Green Gorilla®

ProLine Series

Future of Spraying In Pest Control:

Automated Compressed Air Technology Vs. Manual Pump Systems

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Stagnation of New Delivery Methods

For almost 125 years the professional pest control industry has attempted to evolve the delivery of pesticides in an effort to control and eliminate pests in both residential and commercial environments. Although pesticides have radically changed and evolved over this time period, from chlorinated hydrocarbons and organophosphates, to today's most widely used pesticides: neonicitodes and synthetic pyrethroids, delivery systems have not.

During this time period, numerous formulations have been developed: from baits, gels, dusts, aerosols, and the ever present liquid formulations in an effort to deliver the most effective active ingredient to eliminate pests. However, while the formulations have evolved, the delivery systems have remained unchanged.

Using Technology to Drive Growth

As fast-growing companies achieve greater market penetration, gain more customers, they often struggle to keep up with the demand. The key challenge to supporting that growth is laying the groundwork to scale the business effectively and efficiently while maintaining customer service.

Over the past several years there have been tremendous technology advances in the areas of digital instrumentation, microprocessors and rechargeable battery cells. These advancements have allowed age old products across many industries to make an evolutionary step forward. The hand held compressed air sprayer is one such product where technology can be applied to make a significant impact for companies that use sprayers on a daily basis in many industries.

This white paper compares traditional manual commercial sprayers to the Green Gorilla intelligent commercial spray system and provides the impact to total cost of ownership. By better understanding the differences between each system the Pest Management Professional (PMP) will be in a much better position to understand how automation can help their company grow more rapidly and become more profitable.

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Over the last several decades, there has been intense emphasis on driving improvements in service delivery, i.e. productivity by the service provider (the PMP, technician, or route manager), in order to improve the profits of the owner operator(s) of the pest control business. Some of these technologies are as follows:

1. Cell phones for easier access to the end user customer to contact the service provider in a timely manner.
2. GPS technology so that the service provider can reach and service a Customer in a timely manner.
3. Routing and Scheduling Technology so the service provider can route and schedule Customers in a tighter grid pattern.
4. Handheld computer systems to minimize paper work and allow the service provider better accuracy in customer accounts.

"I purchased a Green Gorilla with Advanced Spray Technology for an employee who had been complaining about shoulder issues from constantly having to pump a backpack sprayer.

Since then the employee loves it and the productivity has definitely increased. We plan on purchasing one for each of our service trucks."

-Keith Brooker, CEO of Paragon Pest Solutions, Inc. Brevard, Fl

Unfortunately, none of these technologies have improved the physical day to day strain and fatigue of the service provider. They have, however, to some extent, improved productivity and profits.

As stated previously, the delivery of pesticides has evolved very little over the past 125 years. For the purposes of this discussion, a focus specifically on the delivery of liquid pesticide formulations, hence compressed air sprayers, is given.

Comparing the Automated Vs Manual Sprayer

The modern commercial compressed air sprayer used in the pest control industry for the past 6 decades was developed in the early 1950's.

There are several challenges with this technology as follows:

1. Pumping is non-productive time that does not produce results i.e., productivity or profits.
2. Precision control for the delivery of pesticides is virtually impossible in the course of a treatment.

3. Manual hand pumping, the primary method to pressurize the tank, is timely and fatiguing. It is estimated that a service provider can exceed hundreds of pumps in an average day of service.

4. This repetitive pumping action, over years of use, wears on the service provider's physical well-being.

5. Having been designed during the 1950's it has a 1950's look. In essence it has not changed or evolved with the pest control industry.

"The Green Gorilla has been a great addition to our arsenal in serving our residential and commercial pest customers.

We use the Green Gorilla as an outside perimeter treatment to control ants, cockroaches, and crickets.

The battery pack allows us to perform the service quicker."

-John Faulkner
Owner of Faulkner Pest Service
Amarillo, TX

Comparison of Systems

To quantify the differences in application time between systems, lab testing was performed on a traditional manual pump sprayer and an automated spray system. The equipment used in the tests were the B&G 1-gallon capacity sprayer and the Green Gorilla ProLine Vi Series System 1.5-gallon capacity. Both pieces of equipment are considered low pressure systems (less than 25 psi) and the type typically used in the field for pesticide delivery.

Testing was performed to evaluate the impact of manual pumping on delivery with respect to both time and pressure consistency. Inefficiencies in time directly impact productivity and large pressure variations directly impact rate of delivery ultimately impacting the consistency of the pesticide barrier. Therefore, studies to understand and quantify the differences is of great importance to the PMP's.

To normalize wand differences between systems, calibration of the flow rate between the B&G sprayer and the Green Gorilla ProLine System was completed by initially setting a nozzle pattern and using the same wand, nozzle and nozzle pattern on each tank. This method ensured identical flow rates and pattern profile, as well as, eliminated uncertainties with respect to nozzle manufacturing tolerances and pressure drop within the spray handle itself. Flow rate for each spray pattern was measured and documented using a calibration container for each test performed.

The impact on flow rate due to the differences in the manufacturers supply tube and inside diameter of the wand hose are assumed to be negligible. This is a reasonable assumption because the nozzle flow area is orders of magnitude smaller than the flow areas associated with these components which results in the largest pressure drop occurring at the nozzle.

For testing, the AA31 shutoff valve body equipped with an 18-inch extension and a 5500-X8 nozzle manufactured by Tee Jet® Technologies, were used. The 5500-X8 nozzle is an adjustable cone jet tip that rotates through a half turn to provide a wide angle cone pattern to a straight pin stream spray. Both the pin stream and cone pattern are typical field spray patterns used by the PMP, a variation of each of these spray patterns was evaluated in this study.

The first nozzle setting was a pin stream spray to simulate the user reaching overhead locations such as under eves or along roof edges. The flow rate for this nozzle setting was tested and documented to be 1100ml/min at 18 psi. The second setting tested was a cone spray pattern. This pattern is typically used in perimeter applications. The flow rate for this pattern was measured and documented to be 925ml/min at 18 psi. This pattern produced a 10-inch diameter cone at a distance of 18-inches from the surface (30° Spray Pattern).

All flow tests are performed by spraying 1 gallon of water into a calibration container. The test began with the system at the required starting pressure. For all tests performed on the manual sprayer, both pressure and number of times the manual pump was cycled were documented. For the automated system, the operating pressure throughout the test was documented. Monitoring of the tank pressure was accomplished through the use of an integrated pressure gauge. The same pressure gauge was used in all test. The results of these tests are shown in Table 1 on the following page.

> I've worked in the pest control industry all my life… But it is rare that a product stands our like your Green Gorilla sprayer.
>
> …I have to admit I was somewhat skeptical. The product is well designed and works great.
>
> My son saw me use it, borrowed it, and as a result I had to order another one. My brother saw me use it, borrowed it, and I had to order another one. I guess that's what comes from working in the family business! I'm only concerned my other employees will want them too.

- Arnie Fishon
ABCO Termite & Pest Control, Inc. Stony Brook, NY

Spray System	Contents	Volume Sprayed (gal)	Pressure Range (psi)	Spray Pattern	Spray Time (min:sec)	# of Pumps
B&G	water	1	16-18	Pin Stream	4m:49s	24
B&G	water	1	16-18	Cone	6m:18s	22
GG ProLine	water	1	16-18	Pin Stream	3m:25s	N/A
GG ProLine	water	1	16-18	Cone	4m:10s	N/A

Table 1

Test Results of manual vs. automated spray system

Results Summary

The lab results indicate that the time to spray 1 gallon of water was reduced by 29.2% using the Green Gorilla ProLine System in a pin stream pattern configuration. The time to spray 1 gallon of water was reduced by 33.8% using the Green Gorilla ProLine System in a cone pattern configuration.

Lab testing of the manual system showed an average of 23 stoppages to manually pump the tank to maintain pressure within 2 psi. The Green Gorilla ProLine system pressure was monitored throughout the spray test and consistently maintained pressure within the appropriate 16-18 psi pressure range. The next section details testing over a wider range of pressure typical for manual type sprayers used in the field and the impact on flow rate and delivery.

Precision Control

For compressed air sprayers the flow rate at the tip is directly related to tank pressure. Using classical engineering methods to calculate flow through an orifice, it is shown that the greatest variance in flow rate with respect to pressure occurs from 0 to 50 psi. Figure 1 shown below graphs flow rate as a function of pressure for an orifice size of 0.050-inches which is a typical opening size for many spray tips. From the graph the percentage change in flow rate from 10 to 20 psi is 41%, from 20 to 30 psi is 22%, from 30 to 40 psi is 15% and from 40 to 50 psi is 11%. Hand held manual sprayers typically operate in the 10 to 20 psi range where small pressure changes have the highest impact on flow rate, or stated another way, a 41% change.

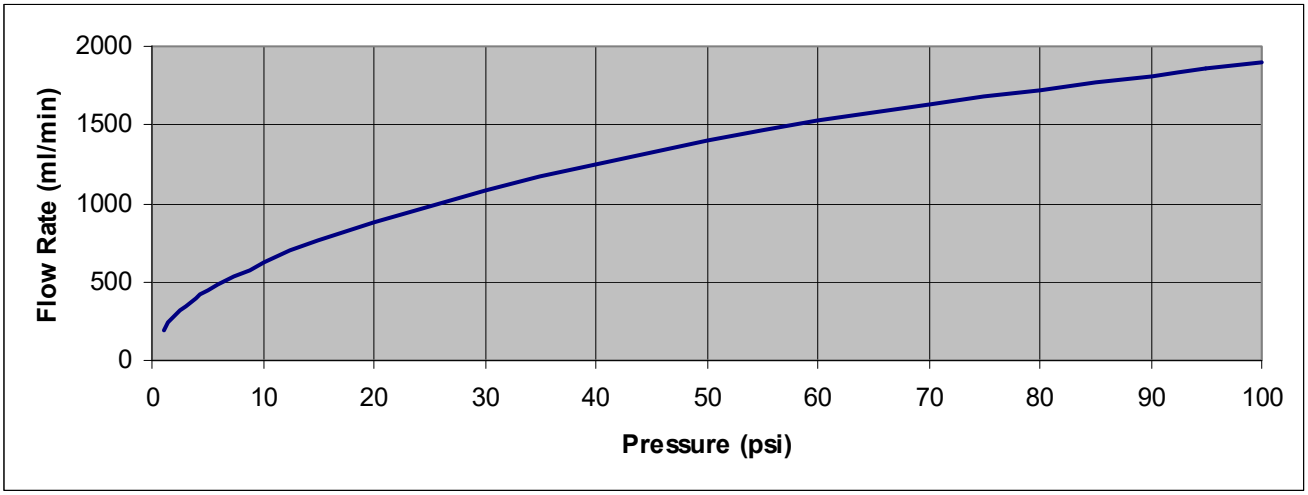

Figure 1

Flow Rate as a Function of Pressure

To better understand this relationship a study of flow rate and pressure was conducted simulating everyday commercial use. The study used a B&G 1-gallon sprayer equipped with an AA31 shutoff valve body, 18-inch wand extension and a X-8 Nozzle adjusted to a Pin Stream pattern. The system was equipped with a pressure gauge to measure tank pressure for the duration of the test. The tank was pumped to a pressure of 20 psi at the start of the test.

A group of users were then asked to spray and begin manual pumping when their observation of flow rate became too low. The results of the test showed the average minimum pressure or the pressure where they began pumping was 10.5 psi. The flow rate at each end of the pressure range was measured using a calibrated container. At 20 psi the flow rate was measured to be 1350 ml/min. The flow rate was measured again at 10.5 psi and was documented to be 750ml/min. This observation resulted in a 44% variance in product application which corresponds well with classical engineering calculations shown in the Figure 1 graph on the previous page. From this study, the main conclusion is, there is a large change in flow rate for relatively small changes in pressure. This directly equates to pesticide distribution and the integrity of the pesticide barrier when manual pump sprayers are used.

Figure 2 on the following page illustrates the drop in tank pressure as a function of time. The input to this graph is based on test results using a B&G 1-gallon sprayer with a Spray Systems X-8 nozzle adjusted to both a pin stream and cone pattern. The tank was initially filled with 1 gallon of water. From the graph it is shown that a 10 psi drop occurs in 28 seconds for a pin stream pattern and 35 seconds for a cone pattern. This equates to a significant amount of manual pumping during treatment and still results in a 41% to 44% variance in chemical distribution. The Green Gorilla ProLine Series systems virtually eliminates this variance by precisely controlling pressure throughout the delivery process resulting in a consistent pesticide barrier.

I have over 13 years experience in pest control and traditionally used B&G's over the course of my career. The Green Gorilla is a breath of fresh air, it is durable, has good power and the battery can last for days. I enjoy the plastic sprayer because I live in a colder climate and it has less parts to be broken by freezing weather. I am getting up to 15 ft with my pin stream applications without having to pump. It puts out a good amount of product and the adjustable spray nozzle is much easier to adjust than the B&G nozzle. Not to mention, it looks professional and my customers are always commenting on it. Without a doubt, this is one of the best sprayers on the market.

Josh McCloud
Owner/Operator
HoldFast Enviro Pest Solutions

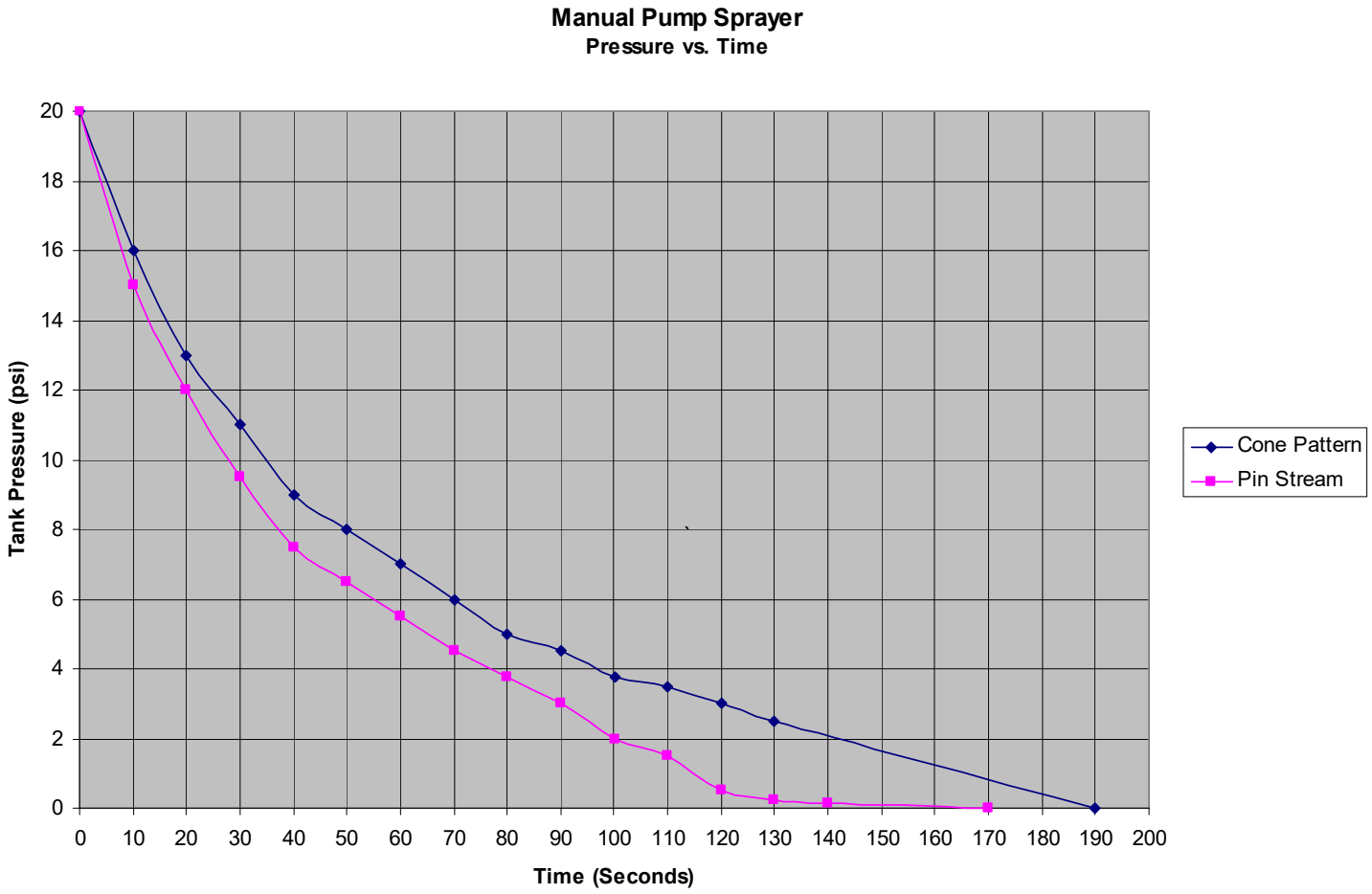

Figure 2

Reduction in tank pressure as a function of time

Total Cost of Ownership

When analyzing new equipment, purchasing decisions should consider the long term cost of ownership. The total cost of ownership over the life of the equipment is essential in determining the best value and return for the business operator. By understanding the total cost of ownership we enable ourselves to choose the best equipment with the highest Return on Investment (ROI), providing us with a competitive advantage in the marketplace.

This section details the analysis for total cost of ownership of both the Green Gorilla Spray System and a standard B&G pest control sprayer typically used in the pest control industry. When performing the study we followed the recommended maintenance schedule for both pieces of equipment over a 5-year period. The 5-year period represents the depreciable life of serviceable pest control equipment. The useful life of serviceable pest control equipment may be longer and is determined by the users care and maintenance of the equipment.

"Having a compressed air sprayer that enabled a steady rate of delivery is, in my opinion, the next generation of spray technology.

The lithium ion battery provides for consistent, uninterrupted service.

It tends to save you chemical and time by being able to provide a uniform application rate around a facility."

- Timothy A. Regal
Owner of Regal Pest Control, LLC, Plymouth, MI

The total cost of ownership analyses detailed in this white paper includes the initial purchase price as well as all of the direct and indirect expenses of using the equipment over a 5-year period. To quantify the operational cost, a consistent set of realistic parameters was applied to both pieces of equipment. The operational cost assumptions were based on spraying an average size single family home in the United States.

The United States Census Bureau (www.census.gov) determined that the median square footage for a single family home was 2,169 in 2010 and 2,467 in 2015. The majority of homes in the census data were between 1 and 2 stories with a small percentage being 3 story structures. Using this data it is conservative to assume an outside perimeter of 150 linear feet which equates to a 45 x 30 foot 2 story home size. For this analysis 160 linear feet of treatment was assumed, 150 linear feet on the exterior and 10 linear feet on the interior. This is representative for most residential treatments.

We assumed a typical application of TERMIDOR® 80 WG insecticide over 160 linear feet. Per the manufacture's label, the specified application rate is "2 quarts of Termidor 80 WG finished dilution per 160 linear feet. This dilution is to be applied at a low-pressure (25 psi or less at the nozzle) using a coarse general surface spray along the foundation exterior perimeter to an area one foot up and one foot out from where the ground meets the foundation."

The operational costs assumption considered spraying 12 jobs/day at an average spray pressure of 16-18 psi for 260 days per year. Each job is assumed to be 160 linear feet of application, as previously outlined , with a spray pattern consistent with the manufactures label. The cone spray pattern previously detailed in the Comparison of Systems section is the assumed pattern for each piece of equipment analyzed, as well as, the associated rate of delivery. This approach isolates the delivery time between the manual sprayer and the automated sprayer independent of the wand. Table 2 on the following page summarizes a 5-year total cost of ownership for the Green Gorilla 1.5-gallon ProLine Vi Pro system with an 8-inch extension and Table 3 summarizes a 5-year total cost of ownership for the B&G 1-gallon sprayer with a 9-inch extension. The same wand configuration was used on each system during operational testing. The wand configurations specific to each system are used in determining the 2016 purchase price of the systems.

GREEN GORILLA 1.5gal with 8" Wand						
Cash Outflows	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Purchase Cost	$377.01	$0.00	$0.00	$0.00	$0.00	$377.01
Maintenance						
PowerPack Filters	$7.60	$7.60	$7.60	$7.60	$7.60	$38.00
Lithium Ion Batteries	$0.00	$0.00	$29.85	$0.00	$0.00	$29.85
O-Ring Seal Kit	$0.00	$0.00	$9.09	$0.00	$0.00	$9.09
Strainer	$1.66	$1.66	$1.66	$1.66	$1.66	$8.30
Wand Hose	$0.00	$0.00	$21.31	$0.00	$0.00	$21.31
Maintenance Labor ($25/hr)	$6.30	$6.30	$12.60	$6.30	$6.30	$37.80
Labor Cost to Charge PP and Clean Tank	$655.20	$655.20	$655.20	$655.20	$655.20	$3,276.00
Labor Cost to Treat	$2,730.00	$2,730.00	$2,730.00	$2,730.00	$2,730.00	$13,650.00
Yearly Total	$3,777.77	$3,400.76	$3,467.31	$3,400.76	$3,400.76	$17,447.36

Table 2

Green Gorilla ProLine Vi Series Total Cost of Ownership

(Excludes Wand Maintenance)

B&G 1gal with 9" Wand						
Cash Outflows	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Purchase Cost	$280.00	$0.00	$0.00	$0.00	$0.00	$280.00
Maintenance						
GD-124 Replacement kit	$37.00	$37.00	$37.00	$37.00	$37.00	$185.00
Wand Hose	$0.00	$0.00	$25.16	$0.00	$0.00	$25.16
Strainer Kit	$13.00	$13.00	$13.00	$13.00	$13.00	$65.00
Maintenance Labor ($25/hr)	$6.30	$6.30	$12.60	$6.30	$6.30	$37.80
Labor Cost to Clean Tank	$546.00	$546.00	$546.00	$546.00	$546.00	$2,730.00
Labor Cost to Treat	$4,127.76	$4,127.76	$4,127.76	$4,127.76	$4,127.76	$20,638.80
Yearly Total	$5,010.06	$4,730.06	$4,761.52	$4,730.06	$4,730.06	$23,961.76

Table 3

B&G 1-Gallon Sprayer Total Cost of Ownership

(Excludes Wand Maintenance)

Tables 2 and 3 show the 5-year total cost of ownership for the Green Gorilla ProLine System as $17,447.36 and the B&G 1-gallon sprayer as $23,961.76. Each system can be adapted to several types of wands, therefore the maintenance cost associated with the wand was not included in the analysis. The total cost of ownership of the B&G 1-gallon system over 5 years of operation is $6,515 higher than the 1-1/2-gallon Green Gorilla ProLine Vi System based on treating 12 jobs per day for 260 days as outlined above, see Figure 3. Figures 4 and 5 on the following pages graph the annual savings benefit of using the Green Gorilla system for a wide range of the number of jobs and total linear feet sprayed per day, respectively.

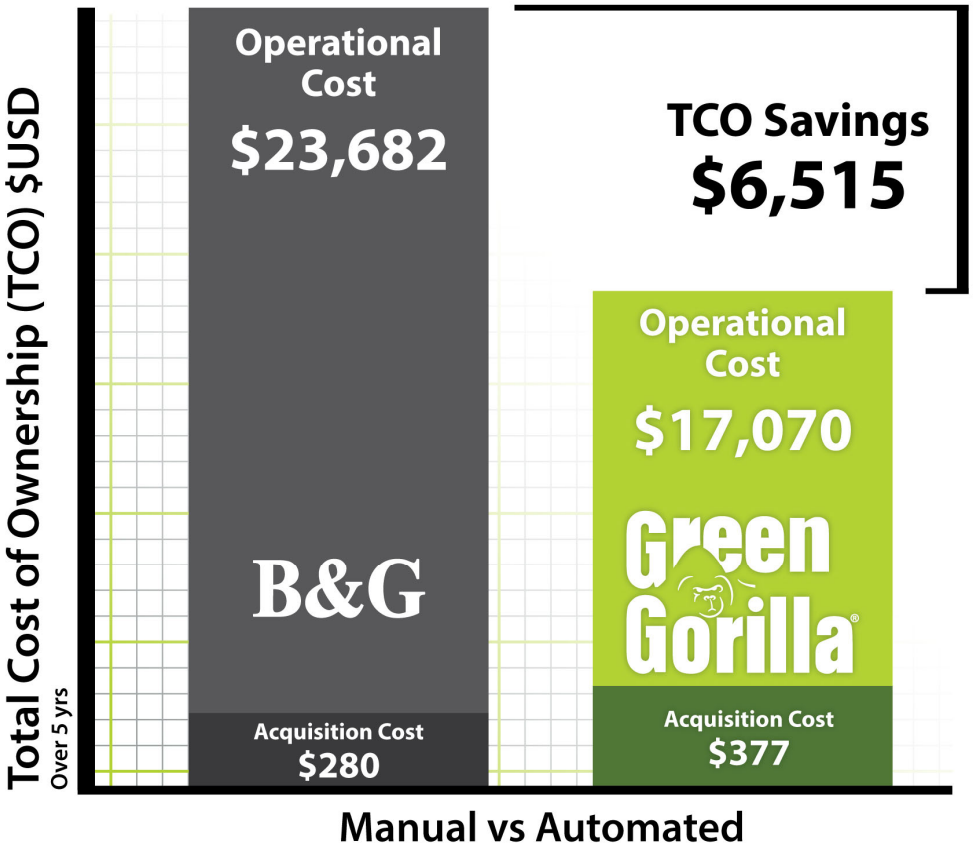

Figure 3

Total Cost of Ownership Comparison

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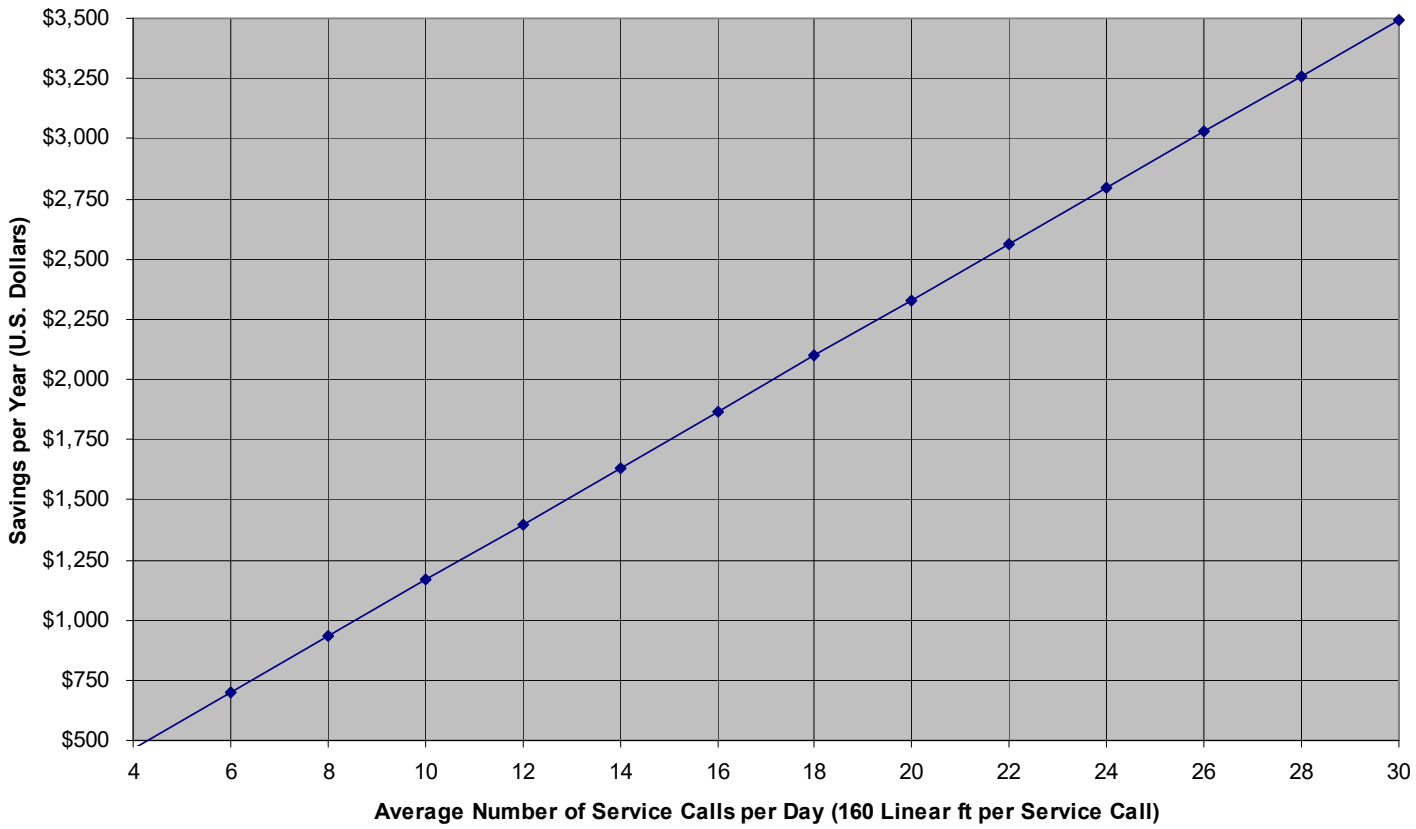

Figure 4

Savings per Year vs. Number of Service Calls per Day

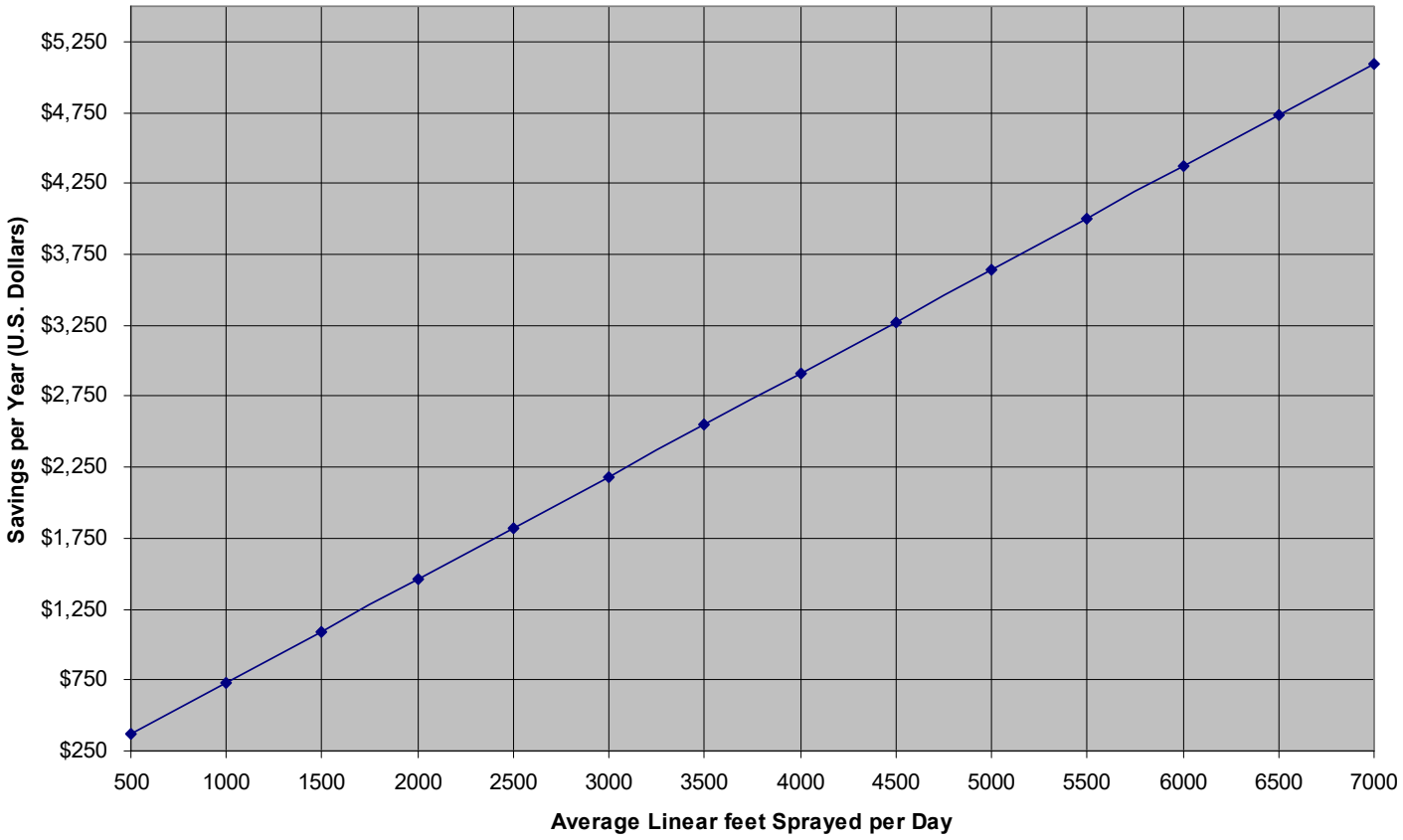

Figure 5

Savings per Year vs. Linear Feet Sprayed per Day

For the total cost of ownership analysis there are other factors to consider which cannot be universally applied or adapted to all users. Some of these factors include training costs, insurance cost, depreciation expense tax savings, change costs and call back/reapplication cost. When considering the Green Gorilla the impact on insurance cost with respect to workman compensation claims may be reduced due to the elimination of manual pumping. Call back and reapplication cost will be reduced due to precision control of pressure virtually eliminating weak areas in perimeter application due to under application of the pesticide. Each of these factors are unique to the owner/operator but, should be considered in the total cost of ownership when making an equipment decision.

Conclusion

When using a manual sprayer, precision control of pesticide delivery is virtually impossible due to the repetitive pumping required to maintain constant pressure. Because the end user has no way of knowing the tank pressure in a manual system, accurate pressure control is impossible. By implementing Smart Pressure Technology™ with the Green Gorilla ProLine system, the delivery system maintains optimum pressure and eliminates the need for pumping, reduces user fatigue and potential worker injury, improves application rate, and most importantly, improves productivity. In essence, this is the first automated delivery system of its kind that truly improves the service providers' ability to get more done in a day and ensures that all PMP's across the organization are applying the pesticide in the same way. It is estimated that on average a service provider pumps a traditional manual sprayer unit 100 + times per day.

Based on the lab tests, studies and analyses, it can be shown that a reduction in application time of up to 33% can be obtained using the Green Gorilla Intelligent Spray System for controlling tank pressure when compared to using a traditional manual pump sprayer. The reduction in spray time and precise pressure control directly equate to cost savings for the owner/operator. The cost savings is directly obtained through an increase in productivity as well as reduced customer call backs by applying a consistent pesticide barrier at the customer site.

When considering new equipment the total cost of ownership must be taken into account. The offset or price difference between the Green Gorilla ProLine System and the B&G 1-gallon system is $101. This initial purchase price difference is recovered through operational savings in the first 21 work days when using the Green Gorilla and the purchase price for the entire system is recovered in less than 4 months. These are very compelling reasons to consider this new technology when growing your business.

In Summary:

- The Green Gorilla ProLine System reduces delivery time 31.5% on average when compared to traditional manual sprayers.
- When using a traditional manual sprayer, operators do not begin to pump again until the pressure has dropped to 10.5 psi on average. This drop occurs in the first 28 to 35 seconds of treatment.
- Automation ensures label rate application.
- Total Cost of Ownership is reduced by 27% over 5-years when using the Green Gorilla ProLine System when compared to the B&G manual pump system.
- Using the Green Gorilla ProLine System ensures improved productivity, reduced user fatigue, and improved profits.