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THE COBY PROCESS: NEW VALUE-ADDED USES OF COTTON BYPRODUCTS FOR THE GREEN INDUSTRY

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Abstract

Byproducts produced from cotton gins are commonly seen as a financial liability affecting the bottom line to the producer. The COBY process was developed with the intention of adding value to these byproducts in an effort to change the liability into a source of revenue for cotton gins and producers alike. The COBY process is designed to produce various end use products from the same raw material. One of these products is mulch. The purpose of this research was to evaluate various application rates of COBY in suppressing weeds and to determine if the product had any adverse affects on plant growth and flower quality. Studies were conducted at two different locations to evaluate and compare the COBY product in use as a dry-applied mulch for flowering plants. Ten separate treatments were evaluated for a period of six weeks. The results showed that, after six weeks, the application rates of 400 and 600 lbs per 1000ft^2 successfully suppressed weeds without adversely affecting flower quality.

Introduction

Gin byproducts are primarily comprised of organic matter such as lint, immature seed, burs, sticks, and leaves. In addition to the organic matter, other items such as soil (sand) and/or rocks can be in the byproducts produced from a cotton gin. Various applications for cotton gin byproducts have been researched extensively over the past four decades. Uses for gin byproducts that have been researched include: 1) livestock feed (Ardnt et al., 1980; Ardnt and Richardson, 1985; Poore and Rogers, 1995), 2) energy source (Lalor et al., 1976; LePori et al., 1981; White et al., 1996), 3) raw materials in construction products (Biblis, 1977; Kolarik and Smith, 1978), and 4) soil amendment (Box and Walker, 1959; Yau and Chang, 1972; Huitink, 2002). All of these applications have shown promise, however, a consistent widespread use of this biomass has yet to be realized across the cotton belt.

The Green Industry is an industry that focuses on recycling man-made and natural products to promote environmental friendly applications that help reduce waste and emissions from industrial sources. The Green Industry is commonly associated with the landscaping and horticulture industries. It is these industries where the long-term potential use of gin byproducts may be best suited. These industries focus on areas such as weed suppression, grass seed establishment, bedding mulches, fertilizers, and erosion control. The use of a value-added product produced from gin byproducts that could meet the specifications and supply the demand for the various products used, in these industries, could result in a viable use of this raw material and provide an additional source of revenue to producers and gins alike.

One of the areas researched, soil amendment, has focused on the use of both the raw and/or composted material. Of these two areas, the composted product is the most cost and labor intensive and can take from 3 to 7 weeks (Alberson and Hurst, 1964; Hills et al., 1981; Hills, 1982). The COBY process (Holt and Laird, 2002) developed at the USDA-ARS, Cotton Production and Processing Research Unit in Lubbock., Texas, is a method of adding value to waste byproducts from cotton processing facilities. The reasons behind the development of the process were: 1) To produce various marketable products by adding value to the raw material; 2) Reduce the abrasiveness of cotton byproducts commonly encountered in processing; and 3) Develop a process that could be relatively easily installed and operated at existing cotton processing facilities. Some of the products considered in the development of the process were the production of soil amendments such as a mulch or fertilizer. In the case of a fertilizer, the byproducts would act as an organic carrier for the nitrogen (N), phosphorous (P), and/or potassium (K) desired. Likewise, other additives necessary for weed or pest control could be added with relative ease. In the case of a mulch, the COBY technique would process the material in such a manner that weeds, disease, and/or insects could be eliminated from the raw material thus enhancing its value for various mulch applications such as hydro-seeding, bedding, grass seed establishment, and/or growing medium. These various uses of the COBY product have yet to be evaluated. The objectives of this study were two-fold: 1) evaluate the COBY products effectiveness at suppressing weeds and 2) determine if it adversely affects plant growth.

Materials and Methods

Plot Layout and Treatment Application

All treatments were evaluated at two locations: Manteno and Urbana, IL. Experiments were established on June 18, 2002 at Manteno and June 19 at Urbana. The experimental flowerbeds were first treated with glyphosate (500 mL/L) to kill all existing vegetation. After 10 days, the soil was tilled to a depth of 4 inches using a roto-tiller. The ground was graded smooth using a gill bar to ensure a firm soil for establishing ornamental plants. The flowerbeds were relatively flat at the time the treatments were established. The plot size for each treatment was 5 ft x 5 ft = 25ft^2. The mulch treatments were applied by hand to establish a uniform distribution of material in each plot. COBY materials required hand separation in order to achieve a uniform distribution in each plot. Ageratum (*Ageratum houstonianum*), also known as Floss Flower (cultivar 'Hawaiian Blue') and shown in Figure 1, were started in a greenhouse potting mix and transplanted into the plots when the plants were about 4 inches tall (about 6 weeks from seeding). Ageratum plants were established on 1 ft centers, i.e., 25 plants per plot. The plants were established in the plots by digging a shallow hole (3 inches deep) and gently firming the soil around the stem of the plants. The mulch treatments were moved aside prior to planting the Ageratum and then the mulch was relocated around the base of each plant. Immediately following the planting of the Ageratums, the entire experimental area was watered using an irrigation system in such a manner as to saturate the soil and ensure complete uniform coverage of all plots. The planting beds were maintained in a moistened condition. Figure 2 shows a picture of the final layout of the plots prior to testing.

The COBY Product

The raw material used was unground byproducts acquired from a commercial gin located in the South Plains of Texas. The material was processed, using the COBY technique, at a facility used to crush cottonseed and produce crude cottonseed oil and cottonseed meal pellets. This facility was chosen since a majority of the equipment needed was already in place. Figure 3 shows a schematic of the equipment used to produce the COBY product.

The material was loaded into a conveyor hopper that supplied the bulk feed bin. The bulk feed bin was a live-bottom bin with three 12-inch augers. Upon exiting the feed bin, the gin byproducts were sprayed with a starch and water slurry and conveyed, in a 12-inch auger, to a side-feeder that force-fed the byproduct slurry mix into an Insta-Pro model 2500 extruder. The product exiting the extruder was conveyed to a storage pile where the product was gathered and then hauled to a separate building for drying. Since this facility did not have a belt drier, stacking the wet material over a 40-foot span of 10-inch perforated PVC pipe and pulling ambient air through the pile dried the product. The product remained on the drying line for 24 to 48 hours depending on the relative humidity. Once dried, the product was bagged and shipped to Summit Seed Incorporated in Manteno, Illinois.

The starch slurry consisted of 2 lbs of starch to every gallon of water in the slurry tank. The starch/water slurry was not gelatinized prior to the extruder. Instead, the extruder was used to gelatinize the starch during the extrusion process. The starch slurry was applied at a consistent rate via a gear pump driven by a 0.75 Hp DC motor regulated by a DC drive. The amount of starch added to the byproducts was 6% by weight of the products (i.e. 30 lbs/min of byproducts had 1.8 lbs/min of starch added). Feed from the bulk feed bin was determined from a curve established prior to producing the mulch. A Siemens 20 Hp frequency inverter connected to a 10 Hp AC motor regulated the output from the bulk feed bin. The AC motor powered the feed bin augers through a 60 to 1 gear and sprocket reducer. Prior to processing the mulch, the raw material was loaded into the bulk feed bin and emptied into a bin placed on a scale at four different drive settings. The amount of material emptied during 15 minutes of operation was recorded for each of the four settings. This procedure was repeated three times for each setting in order to establish the curve necessary to determine the raw material output of the bulk feed bin at various intermediate frequency settings. The same procedure was followed to produce a curve for the starch/water slurry output. Temperatures of the extruder were recorded from two type-K thermocouples placed within the thermocouple wells located on the extruder barrel.

Experimental Design and Data Collection

There were ten treatments consisting of three COBY (COBY 200, 400, and 600), three Silt Stop® mixtures (Silt Stop 3.5, 7, and 10.5), three COBY/Silt Stop blends (COBY/Silt Stop 200, 400, and 600), and a control. Silt Stop® is a polyacrylamide erosion control powder that is commonly used in the hydro-seeding industry to reduce soil erosion. Silt Stop is a registered trademark of Applied Polymer Systems Incorporated. The Silt Stop treatments evaluated in this study were mixed with gypsum at a rate of 1oz per 33oz of gypsum in order to enhance handling characteristics of the Silt Stop. The application rates per 1000 ft^2 for the COBY and COBY/Silt Stop blends were: 200, 400, and 600 lbs. For the COBY/ Silt Stop blends, the COBY was applied to the plot first and then covered with a uniform rate of the Silt Stop/gypsum mixture. The application rates for the Silt Stop mixtures were: 3.5, 7, and 10.5 lbs/1000 ft^2.

The experiments at the two test locations were arranged using a completely randomized block design with four replications. Standard analysis of variance techniques were used to analyze the data to determine statistically significant differences among the three treatments by the Ryan-Einot-Gaberiel-Welsch Multiple Range Test at the 90% confidence interval. The first ratings for each trial began one week after the planting date. All plots at both locations were evaluated weekly for: 1) flower quality of the Ageratum; and 2) number of weeds visible. At the time of the first rating, only Ageratum quality was evaluated since no weeds had emerged. The plots were rated for five consecutive weeks with visible weeds beginning on the second week after planting.

Results

The effects of the treatments on flower quality are shown in Table 1 for the first and fifth weeks readings. There was no significant difference in flower quality due to the treatments at either the Manteno or Urbana test sites. However, after the first week at both test sites, the plots containing the 600 and 400-pound application rates of the COBY product had plants that exhibited signs of temporary nitrogen burn. After the third week, all signs of nitrogen burn were gone and the plants did not display any additional differences from the control. After the fifth week, at both locations, no significant differences were noted in either plant robustness or flower quality for any of the treatments.

Table 2 shows the average number of weeds for each treatment at both the Manteno and Urbana test locations. Since the weeds did not appear until after the first week, the first and last readings (Week 2 and Week 6) are shown in the Table 2. After the second week at the Manteno test site, the COBY 600 test plots had an average weed count of 0.25 that was significantly different from the control (10.56), Silt Stop 7 (11.75), and Silt Stop 10.5 (10) treatments. At the Urbana test site, all of the COBY 400 and 600 treatments displayed significantly fewer weeds than the control, Silt Stop 3.5, and Silt Stop 7 plots. After the sixth week at both locations, all of the COBY 400 and 600 treatments had considerably less weeds than the control and two of the Silt Stop treatments. However, the COBY 200 treatments did not significantly suppress weeds, compared to the control, at either location.

Conclusions

Overall, the treatments containing the higher application rates of COBY exhibited fewer weeds than did the other treatments. The suppression of weeds was shown to occur without adversely effecting flower quality of the Ageratums. However, the COBY 200 treatment's success varied from the control according to location, indicating that the desired COBY application rate necessary to adequately suppress weeds is higher than 200-lbs/1000 ft^2. Results from this study indicate promising potential for the use of COBY in weed suppression applications. Currently, the market for wood and bark mulches is estimated at a half billion dollars a year (Wilkinson, 2003) with a yearly consumption of 13 to 15 million tons. This estimate contains only wood and bark mulches since these products are processed and records are easier to obtain than with non-processed materials such as straw and pine needles. The introduction of processed gin byproducts into a market this large would have limited impact on the overall supply and demand and could provide an ideal application for their use.

Because of this work, future studies are planned to further evaluate COBY in various applications associated with the Green Industry. Future COBY mulch work will include: 1) comparison to traditional mulches such as wood bark and pine needles; 2) determine its effectiveness at reducing soil erosion versus commonly used methods; 3) evaluate its use in turfgrass establishment applications; 4) assess whether it is more effective in loose or pelleted formulations; 5) document the degree to which the COBY process destroys weed seed in the raw material (gin byproducts), and 5) evaluate its use in hydro-seeding applications.

Acknowledgement

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Disclaimer

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Table 1. Mean flower quality results (9=robust plant) from four replications for the Manteno and Urbana test plots for the first and fifth weeks.

Treatments[#]	Manteno, IL		Urbana, IL	
	First Week	Fifth Week	First Week	Fifth Week
COBY 600	6.75*	7.50	6.00	7.25
COBY 400	6.75	7.75	6.00	7.00
COBY 200	7.00	8.00	6.50	7.50
Silt Stop 3.5	7.25	8.00	6.00	7.00
Silt Stop 7	7.25	8.00	6.00	7.25
Silt Stop 10.5	7.25	7.75	6.50	7.50
COBY/Silt Stop 600	6.50	7.50	6.25	7.75
COBY/Silt Stop 400	7.00	7.25	6.75	7.75
COBY/Silt Stop 200	7.00	8.00	6.25	7.25
Control	7.70	8.00	6.25	7.50

The numbers following the treatment names indicate the amount of product (lbs) applied per 1000 square foot (i.e. COBY 600 was 600 lbs per 1000 ft^2). The COBY/Silt Stop treatments were blends that contained the same amount of Silt Stop and applied at the rates listed.

* There were no significant differences between treatments for each recording period.

Table 2. Mean number of weeds from four replications for the Manteno and Urbana test plots for the second and sixth weeks.

Treatments#	Manteno, IL		Urbana, IL	
	Second Week	**Sixth Week**	**Second Week**	**Sixth Week**
COBY 600	0.25b*	8.75c	1.00b	30.00cd
COBY 400	8.50ab	18.75c	1.50b	48.75bc
COBY 200	7.50ab	32.50bc	5.75ab	73.75a
Silt Stop 3.5	6.50ab	62.50a	9.75a	92.50a
Silt Stop 7	11.75a	48.75ab	10.50a	88.75a
Silt Stop 10.5	10.00a	60.00a	5.75ab	77.50a
COBY/Silt Stop 600	3.25ab	17.50c	0.00b	21.25d
COBY/Silt Stop 400	4.00ab	15.00c	1.25b	52.50b
COBY/Silt Stop 200	7.75ab	30.00bc	3.25b	78.75a
Control	10.56a	53.33ab	9.75a	82.50a

The numbers following the treatment names indicate the amount of product (lbs) applied per 1000 square foot (i.e. COBY 600 was 600 lbs per 1000 ft^2). The COBY/Silt Stop treatments were blends that contained the same amount of Silt Stop and applied at the rates listed.

* Means within the same column followed by different letters are significant at the 90% confidence limit.

Figure 1. Picture of Ageratum, also known as Floss Flower, used in this study.

Figure 2. Final layout of treatments, prior to evaluation, at the Manteno, Illinois test site.

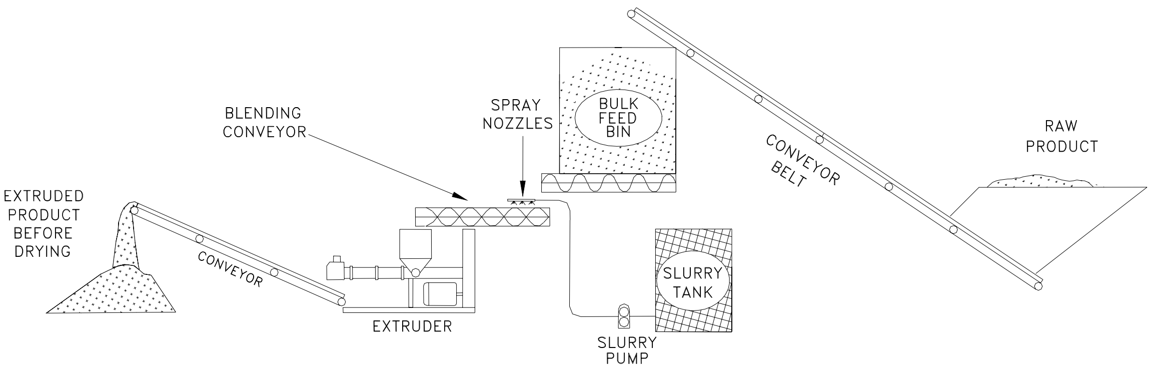

Figure 3. Schematic of processing equipment used to produce COBY product.