

Increasing Small Farm Capacity: Introduction to Small Scale Farm Machinery and Equipment

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I. Introduction

A discussion about farm equipment for small-scale agriculture risks listing every machine and implement needed to run the collective dream farm of the participants. This is not the goal of this presentation. As Organic Transition Specialist with ACORN, I meet many new entrants to agriculture and people who are ramping up activity from a household garden to some level of commercial production. To a large extent, these individuals lack the familiarity with farm equipment that people who grow up on a farm already have running in their veins. In most cases, their intended scale of operations is small to medium size and sometimes fairly specialized. The following paragraphs will address some of the more important points about acquiring the equipment needed to operate these farms.

The variety of equipment available for use on small farms is broad and, for some, can be very intriguing. Properly chosen tools and implements can:

- (i) improve soil and crop management
- (ii) speed up tasks
- (iii) save labour
- (iv) reduce costs
- (v) reduce physical demands on the body
- (vi) increase safety.

Yet for a beginning market gardener there is a strong case for starting with as little equipment as possible. It costs much less. Furthermore, there is only so much investment for equipment that a small farm can support. As the operation takes shape it will become clear which pieces of equipment are essential and the grower can probably avoid buying unnecessary clumps of rusty steel and seized-up motors. Furthermore, despite a natural tendency to value any device that saves on manual labour, the value of well-designed hand tools should not be overlooked. With every purchase of equipment or tools, the new owner should believe their acquisition is absolutely essential and that they are finally ready to conquer the world.

The Main Categories of Equipment

Traction	(tractor, horse)
Primary tillage	(plough, chisel plough, tiller, broad fork)
Secondary tillage	(discs, harrow)
Seeding	(seed drill, packer, push seeder, hand seeder)

Weeding/cultivation	(finger weeder, flame weeder, roller hoe, wheel hoe)
Spraying	(tractor sprayer, backpack sprayer)
Harvesting	(combines, diggers, digging forks, bulk bins, totes, baskets)
Carriage	(wagons, manure spreaders, wheelbarrows)
Handling	(frontend loader, pallet jack, washing and sorting equipment)
Specialty	(snowblower, scraper blade, logging winch)

II. Buying Used Equipment

Anybody considering the purchase of farm equipment for the first time, above and beyond the usual hand tools, should consider a trip to the nearest equipment dealer. Drive around the back lot, through the line-up of used machines and assess your response. If the interest in the mostly rusty pieces of gear is grudging, this should tell you something. Used machinery may not be a good fit with your personality or the realization may dawn on you that you are no mechanic. And if the machinery is of absolutely no interest then perhaps put the expansion plans on hold or consider livestock and rotational grazing where the most complicated machine will be the electric fence.

There is good value in used equipment, but the shrinking number of farmers and the increasing size of farms mean that the supply of gear of a scale suitable for small farms is diminishing rapidly. Little gems may still be found hidden away in some old fellow's barn that, with diligence, he can be persuaded to part with at a fair price. Sometimes a farm auction will also yield just the right piece of gear. The best deals are usually obtained by those that have the patience and endurance to rigorously search for what they need.

Before purchasing used equipment, the buyer must carefully consider:

- (i) the cost of spare parts (if available)
- (ii) the proximity of repair shops or the buyer's aptitude as a mechanic
- (iii) the buyer's inclination to service and maintain equipment
- (iv) the likelihood of being able to fix a machine promptly when it breaks
- (v) the machine's adaptability to more modern pieces of equipment (I.E. Will it connect up?)

All machinery, new or old, can break down, but the best bargain in the world is of little use if it is broken down when needed most. Second hand disc harrows have no value, at any price, if the discs are worn and crippled with rust.

Many of these points apply when buying new equipment, as well. You may also consider building your own. It is surprising what a little ingenuity, some scrap metal and a welder can conjure up if a person sets their mind to it. On my own farm, I have used a homemade mulch layer and a deep cultivator that a friend manufactured for a fraction of the cost of new equipment. Even if you can't weld, there is usually someone in the community who does. Indeed, many machinery dealers attending trade shows in Atlantic Canada have remarked that despite great interest in any wares on display, they rarely sell anything because farmers go home and build the machine themselves.

III. Tractors

A tractor is not always a necessity on a small farm. A person may work up to 2 acres of market vegetables with only a walk behind tiller, and the occasional task performed by a neighbour or custom operator. In fact, a young, energetic market gardener might be encouraged not to purchase a tractor until they are certain that farming will be a long-term endeavour.

Nonetheless, if all the potential uses for a tractor are tabulated, especially those equipped with a front-end loader (quick attach is best), there is little doubt that a well chosen tractor is a tremendous asset on a small farmstead. From the point of view of human wear and tear alone, buying a front-end

loader will be invaluable and add many years to a person's working life. There is enough physical work in day to day operations handling produce or livestock feed that the farmer should not have to rely on a fragile back for lifting operations unless absolutely necessary.

Given that most farms are in rural areas where long driveways and/or woodlots are common, it is reasonable to consider the value of specialized equipment such as snowblowers, scraper blades, logging winches and wood splitters that require a tractor to operate. It can be easier to justify a tractor for field work knowing that it will have other uses for which you must otherwise pay. Like moving snow.

The variety of intended uses will affect the choice of tractor. For example, is four wheel drive needed? Carefully assess what your needs may be, what you can afford and make choices accordingly. If you plan to buy only one tractor, avoid the older machine that runs well and is in good repair, but has no front-end loader or hydraulics and is not really good for anything but pulling.

IV. Tillage Equipment

Perhaps the most important consideration when choosing tillage equipment is matching the implement with the size of the tractor. Equipment salesmen rarely discuss engine horsepower (HP) in their work. Instead, they speak either in terms of PTO (power take off) HP (=85% of engine HP) or drawbar HP (=86% of PTO HP).

Several rules of thumb can be used to guide equipment purchases, although actual requirements will also depend on the terrain and soil type (light or heavy) where the equipment will be used. For example, a disc harrow requires 5-7 drawbar HP per foot of width. Therefore, on average, a 50 HP tractor can effectively pull about a 6 ft disc harrow ($50 \text{ HP} \times .86 = 43 \text{ PTO HP}$ $\times .86 = 37 \text{ DBHP}$ / 6 = about 6 feet). To function effectively, discs must be pulled fast enough to both slice and throw soil and stubble.

Ploughs typically require 15-20 PTO HP per bottom. Therefore, a 135 Massey Ferguson tractor will do well to pull a two bottom plough. A MF 270 tractor, on the other hand, is well equipped to handle a 3 bottom plough.

S-tine cultivators are trickier. People tend to pull them too deep rather than use them as a finishing tool as they are intended. The number of teeth and the type of point or sweep can affect the power requirements considerably. As a general rule, allow 7-10 drawbar HP per foot. A rolling crumbler or a tow behind log will increase the HP needed. (An implement 10 feet wide pulled at a speed of 5 mph, will cover an acreage equal to the speed. In other words, a 10 ft S-tine travelling at 5 mph will cover 5 acres in one hour.)

The Broadfork

The broadfork is a primary tillage tool consisting of 4-6 teeth on a 2 ft wide, two handled fork. Popularized in North America by Elliot Coleman in *The New Organic Grower*, a properly designed broadfork is surprisingly effective on small plots of land. Although not for the faint of heart, a broadfork can eliminate the need for a tiller in a greenhouse. It has the added benefit of not creating fumes or accidentally running through sidewalls.

Tillers

Tillers straddle the boundary between primary and secondary tillage. They range in size from tractor mounted rotovators to the diminutive, but handy, 8 inch Mantis garden tiller. Because all tillers tend to pulverize the soil and create the equivalent of a plough sole with overuse, growers should

consider compensatory techniques such as adding organic matter to the soil.

Matching a rotavator to a tractor depends both on the total number of teeth (the more teeth, the greater the HP needed) and the weight of the machine. The necessary tractor horsepower is often provided in advertisements for new rotavators. Caution is advisable when buying used rotavators because some older models are extremely robust but of little use if the tractor cannot easily lift or drive them.

The Spring, 2009, edition of the Canadian Organic Grower has a number of articles about walk-behind tillers, including the results of a “till-off” between various models and a cautionary note about overuse. By and large, walk-behind tillers should be chosen according to their performance, manoeuvrability, cost, durability and availability of parts and service.

V. Seeding and Seeders

Good seeding equipment is invaluable to any farmer. Field crops can be seeded by any number of pull-type drills. If a drill is not within the budget then even a hand crank seeder held around the waist can work well for cover crops, forages and some cereals with a little practice. Disc-type fertilizer spreaders can also serve the purpose, even though calibration is not very refined. A seeding operation should create good soil-to-seed contact. Ideally the seeder will bury the seed at the desired depth. A harrow can otherwise “harrow the seed in.” A packer or land roller should be used to firm the soil around the seed. Packing ensures good germination and should be used for cover crops and green manures as well as any cash crop.

Market gardeners often find selecting seeders suitable for planting a variety of vegetable crops troublesome. Any number of specialized seeders adapted to fine greenhouse and garden soils are advertised in the back pages of seed catalogues, but finding a good push seeder that works in rough terrain with heavy soil, sod clumps or stone is challenging. Lightweight seeders such as the Earthway are not known for good performance in the field. On the other hand, the extremely durable but heavy, Planet Junior, pushes past most obstacles in the field but is somewhat cumbersome in a greenhouse.

Many push seeders are of the dribble type that scatter seed in a row at more or less the same depth. Precision seeders (the Stanhay is a well known brand) place a certain number of seeds at an intended depth and spacing. In general, precision seeders reduce seed costs, result in better plant spacing and reduce thinning costs. On the other hand, precision seeders cost more, there are fewer seeds to break the soil surface during germination and they require excellent soil preparation to establish good stands. (see www.ces.ncsu.edu/depts/hort/hil/hil-36.html).

The Earthway seeder, the Planet Junior (www.marketfarm.com), the European push seeder, the Stanhay seeder and the Wang seeder (www.willsie.com) provide a variety of planting options for the vegetable grower. Another consideration is whether the seeder is suited to handling pelletized seed.

VI. Weeding and Cultivation

The variety of weed control methods and equipment is seemingly endless. Equipment designed for tractors ranges from finger weeders, rotary hoes and flame weeders to a huge range of cultivators mounted behind, between and in front of the tractor wheels. Wiggle hoes and the rotary RegiWeeder are other options. Tractor design features such as offset steering, high clearance and hydraulic capacity are important considerations for a variety of mechanical weed control options. Implements for laying plastic mulch can do a great deal to avoid weed problems in the first place. An excellent video, Vegetable Farmers and their Weed Control Machines, by Vern Grubinger, University of Vermont Extension, describes many of these methods in detail.

Not to be forgotten are hand tools. A new generation of roller hoes and wheel hoes, as well as traditional hand hoes have greatly increased the efficiency and effectiveness of weed control in market vegetable production. Increasingly, these tools are advertised in seed catalogues.

Reference: Steel in the Field: A Farmers Guide to Weed Management Tools. On-line only. Sustainable Agriculture Research and Extension.

VII. Spray equipment

With the exception of some fruit growers, organic farmers do not generally place much emphasis on spraying equipment. This is understandable given that we try to avoid spraying when possible. Nonetheless, a market gardener, growing a variety of vegetables and berry crops, can spend a considerable amount of time spraying insecticides, fungicides and foliar fertilizers during the course of a summer.

For both environmental and economic reasons, it is important that sprays are applied at the proper rates with good coverage of the plant. **Coverage is critical.** Nozzle type, droplet size and application rates are crucial issues for applying costly new pesticides such as Spinosad products effectively and economically.

A wide variety of sprayers are available, although the more specialized units are often not widely distributed in Atlantic Canada. These range from tractor-mounted sprayers, pull-type sprayers, ATV-mounted sprayers and many types of backpack sprayers. Tractor sprayers with wide booms are ideal for field crops, but have poor manoeuvrability around small fields or vegetable beds. Often the tank is inconveniently large for small applications. In recent years, a variety of smaller (30-100 gal.) sprayers have appeared on the market including small, pull-type models.

Backpack sprayers range from the \$35 budget models to \$600 motorized units. For spraying non-critical substances such as seaweed extract or fish emulsion, budget models may be more than adequate. For more expensive sprays and detailed work, growers should consider units that can be more finely calibrated and possibly fitted with wands equipped with four nozzles rather than the usual single nozzle. Ideally, a backpack sprayer will have a comfortable harness, not be prone to plugging, be easily cleaned and be adaptable to different wand and nozzle configurations.

A good source for a variety of sprayers, large and small, is Rittenhouse, based in Ontario. www.rittenhouse.ca.

VIII. Harvesting and Handling

The range of harvesting and handling equipment for small farms is somewhat underdeveloped simply because mechanization is not always cost-effective on a small scale. The need for harvest aids is great, however, because an incredible amount of harvesting and handling is done by hand which ends up being physically taxing and exhausting. Hand harvesting works to a point, but there must be an accounting for wear and tear on the human body, which, over a period of years, can substantially reduce a persons physical ability or inclination to grow heavy crops like root vegetables and squash.

Any device that can reduce or eliminate lifting and carrying by hand should be considered. The right tractor is a big help. Front-end loaders and pallet forks attached to 3 point hitches or loaders are almost essential over the long-term. Bulk bins are another valuable tool to ease the workload, but it should be kept in mind that if the bin is emptied by hand rather than with an automated dumping system, bending over the edges is a sure recipe for a sore back.

Automated washing and sorting equipment is also of great value. Willsie Equipment Sales

(www.willsie.com) in Thedford, Ontario, carries a range of small-scale harvesting and washing equipment.

IX. Equipment for All Terrain Vehicles (ATVs)

Although many people consider ATVs a menace, their potential role in farming operations should not be overlooked. Apart from providing a rapid and fairly forgiving form of transport on the farm property, an increasing array of equipment is designed specifically for use with these vehicles. For example, seeders, spreaders, harrows, discs, carts, scrapers and even snowblowers have been designed for ATVs. For some applications, this equipment may do an acceptable job for a reasonable price.

X. Custom operators

Hiring custom operators for specialized jobs can be very cost-effective. A \$50 per hour fee for custom ploughing, rotovating, baling hay and combining and the like may seem high, but, in general, shelling out a few dollars for occasional work can easily compensate for the purchase, maintenance and depreciation costs of equipment purchased outright. It all depends on how much the machinery will be used. Besides, if the machine breaks you are not responsible. It is not always easy to find someone to do the work in a timely manner, but hiring out can free the farmer for other tasks, as well as generate healthy social interaction within a community.

XI. Final thoughts

It has been said that to be a farmer a person must be a mechanic. By and large this is true. It is also true that farmers can very easily invest too much money in equipment, money that will never be recouped. Investment should be considered carefully with the long-term goals of the farm and farmstead kept in mind. The value of good hand tools for some operations like seeding and weeding should not be overlooked, and investment in equipment for lifting and product handling is highly recommended when possible. One other feature of equipment also deserves mention. Rust never sleeps.

A good source for a variety of small-scale equipment distributed in Atlantic Canada can be found at www.farmfleet.com or 839 McLellans Brook Rd. New Glasgow, N.S. B2H 5C5; Tel: 902-755-0858; Email: farmfleet@execulink.com