Comparison of Two Different Organic Fertilizer Sources for Flue-Cured Tobacco

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ABSTRACT

Limited research is available to farmers and extension personnel seeking nitrogen fertilization recommendations for organic production of flue-cured tobacco in the Southside of Virginia. With growth in organic tobacco production in the area due to an increase in contracts offered by Santa Fe Natural Tobacco Company, the need for independent research on fertilization for the crop became clear. Research was conducted to compare the effects of the current organic tobacco fertilizer (8-5-5) to a new product considered to be more readily available (3-2-3) on flue-cured tobacco at the Southern Piedmont Agriculture & Research Extension Center near Blackstone, Virginia for the 2015 crop year. The effects of total nitrogen rate were also analyzed at rates of 65, 85, and 105 lbs of nitrogen to the acre. Additionally, sidedress applications of two products 13-0-0 and 16-0-0 were evaluated. Production other than fertilization treatments followed those of conventional tobacco. Plots were soil sampled a total of six times throughout the season and evaluated for nitrogen and ammonium content. Petiole samples of the fourth leaf from the top were taken from four plants in each plot four times throughout the season. Petioles were crushed and the extract analyzed for nitrate content. Total yields were determined after four harvests and the cured leaf graded for quality. Test results did not indicated a nitrogen rate effect for yield but there was a significant increase in yield with the 3-2-3 fertilizer compared to the 9-5-5.

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INTRODUCTION

History of tobacco in Virginia

It is rare to hear the mention of Virginia history without inclusion of the importance of tobacco to the economic success of the early settlers. Although one species of the plant, *Nicotiana rustica*, was already present and being cultivated in the colonies by the Native Americans, it was not until John Rolfe imported seeds of the milder *Nicotiana tabacum* from the West Indies around 1611 that the potential role of tobacco in the New World was recognized (Lauterstein, 2008). As production and curing methods were fine-tuned, exports to Britain soon found it to be competitive with Spanish tobacco. The ease of shipping the crop compared to other commodities, the profit per acre, and the crop's suitability to colonial Virginia soils made it catch like wildfire. As yields declined, the crop was pushed out of the tidewater region, establishing itself securely in the piedmont by 1800 (Herndon, 1957). Over 200 years later, tobacco roots still run deep in the agriculture of the southern portion of the piedmont region, termed Southside. Today, Southside producers continue to grow conventional flue-cured tobacco, but have begun branching out into organic production in recent years.

Problem & Purpose

Organic tobacco production marks an area of growth for the United States industry. Santa Fe Natural Tobacco Company is currently the sole company offering organic contracts to tobacco producers, using the tobacco in its "additive free tobacco" products (Santa Fe Natural Tobacco Company, 2015). With the organic food movement, interest in organic tobacco has grown tremendously, increasing the demand for organically produced tobacco leaf and the search for producers.

Due to the uniqueness of organic tobacco products and the added costs of production, organic tobacco contracts offer a premium price to growers, making it a very desirable crop to produce. As might any new crop, the growth of organic tobacco has brought with it many unanswered questions about the best production techniques and available and allowable inputs. As Southside producers have dived into organic production, they have presented extension agents, specialists, and researchers with the problems they face under their new protocols, identifying the need for research in this area. Seeing the need for research-based information specific to the Southside region, Dr. Reed and myself worked to address of the most basic needs of producing the crop – that of nitrogen fertilization.

Project Objectives

Organic tobacco producers in Southside are currently using Nature Safe pelleted fertilizer with a total nutrient analysis of 8-5-5. This product is comprised of slowly available nitrogen sources including meat, feather, bone, and blood meal (see Appendices). A new product Perdue's MicroSTART60 Prill 3-2-3 is OMRI certified. MicroSTART60 is comprised primarily of poultry litter which is more readily available to plants. The overlying goal of this research was to compare the current nitrogen product of the more slowly available but higher nutrient content 8-5-5 fertilizer to the new more readily available but lower concentrated 3-2-3 product. The thought here was that the new product might be better able to meet early season nitrogen requirements and provide organic producers with an additional option. In order to provide producers with the best information possible on which to base their management decisions, the two products were compared with two different organic sidedress nitrogen products each at three different total plot nitrogen rates: 65, 85, and 105 lbs/A. Soil and petiole samples would be taken throughout the season to monitor plant nitrogen levels. Leaf quality after curing would also be evaluated as the ultimate goal is high quality tobacco.

Significance of the Problem

Nitrogen availability with blood and bone meal products such as in the 8-5-5 product tested here, can take months to become plant available (Card et al., 2014). This affects product application timing as producers balance early fertilizer application with planting time and the associated costs. Additionally, product choice affects overall quality and yield if plants are unable to grow, defend themselves against pests, and out-compete weed pressure from the start. Poor application timing can result in loss in product as slow-acting fertilizer may not be available until after peak nutrient requirements. If producers are aware of the low early availability, they may choose to apply at a rate in excess of needs which may cause a surge in plant pests, burning of plants later, or runoff and leaching. All of these things ultimately could result in a loss in profit for producers, poor crop quality, and potential environmental issues. Providing producers with the best information available specific to their needs and location is imperative to successful and sustainable agricultural production in Southside. The earlier questions are addressed the greater the producer savings and overall economic impact on the region.

REVIEW OF THE LITERATURE

Few organic fertilizer products have been evaluated for use in tobacco production although there are many on the market. Though general organic products such as manures have been used for centuries in agricultural production and were even the primary source of nitrogen prior to the 20th century, these water-dense by-products make transportation and application tedious and expensive (Havlin et al, 2005). Limited information and few recommendations are available for organic producers. Even the National Sustainable Agriculture Information Service (ATTRA) publication on organic production fails to offer concrete options to tobacco growers (Kuepper and Thomas, 2008). The most recent research with respect to tobacco has involved that of bone, blood, and other meal products which must be applied in advance of planting to ensure proper uptake by plants (Hight, 2009). Most recently work has been done in China to evaluate the effects of organic fertilizer composed of plant products such as rapeseed and sesame on tobacco quality, but it has not been evaluated on the quality or yield of organic tobacco specifically (Zeng and Long, et al, 2013). Little research has been done to date.

PROJECT METHODOLOGY

Current organic flue-cured tobacco producers in Southside Virginia will receive direct benefit from this research. However, this knowledge could greatly impact other researchers around the country pursuing similar projects, fertilizer manufacturers developing products for or marketing products to organic tobacco growers, tobacco industry professionals as they advise and place requirements on their growers, and extension agents and specialists around the country as they share their knowledge with their clients.

Keeping in mind the target audience, the experiment was designed to look at many variables of only one aspect of organic tobacco production – nitrogen fertilization. All other production practices were kept the same and pest management was carried out as per a conventional crop in order to truly determine the effects of organic nitrogen fertilization alone. No pre-plant fertilizer was applied as in conventional production.

The test was conducted at Virginia Tech's Southern Piedmont Agricultural Research & Extension Center near Blackstone, VA. The soil type across the plots was a Durham coarse sandy loam (fine-loamy, siliceaous, semiactive thermic Hapludult). Pre-plant soil test results returned pH at 6.6, P with a H- rating and K with a M rating. Organically produced Cross Creek 143 tobacco plants were transplanted 21 May. Treatment variables included fertilizer source and rate. Two complete NPK fertilizers were evaluated (Nature Safe 8-5-5 and Perdue MicroStart60 Prill 3-2-3) as well as two sidedress fertilizer applications (Allganic 16-0-0 and Nature Safe 13-0-0). The total N rates tested were 65, 85, and 105 lbs/A. The NPK fertilizers were banded at a rate of 42 lbs/A across sources the day following transplant. Additional sidedress nitrogen was band applied two weeks later to provide the total N rates to be evaluated. The check treatment was applied in the same way with conventional tobacco fertilizer 6-6-18 as the NPK source and a sidedress application of 16-0-0 for a total N rate of 65lbs/A. In order to meet the potassium requirements noted in the pre-plant soil test as well as to remove any potential plant performance differences due to potassium rates from the NPK sources, additional potassium sulfate (K_2SO_4) was applied on a per plot basis to bring the total potassium application up to the desired 135 lbs/A (Table 1). The test was designed in a randomized complete block with four repetitions. Individual plots consisted of four rows four feet apart and 40 feet in length, with an in-row plant spacing of 22 inches. Petiole samples were taken from the outer border rows so as to not influence yield data of the center two rows.

Table 1. Description of treatments in the organic fertilizer source test at the Southern Piedmont Agricultural Research & Extension Center (SPAREC) near Blackstone, VA in 2015. Variables included NPK fertilizer sources, sidedress fertilizer sources, and total nitrogen rates.

Treatment	NPK Fertilizer Source	Product Rate (lbs/A)	Additional K_2O (lbs/A)	Total K_2O (lbs/A)	Sidedress Fertilizer Source	Sidedress Product Rate (lbs/A)	Total N (lbs/A)
Conventional Fertilization Check Treatment							
1	6-6-18	700	9	135	16-0-0	144	65
Organic Treatments							
2	8-5-5	525	109	135	13-0-0	177	65
3	8-5-5	525	109	135	13-0-0	331	85
4	8-5-5	525	109	135	13-0-0	485	105
5	8-5-5	525	109	135	16-0-0	144	65
6	8-5-5	525	109	135	16-0-0	269	85
7	8-5-5	525	109	135	16-0-0	394	105
8	3-2-3	1400	93	135	13-0-0	177	65
9	3-2-3	1400	93	135	13-0-0	331	85
10	3-2-3	1400	93	135	13-0-0	485	105
11	3-2-3	1400	93	135	16-0-0	144	65
12	3-2-3	1400	93	135	16-0-0	269	85
13	3-2-3	1400	93	135	16-0-0	394	105

Data Collection

Both soil sample N and petiole N were evaluated. Petiole samples were taken from the fourth leaf from the top of four random plants on the border rows for each plot beginning after plant topping on 24 July (Table 2). This was done to maintain leaf position throughout the season and was done four times throughout the season corresponding to the progressive harvest of leaves which began at the bottom of the stalk. Lamina was stripped from the petioles in the field and petioles placed in labeled plastic bags for transport to the lab. In the lab, petioles were cut into sections of roughly four inches of clean stem at the base of the leaves. Each plot's petioles were crushed in a hydraulic jack plant press and the extract immediately tested for nitrate-N with a Cardy Nitrate Meter and the data recorded (Spectrum Technologies, Aurora, IL).

Soil samples were taken six times throughout the season, corresponding to significant production practices or stages in crop development, and evaluated for both nitrate-N and ammonium-N (Table 2).

Soil samples were taken from 20 cores in the center two rows of each plot and placed in labeled soil boxes for transport to the lab. In the lab, samples were dried, ground, and extracted (Maynard, et al 2008). The extracts were frozen until they could be analyzed. Samples were evaluated for nitrate and ammonium concentrations using a SmartChem autoanalyzer (Unity Scientific, Brookfield, CT) following manufacturer's procedures (Unity Scientific, 2012, 2014). A USDA Agricultural Marketing Services tobacco grader evaluated leaf quality, assigning numeral grade index as described by Bowman et al (1988).

Table 2. Dates for transplant, topping, and soil and petiole samples of organic fertilization trials, Blackstone, VA, 2015.

Action	Sample Date
Transplant	06/21/15
Soil Sample 1	06/23/15
Soil Sample 2	07/08/15
Soil Sample 3	07/24/15
Soil Sample 4	08/05/15
Soil Sample 5	09/14/15
Soil Sample 6	10/02/15
Topping	07/24/15
Petiole Sample 1	08/14/15
Petiole Sample 2	09/09/15
Petiole Sample 3	10/06/15
Petiole Sample 4	10/13/15

RESULTS, DISCUSSION, AND RECOMMENDATIONS

Results and Discussion

Plant nitrogen status and grade and yield were analyzed to determine the results of nitrogen fertilization on the crop. Petiole sap nitrate level is considered a measure of the nitrogen status of a tobacco plant, and is much more effective in illustrating plant uptake than is soil nitrogen level, although nitrate levels in sap correlate to soil nitrogen available for uptake by the plant. This is impacted by test factors such as fertilizer source and rate as well as extrinsic factors such as weather. A comparison of petiole sap nitrate levels for the three NPK fertilizer sources with a 16-0-0 sidedress and a total nitrogen rate of 65 lbs/A is shown in Fig 1. The regression equation for each NPK fertilizer source is as follows, with DAT = days after transplanting:

6-6-18 $NO_3 = 2566 - 14.5 \times DAT$ $r^2 = 0.41$

8-5-5 $NO_3 = 2990 - 28.0 \times DAT$ $r^2 = 0.97$

3-2-3 $NO_3 = 2342 - 19.2 \times DAT$ $r^2 = 0.97$

These data are taken for the fourth leaf on the plant at each of the four harvests and thus represent the maturation and ripening of a specific leaf position across the season. Both organic fertilizer sources exhibit a significant linear relationship between petiole sap nitrate levels and days after topping (increased maturity). However, petiole nitrate level for the conventional fertilizer (6-6-18) peaked at the time of the second harvest and, therefore, does not exhibit a linear relationship. One explanation for this observation may be differences in the availability of nitrogen between the conventional fertilizer and the two organic sources, but additional analysis of soil nitrogen and weather data is necessary.

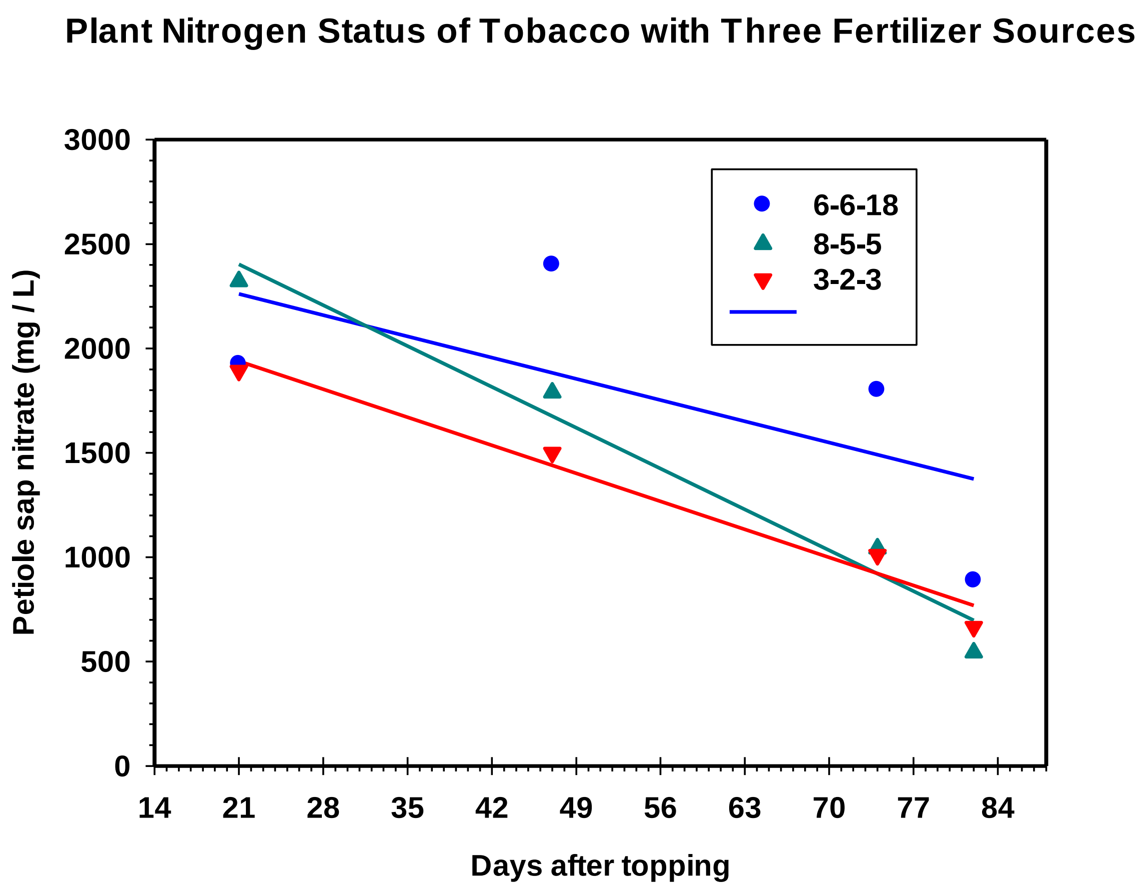


Figure 1. Petiole sap as a measure of plant nitrogen status in tobacco of three NPK fertilizer sources, Blackstone, VA, 2015.

The analysis of variance of agronomic factors affecting cured leaf yield and quality is explained in Table 3. Of the three main factors, only NPK fertilizer source showed a significant difference ($P < 0.002$) for yield. The respective yields for each of the NPK fertilizer sources across rates were: 3393 lbs/A for 3-2-3, 3061 lbs/A for 8-5-5, and 3204 lbs/A for the 6-6-18 conventional fertilizer. The conventional treatment was not significantly different from any other treatment, but there were significant differences between the highest and lowest yielding plots with the 3-2-3 plots yielding above the control and 8-5-5 below the conventional treatment. No significant differences were observed for grade index.

Table 3. Analysis of variance (ANOVA) of agronomic factors in the organic fertilizer source trials, Blackstone, VA 2015.

	Yield		**Grade Index**	
Source	F-value	P > F	F-value	P > F
Rep	**7.57**	**< 0.0001**	0.68	0.6919
Organic Fertilizer Source	**31.85**	**< 0.0001**	0.61	0.4368
Sidedress	0.16	0.6944	0.37	0.5450
Nitrogen Rate	1.72	0.1866	0.59	0.5586
Organic Fertilizer Source x Sidedress	0.01	0.9233	0.59	0.4450
Sidedress x N Rate	0.63	0.5341	2.29	0.1079
Organic Fertilizer Source x N Rate	0.23	0.7988	0.26	0.7737
Organic Fertilizer Source x Sidedress x N Rate	0.14	0.8693	0.03	0.9667

Economic Implications

Due to the nature of agriculture, I found it important to consider the costs of the different treatments applied to aid producers in their decision-making. Table 4 shows the prices for each of the products used in this study. Table 5 shows the different treatment components and their individual costs as well as the overall cost of that particular treatment. All product costs included, there is negligible difference in the average costs of the 3-2-3 and 8-5-5 treatments. The 3-2-3 product proves to be not only an effective, but a competitive economic option for organic tobacco production.

Table 4. Product prices of NPK fertilizer source and sidedress fertilizer sources for the organic fertilizer source trials, Blackstone VA, 2015.

Product	Price/50lb bag	$/ton
Nature Safe 8-5-5	$22.375	$895
Nature Safe 13-0-0	$26.625	$1065
Allganic 16-0-0	$22.625	$905
MicroSTART60 3-2-3	$8.625	$345
6-6-18	$19.88	$795
0-0-50	$25.625	$1025

Table 5. Costs of individual treatments included in the organic fertilizer trials, Blackstone, VA, 2015.

Trt.	NPK Source	Product Rate (lbs/A)	NPK Cost ($/A)	Additional K (lbs/A)	Additional K Cost ($/A)	Sidedress Source	Sidedress Product Rate (lbs/A)	Sidedress Cost ($/A)	Total Trt. Cost/A
Conventional Fertilization Check Treatment									
1	6-6-18	700	$278.25	9	$4.62	16-0-0	144	$65.16	**$348.03**
Organic Fertilizer Treatments									
2	8-5-5	525	$234.94	109	$55.87	13-0-0	177	$94.26	$385.07
3	8-5-5	525	$234.94	109	$55.87	13-0-0	331	$176.26	$467.07
4	8-5-5	525	$234.94	109	$55.87	13-0-0	485	$258.27	$549.08
5	8-5-5	525	$234.94	109	$55.87	16-0-0	144	$65.16	$355.97
6	8-5-5	525	$234.94	109	$55.87	16-0-0	269	$121.73	$412.54
7	8-5-5	525	$234.94	109	$55.87	16-0-0	394	$178.29	$469.10
							Average 8-5-5 Treatment Cost		**$439.81**
8	3-2-3	1400	$241.50	93	$47.67	13-0-0	177	$94.26	$383.43
9	3-2-3	1400	$241.50	93	$47.67	13-0-0	331	$176.26	$465.43
10	3-2-3	1400	$241.50	93	$47.67	13-0-0	485	$258.27	$547.44
11	3-2-3	1400	$241.50	93	$47.67	16-0-0	144	$65.16	$354.33
12	3-2-3	1400	$241.50	93	$47.67	16-0-0	269	$121.73	$410.90
13	3-2-3	1400	$241.50	93	$47.67	16-0-0	394	$178.29	$467.46
							Average 3-2-3 Treatment Cost		**$438.17**

Recommendations

Results of this study would indicate that Perdue AgriRecycle's MicroSTART60 Prill 3-2-3 is a viable alternative to the Nature Safe 8-5-5 product in common use. Although the results reported here represent just one year, with the significant difference in yield from the source of nitrogen, I would recommend the MicroSTART60 Prill 3-2-3 as a viable option for organic flue-cured tobacco producers. The more readily available poultry litter material of this product may provide earlier nutrient availability than that of the 8-5-5. In order to compensate for the delay in nitrogen availability with the 8-5-5, we should consider pre-transplant application of this product. Additional research is needed to confirm these results.

REFERENCES

Bowman, D. T., A. G. Tart, E. A. Wernsman, and T. C. Corbin. 1988. Revised North Carolina grade index for flue-cured tobacco. Tob. Sci. 32:39-40.

Card, A., D. Whiting, C. Wilson, and J. Reeder, 2014. Organic Fertilizers. CMG Garden Notes 234. Colorado State University, Fort Collins, CO.

Havlin, J., J. Beaton, S. Tisdale, and W. Nelson. 2005. Nitrogen. p. 141. Soil Fertility and Fertilizers. Seventh Edition. Pearson Education, Inc., Upper Saddle River, NJ.

Herndon, M. 1957. Tobacco in colonial Virginia; the sovereign remedy. Virginia 350th Anniversary Celebration Corporation, Williamsburg, VA.

Hight, P. 2009. Organic Tobacco - Something New on the Horizon. Agronomic Services. Available at http://www.ncagr.gov/agronomi/release/11-01hight.htm (verified 2015).

Kuepper, G., and R. Thomas. 2008. Organic Tobacco Production. ATTRA, U.S.A.

Lauterstein, K. 2008. Tobacco Farming in Virginia - A Short History. The Roanoke Times: NA32–NA32.

Maynard, D. G., Y. P. Kalra, and J. A. Crumbaugh. 2008. Nitrate and exchangeable ammonium nitrogen. In: M. R. Carter and E. G. Gregorich, editors, Soil sampling and methods of analysis 2nd ed. CRC Press, Boca Raton, FL. p. 71-80.

Santa Fe Natural Tobacco Company. 2015. The Brand Behind the Passion. Product Overview. Available at https://www.sfntc.com/site/ourproduct/overview/ (verified November 2015).

SAS Institute. 2013. The SAS system for Windows. Release 9.4. Sas Inst., Cary, NC.

Spectrum Technololgies. 2009. Cardy Nitrate NO3- Meter: Product Manual. Spectrum Technologies, Inc., Aurora, IL.

Spectrum Technologies. 2011. Hydraulic Plant Sap Press. Product Manual. Spectrum Technologies, Inc., Aurora, IL.

Unity Scientific. 2012. Smartchem 170 and Smartchem 200: Method AMM-003-A. Unity Scientific, Brookfield, CT.

Unity Scientific. 2014. Smartchem 170 and Smartchem 200: Method NO3-001-B. Unity Scientific, Brookfield, CT.

Zeng, W., S. Long, M. He, H. Fan, and X. Cui. 2013. Effects of Combined Use of Tobacco Special Inorganic Fertilizer and Cake Organic Fertilizer on the Quality of Tobacco K326. Agricultural Science & Technology 14(8): 1142–1146. Available at http://search.proquest.com.ezproxy.lib.vt.edu/docview/1465247341?pq-origsite=summon (verified January 2015).


Loveland
PRODUCTS INC.
Orange Tobacco
6-6-18
Guaranteed Analysis
Total Nitrogen (N) 6.00%
1.5% Nitrate Nitrogen
Available Phosphate (P_2O_5) 6.00%
Soluble Potash (K_2O) 18.00%
Calcium (Ca) 1.00%
Magnesium (Mg) 1.20%
1% Water Soluble Magnesium (Mg)
Sulfur (S) 5.00%
Boron (B) .02%
Iron (Fe) .25%
Manganese (Mn) .12%
.001% Water Soluble Manganese (Mn)
Molybdenum (Mo) .005%
Zinc(Zn) .08%
Derived From: Ammonium Sulfate, Diammonium Phosphate, and Muriate of Potash.
Maximum Chlorine (Cl) 3.00%
KEEP OUT OF REACH OF CHILDREN
CAUTION
Guaranteed By:
LOVELAND PRODUCTS, INC.
P.O. BOX 1286
GREELEY, CO 80632-1286
Net Wt. 50 lbs. (22.68 kg)

Nature Safe®

A Premium Formula of Natural & Organic Ingredients

8–5–5
Landscape Fertilizer

Pelleted Grade

Net Wt. 50 Lbs. or Bulk Bags

SGN: Super Fine 90-100 • Fine 130-140 • Coarse 220-230

GUARANTEED ANALYSIS

Total Nitrogen (N)	8.0%
0.3% Ammoniacal Nitrogen	
6.8% Water Insoluble Nitrogen*	
0.9% Other Water Soluble Nitrogen	
Available Phosphate (P_2O_5)	5.0%
Soluble Potash (K_2O)	5.0%
Calcium (Ca)	4.5%
Sulfur (S)	1.0%
1.0% Combined Sulfur (S)	

Source of Nutrients:

Meat meal, hydrolyzed feather meal, bone meal, blood meal and sulfate of potash.

*This product contains 6.8% slow release nitrogen from meat meal.

General Information:

Nature Safe 8-5-5 Landscape Fertilizer is formulated to deliver a balanced fertility package with primary and secondary nutrients ideal for lawns, landscapes and organic crops. Nature Safe 8-5-5 consists of various proteins such as meat, bone and blood meals, that provide slow release nitrogen over an 8-12 week period. Nature Safe 8-5-5 contains 4.5% calcium, an essential nutrient for plant and soil health. Carbohydrates in the form of simple sugars and starches are added to stimulate microbial activity. Humus is included to buffer the soil against extreme salt concentrations and improve soil structure for tolerance during heat and drought conditions. Virtually all of the product is utilized through plant uptake, with minimal leaching and volatilization. Nature Safe 8-5-5 Landscape Fertilizer is OMRI listed and allowed under NOP guidelines validating its use in the production of organic certified crops.

Directions for Use:

Established Turfgrass: Use as a topdressing for lawns, landscapes or any established turf. Apply 6.25 to 12.5 lbs. per 1,000 sq. ft. or 3.0 kg to 6.0 kg per 100 m^2 (0.5 lb. to 1 lb. of actual N). Results are enhanced during aeration. Covers from 4,000 to 8,000 sq. ft.

Grow-ins: Apply 12.5 lbs. of product per 1,000 sq. ft. for 1 lb. of actual nitrogen to be raked into the top 4 inches of topsoil during seedbed preparation.

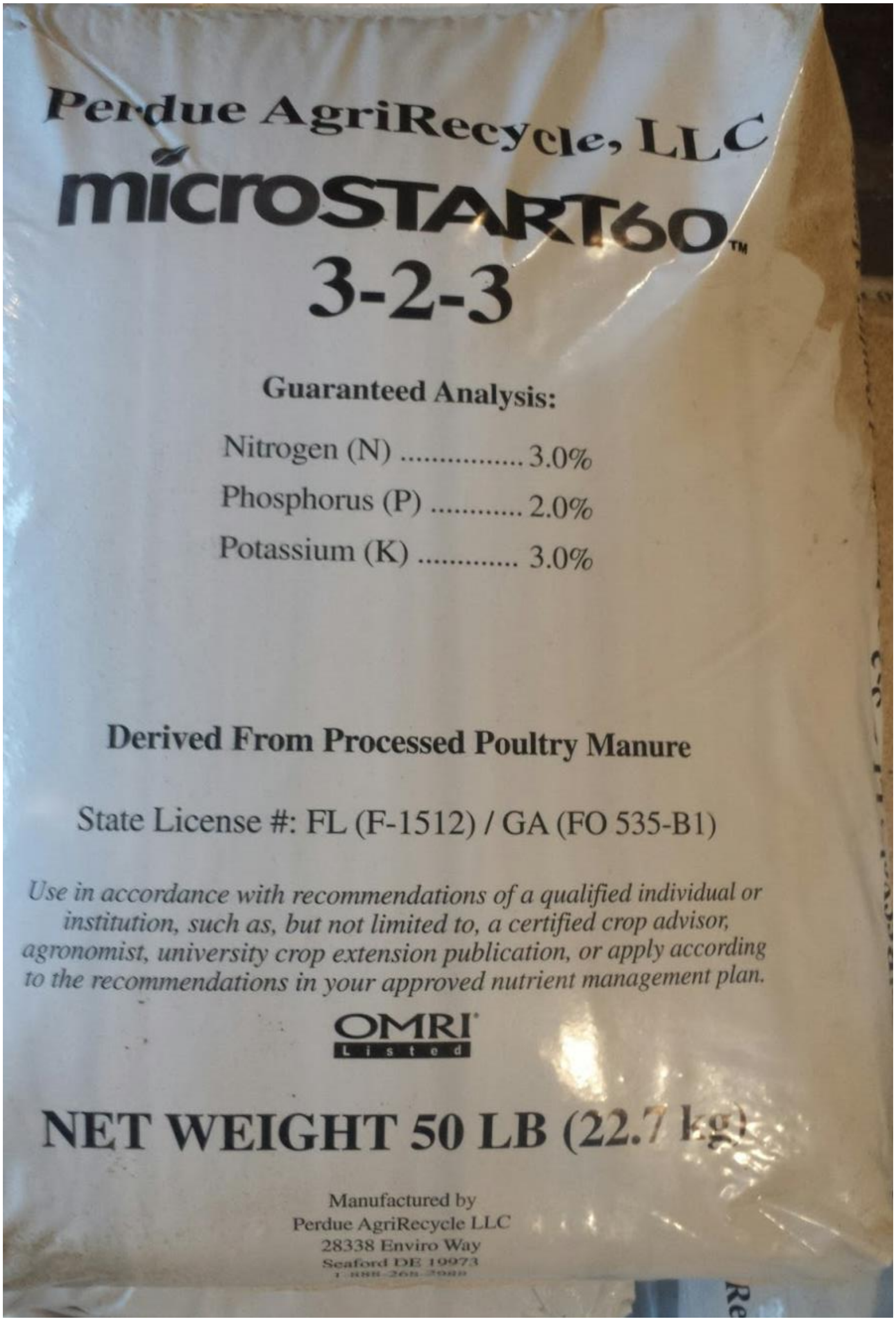
Flower Beds: In early spring apply 1 lb. (2 cups) per 25 sq. ft. Work into soil bed, plant flowers and water. Repeat application when buds begin to bloom.

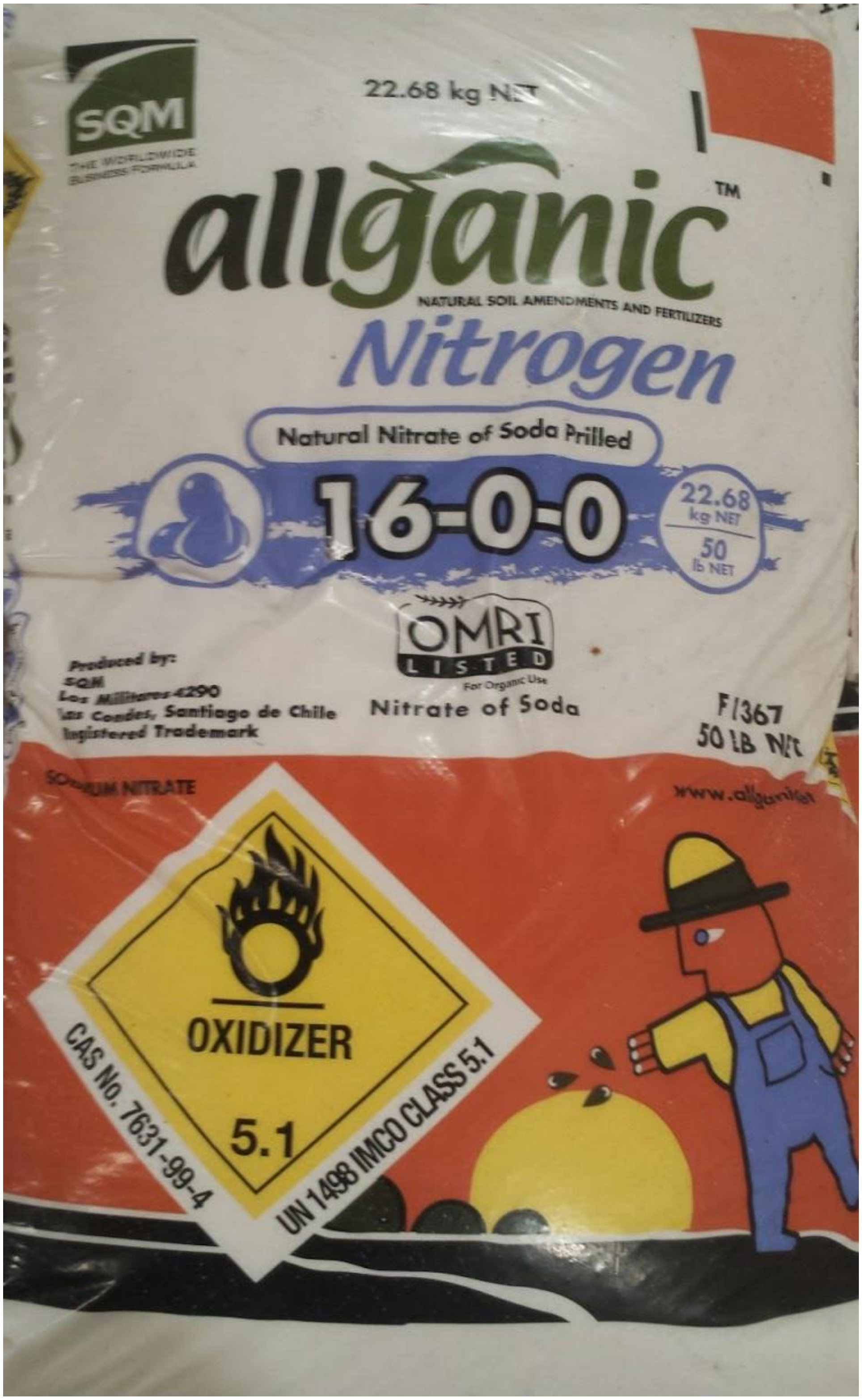
Organic Farming:

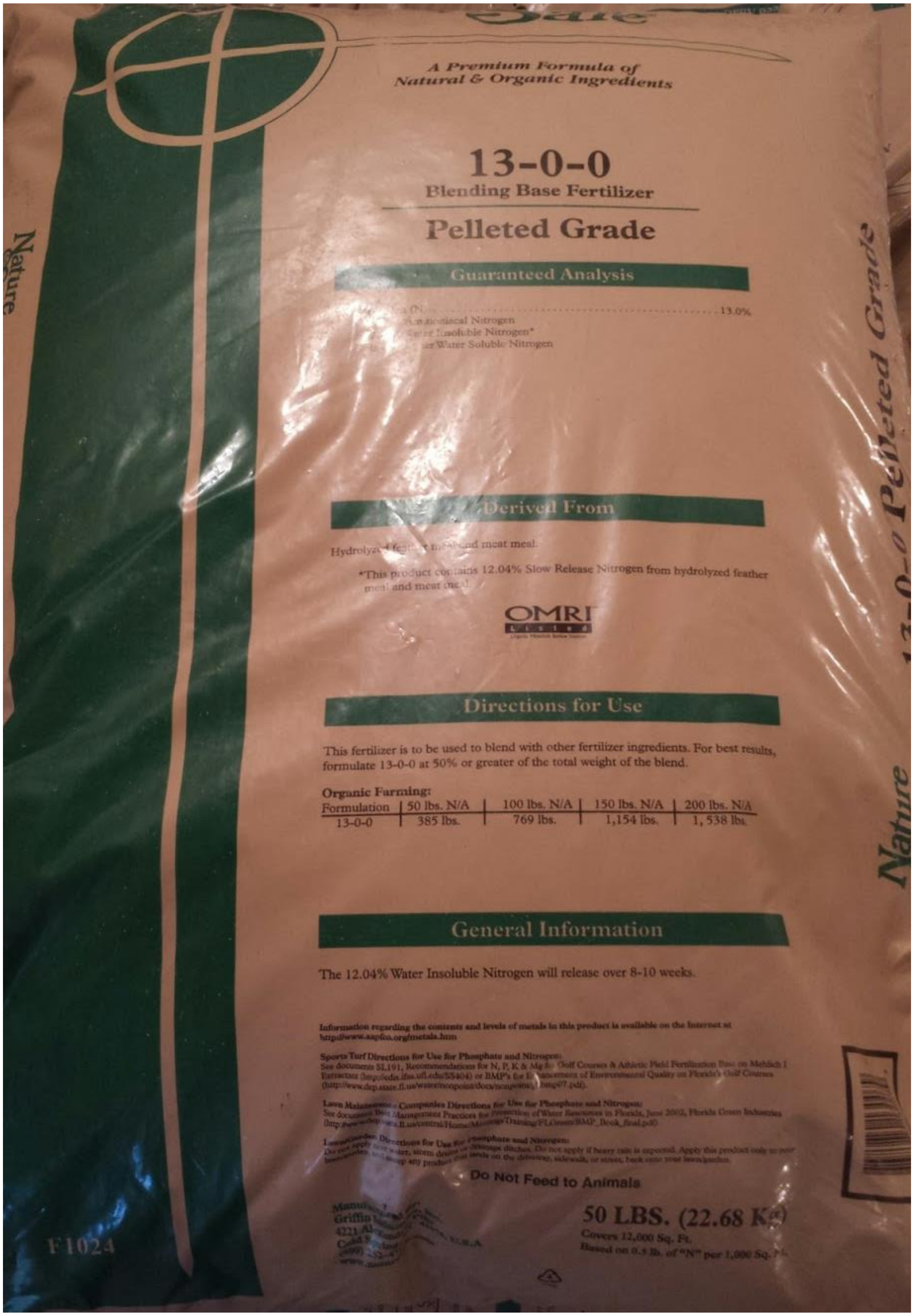
Formulation	50 lbs. N	100 lbs. N	150 lbs. N	200 lbs. N
8-5-5	625 lbs.	1,250 lbs.	1,875 lbs.	2,500 lbs.

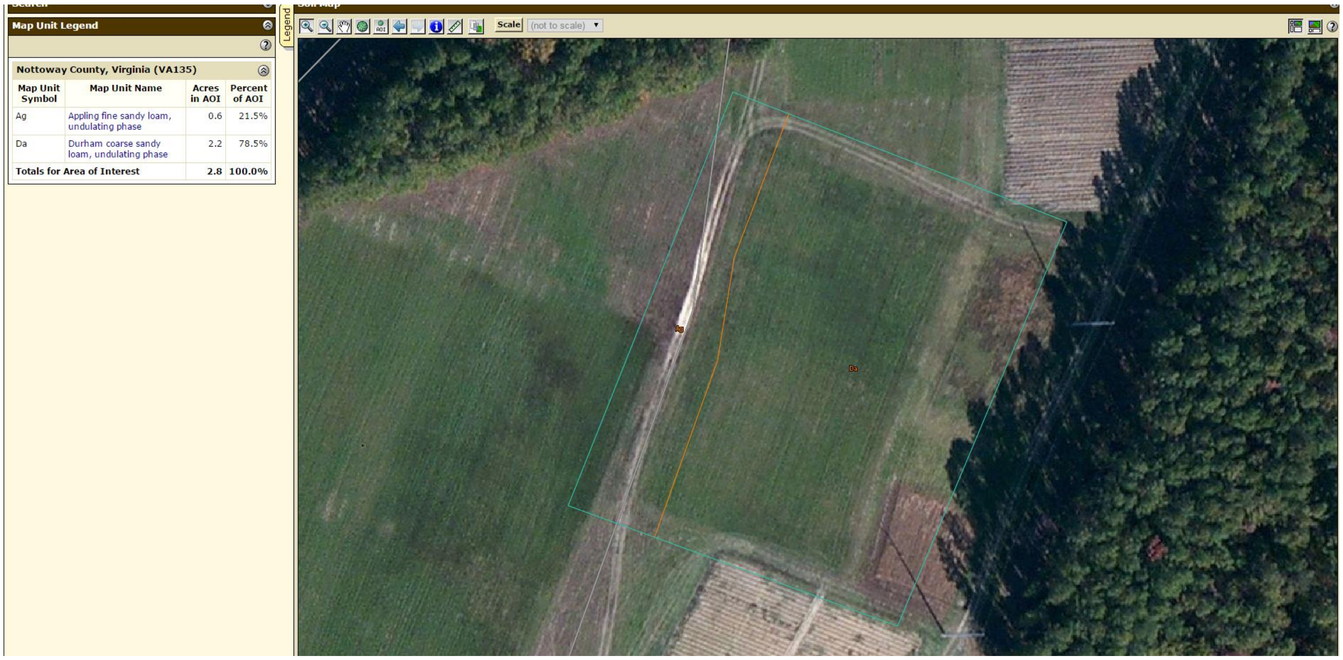
Griffin Industries • 4221 Alexandria Pike • Cold Spring, KY 41076
• (800) 252-4727 • Fax (859) 572-2574 • www.naturesafe.com •

SPEC-3


Perdue AgriRecycle, LLC
microSTART60™
3-2-3
Guaranteed Analysis:
Nitrogen (N) 3.0%
Phosphorus (P) 2.0%
Potassium (K) 3.0%
Derived From Processed Poultry Manure
State License #: FL (F-1512) / GA (FO 535-B1)
Use in accordance with recommendations of a qualified individual or institution, such as, but not limited to, a certified crop advisor, agronomist, university crop extension publication, or apply according to the recommendations in your approved nutrient management plan.
OMRI Listed
NET WEIGHT 50 LB (22.7 kg)
Manufactured by
Perdue AgriRecycle LLC
28338 Enviro Way
Seaford DE 19973


SQM
22.68 kg NET
allganic™
NATURAL SOIL AMENDMENTS AND FERTILIZERS
Nitrogen
Natural Nitrate of Soda Prilled
16-0-0
22.68 kg NET
50 lb NET
OMRI LISTED
For Organic Use
Nitrate of Soda
Produced by:
SQM
Las Condes, Santiago de Chile
F/367
OXIDIZER
5.1
CAS No. 7631-99-4
UN 1498 IMCO CLASS 5.1


A Premium Formula of
Natural & Organic Ingredients
13-0-0
Blending Base Fertilizer
Pelleted Grade
Guaranteed Analysis
13.0%
Derived From
*This product contains 12.04% Slow Release Nitrogen from hydrolyzed feather
OMRI
Directions for Use
This fertilizer is to be used to blend with other fertilizer ingredients. For best results, formulate 13-0-0 at 50% or greater of the total weight of the blend.
Organic Farming:
Formulation | 50 lbs. N/A | 100 lbs. N/A | 150 lbs. N/A | 200 lbs. N/A
13-0-0 | 385 lbs. | 769 lbs. | 1,154 lbs. | 1, 538 lbs.
General Information
The 12.04% Water Insoluble Nitrogen will release over 8-10 weeks.
Do Not Feed to Animals
50 LBS. (22.68 K
F1024
Nature
13-0-0 Pelleted Grade
Nature


Map Unit Legend
Nottoway County, Virginia (VA135)
Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI
Ag | Appling fine sandy loam, undulating phase | 0.6 | 21.5%
Da | Durham coarse sandy loam, undulating phase | 2.2 | 78.5%
Totals for Area of Interest | 2.8 | 100.0%
Legend
Scale
(not to scale)