It’s a Bird, It’s a Plane,

It’s Super Silage II!!!

New Mexico

Supercomputing Challenge

Final Report

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Executive Summary:

This year we expanded upon the project we did last year, which was about the production of silage with the help of (good) bacteria, also called inoculant. Silage is an important aspect of our lives, directly and indirectly. It is also about getting the best possible and economical feed for the cattle. The process of fermentation usually takes months. With the inoculant we can shorten that time immensely.

We want to save the dairies and feedlots in our area money by using inoculant to rapidly break down the silage that dairies and feed lots use. Inoculant is a powdery substance that is sprinkled over the green chop before it is sealed in the bags or pits. We can save money using bacteria to break down silage more quickly. The results show faster production and higher quality products from the animals, and therefore putting money in the stockman's pocket.

Background Information:

Silage is an important part of today's beef and dairy industries, and they are both common in our area. Silage is fermented vegetable matter used to feed cattle. Silage bags are the big white bags on the side of the road beside the dairies. Silage pits are usually cement lined holes in the ground. Our project is about saving money for the cattlemen and dairymen. We will do this by modeling how the silage is made. Using an inoculant will speed up the process. Not using an inoculant will still make silage since natural bacteria will have the same effect but it will take much longer. The difference is that there is no extra money involved in using natural bacteria. However, the inoculant is more efficient and will save more money annually by saving time in feed production. Instead of three months to ferment green chop (a growing crop that is harvested and cut into various sizes) into silage, using inoculant cuts the fermentation time to three weeks. If you put ten tons of silage in a bag to ferment, by the time it is ready, there will only be about eight to nine tons left. This is why time is an important variable. You lose tonnage the longer it takes to ferment. This saves the producer much time and money.

Last year we researched the process of ensiling, which is the major process of the project. Ensiling is the act of chopping and compacting silage. This is a major process in our project. Without the cutting, the microorganisms wouldn’t be able to accurately break down the silage. The compacting is also important. Compaction prevents the air from circulating through the fermenting feed, and causing it to rot. Too much water will make the feed rot just as too much oxygen will, likewise too little water will prevent the green chop from ensiling correctly. Therefore the process ensiling is vital to making good, efficient, cattle feed.

Using silage also improves the animal’s ability to digest the feed by breaking down some of the coarser cell walls that prevents the animals from getting as many of the nutrients as they can. Feeding hay is the alternative to using silage. The main problem with hay is that it takes too long to break down the cell wall. By the time the animal’s digestive system breaks down the cell wall, and get the nutrients, the hay has already passed through the animal. Also, if we can get more nutrients into the animals it can result in a better quality product and more of the product. Nutrients can also help cattle grow faster, bringing more money to the producer. At this point in time, the prices of feed and cattle all over our area are slowly rising. In fact the price of cattle is at about three dollars a pound. At that price dollars quickly add up and if you have a bigger animal, you get a bigger paycheck. Dairymen and feedlots can spend well over $200,000 a month on silage, depending on their size. Any savings quickly add up!

Method Description.

For this project we have included the following variables:

Chop size- The chop size is the size the farmer decides to chop up the corn, wheat, hay grazer, or maize stalks. This affects how quickly the silage will break down and how compact it will be. Having a smaller chop size allows the silage to break down more quickly because it has more surface area.

Amount of inoculant- This variable is important because if you have too much inoculant, you are wasting money. If you have too little, it will not be as efficient.

H2O and O2- The water and oxygen levels affect the silage because if there is too much of either, the silage will rot, making you lose money.

Amount of green chop- The amount of green chop or the compaction level of the pit will greatly affect how well the silage ferments. If it is not compacted it will allow oxygen and water to get in and spoil the silage. We have also included monitors.

We have made a monitor to show savings, good silage, and bad silage. We also made a graph to show the good silage compared to the bad silage. To help with monitoring our savings we have added special numbers to our programing to simulate what our actual income would be.

We have brought a few more equations into our program to help figure out a profit and a value for our silage.

```
set profit ( profit - (amountinnoculant * innoculantcost / 1000 ) )

set profit (profit + ( round (silagevalue * count patches with [pcolor = brown] / 1000)))

set spoilagevalue ( round (( count patches with [pcolor = black] / 1000 ) * silagevalue))
```

Verification and Validation:

To achieve our results, we used the tool behavior space. At first we struggled with trying to complete the spreadsheet. Eventually we prevailed after twelve attempts. Our spreadsheet shows all of the options for our variables and shows the best profit based on those numbers. A statistical analysis of the behavior space run shows us the best combination of inputs. Each individual farmer will be able to use his individual resources to determine the inputs to make the best silage for his conditions. An example from three different parts of our behavior space is shown below:

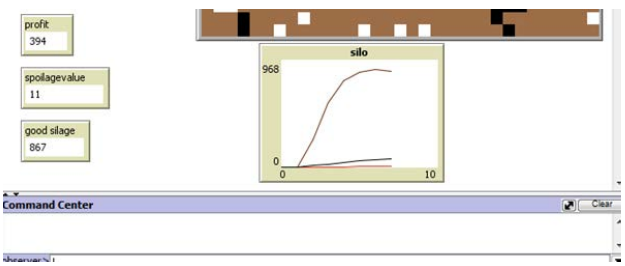
BehaviorSpace results (NetLogo 5.1.0)													
code programing team 74-3-30.nlogo													
experiment													
03/30/2015 16:30:56:498 -0600													
min-pxcor	max-pxco	min-pycor	max-pycor										
-16	16	-16	16										
[run numb	amountin	silagepric	amountgr	amountH2	amountO2	chopsize	innoculan	[reporter]	[final]	[min]	[max]	[mean]	[steps]
1	0	35	500	10	5	1	50	profit	397597	0	397597	261582.4	263
2	0	35	500	10	5	1	140	profit	413421	-149	413421	242980.1	324
3	0	35	500	10	5	1	230	profit	419318	-107	419318	254627.9	382
4	0	35	500	10	5	3	50	profit	414203	0	414203	230135.9	305
5	0	35	500	10	5	3	140	profit	414003	-61	414003	216467.3	250
6	0	35	500	10	5	3	230	profit	360301	-190	360301	187445.3	264
7	0	35	500	10	5	5	50	profit	393660	0	393660	224096.3	287
8	0	35	500	10	5	5	140	profit	452511	-35	452511	251082.2	319
9	0	35	500	10	5	5	230	profit	367942	-235	367942	196837.1	263
10	0	35	500	10	15	1	50	profit	251189	0	251189	145223.4	262
11	0	35	500	10	15	1	140	profit	283996	-52	283996	181766.2	322
12	0	35	500	10	15	1	230	profit	196658	-269	196658	103555.4	205
13	0	35	500	10	15	3	50	profit	256878	0	256878	142459.1	247
14	0	35	500	10	15	3	140	profit	240082	-79	240082	129519	231
15	0	35	500	10	15	3	230	profit	161908	-154	161908	97228.71	230
16	0	35	500	10	15	5	50	profit	230221	0	230245	155839.8	336
17	0	35	500	10	15	5	140	profit	232351	-123	232351	130586.1	254
18	0	35	500	10	15	5	230	profit	218839	-232	218839	114839	218
19	0	35	500	20	5	1	50	profit	304277	0	304277	213335.1	401
20	0	35	500	20	5	1	140	profit	287303	-61	287702	206659.9	411
21	0	35	500	20	5	1	230	profit	226458	-214	232478	165962.2	371
22	0	35	500	20	5	3	50	profit	306644	0	306644	157440.5	215
23	0	35	500	20	5	3	140	profit	223489	-52	223489	143451.8	294
24	0	35	500	20	5	3	230	profit	250401	-92	250401	143294.8	255
25	0	35	500	20	5	5	50	profit	322569	0	322569	207448.4	328
26	0	35	500	20	5	5	140	profit	249685	-61	249685	168880.9	337

231	100	35	500	10	15	3	230	profit	31044	0	31044	12290.38	12
232	100	35	500	10	15	5	50	profit	34954	0	34954	14336.77	12
233	100	35	500	10	15	5	140	profit	31729	0	31729	12582.31	12
234	100	35	500	10	15	5	230	profit	31427	0	31427	12630.46	12
235	100	35	500	20	5	1	50	profit	31014	0	31014	12385.17	11
236	100	35	500	20	5	1	140	profit	24974	0	24974	9681.545	10
237	100	35	500	20	5	1	230	profit	28219	0	28219	11134.67	11
238	100	35	500	20	5	3	50	profit	29228	0	29228	11247	11
239	100	35	500	20	5	3	140	profit	28884	0	28884	11294.83	11
240	100	35	500	20	5	3	230	profit	27825	0	27825	10840.33	11
241	100	35	500	20	5	5	50	profit	37939	0	37939	15557.21	13
242	100	35	500	20	5	5	140	profit	31693	0	31693	12627.31	12
243	100	35	500	20	5	5	230	profit	24580	0	24580	9343.545	10
244	100	35	500	20	15	1	50	profit	31462	0	31462	12813.77	12
245	100	35	500	20	15	1	140	profit	40856	0	40856	17489.75	15
246	100	35	500	20	15	1	230	profit	26663	0	26663	10529.92	11
247	100	35	500	20	15	3	50	profit	28616	0	28616	11348.33	11
248	100	35	500	20	15	3	140	profit	20985	0	20985	7942.1	9
249	100	35	500	20	15	3	230	profit	32187	0	32187	12949.57	13
250	100	35	500	20	15	5	50	profit	28003	0	28003	11274.75	11
251	100	35	500	20	15	5	140	profit	23583	0	23583	9181.818	10
252	100	35	500	20	15	5	230	profit	25935	0	25935	10124.08	11
253	100	35	1000	10	5	1	50	profit	37083	0	37083	14098.75	7
254	100	35	1000	10	5	1	140	profit	36699	0	36699	13916.38	7
255	100	35	1000	10	5	1	230	profit	35692	0	35692	13342.88	7
256	100	35	1000	10	5	3	50	profit	37355	0	37355	14236.75	7

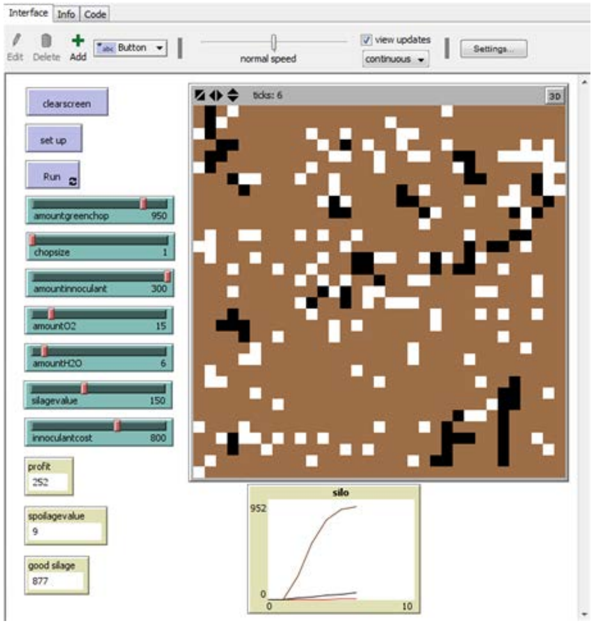
442	220	35	500	10	15	1	50	profit	20082	0	20082	8328.375	7
443	220	35	500	10	15	1	140	profit	22559	0	22559	9192	8
444	220	35	500	10	15	1	230	profit	21822	0	21822	8934.556	8
445	220	35	500	10	15	3	50	profit	23288	0	23288	9660.333	8
446	220	35	500	10	15	3	140	profit	22253	0	22253	9215.222	8
447	220	35	500	10	15	3	230	profit	22021	0	22021	9084.889	8
448	220	35	500	10	15	5	50	profit	22537	0	22537	9283.889	8
449	220	35	500	10	15	5	140	profit	22856	0	22856	9528.333	8
450	220	35	500	10	15	5	230	profit	18778	0	18778	7651	7
451	220	35	500	20	5	1	50	profit	35293	0	35293	15458.25	11
452	220	35	500	20	5	1	140	profit	23529	0	23529	9801.111	8
453	220	35	500	20	5	1	230	profit	18718	0	18718	7650.75	7
454	220	35	500	20	5	3	50	profit	24407	0	24407	10286.67	8
455	220	35	500	20	5	3	140	profit	29998	0	29998	13058	10
456	220	35	500	20	5	3	230	profit	25239	0	25239	10509.3	9
457	220	35	500	20	5	5	50	profit	27052	0	27052	11351.7	9
458	220	35	500	20	5	5	140	profit	26697	0	26697	11209.8	9
459	220	35	500	20	5	5	230	profit	29383	0	29383	12415.36	10
460	220	35	500	20	15	1	50	profit	23050	0	23050	9647.444	8
461	220	35	500	20	15	1	140	profit	27390	0	27390	11547.36	10
462	220	35	500	20	15	1	230	profit	21094	0	21094	8814.667	8
463	220	35	500	20	15	3	50	profit	21896	0	21896	9124.778	8
464	220	35	500	20	15	3	140	profit	37889	0	37889	17085.57	13
465	220	35	500	20	15	3	230	profit	27968	0	27968	11836.73	10
466	220	35	500	20	15	5	50	profit	18717	0	18717	7723.5	7
467	220	35	500	20	15	5	140	profit	21368	0	21368	8839.444	8
468	220	35	500	20	15	5	230	profit	33722	0	33722	15063	12

Results:

We expected an increase in efficiency in the least amount of time, and that is what we found. Last year we achieved the optimum size of green chop, and the amount of inoculant to use. This year we expanded our level of experience and add two more variables: water levels, and compaction levels. We also added the financial aspect of the project. We have found a profit based on the cost of silage and inoculant and how much money we lose based on the rotting silage. These results will be verified and shared with the local producers.



These are some of our monitors. We have succeeded in finding the profit, as well as the good silage versus the bad silage. In the graph we have the good silage, the bad silage, and the time all graphed.



This is after we run our program. It shows the graph and the monitors as well as our variables. You can see the black that represents the bad silage and the brown that represents the good silage. The numbers changed, just as we expected, based on the sliders in our program.

Conclusion:

In conclusion, you can save money by using inoculant to speed up the fermentation process. To a point you will be increasing your income from adding more inoculant, but when you get too much you start losing money. In an average silage pit there are about 3500 tons to ferment, and in a bag there are about 350 tons. A ton of fermented silage costs about $75 a ton. If it is not fermented, it costs about $50-52 a ton. The reason the fermented silage is a better buy, is because if a customer bought a ton of the chopped silage, they would still have to inoculate it, taking time and money. To buy the fermented silage saves the customer time and money and puts money in the producer’s pocket. We accomplished our purpose of finding a good balance of the variables to save and make money. Using the inoculant, the farmers profit increases.

Citations:

Thesis:

Fermentation Analysis: Use and Interpretation

Ralph T. Ward

Brochure:

Sil-All Lallemand Animal Nutrition

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