AIR SEEDING--THE NORTH AMERICAN SITUATION

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Introduction and Background

Air seeders are a relatively recent development in agricultural technology.
Initial European work started in the 1950's and spread to Canada and Australia in the sixties. In North America it took the better part of the 1970's for the initial ground breaking work and adoption by the first and most adaptable farmers. Since that time there have been tremendous strides made in development of the technology. Air seeders have become more accurate, easier to use and capable of a wider scope of field operations. This development has moved air seeding from a system for the highly innovative few to the mainstream.

This paper will examine the development of air seeders in Western Canada, review the current air seeding situation and discuss technological developments which may be yet to come.

Historical Developments

Under historical development there are two phases. The first phase is from the initial invention and introduction to the end of the seventies. Phase two covers the period of rapid development and acceptance of air seeders.

A. Phase I: Early Struggles (1965-79)

The initial phase of air seeder development could be summarized as a time when the technology struggles for acceptance. Most development utilized existing heavy duty tillage machines as the seed placement tool but placement was not accurate. Some units also had metering or distribution deficiencies causing the coefficient of variation (CV) of seed distribution to be higher than acceptable. Assurance of an acceptable crop stand did not compare favorably with drills or discers which dominated seeding technology at the time air seeders were introduced. Many farmers were unwilling to risk seeding with the units.

Air seeding technology originated in Germany with the Wieste Pneumatic applicator developed in the fifties and patented in 1966. One of the earliest North American uses of air for seeding may be a U.S. patent taken in 1925 utilizing compressed air for Row Crop seeding. The early Cyclo Planter was first in production in 1971.

The earliest North American air seeder, as we know it, was developed by Grant Henry at Agri-Steel in Minnedosa, Manitoba in 1965. This was tested by University of Saskatchewan personnel at Laporte, Sask. in 1966. Jerome Bechard of Sedley purchased the Henry Machine in 1967/68 and also imported a Wieste applicator from Germany about the same time.

Another air seeder development was by Henry Bunnymier of Fulda, Saskatchewan, who innovated his own tillage and air seeder in 1967. Inland Steel built it for him in 1968.

One of the earlier commercial seeders included that of Ross and Davies of Antler, Saskatchewan. This unit was patented in 1975 and was to become the first successful commercial design going into production prior to 1979. It was built by Prasco is Winnipeg. A seeder by Sherman Quanbide under development in 1977 was to become the Wil-Rich seeder.

Air-Vator built a Bechard style seeder in North Dakota during the period from 1976 through 1978.

Very little acceptance for the idea of air seeding was to be found in the early years.

B. Phase II: Rapid Development (1979-89)

Air seeding was to find its first major niche on farms -- not primarily for seeding, but as a new method for applying fertilizer. The concept of fertilizer banding was to offer a reduced risk situation for farmers to try out this new technology. Increasingly larger acreages began to be seeded to coarse grains and some oilseed crops.

1979 appears to have been a pivotal year in air seeding technology. Friggstad Ltd. in Canada and John Deere in the U.S. began producing air seeders using Wieste components under exclusive rights from Wieste in Germany. Prasco was the first commercial success in 79/80. Flexi-coil produced the "Air Flow" seeder in 1981 -- a modified Australian seeder from Fusion Engineering.

Following this time, many air seeders were to appear on the market. The early eighties saw Morris market the Australian Napier Grassland, and Bourgault Ltd. producing seeders utilizing the Bechard seeding system. Wil-Rich, Leons, Concord, Great Plains, Case I.H., C.C.I.L. and other companies were producing seeders during this time.

Air conveyance and spreading of granular herbicides also developed during this period. The Valmar was manufactured at Elie, Manitoba; Beline at Kindersley, Saskatchewan; and Gandy at Owatonna, Minnesota.
After the initial excitement of the early eighties, there was reduced farmer interest in air seeders for time. This was partly because of the recession but also some of the early experiments of seeding with air seeders appeared to have produced less than favourable results. Some companies did not sustain development and several seeders released in the 80's were discontinued.

Air seeders required a higher level of operator knowledge or competence to control air flow, prevent lines plugging, (delivery line blockage or obstruction) and keep these lines in good repair. Central metering, as compared to "all-run" metering of conventional drills and discers, offered major advantages -- but also wide vacant swaths of evidence if something did not work right.

Electronic control and monitoring (not utilized on drills and discers) became standard on air seeders. This new application of electronics was unique and required special development. Service problems related to electronics were disproportionately high on early models.

Even with problems, air seeders were selling in the early to mid '80's and they were beginning to "catch on". A number of farmers, especially large-scale farmers, saw past the problems to the advantages of air seeding. Time and labour savings and the ability to cover larger areas with a smaller capital investment were significant. Fifteen to twenty percent more area could be seeded each day based on the savings in filling time alone. Add to this transport facility and quicker clean out, the average daily seeded area could increase by as much as 30 percent. The ease of transport made it easier to farm land that was increasingly distant from the home site. Management-oriented and innovative farmers were the reason that the development of air seeders was able to continue.

This was a learning time for both the users and the manufacturers of this new technology. It took both time and experience to begin to produce crops to the accepted standard. One lesson learned was the necessity of closing the soil well after seeding (i.e. to harrow and pack well). The availability of the harrow packer allowed farmers to achieve desired crop stands with the air seeder and thus it continued to rise in acceptance. This appears to be at least one of the major differences between the Canadian and U.S. market. Whereas in Canada, sweep placement of seed was accepted with the harrow packer, its acceptance in the U.S. has been less enthusiastic. The air seeders that have made significant inroads in the U.S. market tend to be those which offered row-style seeding with row packing.

The manufacturers, for their part, began to look for ways to make seeders better. In the mid-to-late eighties a new level of sophistication was reached. For example, the (coefficient of variation) rows of the Flexi-coil Air Flow seeder dropped from 9.8 percent when tested in 1982 to 3.7 percent when tested in 1988. Enhanced metering and distribution systems resulted in accuracy to match traditional seeding units. PAMI reported in April 1988 that, "Metering distribution uniformity and seed placement have all improved to the level that air seeders are now equivalent to a conventional hoe drill and a viable alternative as your next seeding system."

Better fan systems were adapted to the seeders. Here again, Flexi-coil provided a fan change such that the major operating range of the fan coincided with its peak efficiency range. This effectively doubled the air operating efficiency from 25 and 30% to 50 and 60%, cutting the air horsepower requirement in half. This permitted a large capacity seeder to be operated from tractor hydraulics.

Significant improvements were made in manufacturing systems and production techniques. Quantities increased and prices began to decrease. The availability of versatile and acceptably priced air seeders, coupled with cropping successes, caused a boom in the sales of air seeders.

Current Situation

Currently, air seeders are no longer only the domain of the large, upscale farmer. More mid-to-average-size farms are employing air seeders for many of the same reasons of the early, larger farms. The ability to seed more efficiently and more rapidly, with less help and smaller total outlay on equipment, is an appealing formula for farmers who are pressed for time and have tight capital budgets.

A. Configurations

Air seeders manufactured currently can be roughly grouped into broad categories according to their particular configuration.

1. Pressurized vs. Non-Pressurized Tanks

This is a basic classification. Air conveyance operating pressures must be dealt with at the metering device. One method is to pressurize the grain tank so that pressures upstream and downstream of the meter are similar. If the tank is not pressurized, the pressure differential must be handled in another manner. Typically, a venturi is used; but some systems use an air-lock device.

2. Distribution Systems and Metering

These fall into three classifications:

a) Single Central Meter

Here, one variable speed meter of variable displacement meter delivers product into a single line. The product is divided through a primary manifold and then usually further divided through secondary manifolds for delivery to the final runs. The meter consists of a fluted wheel, an auger or a conveyer belt.

b) Multiple Central Meter

The product is divided into several lines at the point of metering and only secondary manifolds are used to further divide the product flow to the final runs. The meter is typically a fluted roller or pegged feed roller of variable speed. Variable displacement features are often also necessary to allow use on a wider range of products.

c) All-Run Metering

Individual metering is provided at the tank for each run and no splitting manifolds are used. As in the multiple central meter, the meter is typically a fluted roller or a pegged feed roller. Smooth rollers and star wheeis are also used.

All these configurations are currently being successfully marketed. In addition, most manufacturers provide at least two metering systems on the air seeder to allow for the simultaneous application of two products. This requires separate tanks and separate metering. The products are deposited into the same delivery line("single shoot") or deposited and conveyed in separate lines ("double shoot"). In the later case, a double distribution system is required on the tillage tool.

Secondary header arrangements also vary widely. Product is fed to the header from the top - "top feed", from the bottom ("bottom feed") or horizontal ("horizontal feed"). The "horizontal feed" utilizes a fan-style header rather than a circular one. The number of ports in the secondary header range from a few ports up to 12 or 15. This number is even higher where mechanical splitting rather than air splitting is used in the secondary header. On some primary distribution headers the number of ports is as high as 32.

3. Tank and Cart Styles

Total tank capacity on current air seeders is typically between 100 bushels and 200 bushels of wheat, though some are larger.

These tanks are supported on high-clearance frames configured as four-wheel carts, three-wheel carts, and two-wheel carts. The two-wheel units are usually designed for towing between the power unit and the incorporation tool - "tow between." A high percentage of Flexi-coil sales are "tow-behind" units (i.e. towed behind the tillage tool).

Almost all tanks are designed to drain the product completely into the meter area. Clean-out is conveniently provided for easy access with an auger. Often the auger is fitted along with the tank, providing loading and unloading facility.
Other features include: advanced monitoring of system functions (including "all-run" blockage monitoring), special lighting packages, and means for calibration of the seeder to ensure metering accuracy.

Safety considerations involve adherence to ASAE specifications in such areas as safety, lighting packages and safety chains at single point towing locations.

4. Fan and Fan Drives

The air supply for carrying the product is invariably provided by a centrifugal fan mounted on the seeder. These fans have various blade configurations; some backward, some forward and many are straight blade.

These fans are usually hydraulically driven from the tractor hydraulics but many are also available with gas or diesel engine drives. Still others are P.T.O. driven and some are ground wheel driven.

B. Seed Placement Tools

The Canadian market is currently dominated by the use of a cultivator sweep as the air seeder seed placement tool. Many cultivator innovations have been developed to meet the placement accuracy requirements of air seeding. Sweep-style cultivator types have been reworked for improved accuracy of seed depth. Larger working widths have also prompted the need to improve the cultivators' ability to conform to the contours of the land. Floating-hitch cultivators have become the norm for air seeder outfits. Further flexibility of the wing sections and within the wing sections are being developed to enhance placement accuracy.

The heavy duty openers, typical on many of these tools, allow “one-pass" seeding operation into standing stubble or other minimum-till applications.

Several companies offer seed placement units that are not cultivators, but utilize openers that are more like the traditional hoe drills and double disc drills. A common element of these seeders in the integrations of the packer-wheels on the unit and usually in a row packing configuration.

C. Granular Application

The technology of air conveyance for granular herbicide application has been successfully developed and utilized by several companies. These were initially designed as "stand alone" units specifically designed for the unique requirements of granular application. The tank size was smaller, as were the fans. The metering was of higher precision, but with less capacity.

A common application of these units is to mount them on the tillage hitch, spreading the granules ahead of the sweeps for incorporation into the soil.
A trend observed in recent years is for some of these units to increase in size and be utilized as "air seeders" in their own fight, applying fertilizers and oilseeds etc. They also are offered in multiple-tank configuration for dual product application. Because they are often used in conjunction with air seeders, a common air supply from the seeder can be utilized, eliminating the fan and fan drive requirement on the applicator. Stand-alone applicators are to be viewed as complete air seeders extending the size range of seeders down to the smallest tank sizes. Alternately, without a fan and fan drive, they perhaps can be viewed as "third tank" options to the "traditional" air seeder.

D. Level of Acceptance

Presently, there are approximately 14000 air seeders in use in the Northern Great Plains area. This means at least one farmer in every six is using an air seeder. The common width of machine being used is 36 feet. It is typically used to seed and/or fertilize, on average, 1500 acres. In the past, air seeders were well adapted for farms in excess of 2000 acres. A growing number of farmers with 500 to 1000 acres to seed are looking at the air seeding system as a possible alternative for their operations. The average size of unit and acres used depends on the geographic location. As a result, manufacturers are faced with marketing units ranging in size from 20 to 60 feet. The air seeding system is particularly well-suited to the varying climatic, geographic and specific client needs.

The use patterns of air seeders are changing as well. In the past, pneumatic distribution systems were primarily used for and were well suited to deep-banding fertilizer. The current situation is that 10-15 percent of air seeders are being used for just fertilizing, 10-15 percent for just seeding and 70-80 percent for seeding and fertilizing. The percentage of farmers making use of the air seeders' multi-function capabilities will continue to grow.

Future Developments

Use of air seeding on ever-increasing acreage, more diverse soil types and varying conditions have suggested several areas for improvement. Much of the current technology, already detailed, reflects ongoing improvements to the seeders. In the future, perhaps the changes will not be dramatic, but rather a slow evolution, as the market dictates. However, we might venture some guesses or raise some questions regarding future development.

A. Application

We have already witnessed the demands placed on the air seeder to be more than a tool to band fertilizer. It must meter coarse grains accurately and distribute them evenly. Oilseeds, such as canola, followed hard on the heels of the coarse grains -- except the metering rates were much lower and the placement must be more accurate. Next came the pulse crops. Lentils have disc-shaped seeds and are highly subject to cracking. Peas of various sizes --some very large -- are subject to splitting, and can be rough and abrasive. Add yet another material such as granular herbicides to the list of products and attention must focus on improving the metering system.

Another dimension to these demands for diverse product metering is the facility to switch from one product to the other and in different combinations of "single shoot" and "double shoot," both broadcasting and incorporating.

Manufacturers are now moving toward adapting air systems to drills, using a central tank and air conveyance to the openers. This will no doubt broaden the area of acceptance of air seeders. These new users may be more demanding of the seeder and applicator in terms of precision.

Accuracy can be improved. It is believed that a 5 percent overall distribution C.V. or better, for all products, including granular, can be attained consistently in the field.

Perhaps "real time" soil probing for organic matter content and soil pH will dictate a new dimension in fertilizer application in terms of variable rate and product blending.

B. Features

Will we continue to see seeders improve in terms of mechanical and air efficiency for a further reduction of power input? If so, perhaps this will also be integrated with improved aesthetic -- coupling the seeder and tillage tool. These factors together may move the air seeder down in size and higher in volume production.

Will the future operator have more demand -- or less demands -- placed on him in terms of the degree or type of management required to successfully operate his air seeder? Will the future seeder be more forgiving of crucial operator errors?

Can it be simply "simple" and yet meet the requirements of diverse users as if tailor-made for each?

If the last 10 years are any indication, we may not have long to wait for the answers.