williams et al. (1978). The reaction mixture contained 10 \( \mu L \) enzyme extract, 1.4 mM myo-inositol, 1 \( \mu M \) UDP-galactose, 1.48 \( \times \) 10\(^{4}\) Bq UDP-[\(^{14}\)C(U)]-galactose (sp. act. 1.25 \( \times \) 10\(^3\) Bq/\( \mu mol \)), 5 mM MnCl\(_2\), and 18 mM HEPES, pH 7.2, in a total volume of 55 \( \mu L \). Reactions were terminated with 200 \( \mu L \) of absolute ethanol and diluted with 300 \( \mu L \) Ho. Unreacted UDP-[\(^{14}\)C]-galactose was removed by the addition of 300 mg DE 52 anion exchange cellulose (Whatman, Maidstone Kent, UK), followed by incubation on a shaker at room temperature for 20 min. The tubes were centrifuged at 9000 \( g \) for 5 min. A 100-\( \mu L \) aliquot of the supernatant was added to 10 \( mL \) of the scintillant Ecoscint (National Diagnostics, Manville, NJ). Radioactivity was measured using a Mark III liquid scintillation spectrophotometer (TM Analytic, Elk Grove Village, IL).

Table 1

<table>
<thead>
<tr>
<th>Seed Maturity (R6.5 to R8)</th>
<th>Weight Increase</th>
<th>Length Increase</th>
<th>Color and Pod Color</th>
<th>Growth Habit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowell &amp; Kuo</td>
<td>11%</td>
<td>5%</td>
<td>Indeterminate</td>
<td></td>
</tr>
<tr>
<td>Williams 82</td>
<td>14%</td>
<td>6%</td>
<td>Indeterminate</td>
<td></td>
</tr>
</tbody>
</table>

**RESULTS**

**Seed Growth and Maturation**

Although Williams 82 and Wolverine are considered indeterminate and determinate cultivars, respectively, their growth habits were similar under the growth chamber conditions used in this study. Seed weight, length, and color and pod color were used to establish time of seed fill and maturation (Table 1, Fig. 1A). Linear seed fill \((r = 0.97)\) (R5.5 to R6.5) and seed maturity (R6.5 to R8) were approximately 11 and 5 \( \text{d} \) longer, respectively, for Wolverine than Williams 82. Fresh and dry weights also were determined in Wolverine seeds at 35 \( \text{d} \) after flowering (DAF). These seeds measured 9 to 12 \( mm \) in length and had fresh and dry weights intermediate to seeds 7 to 8 \( mm \) (30 DAF) and 13 to 14 \( mm \) (40 DAF) in length. Physiological maturity at R7 (TeKrony et al., 1979) corresponded to maximum dry weight (Fig. 1A). Moisture content per seed was similar in both cultivars (Fig. 1B), and the R8 beans used in this study contained 160 g kg\(^{-1}\) moisture.

Fresh and dry weights were up to threefold and twofold higher, respectively, in seeds of Wolverine than Williams 82 during development (Fig. 1A). Although the end of linear seed fill at R6.5 corresponded with maximum fresh weight, dry weight increased 6% in Williams 82 seeds and 14% in Wolverine seeds from R6.5 to R7. This greater weight increase in Wolverine coincided with a longer seed fill duration and a larger seed size (Table 1).

**Carbohydrate Extraction and Quantitation**

Soybean seeds from each GS were lyophilized and ground to a uniform powdery mortar and pestle. Samples were defatted with hexane and extracted in a minimum of 10 \( mL \) or a ratio of 1:30 (w/v) at 80 °C 800 mL L\(^{-1}\) ethanol (aqueous), and sugars were analyzed according to Kuo et al. (1988). Quantitation of sugars was based on an internal mannitol standard added to each sample according to the prefedated dry weight.

Sucrose, raffinose and stachyose were also analyzed by a reverse-phase, Alltech amino-based carbohydrate 600CH column (Deerfield, IL) with 750 mL L\(^{-1}\) acetonitrile (aqueous) as the mobile phase at 2 mL min\(^{-1}\) and 35 °C. Elution was monitored by a Spectra-Physics 6040XR refractometer, and sugar quantitation was determined by comparison with external oligosaccharide standards.

**Statistics**

Means of soluble sugar content and enzyme activities were compared by Duncan's multiple range test after differences between GS were found to be significant \((P < 0.01)\) in an analysis of variance. Examination of \( \alpha \)-galactosidase activity in seeds of both cultivars during development suggested a linear relationship. These data were analyzed by regression. Standard error (SE) was determined for soluble sugar content and enzyme activities from a minimum of three replications.
Soluble Sugars

Sucrose concentration in seeds of both cultivars was 1 mg seed$^{-1}$ or less through R5.5 and increased approximately threefold by R6 in Williams 82 (Fig. 2). A transient, 33% decrease occurred in sucrose levels at R6.5 in these seeds. In Wolverine, sucrose levels increased rapidly from R5.5 to R7 to a level fivefold higher than in Williams 82 before decreasing at R8. Fully mature (R8) seeds of Wolverine had a twofold greater sucrose content than Williams 82 (Fig. 2), although seeds of Wolverine were approximately two-fold larger than those of Williams 82 at this GS with respect to fresh and dry weights (Fig. 1A).

Glucose and fructose, the catabolic products of sucrose, were detected during development in seeds of both cultivars (Fig. 2). Glucose appeared throughout development in both cultivars and the low levels prior to R5.5 were comparable. Glucose increased rapidly during seed fill, and its content was twofold greater in Williams 82 than Wolverine. Levels during maturation remained relatively constant. The lower glucose content in Wolverine seeds coincided with the higher sucrose content during maturation (Fig. 2). Trace amounts of fructose were detected in Williams 82 seeds only through R5.5, while fructose was present in low amounts throughout development in seeds of Wolverine (Fig. 2).

Initial raffinose and stachyose accumulation began at R6.5 and R6 for Williams 82 and Wolverine, respectively (Fig. 2). In Williams 82 seeds, raffinose increased twofold and stachyose increased threefold during maturation. Trace quantities of raffinose and stachyose were detected in Wolverine seeds at R6 (full seed), but significant accumulation began at R6.5. Raffinose levels decreased linearly ($r = 1.00$) from R6.5 to R8, while stachyose increased fourfold from R6.5 to R7 and declined slightly at R8 in these seeds (Fig. 2). Raffinose levels were similar in mature seeds of both cultivars, and stachyose content was threefold higher in Wolverine compared to Williams 82.

Substrates for raffinose and stachyose include myo-inositol and galactinol. Myo-inositol content in the seeds increased linearly ($r = 0.98$) up to 1 mg seed$^{-1}$ through R6 and R6.5 for Williams 82 and Wolverine, respectively. These levels decreased an average of 32% during maturation in Williams 82 and to barely detectable levels during maturation in Wolverine (Fig. 2). Trace quantities of galactinol were measured in both cultivars throughout development beginning at R5 and prior to the detection of raffinose and stachyose (Fig. 2). These levels increased over 60% at R6.5. During seed maturation, galactinol remained relatively constant in Williams 82 and increased linearly ($r = 0.99$) in Wolverine. This increase resulted in up to threefold higher galactinol content in seeds of Wolverine. Myo-inositol content was up to 40-fold higher than galactinol in the seeds prior to R6.5 in both cul-

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Fig. 2. Soluble sugar content in developing soybean seeds. The top two graphs indicate levels of sucrose, glucose, and fructose, while the bottom two graphs indicate levels of stachyose, raffinose, myo-inositol, and galactinol in seeds of Williams 82 and Wolverine. Values are the means of a minimum of three extractions. Bars represent ± SE.

Fig. 3. Sucrose synthase activity in developing seeds of Williams 82 and Wolverine soybeans. Values are the means of a minimum of three extractions. Bars represent ± SE.
tivars. During final maturation, however, galactinol content was comparable to myo-inositol (Fig. 2). This change during maturation coincided with the increase of raffinose and stachyose in seeds from both cultivars.

**Enzyme Activities**

Measured enzyme activities were more than sufficient to account for product (soluble sugar) content in the seeds. Increases in sucrose synthase and alkaline invertase activities in both cultivars corresponded to accumulation of the majority of fresh and dry weight (Figs. 2A, 3, 4). Sucrose synthase and alkaline invertase activities were low (below 45 and 12 nmol sucrose seed\(^{-1}\) min\(^{-1}\), respectively) prior to seed fill in both cultivars (Fig. 3 and 4). From R5 to the beginning of linear seed fill (R5.5), sucrose synthase and alkaline invertase activity increased sixfold and twofold for seeds of Williams 82 and Wolverine, respectively. Sucrose synthase activity increased from R5.5 through R6.5 for Williams 82 and through R7 for Wolverine (Fig. 3). Although this activity did not initially increase as rapidly during linear seed fill in Wolverine compared to Williams 82, sucrose synthase activity in Wolverine was twofold greater by R6 and remained significantly higher compared to Williams 82 throughout the remainder of seed development. Sucrose synthase activity decreased at the end of linear seed fill in Williams 82 and at full maturity (R8) in Wolverine (Fig. 3). Higher sucrose synthase activity coincided with the increased dry matter accumulation in Wolverine seeds (Figs. 2A and 3).

During seed fill, alkaline invertase activity increased through R6 in Williams 82 and R6.5 in Wolverine (Fig. 4). From R5.5 to R6, this activity was at least twofold higher in Williams 82 compared to Wolverine. Highest alkaline invertase activities at R6 for Williams 82 and R6.5 for Wolverine, however, showed no significant difference between the two cultivars (Fig. 4).

During the majority of seed development, changes in acid invertase activity did not coincide with fresh and dry weight increases (Fig. 2A and 4). Acid invertase activity in both cultivars remained below 45 nmol glucose seed\(^{-1}\) min\(^{-1}\) throughout seed development (Fig. 4). In both cultivars, acid invertase activity was comparable to alkaline invertase prior to seed fill, at R7, and for Wolverine at R8. Acid invertase activity transiently increased twofold at the beginning of seed fill in Wolverine. This activity averaged twofold greater in Wolverine seeds compared to Williams 82 (Fig. 4).

Galactinol synthase activity in both cultivars was comparable through R5 and corresponded to the occurrence of galactinol (Fig. 2 and 5). Twofold increases and the highest levels of galactinol synthase activity occurred at R6.5 and R6 for seed of Williams 82 and Wolverine, respectively. Galactinol synthase activity remained constant in Williams 82 and decreased fourfold in Wolverine to the level in Williams 82 at R8. The highest galactinol synthase activities corresponded with the initial formation of raffinose and stachyose (Fig. 2 and 5). This activity preceded the...
highest stachyose levels at R7 in both cultivars by two growth stages.

The α-galactosidase activity occurred throughout development in seeds of both cultivars, and highest rates of activity corresponded to the accumulation of raffinose and stachyose (Fig. 2 and 6). α-Galactosidase activity in seeds of Williams 82 and Wolverine was similar and increased linearly ($r = 0.96$ and 0.93, respectively) throughout development (Fig. 6).

**DISCUSSION**

This study is the first report of sucrose synthase and both alkaline and acid invertase activities during soybean seed development in cultivars that have a relatively high (Wolverine) and low (Williams 82) dry matter content per seed. Sucrose synthase and alkaline invertase have been associated with dry matter accumulation and/or sucrose partitioning in various sink tissues (Glasziou and Gaylor, 1972; Giaquinta, 1979; Dale and Housley, 1986). Relatively high levels of these enzyme activities (Fig. 3 and 4) during the majority of dry matter accumulation (Fig. 1A) indicate that these enzymes also may be associated with this process in developing soybean seeds. The twofold to threefold greater dry matter content in seeds of Wolverine during maturation coincided with up to threefold higher sucrose synthase activity (Fig. 3). Higher rates of dry matter accumulation also have been shown to correspond to higher abscisic acid concentrations in large-seeded soybean genotypes (Schussler et al., 1984). Low activity of acid invertase at the time of 90% dry matter accumulation in both cultivars suggests that this enzyme may not be associated with dry matter accumulation in soybean seeds (Fig. 1A and 4).

The most important time period for partitioning of soluble sugars to raffinose and stachyose appears to be from full seed (R6) to beginning maturity (R6.5). Significant raffinose and stachyose accumulation in both cultivars commenced at beginning maturation (R6.5) (Fig. 2), as has been reported in other soybean cultivars (Bils and Howell, 1963; Saravitz et al., 1987). A transient, 33% decrease in sucrose content at this time in seeds of Williams 82 coincided with this initial accumulation of raffinose and stachyose. A similar relationship was noted in other soybean cultivars with different oligosaccharide contents (Handley et al., 1983; Saravitz et al., 1987). The presence of high sucrose content in seeds of both cultivars at this time, however, suggests that competition for sucrose between sucrose metabolizing enzymes and raffinose and stachyose synthesis by galactosyl transferase is probably not a major factor in this process. The decrease in sucrose in Williams 82 corresponded to increased glucose content and relatively high sucrose synthase and alkaline invertase activities and could be caused by increased catabolic activities of these enzymes at beginning seed maturation. A similar decrease in sucrose levels did not occur in maturing seeds of Wolverine (Fig. 2), although the more indeterminate-like growth habit of this cultivar under controlled environment conditions may have obscured this change.

Galactinol synthase has been considered an important regulator of carbon partitioning between sucrose and raffinose and stachyose in developing soybean seeds (Saravitz et al., 1987). The reaction catalyzed by this enzyme is the committing step in the biosynthetic pathway for raffinose oligosaccharides. Highest galactinol synthase activity (Fig. 5) coincided with initial raffinose and stachyose formation (Fig. 2), as has been previously noted in soybean seeds (Handley et al., 1983; Saravitz et al., 1987). Increases in galactinol content during significant raffinose saccharide accumulation at R6.5 likewise corresponded with decreases in the substrate myo-inositol in both cultivars (Fig. 2). Galactinol synthase activity and galactinol during linear seed fill, however, preceded the presence of raffinose and stachyose during both beginning maturity (R6.5) in Williams 82 and full seed (R6) in Wolverine. Furthermore, the accumulation of stachyose at beginning maturity is rapidly increasing in both cultivars (Fig. 2), while galactinol synthase activity changes little in Williams 82 and decreases rapidly in Wolverine (Fig. 6). Galactinol synthase, then, may not be the sole regulating factor in the partitioning of sucrose to raffinose sugars in developing soybean seeds.

The α-galactosidase activity increased in both cultivars during seed growth (Fig. 6) and has also been reported in 'Forrest' soybean (Herman and Shannon, 1985). The function of α-galactosidase in developing soybean seeds still is unknown. It has been suggested that α-galactosidase may degrade raffinose and stachyose in developing soybean seeds (Pridham and Dey, 1974; Herman and Shannon, 1985). The α-galactosidase does catalyze rapid raffinose oligosaccharide breakdown in germinating seeds (Kuo, unpublished data). The activity of this enzyme in developing seeds is the highest at the time when most raffinose and stachyose have been accumulated (Fig. 2 and 6). Thus, α-galactosidase may not be a major factor in the metabolism of raffinose and stachyose during their accumulation in developing soybean seeds.

In summary, oligosaccharide metabolizing enzymes were compared in seeds of two soybean cultivars that differ in dry matter and soluble oligosaccharide content. Although it is difficult to compare in vitro results to in vivo processes, results suggest that sucrose synthase and alkaline invertase activities are likely involved in the seed fill process and that galactinol synthase may play a regulatory role at the onset of raffinose and stachyose formation. The pattern of raffinose and stachyose accumulation, however, suggests that other enzyme activities, such as galactosyl transferases, may also be important in the regulation of raffinose saccharide metabolism in soybean. Further research in the role of galactosyl transferase and its interaction with galactinol synthase during seed development is needed.

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