Evolution of the Plastic Greenhouse

Joseph V. Florentine

Rutgers University

Who invented the plastic greenhouse?

- Dr. Emmert of the University of Kentucky published a paper in 1954 describing a field greenhouse covered with polyethylene plastic.
- Mentions using this design as early as 1947
- A field greenhouse was used for starting transplants

August 5, 2005
Gene
Thank you for the information you sent to me on plastic greenhouses. I gave my talk on the "Evolution of the Plastic Greenhouse" at the
It's attached to this email. I lost count of how many people came up to me and said they never knew that the inflated plastic greenhouse
I met with the new Dean on Tuesday and mentioned my experience to him and the need for a technical writer to promote the work bein

Hope you are doing well, take care.

Joe

P.S. Next year's AERGC meeting will be in Saskatoon, Canada

Joseph V. Florentine
Director, Greenhouse Operations & Planning Rutgers University, Cook Campus
88 Lipman Drive, Room 113
New Brunswick, NJ 08901
Phone (732) 932-9034
Fax (732) 932-4176
florentine@aesop.rutgers.edu

Why a Plastic Greenhouse?

- Inexpensive compared to a traditional glass greenhouse
- Originally a temporary structure used only to start plants in Spring or over-winter plants
- One third reduction in heating costs with two layers of plastic

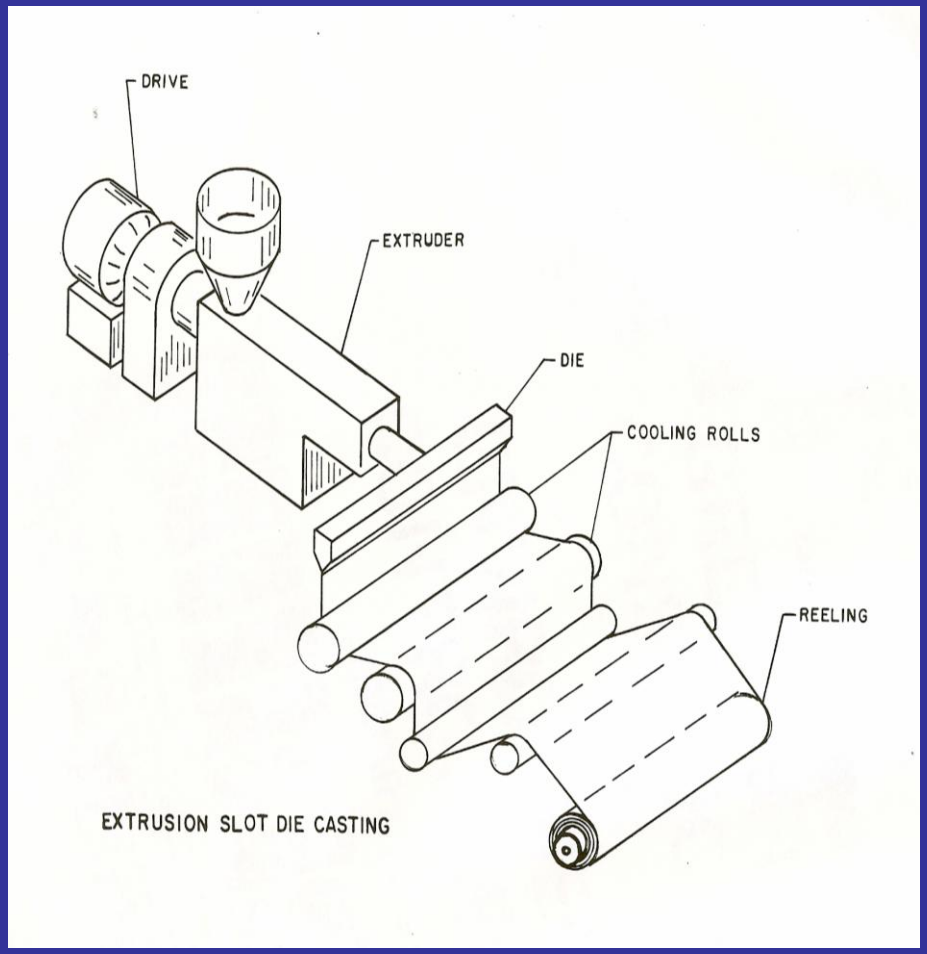
Why Polyethylene?

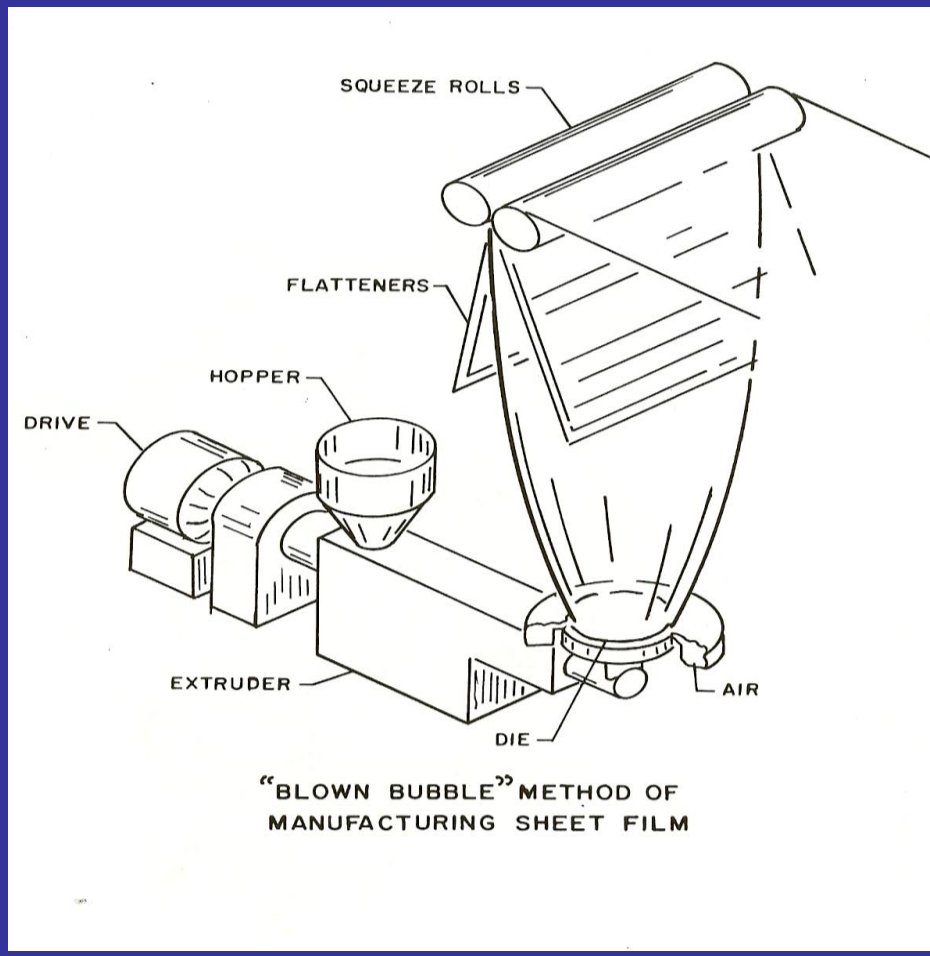
- PVC was available but came in smaller sizes
- PVC had problems with darkening, collecting dirt and stretching (creeping)
- Mylar available but came in narrow strips and was very noisy
- Polyethylene was less expensive

Problems with Plastics back then

- UV resistance not very good, plastic broke down within 5 to 8 months.
- Needed support to keep from tearing from wind damage
- Condensation on inside caused dripping on plants.
- Weakness at folds in plastic

Plastic Sheet Manufacturing





John Bartok Jr., Plastics, Proceedings from the Greenhouse Construction and Environmental Control Seminar 1/16/69

What Happened Next?

- Experiments at Rutgers and other universities in late 50's and early 60's with wood frame plastic covered greenhouses using one and two layers of plastic film
- Problems keeping plastic taut enough to prevent flapping in the wind and the two layers of plastic from touching were an issue

Early experiments with plastic greenhouses

Prof Reed's first plastic greenhouse using Mylar to cover it. The material came in narrow strips so needed to be fastened on all the rafters

Early wood frame design for low cost greenhouse to cover with poly to start spring plants

Courtesy of Dr. Mears

Slant Leg Greenhouse

- In the early 60's Prof. Roberts designed the first prototype of the slant leg greenhouse. It is 19' x 24' which at the time was the largest a greenhouse could be covered with a single piece of plastic. The structure proved to be more durable than conventional wood/plastic greenhouses.

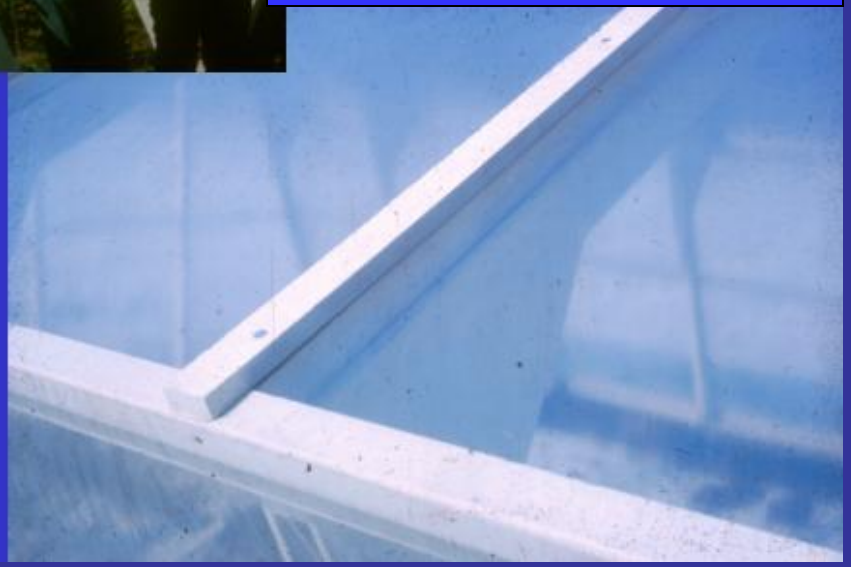
Slant leg greenhouse built in 1962

Courtesy of Dr. Mears

The labor intensive job of covering a plastic greenhouse in the early 60's

Battens required on each rafter to support plastic

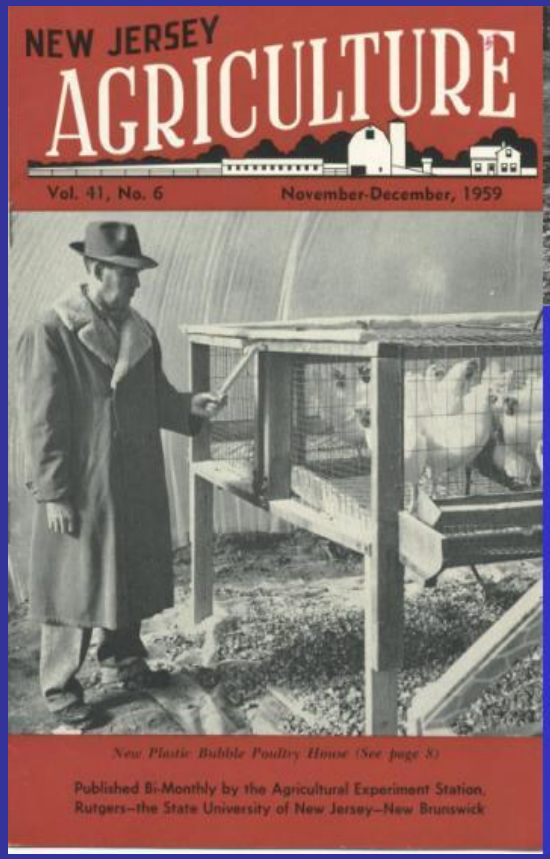
One layer on then spacer then second layer



Courtesy of Dr. Mears

Idea for inflated greenhouse

- In the late 1950's, Prof. Reed of Rutgers University experimented with inflated plastic structures. This showed how an enclosed environment could be made from plastic film without support.



Prof. Reed and his first air supported bubble house. The first version of this was in 1957 beside the cottage where graduate students lived. They took care of the chickens for the poultry stress response test in exchange for the eggs.

Courtesy of Dr. Mears

An idea that revolutionized the plastic greenhouse

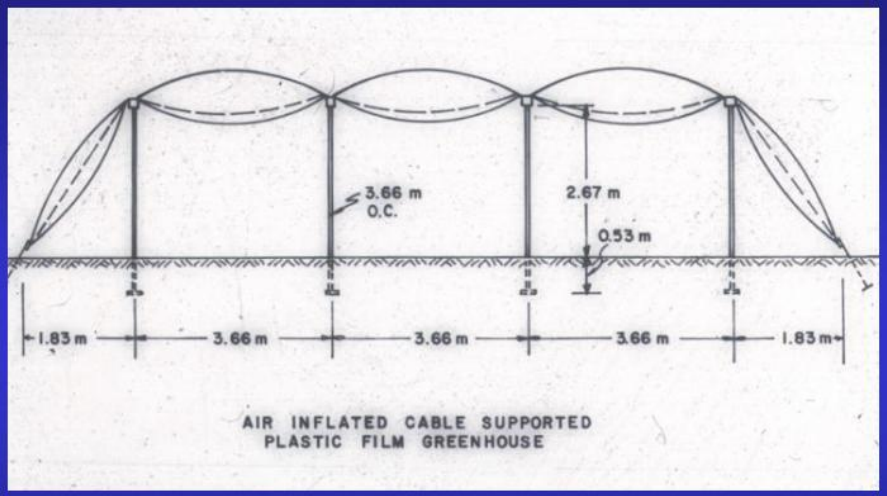
On the morning of December 25th 1964 the idea to inflate two layers of plastic with a small blower came to Prof. Bill Roberts.

Landmark greenhouse air inflated – only edges fastened

Inflation blower inlet takes outside air

Courtesy of Dr. Mears

First Gutter Connected Greenhouse

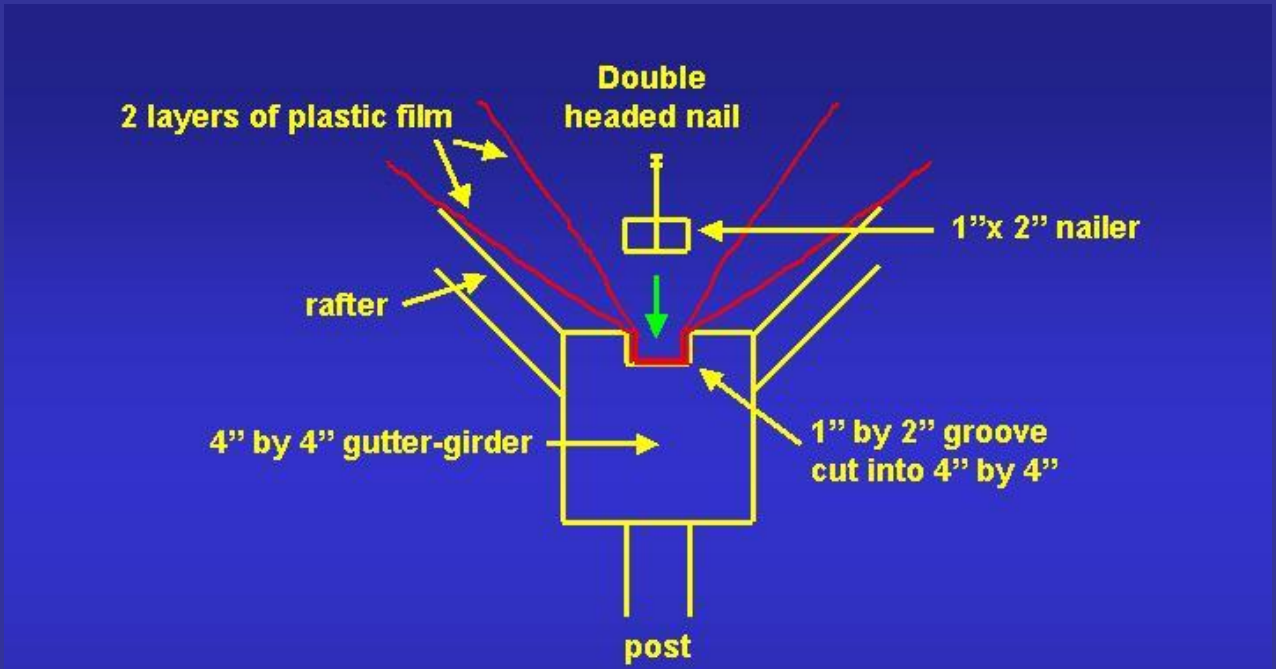


Design for a cable supported greenhouse covered with two layers of inflated plastic film

First cable supported greenhouse constructed without rafter or hoop supports

Courtesy of Prof. Roberts

Early Gutter Connect Design



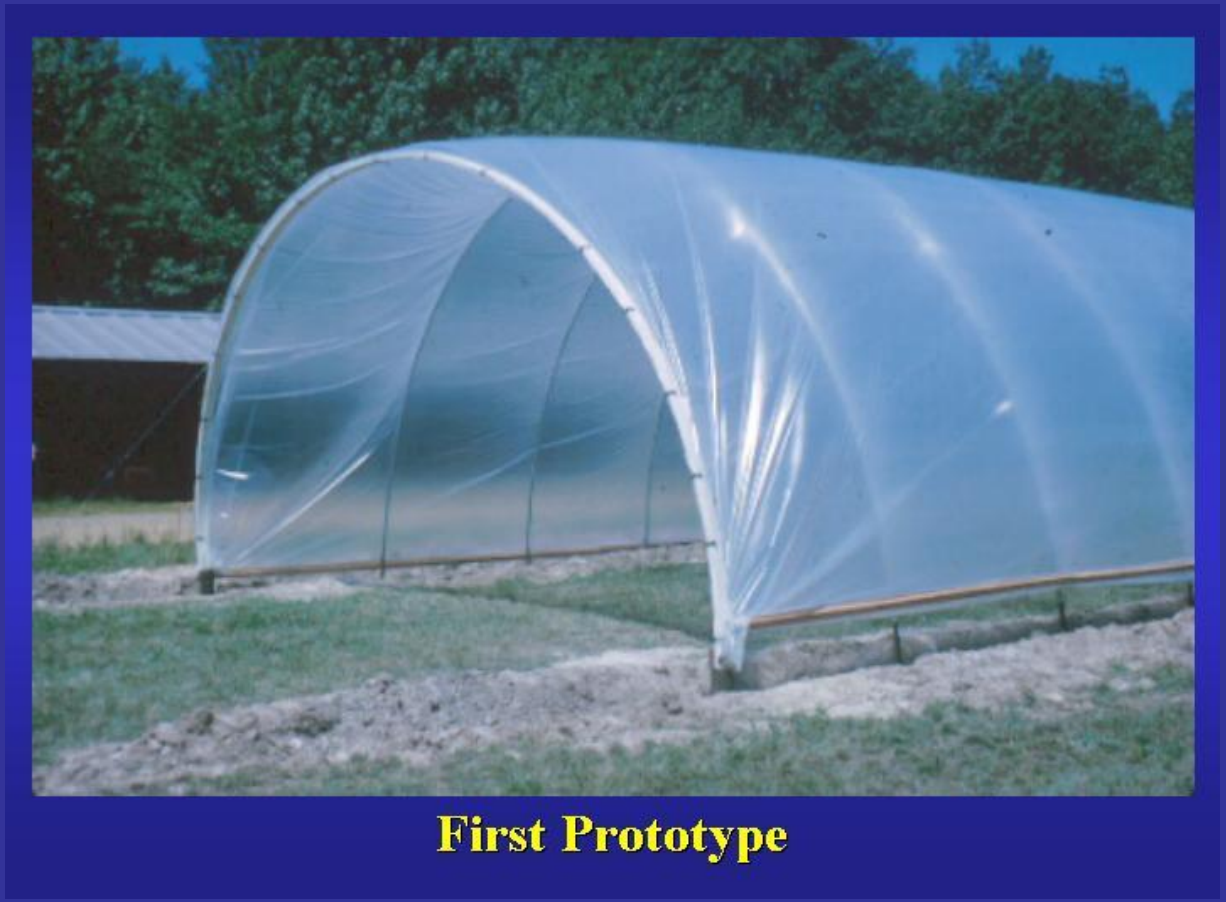
Orie Van Wingerden Greenhouse design (1966):
double covered and inflated
Pompton Plains, NJ

Courtesy of Prof. Roberts

Invention of “Poly-Lock” (Frank Stuppy) and gutter-connect (Aart Van Wingerden & Kenneth Bryfogle) systems.

Courtesy of Dr. Jensen

First air inflated plastic pipe supported greenhouse



First Prototype

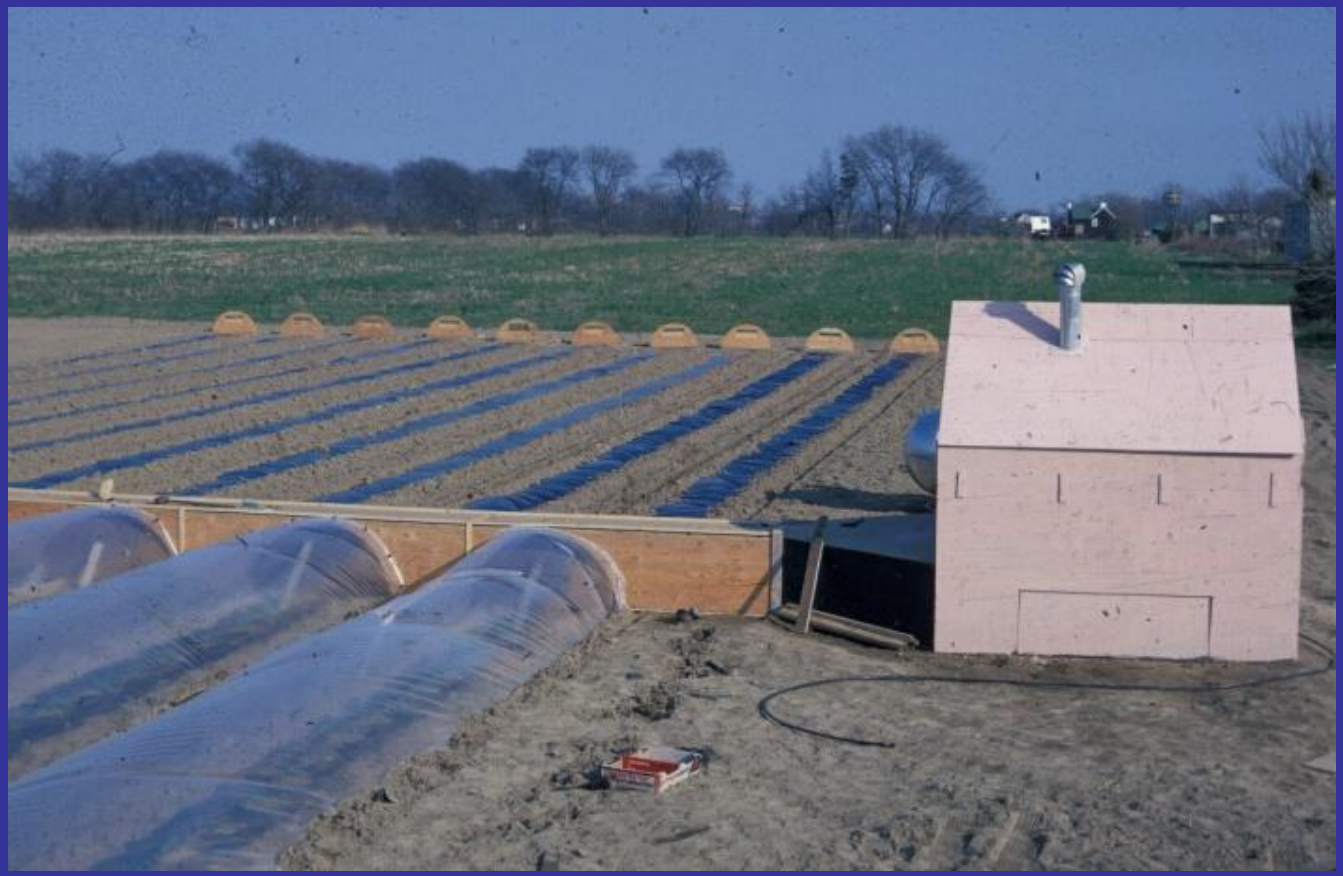
Courtesy of Prof. Roberts

More research on plastic films

Getting some film tension data in the lab

Courtesy of Prof. Roberts

Other research with inflated plastic at the time



Courtesy of Dr. Jensen

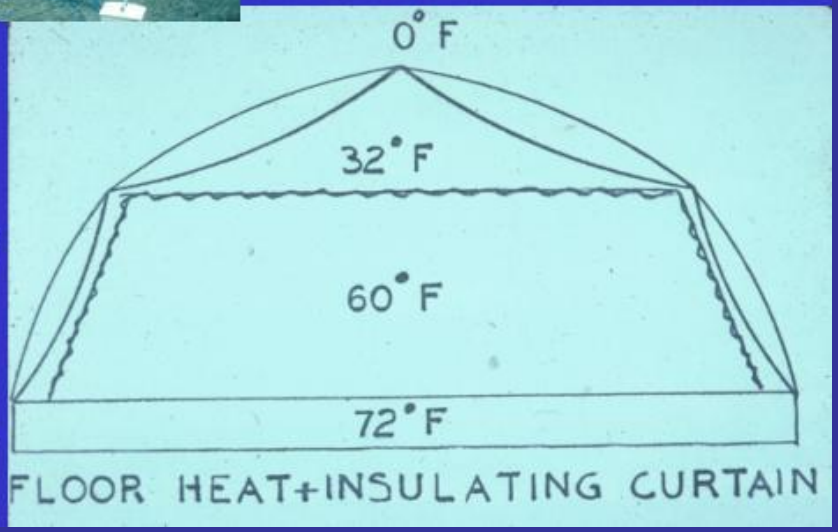
Sometimes they weren't sure if it would work.

Courtesy of Dr. Jensen

Energy savings research in the late 60's

Double poly plus curtain plus floor heat

Low source temperature even heat and efficient



Courtesy of Dr. Mears

Early attempts in the 70's with commercial energy/shade systems

Early tries with curtain systems had some problems

Progress took time but workable systems were developed

Courtesy of Dr. Mears

Solar Energy Research

Site in 1976 start of solar energy research

Site in 1978 the cable house has roof bows now

Courtesy of Dr. Mears

1980's
Research on open roof greenhouses and IR absorbing polyethylene

Natural ventilation concept 1985

Rack and pinion to open at the gutter

Courtesy of Dr. Mears

1990’s research at the Burlington County, NJ Resource Recovery Complex

Courtesy of Prof. Roberts

Open Roof Greenhouse built in 2000

The impact of the inflated plastic greenhouse

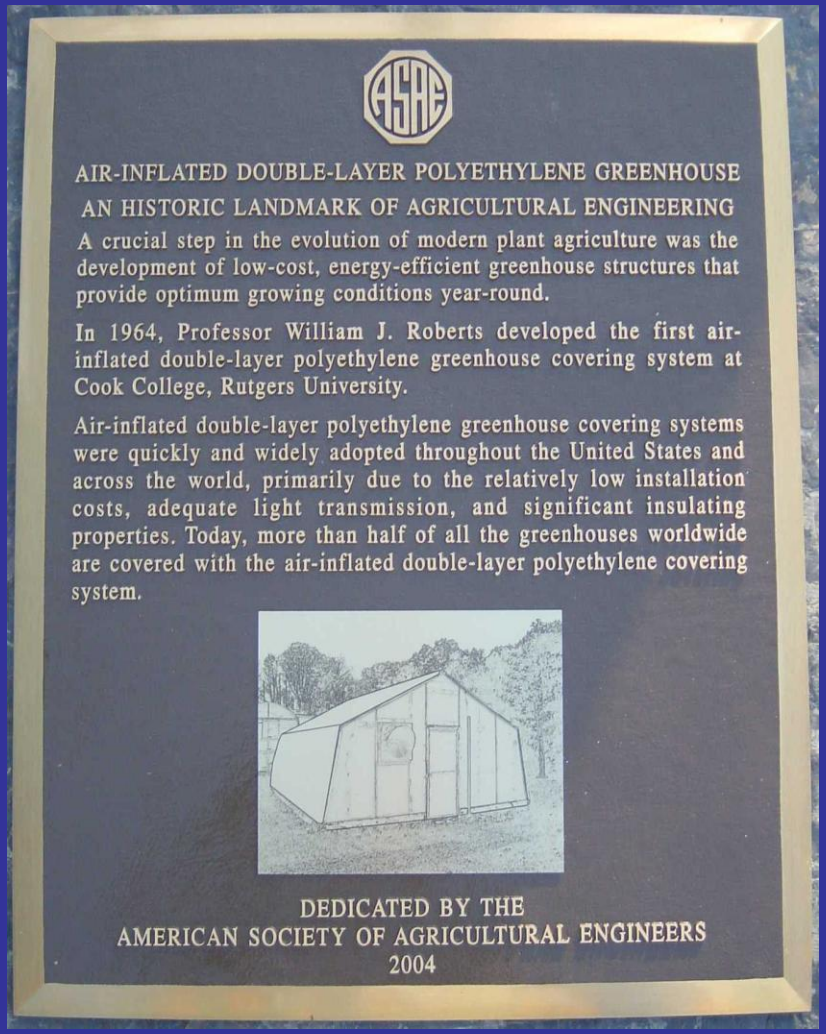
- Reduction in time and materials to build
- Durable design
- Used in emerging nations to extend crop production
- Over 1.9 million acres world wide

First air inflated plastic greenhouse becomes a historic landmark of agricultural engineering, June 4, 2004

ASAE President Robert J. Gustafson (L) and Professor Emeritus William J. Roberts in front of the first air-inflated double-layer polyethylene greenhouse (photograph by Alan Goldsmith)

Courtesy of Prof. Roberts

Designated as “a crucial step in the evolution of modern plant agriculture”



Professor Emeritus and Mrs. William J. Roberts
June 4, 2004
(photograph by Gene Giacomelli)

Many growers also deserve credit for taking chances with early designs of plastic greenhouses

- Kenneth Bryfogle
- Bill Krais
- Frank Stuppy
- Bill Swanecamp
- Orie Van Wingerden
- Aart Van Wingerden

Special Thanks to:

Dr. A.J. Both, Bio Resource Engineering, Rutgers University
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Mark Jordan, Techmer Inc.
Thomas Manning P.E., Rutgers University
Dr. David Mears, Bio Resource Engineering, Rutgers University
Ruth Novak, Bio Resource Engineering, Rutgers University
Prof. Emeritus William Roberts, Bio Resource Engineering, Rutgers University

These people were invaluable in the restoration of the first inflated plastic greenhouse

Jerry O'Donnell and Mel Braxton

Jeff Akers and Dave Lear

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Thank you