



Agricultural Utilization Research Institute

Final Report

SOYBEAN MEAL FERTILIZER MARKET ANALYSIS AND COMMERCIALIZATION ENHANCEMENT POTENTIAL IN RESIDENTIAL & HORTICULTURAL MARKETS

Prepared by the Agricultural Utilization Research Institute for the Minnesota Soybean Research & Promotion Council

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EXECUTIVE SUMMARY

The opportunity for specially formulated soybean meal natural fertilizers is particularly bright. These natural fertilizers contain vital macro and micronutrients and amino acids that stimulate plant and grass growth. Because they are USDA feed grade, they are safe for children, pets and plants. The nutrients contained in soybean meal are slow-release and, therefore, will have a lower risk of leaching than chemical/conventional synthetic fertilizers. SBM blended with urea does have some long-term potential to leach albeit minimal. Best practices should be used when applying lawn and garden fertilizers. Based on market analysis, market research and demonstrations, the Agricultural Utilization Research Institute (AURI) and Axiom Marketing (Axiom) believe there are significant opportunities for specially formulated soybean meal natural fertilizers.

Additional soy crush facilities are being built over the border in Casselton and Spiritwood, North Dakota and a third is proposed for Grand Forks, North Dakota. In addition, the Ag Innovation Campus small soybean crush facility in Crookston, Minnesota will begin crushing this fall. Thus, more soybean meal (SBM) will be available in the marketplace. The AURI, in cooperation with Axiom Marketing, conducted a market analysis to study the potential for soybean meal-based fertilizers and soil amendments in residential lawns and gardens, greenhouses, non-shade nurseries and managed turf. All figures referenced in this report can be found in Axiom Marketing's Soybean Meal Fertilizer Analysis, which is included in this report as Appendix A.

The project evolved to include the development and formulation of three SBM fertilizers. Axiom and its sister company AminOrganix formulated two blends with 50% SBM content and a third with 25% SBM content. Form-A-Feed, a manufacturer in central Minnesota, processed and bagged the fertilizer for this project. A request was submitted to the Minnesota Soybean Research & Promotion Council (MSR&PC) to initiate the formulations and development of three SBM fertilizers in 2023. The MSR&PC granted special funds for these products to be developed. Two of the 50% fertilizers were developed; the third is scheduled to be manufactured in early 2024.

The demonstrations of the 16-0-8 lawn fertilizer, which contains 50% SBM, indicated improved color and density for lawn grasses as compared to unfertilized areas of grass (see Figure 30). AURI, along with three university partners, established demonstration plots in Minnesota at Ridgewater College in Willmar, Minnesota State University (M State) in Fergus Falls, and Northland Community & Technical College (NCTC) in Thief River Falls. Fertilizer formulations demonstrated at these sites included the 16-0-8 lawn fertilizer. Observations of the demonstrations were completed by AURI staff. Weather conditions in Willmar and Fergus Falls were extremely dry limiting the observable effectiveness of the fertilizer. Weather conditions in Thief River Falls were adequate with regular rainfall for comparable analysis.

A Phase 2 proposal focused on SBM fertilizers was approved by MSR&PC for the fiscal year 2024. Early indications are that there may be value-chain development opportunities for SBM fertilizers in the upper Midwest. AURI has had contact with potential partners who would like to further develop this opportunity.

PROJECT GOALS

GOAL 1: IDENTIFY AND ASSESS MARKET OPPORTUNITIES FOR SOYBEAN MEAL USE IN HORTICULTURAL FERTILIZERS AND SOIL AMENDMENTS.

Goal 1 Findings (Axiom Marketing)

Axiom Marketing reports that according to USDA, residential lawn and garden acreage comprises 31.6 million acres compared to 3.1 million acres for managed turf/sod acres and 546,000 acres for nursery non-shade. Axiom Marketing estimates sales growth rates at 30%+ for residential and 10% for nursery non-shade. Managed turf/sod remains static (see Figures 1 and 2).

Figure 1: Industry Segment – Vertical Market Acres



https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Census_of_Horticulture_Specialties/hortic_1_0034_0034.pdf
<https://reeis.usda.gov/web/crisprojectpages/0219589-breeding-genetics-and-cultivar-development-of-turfgrasses.html>

Figure 2: Industry Segment – Estimated Sales Growth



<https://www.nass.usda.gov/Publications/Highlights/2020/census-horticulture.pdf>

<https://www.nass.usda.gov/Newsroom/archive/2020/12-08-2020.php>

<https://www.prnewswire.com/news-releases/organics-will-expand-penetration-in-lawn--garden-fertilizers-market-through-2024-301221975.html>

According to Axiom, annual retail sales of lawn and garden products account for \$13.88 billion among the 123.6 million households in the United States. Estimated annual sales for lawn and garden fertilizers are \$604 million. The average U.S. lawn size is 9,000 square feet (see Figures 3 and 4).

Figure 3: Lawn & Garden – Quick Stats



<https://www.nass.usda.gov/Publications/Highlights/2020/census-horticulture.pdf>

<https://gardenresearch.com/view/national-gardening-survey-2021-edition/>

<https://www.brecks.com/blog/covid-gardening-retail-boom>

<https://blog.marketresearch.com/lawn-garden-month-sales-statistics-infographic>

<https://www.prnewswire.com/news-releases/organics-will-expand-penetration-in-lawn--garden-fertilizers-market-through-2024-301221975.html>

<https://blog.marketresearch.com/lawn-garden-month-sales-statistics-infographic>

<https://www.prnewswire.com/news-releases/organics-will-expand-penetration-in-lawn--garden-fertilizers-market-through-2024-301221975.html>

<https://blog.marketresearch.com/lawn-garden-month-sales-statistics-infographic>

<https://www.prnewswire.com/news-releases/organics-will-expand-penetration-in-lawn--garden-fertilizers-market-through-2024-301221975.html>

Figure 4: Lawn & Garden Sales

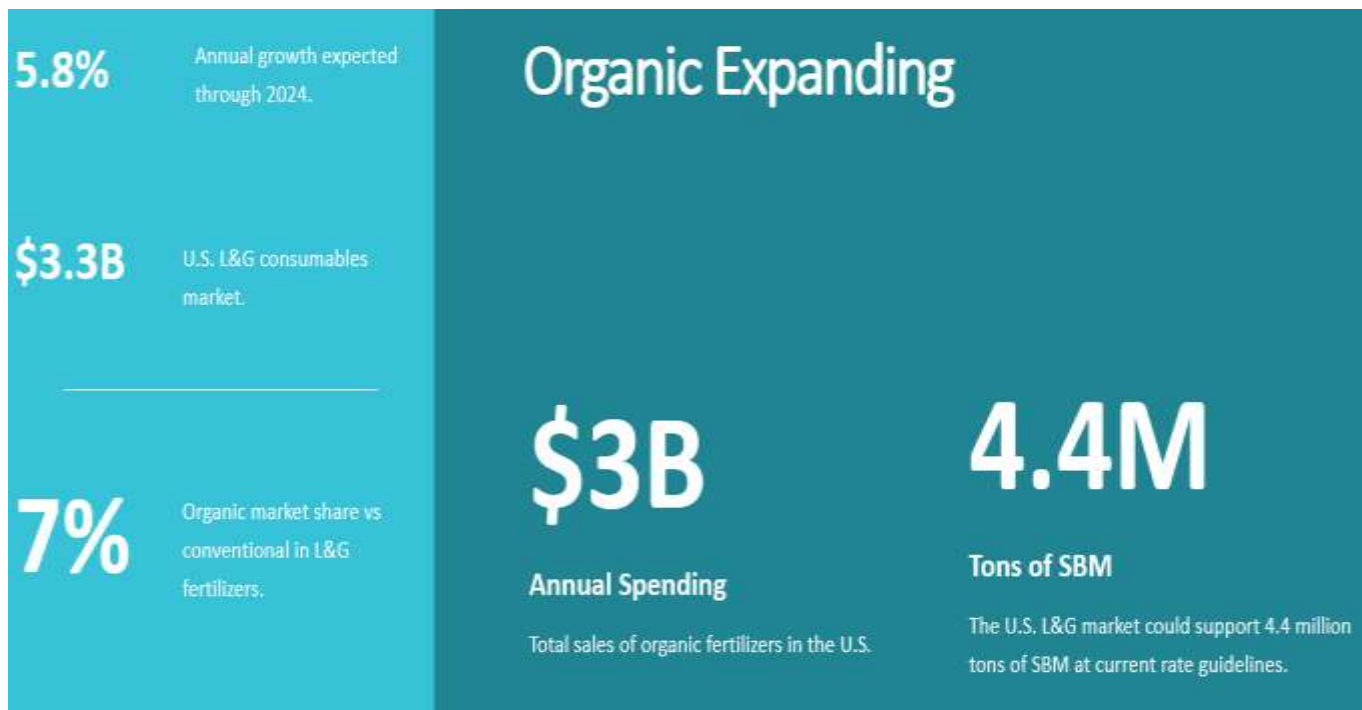


<https://blog.marketresearch.com/lawn-garden-month-sales-statistics-infographic>

<https://www.prnewswire.com/news-releases/organics-will-expand-penetration-in-lawn--garden-fertilizers-market-through-2024-301221975.html>

Organic fertilizer sales are estimated to grow at 5.8% per year due to increased Gen Z participation in gardening activities and increased public awareness of the negative effects of chemical fertilizers. Presently, organic lawn and garden product sales account for \$3.3 billion, or 23.7% of the \$13.88 billion residential market. However, organic fertilizers account for only 7% of the lawn and garden fertilizer market (see Figure 5).

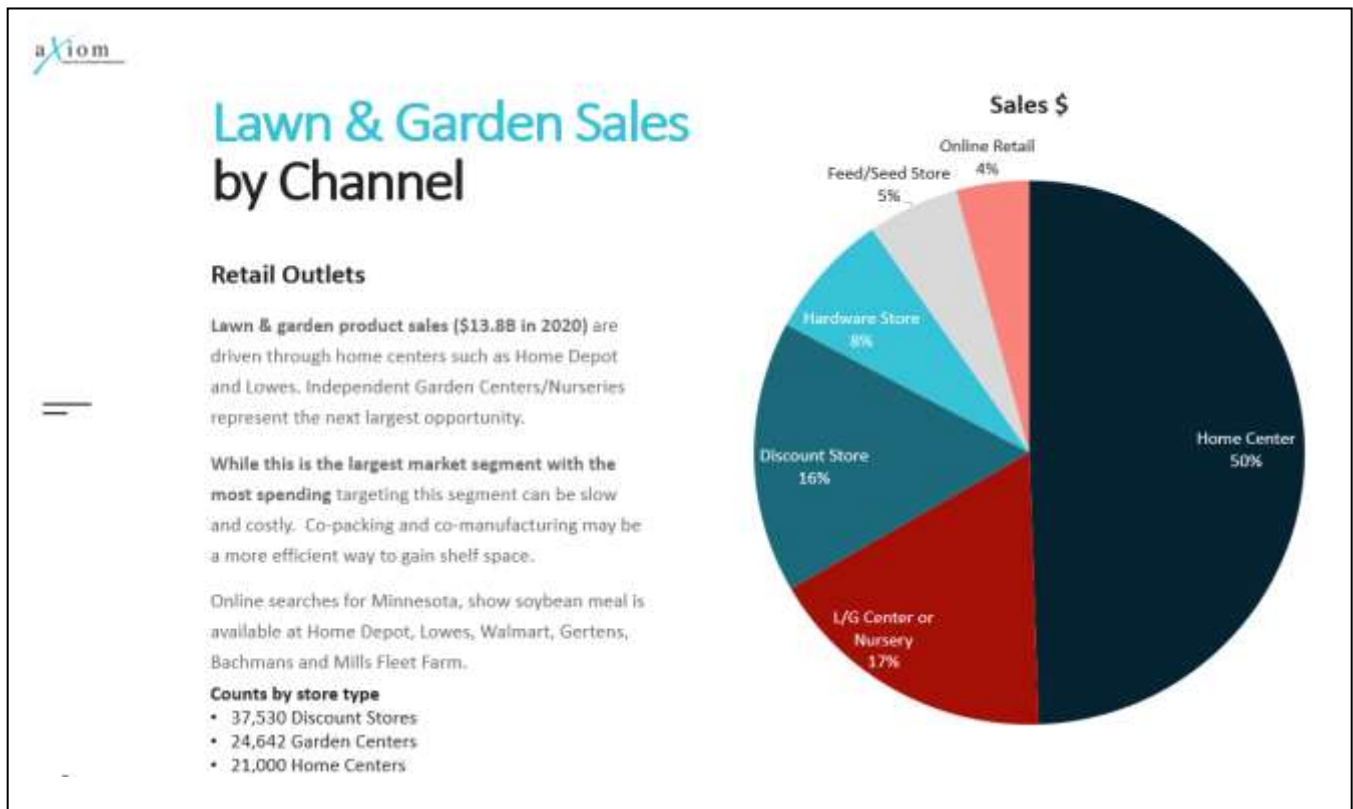
Figure 5: Organic Expanding



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Sales of lawn and garden products are dominated by home centers (50%.) The remaining 50% is split among lawn and garden centers (17%), discount stores (16%), hardware stores (8%) and feed/seed stores (5%.) Home centers and discount stores dominate metro areas while hardware stores and feed/seed stores dominate rural areas (see Figure 6).

Figure 6: Lawn & Garden Sales by Channel



<https://gardenresearch.com/view/national-gardening-survey-2021-edition/>

<https://www.landscapeprofessionals.org/LP/About/Industry-Statistics/LP/Media/landscape-industry-statistics.aspx>

636,249 Landscaping Services businesses in the US as of 2022, an increase of 5.5% from 2021. 24642 garden centers. 21,000 home centers and hardware stores in US>

<https://www.scrapehero.com/largest-discount-stores-in-us/>

Dollar General, Family Dollar, Big Lots, Sam's, Costco

Nursery non-shade operations purchase \$192 million of fertilizer each year for applications which translates to \$351 per acre. The average growth rate is 7% since 2014. The largest nurseries purchase the bulk of crop nutrition inputs which include fertilizer, lime and soil conditioners (see Figures 7-9).

Figure 7: Nursery, Non-shade Consumable Purchases



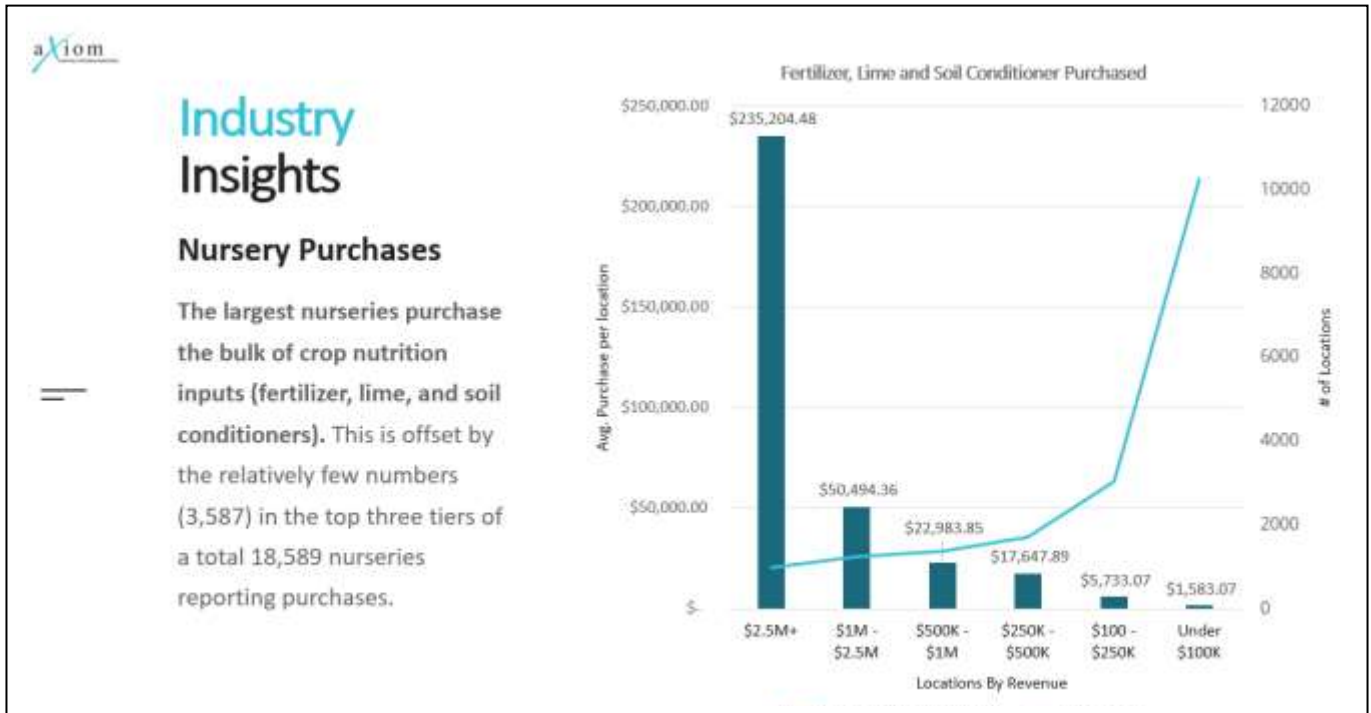
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Census_of_Horticulture_Specialties/hortic_1_0033_0033.pdf

Figure 8: Nursery, Non-shade Plant Sales



<https://www.nass.usda.gov/Publications/Highlights/2020/census-horticulture.pdf>

Figure 9: Industry Insights



https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Census_of_Horticulture_Specialties/hortic_1_0032_0032.pdf
https://giecdn.blob.core.windows.net/fileuploads/file/2015nmtop50insert_list-new.pdf

Managed turf accounts for more than \$4 billion in annual sales on 2.8 million acres. Throughout the U.S. there are 184,000+ parks, golf courses, sports fields, schools and sod farms. The average acreage for a typical park and recreation department is 1,340 acres. Sports turf, which is a subsection of managed turf and encompasses golf, accounts for \$1.8 billion in annual sales translating to \$457 per acre. Golf and assorted professional markets spend annually \$5,000 and \$4,333, respectively (see Figures 10-12).

Figure 10: Managed Turf – Quick Stats



<https://www.nass.usda.gov/Publications/Highlights/2020/census-horticulture.pdf>

<https://turf.missouri.edu/stat/reports/pdf/industry.pdf>

Source Mizzou from Craig 1/10/2021 call

Figure 11: Managed Turf - Segment



Volume v Value - Partnerships

Tie to municipal values vs. budgets

Data labels

Figure 12: Managed Turf – Inputs Breakdown



<https://www.gcsaa.org/uploadedfiles/Environment/Enviro>

https://s.giannini.ucop.edu/uploads/giannini_public/c0/51/c0515901-80cf-4ca3-bc60-eee26ba26433/v13n3_3.pdfmental-Profile/Property-Profile/Golf-Course-Environmental-Profile--Property-Summary.pdf

GOAL 2: ANALYZE SOYBEAN MEAL AND BLENDS IN VALUE-ADDED FERTILIZER AND SOIL AMENDMENT PRODUCTS.

Goal 2 Findings (Axiom Marketing)

Axiom Marketing found in its market analysis that the primary need for residential markets is to make the grass quickly turn green in the spring, keeping it green all season long and minimizing weed development throughout the summer. In addition, for homeowners with pets and children, safety is a concern. Safety is also a concern related to chemicals (conventional synthetic) contained in many lawn and garden fertilizers (pre-emergent herbicides, insecticides, and even fungicides) sold at home centers, discount and hardware stores.

The dominant delivery form for residential is granular. The barrier for residential markets is a concern about efficacy because of the dominance and consumer confidence in branded chemical-based (conventional synthetic) fertilizers such as Scotts® Weed and Feed or MiracleGro® and private label products sold at retailers.

For residential markets, formulated SBM natural fertilizers offer a natural non-chemical source of nitrogen (N) that is safe for pets and children. The potential for nitrogen contained in SBM to leach into groundwater or surface water sources is less because of its slow-release form. Unlike synthetic sources of N, SBM will not burn grass or plants. Organic gardeners have long been passionate about SBM as a soil amendment. They will now be able to see how SBM works when formulated with other natural feed-grade ingredients.

Axiom completed a series of in-depth interviews with fertilizer formulators and agronomists to get their feedback on SBM. The findings were highly positive among formulators as shown below (See Figures 13 and 14).

Figure 13: Formulator Depth Interviews – 7 Completed – Summary

Topic	Summary
SBM Use in Fertilizers	- SBM and soy byproducts are used by all but one formulator. - High familiarity with SBM.
SBM Benefits	- SBM is high in crude protein, energy, amino acids, enzymes and growth stimulants. - SBM is a carbon source and contains plant-available Ca in addition to Nitrogen/Phosphorus/Potassium (NPK). - It's natural, but not Organic Materials Review Institute (OMRI) certifiable due to heating.
SBM Negatives/Concerns	- SBM is perceived as expensive. - It is high in oil which can impact soil conditions. - It doesn't have high levels of NPK. - It can retard seedling growth and damage plants according to North Carolina (NC) State reports. - No immediate green up/growth pop - Few academic studies supporting its use.
Value-Added SBM Supplements	- Sugars (molasses, chitosan, and other polysaccharides.) - Micronutrients (Zn, Mg, Ca, Bo) sprayed onto SBM granular base. - Urea
Cost and Ingredient Decisions	Based on nutrient value of other nitrogen (N) sources – natural or synthetic.
Granular or Liquid	Granular, granular, granular

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Figure 14: Agronomist Depth Interviews – 3 Completed – Summary

Topic	Summary
SBM Use in Fertilizers	- Two of them use specialized fertilizers with soy products. - None of the agronomists were highly familiar with SBM compared to the formulators.
SBM Benefits	- The primary benefit is an organic N and C source. - Possible secondary benefit mentioned by only one agronomist was increased water holding capacity. - None of the agronomists could identify other benefits identified by formulators.
SBM Negatives/Concerns	- Perceived as a costly source of N vis-à-vis synthetics with higher N content. - Burning/phytotoxicity (likely based on NC State study.) - Low customer awareness of SBM benefits as a fertilizer ingredient. - May attract insects. - May tie up other nutrients due to carbon content.
Value-Added SBM Supplements	- Peat - Urea - Micronutrients
Cost and Application Decisions	- Nutrient value of other N sources drives application decisions. - Growers looking for the cheapest/highest ROI N source. - SBM is perceived as costing more than other N sources.
Granular or Liquid	- Granular - Limited interest in liquids by agronomists because of low pricing and relatively low usage compared to granular.

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The primary need for nursery non-shade operations is to produce the healthiest plant as quickly as possible with the longest possible shelf-life appeal at retail. A secondary need is to control input costs. Nursery non-shade customers need affordable, long-lasting nutrient sources that do not leach. Nursery growers who produce perennials, shrubs, blooming woody ornamentals and trees predominantly rely on granular fertilizer. Greenhouse growers who produce annual flowers, vegetable plants and indoor plants predominantly rely on liquid fertilizer. The barrier for nursery growers is that SBM does not contain enough N (see Figure 15).

Figure 15: Formulator Depth Interviews – Detailed Findings

Topic	Commentary
Cost and Ingredient Decisions	1. "We don't add any ingredients to REV®. Just our peat." 2. "It's all about the current total nutrient values of meals, the total chemical extraction and what pure nitrogen costs. Need to take an equivalent look at alfalfa seed, feather meal and compare it against SBM cost. SBM cost is good where you produce but not when you need to ship it. That's why I use cotton seed. Pure N is worth whatever the cheapest source of NPK is." 3. "Start with the nutrient value. A ton of UAN 32 (Urea Ammonium Nitrate) costs \$600 for 32 parts of N. I can buy a ton of SBM for \$300 for 7 parts of N." 4. "Back the ingredient cost into the finished product price. The math <u>has to</u> work." 5. "Scotts® is all about price. They buy in large volumes. They have huge inventories of unused ingredients." 6. "We adjust ingredient percentages based on pricing <u>as long as</u> it doesn't impact performance. Most use it if price is lower than other ingredients. If price is lower than feathers blood meal and other N sources." 7. "We negotiate quarterly to get the cheapest input price. Our customers switch things out based on price."
Barriers to Trying SBM	1. "Mental blocks. You can have a great product that works. People still <u>have to</u> accept it." 2. "SBM is too expensive. Cotton seed is cheaper and easier to get rid of oil." 3. "Pricing." 4. "No university <u>hort</u> studies talking about the value of SBM." 5. "No immediate green up." 6. "Price. Supply. Shipping soy to China. Concerns about phytotoxicity." 7. "No barriers for us. Already using it. "
Likely Consideration	1. "If someone could formulate a product for a new SKU. Biggest thing with fertilizer is that customers want cheapest NPK." 2. "I don't include it in fertilizers. I use cotton seed. SBM can't be used for organic fertilizers because you <u>have to</u> cook it." 3. "Yes. Already using soy byproducts. SBM could provide carrier base that I could spray our liquids on and have a new SKU. We could use this as a dry blend or a liquid substrate." 4. "<u>Hort</u> fertilizer manufacturers are unlikely to consider. Not enough N." 5. "Scotts® is unlikely to consider SBM because of stockpiles of synthetics." 6. "Already use SBM." 7. "We've always put lots of SBM in our fertilizers (and our feeds.)"

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Nursery growers will likely not recognize the value of SBM because few academic studies supporting its use have been published. However, SBM does have value for soil mixes that growers blend themselves for use in their operations and for sales to consumers. Another benefit is that SBM may become less expensive in the future than pelletized urea granules (see Figures 16-18).

Figure 16: Formulator Depth Interviews – 7 Completed - Summary

Topic	Summary
SBM Use in Fertilizers	- SBM and soy byproducts are used by all but one formulator. - High familiarity with SBM.
SBM Benefits	- SBM is high in crude protein, energy, amino acids, enzymes and growth stimulants. - SBM is a carbon source and contains plant-available Ca in addition to Nitrogen/Phosphorus/Potassium (NPK). - It's natural, but not Organic Materials Review Institute (OMRI) certifiable due to heating.
SBM Negatives/Concerns	- SBM is perceived as expensive. - It is high in oil which can impact soil conditions. - It doesn't have high levels of NPK. - It can retard seedling growth and damage plants according to North Carolina (NC) State reports. - No immediate green up/growth pop - Few academic studies supporting its use.
Value-Added SBM Supplements	- Sugars (molasses, chitosan, and other polysaccharides.) - Micronutrients (Zn, Mg, Ca, Bo) sprayed onto SBM granular base. - Urea
Cost and Ingredient Decisions	Based on nutrient value of other nitrogen (N) sources – natural or synthetic.
Granular or Liquid	Granular, granular, granular

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Figure 17: Agronomist Depth Interviews – 3 Completed – Summary

Topic	Summary
SBM Use in Fertilizers	- Two of them use specialized fertilizers with soy products. - None of the agronomists were highly familiar with SBM compared to the formulators.
SBM Benefits	- The primary benefit is an organic N and C source. - Possible secondary benefit mentioned by only one agronomist was increased water holding capacity. - None of the agronomists could identify other benefits identified by formulators.
SBM Negatives/Concerns	- Perceived as a costly source of N vis-à-vis synthetics with higher N content. - Burning/phytotoxicity (likely based on NC State study.) - Low customer awareness of SBM benefits as a fertilizer ingredient. - May attract insects. - May tie up other nutrients due to carbon content.
Value-Added SBM Supplements	- Peat - Urea - Micronutrients
Cost and Application Decisions	- Nutrient value of other N sources drives application decisions. - Growers looking for the cheapest/highest ROI N source. - SBM is perceived as costing more than other N sources.
Granular or Liquid	- Granular - Limited interest in liquids by agronomists because of low pricing and relatively low usage compared to granular.

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Figure 18: Formulator Depth Interviews – Detailed Findings

Topic	Commentary
SBM Use in Fertilizers	1. "Don't use SBM. Don't know much about it. Thinking about putting REV® into pellet – could work with SBM, REV® and urea. Need to find someone to formulate." 2. "Very familiar with SBM. Used it all the time at Cargill. I think cotton seed meal is better. It contains less oil. It's more consistent than SBM. It's easier to get in South." 3. "We use soy hull distillate from the wet milling side, not crushing. Soak the seed and extract the skin coats with waters and acids." 4. "We used soy hydrolysate in liquid fertilizers." 5. "Scotts® uses a little SBM in its natural granular blends." 6. "Our fertilizers contain 10-20% SBM." 7. "We use SBM in our feed grade fertilizers because of what they contain."
SBM Benefits	1. "So much of SBM is 7-2-2. If you can add something to it to make it better. All benefits seem interesting." 2. "Provides lots of crude protein (87%) and nitrogen (7.84%). Has Ca, N and Zn. Provides protein and energy to the soil." 3. "Aminos, some carbon, plant hormones, some calcium there that's readily available. Host of micros, organic compounds and aminos. 20% soluble carbon." 4. "Natural. Is SBM OMRI approvable?" 5. "Nutrition content." 6. "Good source of amino acids. SBM has more lysine. Has other enzymes too. Cheaper way to get lysine and tryptophan." 7. "Provides carbon to the soil. Rich carbon source to feed soil. Protein. Amino acid profiles."
SMB Negatives	1. "Not sure." 2. "It contains more oil. Sometimes it's more than 5% oil. You need to be <u>really careful</u> on the cost of SBM. Cotton seed is less expensive in the South. One problem with SBM is that when you heat it you lose volatile N content." 3. "Volatile compounds coming off during heating of the SBM. Delivery form. Need to define nutrient value." 4. "Never delivered the punch of growth that is necessary for horticulture." 5. "Not sure." 6. "Can retard new seedling growth like corn gluten meal. Low on N compared to blood meal. Cost. NC State studies. " 7. "Few to no negatives."

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The primary need of premium managed turf operators is keeping the grass green. Because of this, managed turf operators apply the highest amounts of inputs of all three market groups studied by Axiom -- including fertilizers, herbicides, insecticides and fungicides. The primary application form for managed turf is granular. For putting greens, it is liquid. The barrier for the sports turf market is the dominance of chemical-based (conventional synthetic) fertilizers.

For managed turf operations, SBM offers a vital source of carbon to feed vital soil microbial populations which convert nitrogen (N), phosphorous (P), and potassium (K) or NPK into a usable form for plants. In addition, the microbes aerate the soil and increase porosity so the soil can absorb and hold more water.

Many of the top-managed turf operations are located near metro areas and are being increasingly regulated by city, county, state, and – in some cases – national entities. The regulations are focused on surface water runoff, groundwater infiltration, worker safety, and environmental safety. For these operations, SBM fertilizers should be an attractive option.

Some managed turf operations may not recognize the value of SBM because they believe that chemicals (conventional synthetic) offer the best results. As mentioned above, there are few academic studies supporting its use that have been published. However, turf operations that have certification by entities focused on the environment will likely have an interest.

There may be pricing advantages due to the current high cost of synthetic N sources caused in part by the invasion of Ukraine and increased global commodity prices that drive fertilizer prices. The cost of SBM will be closely compared against the cost of other N sources (see Figures 19-21).

Figure 19: Fertilizer Manufacturing – Natural Ingredients



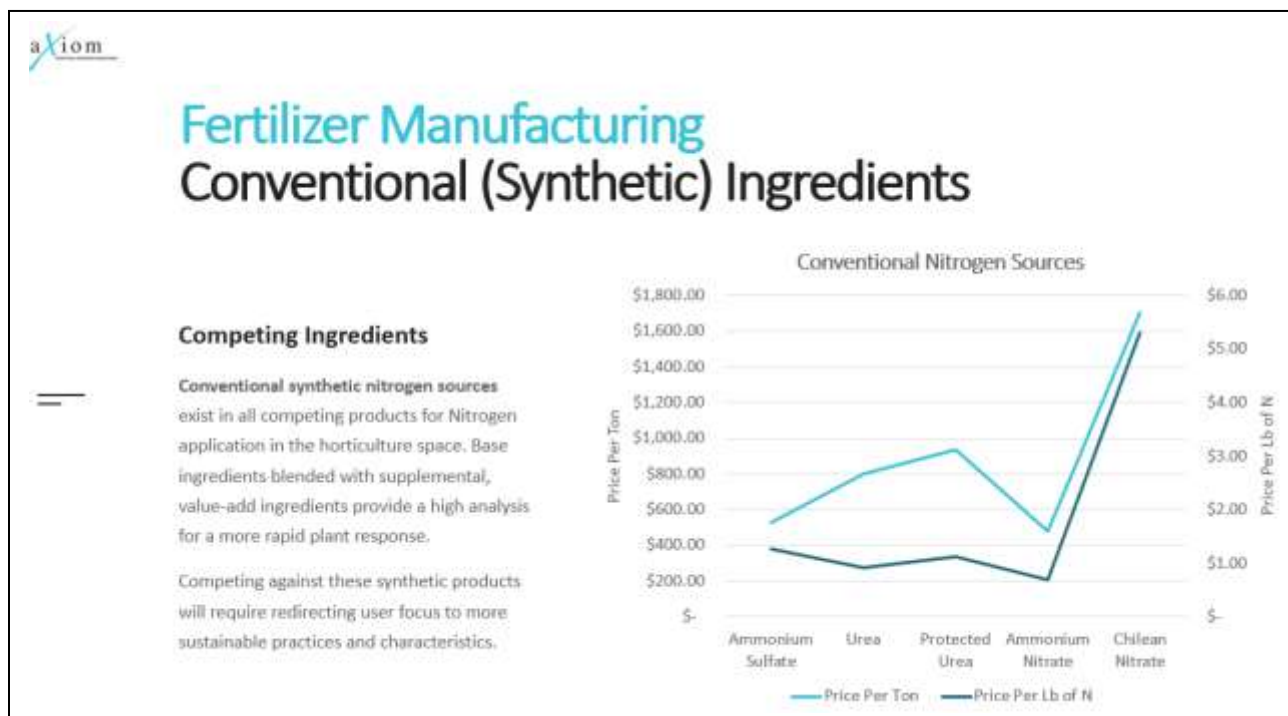
<https://www.ers.usda.gov/data-products/fertilizer-use-and-price.aspx>

Figure 20: Formulator Depth Interviews – Detailed Findings

Topic	Commentary
Cost and Ingredient Decisions	1. "We don't add any ingredients to REV®. Just our peat." 2. "It's all about the current total nutrient values of meals, the total chemical extraction and what pure nitrogen costs. Need to take an equivalent look at alfalfa seed, feather meal and compare it against SBM cost. SBM cost is good where you produce but not when you need to ship it. That's why I use cotton seed. Pure N is worth whatever the cheapest source of NPK is." 3. "Start with the nutrient value. A ton of UAN 32 (Urea Ammonium Nitrate) costs \$600 for 32 parts of N. I can buy a ton of SBM for \$300 for 7 parts of N." 4. "Back the ingredient cost into the finished product price. The math has to work." 5. "Scotts® is all about price. They buy in large volumes. They have huge inventories of unused ingredients." 6. "We adjust ingredient percentages based on pricing as long as it doesn't impact performance. Most use it if price is lower than other ingredients. If price is lower than feathers blood meal and other N sources." 7. "We negotiate quarterly to get the cheapest input price. Our customers switch things out based on price."
Barriers to Trying SBM	1. "Mental blocks. You can have a great product that works. People still have to accept it." 2. "SBM is too expensive. Cotton seed is cheaper and easier to get rid of oil." 3. "Pricing." 4. "No university hort studies talking about the value of SBM." 5. "No immediate green up." 6. "Price. Supply. Shipping soy to China. Concerns about phytotoxicity." 7. "No barriers for us. Already using it."
Likely Consideration	1. "If someone could formulate a product for a new SKU. Biggest thing with fertilizer is that customers want cheapest NPK." 2. "I don't include it in fertilizers. I use cotton seed. SBM can't be used for organic fertilizers because you have to cook it." 3. "Yes. Already using soy byproducts. SBM could provide carrier base that I could spray our liquids on and have a new SKU. We could use this as a dry blend or a liquid substrate." 4. "Hort fertilizer manufacturers are unlikely to consider. Not enough N." 5. "Scotts® is unlikely to consider SBM because of stockpiles of synthetics." 6. "Already use SBM." 7. "We've always put lots of SBM in our fertilizers (and our feeds.)"

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Figure 21: Fertilizer Manufacturing – Conventional Ingredients



<https://www.ers.usda.gov/data-products/fertilizer-use-and-price.aspx>

Soybean Meal Fertilizer Manufacturing and Demonstration Sites

AURI, Axiom and its sister company AminOrganix discussed and then formulated three potential SBM fertilizers for lawn and garden applications in less than four weeks by modifying existing successful AminOrganix fertilizer formulas.

Two of the fertilizers were 50% SBM and a third that was delayed in formulation until early 2024 was 25% SBM by content. Below are details on the Form-A-Feed facility in Stewart, Minnesota (MN) where the fertilizers were blended and bagged according to specifications as well as details on the 16-0-8 fertilizer blend.

Form-A-Feed Manufacturing Facility in Stewart, MN

The Form-A-Feed facility (Figure 22) is capable of manufacturing multiple lines of soybean meal fertilizer formulations. Form-a-Feed has plants in Stewart, Minnesota (MN) and Richmond, Wisconsin (WI). Both blending facilities are licensed by the states of Minnesota and Wisconsin respectively. AURI and Axiom Marketing understand that both facilities could be major manufacturing sites for SBM fertilizers in Minnesota and the Upper Midwest. In phase 2 of the SBM fertilizer project, AURI recommends a deeper understanding of the value chain relationship between these manufacturing facilities and retailers in South Central Minnesota.

Figure 22: Form-A-Feed facility, Stewart, MN



<https://earth.google.com>

Figure 23: AminOrganix 16-0-8 Blend Label



16-0-8

Natural Based Fertilizer
No manures, made to FDA feed grade standards
Soybean Meal content 50%

Guaranteed Analysis		Derived from:
Total Nitrogen(N)	16.00%	Urea, soybean meal,
12.00% Urea Nitrogen		hydrolyzed poultry feather
4.00% Water Insoluble Nitrogen*		meal, sulphate of potash,
Available Phosphate (P ₂ O ₅)	0.00%	potassium chloride, calcium
Soluble Potash (K ₂ O)	8.00%	carbonate, elemental sulfur,
Calcium (Ca)	0.80%	cobalt sulfate, iron sulfate,
Magnesium (Mg)	0.30%	magnesium oxide,
0.18% Water Soluble Magnesium		manganese sulfate, zinc
Sulfur (S)	1.90%	sulfate, sodium molybdate.
1.60% Combined Sulfur(S)		
0.30% Free Sulfur(S)		
Cobalt (Co)	0.0005%	
Iron (Fe)	0.70%	*4.00% slowly available
0.70% Water Soluble Iron		nitrogen from soybean
Manganese (Mn)	0.25%	meal, hydrolyzed poultry
0.08% Water Soluble Manganese		feather meal, and
Molybdenum (Mo)	0.0005%	molasses.
Zinc (Zn)	0.10%	
0.10% Water Soluble Zinc		

SATISFACTION GUARANTEED
 Manufactured for Aminorganix®
 3800 American Blvd W Ste 1500
 Bloomington, MN 55431
25 Pounds 11.34 kg
crk 07/28/2023 76372473

76372473
Experimental product, not for resale
Lawn Fertilizer
 Project supported by:
MINNESOTA SOYBEAN PROMOTION AND
RESEARCH COUNCIL CHECKOFF

Sites Demonstrations

Three university sites were chosen to demonstrate the soybean meal fertilizer 16-0-8 blend (Figure 23). The fertilizer was applied in June 2023 working with the maintenance departments at each location. AURI delivered the product and assisted in the applications. The sites included:

1. Northland Community and Technical College in Thief River Falls, MN (Figure 24)
2. Minnesota State Community and Technical College in Fergus Falls, MN (Figure 25)
3. Ridgewater College in Willmar, MN (Figure 26)

Below is a map of the locations of the selected sites.

Each site comprised 100 x 100 feet application areas next to larger unfertilized grass areas. The Thief River Falls site application took place on June 21st. Follow-up visits were conducted by AURI staff.

Figure 24: Northland Community and Technical College – Thief River Falls, MN



<https://earth.google.com>

Figure 25: Minnesota State Fergus Falls Campus – Fergus Falls, MN. The application occurred on June 15, 2023



<https://earth.google.com>

Figure 26: Ridgewater College – Willmar, MN. The application occurred on June 15, 2023



<https://earth.google.com>

Demonstration application photos per site location (Figures 27-29):

Figure 27: Northland Community & Technical College Application



Photo credit: Becky Philipp, AURI

The product formulation was easy to apply. The material did not clump, and the spreading was uniform. The fertilizer (16-0-8 blend) was applied by AURI at the recommended rate of 4,500 square feet per 25-pound bag.

Figure 28: Minnesota State College, Fergus Falls, MN Application



Photo credit: Harold Stanislawski, AURI

AURI staff worked with the maintenance department at Minnesota State for product calibration and application.

Figure 29: Ridgewater College in Willmar, MN Application



Photo credit: Harold Stanislawski, AURI

AURI staff worked with the maintenance department at Ridgewater College for product calibration and application.

Product Evaluation (16-0-8) of SBM blend fertilizers as of July 10 (day 19) in Thief River Falls at Northland Community and Technical College (Figure 30).

Figure 30: Product Application Comparison



Photo credit: Becky Philipp, AURI

16-0-8 blend

Unfertilized area

A second application of fertilizer was applied in Thief River Falls at Northland Community and Technical College on July 24 (Figure 31(a)). Product evaluation (16-0-8) of SBM blend fertilizers as of August 11, which was 51 days after the first application and 18 days after the second application, as shown in (Figure 3(b)). Figure 31(c) depicts the condition of the fertilized grass area as of September 29, 2023, with the unfertilized grass area as indicated.

Figure 31(a): Second Application at NCTC



Photo credit: Becky Philipp, AURI

Figure 31(b): Product Application Comparison



Photo credit: Becky Philipp, AURI

16-0-8 blend

Unfertilized area

Figure 31(c): Product Application Comparison



Photo credit: Becky Philipp, AURI

The Thief River Falls area received more rain compared to Willmar and Fergus Falls which each received less than three-quarters of an inch of rain from application throughout the evaluation period. The 16-0-8 blend with more nitrogen content showed a darker green color than the unfertilized area. According to Shannon Boen, NCTC Grounds and Road Maintenance Coordinator, “The fertilizer performed well in the area tested. It was both easy to apply and spread. Rain occurred when needed to provide a good read on the fertilizer performance. I mowed the grass weekly and it looked very nice. The 16-0-8 blend went on heavier and produced a thick turf with a lush green appearance. There also seemed to be fewer weeds in that area-- healthier turf means less weeds!”

The product evaluation (16-0-8) of the SBM blend fertilizers for Minnesota State in Fergus Falls, MN as of August 31 captured in Figure 32 depicts the effects of the drought conditions and high heat index on the demonstration site. This is also reflective of the Ridgewater College site in Willmar, MN. These dry weather conditions were an obstacle in assessing the true performance of the fertilizer at these sites.

Figure 32: Product Application (16-0-8) Comparison



Photo credit: Harold Stanislawski, AURI

16-0-8 blend

Unfertilized area

AURI, Axiom and its sister company AminOrganix also formulated a 7-1-7 blend. This 7-1-7 blend is formulated for residential consumers interested in natural fertilizer products. This fertilizer is approved for garden and lawn starter applications. This blend is suitable for flower gardens, vegetable gardens and new lawns. This fertilizer contains 50% SBM and is considered a natural fertilizer. It competes with other natural fertilizers in its class. Information about the specifics of the 7-1-7 blend is available on the product label below (Figure 33).

Figure 33: AminOrganix 7-1-7 Blend Label



7-1-7

Organic Fertilizer

No manures, made to FDA feed grade standards

Soybean Meal content 50%

Guaranteed Analysis Total Nitrogen(N) 7.00% 7.00% Water Insoluble Nitrogen* Available Phosphate (P ₂ O ₅) 1.00% Soluble Potash (K ₂ O) 7.00% Calcium (Ca) 2.80% Magnesium (Mg) 0.30% 0.18% Water Soluble Magnesium Sulfur (S) 1.90% 1.60% Combined Sulfur(S) 0.30% Free Sulfur(S) Cobalt (Co) 0.0005% Magnesium (Mg) 0.30% Iron (Fe) 0.70% 0.70% Water Soluble Iron Manganese (Mn) 0.25% 0.08% Water Soluble Manganese Molybdenum (Mo) 0.0005% Zinc (Zn) 0.10% 0.10% Water Soluble Zinc		Derived from: Soybean meal, hydrolyzed poultry feather meal, sulphate of potash, potassium chloride, calcium carbonate, elemental sulfur, cobalt sulfate, iron sulfate, magnesium oxide, manganese sulfate, zinc sulfate, sodium molybdate. *7.00% slowly available nitrogen from soybean meal, hydrolyzed poultry feather meal, and molasses.
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SATISFACTION GUARANTEED

Manufactured for Aminorganix®
 3800 American Blvd W Ste 1500
 Bloomington, MN 55431
 07/28/2023 76371473 crk



76371473

25 Pounds 11.34 kg

Experimental product, not for resale

Garden and Lawn Starter Fertilizer

Project supported by:
 MINNESOTA SOYBEAN PROMOTION AND
 RESEARCH COUNCIL CHECKOFF

Figure 34 below displays a price chart and fertilizer product comparison that was prepared to show how these SBM fertilizers compare with other products that are in their product class. From the cost of nutrition per pound analysis, SBM fertilizers can compete in the marketplace.

It is recommended that the higher N formulation containing 25% SBM (24-0-8) be manufactured and demonstrated in early spring applications. The 24-0-8 blend will be deployed through the next grant activity.

Figure 34: AminOrganix Fertilizer Product and Retail Comparison



AminOrganix Fertilizer Product and Retail Comparison

Product	Milorganite 6-4-0	AminOrganix 7-1-7 (50% SBM blend)	Down to Earth SBM 7-1-2	Old Farmer's Almanac Natural Lawn Food	Scots Natural Lawn Food	AminOrganix 16-0-8 (50% SBM blend w/Urea)	Sta-Green Natural Fertilizer	AminOrganix 24-0-8 (25% SBM blend w/Urea)	ACE All Purpose Lawn Fert. (w/Urea)
Nitrogen%	6	7	7	10	11	16	16	24	29
P2O5%	4	1	1	0	2	0	0	0	0
K2O%	0	7	2	2	2	8	10	8	4
Calcium%	1.2	2.8	0	0	0	0.8	0	0.8	0
Sulfur%	0	1.9	0	0	0	1.9	0	1.9	0
Cobalt%	0	0.0005	0	0	0	0.0005	0	0.0005	0
Magnesium%	0	0.3	0	0	0	0.3	0	0.3	0
Iron%	4.0	0.7	0	0	0	0.7	0	0.7	0
Manganese%	0	0.25	0	0	0	0.25	0	0.25	0
Molybdenum%	0	0.0005	0	0	0	0.0005	0	0.0005	0
Zinc%	0	0.1	0	0	0	0.1	0	0.1	0
Nutrition per bag	15%	21%	10%	12%	15%	28%	26%	36%	33%
Nutrients	4	11	3	2	3	10	2	10	2
Retail price/lb.	\$0.480	\$1.398	\$1.512	\$0.877	\$1.508	\$1.440	\$1.000	\$1.798	\$1.667
Coverage in sq ft (N=.75)/25# bag	2000	2333	2333	3333	3667	5333	5333	8000	9667
Cost per 1000/sq. ft	\$6.00	\$14.98	\$16.20	\$6.58	\$10.28	\$6.75	\$4.69	\$5.62	\$4.31
Cost per lb. of nutrition	\$3.16	\$6.64	\$15.12	\$7.31	\$10.05	\$5.13	\$3.85	\$4.99	\$5.05
Bag sizes (lbs.)	20/32	25/5	40	20	29.1	25/5	25	25/5	14
Safety	Not suitable as feed	FDA Feed Grade	Not suitable as feed			FDA Feed Grade		FDA Feed Grade	
Information		40% Retail GM price	Only available in		Box Store Pricing 28%	40% Retail GM price	Box Store Pricing 28%	40% Retail GM price	Ace ONLY: GM Typically

Compare products at 1 lb. N or .75 lbs. N per 1,000

25 lbs. of Milorganite covers 2,000. Milorganite will damage grass over long periods with too much Iron and no magnesium to offset it.

NOTE: Consumer lawn fertilizers in Minnesota must have 0% phosphorus. They can all be used as lawn starter and garden fertilizers or where soil tests prove phosphorus is needed.

Next Steps for Commercialization and Utilization of SBM Fertilizer Blends:

1. Manufacture and test the higher N blend containing 25% SBM and urea for early spring application. Additional blends could also be considered using Dried Distillers Grains (DDGs) from corn as part of the formulation.
2. Accelerate manufacturing and distribution of SBM blended fertilizers in the Midwest via Form-A-Feed locations in Minnesota and Wisconsin. Phase 2 work will help solidify costs for higher volumes and explore additional manufacturer opportunities. Wisconsin is a logical market for SBM fertilizers with a manufacturing plant owned by Form-a-Feed in Richmond, WI. South Dakota, Iowa and North Dakota markets are also logical markets given their proximity to Minnesota.
3. Investigate rural distribution opportunities with local rural co-ops, farm stores, greenhouses and garden centers and golf courses.
4. Solidify the value chain to market the fertilizer to identified consumer and institutional markets.
5. Provide outreach information on locally produced and farmer-raised soybeans as part of a healthy lawn and garden.
6. AURI will identify further sales and distribution opportunities for SBM blended fertilizers.

GOAL 3: PREPARE A WRITTEN REPORT ON HIGH-POTENTIAL MARKETS AND COMMERCIALIZATION AVENUES.

Goal 3 findings included the following (Axiom Marketing report)

Commercialization barriers:

- 1.) Awareness and confidence in the superior performance of chemical-based (conventional synthetic) fertilizers
- 2.) Limited academic research by land grant universities on the efficacy of SBM as a plant nutrient

Commercialization bridges for SBM:

- 1.) High awareness of SBM advantages among fertilizer formulators
- 2.) Natural N source that is less likely to leach than conventional synthetic sources
- 3.) Natural carbon source that builds soil

Unlike agronomists and most consumers, fertilizer formulators are well aware of the benefits of SBM for fertilizers and soil amendments. Formulators see it as a source of nitrogen (N), Carbon (C), and calcium (Ca), which are vital for plant growth and plant health. Agronomists and most consumers like the fact that SBM contains 7% N. They like that it is a natural, non-biochar carbon source that feeds microbial populations and replenishes the soil. Several respondents mentioned that Ca strengthens plant cell walls and stems. A couple of respondents also recognized that SBM contained amino acids, which stimulate plant growth (see Figures 35-39).

Figure 35: Formulator Depth Interviews – 7 Completed - Summary

Topic	Summary
SBM Use in Fertilizers	- SBM and soy byproducts are used by all but one formulator. - High familiarity with SBM.
SBM Benefits	- SBM is high in crude protein, energy, amino acids, enzymes and growth stimulants. - SBM is a carbon source and contains plant-available Ca in addition to Nitrogen/Phosphorus/Potassium (NPK). - It's natural, but not Organic Materials Review Institute (OMRI) certifiable due to heating.
SBM Negatives/Concerns	- SBM is perceived as expensive. - It is high in oil which can impact soil conditions. - It doesn't have high levels of NPK. - It can retard seedling growth and damage plants according to North Carolina (NC) State reports. - No immediate green up/growth pop - Few academic studies supporting its use.
Value-Added SBM Supplements	- Sugars (molasses, chitosan, and other polysaccharides.) - Micronutrients (Zn, Mg, Ca, Bo) sprayed onto SBM granular base. - Urea
Cost and Ingredient Decisions	Based on nutrient value of other nitrogen (N) sources – natural or synthetic.
Granular or Liquid	Granular, granular, granular

Axiom – Appendix A, page 32

Figure 36: Agronomist Depth Interviews – 3 Completed - Summary

Topic	Summary
SBM Use in Fertilizers	- Two of them use specialized fertilizers with soy products. - None of the agronomists were highly familiar with SBM compared to the formulators.
SBM Benefits	- The primary benefit is an organic N and C source. - Possible secondary benefit mentioned by only one agronomist was increased water holding capacity. - None of the agronomists could identify other benefits identified by formulators.
SBM Negatives/Concerns	- Perceived as a costly source of N vis-à-vis synthetics with higher N content. - Burning/phytotoxicity (likely based on NC State study.) - Low customer awareness of SBM benefits as a fertilizer ingredient. - May attract insects. - May tie up other nutrients due to carbon content.
Value-Added SBM Supplements	- Peat - Urea - Micronutrients
Cost and Application Decisions	- Nutrient value of other N sources drives application decisions. - Growers looking for the cheapest/highest ROI N source. - SBM is perceived as costing more than other N sources.
Granular or Liquid	- Granular - Limited interest in liquids by agronomists because of low pricing and relatively low usage compared to granular.

Axiom – Appendix A, page 29

Figure 37: Formulator Depth Interviews – Detailed Findings

Topic	Commentary
SBM Use in Fertilizers	1. "Don't use SBM. Don't know much about it. Thinking about putting REV® into pellet – could work with SBM, REV® and urea. Need to find someone to formulate." 2. "Very familiar with SBM. Used it all the time at Cargill. I think cotton seed meal is better. It contains less oil. It's more consistent than SBM. It's easier to get in South." 3. "We use soy hull distillate from the wet milling side, not crushing. Soak the seed and extract the skin coats with waters and acids." 4. "We used soy hydrolysate in liquid fertilizers." 5. "Scotts® uses a little SBM in its natural granular blends." 6. "Our fertilizers contain 10-20% SBM." 7. "We use SBM in our feed grade fertilizers because of what they contain."
SBM Benefits	1. "So much of SBM is 7-2-2. If you can add something to it to make it better. All benefits seem interesting." 2. "Provides lots of crude protein (87%) and nitrogen (7.84%). Has Ca, N and Zn. Provides protein and energy to the soil." 3. "Aminos, some carbon, plant hormones, some calcium there that's readily available. Host of micros, organic compounds and aminos. 20% soluble carbon." 4. "Natural. Is SBM OMRI approvable?" 5. "Nutrition content." 6. "Good source of amino acids. SBM has more lysine. Has other enzymes too. Cheaper way to get lysine and tryptophan." 7. "Provides carbon to the soil. Rich carbon source to feed soil. Protein. Amino acid profiles."
SMB Negatives	1. "Not sure." 2. "It contains more oil. Sometimes it's more than 5% oil. You need to be <u>really careful</u> on the cost of SBM. Cotton seed is less expensive in the South. One problem with SBM is that when you heat it you lose volatile N content." 3. "Volatile compounds coming off during heating of the SBM. Delivery form. Need to define nutrient value." 4. "Never delivered the punch of growth that is necessary for horticulture." 5. "Not sure." 6. "Can retard new seedling growth like corn gluten meal. Low on N compared to blood meal. Cost. NC State studies." 7. "Few to no negatives."

Axiom - Appendix A, page 30

Figure 38: Agronomist Depth Interviews – Detailed Findings

Topic	Summary
SBM Use in Fertilizers	1. Don't know a lot about it. I think there's some SBM in the granular. Need to dig into it deeper. 2. I've heard of it but never have used agricultural fertilizers containing SBM in row crop farming or specialty crop ag. 3. SBM is not included in our programs; however, sometimes we use soy hydrolysate.
SBM Benefits	1. There's <u>definitely</u> a benefit. Don't know all the benefits. 2. There's N in SBM. It probably has some C in it. Not sure what else. 3. SBM is a source of organic N without having to utilize fish, blood or poultry products. It has less smell.
SMB Negatives/Concerns	1. No one in golf or polo knows anything about SBM. Some concerns about burning and phytotoxicity. 2. SBM costs a lot for the <u>amount</u> of N you get. 3. I have not seen any negatives <u>as of yet</u>. When we are limited to organic N the value of N is typically low and costly.
Value-Added SBM Supplements	1. Homeowners in Florida would use it if it's marketed in a certain way and put with something else like peat. 2. Not sure. 3. I'd add other organic components – kelp, <u>humic</u>, other organic minor nutrients.
Cost and Application Decisions	1. What's the cost of N per acre from different sources. Our decisions are based on cost of <u>lbs</u> of N required for each app. 2. Cost of the N you're applying is king. We look at ROI on our crop nutrition program decisions. How much more yield will I get by applying SBM? 3. Soy is not <u>new</u> and the cost is high typically. The fit currently is in organics where N is low in analysis and is costly.
Granular or Liquid	1. Granular for turf. 2. Mostly granular. Maybe liquid for permanent crops. 3. Soy can be used both for <u>granulars</u> and liquids. The question is how how to convert the SBM into a liquid that can be applied through a fertigation system.

Axiom - Appendix A, page 35

Figure 39: Agronomist Depth Interviews – Detailed Findings

Topic	Summary
Opportunities with Synthetics	1. It should definitely work with urea. We use lots of urea in our programs. Could work well with micronutrients. 2. There should be some opportunities. Haven't really thought about it. Focus on NPK sources and how SBM works. 3. If you talk sustainability, there may be a fit. The higher available nutrients in synthetics allow you to reduce inventory and use higher concentrations. Organic today is clearly the ticket for soy usage.
Barriers to Trying SBM	1. No one thinks about SBM down here. No one knows what it does. 2. Not enough N to make a difference in row crop and specialty crop ag. Cheaper to use synthetics and urea. 3. I don't see any barriers in the process we use. I think granulating will certainly up the price considerably and current cost is relatively high.
Likely Consideration	1. May consider it for applications that demand natural. Likely never be approved by OMRI. 2. Unlikely. 3. May be interesting. SBM is a source of N that could be a catalyst for dry fertilizers.
Manufacturers Most Open to Considering SBM for Fertilizers	1. Nursery and residential fertilizer manufacturers and applicators looking for natural fertilizers that don't leach. 2. Not sure. Maybe liquid manufacturers who want more N. 3. Organic today is the ticket for SBM. Futuristic growers will lean toward organic inputs just to be evolving toward softer products. Only the most innovative formulators and retailers will be positioned to meet these needs. Wilbur, CPS, etc.
Liquid Fertilizer Trends	1. Manufacturers are trying to pack as much nutrition in as possible to increase prices including micronutrients. The goal is to create a product that can be sold at a premium price. 2. Not sure. 3. OMRI certified liquids
University or Private Research Sources	1. Clemson, NC State, maybe Auburn. 2. No idea. 3. I've not seen anything on this. Nothing from universities. Nothing from Wilbur, Simplot, CPS, or Helena.

Axiom - Appendix A, page 30

As mentioned above, the cost of SBM will be closely compared against the cost of other N sources. Agronomists and formulators see SBM as expensive – based on commodity prices for soybeans. They had little awareness of increased crushing plants being built to support the increased need for biofuels.

We believe the highest potential vertical market is the residential market. It constitutes the largest and fastest growing of the markets we studied. We believe the rural residential market can provide a foothold to establish SBM fertilizers as a viable category for the following reasons:

- Pride of usage of an SBM-based product among rural consumers and soybean producers
- Lower competition from home centers and discount stores
- Larger lawns and gardens compared to metro area homeowners
- Increased incidence of hardware stores and feed/seed stores

Possible commercialization pathways include:

- Distribution agreements with the top 10 regional farm cooperatives in Minnesota including United Farmers Cooperative, Central Farm Service, Pro-Ag, Farmers Win Co-op and others
- Distribution agreements with rural cooperative retail outlets owned by national farm cooperatives including CHS and Land O' Lakes
- Distribution agreements with rural retailers such as Runnings, Mills Fleet Farm and others
- Potential for distribution agreements with Farmers Union Industries

Possible product commercialization opportunities include:

- AminOrganix lawn fertilizer formulations that include 50% SBM and 25% SBM with urea

- Future AminOrganix SBM garden formulations that are specific to tomatoes, flowers, roses and spring bulbs
- Future SBM-only soil amendments
- Nutritional SBM amendments for compost sold by municipality yard waste composting facilities and food processing plants
- Liquified SBM fertilizers for greenhouse growers

In support of Goal 3, as it pertains to outreach efforts, AURI developed a one-page handout focused on the SBM fertilizer blends developed as part of the project work. This handout was displayed, along with a sample of the product (see Appendix B), in AURI's and MSR&PC's respective tents during the annual 2023 Minnesota Farmfest in Redwood Falls, MN. See Appendix C for a copy of the handout. This year's attendance at the three-day Farmfest event was estimated at 26,800 people.

Meetings were held with the facilities management personnel at Minnesota State, Ridgewater College, and Northland Community & Technical College in Minnesota. This resulted in fertilization demonstration trials in 2023 at each site.

Posters were also developed for use at future tradeshow events and the 2024 MN Ag Expo to further educate about SBM fertilizer products.

An article is also planned for AURI's *Ag Innovations News (AIN)*, November 2023 issue, highlighting the findings of the SBM fertilizer analysis and the opportunities for increased SBM use in fertilizer blends.

CONCLUSION

SBM blended fertilizers have market opportunities for residential and selected institutional markets. Further marketing research and promotion of these blended and natural fertilizer options will be critical for future growth with SBM in fertilizer applications. Research from this project indicates that Minnesota and Wisconsin have manufacturing capabilities, distribution options, adequate sources of sustainable SBM grown by Minnesota farmers, and interest from consumers and horticultural operators.

The 7-1-7 SBM blend constitutes a good opportunity for gardeners who are interested in natural fertilizers. These individuals actively seek out products that are chemical (conventional synthetic) free for use in their gardens and on their lawns.

A phase 2 project has been approved and is underway to further formulate additional SBM fertilizer blends that have applicability in specific horticultural settings. The educational institutions involved in this project are interested in continuing demonstration relationships with MSR&PC and AURI. It is also recommended that further work be done to develop the value chain relationships to ensure sales in the marketplace.

APPENDICES

NOTE: Please see the PDF Attachment Section to view each Appendix included herein.

Appendix A: Axiom Marketing - Soybean Meal (SBM) Fertilizer Analysis Report



APPENDIX A - AURI
AXIOM SBM REPORT_

Appendix B: AURI 2023 Farmfest SBM Fertilizer Display Photo



APPENDIX B - 23018
SBM Fertilizer Farmfes

Appendix C: SBM Fertilizer Handout



APPENDIX C -
AURI_FarmFest_Handc