Investigating the Causes of Seed Returns in the Agribusiness Industry

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Abstract

This research explores the causes of dealer demand amplification leading to a high volume of seed returns in a typical agribusiness supply chain. Seed production occurs months in advance of grower demand, resulting in a limited supply of specific seeds. To hedge against shortages, dealers inflate orders. If demand materializes, dealers benefit from their inflationary behavior. If it does not, they incur no considerable losses since they can return excess inventory at no additional costs. With limited visibility of actual demand the supplier cannot assess if orders are real or simply dealer inflation. Salespeople's effort in positioning seeds, however, can clarify the distinction. But salespeople must also push seed delivery to meet sales targets. Using a system dynamics approach, we learn that policies capable of reducing seed returns: control the pace of dealers' orders, provide a more frequent sales target review period, and implement a framework for sales-people behavior.

1. Introduction

Hoarding – storing up supplies – is a common occurrence during shortages of "hot" products, ranging from the basic (e.g. gasoline and food) to the sophisticated (e.g. pharmaceutics and new technology products). For instance, stringent gasoline shortages took place during the OPEC oil embargo against the United States in 1973 and the oil supply reduction after the Iranian revolution in 1979. Both periods were marked by service stations rationing the maximum amount of gasoline purchased per customer and by panic consumer buying, with anxious consumers lined up at service stations trying to top off their tanks. Some analysts reported that the hoarding was worse than the oil embargo itself, leading to illegal storage of the fuel [1]. In December 1999, overcautious customers, fearing that Y2K problems would interrupt food supplies stocked up on basic and emergency products such as water, food and batteries [7]. More recently, following the anthrax attacks of 2001, customers in the U.S. rushed to drug stores to pile up on their supplies of Cipro, a brand of antibiotics used to combat anthrax's effects, causing generalized shortages of the drug [3]. In all such cases, customers hoarded products to hedge against the expectation of shortages, often causing impacts much larger than if real shortages took place.

This paper investigates the impact of hoarding in the agribusiness industry, leading to excess seed returns – twice as high as the industry average – in a major seed company. We develop a system dynamics model to explore the potential causes of the problem and policies capable of mitigating the returns. The seed company sells corn and soybean seeds to agribusiness and seed-only dealers, which resell the seeds to growers. While the latter dealers sell only seeds, the former dealers sell also herbicides and other agribusiness products. Figure 1 represents the distribution channel for this business.

In the agribusiness industry, seed returns are common. The perceived cost associated with returns is much lower for seed companies than the perceived costs associated with lost sales and market share. Hence, the seed companies often encourage dealers to carry overstock of seed inventory that can lead to opportunistic sales or even prevent competitors from having shelf space to display their products. Traditionally, the industry averages a 15% return rate for corn seeds. But this number varies with the weather, the number of hybrids and the volume of sales. For example, a hybrid that has a high bushel-per-acre performance in dry weather is unlikely to sell well in wet weather year. In addition, the seed company pays for all costs associated with returns, which includes transportation, testing, reconditioning, repackaging and discards. Even when the storage conditions at the dealers are satisfactory, the seeds must still be tested and repackaged. Many times, however, seeds stored in poor conditions need to be discarded. Furthermore, not all seeds returned can be reconditioned. Corn has a maximum three-year shelf life. In a business characterized by revenues of US$200 million, the costs associated with transportation, repackaging, retesting, reconditioning, and lost sales reach about 10% of the total. More importantly, the presence of excess returns also suggests other sources of unnecessary costs and low performance such as excess capacity and low capacity utilization. Such costs may far out-weight the costs directly associated with returns.

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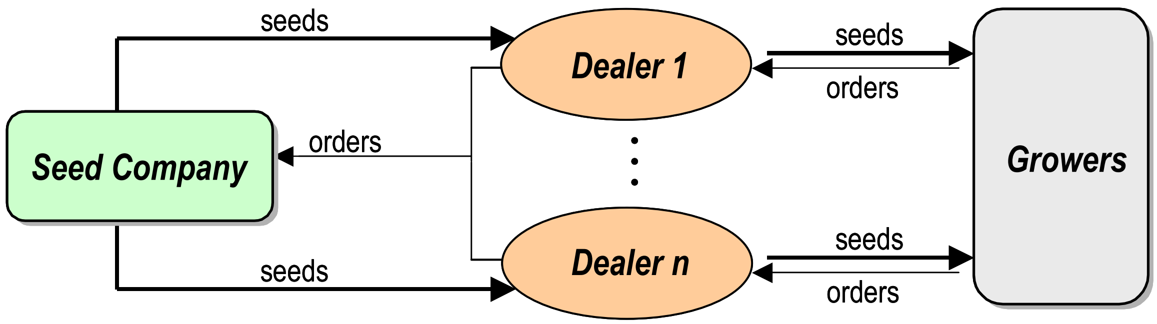

Figure 1. Distribution channel for the seed company

On one hand, there are clear benefits associated with overstocking seeds at dealers. On the other hand, excessive overstocking can increase the costs far beyond the potential benefits.

Our results arise from a three-month in-depth study of sales, services, planning, operations, logistics, and order processes at the company site, a major U.S. manufacturer of corn and soybean seeds. During this period we conducted about thirty semi-structured interviews with company and dealers' managers. Eighty percent of the interviewees were managers in charge of operations, logistics, quarterly initiatives, production planning, demand forecasting, sales, order processing, and supply chain management. Through this work, we collected quantitative and qualitative data supporting the development of a system dynamics model of the problem. The quantitative data included monthly returns and net sales, weekly requests and shipment rates, and sales quotas and fraction of such quotas met. The qualitative data included managers' decision heuristics for performing daily activities and the causal relationships among different areas of the business.

Insights from our investigation suggest that the seed company can adopt a number of initiatives that will help them reduce seed returns. First, the seed supplier can place more focus on grower order accuracy, particularly using the information gathered by sales people as a proxy for grower orders. While waiting for growers to place their orders with dealers may create logistics' challenges for the company to timely position the seeds through its supply chain, having access to sales people research data provides a timely surrogate for grower demand. Second, the seed company can emphasize the need to position the seeds and educate the sales-people about the importance of their role. The sales force faces tremendous pressure to meet the company's financial goals. Under such stress, sales-people push seeds instead of positioning them on dealers that have the corresponding grower demand. Third, the supplier can re-evaluate the timing for receiving dealers' orders and sending the seed shipments, allowing for more time to sales-people to meet their sales quotas. We find that a policy that allows dealers to confirm their early orders may ease the hoarding, as dealers learn more about true grower demand.

Finally, the company can emphasize the management of the whole product portfolio. Frequently, "hot" performing seeds are quickly allocated to dealers compared to low performing ones. This often leaves dealers with a perception that supply (for the products they want) is unreliable. Furthermore, it leaves the supplier with unallocated low performing seeds. Thus, it is important to manage "hot" selling products by exception, managing the allocation of such products with particular care. To manage the perception of dealers, the supplier can provide them with a status on the adopted allocation policy for and the availability of "hot" products. In addition, the supplier can recommend the whole seed portfolio, suggesting which low performing seeds are good substitutes for specific "hot" products.

This paper proceeds as follows. The next section provides an overview of the problem. Section 3 discusses managers' initial assessments of the causes of the problem and the following section investigates the causal hypotheses underlying seed returns. Section 5 presents the main concepts in a system dynamics model followed by results and analyses in section 6. We conclude with a discussion of insights and areas for further research.

2. Problem description

Consider the timing of corn seed production in the agribusiness industry (Figure 2). The seed company plans which hybrids and the volume it will produce from January to March, before planting takes place in April. Once the choices of crops have been made, the product mix available for the following season is fixed. At the same time, growers are planting the seeds produced and sold by the company in the earlier season. The company harvests its seeds in late October and proceeds to test and bag the corn hybrids that will sell in the coming season.

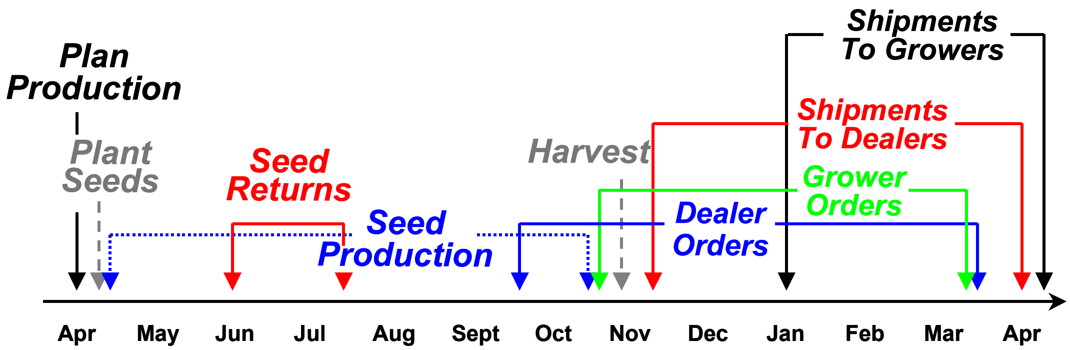

Figure 2. Timing of corn seed production, orders and shipments

The products are ready for delivery in mid November, when the company starts shipping to dealers. While production only becomes available in November, dealers place their orders as early as mid September in an attempt to get the hot performing hybrids they want. Given the large number of hybrids and the uncertainty associated with weather conditions, it is difficult to predict which products will perform best in the field. Nevertheless, dealers base their orders on products that performed well in the previous season and seed company performance data on new products.

Although some growers may start ordering as early as mid October, the bulk of their orders come in December and January. But since these seeds will only be used at the end of March and April, they often delay receipt of the seeds. Placing the orders early provides dealers with better information on grower demand and gives them a better chance to get the seeds they want. The seed company finishes shipping the corn seeds to dealers in early April. Returns often take place in June and July long after the selling season is over.

While the seed company provides performance data on each hybrid for the last three years (including new product introductions), growers use mainly current season's performance as a basis for which hybrids to order this year. This makes sense for several reasons. First, the information is salient. Growers have just finished harvesting their crops, so the information about the productivity of different seed hybrids is readily available to them. Furthermore, the information is tangible. Instead of numbers and plots on a performance report, growers can physically see that some hybrids lead to a large number of bushels per acre. They can compare the volume space different crops take on storage. But since dealers place orders in September prior to information on grower demand, such orders may not necessarily translate into sales.

Over the last five years, the seed company faced a steady increase in the returns of corn seeds, rising from 15% in 1996 to 30% in 2001. At the time of the intervention the company had returns twice as high as the industry average. Returned seeds cannot be reconditioned in time to be sold in the current season. In addition, the hoarded seeds often included hot selling products the previous season. Hence, the seed company commonly received returns of seeds that were in high demand during the season.

3. Managers' assessment of causes

Managers in the seed company offered a number of potential causes for the increase in returns. Some managers pointed out that dealers could order as much as 50% of prior year sales by mid September, when the seed company would start accepting orders. Furthermore, dealers could order up to 100% of prior year sales before grower demand became available. Growers would not place most of their orders until November or December (Figure 3). Managers claimed that returns were an intrinsic part of the business and were willing to accept some level of returns. As one manager told us: "[Excess returns] are the nature of the beast." A potential solution considered to tackle this cause would be to rely directly on grower order demand. Dealers mentioned that their concern of being left without the seed hybrids they desired required them to order as many hot selling seeds as possible early in the season. For instance, if they sold 500 bags of a specific hot hybrid, they would not hesitate in placing an order for more than 250 bags early in September. Hence, the ability to compare dealers' orders directly with grower's orders would allow the seed company to realize which dealers are hoarding which seed.

Implementing such policy, however, faced constraints associated with getting the data on grower's orders and using it effectively. First, many dealers were unwilling to share grower orders because they feared that the company may bypass them to sell directly to growers. In addition, managers claimed that even if they could obtain grower orders, they might not have use for such data. Since grower orders become available only in late November, they would not allow the company to meet its yearly revenue quota. The problem is compounded by the lack of visibility of seed stocks once the seeds are in the distribution channel. The company cannot reposition inventories during the selling season, and the market for resale among dealers is usually small. Hence, once the seeds are sent to a location they are usually committed there, until they are either consumed by growers or are returned to the seed company.

Another possible cause of returns dealt with the lack of adequate incentives. For instance, dealers face significant penalties for under-stocking seeds, which included sales and reputation losses. However, there are few or no penalties for over-stocking seeds. Prior to the 2000 season, dealers could send seeds back to the manufacturer without any penalties. When seed returns rose in excess of 25% the company introduced an incentive plan charging dealers a restocking fee of 2% of the tag price, for returns in excess of the industry average of 15%. Even though this policy implied in a minor cost for dealers, returns decreased the following season perhaps because some dealers reduced their hoarding. Managers recognize that allowing returns in the first place is part of the problem. This practice, however, is industry standard and managers believed that more stringent return policies could lead to loss of market share.

Managers' initial assessment of the causes of the problem provided a starting point to our investigation. We followed up with their insights on our interviews, always focusing on learning the potential mechanisms capable of generating the dynamics of increased returns. The following section describes our exploration on the potential causes of the problem and the causal relationships among different parts of the organization contributing to increased seed returns.

4. Sources of dynamic behavior

As mentioned earlier (figure2), the seed supplier starts shipping seeds to dealers in mid November. In addition, its fiscal year ends in December. Therefore, any discrepancies between current and target revenues must be met within that six-week period. During such period, the sales people will face increased pressure to meet the yearly revenue targets. At the same time, most growers will still not have firmed their orders with dealers for the coming season. Hence, while sales people will push the seeds hybrids to dealers to meet the revenue quotas, they may be pushing the seeds to dealers lacking the appropriate grower demand. However, as sales people effectively sell more seeds, revenues increase, easing the pressure from corporate headquarters. The managerial response of focusing sales people's effort in pushing seeds has the desired consequence of increasing revenues in the short run and meeting the revenue goals for the year. Figure 3 shows the balancing *Revenue Loop (B1)*.

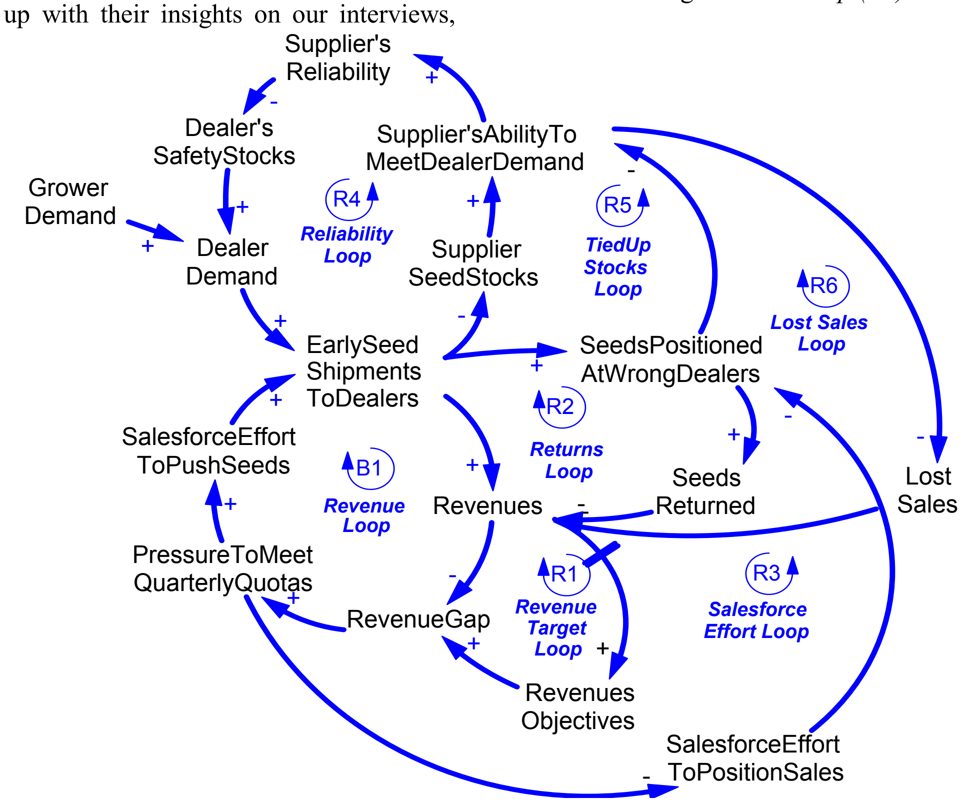

Figure 3. Causal loop diagrams mapping sales force effort, supplier reliability and lost sales

Over the years, as the company consistently meets the revenue targets by shipping more products to dealers early on, managers learn that they can increase the revenue targets for the company. This generates a reinforcing loop – the *Revenue Target Loop (R1)* – that intensifies year after year the pressure felt by the sales people, when the company's revenues are increasing.

While shipping seeds early in the season reduces the stress on sales people and allows the company to grow, it also leads to a poor positioning of seeds with dealers. Ultimately, seeds end up at dealer locations with inadequate grower demand. If seeds are shipped to wrong locations they will be returned at the end of the season reducing next years' revenues. This will increase next year's pressure on sales force even further. The reinforcing *Returns Loop* (R2) captures the dynamics associated with returns. Not only the benefits of pushing seeds takes place instantly, sales people immediately get rewarded for meeting the revenues' target, the costs associated with such decisions occur only in the following year.

Interestingly, the more information sales people have on grower demand at specific locations the fewer seeds positioned at wrong dealers. To get information on grower demand, sales people must spend a considerable amount of time with dealers and growers to understand what hybrids were used the year before, target growth and current sales forecasts. When sales people face pressure to meet the revenue quotes, however, they do not have a chance to spend the necessary amount of time to understand dealer and grower needs. Instead, sales people increase the volume of sales by pushing seeds to any and all dealers, including "wrong" dealers, that is, those without the corresponding grower demand. When sales people choose to allocate their time pushing seeds instead of positioning them the probability of sending seeds to "wrong" dealers increase. The reinforcing *Sales-force Effort Loop* (R3) describes the dynamics that take place as the volume of early shipments increase and a greater fraction of them end up in "wrong" locations. The impact of pushing seeds instead of positioning them leads to an increase in returns and greater pressure to meet the revenue goals in the following year.

The situation, however, is worse than that. Early shipments also erode the supplier's seed stocks and its ability to fill later demand. This contributes to dealers' perceptions of low supply reliability, to which they respond by increasing their safety stocks and hoarding seeds early in the next season. This is captured in the reinforcing *Reliability Loop* (R4). The supplier's ability to meet demand is also curtailed by the fact that she has no supply chain visibility. Hence, seeds positioned at dealers without the corresponding demand cannot be repositioned later. This creates the additional *Tied Up Stocks* reinforcing loop (R5). Finally, the supplier's inability to meet dealer demand leads to lost sales opportunities and lower potential revenues, captured in the *Lost Sales* reinforcing loop (R6). In summary, early shipments of seeds allow the seed supplier to meet the current year's revenue target, but may do so at the expense of the following year's performance, as measured in terms of increased returns, increased sales people pressure, low supplier reliability and lost sales.

The discussion above provides insights on the dynamics generating seed returns. But to gain a deeper understanding of the processes and to investigate policies that can effectively mitigate the volume of returns, we build a formal system dynamics model of the relationships discussed above in the next section.

5. The model

Here, we formally explore the tradeoffs associated with early seed shipments. The system dynamics model captures the managers' actions capable of enhancing the return of corn seeds. In particular, we focus on the effect that the financial pressure to meet yearly net income targets has on sales people's effort allocation. The model consists of a high order (17 state variables) system of nonlinear ordinary differential equations, totaling about 120 equations. The model is run for 10 simulated years. We discard the first five years to get rid of transient behaviors in the model. Since the corn seed business is mainly a first and fourth quarter (Q1 and Q4) business, we assume for simplicity that a simulated year has 26 simulated weeks.

We adopt a level of aggregation that is sufficiently high to emphasize the interaction of the seed company supplier with its dealers through the company's sales force. For instance, we assume that the supplier produces a single seed hybrid and has a single warehouse. These assumptions do not impact the dynamics of interest. While seed hybrids have different performance, both high and low performing products suffer from returns, due to dealers' attempts to hoard products early in the season. Instead of investigating low and high performing products, we build a generic model and change parameter when dealing with different types of hybrids. Here, we focus on high performing products.

A few months prior to harvesting last years' crops, dealers start placing orders to the seed company. The early orders take place due to dealers' perception of unreliable supply on the previous year. These orders are stocked in an order bank until later in the year when they can be scheduled and dealers can take delivery. Once the orders are scheduled, the seed company establishes a goal of one week to deliver them. Filling orders depletes the seed company inventory. Seed obsolescence also depletes supplier's inventory of seeds. Seed production and seed returns replenish the inventory of seeds every year. We assume that production is constant every year and returns will endogenously depend on sales people allocation of seeds during the selling season.

We assume uniform dealers and sales representatives. That is, they respond to the same stimuli and also in the same way. Given our purpose of understanding the causes of seed hoarding and mitigating its effects, we find that it is not important to differentiate dealers and sales reps. While individually they do differ in the intensity of their responses, our interviews support such assumption. With respect to the effort spent by sales people, we assume that sales people will allocate a maximum amount of effort between two activities: pushing seeds to dealers or positioning them. For simplicity, we assume that there is no shirking among sales people. This is a conservative assumption. If we allowed for shirking the amount of time devoted to positioning would be decreased even further during pressured times, making our results even more pronounced.

Max Effort □ *Pushing Effort + Positioning Effort*

The way it has been defined the effort allocated to pushing seeds will simply be given by the difference between the maximum effort and the effort allocated to positioning seeds.

Four important assumptions generate the dynamics in the model. First, we disaggregate dealers' inventory in two different types: those located at "right" and "wrong" locations. Inventory located at "right" locations have corresponding grower demand and can generate final sales. In contrast, seed inventory located at "wrong" locations must be returned to the seed company at the end of the planting season. For simplicity, we assume that once the corn seeds reach a specific dealer location they cannot be shipped to another one. In the real system, seed shipments across dealers are not common; hence, our assumption matches reality closely.

Second, a direct consequence of an increase in effort to push seeds is an increase in the scheduling rate. That is, the scheduling rate is a function (*h*) proportional to sales people's pushing effort.

Scheduling rate = h (Pushing Effort)

Third, the probability of shipping to the right location increases with the sales force effort in positioning the seeds close to grower demand. The more time sales people spend understanding dealers' current forecasts and past sales the higher the likelihood that they position the seeds in locations that have grower demand.

P (Ship to right location) = f (Positioning Effort)

where: $f > 0$, $f' > 0$, $f(0) = P_{Min}$, and $f(1) = P_{Max}$.

Fourth, sales people allocation effort depends on the financial pressures they experience. There are two important sources of financial pressure one that takes place at the end of every quarter and the other that takes place at the end of the fiscal year. We assume that sales people consider a linear combination of both pressures to decide how to allocate effort. The nonlinear function (*g*) captures the fact that when pressure is low (high), the sales people allocate more (less) time positioning seeds.

Positioning Effort = g (Yr Pressure, Qtr Pressure)

where: $g > 0$, $g' \leq 0$, $g(0,0) = e^{p}_{Max}$.

The ratio of the fractional gap in revenues and the fractional time remaining in the corresponding period determines pressure. The fractional gap in revenues is the gap in revenues normalized by the target revenue in the period (quarter/year), where the target revenue is determined by the sum of last year's revenues and the accrued costs of seed obsolescence and returns. The equation below shows the formulation for pressure.

$$Pressure = \frac{\dfrac{TargetRevenue - CurrentRevenue}{TargetRevenue}}{\dfrac{TimeRemaining}{Period}}$$

The following section presents a base case run of the system dynamics model. It also investigates a number of policies capable of reducing seed returns.

6. Model analysis

The base run shows five simulated years, that is, 26 weeks depicting Q1 and Q4 of every year. The supplier allows dealers to order a maximum of 50% of previous year's sales in the beginning of Q4. Dealers' place the remainder of their orders uniformly throughout Q4, reaching 75% by mid October, and 100% by mid November. This pattern reflects a policy implemented by the seed company to control the pace of ordering. Prior to such policy, dealers' orders shot up in the beginning of Q4 leaving many regions without any supply. While dealers' orders increase steadily, the supplier begins scheduling orders to be shipped by November. Figure 4 shows the stock of orders in the company's ordering system, resulting from the inflow of orders and the outflow of scheduling.

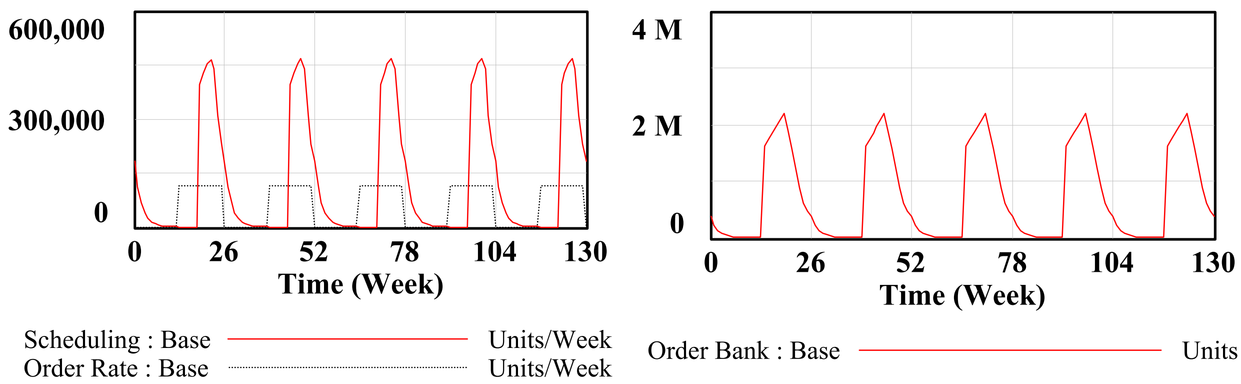

Figure 4. (a) Inflow and outflow of dealer orders and (b) stock of orders at seed supplier

As the supplier ships the seeds to dealers, it accounts the revenues for the sale. Prices for the seed hybrids are constant ($100/bag) within each planting season. Every year, the supplier will try to meet a goal for revenue that take into consideration past revenues. Initially in the quarter, pressure to meet the revenue quota is low since sales-people have plenty of time to make their sales. As time goes by, however, this pressure increases. Figure 5a shows the pressure on sales-people. The graph has two peaks, indicating an increase in pressure at the end of each quarter (Q1 and Q4). The peak at the end of the year (Q4), however, is more pronounced due to the little time available to meet the revenue target.

During high-pressure periods, sales-people devote a lot of time pushing the seeds to dealers and almost no time positioning them. Figure 5b shows sales-people efforts in positioning seeds at the dealers with appropriate grower demand and effort to push seeds to meet the revenue quota. While emphasis on pushing seeds may not seem rational in the long-term, sales people have huge incentives to do this. First, sales-people's financial rewards are directly proportional to meeting revenue targets. Bonuses, ranging from zero to 40% of base salary, depend on the fraction of the revenues quota the team achieves. Not meeting the quota has a clear negative impact: the team receives a low bonus. There is no ambiguity in the costs associated with such outcomes. This is in sharp contrast with the costs associated with returns. Sales teams are charged an "obsolescence rate" for returned seeds that spoil. All teams, regardless of individual contribution to total returns, share equally these costs. The sales people we interviewed were unable to specify the policy used to charge them. In addition, they could not quantify the dollar value that the charge represented.

Second, the rewards for pushing seeds occur closer in time. Sales-people receive their bonuses at the end of the year (Q4), just when pushing seeds to dealers is more pronounced. In contrast, returns only accrue in the following year. Returns take place at the end of Q1. At that time, the revenues associated with the returns are discounted from sales teams current volume of sales. Since the fiscal year starts in Q1, their bonuses will only get impacted in the end of the next year, for seeds that have been pushed to dealers in the previous year. Hence, the cost (seed returns) associated with pushing seeds take place one year later than the benefits (bonus of meeting revenue quotas). Hence, the incentives to pushing seeds to dealers are not only unambiguous but they take place shortly after the actions are made.

Third, it takes much less effort to push seeds than to position them, hence, selfish sales teams may be better off in the short-term by shirking. Consider the amount of time and effort associated with positioning the seeds in dealers with adequate demand. The sales person must first call the dealer to schedule a personal visit, where both can go over the current replenishment plan. This allows the dealer to check with some of his growers on the types and volumes of hybrids that he intends to purchase this season. Prior to the visit, the sales person retrieves last year's sales information that serves as a reference for this year's sales. At the scheduled date, the sales representative visits the dealer to discuss his purchase plans. This can take one whole afternoon, during which they compare last year's sales with the current year intentions accounting for the dealer's growth strategy and customer policies. This process leads to a good estimate of grower demand instead of simply a wild guess. Now consider the time and effort required with pushing seeds to dealers. In some cases, this boils down to a telephone call of a few minutes where the sales rep lets the dealer knows that he is sending some additional bags of seeds. This uneven amount of effort to push seeds compared to effort of positioning them is likely to lead pressured sales reps to choose the former instead of the latter.

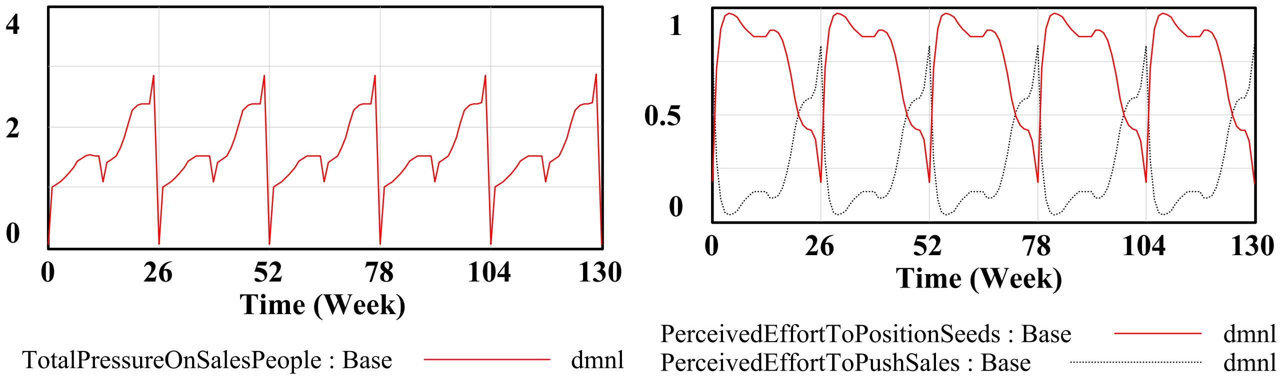

Figure 5. (a) Pressure to meet revenue quota and (b) sales-people effort to position / push seeds

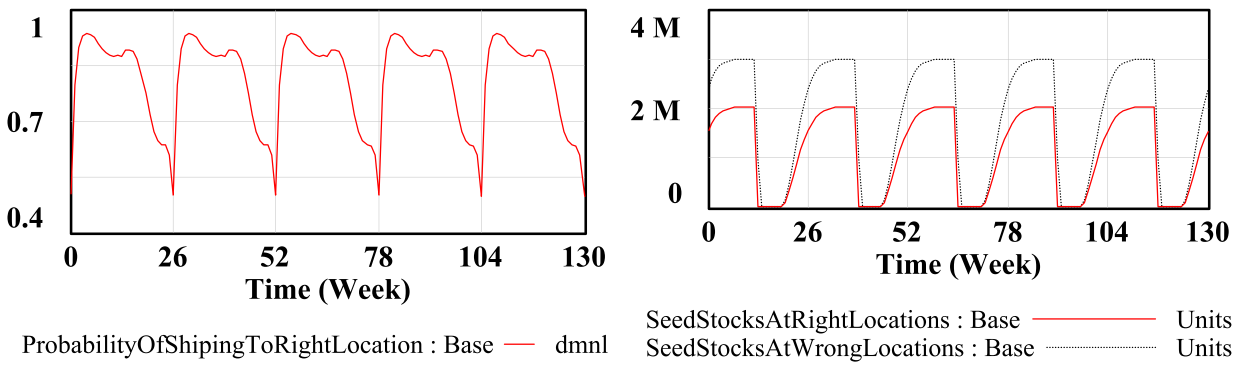

Figure 6 – (a) Probability of shipping to right locations and (b) seed stocks at different locations

Finally, the unparallel timing of benefits and costs actually generates an important reinforcing loop that intensifies the detrimental dynamics leading to high returns. When sales people push sales to ease the short-term financial pressure, they generate returns in the following year. When these returns come in, the seed company discounts the revenues associated with those seeds from the sales-people accounts. Now, with their current sales adjusted by last year's returns, sales teams must meet an even larger revenue quota. Hence, they become even more pressured in this calendar year to meet the revenue target. Under additional stress, they must again rely on the strategy of pushing seeds, which will lead to even higher returns in the following year.

As pressured sales people push seeds, they incur a greater probability of sending it to dealers where no corresponding grower demand is available. Figure 6a shows that the probability of sending seeds to the "right" locations decreases with the end of every quarter, being more pronounced at the end of every year. This leads to a stock of seeds in "wrong" locations – where no grower demand is available (figure 6b) – ultimately returning to the seed supplier.

The base case simulation shows how pressure to meet the revenue target can lead to poor decision-making by the sales people, resulting in increased seed returns. Next, we explore policies that can mitigate the impacts caused by such poor decisions. We divide our policies in two types: timing of orders and shipments and sales-force pressure.

6.1. Timing of orders and shipments policies

In the base case, we identified that the pressure peaks at the end of every year (Q4) were more pronounced than the ones at the end of the season (Q1). This was due to the little time available to sales teams at the end of the year to meet their available quotas. Sales people have only about seven weeks to meet their revenue quotas.

The first policy we test (Early Ship) allows shipments to dealers to take place earlier in the quarter. This provides sales teams with additional time to fill their quotas and hence it reduces the financial stress they experience. Under lower stress, sales teams have an opportunity to position more seeds, correcting some of the discrepancies introduced during the early stock ordering process. This policy increases the probability that seeds are sent to the right dealers, which in turn reduces the amount of seeds returned. We implement this policy by allowing the seed company to start scheduling delivery of seeds four weeks in advance.

The second policy (Confirm) tested addresses the timing of orders placed by dealers. Early in the season, dealers inflate their orders for high performing products. To deal with this, the seed supplier can implement a confirmation period of one month, within which the dealers have a chance to revise their orders with additional grower demand information. This policy gives dealers an opportunity to adjust their orders to reflect real grower demand. The result of this policy is to start with an order bank that more closely reflects grower demand, rendering sales teams' actions of pushing seeds less effective in causing returns. We implement this policy by reducing the probability of sending seeds to wrong locations, reflected in the more accurate dealer orders.

Figure 7 shows the seed stocks at wrong dealers for these policies compared to the base case. We find that these policies (early shipments and order confirmation period) reduce the amount of returns by 57% and 32% respectively. Hence, the seed supplier can effectively reduce returns by shipping to dealers earlier in the season and by confirming early orders to improve accuracy of its order bank.

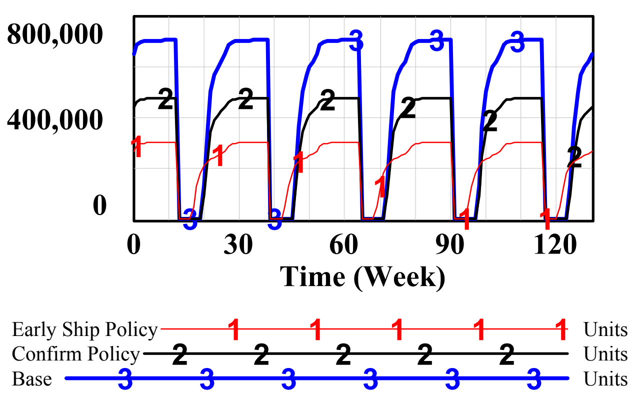

Figure 7. Wrong dealer stocks - timing policy

6.2. Sales force pressure policies

The base case pointed out the conflict that arises from the dual role of sales people: pushing seeds to meet revenue quotas and positioning seeds to direct them to right dealers. This set of policies emphasizes the important role played by sales teams in positioning seeds. They have the intention of preventing the stress experienced by sales people or to minimize its impacts. We explore two policies in this section. One addresses the response of sales teams to pressure and the other deals with ways of diluting the pressure experienced by sales teams during the selling season.

Consider the sales teams' response policy first (Conservative Teams). Our interviews suggest that while all sales people respond to financial pressure in a similar way, inexperienced sales people were more prone to pushing seeds to wrong dealers. Their lack of experience lead to inadequate planning as well frequent postponed contacts with dealers. In addition, inexperienced sales people responded more aggressively to financial pressure, resorting more frequently and more strongly to pushing seeds to dealers. Hence, this policy suggests the implementation of protocols and training supporting sales teams. Since hiring and diligently training the entire sales force may take several years, an effective policy in the short-term may be to develop a "best practice sales workshop" championed by experienced sales people. Such workshop would provide guidelines for actions and conduct to sales people. The resulting framework could have a timeline for actions and achievements. When the sales person faced difficulty in keeping up with the timeline, it could provide a set of questions, to understand the causes of the problems, and possible actions to guide sales people's responses. The overall effect of a set of guidelines for sales people would be equivalent to a more conservative sales response to financial pressure. We implement this policy in the model by introducing a function for sales people response that has a smaller slope to the pressure input.

The second policy (Quarterly Focus), we consider a more frequent review of sales teams' performance, instead of the focus on yearly revenues. It is possible to think about this policy in a couple of different ways for the seed company. First, as the end of year (Q4) pressure is more pronounced than the end of quarter (Q1) pressure, we can view this policy as a bigger emphasis on the end of Q1 pressure. This may be difficult to implement since the fiscal year ends with Q4 and there are only seven weeks in that quarter to meet the revenue quota. However, a policy that shifts the fiscal year to go from July to August would ensure that the year-end emphasis would be balanced through different quarters. Second, we could think instead of a more frequent review of sales teams performance. Hence, teams would be measured every month or quarter. And while sales teams would be constantly under some sort of pressure, by increasing the frequency of reviews average pressure would be lower. We introduce this policy by increasing the weight of quarterly pressure on sales teams responses.

Figure 8 shows the seed stocks at wrong dealers for the two policies compared to the base case. We find that these policies (conservative sales teams and quarterly focus) reduce the amount of returns by 38% and 52%, respectively. Hence, the supplier can effectively reduce returns by emphasizing conservative sales responses to financial pressure and by shifting the fiscal year to lag the calendar year in order to dilute the financial pressure experienced by sales people.

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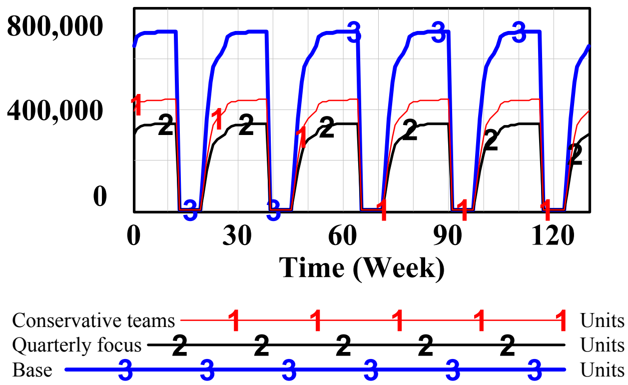

Figure 8. Wrong dealer stocks-pressure policy

7. Discussion

In this investigation we learned that financial pressure faced by sales people lead them to push seeds to dealers that do not have corresponding grower demand. While such actions are very effective in reducing the short-term financial pressure, they lead to seed returns. We gain a number of insights through a system dynamics modeling approach. We believe that this work can help the company reduce the volume of seed returns in the coming years.

We believe that the seed company must place a greater focus on grower order accuracy, particularly using the information gathered by sales people as a proxy for grower orders. This is a message that cannot be over-emphasized to sales teams. While waiting for growers to place their orders with dealers may create logistics' challenges for the company to timely position the seeds through its supply chain, having access to sales people research data provides a timely surrogate for grower demand. As one sales team leader told us: "[What we need are] real orders for real people." Relying on dealers' stocked orders may simply not allow the supplier to reduce the amount of returns. The timing and pressure policies investigated in the previous section suggest that they are effective in reducing seed returns.

Second, the seed company has an opportunity to improve its emphasis on managing the whole product portfolio. High performing hybrids sell fast and quickly disappear from the supplier's inventory, leaving dealers with a perception that the supplier is unreliable. Hence, it is important for the supplier to manage "hot" selling products by exception, specifying an allocation policy for high performing products in advance. To manage the perception of dealers, the supplier can provide them with a status on the adopted allocation policy and the current availability of "hot" products. Furthermore, the supplier must recommend her whole seed portfolio. Advising hybrids that can closely replace unavailable high performing seeds. One senior managers in the seed supplier correctly identified that "it is too late to deal with seed returns, when they finally arrive." Since the supply mix is fixed once seed production is started, sales people must recommend the whole portfolio of products as substitutes for hot products and which risks to take based on past product performance.

Third, there is a great opportunity for clear incentives toward lower seed returns. In particular, the obsolescence charge the company used was equally distributed among all sales people. This created an incentive for sales-people to push seeds, leading to potentially higher returns. By pushing additional seeds, sales people were getting the full benefits of additional sales, but avoided some of the associated costs due to the equal sharing of the obsolescence costs. Since our intervention the policy was corrected to proportionately impact sales teams based on their contribution to obsolescence. While this is a step in the right direction, other opportunities remain for creating disincentives for dealers and sales teams that lead to seed returns. In parallel with the implementation of punishment mechanisms for actions that lead to returns, the supplier can also implement policies that reward sales teams, dealers and growers for low seed returns. Finally, for both types of incentives it is crucial that the seed company provide complete visibility of the costs and rewards of different incentive systems, if it hopes them to be successful.

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