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Comparisons of On-Farm Peanut Drying Systems in the Southwest[1]

P. D. Bloome*, D. D. Kletke, and J. R. Sholar[2]

ABSTRACT

The economic and management characteristics of five types of on-farm peanut drying systems were compared. Costs were determined as average present value costs per tonne using a 15-year planning horizon. The systems compared and their average present values of net, after tax, cash outflows were: high capacity, heated air drying - \$16.50/tonne; low temperature, controlled humidity drying - \$23.07/tonne; fan-powered, natural air drying - \$20.88/tonne; wind-powered, natural air drying in field modules - \$22.15/tonne; and sack drying in the field - \$28.60/tonne. Costs for the wind-powered, field module system were reduced to \$18.00/tonne by Federal Energy Tax Credits (15%) and further reduced to \$9.70/tonne by Oklahoma Energy Tax Credits (30%). Management comparisons included flexibility, drying capacity with respect to weather conditions, seed quality, risks of mold development and possibilities for multiple use.

Key Words: drying, peanuts, energy, quality.

Drying air temperatures exceeding 35C and rapid drying rates (in general, faster than 1/2 percentage point of moisture per hour) are known to cause quality reductions in peanuts (1). In addition, lowest sound splits (SS) and highest germination result when the relative humidity of the drying air does not fall below 40 percent during drying.

Tests comparing low temperature, controlled humidity drying with commercial drying showed a 3% reduction in SS, but a doubling in the required drying time (4). Energy requirements and drying times for high capacity, heated air drying of peanuts with harvest moisture contents from 13% to 32% have been established (3).

To eliminate the purchased energy requirement of drying peanuts, the SOL-AIR drying system has been

Fig. 1. A wind-powered, natural air drying module.

[1]Manuscript No. J-4335 of the Oklahoma Agricultural Experiment Station.

[2]Professor of Agricultural Engineering, Professor of Agricultural Economics and Extension-Agronomy Crops Specialist, Oklahoma State University, Stillwater, Oklahoma 74078.

developed. The system is a wind-powered, natural air drying system. (see Fig. 1). The SOL-AIR system does not collect solar energy directly but utilizes the wind and natural heating of ambient air. All wind energy is, or course, derived from the sun.

The purpose of this study was to compare the management requirements and economics of the SOL-AIR system with four other types of on-farm peanut drying systems.

The systems compared in this study are 1) high capacity, heated air drying; 2) low temperature, controlled humidity drying; 3) fan-powered, natural air drying; 4) wind-powered, natural air drying in field modules (SOL-AIR); and 5) sack drying in the field. The characteristics of each of these systems are given in Table 1.

Table 1. Characterics of On-Farm Peanut Drying Systems.

	High Capacity, Heated Air Drying	Low Temperature, Controlled Humidity Drying	Fan Powered, Natural Air Drying	Wind Powered, Natural Air Drying	Sack Drying in the Field
	(1)	(2)	(3)	(4)	(5)
Capital Costs	Low	Moderate	Moderate	Highest	Lowest
Operating Costs	High	Low	Low	Lowest	Highest
Flexibility for high harvest moisture	Highest	High	Moderate	Low	Lowest
Required harvest scheduling	Highest	High	High	Moderate	Lowest
Drying Capacity	Up to 1/2% per hour	Up to 1/4% per hour	depends on relative humidity	depends on relative humidity and wind	depends on relative humidity, wind and rain
Risk of Mold Growth	Lowest	Low	Low	Moderate	High
Seed Quality	Low	High	High	High	High
Qualify for Seed Bonus	No	No	No	Yes	Yes
Federal and Oklahoma Energy Tax Credits	No	No	No	Yes	No
Multiple Use	Yes	Yes	Yes	Yes	No

Materials and Methods

For the purpose of making cost comparisons, an annual production of 90 tonnes (100 tons) is assumed. For all but the sack drying alternative, twenty loads of 4.5 tonnes (5 tons) must be dried each year. Investment capital requirements for the various systems are given in Table 2.

Table 2. Investment Requirements.

System	Item	Investment	Useful Life
(1) High Capacity, Heated Air			
	2 Wagons	$ 4,000	15 years
	Fan & heater (double)	2,300	8 years
	Total	$ 6,300	
(2) Low Temperature, Controlled Humidity			
	4 Wagons	$ 8,000	15 years
	2 Fans & heater (double)	4,600	8 years
	Shelter	1,000	15 years
	Total	$ 13,600	
(3) Fan-Powered, Natural Air			
	4 Wagons	$ 8,000	15 years
	2 Fans (double)	3,000	8 years
	Shelter	1,000	15 years
	Total	$ 12,000	
(4) Wind-Powered, Natural Air			
	6 Modules	$ 21,000	15 years
(5) Sack Drying	Sacking Trailer	$ 2,000	15 years

A management charge of 1 h/load at $10/h or $200/yr is made. Additional labor is charged at $4.25/h.

Kernel moisture contents from the combine are assumed to be in the 18-19% w.b. range. Required drying times and energy requirements are based on these harvest moisture contents. Higher harvest moistures are incompatible with the SOL-AIR system.

Natural gas and electricity rates are increased at a rate greater than general inflation (2). Depreciation is calculated by the accelerated cost recovery system (ACRS) methods as outlined in the Farmer's Tax Guide.

For the sack drying alternative, loading and hauling costs are assumed to be $15.43/tonne ($14/ton). In all other systems, the twenty loads are assumed pulled to the buying point with a pick-up truck that is already available. For these alternatives, hauling is charged at lh labor/load plus 32 km at $.09/km to cover operating costs. On this basis, hauling costs total $145 annually.

An additional labor charge is made against those systems requiring each load to be moved to the farmstead and attached to a drying unit. This charge is at 0.5 h/load for a total annual charge of $42.50.

The required drying time per load dictates harvest scheduling and the number of drying units required. Assumed drying times and energy requirements are given in Table 3.

Table 3. Drying Times and Energy Requirements.

	High Capacity, Heated Air (1)	Low-Temperature, Controlled Humidity (2)	Fan-Powered Natural Air (3)	Wind-Powered Natural Air (4)
Utility Connections	$ 300	$ 600	$ 400	-
No. of Wagons or modules	2	4	4	6
Average drying time	20 hr	40 hr	60 hr	6 days
Cycle time for each unit	2 days	4 days	4 days	7 days
No. of cycles per season	10	5	5	3 1/2
Natural gas per dry tonne (per dry ton)	$31 m^3$ (1.0 mcf)	$10 m^3$ (0.33 mcf)	-	-
Electricity per dry tonne (per dry ton)	22 kWh (20 kWh)	44 kWh (40 kWh)	66 kWh (60 kWh)	-

Sacks are assumed to cost $.40 each with 55 sacks required per tonne. At delivery the sacks are assumed to weigh 0.36 kg each. With a peanut price near $.55/kg, the market value of the sack is $.20 each. The net cost of sacks is, therefore, assumed as $.20 each or $11/tonne ($10/ton).

The sacking crew is assumed to contain 4 people with an effective sacking rate of 2.7 dry tonnes/h (3 ton/hr). A tractor is required to pull the sacking trailer. The tractor's cash operating costs are estimated at $4/h. Total labor and tractor costs for sacking are estimated to be $7.72/tonne ($7.00/ton). One turning of the sacks is assumed with a cost of $1.65/tonne ($1.50/ton).

Results and Discussion

Table 4 compares the average present values of net, after tax, cash outflows for the various systems. These results are based on a 30% marginal rate of taxation, a 10% discount rate and a 15 year planning horizon. In all cases the 10% investment tax credit is claimed. The average present value of net, after tax, cash outflows may also be described as the amortized annual cost in 1983 dollars.

The high capacity, heated air system has average present value cost of $16.50/tonne which is $4.38/tonne lower than the fan-powered, natural air system and $6.57/tonne lower than the low temperature, controlled humidity system. The sack drying system has average present value costs of $28.60/tonne, which is $12.10/tonne higher than the heated air system.

Table 4 shows that tax credits have a large effect on av-

Table 4. Average Present Value Costs per Ton for the Various Drying Methods.

	Average Present Value of Net, After Tax, Cash Outflows	
	$/Tonne	($/ton)
(1) High Capacity, Heated Air Drying	$ 16.50	(14.97)
(2) Low Temperature, Controlled Humidity Drying	$ 23.07	(20.93)
(3) Fan-powered, Natural Air Drying	$ 20.88	(18.94)
(5) Sack Drying in the Field	$ 28.60	(25.95)
(4) Wind-Powered, Natural Air Drying in Modules with Investment Tax Credit (10%) only	$ 22.15	(20.09)
with Investment (10%) and Federal Energy (15%) Tax Credits	$ 18.00	(16.33)
with Investment (10%), Federal Energy (15%) and Oklahoma Energy (30%) Tax Credits	$ 9.70	(8.80)
Seed Bonus	$ 33.00	(30.00)
Comercial Drying Charges (Caddo County, Oklahoma 1982)	$ 20.00/wet tonne $24-$27/dry tonne	($18) ($22-24)

erage present value costs of the wind-powered, natural air systems. When only the 10% investment tax credit is claimed, present value costs are $22.15/tonne. When the 15% Federal Energy Tax Credit is also claimed, present value costs fall to $18.00/tonne. When the 30% Oklahoma Energy Tax Credit is claimed, bringing total tax credits to 55% of the purchase cost, present value costs are $9.70/tonne. The tax credits have a great effect on present value costs because they occur in the first year and are not discounted as are costs and savings occurring later in the life of the investment.

The 15% Federal Energy Tax Credit is scheduled to end in 1985. The 30% Oklahoma Energy tax Credit is currently scheduled to continue through 1992. In both cases, the farmer has 5 years in which to claim the tax credits through a reduction in tax liabilities. In our example, the farmer would have 5 years in which to claim the $6,300 in tax credits against Oklahoma State Income Tax liabilities. Credits not claimed the first year are less valuable as they must be discounted.

Producers who presently own SOL-AIR modules use either commercial drying or sack drying as a back-up during poor drying years. These additional costs can be estimated by multiplying the percent of the peanuts dried by these methods by the appropriate costs per ton and adding the result to the wind-powered system costs. If, for example, 1/2 of the crop is sack dried one year in three, then $4.77/tonne (1/6 x $28.60) should be added to the wind-powered system costs.

Other Considerations

A seed bonus of $33/tonne ($30/ton) applies to seed peanuts grown under seed contract. At the present time only sack drying in the field and wind-powered, natural air drying in modules qualify for the seed bonus, which is sufficient to cover the costs of either of these methods. Where the seed bonus applies, it causes the economic analysis to heavily favor these approved seed drying methods - and, in particular, the wind-powered system. The likelihood of continued seed contracts in a particular area is an important consideration in choosing a drying method.

While fan-powered, natural air drying and low temperature, controlled humidity drying can also produce excellent seed quality, they do not qualify for the seed bonus. The economic analysis shows that these methods are not economically competitive without the seed bonus. For farmer's stock peanuts, it is simply more economical to add heat and double the system capacity.

High capacity, heated air drying offers a great deal of flexibility. In those years when weather conditions make higher harvest moisture contents desirable, or even necessary, this method has the capacity and flexibility to deal with the additional moisture.

The low temperature, controlled humidity drying method also has flexibility, though the limited heater capacity means slower drying in years of higher moisture and poor drying conditions. A heater can be added to the fan-powered, natural air system during poor drying years.

The wind-powered, natural air and sack drying systems do not have the flexibility to deal effectively with higher harvest moisture or poor drying conditions. With these methods, there is no reserve capacity. This limitation results in greater field losses in some years as the peanuts must field dry below 20 percent moisture content before combining. There is the risk that an effort to save $5 or $10/tonne will result in a greater loss to weather.

The drying tunnels can be removed from the wind-powered, natural air drying modules and sidewall extensions added, allowing the modules to be used as cotton trailers. In some cases, the drying tunnels may be lowered for natural air drying of fairly low moisture content corn. The drying trailers used in the fan-powered systems can also be used for heated air or natural air drying of other grains. Any multiple-use of these systems reduces their fixed costs for peanut drying resulting in total costs lower than those shown in Table 4.

The principle disadvantage of the wind-powered system is its dependence on weather conditions for both airflow and drying potential. During low wind or still conditions, mold can develop within the bed. Mold can also develop when ambient relative humidity exceeds 85 percent for any extended period.

While owners report that molding has been common in some years in the modules, the mold has been confined to the hulls and, with one exception, has not caused the peanuts to be downgraded from Segregation 1. Molding has tended to seal the peanuts against airflow and has caused longer drying times.

The molding that has occurred in the modules points out the need to avoid high harvest moistures, pockets of foreign material and packing the peanuts in the modules. Peanuts to be dried in the modules should be less than 19% moisture content, workers should avoid walking on the peanuts and the modules should not be moved until the peanuts are dry. These good management practices will reduce the risks of mold growth.

Conclusions

1. Low temperature, controlled humidity drying and fan-powered, natural air drying are not economically competitive with high capacity, heated air drying for farmers stock peanuts. These methods would be very competitive economically as seed drying systems.
2. The wind-powered, natural air drying system offers

considerable cost savings when compared to sack drying in the field.

3. For farmers' stock peanuts, the wind-powered, natural air drying system is not economically competitive with heated air drying without energy tax credits, is competitive with federal energy tax credits and has a considerable economic advantage with both federal and Oklahoma energy tax credits.
4. Farmer experience with wind-powered, natural air systems has shown the performance to be highly weather dependent causing large variations in drying capacity and the number of loads each module will dry per year. Low harvest moisture and good management practices are essential. A back-up drying method is required during poor drying seasons.
5. This study considers costs only. The system with lowest total costs may not necessarily be the most profitable due to mold, grade and field loss considerations.

Acknowledgement

We are grateful to the ten Oklahoma peanut growers who willingly shared their experiences as owners of wind-powered, natural air systems.

A brand name is used due to the unique nature of the system. No endorsement is implied.

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