The Economics of Hoop House Fruits and Vegetables

By Jeri Donnell, Jon T. Biermacher and Steve Upson

A hoop house is “a freestanding or gutter-connected covered structure, without heating or electrical power, using passive ventilation for air exchange and cooling, and an irrigation system for crop production.” This “plasticulture” technology is promoted as having benefits, including reducing production risks associated with insect and disease control, and variable growing conditions. Hoop houses have also been said to have potential to extend the growing season to target fruit and vegetable production for niche marketing opportunities. Given the potential production advantages, many growers have been asking for economic information associated with hoop houses and whether or not this technology should be implemented in their operations.

To answer such questions, The Samuel Roberts Noble Foundation evaluated two fruit and vegetable cropping systems (System 1: spinach followed by tomato; and System 2: strawberry followed by yellow and zucchini squash) that were grown in high tunnel hoop houses in south-central Oklahoma for the 2007-2008, 2008-2009 and 2009-2010 growing seasons. The objectives were (1) to determine the expected cost of production for each crop and system, and (2) to determine the breakeven price for each crop in each system. The replicated study utilized four 1,400-square-foot, high tunnel hoop houses with each house having four 238-cubic-foot permanent raised growing beds. All fertilizer treatments were managed based on results from soil samples taken throughout the growing season, and all treatments for weeds, insects, fungi and diseases were administered as needed based on daily visual inspection. Labor requirements were also measured and recorded in hours into one of seven production categories: preplanting, planting, crop care, hoop house maintenance, harvesting, sorting and packaging, and post-crop cleanup. Enterprise budgeting techniques were used to determine expected values for cash operating expenses and fixed costs associated with depreciable assets.

Production yields averaged 648 and 1,918 pounds per house of spinach and tomato, respectively, and 518, 452 and 318 pounds per house of strawberry and yellow and zucchini squash, respectively. Growers can expect to experience less variation in spinach yield across growing seasons compared to the tomato, strawberry and squash crops. This is potentially a result of production timing and the disease/insect complex relative to plant type. Spinach is a cool-season crop that is not subjected to volatile spring temperatures or extreme heat. It is also a non-fruit producing crop, and, therefore, threatened by fewer diseases and/or insects compared to other crops in the study. Growers can also expect hoop house fruit and vegetable production to require a considerable amount of labor. The spinach/tomato system required an average of 152 hours of labor while the strawberry/squash system required an average of 114 hours of labor. Labor largely consisted of crop care and the combined activities of harvesting, sorting and packaging with an allocation of 29 percent and 42 percent, respectively, for the spinach/tomato system and 36 percent and 26 percent, respectively, for the strawberry/squash system.

Economic results indicate growers can expect operating costs to comprise approximately 40 percent of total costs while the remaining 60 percent is comprised of fixed costs associated with depreciable assets. Total costs were $3,620 and $3,461 for the spinach/tomato and strawberry/squash systems, respectively. Labor and house ownership and maintenance costs were the two largest expense categories for both systems;
percent and 26 percent, respectively, for the spinach/tomato system and 25 percent and 27 percent, respectively, for the strawberry/squash system.

Produce from this study was not marketed; however, breakeven prices were determined for each crop in each system, as reported in Table 1. For the scenario where all spinach and tomato produce is sold and labor is valued at $7.75/hour, growers need to receive $3.04/lb for spinach and 86 cents/lb for tomato in order for the spinach/tomato system to break even. Breakeven prices per pound are lower when labor is not valued. Results for the strawberry/squash system can be interpreted in much the same way. Readers should be mindful that water and marketing costs were not included in these calculations. Breakeven prices will be higher than those reported here when the cost of water, marketing and transportation to and from the market is included.

Breakeven prices are especially sensitive to the percentage of marketable yield sold and the value of labor, as alluded to earlier. Profit-minded growers commonly assume that 100 percent of marketable yield can be sold, but previous research shows this is not always the case. A production and marketing study conducted in rural Oklahoma reported that 52 percent, 64 percent and 68 percent of the marketable yield for field tomato, yellow squash and zucchini squash, respectively, could not be sold at market and went to waste. Due to the possibility of post-harvest waste, breakeven prices were calculated assuming that only 75 percent and 50 percent of crops were sold. Breakeven prices assuming percent yield marketed are reported in Table 2. These scenarios can also benefit growers who pursue horticultural activities for recreation/lifestyle purposes. This class of grower may choose to consume 25 percent or 50 percent of produce and/or distribute among family and friends while the remaining produce is sold at market. Spinach and strawberry crops appear to be more sensitive to the percent yield marketed scenarios compared to the tomato and squash crops. For the scenario where only 50 percent of the spinach crop is available for market and labor is valued at $7.75/hour, breakeven price increases from $3.04/lb to $6.07/lb. Under the same scenario, strawberry breakeven price increases from $5.31/lb to $10.62/lb. Growers using hoop house technology should focus on management practices to decrease post-harvest waste, as breakeven prices decrease when a greater percentage of produce is marketed.

You may be familiar with the saying “covered space is expensive space.” That is one of the reasons the spinach/tomato system is recommended for profit-minded growers as compared to the strawberry/squash system – even though total costs are greater in the spinach/tomato system. Strawberry production requires more growing days in the hoop house, which equates to a larger portion of fixed costs and, ultimately, higher breakeven prices when compared to cool-season spinach. Spinach also has less production risk as yields are more stable across years. Considering individual crops, tomato and yellow and zucchini squash are suited to hoop house growing environments; however, when evaluating cropping systems to provide year-round production, spinach appears to have more benefits as a cool-season crop compared to strawberry. Growers wishing to use hoop house plasticulture technology should target warm- and cool-season crops that are economically beneficial and complement each other in a production cropping system.

**FORAGE**

### Springtime Is Pasture and Range “Go Time”

by James Rogers / jkrogers@noble.org

**Springtime in pasture and range management is “go time.”** As I start thinking about spring, here are some of the planning thoughts filling my head.

**Soil sampling**
As temperatures warm, it is a good time to get out and push a soil probe in the ground and pull samples – especially if you have not done so in the past three years. Fertilizer costs in 2011 are on the rise, and one of the easiest ways to save a dollar is fertilizing according to soil test results.

**Annual ryegrass**
March is “go time” for the growth of annual ryegrass. Quality will be high and provide the cow herd with a good boost of nutrition coming out of winter. A lot of our annual ryegrass pasture has been overseeded into bermudagrass, which is a great way to extend grazing days. However, ryegrass can be difficult to manage if it gets too far ahead of you. Ryegrass can shade the bermudagrass and delay its spring green-up, which can hurt summer bermudagrass production. Manage additional ryegrass production by putting extra grazing pressure on it or removing it as hay if the yield is there. Annual ryegrass makes excellent hay if you can cut it in the boot to early head stage and can get it cured.

**Tall fescue**
Springtime is “go time” for tall fescue. It will follow a very similar growth pattern as annual ryegrass. It will begin rapid growth in March, which accelerates into April, then begins to slow down in May. Tall fescue can produce a lot of high quality forage during this time period, but care must be exercised to not hammer it too hard prior to the first of June. It is a good idea to leave tall fescue with 4-6 inch height by June 15, especially along or west of the Interstate 35 corridor, in order to give it a good chance of surviving summer’s heat and dry weather.

**Weed management**
Springtime is also “go time” for weeds. Begin weed scouting in March and target herbicide treatment of annual weeds when they reach an average height of 4 inches. Identify the weeds you are trying to kill, use the right chemical and the right rate. The best deterrent to weeds is maintaining a good grass canopy.

**Grazing management**
With the rapid flush of forage growth in the spring, it is often difficult to imagine running short on grass later in the year – but it happens. Review your stocking rates and your forage fertility program. If you plan on not fertilizing as much as in years past, you also need to consider that you will not be growing as much forage either. Concentrate rotations on cool-season forages first because their utilization period will be approaching its end by the first of June. Move onto the warm-season grasses as they become available. If you have grass getting ahead of you, turn the excess growth into hay or use it for summer stockpile.

**Insect management**
If you have alfalfa, springtime is “go time” for the alfalfa weevil. As a general rule, the weevils are active by Easter. Begin scouting if alfalfa is actively growing prior to that date. If alfalfa weevil pressure is high, they can significantly reduce first cutting yield. Another springtime insect to watch for is the aphid. It is common on winter pasture and alfalfa. Aphids can give the forage a drought-stressed appearance. Fortunately, if economic thresholds are reached, these insects are fairly easy to control.

**Crabgrass**
Springtime is crabgrass establishment time. It works well following cereal rye graze-out. Seeding 3-5 lbs PLS into a firm seedbed from mid-April to the first of May will initiate crabgrass production 45-60 days after establishment. Production can be driven by 50-100 lbs/acre of actual N. Crabgrass quality is very high and makes excellent stocker forage or hay.

**Silver bullets**
Springtime is also when we get hit with all the “latest greatest” chemicals, fertilizer and seed. Make sure that the hype is backed by replicated research. If they don’t have the research – be very leery.

Springtime is a period of rapid change in pasture and range. Spring management decisions will impact pasture and range quality throughout the remainder of the year.
Grazing Workshop I
Become a better forage manager with this one-day workshop. Learn about the planned grazing cycles, grazing rotation, drought preparation, electric fencing and management of introduced forage.

9 a.m.-4 p.m.
April 21
Noble Foundation Pavilion
Registration Fee: $20

Grazing Workshop II
Dive deeper into grazing management while learning about planned grazing, pasture rest and rotation, proper stocking density, plant succession, fencing, the role of fire and proper seeding. The results of 20 years of Noble Foundation grazing management will also be detailed.

9 a.m.-4 p.m.
June 16
Noble Foundation Pavilion
Registration Fee: $20

Basic AG Field Day
This annual event will feature a variety of topics helpful to the novice farmer or rancher. Included sessions will cover calibrating sprayers, controlling feral hogs, gardening with raised beds, harvesting rainwater, handling cattle and more.

8 a.m.-4 p.m.
April 14
Myers Park and Events Center
McKinney, Texas
Fee: $20 by April 1, $30 by April 12, $40 on April 14th.

Basic AG Wildlife and Fisheries Tour
This afternoon tour will teach deer habitat management, pond fencing and beaver exclosures, Eastern bluebird nest box management and tips to attract wildlife to your backyard.

1:30 p.m.-4 p.m.
April 26
Noble Foundation Pasture Demonstration Farm
No Registration Fee

Junior Beef Excellence Program Results
Winners of the Junior Beef Excellence Program will be announced.

6:30 p.m.-9 p.m.
April 7
Southern Oklahoma Technology Center
No Registration Fee

Basic AG
Foundational Knowledge

Junior Beef Excellence Program Results
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6:30 p.m.-9 p.m.
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Southern Oklahoma Technology Center
No Registration Fee
**For more information or to register, visit** [www.noble.org/AgEvents](http://www.noble.org/AgEvents), **or call Tracy Cumbie at 580.224.6411. Preregistration is requested.**

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**Basic AG Spring Management Seminar**
This diverse seminar will teach how to make the most of spring opportunities on the farm. Topics will include controlling sandbur and other weeds, understanding and fertilizing to a soil test, and conducting a fisheries survey.

6:30 p.m.-8 p.m.  
May 3  
Okla. location TBD  
No Registration Fee

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**Advanced Cattle School**
Take your livestock management skills to the next level. This session will cover the optimum cow phenotype, the genetics of feed efficiency, fine-tuned EPDs, benchmarking, maximizing ADGs, byproduct formulation and more.

10 a.m.-4:30 p.m.  
May 10  
Noble Foundation  
Kruse Auditorium  
Registration Fee: $20

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**Basic AG Summer Management Seminar**
Maximize your summer productivity on your farm or ranch by learning about management of the breeding cow herd and calf crop, the economics of hay production and seasonal management of native pecan groves.

6:30 p.m.-8 p.m.  
June 7  
Okla. location TBD  
No Registration Fee

6:30 p.m.-8 p.m.  
June 9  
Texas location TBD  
No Registration Fee

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**Pecan Seminar**
Considering the pecan business? This seminar will prepare you for decisions regarding grove establishment and how to best manage a pecan operation.

9 a.m.-12 p.m.  
May 12  
Noble Foundation  
Kruse Auditorium  
No Registration Fee

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**Pond Management Workshop**
From designing a pond to stocking fish to keeping the water quality healthy, this seminar will cover it all. The event will include both classroom instruction and a pond tour.

1 p.m.-7 p.m.  
June 14  
Noble Foundation Pavilion  
Registration Fee: $20
Filamentous algae are a common concern among pond owners. Sometimes referred to as pond scum or incorrectly as moss (moss is a different division of plants), filamentous algae include hundreds of species; many are true algae, while several are cyanobacteria. Depending upon the species, they can resemble mats of wet wool, hair, cotton or slime that are usually green, but can become yellowish, grayish or brownish. Filamentous algae occur naturally in most surface waters.

A healthy pond ecosystem should have filamentous algae. Filamentous algae are eaten by gadwall, lesser scaup, channel catfish and other organisms. They provide substrate and cover that support aquatic insects, snails and scuds (amphipods), which are important foods for fishes, ducks, amphibians and other organisms. However, filamentous algae can become problematic, especially in ponds with excessive shallow, clear water and nutrient inputs (particularly phosphorus and nitrogen). When over-abundant, filamentous algae interfere with fishing, swimming, boating, irrigation, fish production and pond attractiveness.

A temporary bloom of abundant algae frequently does not warrant control. A narrow strip floating around the margin of a pond usually does not need control. In waterfowl ponds, even more extensive growth can be acceptable. The best way to prevent filamentous algae problems is to build a pond properly and divert nutrients and/or filter nutrients with robust vegetation because limiting shallow water and nutrients minimizes opportunities for algae growth. Where nutrient reduction is impractical in ponds with environments conducive to excessive filamentous algae growth, management options include herbivorous fish, chemical algacides (such as copper sulfate, Cutrine®-Plus, GreenClean®, Reward® and many others), water dyes or pond fertilization to limit light penetration, removal of algal mats by raking or netting, and deepening shallow portions of ponds.

We found herbivorous fish was the least expensive option to provide long-term control in ponds and troughs that consistently grew excessive filamentous algae. Deepening a pond is the only option that lasts longer, but is considerably more expensive. Although many publications claim grass carp do not control filamentous algae well, diploid grass carp always controlled it in Noble Foundation ponds when healthy fish 8 to 14 inches long were stocked at 12 per acre and were contained with appropriate parallel-bar barriers across the spillways. Control usually lasted 20-25 years. Unfortunately, such stocking rates also controlled all submersed aquatic plants and controlled several emersed aquatic species. Lower densities of grass carp, sometimes as low as five or six per acre, frequently controlled filamentous algae, but we did not work enough with lower stocking rates to confidently identify control thresholds. I believe there seldom was a need to stock more than 10 per acre.

As of Jan. 1, 2010, diploid grass carp are no longer legal to stock into Oklahoma ponds and never were legal for Texas ponds. Pond managers who stock grass carp in either state are required to stock triploid grass carp. Triploids have an extra set of chromosomes, which make them sterile. There is some scientific debate whether triploids are as effective as diploids. Personally, I would try triploid grass carp before implementing another more expensive, shorter duration management option.

Goldfish can be an effective option for reducing filamentous algae in livestock troughs that do not go dry. Grass carp do not work well in troughs because they tend to jump out. Goldfish are not a good option for earthen ponds because they usually increase clay turbidity (muddiness), which has negative repercussions for fish production, duck habitat and pond attractiveness.

In summary, many filamentous algae problems can be prevented with proper pond design and management, the mere presence of filamentous algae is not necessarily a problem, and several options exist to manage ponds with excessive filamentous algae.
With many analysts predicting that fertilizer use will return to normal levels during 2011 and expected tight supplies, higher prices are on the way. We hope that they will not reach the astronomical levels seen a few years ago, but we need to be prepared. Since we are expecting higher prices, it makes sense to have a plan to get the most out of our fertilizer dollars. Following are five ways to help get you started.

Test soils
If you have ever been to our educational events, or our consultants have been to your place or have talked to you at the grocery store, or you ever mentioned fertilizing, we told you to soil-test first. Why do we feel so strongly about soil testing? Soil tests are necessary because they are the only way to determine limiting nutrients, pH or the amount of residual nitrogen in the soil. If we apply phosphorus or potassium and they are not limiting, we are wasting money. Likewise, if we only apply nitrogen when phosphorus or potassium are not limiting, we are wasting money. If we apply phosphorus or potassium and they are not limiting, we are wasting money. Likewise, if we only apply nitrogen when phosphorus or potassium are not limiting, we will not get the anticipated yield response. Finally, if soil pH is either too high or low, fertilizers may be unavailable to plants.

Apply nitrogen according to yield goal
We usually recommend nitrogen according to crop-specific yield goals. By setting a realistic yield goal and accounting for the amount of residual nitrogen, we know how much additional nitrogen is needed. Otherwise, we risk not applying enough nitrogen to meet our yield goal or over-fertilizing. Extra production is not a problem for commodity crops, but over-fertilizing to grow more forage than needed is wasteful.

Select the right fertilizer blend
Use a fertilizer blend that meets your specific needs as identified by soil testing. Although convenient, the so-called “complete” fertilizers, like 17-17-17, rarely supply nutrients in the quantities needed. Plants do not use nutrients in equal proportions nor are soil deficiencies usually equal. By purchasing only the nutrients needed in the correct proportions, fertilizer dollars are used more efficiently.

Consider nitrogen source
There are several nitrogen sources, including ammonium nitrate, urea, liquid UAN and anhydrous ammonia. We usually recommend the one with the lowest cost per pound of actual nitrogen; however, other factors such as weather, product availability, application timing and the crop being fertilized may affect your nitrogen source choice. The cost per pound is calculated by dividing the price per ton by the pounds of nitrogen per ton. The table above shows how a lower cost per ton does not necessarily mean a lower cost per pound of nitrogen.

Get the best price
Always compare fertilizer costs from several sources. Variation among sources can be significant – we have seen up to 40 percent for the same product – but be sure to compare the costs as delivered and applied. Another option is obtaining bulk fertilizers directly from a wholesaler. This requires either obtaining a dealer’s license or purchasing through a licensed dealer. If purchased through a dealer, many will reduce their price if bulk fertilizer is delivered directly to the user and they never have to handle it. There are drawbacks, though, including not being able to use a blend, arranging for freight, providing storage space and application. Finally, consider applying with your own equipment rather than the dealer’s. Most dealers will reduce their fertilizer price if they do not have the wear and tear on their spreaders. These are just a few ways to stretch your fertilizer dollars. With high fertilizer prices here to stay, every producer will have to determine what methods will work for their operation.
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### Events

**Fertilizer and Weed Control Meeting** (two dates and locations)
- March 10, Mid-America Technology Center, Wayne, Okla.
- March 24, Kiamichi Technology Center, Durant, Okla.
- Time: 1:30 p.m. - 3:30 p.m.
- No Registration Fee

**Texoma Pasture Conference**
- Date: March 26, 2011
- Location: Ardmore Convention Center, Ardmore, Okla.
- Time: 9 a.m. - 4 p.m.
- Registration Fee: $20 (includes lunch)

**Managing Wild Hog Damage Meeting**
- Date: March 29, 2011
- Location: Ardmore Convention Center
- Time: 1:30 p.m. – 4:30 p.m.
- No Registration Fee

For more information or to register, please visit www.noble.org/AgEvents, or call Tracy Cumbie at 580.224.6411. Preregistration is requested.

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**Location Change**

The location for the Managing Wild Hog Damage Meeting has been changed. The new location is the Ardmore Convention Center. For more information or to register, please visit www.noble.org/AgEvents, or call Tracy Cumbie at 580.224.6411. Preregistration is requested.