

An Improved System for Moving and Storing Small Rectangular Bales – FNE03-478

Richard McDermott
Neptune Farm
723 Harmersville-Canton Road
Salem, NJ 08079
856-935-3612
dickmcd@waterw.com

2. Goals: The purpose of this project was to construct a tool which could be used to reduce time, labor, and storage requirements in harvesting small rectangular hay bales.

3. Farm information: Our 126-acre organic farm saw a seasonal increase in cattle and sheep during the calving and lambing seasons, and as new brood stock was acquired. At mid-summer it carried about 40 grazing animal units, which were reduced by culling and sales to about 32 at year-end. Although we normally raise 10-12 acres of winter wheat each year, we were prevented from planting it by wet conditions in September 2002. We did, however, plant and harvest about 3 acres of oats for a pharmaceutical customer, grazing the residue, which served as a nurse crop for a new planting of hay. In addition to livestock and field crops, we harvested about 3 acres of asparagus and 2 acres of blueberries. Yields on our farm, like those in the surrounding area, were generally below normal because of unusually cold, wet weather.

4. Cooperators: While NOFA's Karen Anderson and David Lee, of Rutgers Cooperative Extension, were both supportive of the project, we did not have to call on them for any material assistance. My partner, Torrey Reade, did substantial organizational work on the project, as well as assisting me with hay production and in our presentation at the NOFA summer conference.

We were very fortunate in our sub-contractors at Duffy & Co. and Fairfield Pallet Co., who enthusiastically entered into the spirit of our experiment and contributed valuable suggestions. We also received excellent feedback from the farmers who attended our workshop at the NOFA summer conference.

5. What we did on the project and how: The most important component of the project was the fabrication of the hay-lifter. The hay-lifter's frame was assembled at Andrew Duffy & Co., a steel fabrication firm in the next county. We visited several times to consult and to inspect the lifter's progress. Unfortunately, production was delayed by a death in the Duffy family, and delivery was complicated by the size of the hay-lifter assembly, which measured 10 feet 6 inches wide by 16 feet long, and weighed about 1500 lbs. By the time the tool arrived, in late August, we had already completed two out of three cuttings of hay, reducing our opportunities for field trial. We had also received feedback during the presentation of the model at the NOFA summer conference which gave me concern about the weight of the hay-lifter's tongue on the tractor's drawbar.

Believing that discretion is the better part of valor, I decided to modify the hay-lifter before taking it into the field. In order to mitigate the drawbar weight, I had to

improve the lifter's balance by moving the wheels closer to the tool's center of gravity. This meant partially dismantling the leg assembly, re-cutting the legs and braces, which were fabricated out of rectangular steel tube, and re-welding the leg sub-assembly. These modifications took a couple of days of cutting, grinding, and welding in our farm workshop. I deferred cutting and raking the last hay field until I had completed the alterations to the hay-lifter.

Earlier in the summer, we had called local pallet companies and learned that one of them could produce a custom pallet more cheaply than we could build it ourselves. We ordered ten and arranged for delivery. Unloading them at the farm proved more difficult than we had anticipated, because of the weight of the pallets and the crudeness of our tools.

Meanwhile, we endured one of the wettest summers on record, leaving few opportunities for cutting and curing decent hay. A dry spell in late September and early October finally gave us the chance to try the system.

6. Results, accomplishments, and unexpected results: On October 8, in the presence of visiting Massachusetts farmers Larry and Noah Siegel, the hay-lifter had its maiden voyage out to the hay field, where it quickly carried several pallets of hay out of the field, and easily backed them into a pair of sheds, taking about half the time that we normally spend on the same operation with hay wagons.

On October 28, we used the hay-lifter again, this time to transport bales which Winslow Farm delivered to us. Although we had anticipated using the hay-lifter only to move harvested hay out of our own fields, the palletized system had an unexpected application in moving hand-loaded purchased hay. We had only envisioned using the hay-lifter with our mechanical bale grapple. However, because it sits on the ground, the hay-lifter is easier to load than a wagon. Farmer Tony Sacco's crew hand-stacked the hay onto pallets, which we lifted with the hay-lifter and carried out to our cowshed.

The hay-lifter itself worked flawlessly, contributing the crucial piece to a small-farm system for moving hay quickly and without hand labor. We did, however, have difficulties in positioning the lifter's forks in the slots of the pallet, rucking up a small ridge of dirt each time we backed up. This turned out to be a problem caused by the old, imprecise, and interdependent hydraulic controls on our aged tractor, which make it difficult to aim the forks accurately. It can be solved by controlling the hydraulics with a spool valve, such as is commonly used to control a front-end loader. Users of this technology will need to be sure to supply adequate controls for the hay-lifter's hydraulic cylinders.

As noted above, we were also surprised by the difficulty of moving and stacking empty pallets, which were both heavy and unwieldy. The hay-lifter can move a single pallet a short distance off the ground, but cannot lift it to a trailer or stack it.

Stacked on the pallets, some wet and loose bales proved unexpectedly soft, and would not form stable self-supporting stacks. Later drier and tenser loads were more stable, but there is room for improvement, as discussed in #9, below.

7. Site conditions: An unusually cold and wet year made haymaking challenging, to say the least. Record rainfall delayed the hay season and spoiled a lot of hay in this area. As a result, we were unable to experiment with the hay-lifter as much as we would have

liked, and did less outreach than we had originally planned. One of the things we had planned to test was outdoor storage of tarped bale stacks, but because this year's hay crop was baled on the wet side, we did not dare risk spoilage by tarping and storing it outside our sheds.

8. Economic findings: Time savings were less than my optimistic expectations, but were nonetheless dramatic, translating into savings of whatever the farmer's hourly rate may be. We do not currently put our time through the farm's income statement, but on farms which book their principals' labor to expenses, adding a hay-lifter to mechanized harvest would save about six hours of farmer time per 500 bales of harvested hay. Some value must also be assigned to the reduced risk of weather damage afforded by speedier transport out of the field, and to better-quality storage. This system is still slower than moving round bales, but it is also more flexible.

At nearly \$5,000, the cost of fabrication of the prototype hay-lifter puts it out of the reach of most small farmers. We are, however, investigating whether it might be mass-produced inexpensively by a farm equipment manufacturer. It would also be feasible for a farmer with good welding skills and a nearby supply of structural steel to build it on the farm, as I had originally planned. In any case, equipment depreciation would result in a non-cash charge of several hundred dollars to annual income.

Our haymaking neighbors loved our custom pallets, which measured 7' by 7' and cost about \$48 apiece. At a buck a bale, this is also not cheap, but the pallets are reusable and reduce spoilage from rot in the bottom layer. The owner of the pallet company, a part-time farmer, thinks he can produce a lighter, less expensive pallet. On our farm, we would book pallets as supplies and expense them in the year in which they were purchased, although they last for three to five years, depending on how and where they are used.

Although wet weather prevented our experiment with tarping palletized hay, an appropriately sized heavy-duty hay tarp costs about \$20, and lasts about three years. (In our area, there is a program for recycling ag plastics which have not been in contact with soil.) The combined cost of outdoor storage of small palletized bales, then, comes to about \$.40 per bale per year, when spread over the useful life of the equipment. This compares favorably with the cost of shed storage, which we calculate at roughly \$1.00 a bale per year, over the twenty-year useful life of the building.

9. The Next Step: Outdoor storage of palletized hay could help solve another problem we face on our farm: how to overwinter healthy livestock with minimal environmental degradation? For years, our cattle have wintered in a sacrifice paddock next to a large pole shed, but the amount of mud this engenders is becoming unacceptable. The NRCS has proposed to solve the problem with a large installation of concrete and a manure storage building, in addition to our existing roofed-over loafing areas. Before resorting to so much expensive impervious cover, we would like to experiment with overwintering the animals on their regular paddocks, with pre-placed weather-tight tarped pallets of hay or round bales, and some kind of facility for grain and mineral supplementation under movable electric fence.

As noted earlier, the hay-lifter system can be improved in several ways. We would like to work on a better stack structure, to prevent bales from tumbling off the load

while it is in motion. This might be achieved with additional structural members, or by changing the relationship of bales within the stack. I also have an idea for an inexpensive attachment to our front-end loader, which would make it easier to lift and stack the big pallets.

10. Using the Practice. We were very pleased with the results of our experiment with the hay-lifter and plan to continue to use it and to modify it in accordance with our findings. It had all of the benefits we anticipated in time and labor savings. It was much easier than a hay wagon to back into a shed, and easier to load by hand. The system is potentially far more flexible than traditional hay storage options. We hope to build on this technology to improve the overall management of our farm.

11. Outreach. We presented the system in a workshop at the NOFA summer conference. Our outline, slides, and attendee feedback are attached. Because we got such a late start in a dreadful haymaking year, we were unable to conduct a twilight meeting, although a number of farmers have seen or discussed the system with us informally. We hope to share the idea with more farmers through articles and demonstrations in the coming year.

Respectfully submitted,

Richard J. McDermott
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